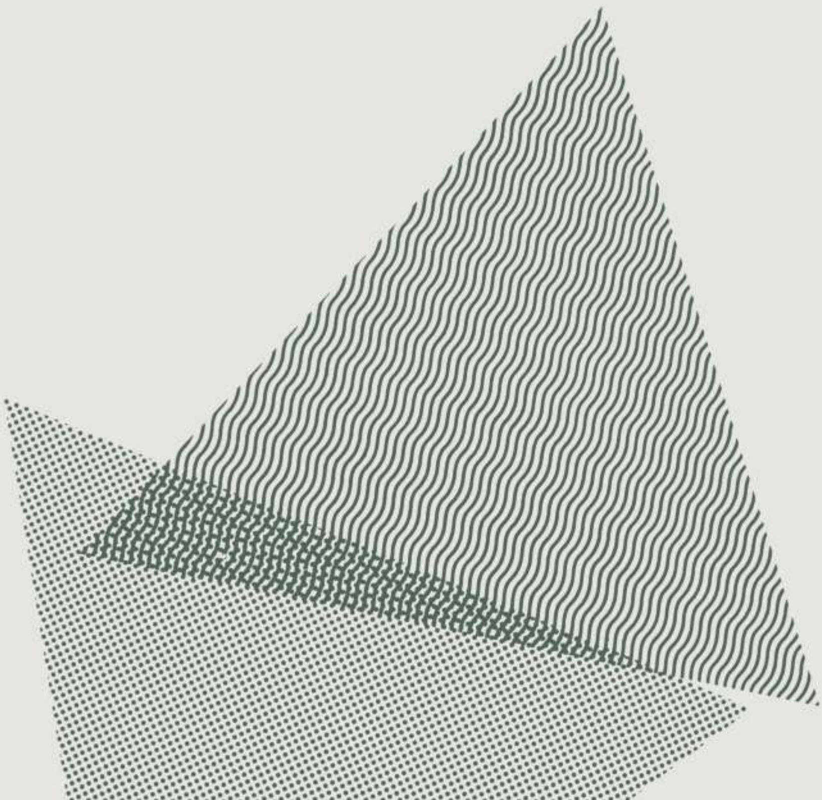
Edited by Edward J. Nell and Willi Semmler

Nicholas Kaldor and Mainstream Economics

Confrontation or Convergence?



Nicholas Kaldor and Mainstream Economics

Confrontation or Convergence?

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WILLI SEMMLER

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Editors' Introduction: Alternative Theories

Nicholas Kaldor certainly believed in alternatives, not only in economic policy but equally in economic theory. Unfortunately, as Thirlwall explains in Chapter 1, he never developed his ideas in the form of a systematic treatise. But in this he is hardly alone; none of the great critics of modern economics has provided a systematic alternative, yet all appear to believe that such a construction is possible. Indeed, like Kaldor and many authors in this volume, most believe that they have contributed significantly to the development of such an alternative, and recognize each other as collaborators in a common enterprise, even though they often define what they are doing quite differently.

Yet mainstream economists tend to think that if something is useful and important, it will be found to be a disguised piece of the corpus of neo-Classical thought. If it is not part of the mainstream, it will either turn out not to be economics, or an answer to a question no-one needs to ask, or just plain wrong.

How can this be? How could a group of able and distinguished scholars be wrong about the meaning of their own best work? But if the scholars' own view is accepted, how can it be that the vast majority of their profession understand what they are doing in a completely different way? Clearly we have to explore what is meant by 'an alternative.'

Kaldor is very definite: economics went wrong when it adopted the 'equilibrium approach,' by which he means the assumption that timeless, rational agents calculate their optimum positions, which are then coordinated and realized through idealized market transactions. Thirlwall gives a careful account of Kaldor's reasons; many economists could – and do – accept such a critique as at least partly valid but ask, what can we do, if we abandon neo-Classical theory? *There is no alternative*!

Virtually every chapter in this volume stands as a partial answer, and a demonstration that there are indeed alternatives; it is neither necessary nor desirable to try to develop a single, overarching theory, addressed to all economic issues of whatever origin. Instead there are many different ways of looking at economic questions, with different strengths and weaknesses, and appropriate to different contexts. Some of these will be closely related to the neo-Classical family, others will be distant, a few will be contradictory.

But all will be economics; a common method can be identified, practised by most economists, and loosely derived from the inherent logic of the subject. Spelling this out may help to explain the relationship between neo-Classical thinking and alternative approaches.

Samuelson gives us a good starting point. The *Foundations of Economic Analysis* begins with an observation from the mathematician E. H. Moore, to the effect that analogies between the central features of particular theories imply that there is a unifying general theory to be found. This general theory is the theory of maximizing behavior, which gives rise to static equilibria which can be compared as different assumptions about parameters displace the equilibria. The *correspondence principle* then relates the conclusions about comparative statics to the stability of the associated dynamical systems.

Maximizing behavior, however, doesn't take place in a vacuum; it has to have a *setting* or a structure. This is provided by the usual assumptions about firms and individuals, in a competitive environment, where the technologies available to the firms and the preferences of the individuals are to be treated as given. Normally the technologies and preferences will be assumed such that substitution will be widely practised, while competition will ensure a quick responsiveness to price signals; but many interesting variations are possible. This constitutes the *setting* of the analysis.

The endowments of factors then provide the *initial conditions* within that setting, the starting point of the analysis. Rational maximizing by individuals is the assumed *mode of behavior*, the *kind of solution* desired is comparative statics, for which the *solution condition* is market-clearing. And that gives us a compact picture of the neo-Classical approach. It also provides a summary of virtually any analytical approach to an economic issue: the setting must be specified by identifying the agents, the knowledge available to them, the social pressures, their goals and desires, the characteristics of the technology, and so on. Then the initial conditions will be spelled out – what exactly is available, in what quantities, to whom? The mode of behavior – that is, the motivation and the procedures or rules to be followed – comes next and then, given these, we will try to develop the most appropriate kind of analysis, based on suitable conditions for solutions.

This is economic analysis, not just neo-Classical economics, but any kind. It starts by identifying a set of agents engaged in economic activity, giving some form to their desires, goals, knowledge and abilities. These agents may be rational individuals, but they could equally be firms driven by institutional goals, or social classes. They may maximize, and if they do they could maximize growth instead of profits, or they could pursue multiple goals. Or they could follow other types of behavior such as adaptive behavior, routines, imitation, or institutionally determined rules. In setting up a starting point or initial situation, we could specify factor endowments. But we could also start from completely different approach laying out the behavioral patterns to be followed, and the conditions to be met; and then solving for one kind of determination or another – an equilibrium (or multiple equilibria), dynamic paths, cycles, or perhaps, determinate disequilibria. In compact form, then, economic analysis will consist of any reasonable specification of:

- Setting or structure, agents and their characteristics
- Initial conditions, endowments, autonomous parameters
- Model(s) of behavior
- Conditions for solutions
- Specification of dynamic paths

Neo-Classical analysis, then, is a particular way of filling in this general format. The agents are individual firms or consumers, where the individual takes precedence – corporations are simply the agents of their individual owners. The individuals are endowed with a certain kind of preferences and access a certain kind of technology: smooth, continuous and with well-defined properties. They are endowed at the outset with constraining amounts of scarce factors, and behave in accordance with a special type of very general maximizing. Solutions are found through market-clearing. The dynamic path is specified through excess demand functions. Small variations on these themes will remain close to the central neo-Classical ideas; larger ones can raise questions. Whether something is or is not 'really' neo-Classical has to be a matter of judgement – many gradations and more or less distant family relationships are possible. But altogether different – even contradictory – specifications can easily be set up, and some will clearly be applicable to economic issues, and will provide competing explanations.

Consider some examples. A Kaldorian/post-Keynesian approach will take households, divided into social classes, and oligopolistic business firms operating given techniques as the setting, with given autonomous spending as the initial conditions. The mode of behavior assumed is that agents will follow sensible rules, given by tradition, custom or routines governing induced expenditures, and the purpose will be to determine the equilibrium in spending, as influenced by relative shares. This may be long run or short run, but it will normally be a *demand* equilibrium; there need be no binding supply-side constraints. Simple variations can adapt this to questions about pricing (mark-up rules) and inflation. No form of maximizing behavior is assumed, and no factor endowments need be considered among the initial conditions. Nor is market-clearing required for equilibrium; the 'injections = withdrawals' condition balances the inducements and inhibitions on spending, and this need say nothing about market supplies or utilization of factors.

A Classical or Classical–Marxian approach takes technology and social classes as the setting, the labor force, or its growth, and capital funds as the initial conditions, assumes an institutionally specific form of maximizing behavior by capitalists, and the following of customary spending rules by households. It then determines the various possible comparative static equilibria of prices, the rate of profits, wages, and also (depending on the assumptions) growth rates, relative industry sizes and consumption, on the basis of a 'reproduction' condition. Once again, no market clearing is involved, no individual maximizing takes place, and there are no binding supply-side constraints. But there is a form of maximizing, and in some versions, initial factor endowments do play a role. The result can be either comparative statics, or steady-state dynamics.

In both approaches, cyclical outcomes or other types of bounded fluctuations can be reached in many ways. Goodwin models take social classes and technology as the setting, start from arbitrary initial conditions, with class behavior following institutionally given rules that are certainly related to maximizing, and solve for the path, showing it to be cyclical or bounded in fluctuations, and showing what other dynamics may be the outcome when parameters are varied. Kaldor, on the other hand, takes his setting to be households and firms, in conditions that define particular patterns of saving and investment in relation to the general level of income. Thus the setting crucially determines the behavior. The condition for solution is that demand be steady – i.e., injections equal withdrawals – but the behavioral patterns will shift over time, and in response to movements in income; as a result, a dynamic path will be traced out with cyclical features.

Neither of these dynamic models draws on individual rational maximizing; both see behavior as strongly influenced by institutions, and behavior, accordingly, might change in the course of time. Neither assumes market-clearing, nor do factor endowment scarcities play any significant role. But both follow the general format for economic analysis.

Neo-Classical thinking provides a very general approach to many kinds of issues. Transactions, almost by definition, involve two sides or parties; one can be considered 'demand', the other 'supply'. Each can then be treated as making its contribution to the transaction by solving a constrained maximizing problem. The solutions can then be traced out on each side for varying values of parameters, and then the resulting correspondence sets can be solved for the values that satisfy both sides – 'market-clearing'. Notice that this last step, which concerns the existence, multiplicity and stability properties of solutions, can easily involve both advanced mathematics and important economic issues – sometimes far removed from maximizing or scarcity. There is nothing intrinsically neo-Classical about the solutions and dynamic properties of economic equations.

Marriage is, in a sense, a transaction – as Jane Austen noted. So it can be analyzed by neo-Classical methods, although we may learn more from Jane Austen's old-fashioned ways. Politics is a series of transactions; again neo-Classical approaches find favor, though how much they deliver is unclear. In economic fields proper, each specific market for factors and final products – labor, capital, land, the firm, the consumer, final goods prices and quantities – can be analyzed in the same way, and then all can be taken together in a general equilibrium. Neo-Classical thinking applies a very general method to all sorts of economic and related questions, a method that can sometimes, according to critics, distort the issues.

Nevertheless, even allowing for this general applicability, it is only a specific instance of the general format for economic analysis. In the *Treatise* Keynes analyzed the different circulations and the price and revenue relations between sectors. Little depended on maximizing, and scarcity played no role, but institutions and rules counted for a great deal. Kaldor's cumulative processes in development, virtuous and vicious circles relating manufacturing and agricultural sectors through the terms of trade, likewise depend on general properties of technology – increasing returns – and the 'rules of the game,' as Joan Robinson put it. These define the incentives and motivations of the agents, and the social context in which they will act.

The great strength of neo-Classicism lies in its ability to apply the same simple but powerful approach to a wide variety of different problems. And this is also is great weakness, for its apparent applicability arises from the tautological facts that any transaction can be broken into a demand and a supply side, and any action can be regarded as a balance at the margin between the forces urging on and the constraints restraining the agent. Any action whatever is carried out to the point where it stops; so many economists regard that point as representing the constrained maximum, where the gains from further action are just counterbalanced by the costs of continuing. Precisely because of the tautology involved, this schema is universal but, equally, it is vacuous.

This is the fundamental reason for the dissatisfaction that has led so many to question the usefulness of the mainstream and begin to search for alternatives. In trying to explain everything, it ends up saying little about particular issues, and what it does say is often misleading. Nor should this be surprising. To make the theory internally consistent and the schema fit, it is generally necessary to make a number of assumptions, that, taken literally, are quite false. We ignore 'indivisibilities' and increasing returns, we assume technology permits widespread substitution, so ignoring or underplaying complementarities; we assume that preferences and production sets are well-behaved, that firms and consumers operate in perfect markets and have perfect knowledge of all relevant market data; that their influence on the market outcome is negligible; and so on. But careful reasoning from false assumptions can reach only false conclusions. The general applicability arises from false abstractions. The application to particular cases requires specific assumptions that are normally not spelled out in perfect competition/perfect information models.

Why not, Kaldor suggested, simply reverse all this? Let's not try to set up a universal theory. Instead, we can develop the theory we need, as we need it, for particular issues, basing our analysis on the actual 'stylized' facts of the setting and the initial conditions, and assuming the incentives and motivations that are actually called for by the rules of the game. This is not as completely pragmatic as it looks at first sight – do whatever is useful – for the various particular theories have to be compatible. The system as a whole is dynamically interconnected; it functions as a whole and major aspects of economics can be understood only as macro phenomena. So the particular theories have to fit into a consistent picture of the whole. But it is a whole economy of a certain kind in a certain era, a stylized picture of, for example, advanced industrial capitalism in the postwar period. It is not 'the market,' everywhere and anytime. Instead of starting with an abstract and universal theme – rational choice and idealized markets – Kaldor proposed to start with the major problems and work out explanations that would point also to policies for managing those problems.

Most of the chapters in this volume do just that. They are problem-oriented, and they develop the theory necessary to understand and deal with the problem. General principles are certainly not neglected, but they are the general principles of a specific kind of economic system – industrial capitalism, for example.

After Part I (Chapters 1 and 2), which surveys Kaldor's work, we have collected together a group of studies on Methodology. Each of these presents an issue, posed by Kaldor, which cannot easily be dealt with by conventional methods. Desai (Chapter 3) surveys Kaldor's contributions to the early stage of the capital theory debate, at a time when he still accepted many neo-Classical tenets. Samuelson (Chapter 4) shows that, remarkably, Kaldor anticipated or independently developed the basic ideas of the von Neumann growth model, and that a strong non-substitution theorem lay hidden in his discussion. Harris (Chapter 5) contends that stability questions – or, more properly, convergence to long-run prices and profit rates – is as difficult a matter for Classical models as it is for neo-Classical ones. Krause (Chapter 6) develops and generalizes Kaldor's compensation criterion, and shows its usefulness in comparing allocations, even when 'individuals' have conflicting preferences. Scitovsky (Chapter 7) examines non-price incentives and competition, showing that many of the positive externalities of the market flow from these.

One of Kaldor's most famous papers introduced an alternative theory of distribution, based on Keynes's 'widow's cruse,' and differential saving propensities in the two basic social classes. The studies in Part III, Saving and Distribution, address issues raised in the subsequent discussions, as do some studies included in other Parts, notably Gram, Hagemann, Kurz and Skott. Marglin and Bhaduri (Chapter 8) provide evidence that the propensity to save out of profits is greater than that from wages, and show how such a saving function combined with investment demand based on profits and capacity utilization can generate two different 'regimes,' stagnationist and exhilarationist, in which wage pressure will have opposite effects. Salvadori (Chapter 9) surveys three classes of worker–capitalist distribution models, and demonstrates the importance of the relationship between the rate of interest and the rate of profit in them. Abraham-Frois (Chapter 10) develops the role of the corporate sector and the valuation ratio, and finds that the level of household saving matters in the final equilibrium position.

Kaldor argued vehemently and imaginatively against Monetarism, and Part IV, Money and Macroeconomics, is largely devoted to one of the main issues he raised – namely, the claim that money is endogenous. Minsky (Chapter 11) discusses financial innovations as means by which the financial community can avoid regulation; one of these, securitization, has become especially prominent recently, weakening the remaining control of the authorities. Tobin (Chapter 12) regards much of the discussion as misplaced; the authorities can control interest rates, and when they do the money supply is endogenous. When they control the money supply, which they can also do, perhaps less successfully, interest rates will be endogenous. Monetarism is misguided, but not because the monetary authorities have lost control. Moore (Chapter 13) compares Kaldor's discussion of interest, credit and money to Marx, Keynes and Kalecki with particular reference to demand-driven supplies of credit. Davidson (Chapter 14) distinguishes different meanings of the claim that money is endogenous or exogenous: it may refer to the elasticity with respect to demand or interest, or to the stability of the money supply function. The different claims have different implications. Lavoie (Chapter 15) surveys the development of Kaldor's views, especially in relation to French critiques of Quantity Theory thinking.

One of Kaldor's most celebrated papers presented his version of a Keynesian business cycle. It took many years for mathematical economists to justify the geometrical intuitions in this paper, and when they did, it became clear that Kaldor had anticipated a whole new field of business cycle theory – the study of 'limit cycles,' pioneered, with techniques of nonlinear dynamics, by Richard Goodwin. Part V, Business Cycles, contains papers contributing to various contemporary Kaldorian themes in this extremely active field. (Several other studies – Harris, Kurz, Marglin and Bhaduri, and Targetti – contain discussions of stability, and Nell presents two cyclical models.) Day and Lin (Chapter 16) present a nonlinear IS-LM system and show that when structural parameters are allowed to shift, in the presence of a strong accelerator effect on instrument and tight money, business cycles or other types of complex dynamics may be generated. (In this regard they differ with Marglin and Bhaduri, and also with the discussion of endogenous money.) In any case, several 'regimes' can be distinguished indicating the analytical power of these methods. Foley (Chapter 17) combines Marx, Keynes and rational expectations into a 'perfect foresight' model, in which the maximizing behavior of the firms, based on rational expectations, brings about exactly the results foreseen – but they are cyclical around the path of accumulation. Shaikh (Chapter 18) shows that breaking up investment into its circulating and fixed components, and distinguishing slow and fast adjustments, makes it possible to show that a capitalist economy will cycle around the warranted growth path. Franke and Semmler (Chapter 19) set out a nonlinear dynamic version of an IS-LM system and exhibit the role of the financial sector, showing that equity finance and debt financing play a major role in the overall dynamics. The conclusions partly rest on an investment function that is reminiscent of Kalecki's work. It differs from the investment function others use, notably Kurz, Skott, Nell, and Marglin and Bhaduri, all of which provide more of an accelerator-like role to capacity utilization and expansion. Phelps (Chapter 20), referring back to a paper by Kaldor on capital theory published in the 1930s, provides a dynamical model of slump and recovery, by using a standard production function and a neo-Classical treatment of consumption/saving. The point of the study is its analysis of the possibly slow recovery from shocks on the dynamics of the system. In its methodology it complements the other studies nicely, though it might reach rather divergent conclusions. Skott (Chapter 21) presents the most Kaldorian study, an elegant updating of Kaldor's approach, showing that cycles can take place at near full employment, a conclusion similar to Shaikh's and different from Nell's. Jarsulic (Chapter 22) shows that when the financial sector is added to a streamlined Goodwin-type model of growth cycles, monetary factors will supplement the labor market in affecting investment, and producing cycles, leading to different policy conclusions.

A great part of Kaldor's life work centered on growth. He changed his mind considerably over the years, and never worked out his ideas fully – as already explained in Skott. But he developed a number of major themes. In Part VI, Theory of Growth, Targetti (Chapter 23) explores his changes of opinion, and develops the agricultural–manufacturing interaction, centering on the terms of trade and technical progress, characteristic of his later years. Kurz (Chapter 24) sets out a simple and elegant steady growth model, with two kinds of labor, technical progress and variable capacity utilization. The result is a beautiful set of diagrams and a classification of alternative regimes, between which the system will tend to shift as different kinds of technical progress take place. Hagemann (Chapter 25) thoroughly explores the implications of the Kaldorian saving function in a two-sector linear growth model, correcting several misimpressions in the literature. Gram (Chapter 26) takes up the question of Harrodian instability in the context of international payments, and shows that under certain limited circumstances, there may be a solution, but that the adjustment will not necessarily imply an international equilibrium.

Kaldor always emphasized that economics should be realistic. Assumptions should be sensible, the structure of the model should not include anything unrealistic, implausible or impossible behavior could never be assumed, and so on. Therefore the outcome of theorizing should tell us about the world. Does it? This is an empirical matter. Part VII, Empirical Evidence on Post-War Growth, takes up the question as regards the post-war world. Boyer and Petit (Chapter 27) examine Kaldor's changing approach to growth and set out several alternative regimes, suggesting on empirical grounds a number of improvements. Gordon (Chapter 28) sets up a Kaldorian macroeconometric model and estimates it, finding it far too unstable. By introducing a number of Marxian and institutional–regulationist modifications this can be corrected, but the distinctively Kaldorian features no longer seem very important. Nagy (Chapter 29) argues that disembodied technical progress, in a very Kaldorian fashion, plays an important role in socialist growth.

All his life Kaldor worked to develop policies that would stabilize the economy and promote justice. He and Hart set out a proposal for a commodity reserve currency, the history and arguments for which Hart presents in Part VIII, Economic Policy and Economic Systems (Chapter 30). Dell (Chapter 31) provides a survey of Kaldor's work in the field of international development. In the final Chapter 32, Nell takes up a theme of Kaldor's later years, the distinction between 'demand-constrained' and 'resource-constrained' economies, and argues that 'Harrodian instability' is really the dividing line between them. On this basis he provides an interpretation of the distinctive properties of modern capitalism and socialism, showing that investment cycles are possible in each, without crossing the boundary between them.

The great variety and high quality of these studies is perhaps the finest tribute our profession could make to the inspiration that Nicholas Kaldor provided for us all.

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Part I
Nicholas Kaldor: An Overall Evaluation

1 Nicholas Kaldor 1908–86*

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1 INTRODUCTION

Professor Lord Kaldor, who died at Papworth hospital near Cambridge on 30 September 1986, aged 78, was one of the most distinguished economists of the 20th century who will be recorded in the history of economic thought as a brilliant theoretician and applied economist, surpassed in originality only by Keynes and Harrod among British economists this century. He was a dominant influence in economic debates on the world stage for over fifty years, and hardly a branch of economics escaped his pen. At the London School of Economics (LSE) in the 1930s, while still in his twenties, he emerged as one of the country's leading economic theoreticians making fundamental contributions to controversies in the theory of the firm and in capital theory; to trade cycle theory and welfare economics, and to Keynesian economics by 'generalizing' Keynes's *General Theory*, which nearly 50 years later led Sir John Hicks to remark, 'I think that your (1939) paper was the culmination of the Keynesian revolution in *theory*. You ought to have had more honour for it.'[1] His reputation was such that in 1938, and still only thirty, he was offered a Chair by the prestigious University of Lausanne – the home of Walras and Pareto – which he reluctantly declined. Keynes thought extremely highly of him. In a letter to Jesus College, Cambridge in 1943 suggesting Kaldor as an Economics Fellow, Keynes wrote, 'I put him very high among the younger economists in the country . . . He is of the calibre which would justify the immediate election to a Readership . . . He is a brilliant talker and one of the most attractive people about the place .'[2] The influence of Keynes, and the exigencies of the Second World War, turned Kaldor into one of the country's leading applied economists, and he continued to mix theoretical and applied analysis thereafter. In the early 1950s as a member of the Royal Commission on the Taxation of Profits and Income, he became one of the world's leading experts on tax theory and policy, writing, amongst other things, a minor classic on the case for an expenditure tax.[3] At the same time, he was the joint architect, with Joan Robinson and Richard Kahn, of the post-Keynesian school of economics, which extended Keynesian modes of

* This Memoir draws heavily on my book, *Nicholas Kaldor* (Brighton: Wheatsheaf Press, 1987). I am very grateful to Dr G. Harcourt for helpful comments on an early draft of the paper.

thought to the analysis of growth and distribution, challenging the prevailing neo-Classical orthodoxy of the determinants of long run steady growth and distributive shares based on factor substitution and marginal productivity pricing. Kaldor's original models of growth and distribution, designed to explain the 'stylized facts' of mature capitalist economies, with their stress on the primacy of the investment decision and embodied technical progress, generated as enormous secondary literature, as did his later thinking on the applied economics of growth, with his stress on the importance of the manufacturing sector as the source of increasing returns. He was highly critical of neo-Classical value theory, or what he called equilibrium theory, with its basic assumption of non-increasing returns in all activities. Kaldor did not believe it was possible to understand the growth and development process within countries, or between countries in the world economy, without a two-sector model distinguishing between diminishing returns (primarily land based) activities on the one hand and increasing returns (primarily industrial) activities on the other. The full implications of his novel thinking in this respect have still to be worked out. Finally, in his last years, he was to lead the intellectual assault on the doctrine of monetarism.

Kaldor lived life to the full both as a professional economist and as a family man. He was passionately interested in the world around him, and in the plight of his fellow men, and how the art and practice of economics could make the world a more agreeable and civilized place in which to live. His belief in a fairer distribution of income and wealth in society, and an intolerance of injustice, made him a life-long socialist. He indulged no hobbies such as music, gardening or collecting; he preferred to occupy his time embroiled in economic problems and ideas that intrigued and perplexed him at both the theoretical and policy level. As a devisor of ingenous schemes, he had no equal: 'the last great innovator', as Professor Ken Galbraith once described him. His view of economics as a moral science – as a branch of ethics in the Cambridge tradition – motivated much of his writing, and led him into policy making at the highest level as a Special Adviser to three British (Labour) Chancellors of the Exchequer, and as an adviser to several developing countries.

He did have financial interests which absorbed a lot of his time. He came from a well-to-do family and he married into wealth. In 1959 he joined with Ralph Vickers of Vickers da Costa in founding an Investment Trust, Investing in Success Equities, which led to other ventures including the Anglo-Nippon Trust, Acorn Securities and Investing in Foreign Growth Stocks. In 1964, when he became adviser to the Chancellor of the Exchequer, he had to resign from the Boards of all these companies, two of which, ironically, were killed by his own hand with the introduction of capital gains and corporation tax.

It was not only his intellect and passion that made Kaldor dominant and controversial; it was also his style, charm and sense of fun which made it impossible not to listen to what he had to say. He possessed that rare charisma and magnetic quality which made it difficult not to fall under his spell. When he was an adviser in Ghana in 1961, his hold over the President, Dr. Nkrumah, was likened unto the captivating powers of the ju-ju magicians! He could be rude and offend people, but this only seemed to enhance his fascination. In lectures and seminars, he would endear his audience by the heavily accented flow of English prose, which was so much a feature of his personality. His background was Hungarian, but like so many European emigrés, he became more English than the English and revelled in her institutions. The image of a rotund and jovial medieval monk holding forth in intellectual discourse fits him perfectly. Although he was untidy and forgetful in private life, he had an extraordinary retentive and well-ordered mind that could recall at an instant the issues and controversies of long ago, and he could pluck statistics from the air like rabbits from a hat in support of his case. This gift could make him devastating in debate. He was always a powerful publicist for his views, and by force of personality and sheer perseverance, he would often wear an opponent down, achieving victory by attrition. He shared with Keynes the urge to protest. He was the most prolific newspaper letter-writing economist of his generation, contributing to debates not just on economic matters, but on social issues and defence as well. Kaldor and Keynes had other intellectual traits in common, and in many ways Kaldor took on, consciously or unconsciously, the mantle shed by Keynes. In particular, both possessed that strong intuition which made them more right in their conclusions and implicit presumptions than in their explanations and explicit statements. Much of Kaldor's work on growth and development falls, I believe, into this category.

Kaldor's love for economics was superceded only by the love for his family from which he derived so much of his inner happiness and self-confidence. In 1934 he married Clarissa Goldschmidt, a history graduate of Somerville College, Oxford, who provided the environment of peace and stability conducive to creativity. The four daughters of the marriage gave him particular pleasure, plus his eleven grandchildren. Kaldor was never happier than when the whole family clan was gathered together for festive or other special occasions in the spacious Edwardian family home at 2 Adams Road, Cambridge, or for holidays at the summer home in Le Garde Freinet, France. He loved to joke and play with young and old. Nothing seemed to trouble him, not even noise. Every day, the ever-open front door of his Cambridge home would invariably see a succession of family and friends toing and froing, while Kaldor worked away unperturbed in his groundfloor study off the entrance hall. He might or might not appear, depending on the urgency of the task at hand. He liked to compartmentalize his intellectual effort, working intensely for long periods and then relaxing. This made him appear at times egocentric (and he was), but then he could also be very generous with his time, receiving a succession of invited and uninvited guests who travelled to Cambridge to see the 'great man' as if on a pilgrimage to Buddha. His dearest Cambridge friend was Piero Sraffa, who in his prime would cycle round from Trinity College to Kaldor's house every afternoon to discuss economics and topical matters of the day.

During his lifetime, many honours were bestowed on him in recognition of his contribution to economic science, and he was in constant demand across the world to give public lectures. He received Honorary Doctorates from the University of Dijon (1962) and Frankfurt University (1982). He was elected an Honorary Member of the Royal Economic Society of Belgium (1955); an Honorary Fellow of the LSE (1970); an Honorary Member of the American Economic Association (1975) – 'a small tribute to your great contribution to economics' is how the President, Professor Kenneth Arrow, described it; a Foreign Honorary Member of the American Academy of Arts and Sciences (1977), and an Honorary Member of the Hungarian Academy of Sciences (1979). In 1970 he was President of the Economics Section (Section F) of the British Association for the Advancement of Science, and in 1974, President of the Royal Economic Society, an honour much coveted by the British economics establishment. In 1974 he was made a Life Peer as Baron Kaldor of Newnham in the City of Cambridge. He used his platform in the House of Lords to great effect. Economic historians will find his speeches one of finest contemporary records of the economic issues of the day, with a pungency on topical matters reminiscent of the polemical style of Keynes.[4] The major honour that eluded him was the Nobel Prize. He was, in the words of *The Economist* newspaper, 'the best known economist in the world not to have received the Nobel Prize'.[5] Why he was overlooked is still something of a mystery. In the first year of the prize, 1969, he was, according to Press reports,[6] on a short list of ten names including Friedman, Samuelson, Meade, Perroux and Kantorovich, but by his challenge to the neo-Classical orthodoxy he probably upset too many influential people in the economics establishment, including, presumably, the Swedish Nobel Committee. It may be significant (and some consolation) that none of the great British economists working in the Keynesian tradition – including Roy Harrod or Joan Robinson – were honoured.

2 EARLY LIFE, 1908–39

Kaldor Miklos (Miki) was born in Budapest on 12 May 1908 into a comfortable middle-class Jewish family. His father, Gyula, was a successful lawyer, as legal adviser to the German legation in Budapest. His mother, Jamba, was a well-educated, cultured woman, particularly versatile at languages, including English. There was a daughter of the marriage and two earlier sons, both of whom died in childhood. The young Kaldor, as the only surviving son, was undoubtedly spoiled. He first started school at the age of six, and then at ten transferred to Budapest's famous Minta (or Model) Gymnasium, which in those early years of the 20th century produced a galaxy of distinguished academics including Michael Polanyi, Edward Teller, Leo Szilard, Theo von Karman, Nicholas Kurti, and Thomas Balogh. The young Kaldor's education was squarely in the classical tradition, and throughout his life he retained a deep knowledge and interest in European culture and institutions. Politics and freelance journalism became his hobbies, and he continued to practice the latter during his student days in Berlin and London. His interest in economics was partly the natural outcome of his fascination with politics and partly inspired by wanting to understand more fully the German hyper-inflation of 1923. His father had also kindled an interest with the purchase of a copy of Keynes's *The Economic Consequences of the Peace*. He enrolled in the University of Berlin in 1925, committed to the study of economics, but stayed only eighteen months. England, he soon learned, occupied the centre of the economics stage, and he arrived in London in April 1927 to register as a General Student at the London School of Economics to sample the lectures and to improve his English. The summer term was enough to whet his appetite and he enrolled for the BSc. (Econ.) degree from October 1927. An allowance from his father and fees from journalism financed his studies. The Hungarian newspaper, *Magyar Hirlap* employed him, and he was the London correspondent of *Pester Lloyd* with his own headed notepaper. He also wrote for the *London General Press* which syndicated his articles in several countries. His speciality was conducting interviews with prominent personalities, particularly in literary circles, including such famous characters as Hilaire Belloc, G. K. Chesterton, Arnold Bennett, H. G. Wells, John Galsworthy, Arthur Conan Doyle and Rebecca West.

In his first year at the School, Kaldor attended lectures by Hugh Dalton and John Hicks, among others, and his supervisor was the economic historian Eileen Power (later Postan) whom he held in high regard. His first year examination performance was no more than mediocre, and he failed (and had to retake) mathematics. There was, however, a dramatic change in the subsequent two years as his interest in economics deepened. Allyn Young, the newly appointed Professor of Economics from Harvard, was a dominant influence in his second year, while Lionel Robbins and a young lecturer, Maurice Allen, dominated his thinking and learning in the third year. Kaldor graduated in 1930 with first class honours, and became the favourite pupil of Robbins, who had been appointed to a Chair in 1929 following the untimely death of Young from pneumonia. Robbins secured for him a £200 research studentship at the School and gave him his first teaching position, supervising second and third year students in economic theory. The research award lasted for two years, one term of which in 1931 he spent at the University of Vienna. His research project was the 'Problems of the Danubian Succession States,' the main fruits of which were four anonymous articles in *The Economist*,[7] an article in the *Harvard Business Review*,[8] and his first published letter in *The Times* on the dominance of farming in the Danubian States.[9] At the same time he was reading widely in economic theory. He took an early interest in Keynes's *A Treatise on Money*, writing to Keynes asking for clarification over his exchange with Dennis Robertson in the *Economic Journal* of 1931.[10]

Friedrich von Hayek, who was induced to London by Robbins as a counterweight to the growing intellectual influence of Keynes and Cambridge, was also a dominant influence on Kaldor's early thinking. His first published paper on "The Economic Situation of Austria" was almost pure Hayek in its cyclical analysis of the slump conditions of Austrian industry. With his undergraduate contemporary, Honor Croome (*née* Scott), he had already embarked in 1930 on an English translation from the German of Hayek's *Monetary Theory and the Trade Cycle*, and he also translated a paper by Hayek on "The Paradox of Saving" which *Economica* published in 1931. It was in connection with unanswered questions from this paper that Kaldor first started to lose respect for Hayek's work, and this culminated later in devastating critiques of his trade cycle theories and other work. He felt increasingly uneasy with the narrow dogmatism and libertarian philosophy of the Austrian school, which both Robbins and Hayek represented. Kaldor wanted to escape, and he gradually did so, particularly with the help of John Hicks. Kaldor and Hicks shared adjacent flats in Bloomsbury and were close friends before their respective marriages in 1934 and 1935. Hicks introduced Kaldor to Walras and Pareto, and Kaldor read various drafts of Hicks' *Value and Capital* that were in preparation between 1930 and 1935. Hicks was also instrumental in introducing Kaldor to the Swedes. Both read in the original Myrdal's 'Monetary Equilibrium' published in 1933, which partially prepared them for the Keynesian revolution to come.

Kaldor became increasingly torn between Robbins and Keynes as mentors. In 1932 he was appointed by Robbins to the staff of the LSE as an Assistant in Economics (later renamed Assistant Lecturer) and naturally felt some allegiance to him, but at the same time he began to feel more secure and independent. His relationship with Robbins waned gradually at first and then gathered momentum to such an extent that Robbins later obstructed his promotion from Assistant Lecturer to Lecturer. Robbins was thoroughly hostile to the Keynesian revolution, effectively denying that the 1930s' depression had anything to do with a lack of effective demand, and denouncing Keynesian remedies of public works. Kaldor was in the United States on a Rockefeller Research Fellowship when Keynes' *General Theory* appeared, and was an immediate convert. He was to play a major proselytizing role in spreading Keynesian modes of thinking to young generations of economists, remaining faithful to the Keynesian tradition for the rest of his life.

In those early years at the LSE, Kaldor's major teaching commitment was a course on the Theory of Costs (later called the Theory of Production). He was a superb teacher.[11] He also lectured in various years on International Aspects of the Trade Cycle, The Theory and Practice of Tariff Making, Advanced Problems of International Trade (shared with John Hicks), Economic Dynamics, Capital and Interest, and Public Finance and the Trade Cycle. As early as 1933, he was beginning to make an academic name for himself. Four major theoretical papers were in embryonic form,[12] he helped to launch the *Review of Economic Studies* and played an active part on the editorial board, and he took an active part in the weekly seminar run by Robbins and Hayek, which in the folklore of the LSE has become as legendary as the Political Economy Club run by Keynes in Cambridge. It was in reading his paper to the Seminar on 'A Classificatory Note on the Determinateness of Equilibrium' that the novel felicitous description of 'cobweb theorem' occurred to him, to explain the oscillatory movements of price around its equilibrium value.

The academic year 1935–36 was spent in the United States where he travelled extensively, meeting many of the leading American economists including Joseph Schumpeter, Edward Chamberlin, Jacob Viner, Henry Simons and Irving Fisher. At the Econometric Society meetings in New York in December 1935 he read a paper on 'Wage Subsidies as a Remedy for Unemployment',[13] and listened to a paper by Henry Simons on the measurement of income which also indicated how expenditure could easily be calculated to form the basis of an expenditure tax. Kaldor was to resurrect this idea later when he turned his attention to tax matters in the 1950s. On return from the United States, his research output continued apace. In the next four years, there appeared his major survey of capital theory,[14] his attack on Pigou's theory of how wage cuts affect unemployment,[15] his critique of Chamberlin and the distinction between monopolistic and imperfect competition,[16] his devastating critiques of Hayek,[17] his generalization of the General Theory,[18] and his seminal papers in welfare economics[19] and on trade cycle theory.[20] This massive theoretical outpouring over a short space of years was inventive and innovative in four major areas of economics, and has had a lasting impact. In the theory of the firm, he contributed to the debate over the incompatibility of the assumption of long period static equilibrium and perfect competition and developed the notion of 'excess capacity' under imperfect competition; he produced a novel (non-linear) theory of the trade cycle; he laid the foundations of the new welfare economics, and in the field of

Keynesian economics, he converted Pigou to Keynes and provided the most convincing rationale for Keynes's theory of the multiplier. Some brief words in each field are in order.

In 1933, Joan Robinson and Edward Chamberlin, in independent contributions,[21] released the theory of firm behaviour from the straight-jacket of perfect competition. One of Kaldor's important contributions, in a seminal paper "Market Imperfection and Excess Capacity",[22] was to demonstrate that free entry into an industry will only lead to perfect competition if there are non-decreasing returns to scale; otherwise free entry will raise unit costs which will ultimately halt the entry of new firms. Each firm will operate near its breakeven point, not where costs per unit of output are at a minimum. This is the famous 'excess capacity' theorem. He went on to argue that if scale economies exist, free entry will not necessarily lead to tangency of the demand curve and the average cost curve because the minimum size of new entry may dilute demand so much that the demand curve facing each individual firm lies below the cost curve, involving all firms in losses. Equally, the threat of this happening may prevent profit being eliminated, so that 'pure' profit may still exist in a state of equilibrium. Like Marshall and Sraffa before him, and Hicks later, Kaldor recognized that increasing returns has profound implications for neo-Classical price, distribution and employment theory. With constant costs, however, profits will never be eliminated as long as the demand for output is less than infinitely elastic, and this is why constant costs leads to perfect competition: 'no degree of product differentiation and no possibility of further and further product variation will be sufficient to prevent this result, so long as all kinds of institutional monopolies and all kinds of indivisibilities are completely absent'. Later, however, he retracted his views on free entry. In debate with Chamberlin[23] over the meaning of 'monopolistic competition', he conceded that if the distinguishing feature of monopolistic competition is an infinite range of differentiated products, there cannot strictly speaking be 'free entry', since no one else can produce an identical product. There can only be freedom of entry to produce substitutes, which leaves the structure of monopolistic competition intact. In another important contribution, "The Equilibrium of the Firm",[24] he developed a novel theory of differences in the size of firms based on the co-ordinating ability of managers as the only true fixed factor of production. It was not a theory to which he later attached much importance. Instead, he followed Kalecki and the principle of increasing risk, based on the gearing ratio of firms. Profits are crucial for expansion, not only in themselves, but by enhancing the ability of firms to borrow in the market.

During this fertile theoretical period of the 1930s, Kaldor also became heavily involved in debates on the trade cycle, taking up cudgels against Hayek and the Austrians. Their theory was monetary in essence, not dissimilar to Wicksell's, relating to divergences between the money rate of interest and the natural rate of interest. Kaldor was to absorb this theory and eventually to demolish it in a powerful paper "Capital Intensity and the Trade Cycle".[25] Hayek himself changed his mind over movements in capital intensity and the origins of cyclical crisis during the upswing. In *Monetary Theory and the Trade Cycle*[26] he argued that capital intensity increased during the upswing which then caused adjustment problems as credit expansion was curtailed. Later, in *Profits, Interest and Investment* (1939), he argued the exact opposite, that employers would seek more labor intensive methods of production as real wages fell (the Ricardo effect). Kaldor also launched into this *volte face*, for which he was partly responsible in the first place, in another powerful paper "Professor Hayek and the Concertina Effect".[27] First, he objected to Hayek's use of the term 'Ricardo effect', since Ricardo's argument concerning factor proportions referred to the relative price of labor and machinery, not to the price of consumption goods affecting real wages. Secondly, he went on to show the special conditions necessary for the Ricardo effect to work, and to argue that if it does work, its quantitative effect would be small. But whatever happens, it can never lead to *less* investment because a rise in the rate of interest, which is a necessary condition for the Ricardo effect to work, will only occur if investment increases. At the empirical level, Kaldor could find no clear cyclical pattern of capital intensity (or 'concertina effect'). He joked: 'I think the evidence rather suggests that the concertina, whichever way it goes, makes a relatively small noise – it is drowned by the cymbals of technical progress.' Kaldor sent Keynes a copy of his 1942 paper to which Keynes replied: 'Your attack on poor Hayek is not merely using a sledge hammer to crack a nut, but on a nut which is already decorticated.' Kaldor reminded Keynes that Hayek had spent the whole of the summer term in Cambridge discussing with students his paper on the Ricardo effect 'creating an unwholesome muddle in the minds of the young'.

Kaldor's brush, and ultimate break, with the Austrians led him to examine the meaning and determination of the concept of the 'investment period' in a major survey of capital theory published in *Econometrica*, 1937.[28] Kaldor concluded that the investment period concept is really nothing more than one way of measuring the ratio of capital to labor, but since there is no unique measure of capital, there is no unique measure of the capital to labor ratio. It is possible, however, to construct *ordinal* measures. He criticized conventional measures which were sensitive to changes in the relative price of inputs and outputs without any change in the real structure of production having taken place, and proposed himself an index of the ratio of 'initial cost' to 'annual cost' in the production of output. In this major contribution to the capital theory debate, Kaldor also anticipated von Neumann's famous result that the rate of interest represents the highest potential rate of growth of an economy which would obtain if nothing were withdrawn from the economic system for unproductive consumption.[29]

Kaldor's own original contributions to trade cycle theory came in two papers 'Stability and Full Employment'[30] and 'A Model of the Trade Cycle',[31] in which he argued that instability is inherent in the economic system itself because there is no reason why the division of income for consumption and saving should be in the same proportion as the division of output. All booms must come to an end, either through credit restrictions, rising interest rates, excess saving or, in the final analysis, through a shortage of labor. The trade cycle is the price to be paid for a high rate of economic progress, which was also the view of Dennis Robertson. Mechanisms do exist, however, that may bring about a stable equilibrium, and in 'Stability and Full Employment' there are to be found the early seeds of Kaldor's macro-theory of distribution which did not fully germinate until 1956. Kaldor first started thinking about trade cycle theory when he gave four lectures on the international trade cycle at the LSE in 1933–4. He realized that the task was to explain oscillations between a low and a high level equilibrium and that this could not be done using a linear accelerator. An S-shaped investment (and savings) curve would be a plausible hypothesis, however. At low levels of output, increased output will not induce more investment because there is excess capacity, and at high levels of output there will be no inducement to invest if increases in output are impossible. Saving is also likely to be a non-linear function of output, but probably more sensitive than investment at both high and low levels of output.[32] With these two functions, Kaldor showed that the economic system can reach stability at either a high or low level of economic activity.[33] Shifts in the curves then produce limit cycles: at high levels of output, the investment curve shifting down and the savings curve up, and *vice versa* at low levels of output.

Another of Kaldor's original insights at this time was in the field of welfare economics. With Hicks, although with prior claim, he was the founder of what came to be called the 'new welfare economics'. Kaldor's short seminal paper 'Welfare Propositions in Economics and Interpersonal Comparisons ofUtility'[34] was a reaction against the nihilism of Robbins and the Paretian school that if an economic change makes some people better off, but others worse off, it is impossible to make a judgement about whether the change is desirable (in the sense of increasing welfare) because individual utilities cannot be compared. Kaldor interpreted Robbins' stance as support for the *laissez-faire* approach to economic affairs, and as a recipe for economic paralysis. Kaldor's innovation was to introduce the idea of compensation tests: that if the gainers from a policy change could *potentially* compensate the losers and still be better off, the economist should be able to endorse the policy change since output must have increased. The compensation test would allow the economist to say something about output, although not about its distribution. A similar distinction between efficiency and distribution had been made by Pigou in his writings on welfare economics, and Hicks endorsed the Kaldor test.[35] The Kaldor–Hicks criterion gave rise to a vast literature, but with no resolution, not least because interpersonal comparisons of utility are still needed if welfare judgements are to be made. There could be changes which satisfy the Kaldor compensation test but which leave the community worse off than before because the income distribution is more 'undesirable' in some sense. This later formed the basis of the attack on the new welfare economics led by Ian Little.[36] There is no solution to the problem of deciding whether one distribution of income is worse or better than another unless a social welfare function is specified which makes explicit value judgements about the income distribution. This was Kaldor's original intuition, which he confirmed in a paper in 1946,[37] and which partly explains why he never participated in the subsequent debates.

In the field of macroeconomics, concerned with employment and the Keynesian revolution, Kaldor's first paper was on wage subsidies and employment.[38] It reflected his neo-Classical background and training – although he tried, at the same time, to forge a bridge between Keynes and the classics. Well before Keynes's *General Theory* was published in 1936, the emerging 'Keynesian' consensus was against money wage cuts because this would simply reduce prices leaving real wages and employment unchanged. Kaldor believed wage subsidies to be a (compromise) alternative, since subsidies do not reduce money demand and therefore should not affect prices. When Kaldor wrote to Joan Robinson about his scheme, she claimed not to understand the argument unless subsidies raised the propensity to consume through a redistribution of income to labour. They would, but that was not Kaldor's point. Kaldor replied in exasperation 'I fear that Cambridge economics is beyond me!'[39] Kaldor was later to join the Cambridge fold, but not before two major contributions which helped to seal the Keynesian revolution. The first was his attack on Pigou, which converted Pigou to Keynesian ways of thinking. This was a notable victory. The second was the generalization of the *General Theory* explaining why it is output and not prices (the rate of interest) that adjusts savings to investment. Pigou was the defender of the classical faith in Cambridge and was quick into print following Keynes's demolition of classical full employment theory. Pigou continued to maintain that a cut in money wages could increase employment in the aggregate independently of a fall in the rate of interest, and published a paper to this effect in the *Economic Journal*.[40] The paper had been accepted by Dennis Robertson, standing in for Keynes as editor, who was ill. On reading the paper, Keynes described it as 'outrageous rubbish beyond all possibility of redemption', and castigated Robertson for publishing it.[41] The sentiments were shared by Kahn, Shove and Sraffa. It was Kaldor, however, who persuaded Pigou of the error of his ways, as Pigou later conceded. Kaldor showed in his response to Pigou[42] that the new equilibrium after a wage cut *must* imply a lower rate of interest. Kaldor modified Pigou's model to make saving a function of income in addition to the rate of interest, and showed that there is no way in which a change in money wages by itself could so alter savings and investment to ensure equality of the two at a *given* rate of interest. Kaldor was the first economist (after Keynes) to use rigorously what later came to be called ' the Keynes effect'. He recognized explicitly that a fall in money wages is exactly analogous to an increase in the nominal quantity of money or a reduction in liquidity preference. Keynes also replied to Pigou, but when Pigou responded to his critics and conceded the argument, it was Kaldor he addressed. He paid him the compliment of saying that 'the theory of the relation between money wages and employment, via the rate of interest, was invented by Kaldor'. Keynes was naturally annoyed by this, having devoted Chapter 19 of the *General Theory* to this very topic. It needs to be stressed, however, that Pigou conceded to Kaldor not on grounds of liquidity preference but on the assumption that an increase in output must reduce time preference and hence the equilibrium rate of interest. This led to the contention by some that a Keynesian conclusion had been accepted, in effect, by a non-Keynesian route. This was an understandable reaction, but Kaldor cleared up the confusion pointing out that liquidity preference considerations need only be invoked to explain why a reduction in time preference (which must occur) *fails* to produce a fall in the rate of interest.[43] Otherwise, with a normal classical savings function the interest rate is bound to fall.

The paper that gave Kaldor the most intellectual satisfaction, however, and his most notable, but neglected, contribution to the immediate Keynesian revolution, was 'Speculation and Economic Stability'[44] (including 'Keynes's Theory of the Own-Rates of Interest', originally written as an appendix, but published much later).[45] It addressed three important questions. First, why does an increase in saving not necessarily lead to an increase in investment; in other words, what are the necessary, if not sufficient, conditions for the workings of the income multiplier? Secondly, what determines the structure of interest rates? Thirdly, what asset sets the ultimate limit on employment by limiting the willingness to invest, and why? Kaldor's answer to the first question was the stabilizing influence of speculators. The greater the stability of price, the greater the instability of income. Kaldor believed that in the real world, the most important type of asset whose price is stabilized through speculation is long term bonds bought with savings. The less price fluctuates, the stronger Keynes's theoretical conclusion that savings and investment will be equated by a change in the level of income rather than by the rate of interest. The question then is what determines the 'normal' price of bonds, i.e. what anchors the long term rate of interest? Dennis Robertson, it will be remembered, accused Keynes of leaving the long term rate of interest 'hanging by its own bootstraps'. Kaldor addressed this question providing a 'bottom up' theory of the rate of interest in which the term structure of interest rates is determined by the convenience yield on money plus a risk premium on assets of different maturities. He repeated and defended this view many years later in his evidence to the Radcliffe Committee on the Working of the Monetary System (1959). Finally, it must be the asset, money, which sets the ultimate limit to employment because only the money rate of interest cannot be negative whereas the own-rates of interest on other assets can be negative and therefore cannot set the limit on investment. Kaldor was reacting against Keynes's suggestion in the *General Theory* that the desire in the past to hold land might have kept the interest rate too high, and that the desire to hold gold might do so in the future.

3 THE WAR AND IMMEDIATE POST-WAR YEARS

The theoretical outpouring at the LSE before the war established Kaldor as one of the world's leading young economic theoreticians. At the outbreak of war he was still only 31 years old. The war had two major impacts on his future career. First, the evacuation of the LSE to Peterhouse, Cambridge brought him into direct contact with the Cambridge Keynesians. Joan Robinson, Richard Kahn and Piero Sraffa became close academic friends, and together they formed the 'war circus', which later became the 'secret seminar' (although everybody knew of its existence!). Cambridge became his natural spiritual home, to which he was later invited to return, and he did so permanently in 1949. Secondly, the imperatives of war, and the necessity to plan for peace, switched his mind from pure theory to applied economics, and he rapidly became one of the leading applied economists of his generation. Apart from pure academic research, including new projects on the economics of taxation and of advertising under the auspices of the National Institute of Economic and Social Research, he became actively involved in the economic aspects of the war in three important fields: the finance of the war effort, national income accounting, and the problems of post-war reconstruction particularly in relation to Beveridge's proposals on Social Insurance and on Full Employment. He became friendly with Keynes and they communicated on a regular basis over a variety of matters connected with war finance and national income accounting. In particular, Kaldor made a number of practical suggestions on how Keynes's compulsory savings scheme might be made operational, and offered many constructive suggestions on the papers Keynes was writing on the estimation of national income. When the White Paper on National Income first appeared,[46] Kaldor's annual reviews of them in the *Economic Journal*[47] became a much-awaited event in the economics calendar in this country and abroad. His detailed grasp of national income accounting, and his attempts at forecasting, proved invaluable when it came to the assessment of the financial burden of the *Beveridge Report on Social Insurance and Allied Services* published in December 1942,[48] a plan which aroused great controversy. Opponents of extended States insurance claimed that it would be necessary to raise employers' contributions and the standard rate of income tax to over 50 per cent, with devastating effects on export performance and work effort. Kaldor showed convincingly that the price to be paid for comprehensive insurance against old age, sickness and unemployment – what Beveridge labelled 'Freedom from Want' – would not be more than ten [old] pence on income tax or six pence on income tax and a penny on a pint of beer.[49] Kaldor was the most influential economist to pave the way for the political acceptance of one of the great social advances of the modern age. The theme of the second Beveridge Report on full employment[50] was 'Freedom from Idleness'. Kaldor's contribution to the Report, contained in the now-famous Appendix C, was to calculate (with Tibor Barna) the revenue and expenditure implications of the government pursuing a fiscal policy to maintain full employment, and in doing so he developed what was virtually the first mini-econometric model of the UK economy. The meticulous analysis received high praise from all quarters in this country and abroad, although there was some questioning of the arithmetic and the optimism over the required levels of taxation for post-war reconstruction.[51] As it turned out, he was too optimistic about the assumed increase in real national income after the war, and underestimated the expansion of public spending on non-social and non-military items.

Kaldor did not confine himself solely to domestic issues. He took a keen interest in the war effort of Germany, and followed closely the economies of the allied countries. He also played a prominent role in public discussion of the international economic issues confronting the world economy at the time, including the Bretton Woods plan for a new international monetary system, and the American loan to Britain.

When the war ended, Kaldor wanted some of the war-time controls retained, to ease the transition to peace and to prevent the prospect of a short-lived boom followed by slump, which characterized the aftermath of the First World War. He identified three major objectives of economic reconstruction: full employment, the elimination of poverty, and improved efficiency. The Beveridge proposals, which he campaigned for, were designed to secure the first two objectives. In pursuit of the third, he favoured the retention of building and import controls, and advocated the continuation and extension of utility production to reap economies of scale.

The reputation that Kaldor built up during the war as an incisive applied economist led to numerous offers of jobs and advisory posts after the war, when the LSE had returned to London. He was made a Reader in Economics at the LSE in 1945, but was more than receptive to outside work, having become increasingly disenchanted with what he perceived to be the right-wing atmosphere of the School. At home, he was employed for a short time in 1946 as an economic adviser by the Air Ministry and Ministry of Supply to assist the British Bombing Survey Unit. He also became a regular contributor to *The Manchester Guardian* writing articles on aspects of post-war recovery. Abroad, he undertook three important missions. The first in 1945 was to act as Chief of the Planning Staff of the US Strategic Bombing Survey of Germany under the overall direction of Kenneth Galbraith. In that capacity, he interviewed many of the German Generals, including Halder, and helped to show that it was not the US Air Force that won the war, but rather the ground troops which proved decisive.[52] In 1946 he served as an adviser to the Hungarian government on its new Three Year Plan, and in 1947 he was invited to assist Jean Monnet at the French Commissariat General du Plan in preparing a plan for the financial stabilization of France. A whole new series of tax measures were proposed,[53] very similar to the reforms he later advocated in the context of developing countries.

Then came the invitation from Gunnar Myrdal to become the first Director of the Research and Planning Division of the newly created Economic Commission for Europe (ECE) in Geneva, originally established to administer Marshall Aid. There were difficulties in him taking leave from the LSE, and he consequently resigned his teaching post at the School after twenty years as student and don. The two years he spent in Geneva were among the happiest and most stimulating of his professional career, living in elegance on the shores of Lake Geneva with a young family, and in charge of a talented handpicked staff – including Hal Lary, Robert Neild, Esther Boserup, Helen Makower and P. J. Verdoorn. Kaldor worked like a Trojan, with the specific task of preparing an annual *Economic Survey of Europe*. When the first (and subsequent) *Surveys* appeared they attracted widespread international interest and were treated as the authoritative account of the economic conditions and trends in both Eastern and Western Europe.

While in Geneva, Kaldor also became involved in several special assignments including acting as adviser to the UN Technical Committee on Berlin Currency and Trade established in the winter of 1948–9 in an attempt to end the Soviet blockade of Berlin, and serving on an UN Expert Committee in 1949 to prepare a Report on National and International Measures for Full Employment. In the former capacity, he cross-examined representatives of the big-four powers in the light of the evidence of each, and then drafted the Report recommending the Soviet mark as the sole currency for Berlin. In the event, the stance of the Western powers hardened as the blockade began to be breached, and the blockade was eventually lifted unconditionally. The widely acclaimed *Report on National and International Measures for Full Employment*[54] was largely drafted by Kaldor, and its adoption by such a wide diversity of interests represented at the United Nations owed much to his verbal dexterity. Much of the Report was devoted to a discussion of the international propagation of cyclical disturbances, and the necessity for countries to strive for balance of payments equilibrium to avoid trade restrictions and deflationary bias in the world economy. Plus ça change plus c'est la même chose! Such was the impact of the Report that Kaldor was asked by the Council of Europe to chair a Working Party on how the recommendations of the Report might apply to Europe. The outcome was a further influential document, *Full Employment Objectives in Relation to the Problem of European Co-Operation*,[55] which recommended, amongst other things, a European Investment Bank and import controls, if necessary, to secure simultaneous internal and external balance. Kaldor's contribution to the international campaign in pursuit of full employment impressed Hugh Gaitskell, the Labour Chancellor of the Exchequer (1950–1), and led in 1951 to his appointment to the Royal Commission on the Taxation of Profits and Income. This was Kaldor's entree to the role of adviser at the highest level in the United Kingdom and abroad.

Kaldor had not been long in Geneva when he was approached by King's College, Cambridge to accept a Fellowship there. King's were short of economists, as Keynes and Gerald Shove had recently died, and Kahn was busy administering Keynes's estate. The *New York Times Magazine* described such an appointment as "being one of such honour and prestige for an economist that there are not five posts in the world more coveted by a man of that profession".[56] Cambridge was his natural intellectual home, and he accepted the offer provided he could postpone his arrival in order to complete his work for the ECE. He finally started teaching in Cambridge in January 1950, with a University Lectureship also conferred on him. King's, and the Cambridge Economics Faculty, remained his academic base for the rest of his life. He was made a Reader in Economics in 1952 and elevated to a Chair (with Joan Robinson) in 1966. Unlike Keynes, he chose not to play an active role in College life, nor did he assume any major administrative role in the Economics Faculty. He preferred to devote his time exclusively to research and writing, and later to politics and the role of adviser in several capacities.

4 TAX MATTERS

Kaldor and John Hicks were the only two academic economists appointed to the Royal Commission on the Taxation of Profits and Income in 1951, with Kaldor much more radical in his approach to tax matters. His immersion in issues of taxation for the next four years turned him into one of the world's leading tax experts. 'The Memorandum of Dissent to the Commission's Report',[57] which he drafted, and his book *An Expenditure Tax* (1955), became minor classics in the literature on taxation. The American public finance expert, Arnold Harberger, described the latter the book as 'one of the best books of the decade in public finance, ranking with the classic works of Edgeworth, Pigou, Simons and Vickrey'.[58] His campaign for a comprehensive definition of income, as the basis for a more equitable tax system, made him more and more influential in Labour Party circles, which culminated in his appointment in 1964 as Special Adviser on tax matters to the Chancellor of the Exchequer and led to a flood of invitations from developing countries to advise on tax matters, starting with India in 1956. Perhaps more than any other economist of his generation, Kaldor had an abiding faith in the power of taxation to alter significantly the performance of an economy. The desire to see social justice was also a strong motivating factor behind all his advice. In the 1960s and 1970s in the United Kingdom, he was the proposer and inventor of a variety of ingenious new tax schemes to enhance equity and to improve the performance of the British economy.

The equity of a tax system is to be judged by whether people with the same taxable capacity, or ability to pay, pay the same amount of tax. By this criterion, Kaldor viewed the UK tax system as 'absurdly inequitable' in the sense that the tax burden on some people was very heavy while on others it was very light according to how income was earned, whether or not they were property owners, and so on. Income by itself, however, is not an adequate measure of ability to pay because however comprehensively income is defined, it ignores taxable capacity that resides in property as such. This constituted for Kaldor an argument for measuring ability to pay by spending power rather than by income, but consideration of an expenditure tax was outside the Royal Commission's terms of reference. Kaldor's Memorandum of Dissent confined itself, therefore, mainly to existing inequities in the tax system relating to the exemption from tax of capital gains and to the differential treatment of the self-employed and others. A flat rate capital gains tax was recommended and this later became official Labour Party policy. Company taxation also came in for criticism. Kaldor wanted a single corporation tax but not an end to tax discrimination against distributed profits until a capital gains tax was introduced. Kaldor's name is identified most closely, however, with the advocacy of an expenditure tax. The idea of an expenditure tax was not new – it had been discussed in the past by Hobbes, J. S. Mill, Marshall, Pigou and Keynes – but no-one before Kaldor had exposed so comprehensively the weaknesses of income as a measure of taxable capacity. Moreover, if wealth is not taxed, inequity is even more acute, and Kaldor wanted to see the taxation of wealth too. A wealth tax became Labour

Party policy, but was never implemented. An expenditure tax has never found favour with any political party in the United Kingdom. India and Sri Lanka (on Kaldor's advice) have been the only two laboratory experiments, and in both countries the tax was withdrawn within a few years of implementation.

After finishing his work with the Royal Commission, Kaldor took a sabbatical year from Cambridge in 1956 and embarked on a world tour with his family, giving lectures wherever he went. He spent half the year in India and the Far East and then went to Latin America as consultant to the Economic Commission for Latin America (ECLA) in Santiago at the invitation of Raul Prebisch, visiting Mexico and Brazil at the same time. He delivered thirteen lectures in Chile on 'The Theory of Economic Development and Its Implications for Economic and Fiscal Policy' and five lectures at the University of Rio de Janeiro on the 'Characteristics of Economic Development' at the invitation of Roberto Campos. He returned to England via the United States where for a short time he was Seager Visiting Lecturer at Columbia University.

His journeys round the world as a tax adviser started in India in 1956, and his classic report on Indian tax reform is by far the most comprehensive.[59] It contains one of the clearest statements ever made of the case for wealth taxation. Many of the recommendations made for India to tighten up the tax system to provide a basis for social justice, efficiency and growth, are found in his later proposals for other countries with suitable modification for individual country circumstances. He gave tax and budgetary advice to Ceylon (1958), Mexico (1960), Ghana (1961), British Guiana (1961), Turkey (1962), Iran (1966), and Venezuela (1976). The proposed reforms and advice invariably received a hostile reception from vested interests, but he never wavered from the conviction that 'progressive taxation is the only alternative to complete expropriation through violent revolution'. The proposals for India, some of which were repeated for other countries, were: (a) that all income (including capital gains) should be aggregated and taxed progressively with a maximum marginal rate of 50 per cent (Kaldor did not believe in 'confiscatory' taxation for social justice); (b) a progressive personal expenditure tax imposed on rich individuals where income tax leaves off; (c) a wealth tax; (d) a gifts tax; (e) a corporation tax imposed at a single rate, and (f) a comprehensive and self-enforcing reporting system, and a more professional tax administration with highly paid officials immune from the temptation of bribes. The Indian Report received a generally hostile reception in the country itself, but was highly praised by tax experts. Ursula Hicks described it as "an outstanding and remarkable achievement".[60] Kaldor became embroiled in political controversy almost everywhere he went. In 1958 he was called to advise the Prime Minister of Ceylon, Mr Bandaranaike. A Report was prepared and accepted, but, owing to racial and other disturbances at the time, it was not published until 1960 – ironically by the newly elected right-wing United National Party who attempted to show that Bandaranaike (and his successor) had failed to fully implement the desirable recommendations relating to the extension of the tax base and the reduction of tax rates. His mission to Mexico in 1960 to make a study of the 'Possibilities and Conveniences of Modifying the Structure and Organization of the Mexican Tax System' was so sensitive that to write the Report he remained *incognito* for a month locked away in the hills outside Mexico City. The Report was never published,[61] the government fearing opposition and trouble from vested interests. A year later he went to Ghana to advise President Nkrumah. The country was in financial crisis, arising largely from the extravagance and corruption of the government. There was an urgent need for tax reform and to increase savings. Kaldor's proposed compulsory savings scheme, and the taxation of multinational companies, caused a wave of political protest and strikes. Later in the same year he was requested by Dr Cheddi Jagan, the Prime Minister of British Guiana, to undertake a comprehensive review of the tax system there with a view to increasing revenue and distributing the burden more equitably. British Guiana was also in a financial crisis with a lack of confidence at both home and abroad, manifesting itself in heavy capital outflows. The budget proposals designed by Kaldor, again including compulsory saving and anti-tax avoidance measures, provoked a general strike and serious anti-government riots which had to be quelled by British troops. 60,000 demonstrators stormed the Parliament building and there were five deaths. A Commonwealth Commission appointed to enquire into the origins of the disturbances, however, exempted Kaldor's budgetary proposals from *direct* blame; it was, the Commission concluded, a case of spontaneous combustion fermented by a number of forces, including an opportunity to protest against Dr Jagan and his government.[62] His mission to Turkey in 1962 at the request of the State Planning Organization was to prepare a memorandum on the problems of fiscal reform for use by the Prime Minister, Mr Ismet Inonu. Most of the proposals, including a novel land tax on the productive *potential* of land, were opposed by the Cabinet representing the landed interest and nothing was done which led four top officials of the State Planning Organization to resign in protest. Despite these setbacks, Kaldor firmly believed that the job of the adviser is to advise to the best of his professional ability, leaving the politicians to decide whether to implement the recommendations or not.

5 GROWTH AND DEVELOPMENT

The 1950s in Cambridge was perhaps the most fruitful period in Kaldor's academic life. While still immersed in tax matters, he began the daunting task, aided by Joan Robinson, Richard Kahn and (later) Luigi Pasinetti, of rethinking the whole of growth and distribution theory on non-neoclassical, Keynesian lines. He was profoundly dissatisfied with both the neoclassical theory of distributive shares, based on the perfectly competitive assumptions of constant returns to scale and marginal productivity factor pricing, and (later) with the neoclassical theory of long run equilibrium growth based on an exogenously given rate of growth of the labor force and technical progress, with adjustment to equilibrium growth brought about by a smooth change in factor proportions. He was also unhappy with the generally pessimistic nature of the 'classical' growth models of Ricardo, Mill and Marx, which appeared to be at variance with the facts of historical experience. In a remarkable series of papers between 1956 and 1966[63] Kaldor helped to lay the foundations of the neo- or post-Keynesian school of economics, with adherents and disciples throughout the world. This was the start[64] of the famous neo-Keynesian – neoclassical controversies between Cambridge, England and Cambridge, Massachusetts, USA, which captivated and preoccupied large sections of the economics profession throughout the 1960s. Kaldor and Joan Robinson became the *bêtes noires* of the American economics establishment. As Ford Visiting Professor at the University of California in 1959, Kaldor acquired the affectionate nickname of 'enfant terriblé of the Bay Area'!

One of Kaldor's earliest attacks on classical pessimism was a bold lecture on Marx that he delivered in Peking in 1956 (which he visited from India), in which he rejected the view that unemployment, cyclical fluctuations and growing concentrations of economic power are the inevitable features of capitalist evolution. The fact that money wages may rise as the reserve army of unemployed disappears does not imply a fall in profits because *real* wages may fall (or not rise as fast as productivity in a growing economy). Money wages and real wages are determined by different forces, and there can be no presumption of crisis based on a falling rate of profit. He went on to expound his own unique macro-theory of distribution (published a few months before in the *Review of Economic Studies*), which originated from a meeting of the 'secret seminar' at the end of 1955, and which derived its inspiration from the insight in Keynes's *Treatise on Money*, Vol. 1 (1930) that profits are the result of the expenditure decisions of entrepreneurs, not the cause, the so-called 'widow's cruse'. Kalecki had the same insight but used it to show why the level and fluctuations of output are particularly dependent on entrepreneurial behaviour, not specifically as a theory of the share of profits in output.[65] He relied instead on the concept of the 'degree of monopoly'. Kaldor's model is beautiful in its simplicity, and it will surely rank in the history of economic thought as one of the fundamental new theoretical breakthroughs of the 20th century. In words, the model states that given that investment is autonomous and determines saving, and given that the propensity to save out of profits is greater than out of wages, there will be a unique equilibrium distribution of income between wages and profits associated with that level of investment. Full employment is assumed, and this was regarded by some as a weakness, but as Sen,[66] Harcourt[67] and Wood[68] have shown, the model can be generalized to non-full employment situations. Kaldor's theory of distribution spawned an enormous literature, including the famous Pasinetti Paradox which showed that even if workers save and receive profits, the theory remains intact with only the distribution of income between workers and capitalists affected, not the equilibrium share of profits in income.[69]

Samuelson and Modigliani challenged Pasinetti's elegant generalization of Kaldor's model, and argued that if realistic parameter values are assumed for the model, the workers' saving propensity will exceed the investment ratio, and capitalists would disappear entirely.[70] In this case, the steady state conditions *would* be determined by the workers' propensity to save out of profits. Kaldor replied with his famous neo-Pasinetti theorem[71] which was never challenged by the Cambridge, Massachusetts school. The new model of distribution also provided within limits an alternative mechanism to that of neoclassical theory for equilibriating the warranted and natural growth rates. If the warranted rate lay above the natural rate, with planned saving in excess of planned investment, the share of profits would fall reducing the savings ratio, and vice versa. This seemed infinitely more plausible to the Cambridge, England school than the idea (as Joan Robinson once graphically put it) of the existing stock of 'jelly' (capital) being spread out or squeezed up to employ all available labor.

In 1957 and 1958, armed with his distribution theory, Kaldor set about to build a growth model to explain what he regarded to be the 'stylised facts' of capitalist economic history: a steady trend rate of growth of labor productivity, a steady increase in the capital-labor ratio, a steady rate of profit on capital, the relative constancy of the capital-output ratio, a roughly constant share of wages and profits in national income, and wide differences in the rate of growth of output and productivity between countries with similar capital-output ratios and distributive shares. Kaldor wanted to show how these various tendencies and 'constancies' are the consequence of endogenous forces operating in capitalist economies, and that it is not satisfactory to explain them on the basis of chance coincidence and unsupported assumptions such as neutral disembodied technical progress, constant returns to scale, and a unitary elasticity of substitution between capital and labor. Apart from his distribution theory, the other main novel feature of Kaldor's growth models was the idea of a technical progress function to overcome the artificial distinction implicit in the production function between movements along a function (due to relative price changes) and shifts in the whole function (due to technical progress). Technical progress, for the most part, requires investment, and investment normally embodies new ways of doing things. The technical progress function thus relates the rate of growth of output per worker to the rate of growth of capital per worker, with the shape of the function dependent on the degree to which capital accumulation embodies new techniques which improve labor productivity. Shifts in the function will change the relation between capital and output, but at the same time will set up forces, through a change in investment, which restores the capital-output ratio to its equilibrium level. Steady long run growth is determined by the parameters of the technical progress function incorporating both exogenous and endogenous forces. With the long-run equilibrium growth rate determined, the equilibrium investment ratio, the profit share and the profit rate can all be derived, providing an explanation of the 'stylised facts' of capitalist development.

As Kaldor grew older (and perhaps wiser?), he lost interest in theoretical growth models and turned his attention instead to the applied economics of growth. Two things particularly interested him: first, the search for empirical regularities associated with 'interregional' (country) growth rate differences, and second, the limits to growth in a closed economy (including the world economy). The distinctive feature of all his writing in this field was his insistence on the importance of taking a sectoral approach, distinguishing particularly between increasing returns activities on the one hand, largely a characteristic of manufacturing, and diminishing returns activities on the other (namely agriculture and many service activities). Kaldor's name is associated with three growth 'laws' which have become the subject of extensive debate.[72] The first 'law' is that manufacturing industry is the engine of growth. The second 'law' is that manufacturing growth induces productivity growth in manufacturing through static and dynamic returns to scale (also known as Verdoorn's Law). The third 'law' states that manufacturing growth induces productivity growth outside manufacturing, by absorbing idle or low productivity resources in other sectors. The growth of manufacturing itself is determined by the growth of demand, which must come from agriculture in the early stages of development, and from exports in the later stages. Kaldor's original view[73] was that Britain's growth rate was constrained by a shortage of labor but he soon changed his mind in favour of the dynamic Harrod trade multiplier hypothesis of a slow rate of growth of exports in relation to the income elasticity of demand for imports, the ratio of which determines a country's balance of payments constrained growth rate. Because fast growing 'regions' automatically become more competitive *vis-à-vis* slow growing regions, through the operation of the second 'law,' Kaldor believed that growth will tend to be a cumulative disequilibrium process – or what Myrdal once called a 'process of circular and cumulative causation' – in which success breeds success and failure breeds failure. He articulated these ideas in several places, most notably in two lectures: his Inaugural

Lecture at Cambridge in 1966,[74] and in the Frank Pierce Memorial Lectures at Cornell University in the same year.[75] Most of the debate concerning Kaldor's growth laws has centred on Verdoorn's Law and the existence of increasing returns. Kaldor drew inspiration for the theory from his early teacher, Allyn Young, and his neglected paper "Increasing Returns and Economic Progress".[76] Young, in turn, derived his inspiration from Adam Smith's famous dictum that productivity depends on the division of labor, and the division of labor depends on the size of the market. As the market expands, productivity increases, which in turn enlarges the size of the market. As Young wrote 'change becomes progressive and propagates itself in a cumulative way', provided demand and supply are elastic. Hence increasing returns is as much a macroeconomic phenomenon as a microphenomenon, which is related to the interaction between activities, and cannot be adequately discerned or measured by the observation of individual industries or plants. Kaldor was convinced by theoretical considerations and by his own research, and that of others, that manufacturing is different from agriculture and most service activities in its ability to generate increasing returns in the Youngian sense.

The difference in the laws of production governing the output of manufactured goods and primary products, and the different conditions under which manufactured goods and primary products are priced and marketed, also lay at the heart of his two-sector model of economic development, in which the ultimate constraint on the growth of a closed economic system is the rate of land saving innovations in agriculture (or more generally land-based activities) as an offset to diminishing returns.[77] Within a framework of reciprocal demand, the growth of industry and agriculture must be in a particular relationship to each other, and it is the function of the terms of trade to equilibrate supply and demand in both markets for growth to be maximized. In practice, the industrial terms of trade may be 'too high' or 'too low', in which case industrial growth becomes either demand constrained or supply constrained. Kaldor was highly critical of neoclassical development theory with its emphasis on allocation and substitution to the neglect of the complementarity between activities, with its prediction that long run growth is determined by an exogeneously given rate of growth of the labor force in efficiency units. He was equally critical of classical development theory with its focus on the supply side of the economy to the neglect of demand. Keynes undermined Say's Law at the aggregate level. Kaldor showed that Say's Law is equally invalid at the sectoral level because there is a minimum below which the industrial terms of trade cannot fall set by the minimum subsistence wage in industry.

Like Keynes, Kaldor believed that the uncontrolled movement of primary product prices was a major source of instability in the world economy, and that some intervention was desirable. This was the theme of his Presidential Address to the Royal Economic Society in 1976,[78] but he had addressed the issue before. He foresaw the collapse of the Bretton Woods system based on the US dollar as the key currency, and in 1964 he had prepared a Report for UNCTAD[79] proposing an international commodity reserve currency, backed by thirty commodities, which would replace the dollar and anchor the price level at the same time. The Report received short shrift, but he never altered his view that such a scheme was desirable. After the introduction of Special Drawing Rights (SDRs) in 1970, he recommended the use of SDRs to finance buffer stocks of key commodities on lines similar to Keynes's International Commodity Control Agency[80] scheme proposed at the time of Bretton Woods, but never adopted.

6 ADVISER TO LABOR GOVERNMENTS, 1964–70 AND 1974–76

When the Labor Party assumed office in 1964, Kaldor was the natural choice of adviser to the Chancellor of the Exchequer. Hugh Gaitskell, who died in 1963, had promised him such a position if and when Labor was returned to power, and James Callaghan kept the pledge, appointing him as Special Adviser on the Social and Economic Aspects of Taxation Policy. His friend, Robert Neild, replaced Alec Cairncross as Chief Economic Adviser to the Treasury, and his Hungarian compatriot, Thomas Balogh, was appointed as adviser to the Prime Minister, Harold Wilson. The appointment of two Hungarians to influential positions in the machinery of government provoked a hostile reaction in the press, as if a sinister Eastern European plot was about to be launched on the British people. Kaldor was portrayed as a tax ogre intent on squeezing the rich. The Labor government inherited a serious balance of payments deficit, and the immediate question was whether sterling should be devalued. Kaldor favoured some form of flexible exchange rate, but Wilson and other influential members of the Cabinet were against any form of exchange depreciation, hoping that a combination of controls and improved industrial efficiency would bring the balance of payments back into the black. As so many times in the past, deflation was eventually resorted to as a substitute for devaluation. Robert Neild was disillusioned and resigned his post. Callaghan approached Kaldor to take the job as Chief Economic Adviser to the Treasury, but he, too, was out of sympathy with the emphasis on deflation. When the government had no option but to devalue in November 1967, Callaghan resigned, and Roy Jenkins became Chancellor. Kaldor stayed on as Special Adviser, but Jenkins distanced himself from him, and in September 1968 Kaldor decided to return to Cambridge full time, staying on in the Treasury as an unpaid consultant and working with research assistants on several research projects including the relationship between budget deficits and the balance of payments (the 'New Cambridge' theory), and the relationship between employment, output and productivity growth, pursuing the ideas in his Inaugural Lecture. In November 1969 he returned to office as Special Adviser to Richard Crossman at the Department of Health and Social Security, where he was responsible, amongst other things, for persuading the government to substantially increase family allowances but at the same time to 'claw back' some of the increase through the tax system – benefitting the poor at the expense of the rich.

As Special Adviser to the Chancellor, Kaldor exerted a considerable influence on tax policy. In the Inland Revenue, where he was first based, he enjoyed a good working relationship with the Head, Alexander Johnston, and with most of the civil servants. Sir Douglas Wass, later Permanent Secretary to the Treasury, has described him as "the only economic adviser to Government that I have worked with who studied the administrative system and sought to fashion his ideas to what the system could bear".[81] Understanding the art of the possible, he never pressed hard for a wealth tax, and never mentioned the introduction of an expenditure tax. He was heavily involved, however, with the introduction and implementation in 1965 of the new capital gains and corporation tax, and with several other new tax initiatives. To encourage investment, particularly in depressed regions, he was instrumental in the replacement of investment allowances by investment grants differentiated regionally, and he played a major part in plugging various tax loopholes to reduce avoidance and evasion. He will be best remembered, however, as the inventor of the Selective Employment Tax, to encourage the diversion of resources from services to manufacturing activity, coupled with the Regional Employment Premium to give an extra boost to manufacturing employment growth in depressed regions. The inspiration for the Selective Employment Tax was based on the theory that manufacturing output growth was constrained by a shortage of labor, and that a tax on labor in services would not be passed on to the consumer in the form of higher prices but be paid for either out of profits or increased productivity. It turned out to be an ideal tax: it raised substantial revenue for the Exchequer at no 'cost' to the consumer, as predicted. It is hard to show that manufacturing output at the time was constrained by a shortage of labor, but productivity in services improved substantially.

Even as a Special Adviser to the Chancellor, he continued to travel widely giving lectures and seminars, and advising foreign governments in an unofficial capacity. In the summer of 1967 he toured four countries, giving his first lecture in Russia, delivering several lectures in Japan, advising the Indian Planning Commission on the budgetary implications of the Fourth Five Year Plan, and holding talks with officials of the Central Bank of Israel.

While in office, Kaldor was prevented from pronouncing publicly on topical matters of the day. Out of office in 1970 he took full advantage of his freedom with a flood of newspaper letters and articles on a whole variety of subjects. He was highly critical of Conservative economic policy between 1970 and 1974 – its monetary profligacy, and its encouragement of consumption to the neglect of the foreign trade sector. He also became heavily embroiled in the Common Market debate, and became the foremost academic critic of Britain's entry on the proposed terms. Armed with statistical ammunition on the 'true' costs of entry, and with his theory of circular and cumulative causation, he warned that Britain could become 'the Northern Ireland of Europe'. The Common Agricultural Policy (CAP) came in for particular attack, but his most devastating critique was contained in a *New Statesman* article 'The Truth about the "Dynamic Effects"'[82] in which he showed the balance of payments costs of entry to be close to one billion pounds, and argued that if deflation is necessary to pay for these costs, the assumed dynamic effects of entry will be negative. Many of Kaldor's prognostications on the costs and consequences of EEC entry have materialized. CAP has absorbed more and more of the Community's resources, Britain's budgetary contribution has been massive, and the balance of payments costs have contributed to the destruction of large sections of manufacturing industry. The dynamic benefits of entry promised by the 1970 White Paper have proved to be illusory.[83]

When the Labor government was returned to power in 1974, Kaldor resumed the role of Special Adviser to the Chancellor, this time to Denis Healey. Once again, the Conservative legacy was a severe balance of payments crisis. Since the floating of the pound in 1972, Kaldor had become sceptical of the efficacy of exchange rate changes as a means of reconciling internal and external balance (one of the few major issues on which he changed his mind) and he campaigned instead for various forms of import controls. Without some form of action, other than exchange rate depreciation, he forecast an 'IMF budget', and this is exactly what transpired in 1976. As far as the broad thrust of economic policy is concerned, Kaldor's influence on Healey was minimal. Disillusioned, he resigned his post in the summer of 1976, and took his seat in the House of Lords. He was, however, responsible for two major tax initiatives: first, stock appreciation tax relief which saved several companies from bankruptcy and, second, a capital transfer tax to replace death duties (including unrealized capital gains on death).

7 MONETARISM

The 1960s witnessed the recrudescence of interest in the doctrine of the Quantity Theory of Money which lay at the heart of what came to be called 'monetarism' and which spread like a plague from the United States to infect susceptible academic communities and eventually the conduct of economic policy in several countries. Its appeal was deceptively attractive. Through control of the money supply it promised a reduction in inflation with hardly any loss of output or employment and without having to talk to the trade unions. Kaldor led the intellectual assault against monetarism, in both the UK and abroad, describing the doctrine as 'a terrible curse'. . . 'a visitation of evil spirits'. . . 'a euphemism for deflation'. His view of monetarism was reminiscent of what Keynes felt about economic policy in the 1920s when in attacking the return to the gold standard in 1925 at the pre-war parity, he described monetary policy as 'simply a campaign against the standard of life of the working classes', operating through the 'deliberate intensification of unemployment – by using the weapon of economic necessity against individuals and against particular industries – a policy which the country would never permit if it knew what was being done.'[84]

Kaldor was not a monetary economist in the sense of Keynes or Robertson. Monetary analysis did not infuse the major part of his work. He was, however, a powerful witness before the Radcliffe Committee on the Working of the Monetary System which reported in 1959, and as Harrod noted in a review of Kaldor's Collected Essays,[85] the Committee's conclusions seemed to reflect Kaldor's evidence, namely that monetary policy is an uncertain instrument of economic policy on account of changes in the velocity of circulation of money and the insensitivity of expenditure to changes in the rate of interest. Kaldor fully concurred with the Committee's attack on the mechanistic Quantity Theory of Money, although, in his own review of the Report, he regretted that it failed to probe more fully into the reasons for the behaviour of monetary velocity.[86] Like Keynes, he believed that prices could rise quite independently of prior increases in the money supply, resulting from wage (and other cost) increases. His explanation of the Phillips curve, however, was a profits based theory of wage increases,[87] which he later turned into a productivity based theory of wage determination arising from leading sectors in the economy.

Kaldor's first major attack on the doctrine of monetarism was in a lecture at University College, London in 1970, directed at Milton Friedman, the undisputed father of modern monetarism.[88] During the 1970s and 1980s, during which his intellectual assault became a crusade, there followed a series of other lectures, including the Radcliffe Lectures at Warwick University 1981, the Page Lecture at Cardiff University 1980,[89] the Chintaman Deshmukh Memorial Lecture at the Reserve Bank of India 1984,[90] and culminating in his magnificent polemic *The Scourge of Monetarism*,[91] reminiscent in style, topicality and pungency of Keynes's *Economic Consequences of the Peace*. This volume contains his masterly 'Memorandum of Evidence on Monetary Policy to the Select Committee on the Treasury and Civil Service 1980', brilliant for its marshalling of the theory and facts relating to the core propositions of monetarism.

The key propositions of monetarism which formed the basis of the application of monetarism in the UK, and which Kaldor attacked, were as follows. First, that the stock of money determines money income. This has at least two important corollaries: that the money supply is exogenously determined, and that the demand for money is a stable function of money income. Secondly, that government borrowing is a major source of increases in the money supply. Thirdly, that government spending crowds out private spending, making government stabilization policy redundant, and fourthly there is, in any case, a natural rate of unemployment and if governments try to reduce unemployment below the natural rate there will be ever-accelerating inflation. Kaldor found all three propositions wanting, either theoretically or empirically. He was adamant that there is a fundamental difference between commodity backed money and credit money, and that in a credit economy, such as advanced capitalist economies, it can never be true to say that expenditure rises because of an increase in bank money held by the public, because credit money only comes into existence because it is demanded. Money is endogenous, not exogenous. Thus changes in the supply of money must be regarded as the consequence of changes in money income not the cause. The endogenous nature of money would also account for studies that find the demand for money to be a stable function of money income. Indeed, contrary to the monetarist proposition that stability is evidence of the potency of monetary policy, for Kaldor it was precisely the opposite that supply responds to demand and proves the impotence of monetary policy. Friedman's initial retort to Kaldor was 'if the relation between money and income is a supply response . . . how is it that major differences among countries and periods in monetary institutions and other factors affecting the supply of money do not produce widely different relations between money and income?'[92] The short answer is that they do, which Kaldor amply demonstrated in his evidence to the Treasury Select Committee of 1980.

Whether government borrowing is a major source of monetary expansion is essentially an empirical question. Kaldor showed for the UK that between 1968 and 1979 there was no relation between the size of the Public Sector Borrowing Requirement (PSBR) and the growth of broad money (M_3). Changes in the money supply were dominated by bank lending to the private sector which is demand determined.

Whether government spending crowds out private spending is also an empirical matter. If there exist unemployed resources, there cannot be resource crowding out. Indeed there should be crowding in through the Keynes multiplier. Financial crowding out owing to higher interest rates to finance government deficits is a possibility, but not inevitable. Higher interest rates may not be necessary and, even if they are, private expenditure may be relatively insensitive. Kaldor found no evidence for the UK that a higher PSBR required ever-rising interest rates.

Kaldor dismissed the concept of the natural rate of unemployment, based as it is on the classical labor market assumptions of diminishing returns to labor and that workers are always on their supply curve, ruling out the possibility of involuntary unemployment, and was contemptuous of the doctrine of 'rational' expectations: 'the rational expectations theory goes beyond the untestable basic axioms of the theory of value, such as the utility-maximizing rational man whose existence can be confirmed only by individual introspection. The assumption of rational expectations which presupposes the correct understanding of the workings of the economy by all economic agents – the trade unionists, the ordinary employer, or even the ordinary housewife – to a degree which is beyond the grasp of professional economists is not science, nor even moral philosophy, but at best a branch of metaphysics'.[93]

8 THE CHALLENGE TO EQUILIBRIUM THEORY

No account of Kaldor's life and work would be complete without more detailed reference to his challenge to neo-Classical value theory (or what he called equilibrium theory) which preoccupied him in later life and which will remain one of his lasting memorials. Few economists are willing or able to attack orthodoxy from within, but Kaldor had the courage and tenacity to do so in a remarkable set of lectures and papers. It was not the concept of equilibrium that he objected to, but the formulation of economic theory within an equilibrium framework and neoclassical modes of thinking with their static emphasis on the allocation and substitution role of the price system to the neglect of the dynamic process of growth and change based on increasing returns. His complaint, also shared by Kornai,[94] was quite simply that the framework of competitive equilibrium, within which so much contemporary economic theory is cast, is barren and irrelevant as an apparatus of thought for an understanding of how capitalist industrial economies function in practice. His war of words with the neo-Classical school started in 1966 with his response to Samuelson and Modigliani[95] in which he declared: 'it is high time that the brilliant minds of MIT were set to evolve a system of non-Euclidean economics which starts from a non-perfect, non-profit maximizing economy where . . . (neo-Classical, general equilibrium) abstractions are initially unnecessary'. His assault gathered momentum in the 1970s with provocative essays on 'The Irrelevance of Equilibrium Economics'[96] and 'What is Wrong with Economic Theory',[97] and culminated in his 1983 Okun Memorial Lectures on *Economics Without Equilibrium*[98] and his 1984 Mattioli Lectures on *Causes of Growth and Stagnation in the World Economy*. There were three major strands to his critique of equilibrium theory. The first was methodological, the second concerned the lack of realism about the way markets function in practice, and the third related to the implications of the neglect of increasing returns.

At the methodological level, Kaldor was strongly against the deductive method of building models on *a priori* assumptions without any firm empirical basis. For models to be useful, the assumptions must be verifiable, not axiomatic – which makes theories tautological. Many of the assumptions of equilibrium theory, e.g. non-increasing returns, optimizing behaviour, perfect competition, etc., are either empirically false or unverifiable. The methodological critique paralleled the disquiet that many economists had been expressing for a long time concerning the use of mathematics in economics which, for the sake of scientific precision, invariably substitutes elegance for relevance.

Kaldor's second major objection to neo-Classical equilibrium theory was its emphasis on the principle of substitution and on the allocative function of markets to the neglect of the creative function of markets and the complementarity between activities. Complementarity, rather than substitution, is much more important in the real world – between factors of production, such as capital and labor, and between activities such as agriculture and industry or industry and services. Static neo-Classical analysis is dominated by the idea that one thing must always be at the expense of something else – a 'tangential' economics as Allyn Young once described it, yet there are a variety of mechanisms whereby the expansion of activities can take place simultaneously. It is equally misleading to think of the market as simply a mechanism for the allocation of resources. Much more important is the role of markets in transmitting the impulses for change when tastes, technology and factor endowments are constantly changing. Nor are market prices the *deus ex machina* by which decentralized market economies function in the real world. Equally important are quantity signals. Loyalty, custom, goodwill and other intangible relations play an important part in market transactions, the more so where the product is not homogeneous and producers are price makers. In these markets prices are also relatively sticky, determined by costs plus a markup, and notions of fairness and goodwill stop prices from being adjusted to take advantage of (temporary) conditions of excess demand.

Finally, there is the problem for equilibrium theory of increasing returns. Marshall, Sraffa, Hicks, among the great economists, all recognized the difficulty. Competitive equilibrium requires perfect competition which is impossible if long run marginal cost is below price. Hicks admitted in *Value and Capital* (1939): 'unless we can suppose that marginal costs generally increase with output at the point of equilibrium . . . the basis on which economic laws can be constructed is shorn away'. The evidence for increasing returns in manufacturing industry is overwhelming from empirically estimated production functions, from Verdoorn's Law, from the very existence of oligopolies and monopolies, and from the fact that although the capital-labor ratio differs between countries, the capital-output ratios of countries are very similar. Increasing returns, based on the division of labor, lay at the heart of Adam Smith's vision of economic progress as a self-generating process, and Kaldor used to joke that economics went wrong from chapter 4, Book I of the *Wealth of Nations*, when Smith dropped the assumption of increasing returns. The concept lay dormant until Allyn Young revived it in 1928.[99] In the meantime, however, the damage was done; the foundations of neo-Classical value theory were laid. Kaldor kept harping back to Young's paper. The implications and consequences of increasing returns for how economic processes are viewed are indeed profound and far-reaching. First, what is the meaning of 'general equilibrium' if increasing returns causes everything in the equilibrium system to change – resource availabilities, technology, tastes, prices and so on? Secondly, once increasing returns are admitted, the concept of an optimum allocation of resources loses its meaning since the position of the production possibility curve itself depends on how resources are allocated. Thirdly, increasing returns undermine the notion that at any moment of time, output must be resource constrained. Finally, if supply and demand interact in the presence of increasing returns, in the manner described by Young, many of the treasured theorems of equilibrium economics become untenable. There is no reason why free trade should equalize factor prices, there is no reason why factor migration should equalize unemployment between regions, and there is no reason why growth rates between countries and between regions should converge.

Kaldor admitted that as a young man he was caught in the equilibrium trap, but he did eventually escape. In his own recollections as an economist[100] he confesses 'most of my early papers were based on the deductive *a priori* method and concentrated on unresolved inconsistencies of general equilibrium theory but without questioning the fundamentals . . . Such was the hypnotic power of Walras's system of equations that it took me a long time to grasp that this method of making an abstract model still more abstract by discovering unsuspected assumptions implied by the results is an unscientific procedure that leads nowhere . . . It was a long journey.'

9 CONCLUSION

Kaldor was one of the most original, inspiring and controversial economists of his day, a unique figure in 20th century economics. His many contributions to economic theory and applied analysis will ensure his place in the history of economic thought. It is perhaps a matter for regret that he never wrote a grand Treatise in the tradition of Smith, Mill, Ricardo, Marx or Marshall. The reason he did not do so was not because he lacked the vision, intellect or ability to write, but because he succumbed to the temptation to become involved in too many projects at the same time, and never found the time to sit down for long concentrated periods which such a magnum opus requires. His nine volumes of Collected Essays are some substitute, however, which give a coherence to his work, and provide a lasting monument to his energy, creativity and endeavour. At his Memorial Service in King's College Chapel on 17 January 1987, there were over 400 people in attendance from all walks of life including one Prime Minister, Ambassadors, civil servants, politicians and economists from all over the world. This is some measure of the affection and esteem in which he was held.

Notes

1. Letter dated 20 May 1986. He was referring to 'Speculation and Economic Stability', *Review of Economic Studies*, October 1939.
2. Letter to Eustace Tillyard, 25 June 1943.
3. *An Expenditure Tax* (London: Allen and Unwin, 1955).
4. See *The Economic Consequences of Mrs Thatcher* (London: Duckworth, 1983).
5. 20 January, 1979.
6. *Financial Times*, 8 August 1969.
7. 14, 21, 28 May and 4 June 1932.
8. 'The Economic Situation of Austria', October 1932.
9. 31 March 1932.
10. See D. Moggridge (ed.), *The Collected Writings of John Maynard Keynes: The General Theory and After, Part I Preparation, Vol. XIII* (London: Macmillan, 1973), p. 238.
11. See the essay by Aubrey Jones in J. Abse (ed.), *My LSE* (London: Robson Books, 1977).
12. They were: 'The Equilibrium of the Firm', *Economic Journal*, March 1934; 'Mrs Robinson's 'Economics of Imperfect Competition'', *Economica*, August 1934; 'A Classificatory Note on the Determinateness of Equilibrium', *Review of Economic Studies*, February 1934, and 'Market Imperfection and Excess Capacity', *Economica*, February 1935.
13. *Journal of Political Economy*, December 1936.
14. 'The Controversy on the Theory of Capital', *Econometrica*, July 1937.
15. 'Professor Pigou on Money Wages in Relation to Unemployment', *Economic Journal*, December 1937.
16. 'Professor Chamberlin on Monopolistic and Imperfect Competition', *Quarterly Journal of Economics*, May 1938.
17. 'Capital Intensity and the Trade Cycle', *Economica*, February 1939. See also 'Professor Hayek and the Concertina Effect', *Economica*, November 1942.
18. 'Speculation and Economic Stability', *Review of Economic Studies*, October 1939.
19. 'Welfare Propositions in Economics and Interpersonal Comparisons of Utility', *Economic Journal*, September 1939.
20. 'A Model of the Trade Cycle', *Economic Journal*, March 1940.

21. J. Robinson, *The Economics of Imperfect Competition*, (London: Macmillan 1933) and E. Chamberlin, *The Theory of Monopolistic Competition* (Cambridge, Mass.: Harvard University Press, 1933).
22. *Economica*, February 1935.
23. 'Professor Chamberlin on Monopolistic and Imperfect Competition', *Quarterly Journal of Economics*, May 1938.
24. *Economic Journal*, March 1934.
25. *Economica*, February 1939.
26. Translation by Kaldor and H. Croome (London: Cape, 1933).
27. *Economica*, November 1942.
28. 'The Controversy on the Theory of Capital', *Econometrica*, July 1937. Also, 'On the Theory of Capital: A rejoinder to Professor Knight', *Econometrica*, April 1938.
29. See J. von Neumann, 'A Model of General Economic Equilibrium', *Review of Economic Studies*, No. 1 1945.
30. *Economic Journal*, December 1938.
31. *Economic Journal*, March 1940.
32. Kaldor effectively anticipated Duesenberry's relative income hypothesis of a 'customary' standard of living below which people dissave drastically and above which they save a lot.
33. 'A Model of the Trade Cycle', *Economic Journal*, March 1940.
34. *Economic Journal*, September 1939.
35. J. Hicks, 'The Foundations of Welfare Economics', *Economic Journal*, December 1939.
36. *A Critique of Welfare Economics* (Oxford: Clarendon Press, 1950).
37. 'A Comment of W. J. Baumol's Community Indifference', *Review of Economic Studies*, Vol. XIV No. 1.
38. 'Wage Subsidies as a Remedy for Unemployment', *Journal of Political Economy*, December 1936.
39. Unpublished letter to Joan Robinson, 3 June 1935, King's College Library, Cambridge.
40. A. C. Pigou, 'Real and Money Wage Rates in Relation to Unemployment', *Economic Journal*, September 1937.
41. For all the correspondence, see D. Moggridge (ed.), *The Collected Writings of J. M. Keynes Vol. XIV, The General Theory and After Part II. Defence and Development* (London: Macmillan, 1973).
42. 'Professor Pigou on Money Wages in Relation to Unemployment', *Economic Journal*, December 1937.
43. 'Money Wage Cuts in Relation to Unemployment: A Reply to Mr Somers', *Review of Economic Studies*, June 1939.
44. *Review of Economic Studies*, October 1939.
45. *Collected Economic Essays*, Vol. 2 (London: Duckworth, 1960).
46. The first was *Analysis of the Sources of War Finance and Estimates of the National Income and Expenditure in 1938 and 1940*, Cmnd 6261 (London: HMSO, 1941).
47. See *Economic Journal*, June–September 1941; June–September 1942, and June–September 1943.
48. Cmnd 6404 (London, HMSO, 1942).
49. 'The Beveridge Report II: The Financial Burden', *Economic Journal*, April 1943.
50. W. Beveridge, *Full Employment in a Free Society* (London: George, Allen and Unwin, 1944).

51. It was calculated that only a 6 per cent rise in tax rates would be required to 'finance' full employment. For a critique of the arithmetic see *The Economist*, 24 February 1945.
52. See *The Effects of Strategic Bombing on the German War Economy*, US Strategic Bombing Survey, Washington 1945.
53. 'A Plan for the Financial Stabilization of France', in *Collected Economic Essays*, Vol. 8 (London: Duckworth, 1980).
54. United Nations, Geneva, 1949.
55. Council of Europe, Strasbourg, 1951.
56. 12 September 1948.
57. Cmnd. 9474 (Londom, HMSO, June 1955), also signed by George Woodcock and Mr H. L. Bullock.
58. *Journal of Political Economy*, February 1958.
59. *Report of a Survey on Indian Tax Reform*, Ministry of Finance, Government of India, Delhi, 1956.
60. U. Hicks, 'Mr Kaldor's Plan for the Reform of Indian Taxes', *Economic Journal*, March 1958.
61. At least not in Mexico. It was published much later in Kaldor's *Collected Economic Essays*, Vol. 8.
62. *Report of the Commission of Inquiry into Disturbances in British Guiana in February 1962*, Colonial White Paper No. 354 (London: HMSO, 1962).
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64. See also, J. Robinson, 'The Production Function and the Theory of Capital', *Review of Economic Studies*, 2, 1954.
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66. A. Sen, 'Neo-Classical and Neo-Keynesian Theories of Distribution', *Economic Record*, March 1963.
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69. L. Pasinetti, 'Rate of Profit and Income Distribution in Relation to the Rate of Economic Growth', *Review of Economic Studies*, October 1962.
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71. 'Marginal Productivity and the Macro-Economic Theories of Distribution: Comment on Samuelson and Modigliani', *Review of Economic Studies*, October 1966.
72. See A. P. Thirlwall (ed.), 'Symposium on Kaldor's Growth Laws', *Journal of Post-Keynesian Economics*, Spring, 1983.
73. See *Causes of the Slow Rate of Economic Growth of the United Kingdom* (Cambridge University Press, 1966).
74. Ibid.
75. *Strategic Factors in Economic Development* (Cornell University: Ithaca, New York, 1967).

76. *Economic Journal*, December 1928.
77. e.g. See his paper 'Equilibrium Theory and Growth Theory', in M. Boskin (ed. *Economics and Human Welfare: Essays in Honour of Tibor Scitovsky* (London, Academic Press, 1979). For a formalization of the model, see A. P. Thirlwall, 'A General Model of Growth and Development on Kaldorian Lines', *Oxford Economic Papers*, July, 1986.
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80. See D. Moggridge (ed.), *The Collected Writings of J. M. Keynes Vol. XXVII: Activities 1940–1946, Shaping the Post-War World: Employment and Commodities* (London: Macmillan, 1980).
81. See the Foreword to my book, *Nicholas Kaldor* (Brighton: Wheatsheaf Press, 1987).
82. 12 March 1971
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85. *Economic Journal*, December 1965.
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88. 'The New Monetarism', *Lloyds Bank Review*, July 1970.
89. *Origins of the New Monetarism* (Cardiff: Cardiff University Press, 1981).
90. *The Failure of Monetarism*.
91. (Oxford University Press. 1st edn 1982; 2nd edn 1986).
92. M. Friedman, 'The New Monetarism: Comment', *Lloyds Bank Review*, October 1970.
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95. Op. cit.
96. *Economic Journal*, December 1972.
97. *Quarterly Journal of Economics*, August 1975.
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2 Nicholas Kaldor Remembered*

J. K. Galbraith

My friendship with Nicholas Kaldor, close and unfailing, lasted over a full fifty years. We first met in the autumn of 1937 when he was a junior presence at the London School of Economics, I a post-doctoral fellow pursuing Keynes and Keynesian economics at Cambridge University. I was frequently in London, came to know both the Kaldors and joined Nicky at the seminars of Hayek and Robbins.

The first was attended, it came to seem, by all of the economists of my generation – Nicky, Thomas Balogh, L. K. Jah, Paul Rosenstein-Rodan, the list could be indefinitely extended. The urge to participate (and correct Hayek) was ruthlessly competitive; sometimes Hayek did not get a chance to speak at all. On one memorable night he came in, seated himself, and announced that he would, in that session, talk of the rate of interest. Nicky immediately took exception to that proposal; he assailed as ridiculous the notion that there was a rate of interest. It is my recollection that on that evening Hayek did not again get a chance to intervene.

In the war years the British government made a poor use of the brilliant Eastern European talent then lodged in the British Isles. We happily were under no such constraint. Arriving in Britain in the spring of 1945, I immediately recruited Nicky, who had been working on the Beveridge proposals, for our reconstruction of the German war economy, and our estimates of the economic and military effects of the strategic bombings. He was wonderfully effective; he was indeed the first to identify the German *blitzkrieg*. (The German *blitzkrieg* design for economic mobilization: a build-up of ordinance to serve the next big attack, then a reduction of output and no sustained mobilization until very late in the war years.) Nicky was also, along with Paul Baran, another immediate deputy of mine, one of the two most unregenerate individualists ever made participants in a military command, if our relaxed operation can be so described. Eisenhower would have been helpless. Or for that matter Patton. I still recall with horror and total frustration my efforts to maintain a minimum of

* The following remarks by Professor Galbraith, one longstanding friend provide a sense of the affection and esteem in which Kaldor was held. Professor Galbraith was not able to attend the conference, but he sent these remarks to be read to the participants and invited guests.

control over Nicky's independent operations. He told me often in later years that his recollection of my efforts was equally adverse.

In these later years he was often our visitor in Cambridge, Massachusetts, I his in Cambridge, England. I wrote part of the *Affluent Society* in his library while occupying the Kaldor house in the summer of 1956. Earlier that year, we were together for several weeks at the Indian Statistical Institute in India.

At that time Nicky was busy selling the expenditure tax. And not without success. I one day asked C. D. Desmuk, then the Indian Finance Minister, how Nicky's effort was going. It was going very well. 'The trouble with Dr Kaldor', Desmuk replied, 'is that he will not take yes for an answer.'

In those days, Nicky was an enthusiastic photographer. He had endowed himself with some, for the time, exceptional equipment. We toured in the Himalayas together; one could not help noticing that Nicky's art was more than a little impaired by not being able to remember to remove the lens cap before focusing in on some particularly compelling scene.

In Calcutta one night, we had a fine farewell dinner for Nicky and Clarisse; they were leaving at midnight for China. This was a rare privilege in those days and one we greatly envied. Sometime after midnight, they were back from the airport. Nicky had forgotten the passports and possibly also the tickets.

Others at this meeting will have told of the Kaldor contribution to economics and, over the years, to British political life. There was the constant flow of highly competent, highly imaginative and utterly independent papers, monographs, and, in later years, reprints from Hansard. I cannot believe that anyone in the British Parliament ever sustained a higher standard of informed economic comment than Lord Kaldor, as with richly deserved recognition he became. In those speeches, one relished particularly the obligatory compliment to some retarded Tory orator and then the unsparing demolition. But also, always, the clearheaded responsible comments on the policy that should be pursued.

I was last week for a couple of days in London. Never had I been there in Nicky's time without seeing him or talking with him. It was sad to realize that this I would never do again. I was very sad, indeed.

I send this evening my affectionate greetings to Clarisse and Catherine, who I have just learned will be with you. Only the physical aftermath of an especially severe week, including a long day in Washington, keep me from being with you. For that too, I am truly sad.

Part II
Methodology and Basic Approach

3 Kaldor Between Hayek and Keynes, or: Did Nicky Kill Capital Theory?

M. Desai

1 INTRODUCTION AND SUMMARY OF THE ARGUMENT

Kaldor is famous as a leading member of that great generation of Cambridge economists – Joan Robinson, Piero Sraffa, Richard Kahn and himself – who together attempted the construction of an alternative paradigm to the neo-Classical/neo-Keynesian synthesis. For Joan Robinson and Richard Kahn, the engagement with Keynes' economics was a continuous one and indeed part of the permanent revolution in economic thinking going on in Cambridge in the 1920s. Piero Sraffa started one phase of that revolution – the one in value theory – but his commitment to the Keynesian revolution was very slight. Indeed one could say that the two Cambridge revolutions, one started by Sraffa in 1926 and the other by Keynes in 1936 (although known earlier in Cambridge), were in contradiction with each other by the 1960s. The second Sraffa revolution begun in 1960 was a fulfilment of the one previously launched in 1926 but it had a value and capital theory that sat uncomfortably with the Keynesian revolution. Despite his intimate acquaintance with and encouragement of Sraffa's work, Keynes in his *General Theory* took in his value theory a pre-Sraffa Marshallian line as far as he took any. Joan Robinson who with her exceptional rigour had worked out the consequences of the first two revolutions, Sraffa 1926 and Keynes 1936, bore the brunt of reconciling the second Sraffa revolution with the Keynesian revolution (See essays in Eatwell and Milgate, 1983).

Kaldor was different. For one thing he came to Cambridge from the outside and he had a well-established reputation by the time he arrived there in the late 1940s. He was not part of the 'circus' and got his Keynes from the published version. By 1936 he had already written innovatively but strictly within the orthodox theory. He was a star pupil of Hayek and Robbins, a co-translator of Hayek's first book, a detached but sympathetic critic of the Cambridge attempts to overhaul Marshallian value theory (see Kaldor, 1960). He was an early authority on capital theory, especially its Austrian variety. Indeed, his 1937 survey of capital theory controversy in *Econometrica* is a brilliant attempt at providing sound analytical foundations for the Austrian capital theory's central theorem about the degree of roundaboutness (Kaldor, 1937, 1960).

Kaldor publicly broke with Hayek in 1938, in his article 'Capital Intensity and the Trade Cycle' (CITC). By the time he wrote his 1942 review article of Hayek's *Profits, Interest and Investment* (PII), 'Professor Hayek and the Concertina Effect' (CE), the rupture was complete. Between 1938 and 1942, Kaldor repudiated not only Hayek but the entire apparatus of Austrian Capital Theory.

This is a well-known episode, most recently told by Tony Thirlwall in his biography of Kaldor (Thirlwall, 1987). In this paper I wish to offer a revisionist account of this episode. My argument can be summarized as follows:

(a) Hayek was engaged between 1925–42 on a very ambitious research programme to integrate money and capital into Walrasian General Equilibrium Theory, using the Austrian approach. He wanted nothing less than an equilibrium theory of the business cycle in a monetary economy with heterogenous capital. By 1942 Hayek, on his account, abandoned this attempt ('Introduction', in Hayek, 1984).

(b) Keynes over-took Hayek in the race to integrate money into economic theory by writing the General Theory. But he never took Walrasian theory or indeed any value theory seriously. What is more he de-emphasized capital theory and in the version of his theory which passed into popularity, flow equilibrium became all important; stocks especially capital stocks, were de-emphasized.

(c) The effect of the Keynesian Revolution was to kill capital theory, especially as regards the problems caused by heterogeneity of capital. The J. B. Clark theory of the aggregate production function with malleable capital won the day over the Böhm–Bawerk/Wicksell theory of capital as produced means of production. It was paradoxically this battle that Cambridge (UK) fought with the other Cambridge in the 1950s and 1960s. The battle brought back the issues that had engaged Hayek in the 1930s, albeit in the context of growth rather than cycles.

(d) Nicky Kaldor was the only economist in the 1930s who had the talent to bridge the gap between Hayek and Keynes. He understood Austrian capital theory and provided the most accessible account of it to date in his 1937 paper. He was also an innovative economist as his many papers in this period show, not least his 1940 Model of the Trade Cycle. He may have been able to bridge the gap between the Keynesian analysis of short-run output determination (with money and flexible prices) with a given level of capital stock and the medium and longer-run theory of growth and cycles with technical progress, heterogenous capital and money that Hayek was striving for. As it was, he dropped all capital theoretic issues from his subsequent contributions to growth and distribution. He adopted one good model with flow equilibrium.

(e) The Cambridge–Cambridge controversy was fought around the issues of capital heterogeneity, capital labor substitutability and the relationship between the interest rate (profit rate) and capital. Subsequent developments have led some Sraffians to re-examine Keynesian theory for its lack of a long-term framework (Garegnani, in Eatwell and Milgate, 1983). Many of the questions raised in this debate were discussed in the 1930s and especially in Hayek's *Pure Theory of Capital* (PTC). Kaldor never took any part in the capital theoretic debate. The only time he entered it was in the Pasinetti–Antipasinetti debate, but even here capital heterogeneity was not at stake (for a bibliography and a summary, see Desai, 1987).

(f) The challenge of integrating money and heterogenous capital in a dynamic cyclical growth model still remains. Kaldor was one of the few if not the only modern economist who knew all the pieces of the jigsaw puzzle. He shaped several of them but he never put them together. Indeed he deliberately discarded half the puzzle he had put together in the 1930s and worked only on the other half. Even when his contemporaries debated the earlier half of the puzzle, Kaldor remained silent. Having once killed capital theory he was not going to revive it.

This is admittedly an arguable thesis that I have put forward. It is also a fairly complex one. We need to go through Hayek's contribution to money and capital theory in the 1930s. In doing this, I contend that Kaldor misinterpreted Hayek in his 1942 critique CE. Hayek had not changed his mind about the cause of capital intensity through the cycle as Kaldor alleged. Indeed Hayek has never changed his mind about anything. A careful reading of all of Hayek's writing, but especially *Prices and Production* (PP), *Profit, Interest and Investment*, PII and PTC, will show that there is a complicated but consistent theory in these writings. But Kaldor's attack was crucial in the abandonment of Hayek and capital theory after the 1930s, but in my view this was to cost the economics profession dearly. This is not to say that Hayek was right, but he was certainly not inconsistent. The empirical question as to whether Kaldor was correct (in his CITC) or Hayek was about the cyclical behavior of capital intensity remains to be resolved. It is only by developing a more general framework, a synthesis of the Hayekian and the Keynesian Kaldors, that one can address this issue. This remains to be done. In what follows, I first reconstruct briefly Hayek's work during the 1930s. This is done in some detail, since it is not very widely known and also because I wish to argue a novel thesis. Then I take up Kaldor's part of the story. The conclusion then follows, I hope, logically.

2 THE HAYEK STORY

Hayek started thinking about problems of economic stabilization and the trade cycle during his visit to the USA in 1924–25 (Hayek, 1984). He came across two ideas to which he has been implacably opposed ever since. *First* is the idea that it is the task of economic policy, especially monetary policy, to stabilize the price level as a way of smoothing out the business cycle. This was first put forward by Irving Fisher among others in the early 1920s. Paradoxically the instrument for such control was to be money supply. Despite his subsequent reputation as a monetarist guru, Hayek was totally hostile to this naive lesson derived from the Quantity Theory and doubted the usefulness of money supply as a policy tool. Hayek proceeded to argue that the general price level had no salience in economic theory since only relative prices mattered. If money was to have any influence on economic activity, this had to come via microeconomic variables. He was full aware that Walrasian theory excluded money as it also ruled out disequilibria. Thus one task was to integrate money into Walrasian General Equilibrium Theory in order to provide a theory of the (equilibrium) business cycle. *Second* was the idea that one could measure business cycles as an aid to controlling them. Hayek explicitly said as early as 1929 in his *Geldtheorie und Konjunkturforschung* (translated by Kaldor and Honor Croome as *Monetary Theory and the Trade Cycle* (MTTC) in 1933) that statistical measurement of business cycles, as advocated by Mitchell and the NBER, could not be carried out since we lacked a prior theory of what caused cycles. Walrasian theory had shown that a competitive equilibrium existed and if disturbed automatic price adjustments would restore it. Hayek also asserted that such adjustment back to equilibrium was virtually instantaneous, though this is not necessarily a result of Walrasian theory. Thus 'no measurement without theory' was his methodological standpoint. Since Walrasian theory ruled out cycles (and by cycles Hayek meant endogenously generated cycles rather than those generated by exogenous shocks as in the recent new classical theory of real business cycles), he sought an explanation for the cycles in an element missing in Walrasian theory, namely money.

In seeking an explanation of cycles, Hayek also knew what he did not think was the case. Cycles or indeed crises were not caused by oversaving. This had been argued in the popular American journals by Messrs Foster and Catchings. In another article written in 1929 (also co-translated by Kaldor with Tugendhat in 1931 into English as 'the Paradox of Savings' (PS), Hayek advanced his theory of how the structure of production changes during the cycle. This was the first exposition of the Austrian theory of capital in relation to business cycles. Hayek spelt out the many intermediate stages of production from early operation with simple labor and land to a final stage of consumer goods produced with raw materials

Table 3.1 Hayek's production structure

		Initial £	*With voluntary savings of £1000*	*With credit of £100 to consumers compensating for £100 savings*
Consumption Goods Demand	1	1,000	900	1,000
Intermediate Stages Demand	2	1,000	900	1,000
	3	1,000	900	1,000
	4	1,000	900	1,000
	5	1,000	900	1,000
	6	1,000	900	1,000
	7	1,000	900	1,000
	8	1,000	900	1,000
	9	1,000	900	1,000
	10	0	900	100
Intensity = *ΣIntermediate* / Consumption		8:1	9:1	8.1:1

Source: Examples taken from Hayek (1929/1939), 229 231, 257.

and instruments produced in previous stages along with labor and land. Hayek used this device to show that a rise in savings, *as long as it was voluntary*, was absorbed as investment by an appropriate fall in the rate of interest. The result was a lengthening of the production period.

In Table 3.1, I reproduce the numerical example Hayek gave in PS. The initial equilibrium is £1000 demand for consumption goods and (for simplicity) £1000 each for eight previous intermediate stages (column A). Thus the ratio of intermediate produces to final product is 8:1. If consumers voluntarily saved £100 more, reducing consumption demand to £900, an additional earlier stage could be made viable as a result of the lower interest rate. Thus there could be nine previous stages with a value of £900 each (column B), the ratio of intermediate to final goods being now 9:1. Thus with the same total demand, £9000, the higher the savings the more capital intensive/longer could the production structure be. It was profitable to do so not only because the interest rate was lower but the productivity of the process was higher. Thus it would be entirely likely that the *volume* of consumption goods was higher in the £900 demand with a 9:1 intensity compared to the £1000 with 8:1. Of course, the new structure will take longer to deliver final goods. Hayek fully expected *prices to go down* over time in a progressive, i.e. a steadily growing, economy. This was another reason why he was against a stable price level.

If now monetary authorities were to reflate the economy by issuing £100 as credit to consumers when the enlarged product of the 9:1 technology comes on the market, then the production structure would suddenly shorten, since £1000 of consumers' demand would need £1000 in each previous stage (column C). The earliest stage started as a result of the lower interest rate would be drained down to £100. The capital intensity will be 8.1 to 1. In terms of Table 3.1, going from column A to column B, there is a lengthening of the structure with total demand unchanged in nominal terms. From B to C, there is a sudden shortening of structure and a loss of capital value in the highest stage of £900. (Now the terms roundaboutness and more or less capitalistic were used to describe this process in the English version PS of the 1929 paper. The German for it was *Kapitalintensität und Kapitalintensiv*. Why Kaldor did not choose the expression capital intensity at this stage as a translator of Hayek's work but for his own definitions in his 1938 CITC was to puzzle Hayek (PII, 17, fn 1).

It was his LSE lectures in 1931 published as PP that allowed Hayek to spell this out. Here again there is a contrast between a barter economy and a monetary economy. The former is growing in an equilibrium fashion as savings grow; they lengthen the period of production and bring prices down as productivity improves. In the latter, there is a possibility of credit being issued by banks. Suppose, Hayek said, that for some reason or another the natural rate had gone above the actual rate of interest. This acts like a fall in the rate of interest with a given rate of profit (natural rate). Producers with techniques of longer gestation lags gained more from a fall in the interest rate than those with a shorter lag.

With a rate of interest of ϱ per cent per annum, a producer with a length of gestation lag T would have to recover $T\varrho$ on his turnover. Thus a ten-year process at 48 per cent is a different proposition than at 3 per cent; the required profit rate goes down from 40 to 30 per cent. If the mark-up over costs is say 32 per cent for all producers then at 4 per cent only an eight-year process if feasible, but if the interest rate falls to 3 per cent even a ten-year process will make excess profits. Of course, in equilibrium the rate of interest will rise to 3.2 per cent. This is because of excess demand for credit by ten-year length producers.

This is the Hayek story about how lower interest rates will cause lengthening. The problem with credit was that it caused this lengthening to be sudden. In PP, Hayek assumes flexible prices and an initial position of equilibrium. This equilibrium connotes full employment of labor which is nonspecific to any stage of production and an optimal length of the production process (capital intensity). The boom is started by higher credit and a fall in the rate of interest. This allows producers of longer techniques to bid for this credit and start off a longer process. They do this by bidding labor away from other stages. In PP, Hayek did not treat the question of money wages explicitly but concluded that initially consumption goods prices rose and implicitly real wages fell. This was the forced saving that financed the early stages of the boom.

Since the longer new process had not yet fructified and the old shorter processes were deprived of labor, the fall in consumption goods output and rise in prices continues. The output of durable goods (measured as work in progress on the old process and the new process) rises relatively to that of consumer goods. The new process producers cannot repay their loans until their product has arrived on the market. But before this can happen, banks have to stop their credit. This may be due to (a) consumers' attempt to restore purchasing power ostensibly, though Hayek was not explicit, by restoring the real wage, or (b) because banks suffered loss of reserves (of gold). Either way the credit to longer process producers stops before they bring products to the market. At the higher interest rate only short processes are viable. But these processes have been starved of labor and raw material (work in progress from previous stages). Thus output of consumer goods cannot be immediately expanded due to shortage of work in progress. This is capital scarcity. But in the aborted new processes, there is idle capacity and unemployed labor. Inflation in the meanwhile continues.

Hayek's PP model has thus *idle capital and unemployed labor* in the now aborted, previously launched longer process. But labor cannot be absorbed in the shorter processes because these need unfinished raw materials to work with, which are not there since the stages from which they emanate have been undermanned in the recent past. Thus there is *capital shortage and excess demand* for labor in these processes. Inflation of consumer goods prices may continue. We have stagflation.

Even this highly condensed version of the PP model will convey to the reader its complexity and the reasons why contemporaries were 'bewitched, bothered and bewildered' by it.

(a) Thus we start with full employment. From the initial fall in interest rate until just before its rise (i.e. the crisis), the production of capital goods defined as finished inputs and work in progress rises relative to the production of consumer goods. During this period, capital intensity has jumped up initially and could be rising or at least not falling until the crisis. When the crisis occurs, the interest rate goes up; the long process is abandoned unfructified and the money wage rises in an attempt to restore the real wage. The output of consumption goods cannot rise immediately (shortage of inventories) but it is high *relative to* the diminished output of intermediate/capital goods. There is unemployment. Capital intensity has fallen. But the price of consumption goods could still be going up and hence the real wage may not be back at its earlier level. This maladjustment of the production process can run its full length and absorb all labor. This may take a long time.

(b) Another bewildering aspect is the use of the word capital. For Hayek capital is not a malleable lump (see PTC, chapter 1, for a most eloquent attack on the malleability assumption). All the intermediate stages of production involve inputs (apart from labor) and outputs which are called capital. The model in PP is almost all in terms of circulating capital but one could include fixed capital. But the product at each stage is not substitutable for that of a previous or a subsequent stage. While labor is not specific, capital is very specific and heterogeneous. Each process involves a multistage ensemble with fixed coefficients as between the capital goods of different stages.

(c) There is by contrast implicitly only a single consumption good. As Kaldor was to show in his 1937 Capital Theory article, for this case we can define capital intensity given certain other restrictions. Thus the longer process will produce the same good but more cheaply. In equilibrium growth, the value of the output of this good relative to the value of the unfinished, intermediate goods will steadily fall, i.e. the production period will rise. In disequilibrium, the output of finished goods shrinks as inputs are directed to the longer process and the value of capital goods is a sum of the work in progress on the old and the new (longer) process. This is a sharp and disproportionate rise in capital goods relative to final goods. If the longer process were to fructify, a new proportion would be restored. But that is at the end of the traverse.

(d) Thus the most difficult aspect was that Hayek's cycle takes place in the traverse between two steady state equilibria. We start with the stationary state, potentially a steadily growing economy, corresponding to an equilibrium rate of interest, which will come down if savings increase voluntarily. A lower rate suddenly comes about due to credit creation. Given time, the economy can converge to the steady state path corresponding to this lower interest rate. But since there is not that time, the traverse away from the old equilibrium ends in a sudden rise in the interest rate – a crisis. Then the economy, if left to its own devices, would return eventually to the old equilibrium assuming that the interest rate has gone back up to its old level. Of course, if the original economy was potentially a steadily growing one, an additional layer of complication has to be added to this traverse.

(e) This was difficult enough but Hayek also wished to point out that even while consumption demand rose, investment declined. This was the most counterintuitive assertion. In a world of malleable capital, this cannot happen. Hayek wrote several papers following PP to explain this (see especially Hayek, 1937/1939). This required Hayek to 'redo' capital theory. The problem was that the demand for additional capital in Hayek's sense depended not merely on the increase in consumption demand but on the process chosen and especially on the capital wasted in switching from one process to another. A fall in consumption (rise in savings) led to a rise in investment since a longer process could be embarked upom. A rise in consumption signalling the end of the boom could lead to disinvestment.

When he wrote PP, Hayek generated much debate not least among some of the brightest young economists of the day – Shackle, Sweezy, Hicks, Rosenstein-Rodan and Kaldor. But there was also a sharp exchange with Sraffa not on his capital theory but on his value theory. In modern terminology, Sraffa's contention was that in a world of flexible prices, money has no role to play and can have no influence on relative prices. Thus Hayek must have departed from his Walrasian model to make money have an impact. He had done this, Sraffa said, by having bankers arbitrarily allocate credit to durable goods producers rather than final consumption goods producers. He had then slipped in a sticky money wage to bring about forced savings. Thus it was the sticky money wage which was doing all the work. Hayek in his reply recognized that he may have had a money wage lag behind prices but protested that he wished to integrate money into production and not treat it as epiphenomenal (Desai, 1982).

In the subsequent explanation, therefore, Hayek changed his tack completely. In the meantime he had growth sceptical of the value of Walrasian theory anyway (Hayek, 1937/1949). Also the General Theory had appeared in 1936 bringing into vogue terms such as liquidity preference, consumption function, etc. So in PII, Hayek started with a modified fixed price model. The interest rate is constant but now the rate of profit (previously the natural rate) can move about. Wages are sticky but prices can move. Labor has limited mobility and we start not with full employment but with unemployment. Hayek also eschewed the use of 'the special terminology' of the Austrian theory of capital.

Hayek thus starts the analysis in PII at the point where he left it in PP. In PP, a sudden rise in the interest rate brings about a crisis, aborting longer processes, but there can be no sudden increase in output/employment of the shorter processes. Now suppose we are at this point. There is unemployment in capital goods industries but none in consumer goods industries. Recall that in PP, the money wage rose at this point but prices of consumer goods could have again raced past the latest increase in money wages. In this world, fix the money wage and the nominal interest but let prices of consumer goods rise sharply. There will then be a rush to augment consumer goods output as quickly as you can. Thus very short-length processes will be immensely profitable, since they have a quick turnover. By the same token, enterprises will be unwilling to start longer processes which will eventually result in higher output.

Let the initial rate of profit be $\pi_o = \varrho_0$ the rate of interest, we now have $\pi_0 + \Delta_p = \pi_1$, Δ_p being the rate of inflation of consumer goods prices. Now processes taking a length $T_j < T'_j$ will be more lucrative, since the higher T_j the lower the turnover. Thus *for different processes producing the* *same good*, the smart producer will choose the lower T_j. But this will involve investment not in machinery or machine-making but anything that quickly generates the nearly finished raw material that can be quickly turned into the final good. An analogy would be that if the demand for hamburgers went up, there will be many more fastfood outlets started than cattle ranches to raise beef cattle. But if fastfood outlets cost less to produce than cattle ranches, total investment will go down. But Hayek's error was not to clarify that *it would not go down absolutely but relative to what it would have done* if, on the other hand, hamburger demand was slumped and a search began for a cheaper, better hamburgers which could only be provided by better cattle. Thus Hayek now had real wage decline, rise in profit rate but a decline in capital intensity and in investment. But since in PP he also had a decline in real wage (and the nominal rate of interest) which led to an increase in capital intensity, this seemed like a flat contradiction. He also made the mistake of conveying that he was discussing the process of the boom in both cases, which he was not. In the latter case of PII, although prices rise, we are in a post crisis situation past the upper turning point of the cycle. In PP, a fall in the actual rate of interest makes investments with the lower profitability and long gestation lag worthwhile. Since Hayek had started with full employment and rigid money wage this also led to a fall in the real wage. But this could be dropped. If we assume unemployed resources, the upswing in PP could start by long processes coming on to being profitable with a fall in interest rates. Later on the interest rate rises and puts a stop on this upswing. At this stage there is unemployment in capital goods industries but not in consumption goods. The PII cycle takes over. If now for some reason, say fiscal expansion, there is an upsurge in consumer demand, producers in consumer goods industries will not be able to expand output suddenly. In a closed economy this will mean a rise in consumer goods prices. This will mean quick expansion in consumer goods output (or in consumer goods imports if it is an open economy). Here again in parallel with PP, one may choose not to invoke a real wage decline but a rise in expected profitability uneroded by wages catching up continuously. In any case real wages could rise in consumer goods industries but not everywhere else since employment expansion in consumer goods industries is limited. *In such a case despite investment rise in consumer goods, the overall series on capital formation could show a decline.*

This is what I believe was Hayek's intention in expositing his theory from a totally different angle in PII as compared to PP. Despite the many switches of assumptions (flexprice to fix price, full employment to underemployment) and of perspective (equilibrium to post crisis), it was the same model. I believe a careful reading of PP, the articles subsequent to PP which are reprinted in PII and the long reading essay in PII itself will vindicate my point. I use the word 'careful reading' deliberately and not

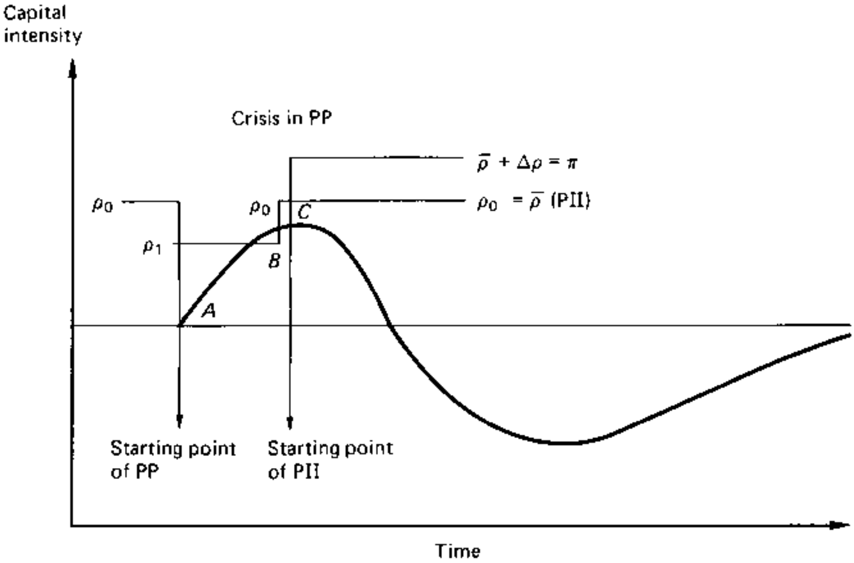

Figure 3.1 A schematic diagram for Hayek's two models

merely for effect. Much confusion could have been avoided by such a reading.

Perhaps a schematic diagram will help. In Figure 3.1, the vertical axis measures some basic cyclical variable – proportion of capital goods to consumer goods or capital intensity. We start with equilibrium capital intensity, at point A. Now the interest rate drops from ϱ_0 to ϱ^1. This is where PP begins. There is a rise in capital intensity as longer processes viable only at lower ϱ (lower profitability) come in. This boom ends sharply at B when ϱ^1 goes up to ϱ^0, its initial position. (This is not strictly necessary; it could overshoot.) This is the crisis point in PP. The boom collapses causing unemployment and excess capacity in the capital goods industry but full capacity in consumer goods. Then sometime after the crisis is the starting point of PII. I have placed it immediately after at C. Now of course we assume ϱ^0 to be fixed at $\bar{\varrho}$. But there is now inflation and the profit rate goes up to $\bar{\varrho} + \Delta p = \pi$. But capital intensity is declining because of the switch to shorter processes.

None of this was accepted in the period following the publication of PII. By now the General Theory had completely changed perspectives, even the meanings of words. Thus price rises could not happen during downturns with unemployment. Labor was mobile between sectors and capital was, if not malleable, quickly augmentable. The problem was not the time taken in construction of machinery or the input-output lag, but the longevity of machinery once installed. This is why investors' long-term expectations mattered. A rise in profitability, current and expected, especially assured by a price rise and fall in real wage would shift the marginal efficiency schedules out and investment would go up immediately. There was no disproportionality problem because we were in a one good economy, not in Hayek's world of one consumption good and many capital goods. This seachange in perspectives is clearly seen in Kaldor's shift of vision between 1937 and 1942. This is the story in the next section.

3 THE KALDOR STORY

Kaldor's disengagement from Hayek takes place in three stages. In the early 1930s he was obviously a star student of Robbins and Hayek. He co-translated Hayek's *Paradox of Savings* and *Monetary Theory and Trade Cycle*. His 1934 paper on the determinateness of equilibrium is an exercise in rigorous thinking within the Walrasian paradigm. Questions on the existence, uniqueness and stability of equilibrium are posed clearly and then tackled with thoroughness. By a determinate equilibrium, Kaldor means an equilibrium which can be shown to exist to which the system will converge if disturbed from it and which the system will stay on if it is at the equilibrium already. The Austrians were much more interested in the process of arriving at equilibrium, especially the way in which people revise their expectations and actions in the light of experience. As he put it, 'The aim of the ('causal genetic' approach of the Austrian school) is to exhibit not so much the conditions of equilibrium under a given situation (the task assumed by 'functional' theories), but to show how, in a given situation, a position of equilibrium is reached – the problem of how prices come into being rather than what system of prices will secure equilibrium'. From his subsequent contrast of the functional (Walrasian) and causal-genetic (Austrian) approaches, one could even say that this article may have set Hayek's mind to the decisive break he made with Walrasian equilibrium in his 1937 Economics and Knowledge article (Hayek, 1937/1949). Kaldor's sophistication as a neo-Classical economist of a high order is beyond doubt (Kaldor, 1934/1960).

It must have been this reputation that got him the invitation to write the survey article on capital theory in *Econometrica* while still in his twenties. The article, a formidable achievement in itself, is the first stage of rupture between Hayek and Kaldor. It is not so much that Kaldor is against Hayek but he certainly conveys the tension between a young theorist clarifying what his elders had taught him and these elders themselves. Ostensibly the paper defends the Austrian theory against attacks by Frank Knight but Kaldor does not endorse the lines that Hayek and Machlup had taken in defence of the Austrian theory but pursues a much more detached and rigorous search for the analytical foundations of the Austrian theory (all the reference are in Kaldor, 1937/1960, and hence unnecessary to repeat here).

The basic problem was the central theorem of the Austrian school that more roundabout methods – those with a longer period of production – were more productive, and as savings grew and interest rates fell in a growing economy, more roundabout methods will come into use. Kaldor's paper is concerned with making this notion precise. Since the lengthening and shortening of the period of production was an important variable in PP, Kaldor's analysis was of obvious relevance to Hayek's theory. There are many other aspects to the debate which are not of immediate interest to us here.

Kaldor provides the minimal conditions under which one can unambiguously define the period of production. Kaldor explores various alternative definitions of this concept:

(a) Value of output stream to value of input stream each appropriately discounted: if these streams are constant and so is the rate of interest, one can unambiguously define the ratio as production (or investment) period.

(b) Equivalently one could say that the rate of initial construction costs of a machine to its annual maintenance cost will also be a measure. This measure of roundaboutness can be used to check if there is a tradeoff between the two – can one by increasing initial cost save on maintenance cost?

IF C is the construction cost, b the constant output stream, a the constant input stream, t 'the period of production', and ϱ the *real* rate of interest, then we have alternatively:

$$a(1+\varrho)^t + b \quad (1a)$$
$$C = (b-a)/\varrho \quad (1b)$$

Now (C/a) is the measure of roundaboutness according to Kaldor but it is an ordinal measure since $C/a = t$ only if $\varrho = 0$, where t is the period of production. In a footnote added in the 1950s, Kaldor adds that it is difficult to relate the investment (production) period t to the construction period or the length of life of the equipment. He gives the Champernowne–Blyth formula relating (C/a) to T, the length of life of the equipment:

$$C/a = T/2 + \varrho T^2/12 \quad (2)$$

Having shown that the production period and durability are different, Kaldor refines the issues further by pointing out that for a machinery producing a consumption good, the output stream can be defined either as a stream of machine services or as a stream of consumption goods produced with the cooperation of labor. Obviously now wages enter into the calculation not only at the construction stage but through the working life of the machinery, i.e. one cannot measure input stream in (1a) unless one is also clear about the output stream. The pure machine output stream relates to durability of capital equipment but the second definition will be correlated with accumulation of capital as such. Now the degree of roundaboutness will go up with accumulation in both the senses only if there is a fixed proportion between labor employed in construction and labor employed in production. Otherwise, accumulation may change the roundaboutness in one way (i.e. up) but diminish the durability. We have to take into account the real product wage and interest rate.

It is in this context that Kaldor casts himself as a defender of Wicksell's version of the capital theory but distances himself from Hayek. The crunch comes in the reply to Knight:

> The average construction period plus the average durability of capital goods merely indicates the average investment period involved in producing *the services of these instruments* and not (or not necessarily) the average investment period of consumption services. It is quite possible that the former should be reduced, when the latter is lengthened; when, e.g., capital accumulation implies the introduction of more 'automatic' machines, which reduce the amount of 'cooperating labor' per unit of output . . . It is only more recent writers, Professors Machlup and Hayek who asserted that the accumulation of capital necessarily involves greater 'average durability'. This is, of course, wrong: so far as I am aware, neither Bawerk nor Wicksell meant to assert it; nor does its denial constitute any sort of disproof of the Austrian theory. (Kaldor, 1938/1960, pp. 194–5)

Kaldor is yet the champion of the Austrian theory though not above criticizing Hayek. He is interested in defending Austrian theory, in clarifying it and in improving it. He is willing to concede that the period of production can only be defined for a single consumption good and may be undefinable at the aggregate level. It will be clear to anyone who reads this paper that some of the problems in the reswitching debate of the 1960s are all here, and despite the extra mathematics of the later generation, one cannot say that there was much greater clarity in the 1960s than in the 1930s. Capital theory is a rather messy subject.

The next stage is a much more decisive break. This is CITC written in 1938. By this time, Kaldor was definitely a Keynesian. The generation gap that was merely an irritant in the earlier phase is now a dividing line between Kaldor and his erstwhile mentors. This paper is also much more sharply directed against PP. It challenges Hayek's PP assertion that the capital intensity (roundaboutness) goes up in the upswing and down in the downswing. Kaldor asserts that capital intensity is counter-cyclical, not pro-cyclical.

Kaldor starts by reviewing the attack on the Austrian hypothesis about capital intensity over the cycle. The investment (or production) period, where it can be defined 'provides no more than a measure of the ratio of capital to labor in production, . . . and the objections which invalidate the investment period concept by no means impair the validity of this ratio'. It will be better, therefore, to drop the expressions 'investment period', 'period of production', or the 'the amount of waiting', altogether and substitute some less ambitious term, such as the 'degree of roundaboutness of production' or the 'degree of capital intensity'. But given that 'capital – real capital – consists of heterogenous, not of homogenous, objects, which themselves embody labor and which periodically have to be renewed or replaced' the capital labor ratio is not an unambiguous concept. But as in the 1937 paper, Kaldor offers 'the ratio between "initial cost" and "annual cost" involved in the production of a constant stream of output' as an adequate index of capital intensity (pp. 122–3).

The next step is to distinguish between this index of investments *in situ* – old capital and new investment. Since capacity utilization can change for an old, already installed capital due to wages and raw material prices, etc., it is the normal capacity on new investments on which Kaldor concentrates. Notice that Hayek's propositions were about the overall capital intensity averaged over old and new processes but Kaldor's are only about new investments. Even this is measurable only at the level of the firm. 'It is more questionable whether we can measure the capital intensity of production for society as a whole . . . Changes in the capital intensity of production in general are the outcome of changes in the methods of production employed by individual firms.' Thus aggregation will be difficult but undaunted Kaldor employs the representative firm subterfuge to evade this problem. ' . . .(A)ny generalization made about the behaviour of the "typical" or "representative" firm will be applicable, *mutatis mutandis*, to the system as a whole. It will be quite sufficient therefore to concentrate our attention on the behaviour of the representativer firm' (p. 124).

Having got this far Kaldor makes two assertions which I believe involve the abandonment of capital heterogeneity. He asserts that higher capital intensity can either be achieved by using labor initially in construction to save on it during production or by building more durable equipment which can save on amortization. Lower amortization represents lower current cost of initially expended labor. It is really however the former method – more automatic equipment – that is the real possibility. Kaldor then goes on to connect labor productivity with the capital output ratio. 'Greater economy of labor, per unit of output, can only be achieved, of course (given technical knowledge), by a greater expenditure of capital per unit of output. Hence the higher the degree of capital intensity adopted, the smaller is the actual productive capacity created by a given amount of output.'

This is the crucial step. In the two quoted sentences the casuality goes either way. A higher capital output ratio is necessary for higher labor productivity and the higher the capital labor ratio the lower the output per unit of capital. Such a reasoning is possible only if we take capital as fixed by initial construction, labor as the only flow input and treat the production functioin as neo-Classical. In Austrian theory this was not the case because capital in the form of unfinished work in progress of previous stages was vital to final consumable output and there were fixed coefficients within each array of a technical process. The labor saved can only be current labor not labor involved in construction. All inputs are current except for the constructed capital. Kaldor's assertions can be expressed succinctly as:

$$Q/L = f(K_o/L) \text{ and } Q/K = g(K_o/L) \text{ with } f'>0,\ g'<0.$$

These come from a function

$$Q = F(K_o, L).$$

K_o is the real value of initial capital and Q is real output, L current labor input.

After this background, Kaldor uses Keynes' mec schedules to solve the problem of choice of capital intensity given different methods of production. Each method is described by a mec schedule. This is something of a jump since a mec schedule can be an index of capital intensity only under the assumption of a constant net revenue stream. As before let a, b represent the value of inputs and output streams and C_O the cost of the machine to be constructed. Then mec is given as:

$$C^i_O = \Sigma(b_{it} - a_{it})(1 + \varepsilon_i)^{-t} \tag{4a}$$

The largest real ε_i that solves this polynomial is the mec of the ith technique. Now if $b_{it} = b_i$ and $a_{it} = a_i$ we get

$$(C^i_O/a_i) = \frac{(b_i - a_i)}{a_i}\Sigma(1 + \varepsilon_i)^{-t} \tag{4b}$$

If p is the price of output and w the wage of the only current input, (4b) becomes

$$C^i_O/wa_i) = [(p/w)(Q/L)-1]\ \Sigma(1 + \varepsilon_i)^{-t}$$

This simplification gives Kaldor the implicit investment equation by setting $\varepsilon_i = \varrho$

$$\varrho = \varrho[p/w,\ C^i{}_0/wa_i]$$

Thus the interest rate and real wages determine capital intensity and hence investment expenditure ($C^i{}_0$).

Now in Kaldor's terminology more capital intensive methods do not involve a longer lag in input coming on the scene but less output per unit of capital. Thus for a given ϱ, higher wages will make the representative firm choose a higher capital intensity technique. This is however an ex ante substitutability on new investment and does not tell us about ex post measured capital intensity for the economy as a whole which involves changing weights of different activities over the cycle. This leads to the result that if in a boom real wages fall, firms will choose *lower* capital intensity, i.e. more labor to capital. This will also give them higher output per unit of investment for which there are ready markets. Then given the representative firm argument, the entire economy is said to have switched to a lower capital intensity. Thus the conclusion is directly opposite to Hayek's.

What I believe Kaldor does here is to start with an Austrian concept and end up with a neo-Classical conclusion. Thus heterogeneity of capital becomes merely different ratios of capital to labor, a situation perfectly fitting within a neo-Classical isoquant. He also begs the question of aggregation over firms by treating the conclusion at the firm level as true economy wide. Thus from a neo-Classical function for a firm, we move to the economy level. It is this switch that gives us the positive correlation between capital intensity and real wage, i.e. the lower real wage the lower the capital intensity. The stages of production, the fixed coefficients as between stages and the dated nature of inputs are all smoothed out. Time and heterogeneity vanish. The Keynesian mec schedule becomes a capital intensity curve.

The final stage of the rupture was the Concertina Effect paper of 1942. By now Kaldor was speaking a different language from Hayek. The 1938 paper had already substituted a malleable model for a heterogenous capital one. But now Kaldor also saw Hayek's definition of capital intensity as being the same as his own. Hayek's periodization of the cycle *was* indeed his definition of the cycle and was different from that of the Keynesians. Thus for the later, unemployment and inflation could not co-exist. Thus Kaldor took Hayek's starting point of an inflation in consumer prices in PII as the same as his own definition of upswing. If real wages fall there must be capital labor substitution and hence intensity must fall. But for Hayek, real wages were falling by virtue of scarcity of capacity in the consumer goods industry. This meant investment in short processes by definition of low capital intensity but it was not a boom that had caused real wages to fall but a post crisis through with reflationary expenditure driving up consumer goods prices when capacity in consumer goods industries is fully utilized. Their differences were about the cause of real wage movement over the cycle. Indeed even the definition of real wage is different. For Hayek it is the product wage and for Kaldor (as for Keynes) it is the real wage in terms of wage goods.

But Kaldor's attack has panache. He also sides with Wicksell and excoriates Hayek. The review article was effective in demolishing Hayek. But then the irony of history is that two things happened later to change our view. In the late 1950s and 1960s the Hayek questions came back via Hayek's arch-critic Sraffa. While not Austrian, Sraffa's theory brought back heterogenous capital goods – commodities produced by commodities – and the notion of capital as a lump and capital intensity as monotonic in real wages became dubious. Hayek tried in PTC to convey the complexity of the capital intensity real wage relation once you abandoned homogenous capital. Kaldor knew this well, as of 1937. But after 1938 he set aside capital theory. The second thing was the appearance of stagflation in the 1970s. Real wages fell in face of high unemployment, contradicting the old predictions that real wages were countercyclical. But the fall in real wages did not cure unemployment. Deindustrialization, i.e. the shift to shorter processes, became rampant in OECD countries as the 1970s progressed while unemployment stayed high and real wages low. Economies in the 1980s have growing industries and decaying ones simultaneously coexisting. There are similar regional differences. Heterogeneity is back.

I believe Nicholas Kaldor could have given us the theory to cope with this. His brilliant grasp of the old capital theory and the new income theory, his work on growth and cycles, on Britain's backwardness and on regional imbalances, all these fragments could have been synthesized into a complete model. But he in his own way went from one to the other, never looking back. It is our task to see if we can fill the gap, not individually but collectively.

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4 A Sweeping New Non-substitution Theorem: Kaldor's Discovery of the von Neumann Input–Output Model

P. A. Samuelson*

Nicholas Kaldor is rightly famous for his many theoretical and empirical researches in the fields of microeconomics and macroeconomics. Among many other accomplishments, he independently discovered the von Neumann time-phased system, in which there are no *primary* (non-producible) factors of production and in which goods as outputs are produced out of themselves as inputs. This remarkable 1937 contribution is little known,[1] much less known for example than Kaldor's 1940 intuitive derivation of a *unique limit cycle* of determinate amplitude and period, that is asymptotically approached from any perturbed initial business-cycle position.

Here I shall describe what Kaldor did in 1937 and relate it to von Neumann's growth model. Aside from explicating his rediscoveries and advances, I shall touch on his gaps in analysis. Most important I shall enunciate a universal non-substitution theorem which lay just beyond Kaldor's vision waiting to be discovered, and which is stronger than the post-1949 non-substitution theorem for Sraffa–Leontief systems involving exactly *one primary* factor of production.

Finally, I shall report some detective work that pretty much clears up to my satisfaction the mystery of how Kaldor could have written down in 1937 certain unmotivated heuristics if he at that time had no knowledge whatsoever of von Neumann's conclusion that the maximum rate of balanced growth of a consumptionless input–output system is numerically equal to its uniform own-rate of interest. Communication bearing on this matter, from John von Neumann to Nicholas Kaldor, probably did take place in Budapest during 1931–32 – even though Kaldor never did have the interest or capacity to tackle the mathematics of von Neumann. On my reading of

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the full evidence, the valid core of Kaldor's 1937 model was essentially original with him.

1 FRANK KNIGHT'S CAPITAL EXPLOSIONS OF THE 1930s

Frank Knight was a great neo-Classical economist as well as being a charismatic teacher and philosopher. In the 1930s, while at the height of his powers, Knight became obsessed with what he regarded as the errors of received capital theory, particularly in its Böhm–Bawerkian Austrian version. His articles on the topic were many and somewhat repetitive. Never a transparently clear writer, Knight reached a record depth of obscurity and petulance in his various polemics on capital theory. Although today it is almost as if Knight had never spent ink on that topic, in the 1930s he crossed swords with Hayek, Machlup, Lange, Kaldor, and many other economists dead and alive.

Knight did have one good point to make. Capital is a hard factor of production to measure. Labor and land, L and T, have their ambiguities but in general the attempts by Böhm–Bawerk, Jevons, and Wicksell were oversimple to try to correlate an increase in capital with a lengthening of *the (average) time period* for which the primary factors are invested, written here as θ. Like Böhm before him, Hayek (1931) was trying to work with an idealized aggregate production function with properties like

$$Q_{t+\theta_t} = f[L_t, T_t; \theta_t] \tag{1}$$

Here an increase in θ_t by itself is conceived to add to output, but in obedience to a law of diminishing returns. Just as L gets its wage as a marginal product $\partial Q/\partial L$, so it is hoped can the interest rate be associated with a marginal-product $\partial Q/\partial\theta$ or $[\partial Q/Q]/\partial\theta$.

There are simple models that do work like this. But real world technology is much more complicated. So argued writers before Knight and after him as well. Knight made good points but buried them in congeries of non-optimal formulations. His texts bristled with humpty-dumptyisms that I can only caricature in crude paraphrases like the following:

> The period of production is either zero or infinity. Henry George was naive to try to separate (Ricardian) land from other factors: the peasants of Europe were made out of the (corn of) land and the land itself is made out of the peasants' blood. There is no beginning and no end to the . . . chicken-egg-chicken . . . process. The demand for capital is virtually infinitely elastic: annual increments to it are so small as to imperceptibly bring down the interest rate. It is a logical absurdity to think of the interest rate as being bid down to zero or even near to that, zero being a

limit that infinitely recedes before us. And besides, so long as goods are not so superabundant as to be free, redundant capitals are inconceivable. Etc., etc.

We face a medley of tautologies, empirical assertions, syllogistic inferences, and *non sequiturs*. With hindsight we see that the von Neumann technology (inclusive of joint products) can cover *all* the time-phased technologies that could arise, sparing Knight the need for philosophical semantics while at the same time conveying his objections to over-special cases. In particular the literature might have been spared the tragic-comic spectacle in which all the sillinesses that J. B. Clark had used against Böhm at the century's turn – concerning the impossibility (actual? methodological?) of disinvesting capital – are recapitulated in Knight's 1930s debates with Hayek and Machlup. It is a curiosity of history that Kaldor, soon after 1937 and by 1955 strongly, gave up most of the positions he had been arguing against Knight; after Sraffa (1960) all serious scholars understood that a monotone decrease in the interest rate could *not* be associated with an unambiguous increase in the roundaboutness of capital or in the Böhmian average period of investment. Fortunately, Kaldor's 1937 model of von Neumann type did not have its validity depend on the validity of the untenable Austrian position that motivated him then.

For the present purpose, I can focus on Knight's wish to keep the interest rate resistant to decline from accumulation. Knight seemed at times to be denying the operation of *any* law of diminishing returns (although, at other times, he seemed content to argue that such a law operated in a barely perceptible degree). More than a century earlier, Ricardo had stressed that, if thrifty accumulation caused capitals to grow while at the same time new supplies of labor were forthcoming in balance at an unchanged subsistence wage, then there would not have to be any decline in the rate of interest so long as there could be tacked alongside of England new islands of land in commensurate scale. By debunking the solidity of the *concept* of limited land, Knight was tacitly emasculating the applicability of any diminishing returns concept.

Knight's opponents, such as Lange (1937) and Kaldor (1937, 1938), frustrated by his extremism, were wont to quote his own treatment of the law of diminishing returns in *Risk, Uncertainty and Profit* (1921) – evoking from Knight the grumble that he was sick and tired of having his PhD thesis quoted against himself.

This account of Knight's activity dissolves any mystery concerning how Kaldor was motivated to analyze in 1937 how goods produce themselves in an environment unconstrained by primary-factor limitations. This so-called von Neumann model is similarly constantly presenting itself to people's notice:

1. Malthus himself, in describing how a virgin America gets settled before land is scarce, already discovered von Neumann's model of exponential growth.
2. Ricardo, in pinpointing how land limitation is the ultimate source of interest rate decline in a classical model, stumbled onto the same concept.
3. Knight, in exaggerating the producibility of Ricardian land, in effect employs the open-growth model.
4. Naturally enough, therefore, Kaldor's debate with Knight motivated him to study such a model explicitly: slaves and machines produce slaves and machines.
5. In between (2) and (3) above, John von Neumann, fresh from perfecting fixed-point and saddlepoint methods in his 1928 game theory, understandably looked around for new fields of application.
6. For completeness, let me also add the reference Samuelson (1949), where at RAND I wrote down essentially Kaldor's 1937 neo-Classical model in its *open*-ended and closed von Neumann form and conjectured the Turnpike Theorem that remained unproved until Radner (1961). (See McKenzie on Turnpike Theory in the *New Palgrave*, volume 4, pp. 712–20.) I knew von Neumann (1937, 1945) and perhaps Kaldor (1937); also I had heard von Neumann lecture at Harvard in the early war period (and had crossed swords with him over his strong assertion that minimizing theory played no role in such models); going beyond von Neumann and Kaldor, I was motivated to consider the non-stationary paths that von Neumann never contemplated. See also Malinvaud (1953) and Dorfman–Samuelson–Solow (1958).

2 KALDOR'S TOUR DE FORCE

To pinpoint for Knight that diminishing returns applies to a capital model only if some primary factor of production cannot be augmented while accumulation is increasing (the vector of) capital goods, Kaldor proposes for analysis a model in which machines and slaves as outputs are produced by machines and slaves as inputs in accordance with constant-returns-to-scale, convex, smooth neo-Classical technology.[2]

Here are the basic quotations concerning Kaldor's competitive model:

> entrepreneurs will individually combine the two factors in such proportions as to maximize the output of a given outlay; and they will tend to produce the factors themselves in such proportions as would maximize the rate of return on a given investment (all in terms of 'bread') . . . Given the cost function[s] of machines, slaves, and bread, there will be

only one proportion between [total?] machines and slaves which will maximize the yield of capital: the proportion at which the value of both machines and slaves (calculated by discounting at the same rate their expected net income) is equal to their respective costs of reproduction. It is this yield which in turn will determine the rate of interest. (All this can also be expressed by saying that the yield on capital will be maximized when the real rates of return, on machine investments and slave investments, are equalised.) This rate will represent at the same time the system's 'maximum rate of growth': the rate at which the stock of resources would increase per unit of time, if consumption were reduced to zero and the services of all productive services were devoted exclusively to their own production [net consumption of bread, beyond its use as fodder to produce slaves].

Thus . . . investment[s] will tend to get distributed in such proportions as would equalise the rate of return on all lines of investment. Once this proportion is achieved, . . . no amount of capital accumulation could change this [real, steady-state interest] rate. [By contrast, if there were a third *non*-augmentable factor like land, or if slaves were free people who own themselves and do not procreate to achieve wealth, Kaldor shows that growth of capital and/or labor relative to fixed land, could lower the intermediate-run wage rate and interest rate toward the (Ricardo, Schumpeter) long-run asymptote of (subsistence real wage, zero interest rate). Where all factors are augmentable, if some positive net saving occurs at Kaldor's invariant interest rate, society would resemble an 'expanding universe' at a rate lower than his interest rate.] (pp. 186–7)

Despite some ambiguities in Kaldor's expositions and intentions, these passages show an impressive insight. Kaldor's results go beyond anything von Neumann (1932, 1937, 1945) ever addressed – since von Neumann never contemplated equilibrium states involving positive net consumptions being withdrawn from the system. Whether Kaldor's intuitive reasons for his results are optimal or complete, the important case where there are no joint products does display Kaldor's qualitative and quantitative conclusions.

The next section shows how crucial has to be the role of Kaldor's tacit assumption of no joint products.[3]

3 DISCRETE-ACTIVITY COUNTEREXAMPLE TO KALDOR

Once Kaldor open-ends his system to have one of the goods consumed – bread or, what is the same thing for our version of him, final services of his second good (slaves) – his equilibrium own rate of interest will in the general case *exceed* the system's maximum potential growth rate. Here is a three-process open-ended von Neumann technology, with joint products, that refutes Kaldor's claim for equality of his competitive rate with the system's maximum growth rate:

$$\begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ -a_{11} & -a_{12} & -a_{13} \\ -a_{21} & -a_{22} & -a_{23} \end{bmatrix} = \begin{bmatrix} +2.2 & +0.8 & +1.2 \\ +2.2 & +2.1 & +1.9 \\ -1 & -1 & -1 \\ -1 & -0.5 & -0.5 \end{bmatrix} \tag{1}$$

The a's are *input* coefficients of the respective columnar activities, and the b's are their *output* coefficients.

If all is saved and no output is devoted to final consumption, the closed system can grow in all its parts like $(2.2)^t$ or $(1 + r^*)^t$. This von Neumann growth mode is achieved when activity 1 is alone used, and symmetry of outputs and of inputs is maintained in this contrived example. (While a symmetric price ratio, $p_2/p_1 = p_s/p_m = 1$, is an admissible perfect-competition equilibrium, using but one activity to produce two goods gives us the usual infinity of price-cost allocations familiar for joint products. In the closed case p_2/p_1 can be 5/7 or anything above.)

What about Kaldor's open-ended case? Here equilibrium gross outputs work out to involve twice as much slaves-plus-bread as machines. All of machine output is used as inputs for activities 2 and 3 in equal halves; but now only one-fourth of slave output is used as inputs, equally divided, for the activities 2 and 3; the other three-fourths is consumed as final bread. Since activity 1, which yields von Neumann's maximum growth rate of $(2.2)^t$ is now non-viable, that growth rate (and *its* equal interest rate) is irrelevant in Kaldor's *stationary* state. The interest rate that competitively obtains is *greater* than the growth rate when unbalanced positive net consumptions are involved.

$$1 + \bar{r} = 2.5 > 2.2 = 1 + r^* \tag{2}$$

How is $1 + \bar{r}$ determined? It is the unique interest rate that permits both activity 2 and activity 3 to coexist at the competition break-even level; and, it is no accident that it *exceeds* von Neumann's growth rate of $1 + r^* = 2.2$, thereby rendering activity 1 competitively non-viable. (Since the competitive equilibrium involves 2 goods and 2 linearly-independent viable activities, the equilibrium price ratio is uniquely determinate, being at unity in my contrived example.)

What Kaldor thought he discovered independently of von Neumann is thus in general not even true.

What we may claim in his defense is that he may have glimpsed the following truths: (1) a von Neumann system without joint products and primary factors does possess a *unique* competitive steady-state interest rate; and since the open-end von Neumann mode is (2) one such steady-state mode with *that* unique interest rate, and (3) with *its* growth rate equal to its interest rate, then (4) *every* steady state involves Kaldor's $1 + \bar{r}$ equal to von Neumann's $1 + r^*$ and $1 + g$ in the absence of joint products.

Since Kaldor is long on heuristics and short on proofs, no court can be sure whether counsel for Kaldor has successfully made out his defense. I prefer to give him the benefit of the doubt since he did state what is a truth under suitably delimited conditions. (Kaldor's afterthoughts of 1938, 1962, and 1984 advance the matter not an inch. His incompletenesses appear to be generic not accidental.)

This whole discussion dramatizes how wrong it is to regard the von Neumann and Sraffa paradigms as refutations of neo-Classical smoothnesses. That is to short change them. As demonstrated in my *Palgrave* piece on Sraffian Economics, Samuelson (1987), what von Neumann and Sraffa illuminate are the *complexities* of *vectoral* neo-Classicism with well-defined marginal products. Whatever can obtain in a discrete-technologies model can also obtain in general neo-Classical models with an uncountable infinity of smooth activities.

4 A CORRECT DERIVATION

In a steady state of competitive equilibrium, there will be essentially two pecuniary variables confronting each entrepreneur and owner of physical machines and slaves. One will be the real interest rate, which by competitive arbitrage must be the same own rate of interest in terms of machines as in terms of slaves. Also, the stationary price ratio between machines and slaves will confront any entrepreneur or property owner: $P_{\text{machine}}/P_{\text{slaves}}$, or P_m/P_s, will be the same as $P_{\text{machine}}/P_{\text{bread}}$ in my scenario where bread and slaves are producible interchangeably; we might as well use as numeraire a unitary price of bread or slave, facing as our two unknowns, r the rate of interest and p_m the price of machines.

Since machines are produced out of slave inputs and machine inputs, the minimal unit cost of production of machines will be the par toward which the equilibrium p_m must gravitate. For each choice of input proportions in the machine sector, there will be a resulting unit cost of production – calculated as the needed outlay on the inputs accumulated forward inclusive of interest:

$$\begin{aligned} p_m &= (p_m a_{mm} + p_s a_{sm})(1 + r) \\ &= (p_m a_{mm} + [1] a_{sm})(1 + r) \end{aligned} \tag{3}$$

where (a_{mm}, a_{sm}) are *feasible* input requirements to produce 1 machine of, respectively, machines and slaves.

Likewise, for the minimal unit production cost of slaves

$$p_s = 1 = (p_m a_{ms} + a_{ss})(1 + r) \tag{4}$$

where (a_{ms}, a_{ss}) are feasible coefficients of production in slave production. ('Feasibility' is not yet 'optimality'.)

For any feasible choice of the four positive *a*s, there will be defined a unique interest rate

$$\begin{aligned}(1 + r) &= p_m/(p_m a_{mm} + a_{sm}) \\ &= 1/(p_m a_{ms} + a_{ss}) > 0 \\ &= 1/(\mathrm{f}[a_{mm}, a_{sm}; a_{ms}, a_{ss}]\, a_{ms} + a_{ss})\end{aligned} \tag{5}$$

where f( ) is defined as the positive p_m root of the following quadratic equation for p_m achieved when r is eliminated from (3).

$$a_{ms}p_m^2 + (a_{ss} - a_{mm})p_m - a_{sm} = 0 \tag{6}$$

$$\begin{aligned}p_m &= [(a_{mm} - a_{ss}) + \sqrt{(a_{mm} - a_{ss})^2 + 4a_{sm}a_{ms}]/2a_{ms}} \\ &= f[a_{mm}, a_{sm}; a_{ms}, a_{ss}]\end{aligned} \tag{7}$$

If, and only if,

$$1 - a_{mm} - a_{ss} + (a_{mm}a_{ss} - a_{sm}a_{ms}) > 0 \tag{8}$$

will the corresponding r be positive.

Out of all the technically possible *feasible* choices for the *a*s, competition will force a choice such that $1 + r$ is maximal. (Why? Because any non-maximal interest return can be *bettered* by competitors who will force the Darwinian laggards into bankruptcy.)

Therefore, as Kaldor must have intuitively perceived, there is an optimal choice of the four *a*s, call it a^*, that will determine a unique positive equilibrium interest rate:

$$p_m^* = f[a_{mm}^*, a_{sm}^*; a_{ms}^*, a_{ss}^*] \qquad \text{from (7)} \tag{9a}$$

$$1 + r^* = 1/(p_m^*\, a_{ms}^* + a_{ss}^*), \qquad \text{QED} \tag{9b}$$

Under Kaldor's strong 1937 neo-Classicism, where his isoquants are all strictly convex, the four a^*s will actually be *uniquely* determined under competition. (Von Neumann and Sraffa could have ties in their discrete activities.)

Note that, in the absence of jointness of production of slaves and machines, any change in tastes toward less or more bread consumed, at the expense of lowering the system's growth rate, can have *no* effect on competition's maximal $1 + r^*$![4]

Note also that my present mode of proof works equally well to handle a von Neumann discrete-activities technology sans joint products.

Kaldor emphasizes that his steady-state growth rate cum-consuming has no need to equal his unique interest rate. Growth can be zero if enough bread is consumed and saving is zero. As he knew, each reduction in net consumption speeds up the growth rate in a Kaldor system where both inputs are needed for both outputs.

Finally, when net consumptions all drop to zero, the growth rate reaches its highest feasible level. Kaldor never tells us how and why he knows that this highest feasible rate of balanced growth does equal his equilibrium interest rate. I have to conjecture that in the summer of 1931 in Budapest, when (as he told his interviewer, Marcuzzo (1986)) Kaldor had extensive discussions about economics with von Neumann, he may well have got wind of *this general* result of von Neumann (which does hold true even in *joint*-production technologies).[5]

5 CONCLUSION

This sums up Kaldor's 1937 breakthrough. Interested readers will find in the Mathematical Appendix enunciation and proof of the sweeping Non-Substitution Theorem that is at the heart of the Kaldorian intuitions. It deserves the adjective sweeping because (in contrast to the 1949 Non-Substitution theorem for a labor technology, which does admit of mandatory substitutions when the profit rate takes on its infinity of different values) whatever *a*s are *ever* optimal in the technology lacking non-producible factors do remain optimal *anywhere*.

Notes

1. Kaldor's admiring biographer, A. P. Thirlwall (1987), out of a 360-page book, devotes only a 1-sentence footnote to Kaldor's 1937 discovery, (p. 43, n. 11; p. 73): 'It was in this paper that Kaldor anticipated von Neumann's famous result that the rate of interest represents the highest potential rate of growth which would obtain if nothing were withdrawn from the system.' The sentence itself is misleading if it is read to suggest that Kaldor did first what von Neumann did later. Since von Neumann gave his 1937–45 paper at Princeton in 1932, at most we are warranted to claim that Kaldor independently discovered around 1937 what von Neumann had already discovered mathematically some time between 1928 and 1932. (More on this puzzle later.) I may add that Kaldor went beyond the von Neumann model in some respects: thus Kaldor does contem-

plate open-ending the model to allow net consumption withdrawals from it, and Kaldor does contemplate a neo-Classical uncountable infinity of alternative activities rather than von Neumann's finite number of activities; on the other hand, von Neumann treats joint production cases and proves various of the things that Kaldor only asserts, and also von Neumann does not assert as true any of the false propositions of Kaldor.

In the *New Palgrave* biography of Kaldor, Adrian Wood (1987, Vol. 3, pp. 3–8) makes no mention of his 1937 discovery. A valuable 1984 interview with Kaldor has a section where he discusses von Neumann, for which see the Italian reference M. C. Marcuzzo (1986). After writing this paper, I have learned of the relevant discussion in Lionello Punzo (1984).

2. Actually, Kaldor refers to a slaves-machines-bread model, where the outputs are producible out of themselves as inputs. I can keep my description two-dimensional and still do justice to Kaldor's intuitions if I assume that what produces slaves can also interchangeably produce equivalent amount of bread; and, for simplicity, I can assume on Kaldor's behalf that bread is the only final consumption good, withdrawable from the system rather than plowed back as input for further growth.

   As will be seen, Kaldor seems never to have envisaged the complications that joint products can occasion – and this even though he talks explicitly of the durability of machines (which is a kind of joint production). I shall explicitly distinguish the no-joint-products case from von Neumann's more general case.

   When I quote from Kaldor's two 1937 and 1938 articles on the subject, my paging references will be to their 1962 reproduced version in Kaldor's *Essays on Value and Distribution*, Chapter 10. Readers can translate these page references, p, into their 1937 equivalent *Econometrica* pages, E, by the following formula:

$$(E–201)/(233–201) = (p–153)/(191–153), \qquad 153 \leqq p \leqq 191.$$

   The similiar conversion formula for the pages in Kaldor's 1938 *Econometrica* rejoinder to the *Reply* in Knight [1938] is given by the formula: $(E'–234)/(245–234) = (p–192)/(205–192)$.

3. The well-chosen neo-Classical counterexample in section 3 of my Mathematical Appendix, like next section's discrete counterexample, will show that Kaldor's qualitative conclusions would *not* correctly characterize a von Neumann *general* technology that has been opened up to some net consumption – this failure being traceable to joint-production complexities. Also, we'll see that even in the subcases where Kaldor's unique and invariant interest rate is validly deducible, there will generally *not* be the unique proportions of (total machine input)/(total slaves input) that Kaldor asserts: each difference in fraction of steady-state incomes saved at the expense of bread consumption will generally alter that ratio of *totals*; but, still, Kaldor's intuition is realized in the sense that, *within* each of the sectors producing machines or slaves, the respective (machines input)/(slaves input) ratios will be invariant under alterations in the composition of final demands.

   Two other caveats are in order. In Kaldor's valid case, his attempt (pp. 187–8) to define for Knight alternative Austrian investment periods does not lead to useful insights. See Kaldor's editorial afterthought, Kaldor (1960, p. 8, n. 1) in which he repudiates his attempts in the 1930s to defend the Austrian concepts of capital.

   Secondly, Kaldor's initial claim that the no-primary-factor case is the natural initial approach for 'a proper understanding of the nature of capital and interest', is not only dubious on its face but is also never cogently addressed.

Posterity is blessed that this momentary belief motivated Kaldor to break new ground with his von-Neumann-like model.

4. In Kaldor (1938, p. 200) he sums up for Knight as follows: 'where all resources are augmentable, the rate of interest is uniquely determined from the production function, and it is *independent of the extent of accumulation* and is equal to the maximum rate of expansion of the system'. Kaldor's 1960 foreword sums up his 1937 results in the single sentence '[In] a slave state . . . the rate of return on capital is 'the system's maximum rate of growth . . . [achievable] if consumption were reduced to zero and the services of all production resources were devoted exclusively to their own production'.' After half a century one values, more than this duplication of von Neumann, Kaldor's intuitive demonstration of the *invariance* of the interest rate under changes in the composition of final demands. Noteable is the absence of the needed ruling out of joint products in these statements and in the 1984 summing up. Apparently Kaldor took the absence of joint products so much for granted that he never noticed his own tacit assumption.
5. Very good intuition could have led to this result in a non-joint-product model with known *invariant* a^*s. But Kaldor never explores such approaches. Instead, this is one of his several teleologies drawn from the thin air (several of which are not even true in general). Before I learned that Kaldor had ever been influenced by von Neumann, I therefore suspected the connection that has been reported in the 1984 interview of Marcuzzo (1986).

   The reader will notice that a shift from zero consumption to consumption of enough bread to reduce saving to zero will definitely alter the ratio, total machines/total slaves, except in the singular case where the two sectors happen to have identical organic compositions of capital. This effect Kaldor seems not to have ever noticed, either in 1937 or 1984.

Mathematical Appendix

1. Kaldor's neo-Classical Case

The machines and slaves outputs are each produced in separate sectors by *smooth* neo-Classical production functions that involve each sector's respective inputs of machines and slaves:

$$q_m^{t+1} = F^m[q_{mm}^t, q_{sm}^t] = q_{mm}^t f_m[q_{sm}^t/q_{mm}^t] = 0 + q_{mm}^{t+1} + q_{ms}^{t+1}$$

$$q_s^{t+1} = F^s[q_{ms}^t, q_{ss}^t] = q_{ms}^t f_s[q_{ss}^t/q_{ms}^t]$$

$$= \text{Bread}^{t+1} + q_{mm}^{t+1} + q_{ms}^{t+1}$$

$$f_m'[\ ] > 0 > f_m''[\ ], \quad f_s'[\ ] > 0 > f_s''[\ ] \tag{1.1}$$

We may generalize to n producible inputs, producible out of themselves without jointness of production:

$$\sum_{v=1}^{n} q_{jv}^{t+1} + C_j^{t+1} = F^j[q_{1j}^t, \ldots, q_{nj}^t]$$

$$[q_{ij}^t] > 0, \quad i, j = 1, \ldots, n \tag{1.2}$$

With Kaldor we may assume all $F^j[\ ]$ are first-degree-homogeneous with contours that are strictly convex; and that output rises from zero to positive if and only if the inputs are all positive. $F^j[\ ]$ being smoothly differentiable, neo-Classical marginal products are everywhere well defined. These regularity conditions imply that

$$\begin{aligned} q_j &= F^j[q_{1j}, \ldots, q_{nj}] = q_j F^j[q_{1j}/q_j, \ldots, q_{nj}/q_j] \\ &= q_j F^j[a_{1j}, \ldots, a_{nj}], \quad j=1, \ldots, n \end{aligned} \tag{1.3}$$

$$\begin{aligned} &F^j[q_{1j}, \ldots, q_{nj}] > 0 \quad \text{iff } [q_{1j}, \ldots, q_{nj}] > 0 \\ &\partial q_j/\partial q_{ij} = F^j_i[q_{1j}, \ldots, q_{nj}] > 0 \\ &\qquad = F^j_i[a_{1j}, \ldots, a_{nj}] = F^j_i[1, q_{2j}/q_{1j}, \ldots, q_{nj}/q_{1j}] \end{aligned} \tag{1.4}$$

Competitive efficiency in the steady state requires that unit costs of production are minimized and present-discounted-values are maximized. Long before 1937, it was known that this implied Taussig–Wicksell discounted-marginal-productivity pricing relations

$$P_j^{t+1}\,(\partial F^j[q^t_{1j}, \ldots,]/\partial q^t_{ij}) = P^t_i(1 + r^t), \quad (i, j = 1, \ldots, n) \tag{1.5}$$

2. Steady-state Properties

In the competitive steady state, we can omit all time subscripts from prices, the interest rate, and proportions of inputs and outputs, writing (1.5) as

$$P_j\, F^j_i[1, q_{2j}/q_{1j}, \ldots, q_{nj}/q_{1j}] = P_i\,(1 + r), \quad (i, j = 1, \ldots, n) \tag{2.1}$$

From (2.1) we verify that *own rates of interest* are then equal in terms of all goods

$$\begin{aligned} 1 + r &= F^1_1[1, q_{21}/q_{11}, \ldots, q_{n1}/q_{11}] = \ldots \\ &= F^n_n[1, q_{2n}/q_{1n}, \ldots, q_{nn}/q_{1n}] \end{aligned} \tag{2.2}$$

To deduce the teleological accomplishments of this competitive equilibrium, we can eliminate from (2.1) the $[P_1, \ldots, P_n; 1 + r]$ pecuniary variables and arrive at Lerner's marginal-productivity-proportionality *rule* for productive efficiency: for i, $j = 2, \ldots, n$,

$$\frac{F^j_i[1, q_{2j}/q_{1j}, \ldots, q_{nj}/q_{1j}]}{F^j_1[1, q_{2j}/q_{1j}, \ldots, q_{nj}/q_{1j}]} = \frac{F^1_i[1, q_{21}/q_{11}, \ldots, q_{n1}/q_{11}]}{F^1_1[1, q_{21}/q_{11}, \ldots, q_{n1}/q_{11}]} \tag{2.3}$$

Together (2.2) and (2.3) are $n + (n-1)^2$ equations involving the following $n(n-1) + 1$ unknowns, $[q_{ij}/q_{1j}; 1 + r]$. With

$$n + (n-1)^2 = n^2 - n + 1 = n(n-1) + 1, \tag{2.4}$$

under Kaldor's strong neo-Classical regularity conditions (2.2)–(2.3) do have a unique solution for their unknowns. With *all* the proportions q_{ij}/q_{1j} uniquely determined, the price ratios $(P_2/P_1, \ldots, P_n/P_1)$, as well as the $[a^*_{ij}]$ matrix, are all uniquely determined. These optimal factor proportions are seen to be the same independently of whether (a) net saving is zero for every output or (b) net consumptions are all zero (von Neumann's case), or (c) *any* steady equilibrium state obtains involving saving of whatever fraction of income and any ratios of final consumption goods.

Since Kaldor's unique $1 + r^*$ does obtain in von Neumann's no-consuming model, and since von Neumann proves his own $1 + r$ does equal the system's maximum rate of balanced growth, Kaldor can prove the equality of the competitive rate of interest and the potential-growth rate in his no-joint-products model. So to speak, this is a serendipitous feature of the model and not its invisible hand's *desideratum*.

3. The Revealing Counterexample

Consider the following neo-Classical *joint*-production version of the Kaldor–Neumann system:

$$[\tfrac{1}{2}(Q_1^{t+1})^2 + \tfrac{1}{2}(Q_2^{t+1})^2]^{1/2} = (5q_1q_2)^{1/2} \tag{3.1}$$

where

$$Q_j^{t+1} = C_j^{t+1} + q_j^{t+1}, \quad j = 1, 2 \tag{3.2}$$

By symmetry, we perceive that the system's most rapid rate of von Neumann growth is proportional to $(\sqrt{5})^t$, which is approximately $(2.236..)^t$, and it is achieved when both goods' outputs are equal. The von Neumann interest rate in that mode is of course also

$$1 + r^* = 1 + g = \sqrt{5} = 1 + 1.236 \tag{3.3}$$

Now let Kaldor open up the von Neumann system. If instead of consuming the fraction zero of their incomes, people were to consume the fraction $1-s$ of their incomes, $s < 1$, consuming equal amounts and values of the two goods, Kaldor's observed competitive interest rate would remain at $1 + r^*$ while his observed growth rate would drop to $1 + sg < 1 + g$. No need yet to modify his sweeping conjectures.

However, honoring his own use of bread as the only good consumed, let us consider *his* stationary state with no growth. In it

$$Q_1^{t+1} = q_1^{t+1} + 0$$

$$Q_2^{t+1} = q_2^{t+1} + \text{bread}^{\,t+1} \tag{3.4}$$

Whether Kaldor knew how to calculate our new stationary competitive equilibrium, we can do it for him.

First, the two own rates of interest must be equal. And second, the equilibrium $(\bar{q}_1, \bar{Q}_1; \bar{q}_2, \bar{Q}_2)$ must balance all competitive supplies and demands at the stipulated no-saving level with bread being the only consumed good.

Setting $q_1 = Q_1 = 1$ for normalization, we can write down our equilibrium conditions as

$$\tfrac{1}{2} + \tfrac{1}{2}(Q_2)^2 = 5q_2 \tag{3.5a}$$

$$\begin{aligned} 1 + r &= \partial Q_1/\partial q_1 = \partial Q_2/\partial q_2 \\ &= 5q_2/1 = 5(1)/Q_2 \end{aligned} \tag{3.5b}$$

From (3.5b) we deduce $Q_2 = 1/q_2$, and substitute that into (3.5a) to learn that

$$5(q_2)^3 - \tfrac{1}{2}(q_2)^2 - \tfrac{1}{2} = 0 \tag{3.6a}$$

The relevant positive root of this cubic equation is

$$\bar{q}_2 = 1/2, \quad \bar{Q}_2 = 2, \tag{3.6b}$$

$$1 + \bar{r} = 5(1/2)/1 = 5(1)/2 = 2.5 \text{ from (3.5b)} \tag{3.6c}$$

From (3.6c) we have our needed contradiction.

$$1 + \bar{r} = 1 + 1.5 > \sqrt{5} = 1 + 1.236 \ldots = 1 + r^*$$

This demonstrates the untruth of any sweeping Kaldorian dictum that a no-primary-factor model must have a unique competitive interest rate equal to its von Neumann growth rate even when it is doing positive consumings in ratios different from those of the von Neumann growth mode. What was seen to be true in *no*-joint-product models is now seen to be quite untrue in *general* joint-production models of the von Neumann type. (For such models, it would seem that the interest rate if anything *exceeds* the system's *potential* growth rate.)

4. How Non-substitution depends on the Number of Primary Factors

Samuelson (1951) derived the Non-Substitution theorem for a one-primary-factor system by calculus derivatives applied to smooth neo-Classical technologies. At that time I deduced but did not publish the 2-primary-factor and m-primary-factor generalization of the 1939 theorem. Here I have been similarly deriving the 0-primary-factor version of it. Although these derivations are neo-Classical, essentially the same results hold in discrete-activities technologies of the von Neumann type (it being understood that in every case we are ruling out intrinsic jointness of productions).

Now we rewrite (1.2) to include m primary-factor inputs in each sector, $(L_{1j}, \ldots, L_{mj})$:

$$\begin{aligned} Q_j = q_j + C_j &= \sum_{k=1}^{n} q_{jk} + C_j, \quad j = 1, \ldots, n \qquad (4.1a)\\ &= F^j[q_{1j}, \ldots, q_{nj}; L_{1j}, \ldots, L_{mj}], \quad L_{ij} > 0 \\ &= Q_j F^j[a_{1j}, \ldots, a_{nj}; \lambda_{1j}, \ldots, \lambda_{mj}] \end{aligned}$$

$$L_{sj} = L_s > 0 \tag{4.1b}$$

Here (λ_{ij}) is a *mxn* matrix of *direct* primary-factor input coefficients. They are non-negative and, under Kaldor's regularity conditions, can be supposed to be positive. Now the F functions are to have the previous regularity conditions operative in the full $(n + m)$-dimensional space of inputs.

Corresponding to (2.2) and (2.3), we now have

$$1 + r = F_1^1[1, q_{21}/q_{11}, \ldots; \ldots, L_{m1}/q_{11}] \tag{4.2a}$$

$$= \ldots = F_n^n[1, q_{2n}/q_{1n}, \ldots; \ldots, L_{mn}/q_{1n}]$$

Table 4.1 Substitution-Theorem Considerations

Number of primary Factors	*Degrees of freedom*
0	0
1	1 (r is specifiable)
2	2 (r and w_2/w_1 specifiable)
.	
.	.
.	.
m	m (r and $[w_2/w_1, \ldots, w_m/w_1]$ specifiable)

$$\frac{F_i^j[1, q_{2j}/q_{1j}, \ldots; \ldots, L_{mj}/q_{1j}]}{F_1^j[1, q_{2j}/q_{1j}, \ldots; \ldots, L_{mj}/q_{1j}]}$$

$$= \frac{F_i^1[1, q_{21}/q_{11}, \ldots; \ldots, L_{m1}/q_{11}]}{F_1^1[1, q_{21}/q_{11}, \ldots; \ldots, L_{m1}/q_{11}]}$$

$$j = 2, \ldots, n; i = 2, \ldots, n + m \tag{4.2b}$$

These are only $n + (n + m - 1)(n - 1)$ independent relations holding on $1 + (n + m - 1)n$ unknowns: namely on $[1 + r; q_{ij}/q_{1j}, L_{sj}/q_{1j}]$. Table 4.1. shows the resulting degrees of freedom (that need to come from composition-of-demand and other extensive equilibrium conditions).

Where positive degrees of freedom occur in the table 4.1 that does not mean that the final economic equilibrium is incomplete. There may well be such an equilibrium and even a unique one. The point is that the *other* equilibrium conditions (tastes, etc.) then impinge on the cost and price relations.

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5 Equilibrium and Stability in Classical Theory*

D. J. Harris**

1 INTRODUCTION

Kaldor begins his paper of 1972 with a resounding blast against what he calls 'equilibrium economics'. The opening paragraph is worth quoting in full for its candid irreverence:

> The purpose of my lecture today is to explain why, in my view, the prevailing theory of value – what I called, in a shorthand way, 'equilibrium economics' – is barren and irrelevant as an apparatus of thought to deal with the manner of operation of economic forces, or as an instrument for non-trivial predictions concerning the effects of economic changes, whether induced by political action or by other causes. I should go further and say that the powerful attraction of the habits of thought engendered by 'equilibrium economics' has become a major obstacle to the development of economics as a *science* – meaning by the term "science" a body of theorems based on assumptions that are *empirically* derived (from observations) and which embody hypotheses that are capable of verification both in regard to the assumptions and the predictions. (Kaldor, 1972, p. 1237)

Kaldor recognizes, of course, that there are different concepts and uses of the idea of equilibrium in economic analysis. Accordingly, he goes on immediately to clarify what he means by 'equilibrium economics':

> the notion of equilibrium to which I refer is that of the general economic equilibrium originally formulated by Walras, and developed, with ever-increasing elegance, exactness, and logical precision by the mathematical economists of our own generation (p. 1237)

This clarification would appear to restrict sharply the application of his criticism to what is now commonly referred to as neo-Classical general equilibrium theory in its specific version of Arrow and Debreu. However,

* The argument of this paper is drawn from a larger project of the author, reported in Harris (1988).
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as the argument proceeds, it becomes clear that he means to bring into the same domain of 'equilibrium economics' a much wider range of economic theory. For, only a few pages later, in seeking 'to pinpoint the critical area where economic theory went astray' he asserts:

> To locate the source of error with more precision, I would put it in the middle of the fourth chapter of Vol. I of the *Wealth of Nations* . . . [where] Smith suddenly gets fascinated by the distinction between money price, real price and exchange value, and from then on, hey presto, his interest gets bogged down in the question of how values and prices for products and factors are determined. One can trace a more or less continuous development of price theory from the subsequent chapters of Smith through Ricardo, Walras, Marshall, right up to Debreu. (pp. 1240–41)

It is evident from this assertion, and from the subsequent discussion, that he means to subject to the same line of criticism both the neo-Classical theory and the theory of the Classical Economists (chiefly Smith and Ricardo) for what he sees as common elements in the basic structure of both sets of theory at the level of their respective theory of value.

Kaldor is returning in this paper to a theme that he had broached many years before, as far back as in 1934 (see Kaldor, 1934a, 1934b). Indeed, the 1972 paper could be considered an extension and updating of the 1934 papers, in the light of certain principles emergent from Keynesian economics, to deal more explicitly with the implications of the problem of increasing returns for 'equilibrium economics'. The issues are further considered in his Okun Memorial Lectures (Kaldor, 1985).

These papers, taken together, address fundamental questions regarding the logic and explanatory significance of equilibrium analysis as Kaldor sees it. In this connection, the earliest paper (1934a) distinguishes between two sets of issues, though the distinction between them is rather blurred and remains so even in present-day practices of economic theorists. One is the issue of *stability* of equilibrium. The other is what Kaldor calls 'determinateness of equilibrium'. In some respects, this latter may be interpreted to conform to what is nowadays commonly discussed as the *existence* and *uniqueness* of equilibrium. On both of these issues, Kaldor's arguments reveal a great deal of scepticism concerning the explanatory significance of an economic analysis constructed in terms of the notion of equilibrium for understanding empirical and historical phenomena.[1]

Of course, so far as Kaldor's work as a whole is concerned, it is worth noting that he himself was not always consistent as regards the practice of 'equilibrium economics'. For instance, he sought to construct a theory of growth of capitalist economies which presumed the existence, uniqueness, and stability of steady-state growth with full employment. After many efforts in this direction, he was not able to show how this growth process could operate under plausible conditions of capitalist markets and investment behaviour. Given his expressed view of equilibrium analysis, one may find in this work a striking paradox.

Nevertheless, the arguments presented in these papers are still very fresh today. They are certainly worth considering in the context of more recent developments on which they have a direct bearing. This is what I propose to do here. In particular, I wish to consider, in the light of the specific cricitisms of equilibrium analysis presented by Kaldor, what advances have been made in developing the structure of Classical theory. For this purpose, I focus on the analytical structure of Classical theory that has emerged from modern efforts (beginning with Sraffa, 1960) to revive and develop that theory, as it relates to the formation of competitive value. In this context, the appropriate and relevant equilibrium concept to consider is that of 'long period equilibrium'. It is characterised by the existence of 'prices of production' at a uniform rate of profit on the supply price of capital, those prices being said to constitute a center of gravitation for 'market prices.'

The arguments of Garegnani (1976) serve forcefully to remind us that this particular notion of equilibrium constitutes a method of analysis that is common to both the neo-Classical and Classical traditions of theory, whatever may be the differences between them as regards their respective theory of value. Of course, if this is granted, there are important questions begged as to how one is to separate the theory from the method and what is the real distinction that would then remain between Classical and neo-Classical theory. Kaldor, on his part, evidently takes for granted that there is 'a more or less continuous development' between the two sets of theories (1972, p. 1241). Others may find this position objectionable. I do not directly address these questions in this paper.

2 THE PROBLEM OF STABILITY

For a long time, detailed analytic treatment of the problem of stability of equilibrium took place mostly within the framework of the static Walrasian theory of general equilibrium, focussing on the idea of price adjustment through *tatonnement*. This idea is now generally recognized to be an extremely artificial construction of the process of price formation in real-world markets (Hahn, 1982). More recent efforts to advance alternative conceptions of the adjustment process in a variety of settings within the framework of neo-Classical theory have shown that, under general conditions, the adjustment process may give rise to complex forms of motion that are unstable and equilibrium itself may be indeterminate (cf. Benhabib and Nishimura, 1985; Boldrin and Montrucchio, 1986; Cass and Shell, 1983; Grandmont, 1985). These results leave in doubt, even in the judgement of some of the practitioners, the explanatory significance of the specific neo-Classical constructions of an equilibrium system.

On the other hand, analytic treatment of the stability problem in the context of the Classical theory has lagged far behind this work. Recently, however, some strides have been made in the direction of a more structured treatment of this problem. It has turned out that a strong instability result can also be found within a range of parameter values for adjustment processes that are thought to be representative of the Classical conception. This is so for even the simplest analytic construction of a Ricardian process of convergence to the stationary state in a highly aggregative setting (see Bhaduri and Harris, 1987). It is so, moreover, in more complex and disaggregated settings (see, for instance, Semmler, 1986).

What, then, is one to conclude from these instability results about the explanatory significance of the specific Classical concept of gravitation to a stationary state or long period equilibrium with prices of production?

Certainly, as a matter of the logic of the concept of long-period equilibrium as a stationary position, the demonstration of stability is a necessary step in the argument if this concept is to be at all logically sustainable. Therefore, these results, on instability of the Classical competitive process, have to be squarely faced. At the same time, it must be recognized how limited and primitive these constructions are. Generally, what this analysis has achieved so far, in my judgement, is to induce initial efforts to put forward an explicit conception of the behavioural and structural properties that are thought to characterize the workings of real economies in motion. In this respect, these efforts constitute, at best, only tentative steps towards constructing a dynamic conception of the economic process.

Insofar as they are based on simulation results, the generality of the results is questionable. Where analytic solutions have been derived, the parameter values demarcating stable and unstable regions are, in many cases, not susceptible to any economically meaningful interpretation. Most importantly, the specification of economic behaviour and institutional structure is seriously lacking in the very elements that are relevant to evaluating the dynamic behaviour of real-world economies. These missing links relate, for example, to labor market interactions, production changes associated with both technology and organization, active (as distinct from passive) price-quantity interventions by firms, the role of financial variables and, last but not least, the formation of expectations. This list represents a tall order of items which, to be all included, would no doubt make the analysis unwieldy and unmanageable. Therefore, perhaps a step-by-step procedure is warranted. But without a specific treatment of these complicating factors, it would seem premature to make a final judgement of stability or instability as a general rule.

One complication, which has attracted some attention, is worth mentioning here because of the deeper issues underlying it. The problem (first pointed out by Steedman, 1984) is this. When market prices differ from production prices, the direction of the price deviation need not be the same as the direction of the profit deviation. They could very well differ. This is for a reason essentially related to the interdependent structure of the economy: if there is a deviation in one industry this sends ripples across the whole structure of prices of other industries which necessarily feed back into the costs and profits of that same industry, so that profits may move in a direction opposite to the price deviation. If there are deviations in other industries as well, the problem is compounded, making it impossible to say *a priori* what is the relation of profit deviations to price deviations.

It is well to see this lack of correspondence between price and profit deviations as a logical possibility. But the important question is: why is this necessarily troubling for the theory? Here, a deeper inquiry is needed into the rules which are supposed to guide economic behaviour in the theory. This result is troubling for the theory if it is assumed that firms are guided in their investment and output decisions by a specific norm that serves as a benchmark from which to judge the existing market situation. This is the norm of prices of production and the profit rate associated with those prices, assuming it is unique. This norm runs into difficulties because it cannot be guaranteed to provide the correct signals to profit seeking firms in their investment and output decisions that would cause the set of all firms to act so as to bring into existence those very same prices of production and corresponding profit rate.

It may be noted here that this norm is a very special one. It follows from the more general principle that firms are guided by the goal of increasing profits. But it is not the only norm that would follow from this principle – there are conceivably many others. This particular norm has the special significance that it is chosen so as to be fully consistent with the presumption that there does exist a unique set of prices of production and corresponding profit rate. The problem then is not simply whether there exists some other norm that is admissible on some arbitrary criterion (cf. Steedman, 1984, p. 135, n. 20).

The problem is, first, that this particular norm, even though it so closely fits the criterion of consistency with prices of production, will clearly not do as a generally acceptable one. The fact is that this norm, when combined with a similar norm for output decisions on the quantity side, can be shown logically not to lead generally to the establishment of prices of production. Under certain conditions, such price–quantity interactions can definitely lead to instability. This is the damaging result that has come out of work done to date on stability analysis of the gravitation process, in which these norms are taken as the guiding principle in the adjustment process (see Semmler, 1986, and other works cited there).

Secondly, the problem is whether there exists *any economically mean-*

ingful behavioural rule at all, no matter how simple or complex, consistent with the goal of increasing profits, that would cause market prices to converge to production prices, when this particular norm that is so congenial to production prices will not do as a rule that is generally capable of achieving that result. What is at issue, therefore, is whether the idea of a convergence of market prices to production prices is sustainable under *any* economically meaningful description of capitalist behaviour as regards decisions on prices, output, and investment. It remains to be shown that it is so and what that description is. At this point, that must be considered to be an open question.

All of the above-mentioned results are interesting and useful. They also address matters that are central to the internal logic of the Classical theory. However, there is a deeper issue which goes beyond anything that is touched by the results discussed so far but which, when it is fully grasped, also allows us to put those results into proper perspective. So far as I can tell, this issue was first clearly and sharply posed by Kaldor in the following terms that are worth quoting in full:

> It is not possible, therefore, to determine the position of equilibrium from a given system of data, since every successive step taken in order to reach equilibrium will alter the conditions of equilibrium (the set of prices capable of bringing it about) and thus change the final position – unless the conditions are such that either (1) an equilibrium system of prices will be established immediately, or (2) the set of prices actually established leaves the conditions of equilibrium unaffected (in which case the final position will be independent of the route followed). (Kaldor, 1960, p. 16)

What Kaldor proposes here, and elsewhere (for instance in 1960, p. 45, and in 1972) is that there is a general problem of *path dependence* affecting dynamic economic processes, attributable to the effects of learning from experience (among other causal factors). This problem has not been widely recognized until recently (see, for example, Arthur, 1988; Arthur, *et al.*, 1987). Once it is recognized, however, then the question of convergence to a predetermined equilibrium position necessarily becomes problematical, unless resort is had to "very rigid assumptions" satisfying the conditions indicated in the quoted passage (such as in the Edgeworth–Walras theory of competition where the assumption of 'recontracting' is crucial, as Kaldor shows).

The issue then is this. The norm of behaviour that is specifically oriented to knowing in advance the vector of equilibrium prices is one which satisfies Kaldor's first condition, insofar as it conforms to the idea of "full experience", and it also satisfies his second condition. Yet, despite this happy coincidence, that norm is clearly not sufficient to guide the economy to the equilibrium position associated with it. This indicates that Kaldor's conditions while necessary are not sufficient. The problem still remains, then, whether there is any behavioural rule that will do, in the sense of being both necessary and sufficient. But, in addition, what we can now see, and this is the deeper point, is the following. Any such rule that is based on a norm related to the equilibrium position must necessarily rule out features of actual economic behaviour in so far as such behaviour entails path dependence.

This point provides general grounds for objecting to the conception of a determinate equilibrium of production prices in Classical theory quite apart from any finding of stability or instability in the gravitation process. In other words, this is a case where, to quote Kaldor again,

> the postulate of the existence of such 'laws' [here, the presumption of 'economic equilibrium'] is refuted if they can be logically shown to be valid only under assumptions that are contrary to observed phenomena. (1972, p. 1245)

3 RELATIVE SPEEDS OF ADJUSTMENT

There are many other considerations, essentially of an empirical nature, that may be introduced to question the efficacy of the mechanism of adjustment to the Classical long-period equilibrium of production prices. These relate, for instance, to various forms of 'barriers to entry' and, hence, to the question of the degree of mobility of both capital and labor. Such 'barriers' are known to occur in practice and, more significantly, can be shown to derive from intrinsic features of production, the innovation process, financial markets, labor markets, and the formation of demand (the literature on this is discussed in Scherer, 1980). Some would infer from these considerations that the case for presuming convergence to a uniform profit rate rests on very weak empirical foundations.

Against this line of criticism, it could be argued that existence of such barriers is only a cause of slowing down or inhibiting the speed of the adjustment mechanism and not a cause of permanently obstructing or negating its effectivity. The process of convergence to a uniform profit rate may still be presumed to occur, if only as a tendency which is never actually realized, as long as there are reasonable grounds for assuming that some of the crucial requirements for its operation are present.

However, there can be no cause for comfort in this latter position. This is because of another and potentially damaging complication. This is another point at which Kaldor's conditions for equilibrium turn out to have much relevance and meaning for the classical theory. I refer here to his condition concerning the 'velocities of adjustment' (1960, pp. 31–3). It is a matter of the *relative* speeds of adjustment. Specifically, in the context of the classical theory, it is a matter of whether the speed of adjustment to the supposed centre of gravity is fast enough relative to that of the changes brought about by forces which determine that centre of gravity so that, for instance, any set of production conditions can be said to be 'dominant' in a meaningful sense (for instance, in terms of the proportion of total output it produces). In particular, what if the speed of adjustment to long period equilibrium is so slow relative to ongoing changes of a permanent nature in the structure and technology of production that those changes continually regenerate divergences in profit rates before any gravitational effect can occur? Under these circumstances, the very idea of a long period equilibrium position would become quite meaningless or irrelevant. To sustain the relevance of this position, therefore, it must be assumed that the pace of technological change is itself very slow or, viewed the other way round, that the rate of diffusion of new techniques is very fast relative to the rate of introduction of new techniques.

For this purpose, it could be assumed that technological change comes in discrete spurts that are widely separated in time so that, in the interim, the economy is sufficiently able to adjust to and absorb the existing 'dominant technique'. This is often supposed to be the form of technological change in the case of so-called 'major' innovations. Indeed, this is the case on which part of the Schumpeterian analysis of capitalist dynamics rested (Schumpeter, 1954). But available research on the actual historical character of technological innovations does not support this view (see, for instance, Jewkes, Sawers, and Stillerman, 1968; Kamien and Schwartz, 1982; Sahal, 1981; Schmookler, 1966; Stoneman, 1983).

Available research suggests that the rate of diffusion of new technologies is actually quite slow on average. Furthermore, innovations appear 'major' only *ex post*, that is, from the standpoint of looking back at their cumulative effects (this does not deny the existence of technological discontinuities or so-called 'radical innovations'). In actuality, they emerge as continual 'minor' improvements that may eventually displace previously existing practices (regardless of whether they are viewed as product or process innovations, a distinction which is in any case difficult to sustain in practice). They achieve apparent stability and 'dominance' only after a long-drawn out process of such incremental improvements, in the course of which improvements in processes and products on the input side originating in other industries are continually disturbing the apparent tendency to a fixed shape and form of the product or process in a given industry.

Going deeper into the process of technical change, it is evident from what we now know about the actual character of this process, that the classical construction of a long period position is seriously at risk (see, for instance, Arthur, 1988; Dosi, 1984; Dosi, *et al.*, 1987; Nelson and Winter, 1982; Sahal, 1981). What is significant for present purposes is, first of all, that there are costly 'search' procedures involved in the process, such procedures being themselves an integral part of the investment decision so that they cannot meaningfully be separated off as an independent and autonomous factor. Secondly, the process is known to entail powerful learning effects from experience in both 'doing' and 'using', so that the economic advantages accruing therefrom are dependent on previously accumulated experience. Thirdly, there is a "lock-in" effect along any trajectory of development of technology such as not only to entail significant advantages for those producers that are ahead (whether they be firms, sectors, regions, or national economies) but also, and at the same time, make it costly to change over to other trajectories.

All of this adds up to the recognition that *technological change is a path-dependent process* in which current economic performance is at every moment crucially dependent on past performance. To this extent, the outcomes of the process, in terms of the set of techniques observed, cannot be meaningfully conceived to be independent of the path pursued. This result calls into question the basic idea involved in the Classical analysis of convergence to a predetermined equilibrium position defined by a known technique.

The idea of 'increasing returns' is a common and familiar reference point for discussion of these effects (as, for instance, in Kaldor, 1972), but the point to be emphasized here is that there is a pervasive and general process underlying this idea.

4 WHITHER, THEN, GOES CLASSICAL THEORY?

So far as study of the problem of stability is concerned, one of the more constructive and potentially fruitful lines of development, in my judgement, is that introduced by Goodwin and his followers (see Goodwin, 1982, and accompanying papers; Goodwin and Punzo, 1987). It has the distinct advantage that it identifies from the outset a general principle, namely, that a possible source of instability lies in the existence of non-linearities associated with cumulative feedback effects in the economic process. One such non-linearity analyzed by Goodwin is the interplay between the 'reserve army' of unemployed labor and the investment behaviour of capitalists, an idea which in his own words led him back to Marx's formulation of capitalist dynamics (Goodwin, 1982). There may be other such non-linearities, and these are worth exploring. Surely, the buildup of such analysis can provide a more solid analytical basis for understanding the workings of real economies and for organising study of concrete historical processes.

The high level of aggregation of the analysis that has been done so far along this line is in some respects a serious limitation, but there is a possibly wider significance that might be conjectured, coming from that very aggregative feature. In particular, if there are real macroeconomic balancing conditions and boundaries that the economy must satisfy (isn't the structure of class relations one of these?), then aggregative models can still tell us something about the sources of instability no matter what the level of disaggregation to which the analysis is subsequently taken. Furthermore, even if the Classical convergence to prices of production held at the microeconomic level, problems of instability might still arise at the macroeconomic level. To this extent, aggregative models may be said to be intrinsically of interest in the study of stability of the competitive process.

Another potentially fruitful line of approach is that of evolutionary models (Iwai, 1984a, 1984b; Nelson and Winter, 1982). They bring into full play a biological analogy (as does the Goodwin model) in contrast with the typical mechanical analogy that has all along been at the heart of economic method. Their emphasis on selection mechanisms and the reproduction of diversity has the potential of generating useful insights into the economic processes by which differentiation of performance, and hence of profit rates, is reproduced. Within this line of analysis, one might conjecture another possible advantage that is the opposite of that stated above for aggregative models, arising in this case from the intrinsically microeconomic level of analysis of evolutionary models. In particular, might it not be the case that some elements of system stability are generated from processes of selection, adaptation, and reproduction of diversity at the microeconomic level?

By combining, in some way not yet clear, the insights obtained from these two lines of analysis it may yet be possible to provide a deeper and more far-reaching answer to the question of stability/instability of the competitive process in capitalist economies.

A larger, more difficult, analytically intractable, and yet more interesting question, concerns the conditions under which one might be able to conceive of a process which builds up through cumulative movements in one direction, as distinct from maintained oscillations, to a point of structural break or discontinuity. This problem, which might be called a 'regime change', takes us far beyond what has been done so far or what can be handled analytically with methods now being used. However, the formal demonstration of the general possibility of chaotic dynamic paths may well be pointing to the need for grappling with this problem. And is this not, after all, the 'grand theme' that really concerned classical thought, especially that of Marx, regarding the process of internal change within capitalism?

A potential danger comes from seeking to collapse history into the Classical model of prices of production. Robinson insistently warned of this danger in her recurrent complaint that the long-period equilibrium method is a way of turning history on its head (hence the title of her essay 'History

Versus Equilibrium', 1974; see also 1980, *passim*). Her point, as I interpret it, is simply this. If all past history had been one of equilibrium, then one may infer that any perturbation which occurs here and now would set into operation forces that cause the perturbation to cancel itself out and bring about a return to equilibrium. The economic system would then be self-correcting, at least for small perturbations. It is quite another thing, however, if history has never been anywhere near equilibrium. It would be illegitimate then to claim that, starting from today, there will come into play a process of getting to equilibrium. The system could, and would likely, wander off into the unknown without ever achieving equilibrium.

A mathematician would correctly reply that, from the standpoint of an abstract analysis of stability, these two cases are not qualitatively different. But, for the social theorist and historian, there is a world of difference between them. Specifically, the difference is that, in the one case, the properties of equilibrium have already been learned in history and can confidently be expected to persist. In the other case, there can be no necessary presumption that a real process of learning, which is in general a path dependent process, will lead to an equilibrium, if any exists and whether it is unique or not. The difference may be represented formally in terms of the following two dynamic processes:

Case 1: $\dot{x} = F_{x_e}(x)$, x_e = equilibrium point

Case 2: $\dot{x} = F_{x_0}(x)$, x_0 = initial condition

Case 1 is an 'equilibrium process' in which the function governing the adjustment process is uniquely defined in terms of the equilibrium solution x_e that is known 'in advance' and invariant to the starting point. Case 2 is a 'path dependent process' in which the function governing movement along any path is uniquely dependent on the initial condition or state variable x_0 and (for full generality) may be considered to shift as experience builds up along a given path. As long as one recognizes the intrinsic and general characteristic of the social process as one of learning on the basis of accumulated experience, as in Case 2, then the presumption of an adjustment to a predetermined equilibrium, whether unique or not, cannot generally be sustained.

Notes

1. At the opposite pole to Kaldor stands Samuelson who unabashedly claims to be an 'equilibrium theorist' following in what he sees as the tradition of the classical economists and Harriet Martineau: 'Remember that the classical economists were fatalists (a synonym for "believers in equilibrium"!). Harriet Martineau, who made fairy tales out of economics (unlike modern economists who make economics out of fairy tales), believed that if the state redivided income each morning, by night the rich would again be sleeping in their comfortable beds and the poor under the bridges (I think she thought this a cogent argument against egalitarian taxes). Now, Paul Samuelson, aged 20 a hundred years later, was not Harriet Martineau or even David Ricardo; as an equilibrium theorist he naturally tended to think of models in which things settle down to a unique position independently of initial conditions' (Samuelson, 1968, p. 12).

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6 On the Resolution of Conflicts by Compensation*

U. Krause

1 INTRODUCTION

The purpose of the present paper is to embed the compensation principle due to N. Kaldor into some more general framework so as to discuss conflict resolving by compensation for social as well as individual decision making. Kaldor's intention in (1939) was to show that the classical argument for free trade does not require interpersonal comparison of utilities. In section 2 Kaldor's compensation principle is presented in detail together with some of its criticism. In contrast to the criticism the formulation of Kaldor's principle as given in this section does not involve utilities. This formulation then leads to a general concept of compensation presented in section 3. Compensation thereby is described by an equivalence relation on the set of alternatives. A conflict among alternatives occurs when there are (at least two) preferences that point in different directions. The conflict resolution hoped for is portrayed by the factor relation obtained by taking the conjunction of the preferences modulo the equivalence relation.

This then provides a framework to discuss multicriteria decision making in section 4. The branch of multicriteria decision making developed in recent years bears relationships to various fields, among others to vector optimization (cf. Jahn and Krabs, 1987; Stadler, 1987; Yu, 1985). One fundamental question is how to aggregate a given set of preferences obtained by evaluating alternatives according to multiple 'criteria' into one single overall evaluation. This is reminiscent of social choice theory, where however the welfare function because of a given fixed preference profile is not of the Arrovian but of the Bergson–Samuelson type. (The impossibility results which are found for the latter type (cf. Fishburn, 1987), are relevant also for multicriteria decision making.) Emphasizing the intrinsic difficulty of getting an overall evaluation in face of conflicts, the multicriteria decision maker has been called also a Faustian decision taker (cf. Steedman and Krause, 1986). The problem of interpersonal comparisons in Kaldor's principle and in social choice in general appears as intrapersonal comparison to the Faustian decision taker. Once the black box of the

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'rational individual' has been opened in this way the neo-Classical postulate of rationality becomes questionable. (Cf. also the empirical evidence reported in Hogarth and Reder, 1987, about deviations from neo-Classical rationality.) Section 5 is concerned with a certain instability of compensation principles and factor relations. Namely, there is the general result on multicriteria decision making that stable preferences must necessarily be lexicographic in some broader sense (cf. Krause, 1987). But lexicography is the opposite of compensation.

2 KALDOR'S COMPENSATION PRINCIPLE AND ITS CRITICISM

In defending the classical argument for free trade against Robbins's criticism, Kaldor argues as follows (1939a, p. 550):

> The effects of the repeal of the Corn Laws could be summarised as follows: (i) it results in a reduction in the price of corn, so that the *same* money income will now represent a higher real income; (ii) it leads to a shift in the distribution of income, so that some people's (i.e. the landlord's) incomes (at any rate in money terms) will be lower than before, and other people's incomes (presumably those of other producers) will be higher. Since aggregate money income can be assumed to be unchanged, if the landlord's income is reduced, the income of other people must be correspondingly increased. It is only as a result of this consequential change in the distribution of income that there can be any loss of satisfactions to certain individuals, and hence any need to compare the gains of some with the loss of others. But it is always possible for the Government to ensure that the previous income-distribution should be maintained intact: by compensating the 'landlords' for any loss of income and by providing the funds for such compensation by an extra tax on those whose incomes have been augmented.

Kaldor's point can be depicted graphically in Figure 6.1.

In Figure 6.1a y is the original state and x is the state after the repeal of the corn laws. First, x represents a state of higher (total) real income. The 45° lines show real income distributions of constant total real income. Secondly, in state x the landlord's income is lower and other people's income is higher than in y. That is, x lies northwest from y. Obviously, there is a conflict between landlords and other people about which of the states x and y is the better one. Hence some interpersonal comparison of utility seems inevitable. It is however Kaldor's point that this need not be the case. For, it is possible by compensation, i.e. simply by redistribution, to move from x to state x' in which both parties are better off. That is, x

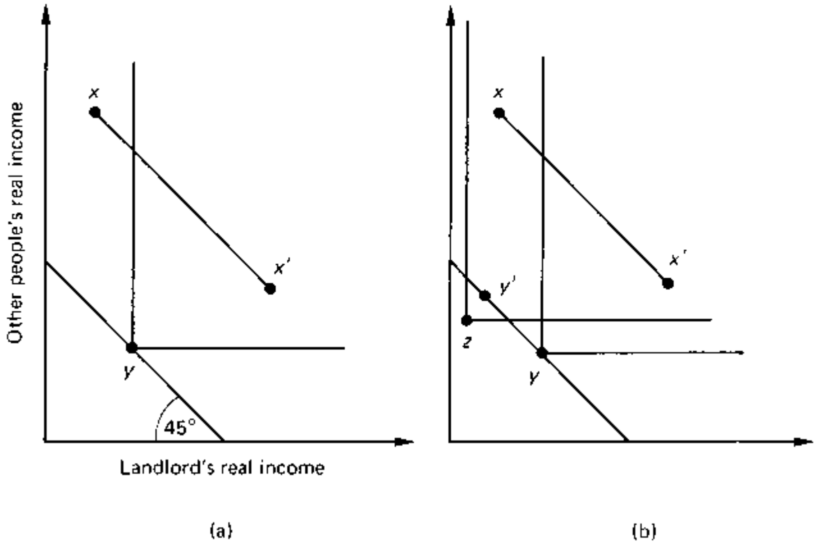

Figure 6.1 The Kaldor relation

should be considered to be better than state y. The following *Kaldor relation* (or Kaldor criterion) comprises what is essential. For two states x, $y \in \mathbb{R}^2_+$ (= positive orthant of the plane) x is better than y in the sense of Kaldor, in symbols xKy, whenever there exists some state x' with the same aggregate real income as x and such that x' is Pareto superior to y. The latter means that $x'Py$ but not yPx', uPv being the *Pareto relation* defined by $u_i \geq v_i$ for all i, where $u = (u_1, u_2)$, $v = (v_1, v_2) \in \mathbb{R}^2_+$. It is obvious from Figure 6.1b that K is *transitive*, i.e. xKy and yKz implies xKz, and also that K is *asymmetric*, i.e. not both xKy and yKx. (See section 3 for a general proof). Thus Kaldor's compensation principle is a nice device to decide the conflict concerning the repeal of the corn laws. (Of course, the Kaldor relation does not discriminate between states of equal aggregate real income for which indifference holds.)

Kaldor's compensation principle however runs into difficulties if more than one commodity is involved. The crucial question then is how a notion of a *real* income is defined. (Cf. also Samuelson, 1950.) Historically, the criticism of Kaldor's compensation principle has taken place in a somewhat different framework, where Kaldor's discussion in real terms was recasted in terms of individual utilities. (I am indebted to A. P. Thirlwall for showing me an unpublished letter to Kaldor by M. Dobb, dated from 20.11.40, where Dobb expresses some doubts about Kaldor's principle. Although the point Dobb makes is not completely clear, it seems that his criticism is in real terms only and does not embark on individual utilities. Anyway, in section 3 it will be shown that even in the one commodity case

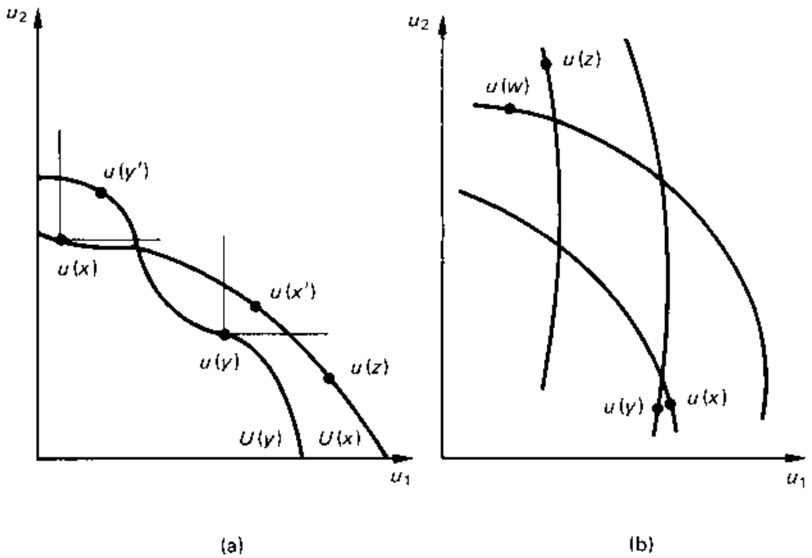

Figure 6.2 The Scitovsky relation

intransitivities for the Kaldor relation arise if the set of alternatives is constrained to some proper subset of $\mathbb{R}^2_+$.) If the number of commodities is n, a state is given by a point $x \in \mathbb{R}^{2n}_+$ specifying for each party (i.e. 'landlords' and 'other people') the quantities of commodities. For state x $u(x) = (u_1(x), u_2(x))$ denotes the utilities of the two parties when being in state x. The *utility frontier* $U(x)$ passing through x is defined as the locus of all utility vectors $u(x')$ where state x' can be reached from x by compensation. The *Kaldor relation in terms of utilities* then reads as follows. For two states x is considered to be better than y, in symbols $x\tilde{K}y$, whenever there exists some state x' such that $u(x') \in U(x)$ and $u(x')Pu(y)$ but not $u(y)Pu(x')$. T. Scitovsky (1941) observed however the paradox that $x\tilde{K}y$ and $y\tilde{K}x$ may coexist as it is depicted, e.g. in the above picture (Figure 6.2a.)

By combining Kaldor's principle with a dual principle due to J. Hicks (1940), Scitovsky proposed the following double-test, also called the *Scitovsky relation.* For two states x is better than y, in symbols $xScy$, whenever $x\tilde{K}y$ but not $y\tilde{K}x$. (e.g. $zScy$ in Figure 6.2a). Obviously, the Scitovsky relation is not complete. Moreover, it may happen that the Scitovsky relation is not transitive, as e.g. in Figure 6.2b where $xScy$ and $yScz$ and $zScw$ but $wScx$. (This was first observed by W. M. Gorman, 1955. An explicit numerical example showing intransitivity for the Scitovsky relation's indifference was given by K. Arrow, 1963.) The intransitivity of the Scitovsky relation disappears in the following variation of Kaldor's principle due to P. A. Samuelson (1950). By the *Samuelson relation* x is better than y, in symbols $xSay$, iff $x\tilde{K}y'$ for any y' such that $u(y') \in U(y)$. The Samuelson relation is not complete and it is not implied by the Pareto relation. (Concerning the various compensation principles and its history the reader is referred to the detailed survey given by A. Takayama, 1972. Cf. also the corresponding chapters in Arrow, 1963 and Sen, 1970.) The drawbacks of the above utility based principles of compensation are rooted in the fact that different utility frontiers may intersect. No such phenomenon can occur in Kaldor's simple real income model where the sets of states which are connected by compensation are straight lines. In the next section it will be shown how this particular feature of Kaldor's model may serve to formulate a rather general principle of compensation.

3 A GENERAL CONCEPT OF COMPENSATION

Kaldor's point in resolving a conflict may be seen more abstractly in that he treats given states 'modulo' distribution. That is, not the states themselves are at stake but classes of states, whereby a class (straight line) is formed by all the states which can be transformed into each other by compensation. Consider, in more detail, some fixed original states y which divides the set of states into four different regions I to IV, as shown in Figure 6.3.

Regions I and III are easy to handle since states in I are Pareto superior and states in III are Pareto inferior to y. However II and IV represent regions of conflict in the sense that a state x therein is preferred to y by one of the parties (1 or 2) but y is preferred to x by the other party. 'Compensation' defines now an equivalence relation $\sim$ on $\mathbb{R}^2_+$. The equivalence

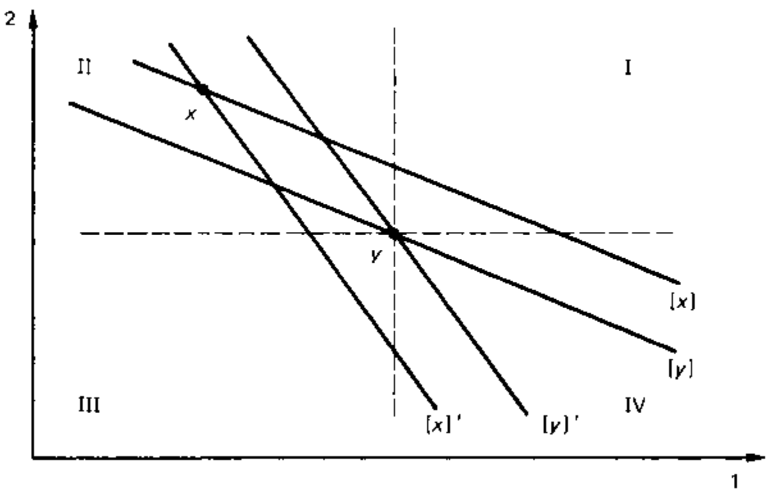

Figure 6.3 Different kinds of compensation

classes containing x or y are represented by the straight lines $[x]$ and $[y]$ respectively. The conflict between x and y is solved à la Kaldor in favor of x since $[x]$ meets the region I of Pareto superior states. One could also say that by Kaldor's compensation principle a preference on the equivalence classes $[z]$ for $z \in \mathbb{R}^2_+$ is established by which $[x]$ is preferred to $[y]$ because the former lies above the latter. Thus what is essential is an equivalence relation $\sim$ on $\mathbb{R}^2_+$ given by compensation and the preference induced on the equivalence classes by the factor relation $P/\sim$. (P the Pareto relation.) This setting makes it explicit that conflict resolution by the Kaldor principle depends on the equivalence relation $\sim$, that is on the kind of compensation assumed. In Figure 6.3 the case of a different equivalence relation $\sim'$ is shown with classes $[x]'$ and $[y]'$ for x and y respectively. Here too a clear decision between x and y is obtained. However, adopting $\sim'$ as compensation rule, y is considered to be better than x, whereas $\sim$ yields x to be better than y. Thus the kind of compensation adopted does matter. (In the corn law-example the different equivalence relations correspond to different kinds of measuring aggregate real income. Measurement as indicated in Figure 6.1a by the 45° line is just one possibility.) This dependence on the compensation rule corresponds to the problem of interpersonal comparison of utilities. It should be noted however that the setting presented does not involve any utility notion.

Being aware of the above mentioned dependence, a general formulation of compensation will be given which then in the next section is employed to also deal with individual decision making.

Consider an arbitrary (non-empty) set X of alternatives on which an equivalence relation $\sim$ together with a quasi-ordering R is given. (For the basic concepts concerning relations the reader is referred to Sen, 1970.) *Quasi-ordering* means a (binary) relation which is reflexive and transitive. Denote by $X/\sim$ the set of equivalence classes $[x]$, $x \in X$. The relation R on X induces as follows a factor relation $R/\sim$ on $X/\sim$:

$[x]R/\sim[y]$ if and only if there exist $x' \in [x]$ and $y' \in [y]$ such that $x'Ry'$.

The factor relation may be pulled back to the original set of alternatives X by

$x\widetilde{R}y$ if and only if $[x]R/\sim[y]$.

Kaldor's compensation principle fits in with $X = \mathbb{R}^2_+$, $x \sim y$ for states lying on a 45° line, R = Pareto relation. $X/\sim$ becomes $R^2_+/\sim$ which is isomorphic to $\mathbb{R}_+$ and corresponds to levels of aggregate real income. (One might say that production comes into play by taking states modulo distribution.) Finally, xKy (as defined in section 2) if and only if $[x]$ is strictly preferred to

$[y]$ in the sense of $R/\sim$. Or, equivalently, xKy if and only if x is strictly preferred to y in the sense of $\widetilde{R}$. (By the isomorphism above K corresponds to the common ordering of real numbers.)

Although R and $\sim$ are transitive relations one cannot expect $R/\sim$ or, equivalently, $\widetilde{R}$ to be transitive too. To check for transitivity the following proposition is sometimes useful. Thereby two relations R and S on a set X *commute* if $R \cdot S = S \cdot R$, the product being the common product of relations, i.e. $x(R \cdot S)y$ iff xRz and zSy for some z.

Proposition: If R and $\sim$ commute, then $R/\sim$ is transitive.

Proof: Assume $[x]R/\sim[y]$ and $[y]R/\sim[z]$, i.e. there exist $x' \in [x]$, $y', y'' \in [y]$, $z' \in [z]$ such that $x'Ry'$ and $y''Rz'$. From $x'Ry'$ and $y' \sim y''$ it follows that $x' (R\cdot \sim)y''$ and by assumption $x'(\sim \cdot R)y''$. Hence there exists some $w \in X$ with $x' \sim w$ and wRy''. By transitivity of R wRy'' and $y''Rz'$ imply wRz'. Thus $x \sim w$, because of $x' \in [x]$, $x' \sim w$, and wRz', $z' \sim z$. That is $xR/\sim z$, and $R/\sim$ is transitive.

In the approach presented a priori different equivalence classes never cross. This parallels with Kaldor's example and contrasts with the utility method discussed in section 2. Also, the approach is flexible in that the data need not be given in terms of real numbers. The above proposition applies also in Kaldor's example. It is easily seen that 'to be Pareto superior' commutes with 'lying on a 45° line'. However, a small modification of Kaldor's example may change the picture completely as shown in Figure 6.4 overleaf.

$R = P$ and the compensation rule $\sim$ being as in Kaldor's example (Figure 6.1a) the only modification is that the set X of alternatives is not the whole of $\mathbb{R}^2_+$ but consists only of those states for which a certain averaged real income ranges from some minimum level to some maximum level (what indeed may be more realistic). Figure 6.4 shows that xKy and yKz but that not xKz. Hence, other than in Figure 6.1b, K is not transitive. Moreover, even $[x]P/\sim[z]$ does not hold. Therefore the factor relation $P/\sim$ is not transitive too. (The finding about K may be expressed also by saying that $P/\sim$ is not even quasi-transitive in the sense of Sen, 1970.) Since neither $[x]P/\sim[z]$ nor $[z]P/\sim[x]$ the factor relation is not complete. In agreement with the proposition obtained P and $\sim$ do not commute, e.g. $y(\sim\cdot P)z$ but not $y(P\cdot\sim)z$.

Compared with the paradoxes discussed in section 2 within the utility framework, no pendant to Scitovsky's paradox appears if the strict relation for $R/\sim$ is defined in the usual way. Compared with the intransitivity as pointed out by Gorman, the intransitivity obtained above is without reference to utilities and occurs even in the case of one commodity only.

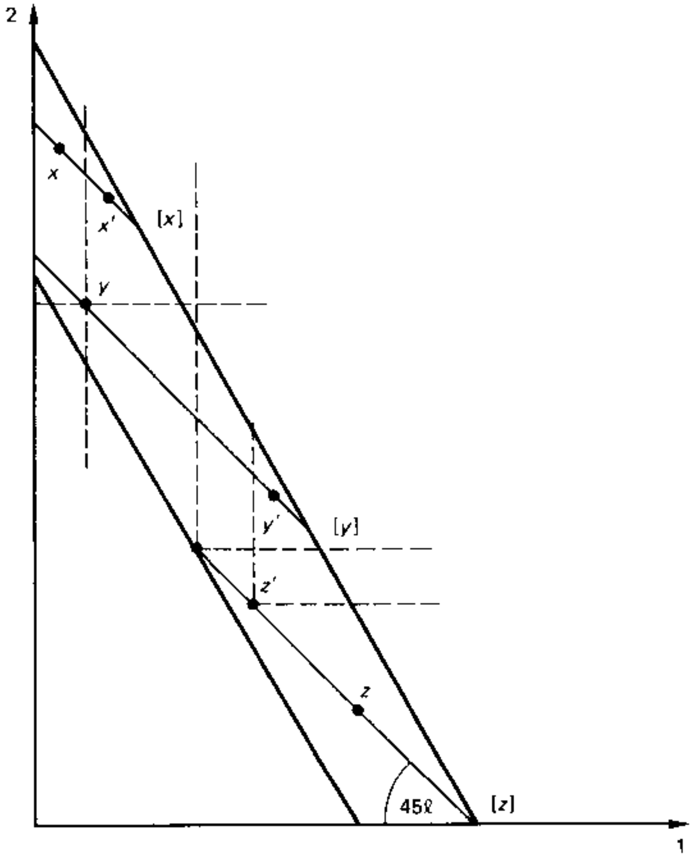

Figure 6.4 Modified Kaldor relation

4 MULTICRITERIA DECISION MAKING

The conflicts considered hitherto have been interpersonal conflicts, i.e. conflicts between different persons (or parties). Of course, of great importance are also intrapersonal conflicts, i.e. conflicts a single person is confronted with when taking decisions. In real life situations both types of conflicts will be relevant at the same time. In the following a model will be sketched briefly which has been developed in Krause (1987) and Steedman and Krause (1986) to picture an individual decision maker who takes the various aspects of the alternative options into account. (See also Yu, 1985 and the collections Jahn and Krabs, 1987, therein particularly Stadler, 1987, and Elster, 1986.) In assessing the alternatives from a set X the decision taker applies several criteria (points of view, aspects, . . .). Let $N = \{1, 2 \ldots, n\}$ be the *set of criteria*. Evaluating the alternatives only with respect to the single criterion $i \in N$ yields some quasi-ordering R_i on X. (The latter is assumed only to avoid unnecessary complications.) This leaves the decision taker with some *fixed profile* or *vector* $(R_1, \ldots, R_n)$ of quasi-orderings on X. To come out finally with decisions, the individual has to *aggregate* the different quasi-orderings R_i, $i \in N$, to get some single overall evaluation R, R being a relation on X. In case the individual manages this non-trivial task in such a way that R too is a quasi-ordering (or even an ordering) one may speak of a *rational agent*. The (quasi-) ordering R then allows the individual to choose alternatives so as to maximize according to R. Empirical evidence suggests that, to say the least, individuals cannot simply be postulated to be rational agents (cf. the contributions in Hogarth and Reder, 1987). Goethe's Faust felt two souls in his breast and it is all but obvious what Faust's overall evaluation could be. To stress the intrinsic difficulty in getting an overall evaluation in face of conflicts, the multicriteria decision maker is also called a *Faustian decision taker*. (Cf. Steedman and Krause, 1986. The difficulty to aggregate diverse aspects is related to what is discussed as 'multiple self', cf. Elster, 1986, in particular Ainslie, 1986.) Technically the above multicriteria decision problem is related to vector optimization (cf. Jahn and Krabs, 1987; Stadler, 1987) and also to social choice. (Cf. Arrow, 1963; Sen, 1970. For a discussion along with Arrow's famous Possibility Theorem see Steedman and Krause, 1986.) However, in contrast to most work in social choice theory, in the multicriteria decision problem as stated above, the preference profile is not variable but fixed. (For fixed profiles within the field of social choice see Fishburn, 1987.)

The logic of conflict in multicriteria decision making is very similar to what has been discussed in the previous sections. There appears a conflict with respect to alternatives x and y if two criteria point into different directions, i.e. if x is strictly preferred to y for some R_i and y is strictly preferred to x for some R_j. The most simple conflict occurs for *elementary preferences* (also called 'bare preference', 'marginal preference', 'basic judgement', cf. Sen, 1970). Thereby an elementary preference E is defined as follows (Krause, 1973): There exists a certain property such that xEy if and only if the property applies to x or the property does not apply to y. It is easy to see that an elementary preference is a complete quasi-ordering. A property of the elements from X may be described extensional by the set $A \subseteq X$ of all elements to which the property applies. Hence elementary preferences E on X correspond to the subsets $A \subseteq X$ via xEy if and only if $x \in A$ or $y \notin A$. The simplest form of conflict would be an *elementary conflict* where, applied to alternatives x and y, two elementary preferences

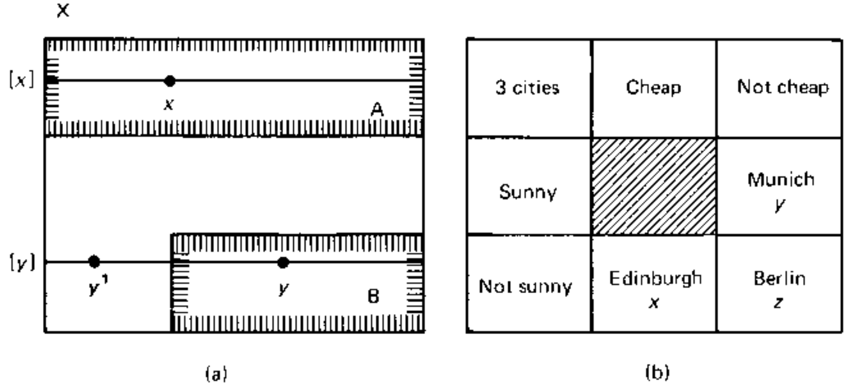

Figure 6.5 Merging alternatives

E and F point into different directions. Such an elementary conflict is shown – for illustrative reasons only – in Figure 6.5a where $B \subseteq X$ is the subset corresponding to F.

Let R denote the relation on X which holds among alternatives if and only if both E and F hold. R is a quasi-ordering that is not necessarily complete and yields no decision between x and y. Because of the conflict one might introduce according to the discussion in section 3 an equivalence relation $\sim$ on X. In Figure 6.5a two alternatives are considered to be equivalent if they lie both on a horizontal line. For the factor relation $R/\sim$ it holds that $[x]R/\sim [y]$ because of xRy'. (Of course, xRy does not hold.) But $[y]R/\sim [x]$ does not hold because neither does $[y]$ meet A nor does $[x]$ meet the complement of A. Thus, although R does not lead to a decision between x and y, the factor relation $R/\sim$ favors strictly the class $[x]$ over the class $[y]$. Or, equivalently, x is strictly preferred to y with respect to $\widetilde{R}$. It turns out that $R/\sim$ is a quasi-ordering. In examples like the above it may become difficult to check transitivity for $R/\sim$. In the above case it is simple because one easily verifies that $\widetilde{R}$ coincides with E. This process to force an issue may be considered as one of *merging alternatives*. The merging of alternatives into equivalence classes may make conflicting details vanish. The same happens in the example shown in Figure 6.5b. In that case $X = \{x, y, z\}$, E is given by the set $A = \{y\}$ of sunny cities, F is given by the set $B = \{x\}$ of cheap cities. There is obviously an elementary conflict in choosing between x and y. Merging alternatives by considering cities from the same country to be equivalent yields that $[x]$ is strictly favored over $[y]$ in terms of the factor relation $R/\sim$. (R as before the conjunction of E and F.) Namely, xRz but not yRx nor zRx. One might say the decision is taken between the 'merged alternatives', viz. the two countries, from which 'England' is chosen over 'West Germany'. This is very much the same as in Kaldor's example where higher aggregate real income is chosen over lower aggregate real income. After that choice is made the particular distribution/city can be chosen from the preferred equivalence class.

One might ask whether elementary preferences are too simple to look at. However, it is not difficult to see that any complete quasi-ordering on a finite set is in a unique manner the conjunction of finitely many elementary preferences (cf. Krause, 1973). In this sense elementary preferences can be considered to be the building blocks for preferences. In Figure 6.5 the process of merging alternatives lead to a transitive factor relation. From the general discussion in section 3, however, it is clear that this need not be the case. Indeed, even for elementary preferences the factor relation is very often not transitive. Thus, the process of merging alternatives may on the one hand resolve a particular conflict, but it may on the other hand create intransitivities. Being forced to resolve conflicts, individuals may apply some kind of compensation and in doing so create intransitivity. Possibly this is one of the reasons for the intransitivities that have been found (cf. Hogarth and Reder, 1987.) This corresponds to what has been said in section 2 about compensation. It will result from what follows that compensation principles and factor relations exhibit a certain instability. As will be pointed out in the next section an aggregation procedure for being stable in some sense needs to be lexicographic or, more generally, hierarchical.

5 HIERARCHICAL STRUCTURES IN CONFLICT RESOLUTION

It is part of the idea of compensation that different states may possibly be considered to be indifferent. In Kaldor's example all states on the same 45° line are considered to be indifferent because they all represent the same aggregate real income. It was this idea of compensation as change among indifferent states that led in section 3 to some general concept of compensation. Thereby indifference, as it belongs to compensation, was modelled as an equivalence relation given from the outside. As it turns out, 'big indifference classes' caused by compensation make compensation principles and factor relations unstable in a specific sense. To illustrate this, consider again Kaldor's example as discussed in section 2. In that particular case the indifference or equivalence relation $\sim$ is induced by a numerical function f, namely $f(x) = x_1 + x_2$ gives the aggregate real income in state $x = (x_1, x_2) \in \mathbb{R}^2_+$. Also $\underset{\sim}{R}$ for the Pareto rule R is induced by f, i.e. $x\underset{\sim}{R}y$ if and only if $f(x) \leq f(y)$. $\underset{\sim}{R}$ is unstable in the sense that a rescaling of states may reverse preference. E.g., for $x = (2,2)$, $y = (1,4)$ $f(x) < f(y)$ and hence y is strictly preferred to x with respect to $\underset{\sim}{R}$. The rescaling $r(z) = (3z_1, z_2)$ on $\mathbb{R}^2_+$, by which actually only the unit for measurement of one of the parties real income is changed, changes x and y into $r(x) = (6,2)$ and $r(y) = (3,4)$ respectively. But now $r(x)$ is strictly preferred to $r(y)$ with respect to

$\widetilde{R}$. (It is easily verified that the above reversal occurs already if only arbitrary small rescalings are admitted. It is because of this that the word 'unstable' is used.) Of course, this phenomenon is related to the dependence of conflict resolution on the compensation principle employed and to the problem of inter (or intra) personal comparison discussed in section 3. Some calculation shows that the above phenomenon is not restricted to the particular function f under consideration. The same applies to any ordering induced on $\mathbb{R}^n_+$ by a numerical function which is not trivial in the sense that it is a constant function or does depend on just one coordinate. Moreover, the instability also arises for the general concept of compensation where no numerical function is at hand (cf. Krause, 1987). Consider the general problem discussed in the previous section where an individual decision taker wants to aggregate a *fixed* set of quasi-orderings R_i, $i = 1, \ldots, n$, into one single relation R, possibly a quasi-ordering too. In what follows, different sets of alternatives X_i for different R_i will be allowed but R will be assumed to be defined on the Cartesian product X of the X_i. Elements from X will be denoted by $x = (x_1, \ldots, x_n)$, $x_i \in X_i$. Call the quasi-ordering R *stable* (with respect to the fixed profile $(R_1, \ldots, R_n)$) whenever for any four alternatives x, y, u, v from X the equivalence of $x_iR_iy_i$ and $u_iR_iv_i$ for all i entrains the equivalence of xRy and uRv; the same is required also when the R_i's and R are replaced by the corresponding strict preferences. (For quasi-orderings defined by numerical functions this notion of stability coincides with the previous one of invariance against rescaling operations provided changes of units and origins are admitted in all coordinates.) The following *result* can be proved (cf. Krause, 1987).

If each R_i possesses at least three indifference classes and if R is stable but not trivial (i.e. not all elements are indifferent), then R must be hierarchical. Thereby 'hierarchical' means some kind of generalized lexicography. To illustrate the result consider the following particular case related to the setting of Kaldor's example. Let $(X_i, R_i) = (\mathbb{R}_+, \leq)$ for $i = 1,2$ ($\leq$ denoting the usual ordering of real numbers), and hence $X = \mathbb{R}^2_+$. Suppose R is a nontrivial stable quasi-ordering on $\mathbb{R}^2_+$ which in addition has the Pareto property in the sense that $x_i \geq y_i$ for $i = 1, 2$ and $x \neq y$ implies that x is strictly preferred to y. Then by the above result, R must be one of the two possible lexicographic orderings on $\mathbb{R}^2_+$. Compared with the quasi-ordering as defined by compensation in Kaldor's example (i.e. $\widetilde{R}$ for the Pareto rule R) the only difference between the two is the stability property. The lack of stability does not mean that compensation principles are useless. On the contrary, being pressed to resolve conflicts, individuals, groups, societies, etc. have to also apply compensation principles that may range from some intuitive 'quid pro quo' to certain factor relations. The lack of stability, however, makes it clear that compensation can work only when sticking to some fixed scale. Any change in that may lead to inconsistencies, in particular to intransitivity.

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7 The Impact of the Division of Labor on Market Relations

T. Scitovsky

Lord Kaldor, or Nicky as most of us called him, was my teacher at the London School of Economics and later became a good friend. My debt to his teaching is evident from several of my early writings, which were based on ideas I first encountered in his published work and which I criticized or developed a little further. More fundamentally, I also learned from him to always focus on the facts (or as he called them 'stylized facts') of the real world and guard against being seduced by elegant theories into mistaking their simplifying assumptions for reality. Remember how he chafed against the assumption of linear homogeneous production functions underlying most economic theories, and how he tried to incorporate increasing returns to scale into growth theory.

The present paper follows in Kaldor's footsteps in so far that it rejects the assumption of perfect knowledge, which underlies general equilibrium theory, and explores the implications of specialization and the division of labor for the market behavior of buyer and seller and the market relations between them.

Division of labor and specialization lead to the fragmentation of knowledge, because they cause everybody to know more than others about their own specialty and less about other people's specialties than they know about them. Moreover, the difference between the specialist's knowledge and the non-specialist's ignorance of each economic activity increases with increased specialization, which also increases the disparity in number between the expert specialists and the inexpert non-specialists in each speciality.

Most economic activities, of course, are pursued only or mainly by the specialized experts in the field. An important exception, however, is market exchange, because the division of labor compels all of us to obtain everything we don't produce ourselves through market transactions. These therefore constitute one, perhaps the only economic activity in which specialists and non-specialists alike must participate.

The typical specialists in market exchange are merchants; their specialist expertise consists in knowing a little more than their customers about the nature and quality of the products they sell, and a lot more than they about the prices, availabilities, warranties, features, etc., of all the different brands and models of the products in their branch of business. Much of that superior knowledge they acquire simply by concluding a lot more market transactions in their own field than their customers on the other side of the market. That is why the typical market exchange is a two-person game between unequal partners, with a specialist and a non-specialist pitted one against the other.

Specialization and the division of labor therefore almost always rule out that essential prerequisite of perfect competition: all the participants' perfect and equal knowledge of market-relevant information. As just argued, specialization causes the two sides of almost all markets to have unequal knowledge of relevant market information; it is natural for those with the better knowledge, the specialists, to use their advantage for driving a better bargain. Moreover, in markets where specialization and economies of scale also create a great disparity in numbers between buyers and sellers, the specialists can best exploit their bargaining advantage by becoming price makers, setting the price and other conditions of their offer unilaterally, on a take-it-or-leave-it basis.

Competition among price makers in such markets is known as monopolistic competition. That is an unfortunate term, because it is semantically loaded and suggests a deliberate restriction of numbers and restraint of competition for the sake of monopoly profits; I believe it and part of monopoly profits to be the natural and inevitable outcome of the division of labor and economies of scale in private enterprise economies.

Moreover, monopolistic competition is also considered bad in a welfare sense, presumably because it detracts from Pareto optimality and optimal resource utilization and usually creates or enhances inequalities. Such a judgment, however, is one-sided at best, because it overlooks the many important benefits that only monopolistic competition can generate in market economies; those benefits may well offset or even more than offset the modest loss of efficiency in resource allocation and utilization that less-than-perfect competition implies. In addition, since many of those benefits accrue to the price takers who pay the price makers' monopoly profits, they also mitigate the inequities that monopoly profits create.

The benefits of monopolistic competition and limited monopoly have been described in the literature but have received scant attention, and certainly much less than they deserve. That is why in what follows I list some of them and discuss their sources and nature.

The demand curve facing the price-making seller is rendered less-than-perfectly elastic by the buyers' insufficient knowledge of market-relevant information, which enables him to set his most profitable price by adding a monopoly markup to marginal cost. Competition among price makers limits the size of that markup but cannot eliminate it completely as long as the sellers retain their superior knowledge of the market.

When he sets his price by adding the optimum markup to marginal cost, the price maker finds himself in a position in which he could further increase his profits (or diminish his losses) by increasing sales, provided he does not stimulate sales by reducing price. That situation gives him two profitable options not available under perfect competition. One is to prepare himself to cater instantly to all spontaneous increases in demand due to changes in tastes or market conditions; the other is to stimulate sales through means other than a price reduction. The first option calls for holding adequate inventories of everything he sells. The second calls for engaging in any one or any combination of the innumerable ways of attracting, pleasing and helping buyers that go under the name of nonprice competition.

I have in mind the information that advertising and window displays provide, the comfort of polite service and conveniently located, clean, pleasant, well-heated, air-conditioned stores, easy terms of payment and credit, warranties, home delivery, refunds for or exchange of returned merchandise with a smile, etc. etc. The cost to the seller of providing all those amenities must be less, of course, than the additional profit he hopes to earn with their aid, but that is not incompatible with their value to customers exceeding what they pay for them when they buy goods at prices that include a monopoly markup over marginal cost.

There are two reasons for believing that those amenities are not only profitable to provide but are beneficial to receive as well. First of all, the existence of discount houses, which sell many commodities for less than other retailers but without the above amenities, enable the public to choose between buying and not buying them along with the goods they buy. The discount houses failure to significantly encroach on the regular retailers' markets shows that most of the public is willing to buy *and pay for* those convenient amenities rather than go without them.

Secondly, the social cost of those among such services and amenities that consumers could just as well buy separately for themselves is usually lower when provided by the seller, who benefits from economies of scale. Consumer credit, for example, and the home delivery of bulky items is cheaper for the seller to provide than for each individual consumer to arrange for. Similarly, adequate inventories held by the seller are almost certainly smaller than the sum total of all the inventories each of his customers would have to hold if they could not count on getting from him all they want at a moment's notice.

Those are the benefits of nonprice competition among retailers. They are collectively known as a buyers' market and seem to have been first discussed in the professional literature by János Kornai.[1] He, however, looked upon them as symptoms of an excess of supply over demand in a perfectly competitive system out of equilibrium, although in market economies, they come about because sellers' monopolistic markups render it profitable for them to increase sales by any means other than price reductions.

We can now look at the corresponding benefits that result from producers exploiting *their* superior knowledge by assuming the price-maker's role in the markets where they sell their products. These are no less important than the benefits consumers enjoy in a buyers' market, because they comprise important inducements and facilities for technical progress and economic growth.

To begin with, producers, just like merchants, also find it profitable to stand ready instantly to cater to all surges in demand and for that purpose to invest in inventories and even some excess capacity. Not only does that enhance the economy's flexibility and resilience by speeding up adjustment to change, it also provides producers with information valuable for their investment policy. For price signals in a competitive market can indicate the need for additional capacity but provide no quantitative information on *how much* investment in added capacity would be profitable. But when price makers keep prices fixed in the short run and so cause sales and inventories to respond to changing demand, then price signals are turned into quantity signals, which are much more informative since they show not only that demand has risen but also by how much it has risen and how great is the individual producer's share in that rise. That is a point Kaldor has often stressed, especially in his Yale lectures.

As to nonprice competition among producers, it is responsible first of all for product innovation: the never ending search for novelty, the redesign of products to make them better or just different, for the proliferation of models, sizes, colors, and for the development and introduction of new products, thereby to cater to differences in taste and to anticipate the changing of fashions and the public's desire for novelty and variety. Secondly, nonprice competition is also responsible for process innovation: development of cheaper methods of production and the sale of cheaper models with undiminished profit margins. That not only raises society's real income, it also diminishes inequalities by making more generally affordable those products that previously were accessible only to the rich.

Those are the benefits of nonprice competition that favor the price takers on the other side of the market. The price maker himself also benefits, of course, and not only from the rise in the volume of his sales and profits. For nonprice competition is an important means of acquiring goodwill, strengthening customer loyalty, differentiating one's product from competing products, thereby assuring the continued flow of monopoly profits, which, as Schumpeter pointed out, is necessary to finance investment and innovation. In short, nonprice competition is the price-maker's weapon for strengthening his monopoly position and protecting it from being eroded by his competitors' actions and the entry of newcomers.

In that respect, nonprice competition has the opposite effects from price competition, which whittles down profit margins and weakens monopoly positions. Another difference between the two is that price reductions are both easily matched and *hard not to match*, involving the danger of a general reduction of prices and profit margins, whereas the subtler nature of nonprice competition and the many forms it can take render it much harder to imitate and retaliate against.

For both those reasons, price makers have a strong preference for nonprice over price competition. I mentioned earlier that the profit-maximizing price forms the borderline below which price reductions are unprofitable and nonprice competition becomes the only profitable competitive weapon. Above that price, both kinds of competition are profitable; but nonprice competition is often preferred owing to its long-run effect of strengthening monopoly positions, even when a price reduction would be more profitable in the short run. Oligopolistic pricing and competition is the prime example of that preference.

Another very important difference between the two types of competition is that between their respective welfare effects. When price competition diminishes the size of profit margins, it brings market prices closer to, and so better indicators of, marginal costs and marginal value products, thereby improving the markets' efficiency in allocating and utilizing resources and their products.

Nonprice competition has very different effects. It is likely to *worsen* resource allocation and utilization if it leads, as it well might, to higher profit margins. On the other hand, all the benefits of monopolistic competition just outlined – the amenities and services consumers enjoy in the buyers' market and the information, inducement and favorable conditions producers need for investment, innovation and growth – hinge crucially on the existence and persistence of monopolistic profit margins, and the scope for them is the greater the larger those profit margins.

It appears therefore that there is a tradeoff between the benefits of perfect competition and those of monopolistic competition. The more we have of one kind, the more restricted becomes the scope for generating the other kind. The two kinds of benefits are so dissimilar that one cannot very well weigh a little more of the one against a little less of the other; neither is there much need for it. We have to accept the shortcomings of our assymmetrical markets along with their virtues; the best we can do is to try and mitigate the shortcomings and make sure that the virtues are realized.

That has a number of policy implications. To begin with, the realization that not deliberate restraints on trade but the division of labor and the resulting difference between buyers' and sellers' knowledge is the main cause of the imperfection and asymmetry of markets greatly weakens the argument for deregulation. Secondly, the fact that monopoly is not all bad but has uses as well calls for policies designed both to secure its advantages (e.g. by patent laws) and to mitigate the inequalities it gives rise to.

Thirdly, the recognition that the welfare effects of price and nonprice competition, while different in nature, are equally beneficial, strengthens the argument for competition and against all outright and collusive restraints on competition. Finally, some public regulation is necessary to assure that nonprice competition will have *only* favorable effects on welfare.

Let me elaborate on the last two points, starting with the latter. Price makers provide information to customers by advertising, and it is clearly cheaper for those who have the information to advertise than for everyone who needs that information to ferret it out separately for him- or herself. In other words, advertising provides a social benefit. Advertisers, however, are more interested in the sales-effectiveness of the information they impart than in its truthfulness, which is why legislation for 'truth in lending' and 'truth in selling' is essential to keep them on the straight path.

As to the argument in favor of keeping competition unrestrained, either by collusive agreement or the driving or buying out of competitors, that must now be seen as a means not only to keep monopoly profits in check and prices reasonably close to costs but also to keep motivating nonprice competition and with it the creation of the benefits it generates. For the securing and prolonging of monopoly positions is a powerful motive for nonprice competition but only as long as they are in danger of being eroded and encroached upon.

The above, though a very short and incomplete summary of a large subject, should nevertheless give some idea of its nature and importance. I had no time even to touch upon the features and problems of the opposite type of asymmetrical markets, in which the buyers have the upper hand and they become the price makers. One would expect that type of asymmetry to have parallel effects to those just discussed and to lead to the creation of *sellers' markets*, in which the buyers provide important social benefits in favor of the sellers facing them. That, alas, has not happened in the most important example of such markets, the labor market, for reasons discussed elsewhere. I have also omitted any discussion of the question of whether any or all of the many valuable services and functions here discussed and attributed to nonprice competition among price-maker sellers also come about in perfect and imperfect symmetrical markets, where nonprice competition is missing.[2]

Notes

1. Cf. J. Kornai (1976), *Anti-Equilibrium: On Economic Systems Theory and the Tasks of Research* (Amsterdam: North-Holland).
2. The questions raised in this paragraph will be discussed in a forthcoming, much more detailed and complete paper on the subject.

Part III
Saving and Distribution

8 Profit Squeeze and Keynesian Theory

S. A. Marglin and A. Bhaduri*

This paper explores one aspect of the relationship between the system of production and the macroeconomic structure, namely the role of profitability in determining investment demand and the level of economic activity. Within the system of production, wages are a cost: the lower are profits per unit of production, the lower the stimulus to investment. In a Keynesian view of the macroeconomic structure, however, wages are a source of demand, hence a stimulus to profits and investment. In this view, aggregate demand provides the way out of the dilemma that high wages pose for the system of production. If demand is high enough, the level of capacity utilization will in turn be high enough to provide for the needs of both workers and capitalists. The *rate* of profit can be high even if the profit margin and the share of profit in output are low and the wage rate correspondingly high.

1 INTRODUCTION: THE UNCOMFORTABLE FACTS OF PROFIT SQUEEZE

Profit squeeze presents a problem for this Keynesian solution. How do we reconcile the argument that profit squeeze was a major cause of the decline in growth rates that took place in the 1970s with Keynesian doctrine on the role of aggregate demand in reconciling the requirements of the system of production and those of the macroeconomic structure? That is the task of this paper.

Our profit-squeeze story goes like this. First, profit squeeze is itself explained by a combination of downward pressure on productivity growth and an upward pressure on wages. As a result of a long period of high employment, productivity growth began to lag behind wage growth in the late 1960s, and this put pressure on profits. Pressure on profits in turn put a two-sided pressure on the growth rate of the capital stock. On the one hand, profits were an important source of saving, so the reduction on

* This paper is a revised and extended version of Chapter 4 of Marglin and Schor (1990). The authors thank the participants in the WIDER project on macroeconomic policy, particularly Tariq Banuri, for comments. Jong-Il You assisted with the regressions in Section 3.

profits made less income available for accumulation. On the other hand, the reduction in realized profits led business to anticipate lower profits in the future, and the fall in expected profits led to a reduction in the demand for investment. In short, high employment encouraged the growth of wages and inhibited the growth of productivity; this put pressure on profits, and the resulting pressure on profits led to a crisis of accumulation.

Basically, the Keynesian objection to this view of profit squeeze is that a higher wage should increase aggregate demand, at least under the assumption that the propensity to save out of wages is less than the propensity to save out of profits. Although higher wages may diminish profit per unit of output, business will make up the difference by an increased volume of production and sales. If investment demand increases with the rate of capacity utilization, there will be even greater aggregate demand, and both aggregate profits and the profit *rate* will be higher even as the profit *share* is lower. In this view there is no trade-off between growth and distribution. High-wage policies promote income equality, output, and growth. Policies which increase the workers' share of the pie also increase the size of the pie.[1]

This argument was a cornerstone of the 'cooperative capitalism' incorporated to a greater or lesser extent in post-World War II regimes of all the industrialized countries, and articulated in left and centre-left politics and economics until the demise of the 'golden age' in the 1970s. It is rightly thought of as Keynesian in nature since aggregate demand, or more precisely deficiencies of aggregate demand, are central ingredients of the story. But a co-operative vision of capitalism based upon stagnationist or under-consumptionist ideas long antedated Keynes, as a resolution of the Leicester framework knitters, put forward in 1817, indicates:

> That in proportion as the Reduction of Wages makes the great Body of the People poor and wretched, in the same proportion must the consumption of our manufactures be lessened.
> That if liberal Wages were given to the Mechanics in general throughout the Country, the Home Consumption of our Manufacturers would be immediately more than doubled, and consequently every hand would soon find full employment.
> That to Reduce the Wage of the Mechanic of this Country so low that he cannot live by his labor, in order to undersell Foreign Manufacturers in a Foreign Market, is to gain one customer abroad, and lose two at home. (Home Office Papers 42.160 quoted in Thompson, 1963, p. 206)

At the turn of the century J. A. Hobson attempted to systematize the under-consumptionist view, as did various others in the late nineteenth and early twentieth centuries. But it took the combination of Depression and the talent of Keynes to make the stagnationist view politically and intellectually respectable. The central point of this chapter, however, is to draw a distinction between a *theory* of a capitalist economy in which aggregate demand plays a central role, and *models* built on particular assumptions about the components of aggregate demand. It is our position that while both the general theory and specific models may hold at certain times, the models are much more bound by time and place than is a theory based on the centrality of aggregate demand. In particular, we view the Keynesian insistence on aggregate demand as an important ingredient to understanding how modern capitalism works quite generally, but the stagnationist model as very much bound to particular places and times.

2 A SIMPLE MODEL

We can present the basic ideas of this essay in terms of a reformulated aggregate demand–aggregate supply model. The reformulation consists primarily of giving a central place to income distribution in the modelling of aggregate demand. Income distribution is reflected in the sensitivity of both the demand for investment and the supply of saving to the profit share. In a second modification of the usual model, we also introduce the rate of capacity utilization z as an additional state variable. The variables π and z replace the variables P and Y in the standard model. One advantage of the present model is that it is normalized in terms that permit it to be applied to the determination of equilibrium over a longer period than the conventional macro-model defined in terms of levels of prices and outputs. Here is the model in summary form:

Accounting Identity: $r = (R/K) = (R/Y)(Y/\bar{Y})(\bar{Y}/K) = \pi z \bar{a}^{-1}$. (1)

Aggregate Demand (Investment and Saving)

Saving Function:	$g^s = (S/K) = sr = s\pi z \bar{a}^{-1}$	(2)
Investment Function:	$g^i = (I/K) = i(r^e(\pi, z))$.	(3)
Equilibrium Condition:	$g^s = g^i$	(4)

Aggregate Supply (Producers' Equilibrium)

Flexible Mark-up $\quad \pi = \pi_0 + b(z)$. (5)

In these equations, S, I, Y and K have their usual meanings, R is total profits per annum, $\bar{Y}$ is potential output, r is the actual rate of profit on the aggregate capital stock, r^e is the rate of profit anticipated on new investment, π is the *share* of profits in income, z is the rate of capacity utilization ($= Y/\bar{Y}$), $\bar{a}$ is the capital/output ratio at full capacity output, and g^s and g^i

are the growth rates of the capital stock desired by savers and investors respectively.

A few remarks are in order. As has been mentioned, the distinguishing feature of our model is the centrality of income distribution in the determination of aggregate demand. The saving function reflects the Classical (or Income Shares) Hypothesis, which assumes that all profit income is saved and all wage income is consumed.

The investment function introduced here is somewhat unorthodox, and will be discussed and defended in some detail below. Suffice it to say here that our formulation is designed to emphasize a central element of the Keynesian view of the economy: the connection between profit expectations and the existing distribution of income between wages and profits.

Although the same class is assumed to save as well as to invest, saving and investment remain separate and distinct actions. It is *not* assumed that agents, be they households, pension funds, or corporations, necessarily save in order to invest or invest only what they individually save. Passive, or endogenous, money may be assumed to bridge the gap between desired investment and effective investment demand when the economy is in a situation of excess demand.

Lastly, we should make it clear that nothing of substance hinges on our assumptions about the supply function. As in many Keynesian analyses, we assume that firms use a mark-up over wage costs to set prices, and that the mark-up varies positively with the rate of capacity utilization ($b'(z) > 0$). The alternative of competitive profit maximization also yields a positive relationship of the mark-up (and hence the profit share) with the rate of capacity utilization, at least on fairly common assumptions about the production function and the organization of markets, specifically, an elasticity of substitution of less than one coupled with competitive product markets.[2]

Before we analyse this model, it may be useful to present its geometry. This is done in Figure 8.1, where we use the profit share π and the rate of capacity utilization z as the two state variables. The schedule IS represents goods-market equilibrium as reflected in Equation (4), in which planned expenditure equals output available and there are no unanticipated changes in inventories. PE represents the supply-side equilibrium, Equation (5), where producers are satisfied with the level of wages and prices. The upward slope of the PE schedule is evident from Equation (5). The slope of the IS schedule, however, depends on the relative magnitudes of various parameters which it is the purpose of this chapter to investigate.

The stagnationist-cooperative version of Keynesian theory turns on the IS schedule having the shape it has in Figure 8.1. The essence of stagnationist co-operation can be seen through the simple comparative-statics exercise of changing the profit share at each point on PE, that is, by displacing this schedule. Imagine the consequences of a reduction in the

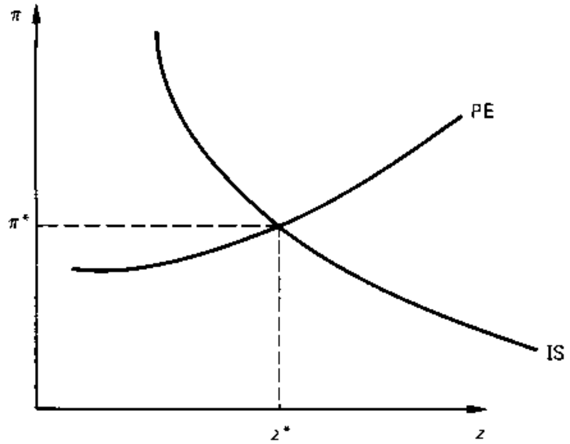

Figure 8.1 Macroeconomic outcome jointly determined by aggregate demand (IS) and aggregate supply (PE)

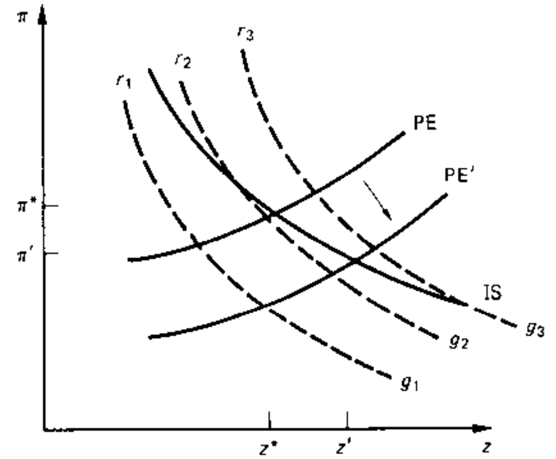

Figure 8.2 Displacement of equilibrium by an increase in real wages

mark-up, that is, an increase in the real wage, associated with each level of output. The PE schedule shifts downwards, as indicated in Figure 8.2. As the picture shows, a higher real wage leads to a lower equilibrium profit share π' but to a higher rate of capacity utilization z'.

So far the argument says nothing about the effect on the *rate* of profit, or on the rate of growth, for that matter. The essence of stagnationist co-operation is that while π' is less than π^*, r' exceeds r^* and g' exceeds g^*, where g' and g^* both refer to goods-market equilibria at which $g^d = g^s$, that is, both are points in the IS schedule. Since

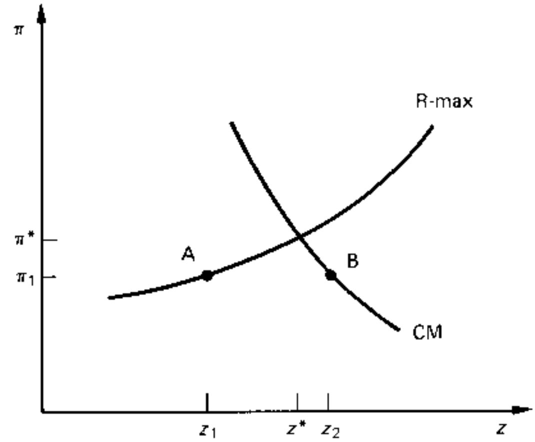

Figure 8.3 Long-run neo-Classical equilibrium

$$g^s = sr = s\pi z\bar{a}^{-1}$$

isoprofit and isogrowth contours are both rectangular hyperbolas, as indicated by the dashed lines in Figure 8.2; they differ only by the constant factor s. Thus, the analytical essence of the argument is that the IS schedule is flatter than the dashed isoquants: in this case, movement down the IS schedule increases rates of profit and growth at the same time as it increases real wages.

Evidently this theoretical argument does not square very well with the argument that profit squeeze was implicated in the demise of the golden age, and it is difficult to reject the view that wage pressure was heavily implicated in the profit squeeze that set in during the 1960s. This appears to leave us with three choices.

First, we can throw out Keynes, that is, eliminate aggregate demand from the analysis altogether, in the fashion of the neo-Classical revival that goes under various names according to time and place – rational expectations, equilibrium business cycles, monetarism, and supply-side economics. It should surprise no one that we do not take this route.

A second possibility is to follow the conventional distinction between the long and the short run and to argue that the writ of Keynes runs for the second but not for the first. In the neo-Classical analysis of the long run, as in Figure 8.3, the IS schedule simply disappears from the analysis. Equilibrium is determined by *two* supply-side considerations: one is a cleared market (CM) condition, which reflects the assumption that in the long run all markets, and in particular labor and capital markets, clear; since workers must be on their supply schedules for the labor market to clear, we may identify the CM schedule with a labor-*supply* schedule. The second consideration, represented by the schedule labelled R-max, is profit maximization. In equilibrium, price (or more generally, marginal revenue) and marginal cost must be equal; R-max is thus a labor-*demand* schedule. In this analysis, the wage and mark-up settle at levels consistent with full employment, which must be understood as a level of employment at which the marginal disutility of labor is equal to the marginal utility of the goods the worker can buy with his or her wages.

In the neo-Classical long run, unemployment can exist only if the real wage is too high, 'too high' here having two meanings. On the one hand, the wage will be too high to make it worthwhile for capitalists to hire the number of individuals corresponding to equilibrium employment: z_1, which corresponds to π_1 on the R-max schedule (at point A), falls short of z^*. On the other hand, high wages induce a greater supply of labor than is available at a profit-maximizing, market-clearing equilibrium: z_2, which corresponds to π_1 along the market-clearing schedule (at point B), exceeds z^*.

We reject the notion that fundamentally different theories apply to the short and the long period. In our opinion, despite the short-run preoccupations of Keynes and others who worked the same street (like Michal Kalecki), Keynesian theory does far more than to offer a theory of the short run. It offers a distinctive way of viewing the capitalist economy in the long run as well. The essential novelty of this approach is precisely the central role attached to aggregate demand and particularly to investment demand as a driving force of the economy. Whatever the shortcomings of this theoretical perspective, the insistence on the centrality of demand remains an enduring contribution to understanding capitalism.[3]

A third possibility for dealing with the apparent contradiction between profit squeeze and Keynesian theory is to accept the framework of the model outlined in Equations (1)–(5), and to argue that profit squeeze is the result of outward shifts of the IS schedule against a fixed, but downward-sloping, PE schedule. Essentially this is the view of Michal Kalecki (1971) and Wesley Clair Mitchell (1913), though neither couched their arguments in terms of a model like the present one.

A fourth possibility is developed here. We utilize the framework summarized in Equations (1)–(5), but we do not rely on a *cyclical* squeeze of profits of the type that would be produced by an outward shift of the IS schedule against a fixed, but downward-sloping, PE schedule. Our argument is more long-run in nature, appealing to the evolution of both the IS schedule and the PE schedule in the quarter century of unprecedented prosperity that followed World War II. The focus of our analysis is on the determinants of saving and investment.

3 INCOME DISTRIBUTION AND SAVING

The formal model developed in this paper makes the classical assumption that capital formation is financed entirely out of profits, an assumption that recalls a central feature of Nicholas Kaldor's seminal work on the theory of growth in the 1950s and 1960s (Kaldor, 1956, 1957, 1961, 1966). Since, as for Kaldor, distributional asymmetry with respect to saving plays an essential role in our model, it makes sense to examine this assumption critically. First, again in line with Kaldor, the assumption that wage income is entirely consumed is made only to simplify the exposition. The essential point is that the propensity to save out of profits must exceed the propensity to save out of wages. Were we to make the standard assumption of elementary texts that the propensity to save is uniform across income classes, it would be difficult to produce the downward sloping IS schedule on which the stagnationist model relies.

But despite the common-sense appeal of the assumption that the propensity to save out of profits is higher than out of wages, it has not found favor with the mainstream of the economics profession. Nor could it be expected to do so, since it flies in the face of the dominant theories of saving, the life-cycle and the permanent income hypotheses.

It should be recognized that the available evidence does not suggest important differences between the propensities to save out of wage and property income across households, at least not for the United States. This is partly due to shortcomings of the data, but more due to the unimportance of US household saving in the accumulation of business plant and equipment – capital in the capitalist sector of the economy. Even according to the conventions of national income accounting, American households accumulate relatively little by way of financial assets. In fact, most 'household' financial saving is attributable to pension funds, which, national income accounting conventions apart, can be lumped together behaviorally with households only if one is willing, in good neo-Classical fashion, to assume that households have the last word and are able, if they wish, to offset the positions that pension funds take (Marglin, 1984, chs 17 and 18).

Apart from pension funds, the bulk of saving for the accumulation of capital in the form of plant and equipment is done by the corporations themselves. Indeed, a contemporary specification of the Kaldorian saving function would distinguish corporations, pension funds, and households, rather than capitalists and workers. Kaldor himself espoused the logic of this position in his 1966 reply to Luigi Pasinetti's assertion that the original two-class model involved a 'logical slip' (Pasinetti, 1962) once workers were recognized to save and, consequently, to own assets.

The neo-Classically inclined will still object. Martin Feldstein (1973, see also Feldstein and Fane, 1973) has argued forcefully that households 'pierce the corporate veil', so that corporations (like pension funds) are really extensions of households when it comes to saving, taking retained earnings on their share portfolios into account when planning the division of disposable income between consumption and saving.

Feldstein presents time-series evidence to back up his theoretical claim, but the evidence is less than compelling. The problem is that consumption and retained earnings enter Felstein's regression simultaneously, so that while Feldstein interprets changes in retained earnings as the cause and changes in consumption as the effect, causality could equally well go the other way. Indeed, one of us has argued (Marglin, 1984, pp. 379–82) that it is much more plausible that causality runs from consumption to retained earnings, *via* aggregate demand and profits, the stickiness of dividends in the short run strengthening the effect of increases in consumption demand on retained earnings.

The subject remains controversial. A number of studies concur with Feldstein, but as James Poterba notes, 'The most important shortcoming of previous work . . . is the failure to treat corporate and personal saving as jointly endogenous variables' (1987, p. 498), in other words, the simultaneity problem noted in the previous paragraph in connection with Feldstein's work. Poterba's own econometrics suggest that the 'veil' is substantial: depending on the specifics of the model and the time period, he finds that a one dollar decline in corporate saving reduces private saving by 25 to 85 cents (Poterba, 1987, p. 501). At the upper limit of 85 cents – the estimate for the longer period, including the Depression as well as the postwar years – the *t*-statistic is sufficiently large (5+) that believers in this sort of econometrics might invest the results with considerable confidence.

Other recent research supports Poterba's conclusion. Edmond Malinvaud (1986, p. 120) reports a regression with French data over the period 1960–83 that suggests a propensity to consume out of wage income of 0.9 and a propensity to consume associated with corporate saving of 0.3. According to these point estimates, a one franc decline in corporate saving would decrease private saving by 70 centimes, and if this franc were transformed into wages, only 10 centimes of the lost saving would be restored. Malinvaud concludes, with characteristic *delicatesse*, 'Feldstein's proposition deserves to be examined further' (p. 120).

As Malinvaud notes, however, his regression too, run in OLS form, is dogged by the problem of simultaneity. Because of this problem, which in our view is only partially solved by the standard practice of introducing instrumental variables, we have begun research using cross-country data. Of course, other problems remain, chief of which is the difficulty of separating saving and investment. And while the research is in an early stage, preliminary results, even if taken with a huge grain of salt, may be of interest in the present context.

The results are based on regressions run with data from sixteen OECD countries, the G-7 and eight smaller European countries.[4] These regressions suggest a strong relationship between private saving and profits with saving measured by the ratio of gross saving to gross domestic product (GS) and profit by the ratio of gross operating surplus in industry, transport, and communications to value added in these sectors (GOS). A regression for the period 1960–85 gave the following results:

Regression no. 1
Averages, 1960–85

$$GS = \underset{(4.0)}{-6.3} + \underset{(0.11)}{0.82}\ GOS$$

$$R^2 = 0.78$$
$$N = 16$$

Japan, the outlier, is partly responsible for the high t-statistic, 7+, on GOS. But even without Japan, there is a high correlation between saving and operating surplus, as the following regression shows:

Regression no. 2
Averages, 1960–85 (without Japan)

$$GS = \underset{(5.4)}{-0.90} + \underset{(0.15)}{0.67}\ GOS$$

$$R^2 = 0.57$$
$$N = 15$$

Contrary to our initial expectations, introducing the average rate of growth of gross domestic product (GR, expressed as an annual percentage) does nothing for the regression:

Regression no. 3
Averages, 1960–85

$$GS = \underset{(4.8)}{-4.0} + \underset{(0.19)}{0.69}\ GOS + \underset{(0.79)}{0.69}\ GR$$

$$R^2 = 0.78$$
$$N = 16$$

But in a regression in which the overall time period is disaggregated into four sub-periods, 1960–67, 1968–73, 1974–79, and 1980–85, the two independent variables appear to have a separate and distinct influence on GS. In a pooled regression, the results are the following:

Regression no. 4
Pooled Regression

$$GS = \underset{(2.8)}{4.9} + \underset{(0.085)}{0.37}\ GOS + \underset{(0.24)}{1.36}\ GR$$

$R^2 = 0.64$
$N = 53$ (data not available for some countries in some periods)

Even apart from the fundamental problem of identifying saving and investment schedules, there are many problems with these results. One is the use of *gross* saving and operating surplus. Even though gross operating surplus is more closely attuned to cash flows than is net operating surplus, higher rates of depreciation will presumably affect GS and GOS similarly. We therefore have also run regressions with net saving (NS) and net operating surplus (NOS) as the variables. The results are somewhat disappointing, even though they still indicate a strong relationship between profit and saving:

Regression no. 5
Pooled Data With Net Saving and Profit

$$\underset{}{NS} = \underset{(3.3)}{18.1} + \underset{(0.27)}{0.61}\ NOS$$

$R^2 = 0.12$
$N = 30$

The point estimate of the profit variable still suggests a strong influence of profit on private saving, but the *t*-statistic, although still significant at the five per cent level, is well below the corresponding value for Regression No. 4. It should be noted that in this formulation the growth rate of GDP is insignificant, indeed, of the wrong sign.

All in all, the evidence gives no reason to reject the classical vision that has animated neo-Keynesian thinking about saving: until there is evidence to the contrary, it seems reasonable to assume, with Kaldor, Kalecki, and Joan Robinson, that the propensity to save out of profits exceeds that of wages.

4 THE THEORY OF INVESTMENT DEMAND

We begin with a formulation that does no violence to views as diverse as those of Jorgenson (1965), Tobin (1969), and Malinvaud (1980), with investment depending on expected profits and the cost of capital:

$$I = I(r^e, \sigma), \tag{6}$$

where I and r^e are defined as before and σ represents the real (inflation corrected) rate of interest. This formulation however raises more questions than it answers. First, there is the problem of normalization: if Equation (6) is supposed to hold over a period longer than the Keynesian short period, in which the capital stock is fixed, it must be normalized to reflect growth in the scale of the economy: assuming the basic structural relations remain the same, given values of r^e and σ can be expected to induce twice as much investment demand when business has doubled in size.

But how do you measure the 'size' of business? By the capital stock, or by output, or by profits? This, of course, is an unimportant issue as long as the economy is on a balanced growth path, for by definition all economic magnitudes then expand proportionately. But what if the capital/output ratio or the profit share change? In this case the choice of one normalization or another implies a theoretical assertion about the investment function, namely that for given levels of its arguments, the level of aggregate investment demand is more likely to be stable as a ratio to one magnitude rather than another.

Despite its theoretical interest, we shall elide this issue, choosing a normalization on the basis of simplicity and convention. On this basis, the capital stock is the obvious choice, and accordingly we shall assume that investment demand per unit of the capital stock is a stable function of r^e and σ. Thus in place of Equation (6) we have

$$\frac{I}{K} = i\,(r^e, \sigma),$$

or writing $g^i = I/K$ as the rate of growth of the capital stock desired by investors,

$$g^i = i\,(r^e, \sigma). \tag{7}$$

We shall simplify even more, by eliminating σ from the investment demand function, so that Equation (7) becomes

$$g^i = i\,(r^e). \tag{8}$$

We make this simplification not because we believe there is good theoretical reason for investment demand to be totally insensitive to the cost of capital, but because our focus lies elsewhere. Besides, it is a fact that over most of the period with which we are concerned, from 1945 to 1980, real interest rates exhibited very little trend, and indeed hovered near zero, despite the pronounced movement in nominal rates. Over the same period, actual profit rates, and presumably expected profit rates, showed considerable movement. Thus, in trying to understand the behaviour of investment during the golden age and its demise, it makes empirical as well as theoretical sense to focus the analysis of investment demand on profit expectations.

The very notion of an expected rate of profit raises important conceptual problems. Although the adjective 'expected' suggests the mean of a probability distribution, the terminology of probabilities must be used very cautiously. For it is of the essence of the Keynesian view of investment that the future is *uncertain*, which is to say not only that it cannot be known precisely but that it lies beyond the grasp of a probabilistic calculus; the outcomes of investment decisions are fundamentally unlike the outcomes of roulette, to a calculus of which (following Knight, 1921) the term *risk* applies.

From a Keynesian point of view, the neo-Classical blurring of this distinction by means of the device of subjective probabilities is problematic, for it obscures an essential difference between investment decisions and other kinds of economic behaviour. There are of course serious problems with the very idea of subjective probability. As Ellsberg (1961) and more recently Kahneman *et al.* (1979) have demonstrated, untutored individuals stubbornly refuse to obey the axioms of probabilistic decision-making as laid down by de Finetti (1937) or Savage (1954). But with due caution the idea of subjective probability provides a useful heuristic for describing the investment-decision process. It has the great merit of emphasizing the state of mind of the investor as a crucial determinant of investment demand.

Indeed the problem with using subjective probabilities lies less in the concept itself than in its customary neo-Classical bedfellow, namely the assumption that the world works as if the markets required to extend neo-Classical general equilibrium theory to an uncertain world – the 'contingent commodity markets' introduced by Arrow (1953) and developed by Arrow and Debreu (1954) and Debreu (1959) – actually exist. For the existence of such markets would have the effect of eliminating the investor's state of mind from the investment-decision process. Indeed with complete markets for contingent commodities over the investment horizon, there would never be any need for an investor to hold physical capital to back his or her hunches about the future.

In fact, the inherent uncertainty that surrounds the outcome of any investment together with the absence of contingent commodity markets makes capital markets and capital accumulation fundamentally different from other economic processes. Many writers, both outside and within the mainstream of the economics profession (for example, Keynes, 1936, pp. 144–5; Minsky, 1986, pp. 190–2; Stiglitz and Weiss, 1981) have recognized this fundamental truth and at least some of its implications, for instance in the area of adverse selection and moral hazard. But it is much less widely accepted that the imperfections inherent in capital markets require more than marginal changes in neo-Classical theory, indeed, require a significantly different theory of how a capitalist economy functions in the long run as well as in the short (Marglin, 1984; Gintis, 1989).

In the Keynesian view, or at least in our 'neo-Keynesian' variant, the argument of the investment-demand function, r^e, is heavily influenced by the subjective probabilities, or state of confidence (to use an older terminology), of the capitalist class. So is the investment-demand function $i(r^e)$ itself. In the absence of contingent commodity markets, capitalists play out their intuitions about the future prospects of the economy through their willingness to add to the stock of productive capital. This assumption is key to the unique role and power that businessmen have, in the neo-Keynesian scheme of things, to shape the course of capitalist development.

In our model, the expected rate of profit depends upon the actual profit share and the rate of capacity utilization, as in Equation (3)

$$g^i = i(r^e(\pi, z)). \tag{3}$$

The first of these variables measures the return to capitalists on condition that goods can be sold; the second, an 'accelerator' variable, reflects the impact of demand conditions. The partial derivatives of expected profit with respect to each variable can plausibly be argued to be positive: a higher profit share and a higher rate of capacity utilization can each be argued to induce higher profit expectations, the first because the unit return goes up, the second because the likelihood of selling extra units of output increases.

5 THE IS SCHEDULE

It should be noted at once that the shape of the IS schedule in Figures 8.1 and 8.2 is *not* guaranteed by the formulation of investment demand summarized in Equation (3). With the saving function defined by

$$g^s = s\pi z\bar{a}^{-1} \tag{2}$$

and the IS schedule defined by Equation (4)

$$g^i = g^s, \tag{4}$$

we have

$$i(r^e(\pi, z)) = s\pi z\bar{a}^{-1} \tag{9}$$

and

$$\frac{d\pi}{dz} = \frac{s\pi\bar{a}^{-1} - i_z}{sz\bar{a}^{-1} - i_\pi}, \qquad (10)$$

where

$$i_\pi = \frac{di}{dr^e}\frac{\partial r^e}{\partial \pi} \text{ and } i_z = \frac{di}{dr^e}\frac{\partial r^e}{\partial z}.$$

The shape of the IS schedule depends on the sign and magnitude of both the numerator and the denominator of Equation (10), but the qualitative structure of the model, which tells us only that i_π and i_z are positive, provides insufficient information to determine even the sign, not to mention the magnitude, of either expression. At issue is the relative responsiveness of desired investment and desired saving to π and z.

A stagnationist regime, one in which (by definition) a lower profit share is associated with a higher level of economic activity, is characterized by a downward-sloping IS schedule: in this case, the expressions $s\pi\bar{a}^{-1} - i_z$ and $sz\bar{a}^{-1} - i_\pi$ have the same sign. In 'exhilarationist' regimes, a higher profit share goes along with a higher level of activity: the IS curve has a positive slope, which is to say the numerator and denominator on the right-hand side of Equation (10) are of opposite signs.

Under what conditions can we specify these signs? In much conventional macroeconomics the numerator is assumed to be positive for reasons of stability. The condition

$$s\pi\hat{a}^{-1} - i_z > 0 \text{ [Keynesian Stability]} \qquad (11)$$

says that at the margin saving is more sensitive than investment to capacity utilization, and this is the standard guarantee of the stability of equilibrium in elementary versions of Keynesian theory. It is tantamount to the condition that the saving schedule be steeper than the investment schedule in a textbook diagram like Figure 8.4. If Condition (11), which we shall refer to as the 'Keynesian Stability Condition', were not to hold, changes in capacity utilization would induce more investment than saving, and any disturbance would set off a cumulative movement away from the initial equilibrium – the multiplier would magnify the initial excess or deficiency of aggregate demand and the process would end only at full capacity utilization or at zero output.

But the Keynesian Stability Condition, though standard in the texts, is necessary for stability only in a model which abstracts from all determinants of equilibrium but the level of output, and in particular, one which abstracts from the impact of the distribution of income between wages and profits on investment and saving.

Once the variable π enters into investment and saving functions, the

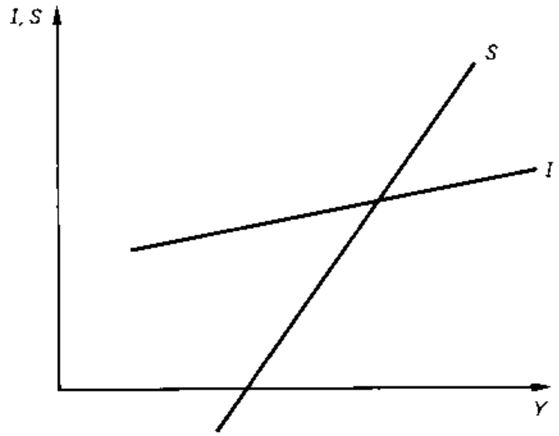

Figure 8.4 A stable equilibrium assured by saving (S) being more responsive than investment (I) to changes in output

Keynesian Stability Condition is not logically required to ensure that displacements from equilibrium are self-correcting. Moreover it is empirically plausible that over some portion of a $z \times \pi$ space investment will be more sensitive than saving to capacity utilization, in violation of the Keynesian Stability Condition.

However, even if there were adequate grounds for assuming the Keynesian Stability Condition, this would hardly clinch the issue. The slope of the IS schedule depends on the sign of the denominator of Equation (10) as well as on the numerator. If the Keynesian Stability Condition holds, then the inequality

$$sz\bar{a}^{-1} - i_{\pi} > 0 \text{ [Robinsonian Stability]} \tag{12}$$

makes $d\pi/dz$ negative and the IS schedule is stagnationist. If the inequality in (12) is reversed, the IS schedule is exhilarationist.

We shall refer to Condition (12) as the 'Robinsonian Stability Condition' because of the role this inequality, or something very much like it, plays in certain long-period formulations of Keynesian theory that drew inspiration from Joan Robinson's work (1956, 1962), particularly Harris (1978), Roemer (1978), and Marglin (1984). In these models, as in the present model, prospective profits are supposed to drive investment, but the expected rate of profit is assumed to depend on the current rate of profit alone. The model is closed by appealing to a form of rational expectations justified by the long-run context of the theory: in equilibrium the expected rate of profit r^e and the actual rate r are assumed to be equal. Robinsonian

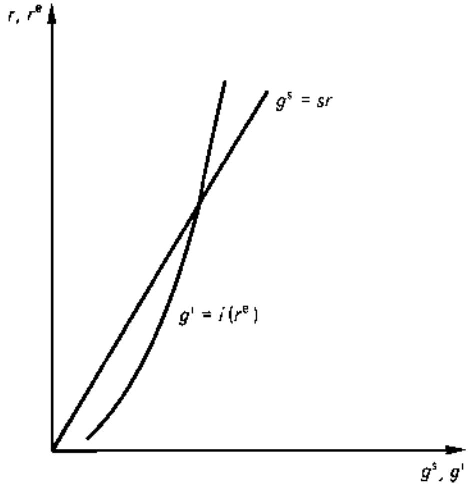

Figure 8.5 Robinsonian stability assured by saving being more responsive than investment to changes in profitability

equilibrium is pictured in Figure 8.5; in the diagram, stability of equilibrium is assured by the assumption that saving is more responsive than investment to changes in profitability (Marglin, 1984, ch. 4, where the model is called 'neo-Keynesian').[5] In effect, the Robinsonian Stability Condition plays the same role in the long-run model that the Keynesian Stability Condition plays in the short-run model.

However, this line of argument is also problematic. The present model describes a longer run than the textbook short run in which capacity utilization is the sole adjusting variable, but its time frame is shorter than the Robinsonian long run in which rational expectations can be invoked to identify the expected rate of profit with the actual rate of profit. In our model there is no assumption that the rate of profit on new investment is equal to the actual rate of profit overall. Quite the contrary: in our time frame, the two rates will normally diverage. In this context, π and z play separate roles, and the single-variable Robinsonian Stability Condition cannot simply be assumed on the grounds that otherwise centrifugal forces would dominate the dynamics of the model.

We can however *derive* rather than assume the Robinsonian Stability Condition, provided we are willing to assume both the Keynesian Stability Condition and a condition we shall refer to as the 'Strong Accelerator Condition'. This last appears to be innocuous enough, requiring us to assume only that an increase in the rate of capacity utilization will, at a given *rate* of profit (as distinct from a given profit *share*), increase the expected rate of profit r^e. Write the investment demand function as

$$g^i = i(r^e(\pi, z)) = h(r^e(r, z)) \tag{13}$$

with the functions i and h connected by the accounting identity

$$r = \pi z \bar{a}^{-1}. \tag{1}$$

It is then straightforward to show that if the inequality

$$h_z = -i_\pi \frac{\pi}{z} + i_z > 0 \text{ [Strong Accelerator]} \tag{14}$$

holds along with the Keynesian Stability Condition, the Robinsonian Stability Condition holds as well.[6]

Indeed, we can prove a stronger result, namely that the IS schedule is flatter than the iso-profit curves, so that, as in Figures 8.1 and 8.2, the regime is *co-operative* as well as stagnationist. That is to say, a decreasing profit share goes along with a higher profit *rate* (and growth rate) as well as with a higher wage bill. The essence of a stagnationist-cooperative regime is that

$$0 > \frac{d\pi}{dz} > -\frac{\pi}{z} \tag{15}$$

which follows from Conditions (11) and (14).[7]

The problem with this line of argument is that it rests on a very weak premiss. It has already been noted that the Keynesian and Robinsonian Stability Conditions cannot be carried over to the present model from the single-variable models in which only capacity utilization or the profit share vary. With respect to the Strong Accelerator Condition, the issue is more complicated. Despite its incorporation into many neo-Keynesian formulations of investment demand (e.g. Rowthorn, 1982; Taylor, 1985), it is by no means certain or even especially likely to be the case that an increase in the rate of capacity utilization will induce additional investment when the profit rate is held constant. The reason is a simple one: if the rate of capacity utilization increases while the rate of profit remains constant, it *must* be the case that the profit margin and share fall. So the effect on investment is the resultant of two forces: the positive impact of higher capacity utilization and the negative impact of lower unit profits. Mathematically h_z is the difference between i_z and and $i_\pi(\pi/z)$, and the qualitative structure of the model gives us no grounds for asserting anything about the relative magnitude of the two terms. This is to say that in a linear approximation of the form

$$g^i = \alpha r + \beta z = \alpha \pi z \bar{a}^{-1} + \beta z \tag{16}$$

the sign of β, where $\beta = h_z$, is indeterminate. It requires a belief in rather strong capacity utilization effects to argue that β is positive.

This belief would be justified if the prime concern of capitalists is whether or not they can sell additional output. In this case the capacity utilization effect may be expected to dominate, and the partial derivative h_z will be positive. If, however, capitalists are confident of their ability to sell extra output, and are concerned rather with their profit margin, the negative, profit share, effect will dominate, and h_z will be negative. One might 'rationally' except the capacity utilization effect to be stronger at low levels of capacity utilization, but the subjective aspect of expectations makes it possible that some or even a large number of capitalists will be confident about their ability to sell their output even when the overall rate of capacity utilization is relatively low. In short, the sign of h_z is an empirical matter about which we are not in a position to make *any* categorical assertion.

As a consequence of the lack of conditions which allow us to attach definite signs to the numerator and denominator of Equation (10), both stagnationist and exhilarationist regimes – downward and upward sloping IS schedules – are possible. Indeed the slope of the IS schedule can change signs in various ways. For instance, it is possible that the IS schedule will have the shape of a 'C', as in Figure 8.6. Observe that in such a case there are two routes to high capacity utilization: one follows the stagnationist logic of higher wage shares, while the other follows the exhilarationist logic of higher profit shares. As Figure 8.6 is drawn, neither stagnationist nor exhilarationist policy is 'wrong'. Either a policy of a high wage share or one of a high profit share, pursued consistently and aggressively, will provide sufficient aggregate demand for high employment and high capacity utilization. In this situation the fatal error is moderation: a compromise of middling wages and profits will provide the worst of possible worlds, in which low capacity utilization and low growth become the order of the day.

However, if high wage and high profit shares are each consistent with high capacity utilization, the implications for growth and distribution of the two strategies are very different. An exhilarationist outcome like A, representing the pair $< z_1, \pi_2 >$ is more favourable for capitalists and less favourable for workers (at least in its immediate consequences) than a stagnationist outcome like B, which represents $< z_1, \pi_1 >$: the point is that π_2 exceeds π_1. And not only does a higher profit share map to a higher profit rate for a given z; since investment and saving are both positive functions of the profit share, the exhilarationist outcome is more favourable for growth as well as for profit. (Thus the long-term consequences for workers are more favourable than the short-term ones.)

The coexistence of exhilarationist and stagnationist branches sharpens the point made at the outset of this chapter, that to reject the policies inspired by a stagnationist reading of Keynes does not require one to reject the Keynesian framework of analysis. One need not reject the theory, as

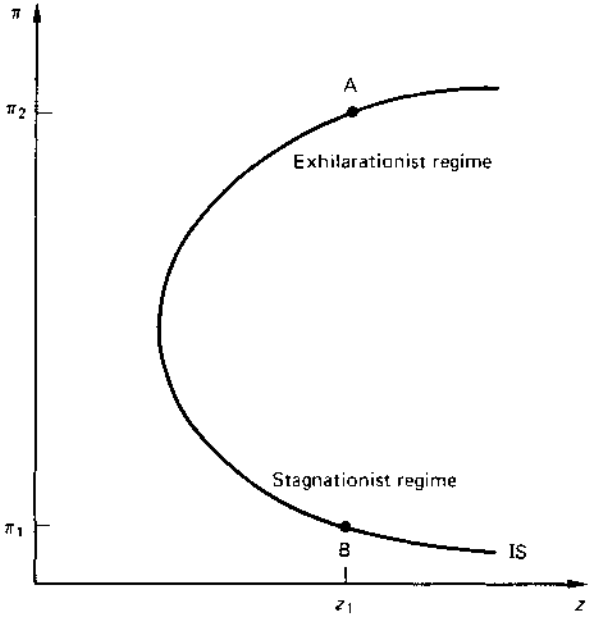

Figure 8.6 A 'C'-shaped IS schedule with stagnationist and exhilarationist branches

critics from Viner (1936, see especially pp. 162–3) to modern monetarists, supply-siders, and enthusiasts of rational expectations and equilibrium business cycles have done, or limit its applicability to the short period, as the mainstream has done, in order to reach neo-Classical conclusions about the relationship between wages, profitability, growth, and the level of economic activity. The programme of a Margaret Thatcher, which is usually justified in terms of one version or another of neo-Classical theory, also makes logical sense as an attempt to move the British economy from a stagnationist regime to an exhilarationist one. One may agree or disagree with the implicit assumptions about the energy of the British capitalist class, but this justification of Thatcherism is more plausible than one based on the presuppositions of monetarism and supply-side economics.

An alternative to Figure 8.6 is the 'U'-shaped IS schedule presented in Figure 8.7, in which stagnationist logic governs at low levels of capacity utilization and exhilarationist logic at high levels of capacity utilization. In the situation described by Figure 8.7, high wages would be appropriate to combat a severe depression, for in this case it is plausible that private investment demand would be weak. But continuation of high-wage policies may be inappropriate at higher levels of capacity utilization, as profit prospects stimulate capitalists to high levels of investment demand. Economists whose imaginations were formed and limited by the background of

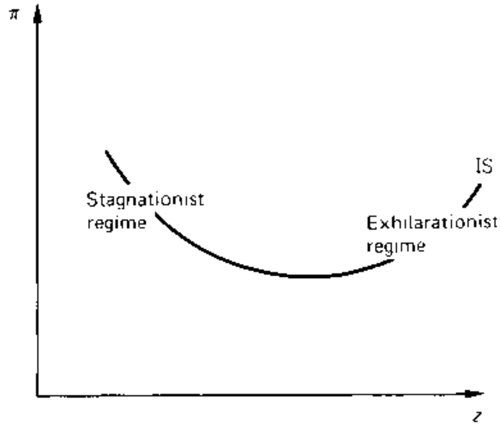

Figure 8.7 A 'U'-shaped IS schedule with stagnation and exhilaration dependent on capacity utilization

depression from which Keynesian theory emerged might easily fail to see that the theory transcends its background. Temperamentally, economists as well as generals are better equipped to fight the last war than the next one.

6 CO-OPERATION AND CONFLICT

So far we have emphasized the distinction between stagnationist and exhilarationist regimes, but we have also had occasion to distinguish between co-operative and conflictual regimes, regimes in which workers and capitalists have a common interest in expansion and regimes in which one class or the other loses from an increase in the level of capacity utilization. If the class interest of workers is identified with the size of the wage bill and the class interest of capitalists with the profit rate (or equivalently – since the capital stock is fixed in the short run – with aggregate profits),[8] then the exhilarationist as well as the stagnationist regime is a co-operative one provided the IS schedule is sufficiently flat. That is, a flat IS schedule, whether upward or downward sloping, will exhibit a positive relationship between capacity utilization and *both* the wage bill and the profit rate.

For the stagnationist regime, this result has already been demonstrated: the wage rate and employment, as well as the profit rate, increase as capacity utilization increases – provided the IS schedule is flatter than the isoprofit curve described by rectangular hyperbolae of the general form $r = s\pi z\bar{a}^{-1}$, in other words, provided the elasticity restriction described by

Condition (15) is met. Condition (15), we have seen, is guaranteed by Keynesian and Robinsonian Stability Conditions, or by the first of these conditions along with the Strong Accelerator Condition. In other words, sufficient conditions for a co-operative *and* stagnationist regime are the 'standard' stability condition that saving responds more strongly to changes in capacity utilization than does investment and the 'innocuous' assumption that the response of investment to capacity utilization, holding the rate of profits constant, is positive.

A similar elasticity restriction applies to the exhilarationist regime. By the very definition of exhilaration, the profit share increases with capacity utilization, so it only remains to establish the conditions under which the wage bill does too. Denote the wage bill by Ω and write

$$\Omega = (1 - \pi)\, z\bar{a}^{-1} K.$$

Then we have

$$\frac{\partial \Omega}{\partial z} = \left[-z\bar{a}^{-1}\frac{\mathrm{d}\pi}{\mathrm{d}z} + (1 - \pi)\,\bar{a}^{-1} \right] K.$$

$$= \left(1 - \pi - z\,\frac{\mathrm{d}\pi}{\mathrm{d}z} \right) \bar{a}^{-1} K.$$

For positive $\mathrm{d}\pi/\mathrm{d}z$, $\partial\Omega/\partial z$ is also positive provided

$$\frac{1 - \pi}{z} > \frac{\mathrm{d}\pi}{\mathrm{d}z}\,. \tag{17}$$

In short, the distinction between co-operative and conflictual regimes refers to the *elasticity* of the IS schedule. By contrast, the distinction between stagnationist and exhilarationist regimes refers to the *slope* of the IS schedule.

Together these two characteristics of the IS schedule characterize wage-led and profit-led growth regimes. A flat and downward-sloping schedule – the intersection of co-operative and stagnationist regimes – describes a wage-led growth regime, a result which follows immediately from the definition of wage-led growth as one in which a higher wage share is associated with a higher rate of accumulation. In a world where accumulation depends on profits, this requires a higher rate of profit. Such a conjuncture is at once *stagnationist* (since under present assumptions the only way a higher wage share can induce a higher rate of profit is by increasing the rate of capacity utilization) and *co-operative* (since the wage share and the profit rate move together). Every other combination of elasticity and slope corresponds to profit-led growth. The stagnationist-

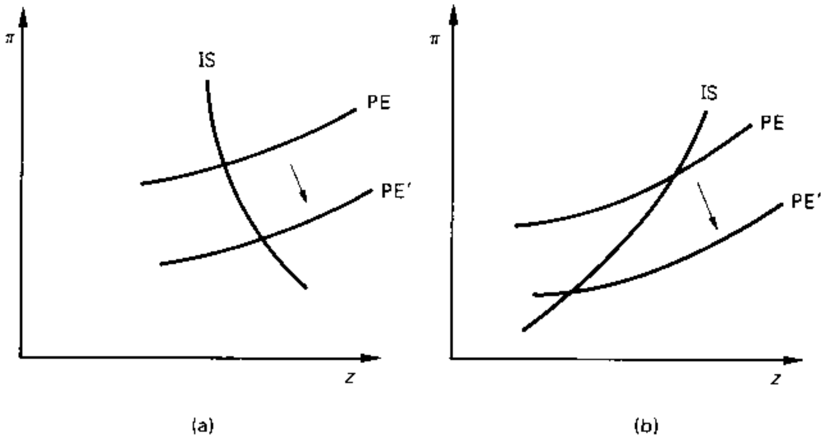

Figure 8.8 High-employment profit squeeze: (*a*) a steep, downward-sloping IS schedule; (*b*) an upward-sloping IS schedule

conflictual regime is exceptional in that higher growth and profit rates are achieved at lower rates of capacity utilization. The other two profit-led regimes, which correspond to an exhilarationist IS schedule, are like the stagnationist-cooperative regime in that higher profit and growth rates go along with higher capacity utilization rates.

Enough of taxonomy: it must be recognized that all discussion of the shape of the IS schedule is necessarily hypothetical. The truth is that we know relatively little about its shape even in the neighbourhood in which the economy has actually been operating and even less about its global shape; it is a matter of pure conjecture what investment and saving propensities would be at levels of profit and capacity utilization far removed from those that have obtained in recent history. Nevertheless, we believe that the historical experience of the golden age suggests some general conclusions about the shape of the investment function at least during the 1960s and early 1970s. The key is that wage pressure squeezed profit rates as well as profit margins, a fact inconsistent with a wage-led growth regime. To explain profit squeeze within our framework compels the conclusion that the IS schedule was highly inelastic or upward sloping (or both), that is, either that the economy was in a conflictual-stagnationist regime, as in Figure 8.8*a*, or in an exhilarationist regime, as in Figure 8.8b. The first possibility seems the more likely if we assume that the immediate post-war period was a time in which the assumptions of wage-led growth held, for the IS schedule need only have shifted from being relatively flat to being relatively steep in order to bring about the conditions of profit squeeze.

7 PROFIT SQUEEZE IN A KEYNESIAN PERSPECTIVE: FROM CO-OPERATION TO CONFLICT

Here, we believe, is how investment demand evolved over the period 1945–80. In our formulation of $i(r^e(\pi, z))$, there are two steps in the mapping from $<z, \pi>$ to I/K; investment demand depends on r^e, and r^e depends on z and π. To recapitulate, the step from $<z, \pi>$ to r^e reflects the idea that expected profitability depends both on the likelihood of additional capacity being justified by demand conditions, and, assuming the output can be sold, on the profit margin. The step from r^e to I/K reflects pure 'animal spirits', which according to Keynes, 'urge to action rather than inaction' (see Keynes, 1936, ch. 12).

It is difficult if not impossible to make a strict separation between the factors which influence one component or the other of the overall mapping from $<\pi, z>$ to I/K. Some variables, like the cost of capital, the fiscal structure (particularly profit taxes and depreciation allowances), and perhaps the full capacity capital/output ratio, may be analyzed more in terms of their effect on the mapping from $<\pi, z>$ to r^e than in terms of their effect on the mapping from r^e to I/K. But factors of a more political, social, and cultural character, like the state of class relations or the state of confidence in the international financial system, cannot be neatly compartmentalized.

All these and other considerations were important to the evolution of investment demand over the post-war period. As has been observed, those who embraced Keynes and saw aggregate demand as the key to prosperity were deeply influenced by the depression of the 1930s. Many Keynesians saw the Great Depression as the direct consequence of the unevenness of prosperity in the 1920s. In the United States, for example, profits grew much more rapidly than wages over the 1920s, and even Keynesians not completely given over to the gospel of wage-led growth believed that the decline in the wage share had led to a shortfall of demand, which in turn led to the pre-war crisis.

In general Keynesians thought it extremely unlikely that private investment demand would play a very active role in the post-war economy. Even if prosperity were 'artificially' maintained by deficit spending, as Keynesians urged, the memory of the Depression and the fear of another would inhibit business from responding to a high profit share with heavy spending on plant and equipment, at least in the short run. Once burned, twice shy. The remedy for the post-war period was seen as lying in a distributional balance tilted towards wages. In short, stagnationist and co-operative logic were coupled to produce a policy of wage-led growth, particularly in the United States.

This may have been a correct diagnosis of the situation immediately after World War II. Profit margins were high practically everywhere in the capitalist world, higher than before the war broke out (Japan being an exception). In the United States the productivity gains of the better part of a decade had yet to be translated into higher real wages, and in war-torn Europe real wages had declined by more than had productivity. Profit margins improved well into the 1950s.

But lacking confidence in the future, fearing that depression, which was widely predicted as the 'natural' aftermath of war, would make additional capacity redundant, capitalists were initially reluctant to commit themselves to new plant and equipment. Investment, in short, was not very responsive to the current profit margin; in our terminology pre-war history had an adverse impact on the mapping from the *current* level of the profit share to the anticipated profitability of investment. Under these circumstances, the IS schedule may well have sloped downwards and been relatively flat; the strategy of wage-led growth may have been the best – indeed, the only – game in town.

Wage-led growth would have benefited capital as well as labor. The same history that made the prospective rate of profit and hence investment demand unresponsive to π would increase responsiveness to z, the more so if a high level of capacity utilization could be maintained for a substantial period of time. At the very least, increasing wages would allow capitalists to earn the same rate of profit – if the increase in volume only made up for the reduction in unit profits.

It is a plausible conjecture that the gospel of co-operative capitalism was a sensible one for the particular circumstances of the immediate post-war period. But as time passed, profit margins remained high and even improved; more important, the anticipated depression never materialized. The consequence was that prospective profits increased even more than actual profits: the mapping from $\langle z, \pi \rangle$ to r^e shifted outwards. And the derivative i_π increased more than did the derivative i_z. Finally, even if the Strong Accelerator Condition held initially, it need not have continued to hold. And once the prospective rate of profit became sufficiently responsive to the profit share to reverse the inequality of the Strong Accelerator Condition, that is, once

$$i_\pi \pi > i_z z,$$

the IS schedule no longer was consistent with a co-operative regime, even if stagnation remained the order of the day.[9]

That is what we believed happened over the first phase of the golden age, over the 1950s and into the early 1960s. The shift in the IS schedule is pictured in Figure 8.9. The 1960s were by and large a period of great prosperity, but beginning in the late 1960s, when the productivity-growth slow-down and wage acceleration began to displace the PE schedule downwards, the equilibrium moved down the new, conflictual IS schedule,

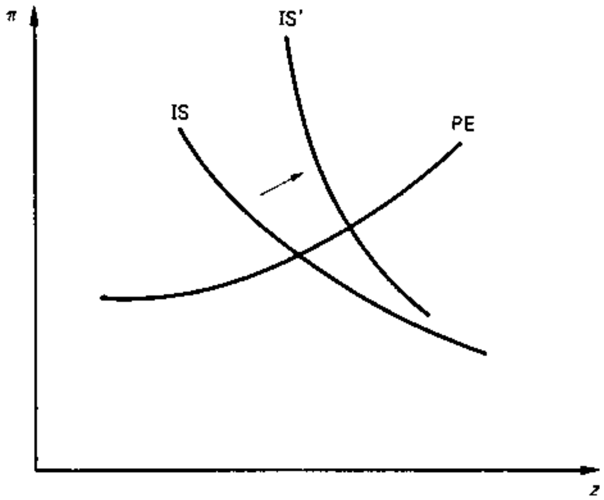

Figure 8.9 Movement of the IS schedule over the 1950s and 1960s

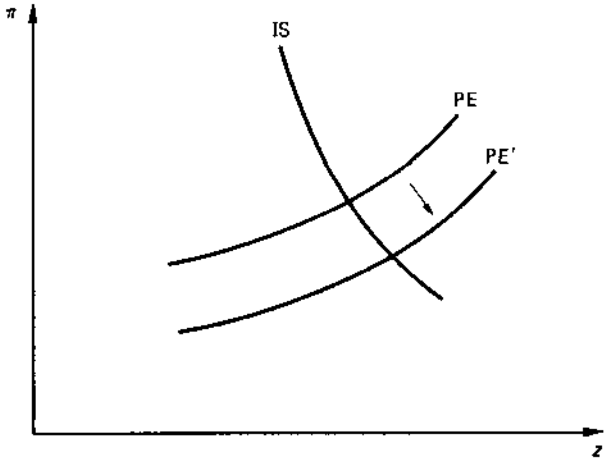

Figure 8.10 A crisis in two parts: movement of the PE schedule in the late 1960s and early 1970s

as in Figure 8.10. The result was a modest increase in the rate of a capacity utilization, but a fall rather than a rise in the rate of profit. Table 8.1 documents this fall in profits.

If this were all that happened, the rate of growth of the capital stock should have fallen as well; given our formulation of saving, capital-stock growth is directly proportional to the profit rate. In fact, the growth rate continued high well into the 1970s, as Table 8.2 shows. Apparently the

Table 8.1 Corporate business net profit rate, 1951–83[a], per cent

Year	ACC[b]	ACC–US	Europe[c]	Canada	France	Germany	Italy	Japan	UK	US
1951	17.5	14.6	14.8	12.4	10.3	21.7	15.0	15.2	12.9	20.2
1952	15.9	14.8	15.1	12.6	9.0	24.8	13.7	14.2	12.6	17.0
1953	15.4	14.9	15.0	11.5	8.6	24.0	13.2	18.9	13.0	15.9
1954	14.7	15.0	15.3	9.4	9.0	23.3	14.3	19.9	13.6	14.5
1955	14.4	16.0	16.2	12.9	9.3	25.8	14.2	18.3	13.9	13.0
1956	15.6	15.6	15.8	13.2	9.5	24.9	14.3	18.3	12.7	15.5
1957	14.7	15.7	15.8	10.6	10.8	24.4	13.8	22.5	12.3	13.8
1958	13.1	14.8	15.1	9.1	10.5	22.5	14.3	20.3	11.6	11.6
1959	15.0	15.3	15.7	9.4	9.8	23.2	15.5	20.4	12.3	14.7
1960	14.9	16.3	16.5	8.8	11.2	22.9	16.6	25.7	13.5	13.5
1961	14.4	15.2	14.9	8.9	11.0	20.2	16.2	26.4	11.2	13.6
1962	14.9	14.1	13.6	9.3	10.2	18.0	14.8	24.3	10.4	15.7
1963	15.2	13.7	13.0	9.9	10.4	16.2	12.6	23.3	11.4	16.9
1964	16.0	14.1	13.3	10.7	11.4	17.0	10.4	23.3	11.8	18.2
1965	16.7	13.8	13.2	10.0	11.6	16.5	11.9	21.4	11.2	20.0
1966	16.4	13.5	12.6	9.7	11.9	15.1	12.8	23.0	9.8	19.8
1967	15.6	13.8	12.5	9.6	12.6	14.3	13.4	26.3	9.5	17.6
1968	16.2	15.4	13.4	10.2	13.2	15.9	14.9	31.6	9.6	17.2
1969	15.4	15.6	13.8	9.7	14.8	15.8	15.8	30.5	9.3	15.1
1970	13.5	15.0	12.6	8.6	14.3	14.5	15.0	32.0	7.5	11.8

continued on page 150

Table 8.1 continued

Year	*ACC*[b]	*ACC–US*	*Europe*[c]	*Canada*	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
1971	12.9	13.4	11.7	8.2	14.6	13.3	11.7	24.8	7.4	12.4
1972	13.1	13.2	11.7	8.9	14.7	12.8	12.0	22.7	7.7	13.0
1973	12.9	12.7	11.3	10.7	14.2	12.2	11.0	19.6	8.0	13.1
1974	10.4	10.5	9.3	10.7	12.2	10.4	10.2	15.2	4.6	10.2
1975	9.5	8.3	6.9	8.3	9.4	9.2	4.1	13.5	3.3	10.9
1976	10.2	9.1	7.7	8.1	7.9	10.7	6.6	14.5	4.0	11.6
1977	10.8	9.6	8.5	7.7	9.2	11.0	5.3	14.4	6.3	12.4
1978	11.0	10.2	8.9	8.0	9.3	11.7	5.6	15.8	6.5	12.2
1979	10.6	10.5	9.4	9.4	9.5	12.2	9.2	14.7	5.4	10.7
1980	9.9	10.3	8.8	9.6	8.5	10.5	11.4	15.4	4.9	9.3
1981	9.6	9.3	7.8	8.5	7.2	9.6	8.3	14.4	5.5	10.0
1982	8.7	9.1	8.0	6.8	6.8	9.6	7.7	13.7	6.9	8.1
1983	9.5	9.2	8.4	6.9	7.1	10.7	4.5	12.9	8.6	9.8

[a] Net profits divided by net fixed capital stock (mid-year) of private sector and public enterprises. Series for Canada, Germany, and Italy and approximations to non-agricultural, non-financial business including imputed profits of self-employed. Series for UK includes North Sea Oil.

[b] ACC (Advanced Capitalist Countries) is an unweighted average of the seven countries in the table.

[c] Europe is an average of I've four European countries.

Sources: Armstrong and Glyn (1986)

Table 8.2 Growth of Business gross fixed capital stock, 1952–1983 (annual % rates)

Year	*ACC*	*ACC–US*	*Europe*	*Canada*	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
1952	3.6	3.0	2.8	4.3	1.6	4.1	4.1	4.0	2.1	4.0
1953	3.5	3.5	2.9	6.9	1.5	4.5	4.3	4.4	2.3	3.5
1954	3.7	3.7	3.3	5.7	1.5	5.5	4.7	4.4	2.4	3.6
1955	3.6	4.0	3.9	5.3	2.2	6.1	5.4	3.6	2.8	3.3
1956	4.1	4.5	4.3	5.6	2.3	7.7	5.9	4.6	2.3	3.7
1957	4.3	5.0	4.6	6.4	2.7	8.0	6.2	6.2	2.4	3.6
1958	4.3	5.2	4.7	6.3	3.1	7.2	6.2	8.0	2.7	3.5
1959	3.6	4.9	4.6	5.4	3.3	7.0	6.0	6.4	2.7	2.4
1960	3.9	5.2	5.0	4.9	3.3	7.4	6.3	7.5	3.1	2.7
1961	4.2	5.7	5.3	4.6	3.6	7.3	7.1	9.8	3.7	2.9
1962	4.4	6.2	5.8	4.2	4.3	7.5	8.4	12.4	3.7	2.6
1963	4.5	6.0	5.6	4.0	4.6	7.1	8.7	11.6	3.1	3.0
1964	4.5	5.8	5.5	4.2	4.7	6.5	8.6	10.3	3.2	3.1
1965	4.9	6.1	5.5	4.7	5.0	6.7	6.0	11.6	4.3	3.6

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Table 8.2 continued

Year	*ACC*	*ACC–US*	*Europe*	*Canada*	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
1966	5.2	5.6	5.2	5.4	4.8	6.5	4.5	9.1	4.2	4.6
1967	5.4	5.6	5.1	5.8	5.1	5.9	4.8	8.9	4.1	5.1
1968	5.1	5.6	4.7	5.6	5.1	4.7	5.3	11.0	4.2	4.6
1969	5.3	5.8	4.7	5.3	5.2	4.6	5.6	12.9	4.0	4.6
1970	5.6	6.3	5.1	5.1	5.9	5.3	5.7	13.7	3.9	4.9
1971	5.5	6.6	5.3	5.2	6.1	6.0	5.4	14.4	3.9	4.2
1972	5.2	6.5	5.3	5.1	6.1	6.1	5.2	13.1	3.7	3.7
1973	5.3	6.2	4.9	5.2	6.4	5.4	4.8	12.6	3.3	4.1
1974	5.5	6.1	4.8	5.4	5.7	5.0	5.1	11.6	3.5	4.8
1975	5.0	5.5	4.5	5.7	6.5	3.8	5.0	9.0	3.5	4.4
1976	3.9	4.6	3.6	5.6	4.7	3.3	3.6	7.4	3.0	3.0
1977	3.8	4.3	3.7	5.4	4.9	3.4	3.8	6.1	2.9	3.1
1978	4.0	4.2	3.6	4.9	4.6	3.4	3.5	6.0	3.0	3.6
1979	4.2	4.1	3.5	4.7	4.5	3.6	3.1	5.9	3.0	4.3
1980	4.4	4.4	3.6	4.8	4.3	3.9	3.1	6.6	3.0	4.4
1981	4.3	4.5	3.7	5.3	4.3	3.8	3.5	6.7	3.0	3.9
1982	4.2	4.3	3.3	5.2	4.3	3.3	3.0	6.8	2.6	4.0
1983	3.6	4.0	3.2	4.5	3.9	3.3	2.5	6.1	2.7	3.2

Sources: Armstrong and Glyn (1986).

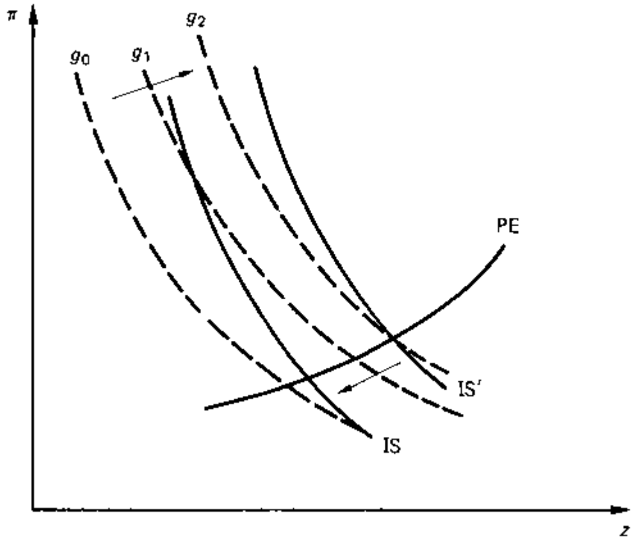

Figure 8.11 Crisis, part two: both the IS schedule and the growth isoquants shift adversely

share of profit devoted to saving rose after the golden age began to tarnish (see below, Section 8. This in turn suggests that investment demand continued to increase, because the IS schedule appears to have moved relatively little at this time. (If investment demand had not increased, the IS curve would have shifted downwards and to the left).

This characterizes the situation into the 1970s. But then new elements enter the picture. First, the cost of energy increases dramatically and the full capacity capital/output ratio increases. Second, aggregate demand management is pursued less aggressively. Finally, towards the end of the 1970s, the very integrity of the international financial system begins to play an increasingly important role. The shift in the position of the PE schedule against a steep IS schedule no longer summarizes the demise of the golden age; the part of the story that deals with the capital/output ratio, demand management, and the international financial system must be told in terms of a downward shift in the IS schedule and a decline in the rate of growth associated with a given equilibrium. This is the part of the story represented in Figure 8.11.

8 PROFIT SQUEEZE AND INVESTMENT RESILIENCE

Observe that the share of investment in *output* fell very little over the period we have been considering, except in Japan, as Table 8.3 demonstrates. Indeed given that the profit share fell markedly (see Table 8.4), the

Table 8.3 Business fixed investment, 1952–83 (% of GDP, current market prices)[a]

Year	*ACC*	*ACC–US*	*Europe*	*Canada*	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
1952	10.0	10.8	9.9	13.8	12.1	11.9	13.1	13.3	5.3	9.5
1953	10.3	10.8	9.7	14.7	11.3	12.2	12.7	13.7	5.1	10.0
1954	10.4	11.0	10.1	14.1	10.9	12.8	12.4	13.7	6.2	9.9
1955	10.8	11.8	11.3	14.4	11.6	14.6	12.5	12.7	7.3	10.1
1956	11.8	12.9	11.7	16.7	12.0	14.9	12.6	16.4	7.9	11.0
1957	12.2	13.6	12.0	17.8	12.7	13.9	13.2	19.0	8.8	11.0
1958	11.2	13.2	12.0	15.5	12.6	14.0	12.3	17.3	9.2	9.5
1959	11.3	13.3	12.0	14.7	12.2	14.1	12.6	18.0	9.2	9.6
1960	12.1	14.2	12.4	14.3	12.2	14.2	13.9	21.2	9.7	10.2
1961	12.6	15.2	13.1	12.2	13.4	14.6	14.3	24.0	10.5	10.1
1962	12.5	14.9	13.0	11.8	13.3	14.7	14.3	23.3	9.9	10.1
1963	12.3	14.6	12.8	12.1	13.5	14.1	14.4	21.9	9.5	10.1
1964	12.4	14.4	12.3	13.5	12.9	14.2	11.9	21.7	9.9	10.5
1965	12.6	13.9	12.0	14.5	12.6	14.3	10.2	19.5	10.1	11.4

1966	12.9	14.0	11.9	15.8	13.1	13.7	10.2	19.8	9.8	11.8
1967	12.8	14.2	11.6	14.6	13.2	12.2	11.2	21.5	9.7	11.3
1968	12.8	14.3	11.4	12.9	12.4	11.8	11.4	22.3	9.9	11.3
1969	13.3	15.0	11.9	12.8	12.8	13.0	11.5	23.4	9.8	11.6
1970	13.7	15.8	12.5	13.1	12.8	14.3	11.8	24.1	10.4	11.3
1971	13.2	15.4	12.7	12.8	13.1	14.5	11.9	22.4	10.6	10.7
1972	13.1	14.8	12.3	12.5	13.1	13.5	11.4	21.2	10.4	11.1
1973	13.6	15.3	12.3	13.0	13.3	12.5	12.5	22.4	10.8	11.7
1974	13.6	15.0	12.1	13.4	13.3	11.2	13.3	21.8	11.1	12.0
1975	12.7	14.0	11.3	14.7	12.2	10.9	11.5	19.5	10.7	11.2
1976	12.5	13.7	11.6	13.5	13.0	11.1	11.5	18.3	10.8	11.1
1977	12.6	13.5	11.6	13.4	12.6	11.3	11.1	17.4	11.3	11.6
1978	13.0	13.5	11.7	13.3	12.3	11.6	10.5	17.2	12.0	12.5
1979	13.6	14.1	11.9	14.4	12.1	12.2	10.7	18.3	12.3	13.0
1980	13.7	14.5	12.2	15.3	12.7	12.5	11.1	18.9	12.0	12.7
1981	13.6	14.3	11.8	16.1	12.3	12.1	10.9	18.6	11.4	12.7
1982	13.0	13.8	11.3	15.0	12.0	11.7	9.7	18.0	11.5	12.0
1983	12.3	13.2	10.9	12.6	11.4	11.9	8.6	17.4	10.9	11.3

[a] Total fixed investment less government investment less housebuilding. It is therefore understand by extent (substantial in UK for example) of government house-building.

Sources: Armstrong and Glyn (1986).

Table 8.4 Corporate business net profit share, 1951–83 (%)[a]

Year	*ACC*	*ACC–US*	*Europe*	*Canada*	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
1951	24.7	26.0	25.5	23.2	27.5	26.9	27.3	30.6	22.2	23.8
1952	23.0	25.8	25.5	23.4	25.4	29.7	24.5	28.6	22.7	21.0
1953	21.9	25.1	24.3	22.3	22.9	28.2	22.4	31.3	22.9	19.6
1954	21.5	24.5	24.2	19.3	22.5	27.8	22.9	28.7	23.1	19.2
1955	23.8	25.5	24.9	25.7	21.8	29.6	21.7	28.2	24.4	22.4
1956	22.2	25.3	24.0	26.3	20.9	29.2	21.6	30.4	22.7	19.9
1957	22.2	26.1	24.4	23.2	22.2	29.6	21.2	35.7	22.5	18.9
1958	20.9	25.0	23.6	22.3	21.0	28.5	21.4	33.1	21.7	17.4
1959	22.8	26.0	24.3	22.9	20.1	29.7	22.4	35.0	22.9	20.1
1960	22.8	27.6	25.2	22.4	21.7	29.4	23.1	40.0	24.5	18.4
1961	22.5	26.6	23.3	23.0	20.9	27.3	22.3	40.5	21.5	18.6
1962	22.4	24.9	21.9	24.0	19.4	25.7	20.2	36.3	20.6	20.0
1963	22.7	24.6	21.3	25.0	19.0	24.5	17.0	35.8	22.5	21.0
1964	23.3	24.9	21.7	26.3	20.0	25.7	14.8	34.5	23.2	21.3
1965	23.6	24.2	21.8	24.8	20.1	25.2	17.3	31.8	22.3	23.0

1966	23.3	24.0	21.1	24.0	20.6	23.8	18.4	32.9	20.2	22.5
1967	22.9	24.9	21.3	24.7	21.3	23.8	18.4	35.2	20.5	21.0
1968	23.5	26.6	22.0	25.8	21.4	25.0	19.3	38.9	20.8	20.5
1969	22.4	26.2	22.2	25.0	22.4	24.6	20.1	36.4	20.6	18.4
1970	20.8	25.6	20.4	23.5	21.6	22.6	18.7	38.4	17.5	15.5
1971	20.4	23.8	19.6	23.1	21.6	21.5	15.8	33.6	18.1	16.6
1972	20.7	24.0	19.9	24.7	21.8	21.0	16.4	32.8	19.0	17.0
1973	20.0	23.0	18.9	27.4	21.1	19.8	14.8	30.4	18.8	16.7
1974	17.3	20.0	16.1	27.8	18.8	17.6	14.3	26.2	12.6	14.3
1975	17.0	17.2	12.7	23.8	15.7	16.5	6.5	25.0	9.3	16.7
1976	17.7	18.1	13.9	23.0	13.7	18.3	10.0	25.6	11.5	17.3
1977	18.6	19.1	15.4	22.4	15.3	18.6	8.3	25.6	17.3	18.0
1978	19.0	20.2	16.0	24.4	15.2	19.8	8.7	27.7	17.8	17.5
1979	18.4	20.7	16.7	29.2	15.5	20.8	13.2	26.6	15.3	15.7
1980	18.0	21.1	16.0	30.4	14.3	18.7	15.6	28.6	14.5	14.4
1981	18.0	20.0	14.9	26.7	12.4	17.9	12.0	27.6	16.5	15.7
1982	17.0	19.7	15.5	22.2	11.8	18.4	11.4	26.7	19.7	13.7
1983	18.2	20.1	16.3	24.3	12.4	20.3	7.1	25.8	23.5	16.0

[a] Net profits divided by net value added of private sector and public enterprises. Series for Canada. Germany and Italy are approximations to non-agricultural, non-financial business including imputed profits of self-employed. Series for UK includes North Sea Oil.

Sources: Armstrong and Glyn (1986).

propensity to *save* out of profits must have risen – if we assume capitalist economies were operating on or near their IS schedules. But this resilience of the investment share to the fall in profitability should not suggest that profits are irrelevant for accumulation. If the profit margins of the 1950s and early 1960s had been maintained in the 1970s and 1980s, then investment demand might have continued to increase, perhaps by enough to offset the decline in the full-capacity capital/output ratio caused by the increase in the price of energy. Moreover, to the extent that restrictive demand-management policies were themselves a response to profit squeeze and an attempt to restore profit margins, the case for restrictive policies would have been weakened considerably. In short, no accumulation crisis need have occurred.

This argument does not however imply that a restoration of profit margins would, in the current business climate, produce immediate benefits in terms of growth. It is one thing to maintain the momentum of a long period of high profits and high growth. It is quite another to *restore* that momentum after a long interlude of desultory performance. If the relatively robust performance of investment over the post-war period is traceable ultimately to a gradual diminution of depressionary fears, then the resurgence of such fears – at present focusing on the weakness of the international financial system – may inhibit the responsiveness of prospective profitability to actual profit margins. Even a substantial improvement in actual profitability might fail to stimulate an investment boom because of fears that the improvement is only temporary. As at the beginning of the golden age, the stagnationist game of wage-led growth could turn out to be the only game in town!

9 BY WAY OF SUMMARY

The primary purpose of this chapter has been to release the Keynesian theory of the capitalist economy both from the stagnationist-cooperative straitjacket that has dominated Left Keynesian thought and from the marginal role that the mainstream has accorded Keynesian theory as a theory of no relevance to understanding the functioning of the capitalist economy apart from the short period. In our view neo-Keynesians at Oxford and Cambridge were developing an important insight of Keynes and Kalecki when they argued that aggregate demand plays a central role in the capitalist economy, in the long run as well as in the short. Furthermore, at least for a large country like the United States or for a large unit like the European Economic Community, for which the small open economy model is of little relevance, investment demand is the centrepiece of the story, both because it is likely to be the most variable and elusive element of aggregate demand, and because of its direct role in the accumulation of capital.

More specifically, this chapter has focused on the dual role of profits in a capitalist economy. Today's profits are, on the one hand, a primary source of saving for the accumulation of business capital. Tomorrow's profits, on the other hand, are the lure which attracts the investor. Under existing institutions, capital accumulation requires high profits, and a squeeze on profits generally leads to a squeeze on capital-stock growth.

Wages also have a dual character under capitalism. On the one hand, wages are costs to the capitalist. On the other hand, wages, or more precisely, the wages of the employees of *other* businesses, are a source of demand. High wages are bad for the capitalist as *producer* but good for the capitalist as *seller*, especially when demand from other sources is weak.

The social democrats and their academic allies, the Left Keynesians, put forward the political and intellectual case for the view that high capacity utilization would resolve the contradiction between high wages and high profits. Emphasizing the demand side, neglecting the cost side, they believed that high wages would contribute not only to high levels of output and employment but also to high levels of profits and accumulation. Capitalists would make up in larger volume what they lost on each unit because of higher wage costs.

The illusion that a new era of 'co-operative capitalism' had replaced the antagonistic class relations of an earlier period persisted until a profit squeeze developed in the late 1960s. At this point, the co-operative interpretation of Keynes became increasingly inconsistent with the facts. One could of course deny the facts. Or deny the theory. Or, as a compromise, relegate the theory to the short period, perhaps a period in which economic agents are surprised by government actions.

Our approach has been different. We believe that the problem has been the way a basically sensible *conception* of the economy was cast into a misleading *model* of the economy. Our purpose here has been to recast the model so that it retains the sense and the insight of Keynesian theory – particularly its insight on profit as the engine of capitalist accumulation.

But the present malaise is not a problem of profit alone. Restoration of profit margins would probably not, at least not very quickly, restore the high levels of investment demand that obtained throughout the golden age and even after its demise. As Schumpeter is reputed to have remarked, one no more restores economic health by simply reversing bad economic policies than one restores the health of someone who has been run over by a truck by simply backing the truck off. A healthy capitalism requires profitability, but in circumstances like the present profitability may follow from wage-led rather than from profit-led growth policies. Over the longer run profit-led growth may once again be feasible, but the transition will surely require active demand management, presumably a possibility only after a successful reform of the international financial system.

The alternative is a much more radical break with the past, a new institutional structure that would decouple accumulation from profitability altogether, as was presumably the ultimate intention of the Meidner plan (Meidner, 1978) of a decade ago. We question the timeliness of such a radical rupture, but we would hasten to add that the two alternatives, restoring profitability and freeing accumulation from dependence on profitability, need not be altogether disjoint. In fact, in our view the essential elements of any left alternative to mainstream policies for restoring growth are (*a*) to recognize the present need for profitability, (*b*) to recognize the ultimate desirability of making accumulation independent of profitability, and (*c*) to provide a bridge from here to there.

Notes

1. A positive relationship between wages and profits can hold only up to full capacity utilization, at which point higher wages will induce higher prices rather than higher output. In the full capacity case, there can be no squeeze on profit margins at all.
2. It is by no means necessary to assume the PE schedule slopes upwards. Within limits, nothing in our argument hinges on the slope of the PE schedule, and in any case our attention here will focus elsewhere.

   For the record, we note that competitive profit maximization was Keynes's own way of modelling the supply side in the *General Theory*. Realism apart, the difficulty with this approach for present purposes is that it makes the real wage depend exclusively on the level of capacity utilization. Within the strict confines of the *General Theory*, one simply cannot examine the consequences of a change in the distribution of income. Distribution is itself a consequence of demand and output rather than a cause, a thermometer rather than a thermostat.
3. Marglin (1984, ch. 4) presents a long-run version of Keynesian theory in a comparative framework. Ch. 19 suggests some problems with the theory (pp. 473–9), and ch. 20 attempts to synthesize Keynesian and Marxian perspectives.
4. Organisation for Economic Co-operation and Development (1987). The sixteen countries are United States, Japan, Federal Republic of Germany, France, United Kingdom, Italy, Canada, Belgium, Denmark, Finland, Iceland, Ireland, Holland, Norway, Sweden, Austria. Luxembourg was omitted as a small outlier whose gross saving rate reached 65 per cent of gross domestic product and averaged over 40 per cent during the quarter century covered by the data. By contrast, the second highest saver, Japan, averaged 33 per cent.
5. One aspect of the Robinsonian model which has gone generally unnoticed is that it implies a stagnationist-cooperative view of capitalism. Since investment demand is a function of r alone, the derivative h_z vanishes and the IS schedule in $\pi \times z$ space is a rectangular hyperbola. Since in this model if is the *rate* of profit

that is determined by saving and investment, the profit share and the volume of output are inversely proportional.

6. By assumption, we have

$$h_z = -i_\pi \frac{\pi}{z} + i_z > 0 \text{ and } s\pi\bar{a}^{-1} - i_z > 0$$

Combining these two inequalities gives $s\pi\bar{a}^{-1} - i_\pi \frac{\pi}{z} > 0$, from which the Robinsonian Stability Condition follows directly.

7. From Condition (14), we have

$$-i_\pi \frac{\pi}{z} + i_z > 0$$

and from Conditions (11) and (12)

$$0 > \frac{d\pi}{dz} = -\frac{s\pi\bar{a}^{-1} - i_z}{sz\bar{a}^{-1} - i_\pi}$$

Hence, combining these two inequalities give us

$$0 > \frac{d\pi}{dz} > -\frac{s\pi\bar{a}^{-1} - i_\pi \frac{\pi}{z}}{sz\bar{a}^{-1} - i_\pi} = -\left(\frac{sz\bar{a}^{-1} - i_\pi}{sz\bar{a}^{-1} - i_\pi}\right)\left(\frac{\pi}{z}\right) = -\frac{\pi}{z}$$

8. There is an element of arbitrariness in identifying class interest of workers with the wage *bill*, as against the wage *rate*. In effect, we are attaching no social utility to the involuntary unemployment that accompanies excess capacity. But there is, or may be, an important 'insider' vs. 'outsider' problem here: the gains of expansion accrue to the newly employed workers, the losses to the already-employed.

   The case for identifying the interests of the capitalist class with the profit rate rather than the profit share is less problematic: we need only assume that idle capacity depreciation as rapidly as utilized capacity.

9. Diminution of the fear of depression could produce not only a shift in the IS schedule, but a change in the sign of its slope as well. If anticipated profitability becomes sufficiently responsive either to the actual profit margin or to the actual rate of capacity utilization, the regime can change from stagnationist to exhilarationist.

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9 Post-Keynesian Theory of Distribution in the Long Run*

N. Salvadori

1 INTRODUCTION

As is well known, the post-Keynesian theory of distribution was generated during the 1950s in Cambridge (Cambridgeshire). The first formal presentation was given in a seminal paper in 1956 by Kaldor. After that Kaldor utilized this theory in formalizing several growth models (Kaldor, 1957, 1961; Kaldor and Mirrlees, 1962) in order to provide a solution to Harrod's problem on the convergence of the 'warranted' growth rate to the 'natural' growth rate. After 1966 Kaldor did not return to the post-Keynesian theory of distribution except to clarify the origins of the theory (Kaldor, 1978, 1980).

In 1962, Pasinetti reformulated the theory and introduced explicitly the assumption of steady growth. He also suggested a change in the saving function of workers and set the interest rate equal to the profit rate. The startling result, which gave rise to a large debate,[1] was that the profit rate depends only on the growth rate and the capitalists' saving ratio, irrespective of anything else including technological data and the workers' saving ratio. The limits of Pasinetti's results have been investigated in many respects. It is now clear that a two-class economy may or may not exist; if a one-class economy prevails, then the profit rate is determined in a quite different way (see, for instance, Pasinetti, 1983).

In this paper three classes of post-Keynesian models of growth and distribution will be presented and discussed. They differ among themselves for the relationships between the profit and interest rates and contain all post-Keynesian models of growth and distribution introduced up to now. All these models are based on the following conditions. There are two social classes, workers and capitalists. Workers' earnings comprise wages (W) and profits (P_w) as interest on loans to capitalists. Capitalists earn only profits (P_c). Workers' and capitalists' savings (S_w, S_c, respectively) are defined by the following functions

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$$S_w = F(P_w, W) \tag{1}$$

$$S_c = G(P_c) \tag{2}$$

For functions (1) and (2) to hold even changing the numeraire F(. , .) and G(•) must be homogeneous of degree one. As a consequence a real number s_c exists such that

$$G(P_c) \equiv s_c P_c$$

i.e. function (2) is in general linear[2]. It will also be assumed that

$$0 < \frac{\partial F}{\partial W} \leqslant \frac{\partial F}{\partial P_w} \leqslant s_c. \tag{3}$$

Furthermore, steady-state growth is assumed. Then workers' and capitalists' capital grow at the same rate (n); i.e. the following constraints hold:

$$F(P_w, W) = \mathrm{n}K_w \tag{4}$$

$$s_c P_c = nK_c \tag{5}$$

where K_w is workers' capital loaned to the capitalists, and K_c is capitalists' own capital ($K_w + K_c = K$).

The three classes of models which will be investigated are characterized by three different assumptions on the financial relationships. In the first class it is assumed that the rate of interest $\left(i = \frac{P_w}{K_w}\right)$, which workers receive from their loans to the capitalists, is equal to the capitalists' rate of profit $\left(\pi = \frac{P_c}{K_c}\right)$ and therefore to the rate of profit overall $\left(r = \frac{P_c + P_w}{K}\right)$, which equals the rate of profit on industrial investments. In the second class of models it is assumed that the rate of interest is a function of π, whereas in the third class of models it is a function of r.

The first class of models has been studied in the general case by Fazi and Salvadori (1985) and Salvadori (1988) and further remarks will be added in section 2. The models in this class enjoy many properties of Pasinetti's (1962) model, which – as a matter of fact – is contained in this class, i.e., a two-class economy may or may not exist, and this depends on the growth rate, capitalists' saving habits, workers' saving and consumption habits, and technological data; if a two class economy prevails then the rate of profit is determined by the growth rate and capitalists' saving ratio only, but if a one-class economy prevails, then the profit rate is determined by the growth rate, the workers' saving and consumption habits, and technological data.

A first general study of the second class of models has been provided by Fazi and Salvadori (1985), and some new material will be added in section 4. It will be also shown that Kaldor's model is the unique model in this class such that the rate of profit overall can be determined independently of the interest rate. The third class of models will be presented in section 5.

A further general remark is connected with the fact that the rate of interest, in the second and third classes of the models presented here, is lower than the profit rate. This assumption has already been made by a number of authors (e.g. Laing, 1969; Balestra and Baranzini, 1971; Moore, 1974; Pasinetti, 1974, 1983; Gupta, 1976; Fazi and Salvadori, 1981, 1985) despite the fact that Pasinetti (1962) argued that '[i]n a long run equilibrium model . . . the obvious hypothesis to make' is that the rate of interest equals the rate of profit. Since the issue still seems to be controversial, I am prompted to justify this assumption. The analyses we are concerned with are statical. For each statical model a class of dynamical models can be considered such that the solution of the statical model is equal to the stationary solution of each dynamical model in the class. If there is no difficulty in assuming that the future is unknown in the dynamical models, then there must be no difficulty in assuming the same in the statical model, even if in this model the quantities grow proportionally and the prices are constant during time. Thus, even if uncertainty is not formally analyzed, this does not mean that it is absent and that people know the future: as a consequence, the rate of interest may well be lower than the profit rate. Donald Harris has suggested to me that the difference between π and i could be also interpreted as related to the earnings of management. Whereas this seems to be a possible interpretation, the uniformity of π requires that the costs to run a business are uniformly proportional to the capital invested by the owner. This is perhaps a stronger assumption with respect to that which states that the ratio between total capital and owner's capital is uniform (which is implicitly required in the other interpretation).

All the models also involve a technological relationship, in addition to the equilibrium conditions (4) and (5). Let

$$v = v(r), \qquad 0 \leqslant r \leqslant R$$

be such a technological relationship, where v is the capital/output ratio, and R is the technological maximum rate of profit. Function v(r) meets the following properties:

$$rv(r) < 1 \text{ if } 0 \leqslant r < R$$

$$Rv(R) = 1.$$

Following Franke (1985) and Salvadori (1988), this paper will give special attention to the construction of this technological relationship: sections 3 and 6 are devoted to the construction of such a relationship when the rate of interest is equal to or lower than the profit rate, respectively.

2 A RATE OF INTEREST EQUAL TO THE CAPITALISTS' RATE OF PROFIT

In this section it is assumed that interest and profit rates coincide. If $i = r = \pi$ and $K_c > 0$, a straight-forward transformation of eq. (5) is all that is needed to determine the rate of profit since $P_c = rK_c$:

$$r = \frac{n}{s_c}. \tag{6}$$

This result is referred to, in the literature, as the 'Pasinetti process' or 'Pasinetti's theorem' or even the 'Pasinetti paradox'. It is a direct consequence of the assumption that the rate of interest is equal to the rate of profit[3, 4] (and $K_c > 0$). In this class of models, if $K_c > 0$, eq. (4) merely serves the purpose of determining the capital shares $\left(\frac{K_w}{K} \text{ and } \frac{K_c}{K}\right)$ via the $\frac{W}{K_w}$ ratio. In fact, from equation (4) we obtain

$$F\left(r, \frac{W}{K_w}\right) = n$$

which defines implicitly $\frac{W}{K_w}$ as a function of r. Let

$$\frac{W}{K_w} = f(r) \tag{7}$$

be this function. It is easily proved that

$$-\frac{s_c}{n - rs_c} f(r) \leqslant f'(r) \leqslant -1. \tag{8}$$

In fact, by differentiating totally with respect to r the identity

$$F(r, f(r)) = n$$

we obtain

$$\frac{\partial F}{\partial P_w} + \frac{\partial F}{\partial W} f'(r) = 0$$

and from Euler's Theorem

$$\frac{\partial F}{\partial P_w} r + \frac{\partial F}{\partial W} f(r) = n.$$

Therefore

$$\frac{\partial F}{\partial P_w} = -\frac{nf'(r)}{f(r) - rf'(r)} \; ; \quad \frac{\partial F}{\partial W} = \frac{n}{f(r) - rf'(r)} \, . \tag{9}$$

Thus, from inequalities (3),

$$0 < \frac{n}{f(r) - rf'(r)} \leqslant -\frac{nf'(r)}{f(r) - rf'(r)} \leqslant s_c$$

from which inequalities (8) are immediately obtained.
Eq. (7) implies

$$\frac{K_w}{K} = \frac{W}{K} \quad \frac{K_w}{W} = \frac{1 - rv}{vf(\mathrm{r})}$$

where v is the capital/output ratio. Hence, $\frac{K_w}{W} \leqslant 1$ if and only if

$$\frac{1}{v} \leqslant r + f(r) \tag{10}$$

Furthermore, if $i = r = \pi$, and $K_c = 0$, then eq. (5) is always satisfied, and $K_w = K$ since capitalists have disappeared. Therefore eq. (4) determines a relation between $\frac{1}{v}$ and r:

$$\frac{1}{v} = r + f(r). \tag{11}$$

A simple graphic exposition of these results is also possible. For this purpose, we need to state the following:

(i) $r + f(r)$ is a non-increasing function;

(ii) $f(0) = \frac{n}{F(0, 1)}$;

(iii) $f\left(\dfrac{n}{F(1, 0)}\right) = 0;$

(iv) $F(0, 1) \leqslant F(1, 0) \leqslant s_c.$

Statement (i) is a consequence of the second of inequalities (8); equality (ii) is obtained by taking into account that

$$f(0)F(0, 1) = n$$

since $F(. \, , .)$ is homogeneous of degree one and

$$F(0, f(0)) = n;$$

equality (iii) is obtained by taking into account that

$$F\left(\frac{n}{F(1, 0)}\,,\ f\left(\frac{n}{F(1, 0)}\right)\right) = n$$

and further that, from the homogeneity of $F(. \, , .)$,

$$F\left(1\,, \frac{F(1, 0)}{n}\ f\left(\frac{n}{F(1, 0)}\right)\right) = F(1, 0)$$

which implies that

$$\frac{F(1, 0)}{n}\ f\left(\frac{n}{F(1, 0)}\right) = 0;$$

inequalities (iv) are direct consequences of inequalities (3).

The above analysis is presented diagrammatically in Figure 9.1, where on the horizontal axis there is the rate of profit overall (r) and on the vertical axis there is the output/capital ratio $\left(\dfrac{1}{v}\right)$. The 45° line OD cuts the first quadrant in two parts: only above the line OD are wages positive ($W > 0$); along OD wages vanish ($W = 0$). Curve AD represents equation (11). Because of inequality (10), capitalists' capital is positive only below curve AD. Line BC represents equation (6). Steady-state growth is only feasible either along the segment AD or along the segment BC.[5]

Taking into consideration the technological relationship between v and r, $v = v(r)$, a long-run equilibrium exists whenever v(r) cuts curve AD or segment BC. If $v(r)$ meets BC at C, then only capitalists earn income. If v(r) cuts AD (point B included) then there is a one-class long-run equilibrium in which capitalists' capital equals zero. A two-class long-run equilibrium is only possible if v(r) cuts the segment BC excluding the extreme points B and C. Hence a two-class economy exists if and only if the technological relationship v(r) satisfies the following inequalities

$$\frac{\frac{n}{s_c}}{\frac{n}{s_c} + f\left(\frac{n}{s_c}\right)} < \frac{n}{s_c} v \left(\frac{n}{s_c}\right) < 1.$$

For the sake of completeness I will also give a condition for the existence of an odd number of equilibrium solutions – hence at least one – for a one-class (workers) economy:

$$\left[\frac{1}{v(0)} - \frac{n}{F(0,1)}\right]\left[\frac{n}{F(1,0)} - R\right] > 0$$

which can be written as

$$\min\left(\frac{F(0,1)}{v(0)},\ RF(1,0)\right) < n < \max\left(\frac{F(0,1)}{v(0)},\ RF(1,0)\right)$$

where $\frac{F(0,1)}{v(0)}$ is the saving per unit of capital if the whole income is given to the workers as wages, and $RF(1,0)$ is the saving per unit of capital if the whole income is given to the workers as profits.

3 ON THE CONSTRUCTION OF THE TECHNOLOGICAL RELATIONSHIP

The technological relationship $v = v(r)$ mentioned in the introduction and in the previous section depends on (a) the technology, (b) the growth rate, (c) workers' consumption habits, (d) workers' saving habits, and (e) capitalists' consumption habits. It is utilized in order (i) to determine the capital shares if two classes exist, (ii) to determine whether one or two classes exist, (iii) to determine the profit rate if only workers exist. Obviously, if capitalists do not exist data (e) do not matter in determining function $v = v(r)$, neither data (d) do. It is possible to prove that data (d) and (e) may be excluded from the construction of the technological relationship when utilized in determining whether one or two classes exist. This will be proved in this section. This can be relevant with respect to two facts. First, in comparative static analysis the technological relationship can

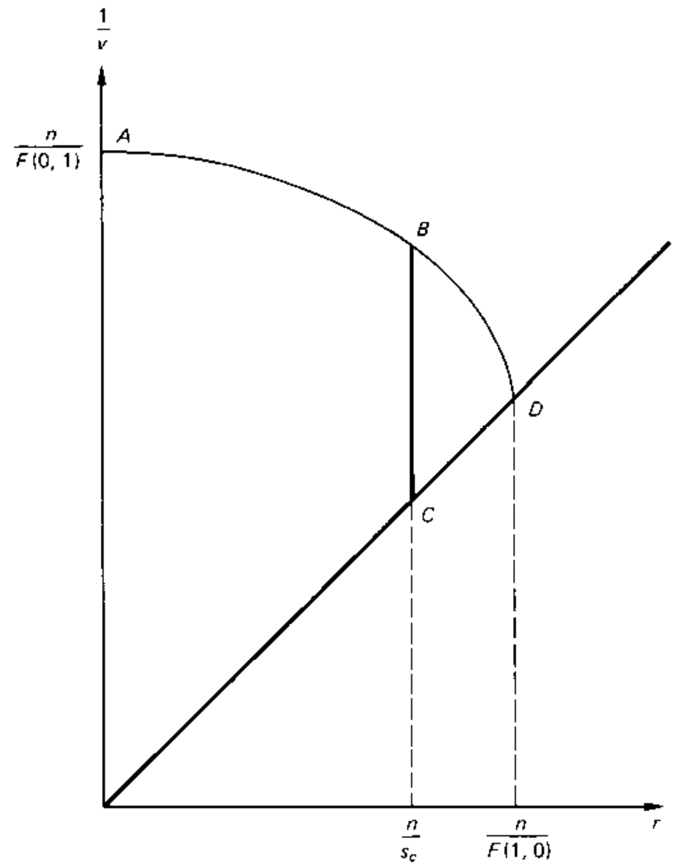

Figure 9.1

remain unchanged if workers' saving habits or capitalists' consumption habits change. Second, from a theoretical point of view, whether one or two classes exist is independent on capitalists' consumption habits: it will be proved that, provided $n < s_c R$, two classes exist if and only if

$$F\left(\frac{n}{s_c}k^*, w\right) < nk^* \tag{12}$$

where k^* is the capital per unit of labour of the sub-system producing the workers' consumption basket and w is the wage rate. The interpretation is that, provided $n < s_c R$, a two-class economy exists if and only if the one-class economy cannot save enough to sustain growth at rate n at $r = \frac{n}{s_c}$.

Let $r = \frac{n}{s_c} < R$, and let us assume that single production[6] prevails. Then at rate of profit r there exists a cost-minimizing technique (A, l); where $A = [a_{ij}]$ is the material input matrix and $l = (l_1, l_2, \ldots, l_n)^T$ is the labour input vector, i.e. a_{ij} and l_i are the amount of commodity j and the amount of labour, respectively, which are necessary to produce commodity i.

Let $c(p)$ and $d(p)$ be the workers' and capitalists' consumption vector functions; i.e., workers are assumed to consume $c_1(p)$ units of commodity 1, $c_2(p)$ units of commodity 2, $\ldots$, $c_n(p)$ units of commodity n, for each unit of numeraire they consume, where p is the price vector and $(c_1(p), c_2(p), \ldots, c_n(p)) = c^T(p)$. Similarly for the capitalists. Obviously $c(p)$ and $d(p)$ are homogeneous of degree -1 and $c^T(p)p = d^T(p)p = 1$, each p. Then,

$$v = \frac{x^TAp}{x^T(I - A)p} \equiv \frac{x^TAp}{wx^Tl + rx^TAp} \tag{13}$$

where

$$p = (1 + r)Ap + wl \tag{14}$$

and

$$x^T = (1 + n)x^TA + [W + (r - n)K_w]c^T(p) + (r - n)K_cd^T(p) \tag{15}$$

Since we can set $W = wx^Tl$, $K_w = \frac{1}{f(r)}(wx^Tl)$, $K_c = x^TAp - \frac{1}{f(r)}(wx^Tl)$, v depends on $f(r)$ and $d(p)$ unless $c(p) \equiv d(p)$ or $r = n$ (i.e. $s_c = 1$). In order to take home our point, let us divide the economy in two subsystems, one producing the workers' consumption basket $c(p)$ and the other producing the capitalists' consumption basket $d(p)$:

$$z^T = (1 + n)z^TA + \left[1 + (r - n)\frac{1}{f(r)}\right]w(z^Tl + y^Tl)c^T(p) \tag{16}$$

$$\begin{aligned} y^T = {} & (1 + n)y^TA + \\ & + (r - n)\left[z^TAp + y^TAp - \frac{1}{f(r)}w(z^Tl + y^Tl)\right]d^T(p) \end{aligned} \tag{17}$$

obviously $z + y = x$. We obtain from (16) and (17) that

$$z^T = \alpha c^T(p)[I - (1 + n)A]^{-1} \tag{18}$$

$$y^T = \beta d^T(p)[\mathrm{I} - (1 + n)A]^{-1} \tag{19}$$

where α and β are scalars to be determined. Since equations (16) and (17) are homogeneous and linear in (z, y), (z, y) can be normalized by setting $\alpha = 1$ in equation (18). Capitalists' capital is positive if and only if $\beta > 0$. In order to determine β, let us multiply both sides of eq. (17) by p, then

$$y^T p = (1 + n)y^T Ap + (r - n)\left[z^T Ap + y^T Ap - \frac{1}{f(r)} w(z^T \mathrm{l} + y^T \mathrm{l})\right]$$

which, since p satisfies eq. (14), can be rearranged as

$$(1 + r)\, y^T Ap + wy^T \mathrm{l} = (1 + n)y^T Ap +$$

$$+ (r - n)\left[z^T Ap + y^T Ap - \frac{1}{f(r)} w(z^T \mathrm{l} + y^T \mathrm{l})\right]$$

i.e.

$$\left[1 + (r - n)\frac{1}{f(r)}\right] wy^T \mathrm{l} = (r - n)\left[z^T Ap - \frac{1}{f(r)} wz^T \mathrm{l}\right]$$

which, since y satisfies eq. (19), implies

$$\beta = \frac{(r - n)\left[z^T Ap - \dfrac{1}{f(r)} wz^T \mathrm{l}\right]}{w\left[1 + (r - n)\dfrac{1}{f(r)}\right] d^T(p)[\mathrm{I} - (1 + n)A]^{-1}\mathrm{l}}$$

Thus, $\beta > 0$ if and only if

$$\frac{z^T Ap}{wz^T \mathrm{l}} > \frac{1}{f(r)} \tag{20}$$

i.e.

$$\frac{r}{r + f(r)} < r\,\bar{v}(r)$$

where

$$\bar{v}(r) = \frac{z^T Ap}{wz^T \mathrm{l} + rz^T Ap}$$

i.e. $\bar{v}(r)$ is the capital/output ratio relative to the workers' consumption basket subsystem. Moreover, $r\,\bar{v}(r) < 1$ since $r < R$. Thus, $\bar{v}(r)$ works as well as $v(r)$ in determining whether capitalists exist or not.[7] Finally, by defining $k^* = \dfrac{z^T A p}{z^T l}$, and taking into account both the definition of $f(r)$ and the fact that $r = \dfrac{n}{s_c}$, inequality (12) is immediately obtained from inequality (20).

4 A RATE OF INTEREST FUNCTION OF CAPITALISTS' RATE OF PROFIT

If capitalists exist ($K_c > 0$) then $\pi = \dfrac{P_c}{K_c}$ is determined by equation (5), i.e.

$$\pi = \frac{n}{s_c}$$

If capitalists do not exist ($K_c = 0$), then π is both irrelevant and undetermined. If the rate of interest is a fraction – or more in general a function – of π, then it can be considered given after π is determined. Obviously $i < \pi$.

From equation (4), and introducing function $f(.)$, we obtain

$$\frac{W}{K_w} = f(i)$$

As a consequence

$$\frac{K_w}{K} = \frac{W}{K}\frac{K_w}{W} = \frac{1 - rv}{vf(i)} \tag{21}$$

By definition the rate of profit overall is a weighted average of i and π

$$r = i\frac{K_w}{K} + \pi\frac{K_c}{K}$$

where $K = K_w + K_c$. Thus:

$$r = i\,\frac{1 - rv}{vf(i)} + \frac{n}{s_c}\left[1 - \frac{1 - rv}{vf(i)}\right]$$

i.e.

$$\frac{1}{v} = \frac{nf(i)}{n - is_c} + \left[1 - \frac{f(i)s_c}{n - is_c}\right] r \tag{22}$$

which has the remarkable property of being linear in r. Moreover, from equation (21) we get that $\frac{K_w}{K} \leq 1$ if and only if

$$\frac{1}{v} \leq r + f(i). \tag{23}$$

It is worthwhile noting that

(i) if $r = i < \frac{n}{s_c}$, then $\frac{nf(i)}{n - is_c} + \left[1 - \frac{s_c f(i)}{n - is_c}\right] r = i + f(i)$;

(ii) if $r > i$, then either

$$\frac{nf(i)}{n - is_c} + \left[1 - \frac{s_c f(i)}{n - is_c}\right] r < r + f(r) \tag{24.a}$$

or

$$\frac{nf(i)}{n - is_c} + \left[1 - \frac{s_c f(i)}{n - is_c}\right] r \equiv r + f(r) \equiv r + \beta(n - rs_c) \tag{24.b}$$

where β is a constant;

(iii) if $r = \frac{n}{s_c} > i$, then $\frac{nf(i)}{n - is_c} + \left[1 - \frac{s_c f(i)}{n - is_c}\right] r = \frac{n}{s_c}$.

Statement (ii) means that either the equilibrium relationship (22) equals $r + f(r)$ and therefore is independent of i, or the equilibrium relationship (22) is lower than $r + f(r)$ for $r > i$ and, as a consequence, two different rates of interest imply two different equilibrium relationships (22). In order to prove statement (ii), we first prove that function $\frac{f(r)}{n - rs_c}$ is not decreasing with respect to r. By differentiating, we obtain

$$\frac{f'(r)(n - rs_c) + s_c f(r)}{(n - rs_c)^2}$$

which is nonnegative because of the first of inequalities (8). If

$$\frac{f(i)}{n - is_c} = \frac{f(r)}{n - rs_c}$$

and $i < r$, then,[8]

$$\frac{f(i)}{n - is_c} \equiv \beta \equiv \frac{f(r)}{n - rs_c} \qquad \text{each } i, \text{ each } r$$

where β is a constant. Thus, identities (24.b) hold. If

$$\frac{f(i)}{n - is_c} < \frac{f(r)}{n - rs_c}$$

then inequality (24.a) holds.

The equilibrium condition (22) depends in general on the interest rate. The unique case in which the rate of profit can be determined independently of i is the Kaldorian model. In fact, if identities (24.b) hold,

$$f(i) \equiv \beta(n - is_c)$$

then

$$\frac{\partial F}{\partial P_w} = s_c \qquad \text{and} \qquad \frac{\partial F}{\partial W} = \frac{1}{\beta}$$

because of equalities (9). Therefore,

$$F(iK_w, W) \equiv s_c iK_w + s_w W$$

where $s_w = \frac{1}{\beta}$. Thus, the Kaldorian model is the only one (in the class of models dealt with in this section) which has the property of determining the profit rate independently of the interest rate.

The above analysis is presented graphically in Figure 9.2, where the curve AD and the segment BC of Figure 9.1 are also drawn. The line EC is defined by equation (22). Segment EC cuts the 45° line at point C, where $r = \frac{n}{s_c}$, and the curve AD at point E corresponding to $r = i$. The line FE is derived from inequality (23). Capitalists' capital is positive only below that line.

The equilibrium is obtained if the technological relationship $v(r)$ meets segment EC. For the existence of a two-class economy, $v(r)$ must cut the segment EC on an internal point. If $v(r)$ cuts the segment EC at the extremes, then a one-class economy exists: at point E only the workers exist, at point C, only the capitalists earn income. The existence of a two-class equilibrium depends on the shape of the technological function

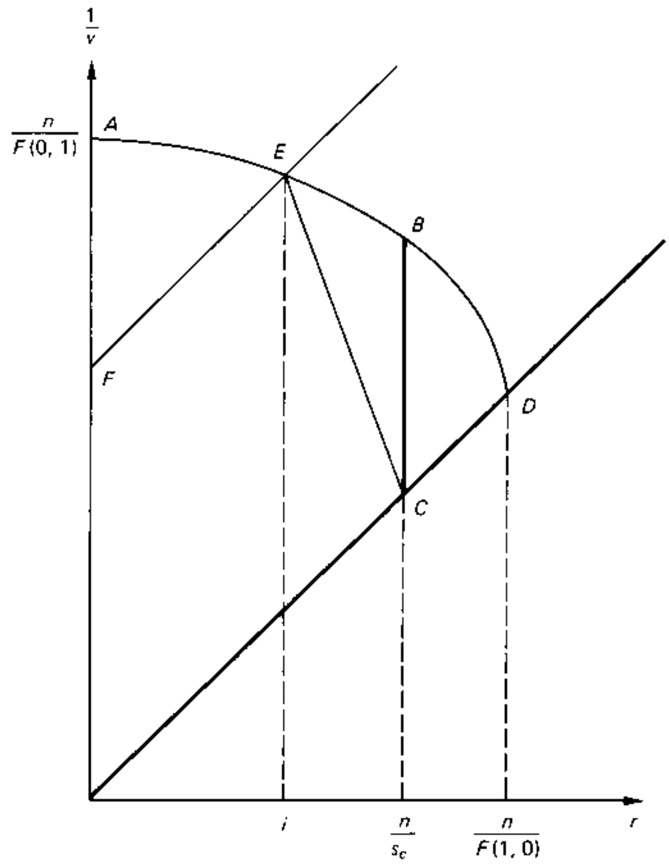

Figure 9.2

$v(r)$. Equilibrium needs not be unique since $v(r)$ can cut segment EC at different points: If and only if

$$\{1 - v(i)[i + f(i)]\}[n - Rs_c] > 0$$

an odd number of (two-class) solutions exist, hence at least one. Otherwise, either no (two-class) equilibrium exists, or there is an even number of (two-class) equilibrium solutions.

5 A RATE OF INTEREST FUNCTION OF THE RATE OF PROFIT OVERALL

In this section the rate of interest will be considered a known function of the rate of profit overall r; i.e.,

$$i = h(r)$$

with the obvious properties

$$0 < h'(r) < 1, \qquad h(0) = 0$$

With the introduction of function $h(r)$, the equilibrium condition (22) becomes

$$\frac{1}{v} = \frac{ng(r)}{n - s_c h(r)} + \left[1 - \frac{s_c g(r)}{n - s_c h(r)}\right] r \tag{25}$$

where $g(r) \equiv f(h(r))$. Obviously $g(0) = f(0)$, $r > 0$ implies $g(r) > f(r)$, and

$$-\frac{s_c}{n - h(r)s_c} g(r)h'(r) \leq g'(r) \leq -h'(r). \tag{26}$$

Furthermore,

(i) if $r = 0$, then $\dfrac{ng(r)}{n - s_c h(r)} + \left[1 - \dfrac{s_c g(r)}{n - s_c h(r)}\right] r = f(0) \equiv$

$\dfrac{n}{F(0, 1)}$;

(ii) if $r > 0$, then either

$$\frac{ng(r)}{n - s_c h(r)} + \left[1 - \frac{s_c g(r)}{n - s_c h(r)}\right] r < r + f(r)$$

or

$$\frac{ng(r)}{n - s_c h(r)} + \left[1 - \frac{s_c g(r)}{n - s_c h(r)}\right] r \equiv r + f(r) \equiv r + \beta(n - rs_c)$$

where β is a constant, the latter alternative holding only in the Kaldorian model;

(iii) if $r = \dfrac{n}{s_c}$, then $\dfrac{ng(r)}{n - s_c h(r)} + \left[1 - \dfrac{s_c g(r)}{n - s_c h(r)}\right] r = \dfrac{n}{s_c}$;

(iv) the function $\dfrac{ng(r)}{n - s_c h(r)} + \left[1 - \dfrac{s_c g(r)}{n - s_c h(r)}\right] r$

(a) is decreasing in r

and

(b) concave for r close enough to $\frac{n}{s_c}$.

Statement (ii) is a consequence of statement (ii) of the previous section since $h(r) < r$. In order to prove the statement (iv)(a) the first derivative of the function is calculated:

$$\left[1 - \frac{s_c}{n - h(r)s_c}\, g(r)\right] + \frac{n - rs_c}{n - h(r)s_c}\left[\frac{s_c}{n - h(r)s_c}\, g(r)h'(r) + g'(r)\right].$$

The first bracket is negative as a consequence of both inequalities (26) whereas the second bracket is non-negative because of the first of inequalities (26). Moreover, $h'(r) < 1$ and $\frac{n - rs_c}{n - h(r)s_c} < 1$, then the first derivative of the function is lower than

$$\left[1 - \frac{s_c}{n - h(r)s_c}\, g(r)\right] h'(r) + \left[\frac{s_c}{n - h(r)s_c}\, g(r)h'(r) + g'(r)\right]$$
$$= g'(r) + h'(r)$$

which is non-positive because of the second of inequalities (26). Statement (iv)(b) holds since the second derivative of the right hand side of equation (25) with respect to r is

$$-\frac{2s_c}{n - h(r)s_c}\left[1 - \frac{n - rs_c}{n - h(r)s_c}\, h'(r)\right]\left[\frac{s_c}{n - h(r)s_c}\, g(r)h'(r) + g'(r)\right] +$$
$$+ \frac{n - rs_c}{n - h(r)s_c}\left[\frac{s_c}{n - h(r)s_c}\, g(r)h''(r) + g''(r)\right]$$

which, if $r = \frac{n}{s_c}$, becomes

$$-\frac{2s_c}{n - h(r)s_c}\left[\frac{s_c}{n - h(r)s_c}\, g(r)h'(r) + g'(r)\right]$$

which is non-positive because of the first of inequalities (26).

The models analyzed in this section have no problem with respect to the existence of one or two classes with a positive profit rate. In fact, capitalists exist, because of inequality (23), if and only if

$$\frac{1}{v} < r + g(r)$$

which in equilibrium always holds since $h(r) < r$ for $r > 0$. Nevertheless an equilibrium may or may not exist.

The above analysis is presented graphically in Figure 9.3, where the curve AD and the segments BC and EC of Figure 9.2 are also drawn. The curve AC is defined by equation (25). Curve AC is always decreasing and is concave for r close enough to $\frac{n}{s_c}$ because of statement (iv). It cuts segment EC at $r = \frac{n}{s_c}$ and at $r = r°$, where $h(r°) = i$. Since i is not given, a different segment EC for each i can be drawn. Note that for $i = 0$, $E \equiv A$: as a consequence the curve AC is up with respect to the straight line segment connecting points A and C.

For the existence of an equilibrium, the technological relationship $v = v(r)$ must cut the curve AC. Equilibrium needs not be unique since $v(r)$ can cut curve AC at different points. If

$$\left[\frac{1}{v(0)} - \frac{n}{F(0, 1)}\right]\left[\frac{n}{s_c} - R\right] > 0 \tag{27}$$

an odd number of (two-class) solutions exist, hence at least one. Otherwise, either no (two-class) equilibrium exists, or there is an even number of (two-class) equilibrium solutions. Inequality (27) is perhaps more interesting written as

$$\min\left(\frac{F(0, 1)}{v(0)}, s_cR\right) < n < \max\left(\frac{F(0, 1)}{v(0)}, s_cR\right) \tag{28}$$

where $\frac{F(0, 1)}{v(o)}$ is the saving per unit of capital if the whole income is given to the workers as wages, and s_cR is the saving per unit of capital if the whole income is given to the capitalists as profits. Even if in interpreting inequalities (28) we must not run too quickly to conclusions since $v(0)$ is not independent on n, it seems possible to argue that if an equilibrium cannot exist, this is because the growth rate is too high or too low with respect to the saving capacities of the economy.

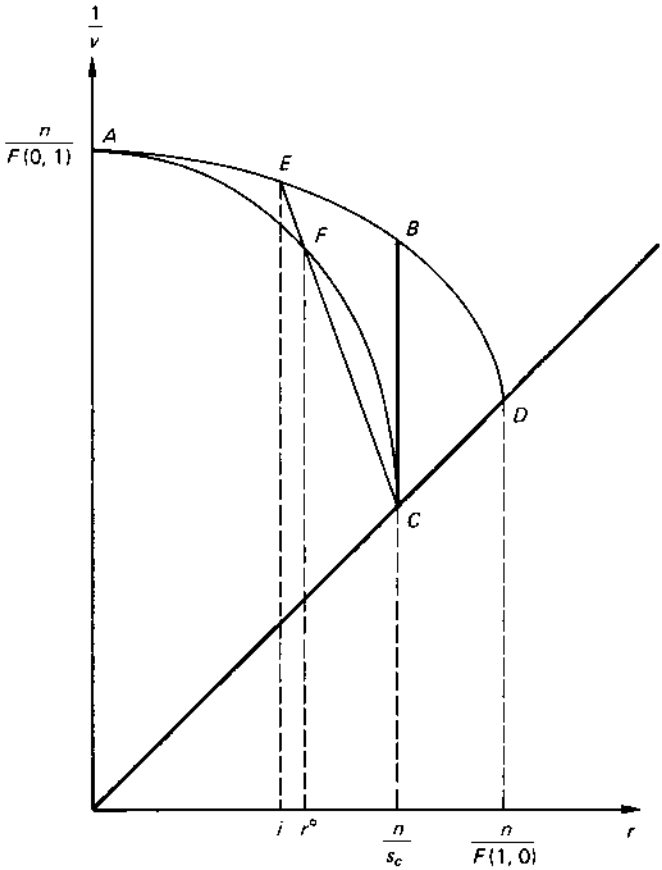

Figure 9.3

6 ON THE CONSTRUCTION OF THE TECHNOLOGICAL RELATIONSHIP ONCE AGAIN

The technological relationship involved in the previous two sections depends on (a) the technology, (b) the growth rate, (c) the interest rate (as a function of π or of r, respectively), (d) workers' consumption habits, (e) capitalists' consumption habits, (f) *either* capitalists' saving habits *or* workers' saving habits. This section is devoted to showing these two ways of building up this relationship.

If $i < \pi$, equation (15) is to be substituted by

$$x^T = (1 + n)x^T A + [W + (i - n)K_w]c^T(p) + (\pi - n)K_c d^T(p) \qquad (29)$$

whereas the technological relationship $v = v(r)$ is built up through equations (13), (14), and (29). We can

– either set $W = wx^T1$, $K_w = \frac{1}{f(i)}(wx^T1)$, $K_c = x^TAp - \frac{1}{f(i)}(wx^T1)$,

since $x^TAp = K \equiv K_w + K_c$ and $f(i) = \frac{W}{K_w}$;

– or set $W = wx^T1$, $K_w = \frac{\pi - r}{\pi - i}x^TAp$, $K_c = \frac{r - i}{\pi - i}x^TAp$,

since $x^TAp = K \equiv K_w + K_c$ and $rK = iK_w + \pi K_c$.

In the former case the technological relationship is independent on capitalists' saving habits, but depends on workers' saving habits. In the latter the technological relationship is independent on workers' saving habits, but depends on $\pi = \frac{n}{s_c}$, and therefore on capitalists' saving habits. Hence, in comparative static analysis in which either workers' or capitalists' – but not both – saving habits are changed the technological relationship can be assumed to be unchanged.

7 CONCLUDING REMARKS

This paper has scrutinized the post-Keynesian theory of distribution and has identified three classes of models in relation to the relationship between the interest rate and the profit rate. Conditions for the existence of an equilibrium have been provided. If the rate of interest is equal to the rate of profit an unsatisfactory circumstance occurs: two equilibrium states are possible and in one of these capitalists are swept away. If the rate of interest is a function of the capitalists' profit rate each equilibrium is a two-class equilibrium except the extreme cases in which $r = i$ and $r = \pi$, respectively. But, conversely, the condition which ensure the existence of an equilibrium depends crucially on the rate of interest; moreover the model does not seem to suggest any reaction either of capitalists or of workers as a reply to the impossibility of finding an equilibrium.

The class of models which appear more appealing, among those here presented herein, seems to be that in which the interest rate is a function of the rate of profit overall: each equilibrium is a two class-equilibrium except the obvious cases in which either wages or profits are nought. Furthermore, the existence of an equilibrium is not ensured only if the growth rate is too high or too low with respect to the saving possibilities of the economy. This seems to suggest that if an equilibrium cannot be maintained, dynamical considerations could be introduced in order to change either the growth rate or the saving habits.

The analysis provided suggests that the study of the determination of the rate of interest can really be very proficuous for developing the theory. It must be added that Kaldor has once again indicated the way: in the appendix to his comment (Kaldor, 1966) to a paper by Samuelson and Modigliani (1966a), he has built up a remarkable model where the share market is introduced. Even if this appendix has not gone unnoticed (see, for instance, Davidson, 1968; Moss, 1978; Mott, 1985–86) this analysis still needs to be developed. This perhaps would also permit the introduction of further links between the post-Keynesian theory of distribution, created and especially developed in Cambridge (UK), and the post-Keynesian analysis of the financial markets, realized especially on the other side of the Atlantic.

Appendix

In this appendix it will be assumed that

$$S_w = F(P_w, W, K_w)$$

$$S_c = G(P_c, K_c)$$

with the obvious properties

$$\frac{\partial F}{\partial K_w} \leq \frac{\partial G}{\partial K_c} \leq 0 < \frac{\partial F}{\partial W} \leq \frac{\partial F}{\partial P_w} \leq \frac{\partial G}{\partial P_c} < 1 \tag{A.1}$$

where $F(. \ , . \ , .)$ and $G(. \ , .)$ are homogeneous of degree one. Since steady-state growth is assumed,

$$F(P_w, W, K_w) = nK_w \tag{A.2}$$

$$G(P_c, K_c) = nK_c \tag{A.3}$$

i.e.

$$F(i, f(i, n), 1) \equiv n \tag{A.4}$$

$$G(\phi(n), 1) \equiv n \tag{A.5}$$

where $\frac{W}{K_w} = f(i, n)$ and $\pi = \phi(n)$ are implicitly defined by equations (A.2) and (A.3), respectively. It is immediately obtained from Euler's Theorem that

$$\frac{\partial F}{\partial P_w} i + \frac{\partial F}{\partial W} f(i, n) + \frac{\partial F}{\partial K_w} = n$$

$$\frac{\partial G}{\partial P_c} \phi(n) + \frac{\partial G}{\partial K_c} = n$$

Furthermore, it is easily obtained by differentiating totally the identity (A.4) with respect to i and to n, respectively:

$$\frac{\partial F}{\partial P_w} + \frac{\partial F}{\partial W} \; \frac{\partial f}{\partial i} = 0.$$

$$\frac{\partial F}{\partial W} \; \frac{\partial f}{\partial n} = 1.$$

and, by differentiating totally the identity (A.5) with respect to n:

$$\frac{\partial G}{\partial P_c} f'(n) = 1.$$

Therefore

$$\frac{\partial F}{\partial P_w} = - \frac{\frac{\partial f}{\partial i}}{\frac{\partial f}{\partial n}}$$

$$\frac{\partial F}{\partial W} = - \frac{1}{\frac{\partial f}{\partial n}}$$

$$\frac{\partial F}{\partial K_W} = n + \frac{\frac{\partial f}{\partial i} i}{\frac{\partial f}{\partial n}} - \frac{f(i,n)}{\frac{\partial f}{\partial n}}$$

$$\frac{\partial G}{\partial P_c} = \frac{1}{\phi'(n)}$$

$$\frac{\partial G}{\partial K_c} = n - \frac{\phi\,(n)}{\phi'(n)}$$

Thus, from inequalities (A.1),

$$n + \frac{\frac{\partial f}{\partial i} i}{\frac{\partial f}{\partial n}} - \frac{f(i,n)}{\frac{\partial f}{\partial n}} \leq n - \frac{\phi(n)}{\phi'(n)} \leq 0 < - \frac{1}{\frac{\partial f}{\partial n}} \leq - \frac{\frac{\partial f}{\partial i}}{\frac{\partial f}{\partial n}} \leq \frac{1}{\phi'(n)} < 1$$

From which it is immediately obtained that, for $i < \phi(n)$,

$$1 < \phi'(n) \leq \frac{\phi(n)}{n} \tag{A.6}$$

$$-\frac{f(i, n)}{\phi(n) - i} \leq \frac{\partial f}{\partial i} \leq -1 \tag{A.7}$$

where inequalities (A.7) are the analog of inequalities (8).

Once n is given π is determined through the function $\pi = \phi(n)$ which has the properties (A.6). Then the analog of the other results of sections 2 and 4 are easily obtained by taking into account the inequalities (A.7). In particular, equations (11) and (22) become

$$\frac{1}{v} = r + f(r, n)$$

$$\frac{1}{v} = \frac{\phi(n)f(i, n)}{\phi(n) - i} + \left[1 - \frac{f(i, n)}{\phi(n) - i}\right] r$$

respectively. It is easily checked that the determination of the profit rate independently of the rate of interest, a characterizing property of the Kaldorian model, holds if and only if the workers' saving habits are defined by the function

$$S_w = F(P_w, W, K_w) \equiv G(P_w + \alpha W, K_w)$$

where α, $0 < \alpha < 1$, is a constant and function $S_c = G(P_c, K_c)$ defines capitalists' saving habits.

In order to obtain the analog of the results presented in section 5 we need only to introduce the function

$$\frac{W}{K_w} = g(r, n) \equiv f(h(r), n)$$

with the properties

$$-\frac{g(r, n)h'(r)}{\phi(n) - h(r)} \leq \frac{\partial g}{\partial i} \leq -h'(r) \tag{A.8}$$

which are obviously obtained from inequalities (A.7) and are the analog of inequalities (26). In particular, equation (25) becomes

$$\frac{1}{v} = \frac{\phi(n)g(r, n)}{\phi(n) - h(r)} + \left[1 - \frac{g(r, n)}{\phi(n) - h(r)}\right] r$$

which is decreasing in r everywhere and concave in r for r close enough to $\phi(n)$ because of inequalities (A.8).

Notes

1. See Meade (1963, 1966), Meade and Hahn (1965), Samuelson and Modigliani (1966a, 1966b), Pasinetti (1964, 1966a, 1966b), Kaldor (1966) and Robinson (1966).
2. Steve Marglin has remarked to me that this a quite unrealistic feature and suggested clarifying this point. The fact is that capitalists' saving function is linear since, following a long tradition, it has been assumed to be a function of capitalists' profit only. If, on the contrary, it were a function of several price variables, then it would be homogeneous of degree one with respect to all these variables and, as a consequence, it would not need to be linear in the capitalists' profit. Just as an example, let

$$S_c = G(P_c, K_c)$$

i.e. capitalists' saving as a function of both their income (P_c) and their wealth (K_c). The consequences of this saving function (and of the workers' saving function analogous to it) are briefly summarized in the appendix.
3. This fact has not always been crystal clear: Samuelson and Modigliani (1966, p. 269), for instance, did not mention this assumption when they reported 'Pasinetti's Theorem', nor did Kaldor (1978, p. xv) in summarizing the debate when introducing volume 5 of his Collected Economic Essays. Pasinetti (1962), nevertheless, was aware of the importance of this assumption, which, he said, 'implies . . . that, in the long run, profits will turn out to be distributed in proportion to the amount of savings which are contributed' (p. [189]), i.e.:

$$S_w = \frac{S_c}{P_c} P_w \equiv s_c P_w$$

which implies

$$S \equiv S_w + S_c = s_c P$$

and since

$$S = I \equiv nK$$

eq. (6) is immediately obtained independently of assumptions on workers' saving habits.
4. The fact that Kaldor obtained a different result for the profit rate calls for an explanation. Pasinetti's (1962) suggestion was that Kaldor had slipped on the simple truism that people who save accumulate capital and then receive profits. But Samuelson and Modigliani (1966a) remarked that 'there need not be a "logical slip" in the Kaldorian model, if it will merely assume that the propensity to save out of income from capital is s_c whether that income is received by capitalists or by workers. This hypothesis, which may or may not be empirically sound, is certainly not logically self-contradictory'. Following this remark, Gupta (1977) and Mückl (1978), rectifying Maneschi (1974), have clarified that, if the rate of interest is equal to the rate of profit, Kaldor's saving habits require that

$$s_w W K_c = 0$$

where s_w is the saving ratio out of wages; and Fazi and Salvadori (1981) have shown that if the rate of interest is lower than the rate of profit, the Kaldorian model is perfectly consistent. Thus, the Kaldor model cannot be in the class of models analyzed in this section.

5. Many of the authors who have dealt with these issues so far have excluded the possibility of an equilibrium along the stretch BD. The usual reason given has been that, along BD, $r > \frac{n}{s_c}$ and therefore $\frac{s_c P_c}{K_c} > n$, implying a rate of growth for capitalists' capital higher than the natural rate of growth n. This argument does not appear completely convincing since, as Fazi and Salvadori (1985) have remarked, if capitalists' capital does not exist from the beginning, then a hypothetical one-class equilibrium could exist also along the segment BD. On the contrary, a one-class equilibrium could exist along the segment AB even if two classes are contemplated at the beginning of the story.
6. A partial extension of this analysis to joint production can be found in Salvadori (1988, appendix 2).
7. A more intuitive argument could be the following. Assume that

$$\frac{r}{r + f(r)} < r\,\bar{v}(r) < 1,$$

then there would be a two-class economy if capitalists consume the same commodities and in the same proportions as consumed by workers. Then let capitalists' consumption pass smoothly from the workers' consumption basket to their own: The output/capital ratio can rise or fall, but it cannot fall below the 45° line; neither can rise over the AD curve. The former fact is obvious since $r < R$, the latter would imply the existence of a capitalists' consumption basket such that $\frac{1}{v(r)}$ would cut the AD curve at B, i.e. the existence of a one class economy would hold. Hence a contradiction. A similar argument holds if $\frac{r}{r + f(r)} > r\,\bar{v}(r)$.

8. I am assuming that function $F(P_w, W)$ is continuously differentiable. If it is not, some qualifications are needed. I will limit myself to giving an example:

$$F(P_w, W) = \begin{cases} \alpha W + s_c P_w & \text{iff } \frac{W}{P_w} \geq 2 \\[2ex] \frac{s_c + 3\alpha}{4} W + \frac{s_c + \alpha}{2} P_W & \text{iff } \frac{W}{P_w} \leq 2 \end{cases}$$

i.e.,

$$f(r) = \begin{cases} \frac{n - rs_c}{\alpha} & \text{iff } r \leq \frac{n}{s_c + 2\alpha} \\[2ex] \frac{4n - 2(s_c + \alpha)r}{s_c + 3\alpha} & \text{iff } r \geq \frac{n}{s_c + 2\alpha} \end{cases}$$

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10 Corporate Behavior, Valuation Ratio and Macroeconomic Analysis

G. Abraham–Frois

The introduction of the corporate sector into the post-Keynesian theory of distribution has been worked out by Kaldor in an appendix to his 1966 paper, named, for obvious reasons 'a neo-Pasinetti theorem'. Some reformulations, and precisions will be useful here before coming to comparisons with other approaches or formulations (especially Marris, 1964, 1971; Kahn, 1972; Wood, 1975; Tobin, 1969).

1 A NEO-PASINETTI THEOREM

Kaldor, in the appendix to his 1966 paper (neo-Pasinetti theorem), examines Pasinetti's proposition that 'the rate of profit, in a true long-run Golden Age equilibrium, will be independent of the rate of savings of "workers"'. Two main difficulties appear: first, it is 'very long run'; second, 'it assumes that workers spend the same fraction of their income, irrespective of whether it accrues to them as property income or wages'.

Capital gains, and consumption on capital gains, must be taken into account. So, supply and demand of securities are introduced in a very simple way which must be briefly recalled here.

Wage and salary earners save (through pension funds and insurance companies) some fraction of their income during their working life and consume it in retirement. So long as population and income per head are rising, savings of the working population must exceed the dissavings of the retired population by an amount which can be expressed as some fraction s_w of current wage-and-salary income. Kaldor assumes further that s_w is net of personal investment in consumer durables, i.e. in housing.

Shareholders' net consumption out of capital (i.e. their consumption out of their dividend income) is some fraction, c, of their capital gains G.

Corporations (1) decide on retaining a fraction s_c of their profits, (2) decide in addition to issue new securities equal to some fraction f ($|f| < 1$) of their current investment expenditure gK (K = capital, g = the growth rate).

Hence the general equation for corporate investment (investment is financed either by retained profits or by new securities issued):

$$
\begin{aligned}
gK &= s_cP + fgK \\
\text{with } P &= rK \ (r = \text{rate of profit}), \text{ one gets:} \\
gK &= s_c rK + fgK \\
r &= \frac{g(1-f)}{s_c}
\end{aligned}
\tag{1}
$$

One can remark here that equation (1), which is very important in all analysis of corporate behaviour and investment (cf. for instance Wood, 1975), does not appear *at this stage* of analysis in Kaldor's formulation. This equation appears later in Kaldor's presentation, to which we can now return.

Equilibrium on the Securities Market

Demand of securities: s_wW.
Supply of securities: cG (sale by shareholders of already existing securities resulting from consumption of their capital gains) + igK (issues by corporations of new securities).

Equilibrium on the securities market then requires:

$$s_wW = cG + fgK \tag{2}$$

If N = number of shares, p = price per share, $G = N.\triangle p$ (change in the market value of securities).

'Valuation ratio' V is defined as 'the relation of the market value of shares to the capital employed by the corporations (or the "book value of assets")': $V = pN/K$ (hence V is identical to Tobin's famous q; moreover, price-earning ratio is just equal to the valuation ratio divided by the rate of profit[1]). With the assumption of a constant valuation ratio (Kaldor is looking for an 'equilibrium value' of V), one gets:

$$V\triangle K - p\triangle N = N\triangle p = G \tag{3}$$

Since $\triangle K = gK$ and $p\triangle N = fgK$ (external financing for part of corporate investment):

$$G = VgK - fgK = (V - f)gK \tag{4}$$

Combining (2) and (4):

$$s_wW - c(V - f)gK = fgK \tag{5}$$

Equilibrium on the Product Market

Investment = gK; saving appears as the sum of corporate savings (s_cP) and personal savings: saving on wages *minus* householder's dissaving because of consumption on capital gains (dividend income does not appear in the equation since K has supposed that capitalists (or shareholders) 'overspend their current (dividend) income'). Hence:

$$s_wW - c(V - f)gK + s_cP = gK \tag{6}$$

Subtracting (5) from (6), one gets:

$$s_cP = gK - fgK$$

$$\text{Since } P = rK \Rightarrow r = \frac{g(1-f)}{s_c} \tag{1}$$

and

$$V = \frac{1}{c}\left[\frac{s_w}{g}\frac{Y}{K} - \frac{s_w}{s_c}(1-f) - f(1-c)\right] \tag{7}$$

Interpretation

Hence, given the savings coefficients (s_w and s_c) and capital gains consumption coefficient, there will be a certain valuation ratio V which will secure just enough savings by the personal sector to take up the new securities issued by corporations. Net savings of the personal sector depends not only on the savings propensities of individuals but on the policies of corporations toward new issues.

In the absence of new issues $f = 0 \rightarrow s_wW = cG(2')$. In this special case $V = \frac{1}{c}\left[\frac{s_w}{g}\frac{Y}{K} - \frac{s_w}{s_c}\right]$ (7′) and $r = g/s_c$ (1′).

Kaldor suggests that in this special case where $f = 0$, equation (1) reduces to the simple Pasinetti formula. However, such an interpretation is false. Corporations in the Kaldor models cannot be identified with the pure rentiers/entrepreneurs of the Pasinetti model, Pasinetti's theorem specifies *personal* distributions which are compatible with steady-state growth equilibrium while the neo-Pasinetti theorem deals with *functional* distributions. Moreover, in Pasinetti's model valuation ratio is always equal to unity. 'Since there is no pure rentier in the Kaldor model, no form of the Pasinetti principle can arise therein' (cf. S. J. Moss, 1978, p. 311). Equation (1′) seems quite similar to Pasinetti's formulation but there is no retention ratio in Pasinetti's analysis. So equation (1) is in no sense a generalization of the Pasinetti theorem. It is simply different.

As noted by Kaldor, the issue of new securities by corporations ($f > 0$) will depress security prices (i.e. V) 'just enough to reduce the sale of securities by the dissavers sufficiently to induce the net savings required to take up the issues. If f were negative and the corporations were net *purchasers* of securities from the personal sector . . . the valuation ratio would be driven up to the point at which personal savings would be negative to the extent necessary to match the sale of securities to the corporate sector' (Kaldor, 1966, pp. 310–11) in such case $s_w W - cG = fgK < 0$.

2 DIFFERENTIAL SAVING PROPENSITIES

Kaldor's analysis may be easily generalized. Household saving behaviour is in fact dependent on the form in which income is received, it may be convenient to distinguish between saving propensity out of wages s_w, saving propensity out of dividends (distributed profits) s_p, and capital gains s_g, with, by assumption $1 > s_g > s_p > s_w > 0$. (It has been estimated that for the United States $s_w = (0.02-0.05)$, $s_p = (0.05-0.7)$ and $s_g = (0.9-1.0)$ (cf. Arena, 1965; Sato, 1971; Moore, 1973).)

Total saving is then the sum of corporate saving $s_c P$ and of personal saving: saving on wages *plus* saving on distributed profits *minus* consumption on capital gains. Hence the equation of equilibrium in the product market:

$$s_c P + s_w W + s_p (1 - s_c)P - (1 - s_g)G = gK$$

With, from (1), $s_c P = s_c rK = gK(1 - f)$, and using the definition of G (cf. (4))

and of course $Y = W + P$:

$$gK - fgK + s_w(Y - P) + s_p(1 - s_c)P - (1 - s_g)(V - f)gK = gK$$

Rearranging terms, there appears the general formula:

$$V = \frac{1}{1 - s_g}\left[\frac{s_w Y}{gK} + \frac{(1 - f)[s_p (1 - s_c) - s_w]}{s_c} - s_g f\right] \tag{8}$$

Of course, if $s_p = 0$ (all dividends consumed – which is Kaldor's assumption) and with $c = 1 - s_g$, we are obviously back to (7). But a second particular case must be examined; if we assume that there is only a single savings propensity s_k for the household sector which applies equally to wages, dividends and capital gains, we obtain from (8):

$$V = \frac{1}{1 - s_k}\left[\frac{s_k Y}{gK} + \frac{(1-f)[s_k - s_k s_c - s_k]}{s_c} - s_k f\right]$$

$$= \frac{1}{1 - s_k}\left[\frac{s_k Y}{gK} - s_k\right] = \frac{s_k}{1 - s_k}\left[\frac{Y}{gK} - 1\right] \qquad (9)$$

which is the formula obtained by Kaldor (with these particular assumptions) in n. 8 of his appendix in the 1966 paper. This is of course a very great simplification, but this interesting reformulation must be handled with great care since it is only in this particular case that the valuation ratio is independent of f. More generally, from (8):

$$\frac{dV}{df} = -\frac{[s_p(1 - s_c) - s_w + s_c s_g]}{s_c} = -\frac{[s_p - s_w + s_c(s_g - s_p)]}{s_c} < 0$$

when $s_g > s_p > s_w$ and $dV/df = 0$ in the case of identical savings propensities which applies to all kinds of personal incomes.

3 FINANCIAL BEHAVIOUR OF COMPANIES AND THE NEO-KEYNESIAN THEORY OF DISTRIBUTION

The purpose of Wood's '*Theory of Profits*' (1975) is to explain 'what determines the profit margin of the individual firm and the share of profits in national income' (p. 1). Some clarification is needed here since, in his introduction, the author says that there should not be any confusion between neo-Keynesian theory of the determination of the share of profits and his own position.

'Confusion between them may arise because both postulate that profits are in some sense determined by investment. But the mechanisms involved are completely different,' (op. cit. p. 14). 'The nature of the causal link between investment and profit is not the same in the two sorts of theories. For the present theory [Wood's theory] revolves around the relationship between profits and the availability of finance, an issue which is tangential to the neo-Keynesian theory, while the neo-Keynesian theory revolves around the relationship between the share of profits and the average saving propensity, an issue which is tangential to the present theory' (ibid.).

However the main part of Wood's propositions seem quite compatible with Kaldor's position. This is quite obvious when Wood studies 'The financial behaviour of companies' (cf. ch. 2). Three ratios are consequently defined:

1. The *gross retention ratio* . . . ratio of internal finance (retained earnings and depreciation provisions) to profits. This ratio denoted by the letter r in Wood's notation does not appear to be different from previously defined ratio s_c
2. The *external finance ratio*, defined as the ratio of external finance (new borrowing and share issues) to investment and denoted by the letter x
3. The *financial asset ratio*, defined as the ratio of the acquisition of financial assets (cash, marketable securities, etc.) to investment and denoted by the letter a (our notation)

If P is the level of profits and I the level of investment, the company's total outlay on capital account is $(1 + a)I$, this being the sum of its investment and of financial assets. Total amount of external finance is xI; the remainder of the outlay $(1 + a - x)I$ must be financed internally, so it must be equal to the amount of internal finance s_cP. Thus it follows:

$$s_cP = (1 + a - x) \ \mathrm{I}$$

and:

$$P = \frac{(1 + a - x)}{s_c} \ \mathrm{I} \tag{10}$$

With $P = rK$, $I = gK$, $f = x - a$ we are back to (10) and Kaldor's formulation. There remains an (apparent) difference since this formula appears as the point of departure of Wood's analysis; in Kaldor's approach, as already noticed, formula (1) appeared as *derived* from (5) and (6), conditions of equilibrium on product market, on one hand, and securities market, on the other hand. But, as already said, equation (1), (5) and (6) are compatible, since dependent on each other (two independent equations); hence, there does not seem to remain any difference, on this point, between Kaldor's and Wood's approach.

However, there remains at least a second point of opposition. When he studies 'The share of profits in national income' (ch. 4, op. cit.), Wood tries to combine *two distinct* determinations of this share of profit $\pi = P/Y$. The first one is derived from (10) or (1) (since there is no opposition between them, as already shown):

$$\pi = \frac{P}{Y} = \frac{(1 + a - x)}{s_c} \frac{I}{Y} = \frac{(1 + a - x)}{s_c} \frac{sY}{Y} = \frac{(1 + a - x) \ s}{s_c} \tag{11}$$

But there is a second determination which arises from the 'neo-Keynesian theory of distribution'; there is a well-known relationship between average propensity to save s and share of profits π:

$$s = s_p\pi + s_w(1 - \pi) \tag{12}$$

Combining (11) and (12), the usual degree of freedom is now lost; the share of profits (and the rate of profit) is now independent of the growth rate:

$$\pi = \frac{s_w}{s_c/(1 + a - x) - s_p + s_w} \tag{13}$$

to be compared to the 'basic equation of the neo-Keynesian theory of distribution':

$$\pi = \frac{1}{(s_p - s_w)} g \frac{K}{Y} - \frac{s_w}{(s_p - s_w)} \tag{14}$$

Alternatively, says Wood (p. 117), one could regard total savings as the sum of retained profits and savings out of household income. The relation between s and π would therefore be (our notation):

$$s = s_c\pi + s_k(1 - s_c\pi) \tag{12'}$$

and

$$\pi = \frac{s_k}{s_c[1/(1 + a - x) - (1 - s_k)]} \tag{13'}$$

where s_k is defined as 'the propensity to save out of household income, which we shall assume for simplicity to be independent both of the composition of the household income and of the extent of capital gains on ordinary shares caused by the retention of profits'. In our notation, this means that $s_g = 1$, and $V \rightarrow \infty$.

Using this same assumption, since equations (1) and (12) or (12′) are supposed to be two *independent* relationships in π and g, (and of course in r and g) Bortis (1982) has analyzed existence and stability of growth equilibria in Wood's model (cf. also Lavoie, 1987, ch. 7). But since it implies that there is no wealth effect in consumption behaviour, it seems quite difficult to go along this line. In his 1975 paper, Moore has suggested that because the propensity to save out of capital gains income is extremely high ($s_g > 0.95$), 'changes in equity prices and in V must operate primarily through their effect on investment expenditures rather than consumption expenditures in order to restore equilibrium in the market for current output' (1975, p. 876). For further examination of this point, it may be useful to analyze now the relation between valuation ratio, growth of firms and investment.

Moreover, there appears a much stronger reason to reject this part of Wood's analysis, which is simply wrong on this last point; the two determinants of the share of profit are not really distinct ones. As already stated, the first determinant (11) is equivalent to Kaldor's equation (1), which is derived from equations (5) and (7). When one deals with rate (or share) of profits and valuation ratio, and since equation (7) is based upon a differentiated saving function quite similar to Wood's equations (12) or (12′), there simply does not exist two distinct determinations of π, but just one.

4 VALUATION RATIO AND GROWTH OF FIRMS

The relation between valuation ratio and growth of firms has been throughly studied by Marris, 1964; Kahn, 1972; Odagiri, 1981. In his 'Notes on the rate of interest and the growth of firms' (1972) – which, incidentally, refers to Marris, Marris and Wood, Robinson, Penrose, but *not* to Kaldor – Kahn defines return on share as equal to current dividend *plus* appreciation of share's price. With the assumption of indifference as between dividends and capital appreciation, this means that 'in a perfect capital market the rate of return on all shares will be equal' (Kahn, 1972, p. 211). Rate of interest i is defined as the return on shares, that is:

$$iVK = (1 - s_c)\,P + G = (1 - s_c)P + (V - f)gK \tag{15}$$

The degree of freedom of the model is thus preserved, since the above expression adds both an unknown i and an independent equation (cf. Moss, 1978). Equation (15) may be written as:

$$\begin{aligned} i &= \frac{(1 - s_c)P}{VK} + \frac{(V - f)gK}{VK} = \frac{(1 - s_c)r + (V - f)g}{V} \\ &= \frac{r - rs_c - fg}{V} + g \end{aligned}$$

Since $(1) \rightarrow g = rs_c + fg$

$$i = \frac{r - g}{V} + g \tag{16}$$

or

$$V = \frac{r - g}{i - g} \tag{17}$$

If $r = i$ (Pasinetti's case) $V = 1$. Another special case appears in golden rule equilibrium; with $r = g$, (16) $\rightarrow i = g$ $(= r)$ no matter what may be the value of V. But it is only these very particular assumptions that $r = i$.

Let us consider the case of a rate of profit below the rate of interest: $r < i$ and then $V < 1$. The growth of firms is then questioned. The first reason is quite obvious from (17): $dV/dg = (r - i)/(i - g)^2 < 0$ when $r < i$; so any increase in the growth rate would endanger valuation ratio; according to Kahn, 'in so far as the management have any feeling of loyalty towards the shareholders, the rate of growth will be pushed below the level which would be established if the rate of interest were equal to the rate of profit' (Kahn, 1972, p. 218). But, according to Kahn, a more powerful factor restraining growth is the fear of a 'take-over'. The risk of 'take-over' which is generally negligible when the rate of growth is low, increases in a significant way with the growth rate.

In chapter 12 of *The General Theory*, J. M. Keynes deals with this relationship between valuation ratio and investment rate:

> But the daily revaluations of the Stock Exchange, though they are primarily made to facilitate transfers of old investments between one individual and another, inevitably exert a decisive influence on the rate of current investment. For there is no sense in building up a new enterprise at a cost greater than that at which a similar existing enterprise can be purchased; while there is an inducement to spend on a new project what may seem an extravagant sum, if it can be floated off on the Stock Exchange at an immediate profit. (p. 151)

What are now the implications of a rate of profit which is above the rate of interest? With $r > i$ $V = (r - g)/(i - g) > 1$ for $g < i < r$. The two limiting cases are $g = 0$ and $g = i$. In the first case, $V = r/i$ for $g = 0$ and $V \Rightarrow \infty$ when $g \rightarrow 1$; here $dV/dg = (r - i)/(i - g)^2 > 0$. It is quite clear that V is negative for values of g between i and r, and becomes positive again for values of g that exceed r. But 'these algebraic results have no economic significance' (Kahn, 1972, p. 219).

This seems to imply that there will be no investment when $V < 1$, *not* that investment is related to V (or q). As a matter of fact, Keynes himself, in the above quotation often used by Tobin, seemed to go to the second conclusion. In a short note of the same page, he adds that in his *Treatise on Money* he . . .

> pointed out that when a company's shares are quoted very high so that it can raise more capital by issuing more shares on favourable terms, this has the same effect as if it could borrow at a low rate of interest. I should now describe this by saying that a high quotation for existing equities involves an increase in the marginal efficiency of capital and therefore

has the same effect (since investment depends of a comparison between the marginal efficiency of capital and the rate of interest) as a fall in the rate of interest (ibid.).

So, we are here back to the traditional comparison between rate of interest and marginal efficiency of capital, which, according to J. M. Keynes, is just another, and simpler, way of relating growth rate, or investment rate, to valuation ratio. One might wonder why Kaldor was preoccupied with consequences of valuation ratio on saving and consumption while J. Tobin analysed its consequences on investment. But this is another question. The only relevant conclusion seems to be that a super-unitary valuation ratio ($V > 1$) is a necessary condition for sustained growth.

5 SAVING AND INVESTMENT

There seems to be some contradiction, which should be further analyzed, between positive shares condition and a super-unitary valuation ratio. With his original formulation, Kaldor concludes that, 'given the Pasinetti inequality $gK > s_w Y$, $V < 1$ when $c = 1 - s_w$, $i = 0$; with $i > 0$ this will be true a *fortiori*' (1966, p. 311). And when he assumes that there is only a single savings propensity for the household sector which applies equally to wages, dividends and capital gains, and denoted s_k, the same conclusion holds: 'this implies that $V < 1$, when $s_k Y < gK$' (ibid.).

Since Kaldor does not insist upon the necessity of a superunitary valuation ratio for sustained growth, no contradiction appears. However, if we take into account this necessity, there should be a contradiction . . . which disappears (cf. Moss, 1978) with a more precise formalization of non-negative profit share.

With the assumption of a uniform savings propensity for the household sector s_k, the savings = investment equation can be written:

$$s_k(Y - P) + s_k(1 - s_c)P - (1 - s_k)gK(V - f) + s_c P = gK$$

$$s_c(1 - s_k)P = [1 + (1 - s_k)(V - f)]\, gK - s_k Y$$

Hence:

$$\frac{P}{Y} = \frac{[1 + (1 - s_k)(V - f)]\, gK/Y}{(1 - s_k)s_c} - \frac{s_k}{(1 - s_k)s_c} \tag{18}$$

and:

$$\frac{P}{Y} > 0 \leftrightarrow \frac{gK}{Y} > \frac{s_k}{1 + (1 - s_k)(V - f)} \tag{19}$$

From

$$V = \frac{s_k}{1 - s_k}\left[\frac{Y}{gK} - 1\right] \tag{9}$$

$$V > 1 \leftrightarrow s_k \frac{Y}{gK} > 1 \text{ or } \frac{gK}{Y} < s_k \tag{20}$$

Quite clearly, there is no incompatibility between (19) – condition of positive share profits – and (20) – condition for a superunitary valuation ratio when $s_k > 0$ and $V > 1 > f$. Kaldor's error lay to condition $gK > s_w Y$ (21) whereas it was the condition (19) which was relevant. The original Pasinetti's conditions follow from setting $V = 1$ and $f = 1$ leaving so $gK/Y > s_k$ (19′).

There is furthermore no incompatibility between the condition for positive share profits and the condition for a valuation ratio larger than any arbitrary, non negative constant k. Under the simplified assumption of a uniform savings propensity for the household sector (for a more general treatment cf. Moss, 1978), the proof of this proposition follows by setting the right side of formula (9) greater than k, which yields:

$$\frac{s_k}{(1 - s_k)}\left[\frac{Y}{gK} - 1\right] > k \tag{21}$$

or

$$\frac{s_k}{k(1 - s_k) + s_k} > g\frac{K}{Y} \tag{22}$$

condition which is clearly compatible with (19) since

$$\frac{s_k}{k(1 - s_k) + s_k} > g\frac{K}{Y} > \frac{s_k}{1 + (1 - s_k)(V - f)} \tag{23}$$

is equivalent to:

$$1 + (1 - s_k)(V - f) > k(1 - s_k) + s_k \tag{24}$$

or $1 + v - f > k$

which is always true, since $s_k \in [0\ 1]$, when $V > k$ and $f < 1$.

So, two conclusions appear; the first one, as already stated, is that there is no contradiction between the two conditions of positive profit shares on one hand and of a sustained growth rate (superunit valuation ratio) on the other; but the second conclusion is that there is a change of sense, and of significance, in the usual 'cambridgian' unequalities.

It is well known that under Pasinetti–Kaldor's usual assumptions, $s_w < I/Y$ or $s_w < gK/Y$ is a necessary condition for nonnegative profit share; so savings propensity on *wages* must be *inferior* to a certain critical proportion given by investment rate to national product. Condition $s_k > gK/Y$ (20), which is a necessary condition for sustained growth (and, once again, not contradictory with positive profit-shares condition) is quite different, since it is concerned with household behavior (the simplified assumption of a uniform savings propensity may be generalized to differentiated propensities to save according to different types of revenue; cf. Moss, 1978). But the main point is that households savings propensity must here be *superior* to the (same) critical ratio of investment rate to national product.

This must be compared with what seems to be a neo-Keynesian, or neo-Cambridgian line of reasoning according to which 'those who control the means of production determine all of the real variables of the system, including the functional distribution of income' (Moss, 1978, p. 316). According to Joan Robinson, 'the Keynesian models (including our own) are designed to project into the long period the central thesis of the *General Theory*, that firms are free, within wide limits, to accumulate as they please, and that the rate of saving of the economy as a whole accommodates itself to the rate of investment that they decree' (Robinson, 1962, pp. 82–3). However, condition (20) implies that household behavior does matter; it does not seem that firms do accumulate as they please.

Moreover, the opposition between classical (or neo-Classical) views and Keynesian lines must be reexamined. Neo-Keynesians usually consider investment decisions as independent from households' saving behaviour although the neo-Classical position has frequently maintained that investment is derived from saving. In the above presentation, where investment decisions appear as independent from saving behaviour, a given growth rate cannot be sustained however if valuation ratio is too low, i.e. if households savings are unsufficient, curbing down Stock exchange prices, valuation ratios and investment projects. Hence, in an economic system where financing problems are taken into account, one cannot deny some interdependence between investment and saving decisions.

6 FINANCE WITHOUT MONEY?

It may seem rather peculiar to consider general problems of finance without taking into account, explicitly at least, any kind of monetary analysis; worse, after further examination, Davidson observed: 'Kaldor's statement is truly a surprising *volte-face* for Keynesian theory, especially since it is a neo-Keynesian of Kaldor's stature who appears to be implying that . . . the level of security prices (i.e. the rate of interest) will cause aggregate personal consumption just to fill the gap between the full employment level of output and investment spending.' He goes on '. . . it would appear, at first blush, that Kaldor has unwittingly resinstated the *deus ex machina* of the neo-Classical system – the rate of interest – as the balancing mechanism for creating 'forced spending' if necessary, to maintain full employment' (Davidson, 1972, p. 300).

However this objection does not seem relevant (cf. Leonard, 1979, p. 135, Lavoie, 1987, p. 189) since full-employment is not a necessary assumption for Kaldor's analysis. But there is another, and more important, point in Davidson's book to which we must come briefly now; household saving decisions are independent of household portfolio balances or liquidity preference decisions so that there is no reason to write (as seems to be implied by Kaldor's equations) that households want only securities, and never money. When household's demand for money is taken into account, determination of securities' price, and valuation ratio, comes out in a much more complicated way.

Anyway, part of the question had already been met by Robinson, when, in a brief account of Kaldor's model, she wrote: 'the banking system is assumed to be generating a sufficient increase in the quantity of money to offset liquidity preference at the rate of interest at which net saving out of incomes paid to households, taken as a whole, is equal to net borrowing by firms' (*Economic Heresies*, 1971, p. 123). So according to this quotation, what is just missing in Kaldor's formulation is an *explicit* treatment of the money market.

Moreover, one may stress another point; the 'rate of interest' with which we have dealt until now is just an implicit rate which has just been 'calculated'. When money is explicitly introduced in the model, with preference for liquidity, the rate of interest which will appear will have, of course, another, and more normal, meaning. Even in the simplest case where there are just two financial assets, say money and securities, households will have of course to chose between those two assets. If the explicit rate of interest is fixed $i = \hat{\imath}$ we have now a new equation in the model and the remaining degree of freedom is now lost. From equation (16) we can write:

$$r = \hat{\imath}V + g(1 - V)$$

and, with $r = (1 - f)g/s_c$ we have now two independent equations for two unknowns r and g so that there should be complete determination of r and g. However, in a more precise formulation, it should appear that f is not exogeneously determined; instead we should have $f = f(i)$ with $df/di < 0$. Since $dV/df < 0$ (cf. supra), the determination of V, and stock-exchange variations, are certainly much more complicated than in the ultra-simplified Kaldor's formulation. Anyway the relation between r and g still holds true (with f depending on i, of course), the adjustment laying on V, of course. And, as already said, for a positive rate of accumulation we need a superunitary valuation ratio and this call for a 'sufficient' propensity to save from households.

Household behavior does matter; firms are not exactly free to accumulate as they like. For each firm, there should be no confusion between rate of (capital) accumulation and rate of growth, since it is always possible to have growth without accumulation. On the macro-economic side, things look different; too low a valuation ratio resulting from unsufficient demand for securities from households will imply an impossibility for a positive accumulation rate.

If quotations get too low – under a critical point corresponding to a unitary valuation-ratio – because of households' demand and/or central banks' policies, investment process could be seriously damaged. Of course, for such a situation to develop, plunge in stock prices should be both considerable and lengthy. Both conditions do not seem to have been met after 1987's crash.

Notes

1. P.E.R. being defined by market value of share/net profit by share and valuation ratio V (= q) by market value of share/ accounting value (per share) of capital employed, one gets:

$$V = \frac{\text{P.E.R.} \times \text{net profit by share}}{\text{accounting value (by share)}} = \text{P.E.R.} \times \text{rate of profit}$$

$$V = \text{P.E.R.} \times r \Leftrightarrow \text{P.E.R.} = V/r$$

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Part IV
Money and Macroeconomics

11 The Endogeneity of Money

H. P. Minsky

One cannot conceive of the short rate being 'determined' in any other way than through the discount rate, or the open – market policy, of the central bank. Indeed, it is only through their power to control the whole range of short term interest rates that the monetary authorities can be said to 'control' the supply of money in its broader sense.[1]

1 INTRODUCTION

It was uncharacteristic of Nicholas Kaldor to take an ambiguous stand on any issue, but in the above it is not clear where he stood on the question of the endogeneity or the exogeneity of money, or whether he believed it to be of importance. In his later writings on money he viewed the attempt to control the path of nominal aggregate demand by controlling the path of an arbitrarily defined money supply – the fundamental policy posture of monetarism – as a 'scourge'.[2] If monetarism was a 'scourge' then the authorities by operating on interest rates could determine the supply of money (money supply is exogenous), but the overall impact of such policies was so adverse that it was not wise to do so. Once the price of monetarism became evident the authorities would have to accomodate the markets (money supply is endogenous).

We, with hindsight, know that Kaldor was correct in viewing attempts to determine the 'supply' of money by the central bank as ill advised. The price in the late 1980s of both theoretical and practical monetarism, as advocated and practiced in the United States and Britain in the early 1980s, was high.[3]

The monetarist experiments of the 1980s produced two types of evidence supporting the view that the supply of money is ultimately endogenous. One centers around the development of conditions in financial markets that are interpreted as threatening a financial disaster: the fear is that a debt-deflation process as described by Irving Fisher may be set off.[4] This threat forces the authorities to intervene and refinance the institutions and market participants who are at risk. This process supplies banks with reserves and therefore with the wherewithal to expand the money supply at a rate determined by the needs for financial stability.[5]

The second route to endogeneity of the money supply focuses on bankers and other players in financial markets as entrepreneurs who seek profits by innovating, by developing new ways to finance positions in existing assets and investment (the creation of new assets). Financial innovation also involves the creation of new assets for the portfolios of both individuals and institutions. These new portfolio assets may well take on the characteristics of money.

This second route emphasizes the changing nature of what passes for an economy's money supply. It leads to an emphasis upon the credit or asset side of the balance sheets of financing institutions. The demand for credit takes the form of proposals to finance that bankers first promote and then either accept or reject. Those proposals that meet the banker's standard of the time will be financed and the funds for this financing will be pulled out of the existing stocks of short term financial assets. Furthermore financing leads to the generation of new types of financial instruments that are accepted into portfolios.

There are periods in history and economic conditions where the money supply was mainly endogenous and other periods and conditions where the money supply was largely exogenous. Understanding what conditions makes money endogenous or exogenous is of vital importance for the authorities who guide monetary, fiscal and institution structure policies. Typically the money supply is in part endogenous and in part exogenous. It is necessary to recognize that interventions that are apt in one set of circumstances may well be inept in another set.

As a consummate economic theorist Kaldor instructed us on the complex interdependencies that characterize economic systems. Complex interdependencies imply that if a policy instrument is used to force a particular alignment of a targeted set of economic variables, variables other than those targeted will be affected. As a result the outcomes and the resulting distribution of the costs and benefits from the policy interventions may well differ, typically adversely, from what the policy makers had in mind when they initiated their operations. The United States' experiment with practical monetarism is an example of a policy posture that led to unanticipated undesirable outcomes.

When Kaldor linked the control of the supply of money by the monetary authorities to 'their power to control the whole range of short term interest rates' he was recognizing that there are markets in which the various instruments that enter into any measure of the supply of money are brought into being and that the monetary authorities can affect the outcome in these markets only as its operations impact upon these markets.

Monetary authorities operate as banks. As such they either exchange their liabilities for assets (they lend or invest) or they guarantee some liabilities (they endorse). The terms on which the authorities operate set the prices of particular assets and therefore the present price of some future assured or contingent cash flows. Arithmetically this is equivalent to setting particular interest rates. If the authorities back off from this limited view of what they can do and try to set something called a quantity of money then the impact on system performance and relative asset prices of the interest rate or exchange rate patterns that result are likely to force the hand of the authorities, if not immediately then in time, as undesired side effects become evident. The dramatic breakdown of Mexico and the Penn Square debacle in 1982 forced the Federal Reserve to abandon monetarist postures.

The issue of the exogeneity/endogeneity of money is therefore linked to how financial and banking markets are intertwined one with the other, the linkages of these markets to the rest of the economy and whether the financial market institutions and operators are mechanical reactors or whether they are entrepreneurial profit seekers. In addition the exogeneity/endogeneity of money issue is linked to the analyst's conception of the economic process. If the analyst's priors are that the monetary mechanism determines only the price level and the rate of change of the price level, then the view would be that the money supply is exogenous: the neoclassical vision and the exogeneity of money are linked. If the priors are that the monetary mechanism is a main player in the determination of investment and through investment the level of aggregate demand then the monetary supply is endogenously determined in the financing processes: the Keynesian vision goes along with the endogeneity of money. In a sense the linkages are

exogeneity <--> neutrality and endogeneity <--> non-neutrality.[6]

2 CAPITALIST FINANCIAL PROCESSES

In Nicholas Kaldor's introduction to a collection of his papers, '*Essays on Economic Stability and Growth*,' Keynes's contribution is identified as providing 'a new way of approaching the economic problem – focusing attention on the relationships between a limited number of strategic aggregates – which proved extraordinarily potent in stimulating further speculation along paths that have brought economists *progressively closer to understanding how capitalist economies work*'.[7]

An implication of Kaldor's interpretation of Keynes's contribution is that *The General Theory* is misnamed, for as it is relevant only to capitalist economies it is *A Special Theory*. The special nature of *The General Theory* was recognized by Keynes in the much neglected short and deep first chapter of *The General Theory*, which in its entirety reads:

Chapter 1

THE GENERAL THEORY

> I have called this book the *General Theory of Employment, Interest and Money*, placing the emphasis on the prefix *general*. The object of such a title is to contrast the character of my arguments and conclusions with those of the *classical* theory of the subject, upon which I was brought up and which dominates the economic thought, both practical and theoretical, of the governing and academic classes of this generation as it has for a hundred years past. I shall argue that the postulates of the classical theory are applicable to a special case only and not to the general case, the situation which it assumes being a limiting point of the possible positions of equilibrium. Moreover, the characteristics of the special case assumed by the classical theory happen not to be those of the economic society in which we actually live, with the result that its teaching is misleading and disastrous if we attempt to apply it to the facts of experience.[8]

This insight leads to a need to specify what exactly is 'the economic society in which we actually live'. As Joan Robinson was given to saying, Keynes wrote about capitalism. A generic capitalist economy is one in which private ownership of the means of production results in incomes to owners that in each case depends upon how a particular set of capital assets, organized in firms, performs in some markets. The particular capitalist economy that ruled in Keynes' time was a small government economy with a sophisticated and evolving financial structure that had Central Banks that were reluctant to intervene. Today's American and other rich capitalist economies are big government economies with even more sophisticated evolution prone financial structures which have Central Banks that are willing to intervene.

To Keynes a major misspecification by the classical economics of his time of the economic society in which he lived centered around the treatment of investment as being determined independently of the monetary and financial structure: to Keynes the observed variability of investment could not be explained by changes in productivity and thrift. Investment could not be divorced from portfolio preferences and financing possibilities. The banking system broadly construed had to be taken into account.

The links between money and investment occur in two ways. Portfolios hold monetary assets, liabilities of financial institutions, as protection against contingencies, as well as assets, or claims upon assets, that enter into production. Secondly, investment spending has to be financed. The demand for money is a demand for assurance as well as for convenience in transacting. Bankers who earn the trust of the community are able to give such assurance: bankers can provide customers with guarantees that funds will be available as needed. This enables customers to undertake projects that take time to mature into producers of cash flows. For a capitalist economy to function well financing and the money supply, which reflects the ability of bankers to create generally acceptable liabilities, have to be responsive to demand.[9]

The logic of Keynes' theory required money to be endogenous. The presentation in terms of a given supply was an expository devise. Unfortunately the exogeneity of money became enshrined in the treatment of liquidity preference as a demand for money.

Kaldor gave pride of place in a volume of his collected essays to *Speculation and Economic Stability*, an article which first appeared in 1939.[10] It is a great pity that this truly seminal piece, picking up from Chapter 12 of Keynes's *General Theory*, was half lost in the sweep of history that began in September 1939 and was not at the center of the discourse on what Keynes was about. This 1939 article could have served to anchor an alternative to the mainline Keynesian doctrines that took off from Hicks and Hansen.[11] The dichotimization of money and finance from income determination, that characterized the development of economics in the early post-war period and which gave rise to the now discredited IS-LM interpretation of Keynes, need not have occurred if Kaldor's 1939 paper had become one of the foundations of the main stream.[12]

In this article Kaldor quite properly identifies the essential characteristic of a capitalist economy as the existence of two sets of prices. One set, the prices of current output, embodies the method by which current operating (mainly labor) costs are recovered. The second, the prices of capital assets and financial instruments, are present prices of claims to future incomes which differ in their assuredness. This second set dances around more than the prices of current output. Asset prices therefore call the tune for the demand of the investment portion of current output.

This second set of prices emerge out of portfolio preferences. As Kaldor put it: 'Bonds and shares are perfect objects for speculation.' In Kaldor's view speculation is the phenomena of determining those prices which reflect the necessarily disparate current views about what conditions will rule in the future.[13]

Kaldor's emphasis upon speculation as determining the price level of capital assets is similar to the uses to which Keynes put the term 'speculation': 'Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes a byproduct of the activities of a casino, the job is likely to be ill-done.'[14] Keynes' distinction between speculation and enterprise dealt with the reasons for holding assets and the turbulence that can enter the price system of assets when the weight of assets priced according to the stream of expected earnings declines relative to the weight of assets priced according to the expectation that their price will increase (or decrease) over a short holding period.

After the crash of 19 October 1987 and the failure of the market to function normally around noon of 20 October 1987 there is little need to remind us that the prices of assets that are purchased and held in anticipation of future price increases have no natural resting place once the expectation of further price increases diminishes or is transformed into an expectation of price declines.[15] Of course expected dividends and retained earnings create an anchor for prices, but such an anchor depends upon the fall of current asset prices having little or no direct or indirect effect upon the aggregate of profit flows.[16]

As a first approximation of Keynes's theory could be interpreted as 'focusing attention on the relationships between a limited number of strategic aggregates'.[17] On deeper analysis the monetary variable is institutionally determined. It's content changes even as the authorities act. Keynesian analysis uses the relationships among a limited set of variables as a method of focusing attention upon the facets of an economy whose historical development in response to market stimuli would tend to be similar. 'Money' stands for one such institutional sectoring, labor for another, etc.

3 THE NATURE OF MONEY

Keynes and Kaldor alike emphasize the actual characteristics of 'the economic society in which we happen to live'. In our type of capitalist economy money is a liability which emerges out of the financing that takes place in the economy. Money in such a construction is an endogenous variable, a creature of the functioning of a capitalist economy where positions in capital assets and ongoing investment need to be financed.

One of the oddities of both the standard version of Keynesian theory and the various forms of monetarism is the assumed exogeneity of money. Exogeneity has two senses. One is to define money as a simple multiple of a monetary base, which in turn is controlled by the central bank. The second meaning of exogeneity requires that profit seeking activity be removed from financial markets and institutions.

The question of an apt definition of money has taken up a great deal of time and attention since the quantity theory was revived in its monetarist-econometric form.[18] Often the definition of money used in econometric research was circular. The logic went as follows: theory (the analyst's priors) tells us that money determines nominal aggregate demand, money concept m_i correlates best with the preferred measure of aggregate demand, therefore money concept m_i is money. Furthermore the prior belief that money drives nominal income was so strongly held that evidence that the money concept that led to the best correlation changed over time was taken in stride. A definition of money that is consistent with the institutions and the mechanics of money creation and destruction is needed if economists are to get out of the circle. But any such definition need allow for changing mechanics of money creation and destruction. But this implies that the money supply depends upon profit seeking activity; i.e. money is endogenous.

In our type of economy, especially since gold was demonetized, money is always created in an exchange between a borrower and a lender. Recall the text book version of the multiple creation of money on the basis of an increase in reserves that results from some central bank operation. In each step of the geometric series that is summed to get the ultimate amount of money that is created, each bank is limited to acquiring assets that are $1-r$ times the clearing gain, where r is the legal or traditional reserve ratio. This argument rests upon the usually unstated assumption that there are customers to whom the bank can profitably lend or from whom the bank can safely buy assets equal to $1-r$ times the clearing gain. It is assumed that there are sufficient household, business or government borrowers whose promises to repay with interest warrant the bank's acquiring their liabilities. This assumption is not necessarily so, $\$(1 - r)$ of acceptable deals may not be available.

In the aftermath of World War II, the analysis of banking and the nature of money was obscured by the existence of a great stock of short term government debt which enabled banks to always be fully invested. The existence of a quantity of short term government debt that was large relative to the assets that banks could hold meant that there never could be a shortage of bankable assets: banks would always be fully invested.

Furthermore when bank assets are mainly such government debt there was no need for banks to have a costly loan acquisition function. The overhead of banks could be small relative to the size of their assets: the mark up on the cost of money that would make a deal profitable was small.

Even in the case of banks that hold government debts the model of banking which assumes an automatic transformation of bank ability to acquire assets into bank monetary liabilities requires that a large stock of short term government debt be outstanding. Interest rate risk can act as a barrier to a bank being fully invested when long term government debt is the available asset.

It is a truism that each bank lends what it gets even though the banking system gets what it lends: this is an implication of the fractional reserve nature of banking. However each bank pays for its deposits, either in interest or in services. In today's environment, where assets are largely loans and banks compete vigorously for deposits, the mark up over the cost of money may well have to be in the neighborhood of 400 basis point for a bank to be able to bring 1 per cent of assets down to its after tax profits. This is in contrast to the price of money – interest on asset relations that ruled when asset and liability acquisition were cheaper. At that time a 200 basis point spread was often adequate.

The spread between the interest rate on assets and the cost of money is not the only source of profits in banking: banks and other financial institutions also can earn fee incomes. One of the effects of the higher structure of non-money costs is that banks and other financial institutions actively pursue fee income. Inasmuch as fee income is often booked when new financing commitments are undertaken, the quest for fee income is often a quest for expansion.[19]

In a modern capitalist economy, which is characterized by a complex structure of financial markets and institutions money is a bearer instrument (negotiable without the permission of the debtor) which emerges out of financing relations. The money instrument states a commitment to make payments which is so believable that it is generally acceptable within a transacting group. Therefore the fundamental property of money is that it is a commitment to make payments on the behest of the holder which is believable because there are underlying cash flows that will enable this commitment to be carried out. This belief exists because financing relations always result from cash today for cash later transactions. The instruments that the 'money issuer' holds, which are promises for cash later, are valuable only as the underlying economic situation makes these cash later promises believable. These instruments acquired in the past are generating cash flows to the banker; it is these cash flows that make the banker's promises believable.

The legitimacy of a credit based monetary and financial structure rests upon the assumption that 'bankers' are qualified to select financing deals whose validating cash flows are likely to be forthcoming.

Furthermore bankers are rich: R. S. Sayers once commented that it is the duty of a banker to be rich. Banker are rich because the expected cash flows to the banker are greater than the expected cash flows from the banker which take place as the owners of bank liabilities exercise their option to use their bank assets to make payments. The banker's being rich is what enables the banker to interpose a margin of safety between his assets and his liabilities. The combination of the purported banker's skill in selecting credits, the actuarial properties of a distributed portfolio, and the interposition of banker's wealth as a guarantee of performance by a bankers liabilities serve to enhance banker's liabilities. This credit enhancement makes it possible for bankers liabilities to cost less in either interest or the value of services rendered than what banker's assets earn: bankers therefore manage a fund and earn a fund income.

The financial structure based upon banker's skill, diversification, and wealth which leads to banker's liabilities being very much greater than banker's balance sheet wealth is unstable for it is vulnerable to asset revaluations, shortfalls of underlying cash flows, and fraud. The modern banking process always includes some methods by which a bank can increase the cash flow in its favor by selling or pledging assets: money markets are the arena in which such cash flow management takes place.

Central banks exist to assure that such cash acquisition can take place even if asset revaluations and the underlying cash flows are adverse: central bank interventions have even taken place to paper over questionable behavior when it is believed that the consequences would be disruptive.

4 SECURITIZATION

Kaldor consistently argued that 'new forms of financial intermediaries or transactions will appear which will cause the situation continually 'to slip from under the grip' of the monetary authorities', whenever the authorities tightened controls.[20] The emergence of securitization of assets that previously were in institutional portfolios, in a regime where the asset carrying but not the paper originating capacity of financial institutions was constrained, illustrates the depth of Kaldor's comprehension of capitalist processes as integrating real and financial practices.

The late 1980s emergence of securitization is a phenomena that validates Kaldor's insights about the fundamental impotence of central banking in a capitalist economy with a sophisticated financial system.[21]

Securitization shows that banker's skills in selecting assets, banker's portfolio diversification, and banker's wealth are not the only way credits can be enhanced. Current markets, which are heavily influenced by the behavior of professional portfolio managers, accept erzatz equity, that is created by liability structures, as substitutes for banker's wealth in the enhancement of credit. Positions in assets and investment financing on terms that are competitive with what banks offer can be funded without recourse to banker's wealth and banker's liabilities.

Securitization, a financing process whose importance has been of increasing at an explosive rate over the past several years, illustrates both the endogenous nature of money and the way central bank controls are offset by market developments. It also shows that money is a financing vehicle and that financial markets and not the authorities determine the nature and the quantity of money. The thrust of ongoing financial market changes may very well lead to the development of fully private and even interest bearing currency.

Securitization involves steps and players. One fundamental prerequisite for securitization is that a large and sophisticated market for financial instruments is in place. Large blocks of managed money in the form of pension funds, mutual funds, insurance reserves and managed trusts make up the environment in which the practice emerged. Once securitization had a base in sophisticated holders, the market for the liabilities created by securitization spread to include portfolios that were not professionally managed.

Households, businesses and governments are the issuers of basic financial paper in a closed economy. This paper is always a prior commitment of some income flow. Wages are typically the income flow that sustains household liabilities, profits sustain business liabilities, and taxes sustain government liabilities.

Derivative financial paper is issued by banks, insurance companies, thrift institutions, mutual funds, investment trusts, etc. Income supporting derivative paper is derived from portfolios that combine basic paper and derivative paper.[22] The fund income profits of institutions that hold basic paper and issue derivative paper are derived from the differential between the interest paid on the derivative paper and the interest on the basic paper.

Since World War II modern capitalisms, in which government deficits sustain aggregate business profits, have been successful in avoiding a serious depression. This has led to a large increase in aggregate wealth whose ownership is widely dispersed.[23] By and large the owners of this wealth do not individually own productive assets but they own positions in pension funds, mutual funds, insurance reserves, etc.

Securitization leads to the creation of derivative assets that are claims upon the cash flows generated by portfolios of financial assets that may be mortgages, automobile paper, mobile home paper, and credit card debts.[24] Securitization involves dedicating the cash flow from a specific set of assets to support a set of liabilities. The managed funds provide a market for the instruments that result from securitization.

Basic paper originates in a negotiation between a lender or investor and a unit, henceforth thought of as a debtor, that seeks financing. A generic name for the lender is banker. The banker may be able to fund the paper by issuing derivative paper or may market the basic paper. (Commercial bankers fund, investment bankers market.) The fundamental questions in the negotiations between a banker and a client being financed center around the debtor's prospects for getting the cash to meet the future payments that are being promised. In a world where information is often private, where knowledge is distorted by optimism and pessimism, and where the fundamental behavior of the economy is not known with confidence a banker, with a favorable reputation because of a track record of originating paper that was validated, is able to pay less on liabilities than he earns on assets, or alternatively to sell the assets he creates for more than he paid for them.

Whenever a unit's capacity to create viable paper is greater than its ability to fund it may lay off the paper. The great monetarist pressure of the early 1980s reduced the equity and therefore the ability to fund of many financial institutions. Their ability to create paper exceeded their ability to permanently fund paper. In this situation the separation of paper creation from funding required only the development of a technique for enhancing the perceived quality of financial instruments that did not depend upon the equity of a financial intermediary. In this situation the now limited ability to fund of the paper originating institutions would be used mainly for bridge financing.

The essential actor in the securitization process is an investment banker who brings together the various participants. Each securitization deal is in some measure unique. In addition to the investment banker the players are the paper originators, the servicer of the paper, a trustee, and the holders of the instruments. Securitization takes place when an investment banker makes a deal with one or more paper originators to acquire a portfolio of like debts, say mortgages, automobile paper, consumer credit obligations, credit card liabilities and even bank loans. The investment banker uses this paper as the source of cash flows that will validate some collection of liabilities which he markets. The proceeds of this marketing pays for the paper and serves as the source of the not inconsiderable banker's profits.

In securitization the underlying paper is turned over to a trustee who, once the deal is done, monitors the underlying assets, collects the monies due on the instruments, and distributes the monies the assets generate to the holders of the various securities. The trustee is mandated to act in the interest of the security holders whenever the instruments in the corpus of the trust do not perform, i.e. the contractual commitment to deliver cash to the trustee is not being honored.

The investment banker collects the funds to pay the originator of the paper by selling securities that are claims against the cash flow. The investment banker tailors the liabilities so that the sum of the commitments on the various types of liabilities is less than the expected receipts from the assets in the trust so that the servicing organization and the trustee can be paid. Furthermore, the various claims against the cash that the instruments in the trust generate are sold for more than the investment banker paid for the underlying securities.

This alchemy is achieved by holding assets in the trust that yield more than the prime rate even as a major part of securities that are sold as claims upon the cash generated by the securities in the trust yield the prime rate or the rate on the highest grade of marketable securities. In order to achieve these lower rates on the liabilities the investment banker needs to arrange for the credits in the trust to be enhanced. This may be done by insurance: the fee may be about 1 per cent of the funds guaranteed. Alternatively a hierarchy of securities with claims against the cash flows generated by the assets may be created. Instruments are issued that have a first claim on the cash flows generated by assets in the trust along with instruments that only have a claim on the cash flows after the primary claimants are satisfied. The rating services have to be convinced that the first claim paper that results is virtually default risk free.

The proposition underlying the acceptance of credit enhancement by setting up a hierarchy of claims against the cash generated by a portfolio of assets that individually carry higher than the best available rates is the same as the junk bond proposition: the various layers of debts that are at the head of the queue of claiments will accept a low enough return so that the secondary claiments can receive a prospective return that is high enough to more than compensate them for the greater default risk they accept.

If there was no fraud, once the deal is done both the originating 'banker' and the intermediary investment banker have no contingent liability. Each party in the hierarchy of claiments presumably has taken an informed position.

We can conceive of a portfolio of securities that is in part funded by notes that promise to pay say $1000 or 1000 ECUs to the bearer on a particular date at a multitude of locations, and which will accrue value, at some discount to a well known market rate, after the initial redemption date. Such an instrument, initially issued at a discount from the face value, can function as an interest paying currency. This currency will not be the liability of any bank and will not carry any promise by a central bank or government to support its market value. Its value will rest solely on the expected cash flow to a well-defined bundle of assets. Securitization may well pose a threat to the central role that banks have played in the creation of money.

5 CONCLUSION

Banking is a pervasive phenomena in capitalist economies, and the richer the economy the more pervasive the phenomena. The nature and scope of derivative securities cannot be limited to those issued by banks or otherwise protected institutions. As markets develop we can expect derivative securities to emerge that take on attributes of money.

Kaldor well recognized the evolutionary characteristics of capitalism and in particular that financial markets are not frozen structures. He appreciated the importance of thinking in terms of a few well selected aggregates. He also knew that the composition and significance of these aggregates changed and that these changes may profoundly affect the behavior of the capitalist economy. Thinking in terms of aggregates is an initial step in the analysis of capitalism. The analysis of the evolution of markets in response to prospects for profits is a vital follow on to thinking in terms of aggregates. We are all indebted to Kaldor for showing us how to combine abstract and institutional analysis.

Notes

1. Nicholas Kaldor, *Essays On Economic Stability and Growth*, 2nd edn (New York: Homes & Meier, 1980, p. 6). (Citation from the Introduction, which is dated January 1960.)
2. Nicholas Kaldor *The Scourge of Monetarism*, 2nd edn (New York: Oxford University Press, 1985).
3. William Greider, *Secrets of the Temple: How the Federal Reserve Runs the Country* (New York: Simon & Schuster, 1987).
4. Irving Fisher, 'The Debt Deflation Theory of Great Depressions', *Econometrica*, 1933; Volume 1, pp. 337–57; Charles Kindleberger, *Manias, Panics and Crashes: A History of Financial Crises* (New York: Basic Books, 1978).
5. One aspect of liquidity preference is that the Central Bank can supply banks with reserves but the banks may not use these reserves to expand their liabilities.
6. The exchange between Keynes and Leontief in the Quarterly Journal of Economics of 1936, 1937 is instructive. Leontief criticized Keynes for constructing a theory that had the outcomes 'Homogeneous of degree zero in money wages'. Keynes pointed out that the orthodox theory had no problem with assuming 'Homogeneity of degree zero in the money supply'. A fundamental proposition of Keynesian theory is that money is almost never neutral, monetary changes affect real developments. But if money is deeply embodied in decision making and if money is created as a result of profit making activity then money, of necessity, is endogenous. W. Leontief, 'The Fundamental Assumption of Mr. Keynes' Monetary Theory of Unemployment', *QJE*, Nov. 1936; J. M. Keynes, 'The General Theory of Employment', *QJE*, Feb., 1937.
7. Nicholas Kaldor, *Essays on Economic Stabilization and Growth*, op. cit., ch. 1, p. 1.
8. John Maynard Keynes, *The General Theory of Employment Interest and Money*, New York, Harcourt Brace, 1936, p. 3. I have eliminated the footnote to this chapter in which Keynes explains his use of *classical*.
9. This was well understood by Schumpeter: Joseph Schumpeter, *The Theory of Economic Development* (Cambridge, Mass.: Harvard University Press, 1936) ch. 3.
10. Kaldor, *Essays*, op. cit. 'Speculation and Economic Stability' first appeared in *The Review of Economic Studies*, October 1939.
11. J. R. Hicks, 'Mr. Keynes and the Classics, A Suggested Interpretation', *Econometrica*, 5, 1937, 147–59; A. Hansen, *Fiscal Policy and Business Cycles* (New York: W. W. Norton). 1941.
12. N. G. Manikow, *Recent Developments in Macroeconomics. A Very Quick Refresher Course*, Cambridge Mass. NBER Working Papers n. 2474; H. P. Minsky, *John Maynard Keynes* (New York: Columbia University Press). 1975.
13. Kaldor, *Essays*, op. cit., p. 23.
14. Keynes, op. cit. p. 159.
15. *The Wall Street Journal*, 'Terrible Tuesday: How the Stock Market Almost Disintegrated A Day After the Crash', 20 November 1987, p. 1.
16. H. P. Minsky, 'Central Banking and Money Market Changes', *QJE* May 1957: Reprinted in H. P. Minsky, *'Can It Happen Again?'* (Armonk New York: M. E. Sharpe 1982).
17. Kaldor, *Essays*, p. 1.
18. David Laidler, *The Demand for Money: Theories and Evidence* (Scranton, Penn.: International Textbook Co., 1969).
19. Some of the roots of the S&L problems of the later 1980s were due to the pursuit of fee income.

20. Kaldor, *Scourge*, p. xiv.
21. Kaldor, *Scourge*.
22. Holding companies also issue derivative paper.
23. S. Jay and David Levy, *Profits and The Future of American Society* (New York: Harper & Row, 1983).
    H. P. Minsky, 'Finance and Profits: The Changing Nature of Business Cycles' Chapter 2 of *Can It Happen Again?* op. cit.
24. In May 1987 the buzzword in the corridors of the annual Banking Structure and Competition Conference of the Federal Reserve Bank of Chicago was 'That which can be securitized, will be securitized'. The November 1987 stock market crash slowed the spread of securitization down but it has resumed as the 'crash' recedes in time.

12 On the Endogeneity of Money Supply

J. Tobin

1 KALDOR ON MONETARISM AND ON KEYNES'S MONETARY THEORY

Nicholas Kaldor gave superb testimony on monetarism to the Select Parliamentary Committee in 1980. There and elsewhere, he effectively criticized Milton Friedman's empirical claims that Money causes Nominal Income. One of his criticisms was essentially econometric, namely that Friedman was using as evidence correlations over periods when central bank policies were accommodative. That is, the authorities were deliberately allowing money stocks to respond to income variations. Such correlations could not indicate what would have happened if the central banks had not been accommodative.[1] Kaldor was surely right in making this econometric point. Of course, the fact that Friedman's correlations don't prove his case does not support any other proposition about the effects of non-accommodative policy.

Elsewhere, Kaldor has criticized Keynes for giving aid and comfort to monetarism by treating 'M' as an exogenous variable in *The General Theory*.[2] I have not been sure how to interpret this criticism. Kaldor might have meant simply that it was unfortunate as an expository device because it encouraged a misleading mind-set. He might have meant that it was an unrealistic depiction of monetary policies. He might have meant something more substantive – that Keynes's theory attributed to monetary policies too much power over output, employment, and prices. Kaldor in 1959 had been influential in bringing the Radcliffe Committee to its view that monetary policies and financial events were a sideshow to the main economic theater.

This last possible meaning seemed to me an unfair and inaccurate portrayal of Keynes's macroeconomics.[3] In fact, the great advantage of Keynes's theory was to delineate the circumstances under which monetary policies and events would and would not affect macroeconomic performance. Moreover, Keynes's apparatus can easily be adapted and elaborated to handle any rule, any degree of accommodation, characterizing central bank policy, whether pegging the interest rate, fixing a monetary quantity, or something in between.

2 'ENDOGENOUS MONEY' AND THE EFFECTIVENESS OF MONETARY POLICY

I do not know what to make of the current excitement about 'endogenous money'. So far as central bank behavior is concerned, we have seen several regimes in the US the past forty-five years. Interest rate pegging, to which the Fed committed itself during World War II, continued until the Accord of 1951. Clearly monetary quantities were endogenous and 100 per cent accommodative during this period. Basic interest rates were exogenous.

The Accord was followed by 'leaning against the wind', a semi-accommodative policy, under which money supply could be roughly and over-simply described as an upward-sloping function of a (nominal) market interest rate. What was exogenous was the Fed's supply function, in position and slope. Given this rule, both money supplies and interest rates were endogenous.

In the early 1960s, the 'bill rate only' policy meant that money supply accommodated money demand at a constant short-term rate, the lowest the Fed regarded as internationally safe. This rate in a sense was exogenous, though changed from time to time in the light of national and international economic and financial conditions.

In the late 1960s and 1970s Fed policies and procedures became more monetarist and less accommodative, monetary quantities became less endogenous, and interest rates became more endogenous and more volatile. The monetarist peak, of course, occurred in the three years October 1979–October 1982. Since that recessionary period, the Fed has set short term interest rates in the light of macroeconomic performance (output, employment, prices, trade balance) and allowed monetary quantities to adapt to monetary demands at those rates under those macroeconomic conditions, downgrading monetary aggregates *per se*.

None of this history is obscure. None of it is at variance with existing monetary and macroeconomic theories. None of it says that monetary policies are ineffective. Indeed the weight of evidence is that Federal Reserve policies have been very effective indeed. Six of nine post war recessions are directly attributable to deliberate monetary policies, conscious anti-inflationary moves. Most recently, both the recessions of 1979–82 and the subsequent recovery were generated and managed by the Fed. The 1979–82 recessions were world-wide. All central banks successfully pursued restrictive monetary policies to subdue inflation. Unlike the Fed, European central banks never reversed gear. Unlike the US, their economies never recovered.

3 OPERATING PROCEDURES

I believe the sketch I have just given is essentially correct. But it does not look inside the black box containing the mechanisms that link actual central bank operations to financial markets, interest rates, monetary quantities, and macroeconomic outcomes. As many of us repeatedly pointed out in exasperated reaction to vulgar monetarism, the Federal Open Market Committee has in its chambers no push-buttons marked M_1, M_2, M_3, or \$GNP. These variables are endogenous in the sense that the paths of their values depend not only on operations the Federal Reserve does control but also on the responses and behaviors of banks, other financial market participants, and multitudes of other agents throughout the world.

Indeed we cannot even say that the Fed strictly determines M_0, the monetary base, either its total or just its unborrowed magnitude, or the aggregate of reserve funds available to depositories subject to reserve requirements. The Federal Reserve can by open market operations on its own initiative expand or contract its assets. But it does not directly control the forms of the corresponding liabilities, some of which – for example, Treasury deposits and the deposits of other governments – are not monetary. Public demands for currency in preference to deposits vary seasonally, secularly, and randomly; they may also respond systematically to interest rates and other economic variables. Banks' demands for excess reserves and banks' borrowing from the Federal Reserve respond endogenously to market interest rates, the Fed's discount rate, and other variables. They also vary seasonally and randomly.

Do these endogeneities prevent the Fed from following policies that effectively fix monetary quantities, like the base or unborrowed reserves or total reserves? They do not. These are short-term endogeneities. In practice the Fed can predict many of them and gauge its operations accordingly. Anyway, the relevant statistics are collected continuously, enabling the Fed to offset quite promptly unexpected and undesired developments. Of course, the more distant a monetary target variable is from its operating instruments, the more difficult it is for the central bank to keep it on track, and the longer it takes. Nevertheless, experience indicates that the Fed can keep M_1, perhaps even M_2, on track within periods of six months to a year. This was surely demonstrated during the three years October 1979 to October 1982, when the Fed's policies were definitely and deliberately monetarist.

During those three years, the operating procedures of the Fed were, like the targets, quantitative. That is, they were designed to make the supply of reserves to the banks exogenous. They succeeded in doing so. Fluctuations in demands for reserves made interest rates extraordinarily volatile.

During most of the post-war era, it is true, the Fed used interest rates as its week-to-week control variables. The Fed certainly can make exogenous the interest rates in markets in which it is prepared to intervene enough to work its will. But since the Accord of 1951 there has been no commitment to peg interest rates. Moreover, interventions were largely confined to keeping short rates, those for T-bills and Federal Funds, within temporary target bands. The intervention bands were frequently changed at or even in between Open Market Committee meetings, held about eight times a year. Thus a policy in which interest rates were effectively endogenous and monetary quantities exogenous could be carried out with interest rates as operating instruments.

4 CONCLUSION

If the message of the 'endogenous money' movement is meant to be that macroeconomic outcomes are beyond the control of the monetary authorities, it is refuted by recent history in the United States and elsewhere. Central banks have repeatedly falsified predictions that the innovations and ingenuities of financial markets would render them impotent. What is endogenous and what is exogenous continues to depend on the policy rules and operating procedures of monetary authorities.

Notes

1. This point was a familiar one in the debates about monetarism in the United States in the 1960s, in which a further point was made: Friedman was using these correlations as evidence at the very same time he was criticizing central banks for being so accommodative.
2. 'Keynesian Economics after Fifty Years', in J. Trevithick and G. N. D. Worswick (eds), *Keynes and the Modern World* (Cambridge: Cambridge University Press, 1983).
3. See my discussion of Kaldor's paper in Trevithick and Worswick, pp. 35–6 and the review article by Walter Salant, *Journal of Economic Literature*, 23, September 1985, pp. 1176–88.

13 Marx, Keynes, Kalecki and Kaldor on the Rate of Interest as a Monetary Phenomenon

B. J. Moore

1 INTRODUCTION

In the investigation of how the social surplus was distributed, Adam Smith, David Ricardo, J. S. Mill and Karl Marx all viewed the rate of interest as some proportion of the rate of profits. Their analysis attempted to describe the factors which determined this proportion, and which prevented the rate of profit from falling to the rate of interest.

When the classical approach was superseded by the development of neo-Classical analysis at the end of the last century, it was concluded that the rate of interest was determined ultimately by the same real forces governing the marginal productivity of capital as were profit rates. In long-run steady-state equilibrium the two rates were considered equal. Observed differences between them were explained in terms of unequal levels of risk, maturity, liquidity, transactions costs, etc. among alternative investments. Analysis of the relationship between interest and profits receded in importance.

Controversy over the relation between interest and profits revived with the publication of the *General Theory*. Keynes attempted to distinguish the factors determining the rate of interest as a 'purely monetary phenomenon' from the real productive forces determining the marginal efficiency of investment and the rate of profits. He was at base concerned to refute the neo-Classical argument that market economies were by nature self-equilibrating at full employment, in which interest rate adjustment held a position of prominence.

The Ricardian vision, that productions are essentially bought by productions, ultimately underlies Say's Law.[1]

> No man produces, but with a view to consume or sell, and he never sells but with an intention to purchase some other commodity . . . By producing, then, he necessarily becomes either the consumer of his own goods, or the purchaser and consumer of the goods of some other person (Ricardo, 1951, vol. 1, p. 290).

The loanable funds theory that interest rates were determined by 'real' forces since they equilibrated the supply of 'funds' from savings (thrift) with the demand for 'funds' for investment (productivity), played a central role in the neo-Classical explication of Say's Law. The neo-Classical theory of interest and profit can rigorously be shown to be appropriate for only a one-asset barter or cooperative economy (Rogers, 1989). Keynes argued that it did not hold for a monetary economy, where output was determined by effective demand.

There was always a minority strain of economists who emphatically rejected this full employment of self-equilibrating vision of capitalist market economies. This study presents a brief sketch of how four major such economists – Marx, Keynes, Kalecki and Kaldor – attempted to formulate the differences between a barter and a monetary production economy, with primary reference to their insights that interest rates should be explained as a 'monetary' rather than a 'real' phenomenon.

2 MARX

In *Theories of Surplus Value* Marx criticized Ricardo's denial of the possibility of general overproduction, with its assertion that 'productions are always bought by productions.' He argued that Ricardo had failed to distinguish 'commodities' from 'products.' Marx maintained that barter of products, the exchange of simple use values, referred to a time *before* capitalist production. Commodities must undergo a process he called 'metamorphosis,' which he represented as *M–C–M*. The first phase *M–C* is called the purchase, and the second, *C–M* is called the sale. The possibility of crisis lies in the separation of sale from purchase.

The conversion of the product into money was the *sine qua non* for commodity production (Marx, 1968). Marx argued in essence that Ricardo had seriously misrepresented the organization of production under capitalism. Production was not a case of *C–M–C*, of exchanging commodities (or effort) for money in order to obtain other commodities –, i.e., the neo-Classical (barter) metaphor. Under capitalism exchange was rather *M–C–M* – i.e., parting with money in exchange for commodities in order to obtain more money.

> The capitalist's immediate objective is to turn this commodity, or rather is commodity capital, back into money capital and thereby to realize his profit . . . the immediate purpose of capitalist production is not 'possession of other goods' but the appropriation of value, of money, of abstract wealth (Marx, 1969, p. 503).

With regard to Marx's treatment of interest it should be noted that vol. 3

of *Capital*, where Marx develops his analysis of the relation between interest and profits, was composed by Engels out of a 'disorderly mass of notes, comments and extracts' rather than a finished draft (Marx, 1972, p. 4). Marx unfortunately never completed his formal analysis of credit and the credit system.

In *Capital* Marx proceeded by first singling out the three classes of people acting in the process of reproduction: money-capitalists, industrial-capitalists, and workers. The money-capitalist owns the interest-bearing capital, alienates it by lending, and the revenue he receives is interest. The industrial-capitalist, not working with his own capital, has to pay interest to the money-capitalist. The industrial-capitalist borrows and employees money capital in the sphere of production to 'exploit labor' and 'generate surplus value.' In the process money capital is transformed into productive capital.

For Marx surplus value is generated only within the sphere of production. The role of money-capitalist is to make capital available to the industrial-capitalist. The money-capitalist does not himself create any surplus value, but simply earns a part of the surplus value generated in the production process. The relationship is antagonistic because what the industrial-capitalist earns is not the gross profit (surplus value) generated by the capital he has employed, but only the gross profit minus the interest he has to pay to the money capitalist.

Marx believed that the rate of interest represented a fairly constant proportion of the rate of profits. While the rate of profit represented the maximum upper limit to the rate of interest, the lower limit was 'altogether indeterminable' (Marx, 1972, p. 360). Interest was a 'commodity sui generis' (Marx, 1972, p. 339).

> The average rate of interest prevailing in a certain country . . . cannot be determined by any law. In this sphere there is no such thing as a natural rate of interest in the sense in which economists speak of a natural rate of profit or a natural rate of wage . . . The determination (of the average rate of interest) is accidental, purely empirical, and only pedantry or fantasy would seek to represent this accident as necessity (Marx, 1972, pp. 362–3).

There is no such thing as the 'natural' rate of interest because the material laws of capitalist production cannot regulate the price of a commodity which exists only outside the sphere of production. Marx argued that there is no way other than by 'common consent' of determining what proportion of profits belong to the lender and what to the borrower. Nevertheless he attempted to itemize some of the forces which would affect the average conditions of competition between lenders and borrowers, including custom, legal tradition, the supply of interest-bearing capital, and state regulation (Marx, 1972, p. 362). He maintained that industrial-capital partially subjugates interest-bearing capital through the creation of the credit system, and conceived the behavior of monetary institutions as reflecting the distribution of power in the Social Structure.

> The State is used against interest-bearing capital by means of compulsory reductions of interest rates, so that it is no longer able to dictate terms to industrial-capitalists (Marx, 1972, p. 468).

Marx concluded his analysis by suggesting that bankers could be viewed as simply the 'cashiers' of the industrial capitalists, paid in the form of fixed charges on the receipts and payments they make on account (Marx, 1972, Pt 5). Marx recognized that 'their profit is generally made by borrowing at a lower rate of interest than they receive in loaning' (Marx, 1972, pp. 402–3). However he never worked out a systematic treatment of credit or banking behaviour in a monetary production economy.[2]

3 KEYNES

In his initial drafts of the *General Theory* Keynes approvingly endorsed Marx's distinction between a barter or real exchange economy and a monetary production or entrepreneur economy. As he expressed it, the essential characteristic of a monetary production economy is that firms and entrepreneurs have no object in the world except to end up with more money than they started with (Keynes, XXIX, p. 89). Like Marx, Keynes argued that the rate of profit emerges in the 'industrial circulation,' while the rate of interest emerges in the 'financial circulation.' While paid ordinarily out of profits, Keynes maintained that the rate of interest was entirely a monetary phenomenon.

One of Keynes' principle motivations in the *General Theory* was to refute the loanable funds theory of interest, since this conflicted directly with his theory of effective demand. He accomplished this by developing his own 'liquidity preference' theory of interest, proposing that the rate of interest was determined by the supply and demand for 'liquidity.' Keynes accepted the neo-Classical argument that in equilibrium the rate of interest would be equal to the marginal efficiency of capital. But he emphatically reversed the neo-Classical direction of causality:

> what the schedule of the marginal efficiency of capital tells us, is, not what the rate of interest is, but the point to which the output of new investment will be pushed, given the rate of interest (Keynes, VII, p. 184).

Like Marx, Keynes rejected the concept of a natural rate of interest *à la* Wicksell, since he could envisage no market mechanism whereby the rate of interest would automatically adjust to the full employment level. He argued that the level of interest rates was a highly psychological and conventional phenomenon, 'its actual value is largely governed by the prevailing view as to what its value is expected to be' (Keynes, VII, p. 202).

In the *General Theory* Keynes developed a variety of arguments why for money alone its marginal efficiency would not fall in response to an increase in demand, so that

> the money rate of interest, by setting the pace for all other commodity rates of interest, holds back investment in the production of these other commodities, without being capable of stimulating investment for the production of money, which by hypothesis cannot be produced . . . Unemployment develops, that is to say, because some people want the moon (Keynes, VII, p. 235).

Keynes was forced into such unpersuasive metaphorical arguments about the exogeneity of the floor own rate of return on money (VII, Ch. 17, 'The Essential Properties of Interest and Money') by his tactical decision to accept 'the quantity of money as determined by the action of the central bank' (Keynes, VII, p. 247). Had he incorporated instead his earlier insights into the *Treatise*, that central banks set the level of interest rates rather than the quantity of the money supply, he would have been able to reach his essential conclusion, that interest rates are a monetary and not a real phenomenon, and that the return on money is exogenous and so 'rules the roost,' much more simply and directly.

In the *General Theory* Keynes purposely fitted 'technical monetary detail' into the background, in order to concentrate on his major battle against Say's Law. But in the *Treatise* he had argued at length that, 'the Central Bank lacks direct control over the quantity of money . . . the governor of the whole system is the rate of discount' (Keynes, V, p. 211).

Keynes explained the existence of a long-term floor rate of interest (his 'liquidity trap') as caused by an indefinite increase in speculative demand for money balances, once interest rates had fallen to historically unprecedented low levels. He argued that at some low but positive floor level of interest rates, expectations that future rates would rise would come to dominate. Expected capital losses on bonds would then cause the speculative demand for money to rise indefinitely.

Keynes' explanation for the liquidity trap does not apply to short-term rates, where capital losses do not occur if rates rise in the future. Once central banks are viewed as setting the level of short-term interests rates, rather than the money supply, a very much simpler explanation for a positive floor level of bank lending rates is available, which does not require any particular assumptions about the behavior of money demand.

Central banks can ordinarily reduce short rates to any low if positive level. Due to the nominal zero return on currency, nominal short-term market rates and the nominal rates banks pay on transactions deposits can never fall *below* zero. The nominal yield on time and savings deposits must ordinarily somewhat exceed zero, in order to compensate holders for any imposed sacrifice of liquidity. The floor level of bank short-term lending rates is determined by the spread which must be charged to cover the average costs of intermediation.

> As the pure rate of interest declines it does not follow that the allowances for expense and risk decline *pari passu*. Thus the rate of interest which the typical borrower has to pay may decline more slowly than the pure rate of interest, and may be incapable of being brought, by the methods of existing banking and financial organization, below a certain minimum figure (Keynes, VII, p. 208).

Even if, as in the late 1930s, the US authorities succeeded in lowering wholesale rates (the 'pure rate of interest') to a few basis points (0.03 per cent), as a result of the spread required to cover the costs of bank intermediation, average nominal leading rates charged by banks never fell below 1.5 to 2 per cent. This is surely a much simpler and more persuasive explanation of the 'liquidity trap.' Long-term rates can then be viewed as simply the market's expectation of the average level of future short-term rates, which will depend on the state of the economy and the central bank's 'reaction function.'

Because Keynes in the *General Theory* proceeded as if the nominal money stock was determined exogenously by the monetary authorities, his liquidity preference theory of the determination of interest rates was unfortunately indeterminate. On his own logic, the demand for money and so the level of interest rates would vary with the level of income. Any resulting change in interest rates would then feed back to affect investment spending.

It was this circularity which Hicks' IS–LM analysis was designed to rescue, but which, by an internal logic of its own, developed into the infamous 'neo-Classical synthesis.' The IS–LM analysis concludes that in long-run equilibrium, assuming some downward wage and price flexibility, interest rates and aggregate demand must continue to adjust through the real balance effect until full employment was finally attained. This was in fact the very neo-Classical conclusion, that in the long run money is neutral and interest rates are determined solely be real forces, that Keynes had always been at utmost pains to deny.

In his correspondence with Hicks concerning the latter's technically brilliant 'Mr Keynes and the Classics,' Keynes was sufficiently off-balance to write, 'I . . . really have next to nothing to say by way of criticism.' However he then went on to add,

> From my point of view it is important to insist that my remark is to the effect that an increase in the inducement to invest *need* not raise the rate of interest. I should agree that, unless the monetary policy is appropriate, it is quite likely to. In this respect I consider that the difference between myself and the classicals lies in the fact that they regard the rate of interest as a non-monetary phenomenon, so that an increase in the inducement to invest would raise the rate of interest irrespective of monetary policy – though they might concede that monetary policy was capable of producing a temporary evaporating effect (Keynes, XIV pp. 79–80).

This correspondence reveals that, even immediately after the *General Theory* was published, Keynes viewed the level of short-term rates as in practice effectively determined simply by the policy of the monetary authorities, as he had earlier maintained in the *Treatise*. This in spite of the fact that he had just developed a sophisticated theory of 'liquidity preference' as his brand new 'general' explanation of interest rate determination.

The logic of Keynes' own analysis would seem to demand that the rate of interest be determined exogenously from outside his system. As Pasinetti has noted,

> What this theory [of effective demand] requires as far as the rate of interest is concerned, is not that it be determined by liquidity preference, but that it is determined *exogenously* with respect to the income generating process. Whether, in particular, liquidity preference, or anything else determines it, is entirely immaterial (Pasinetti, 1974, p. 47).

It seems quite clear that in the *General Theory* Keynes intended that the long-run rate of interest, one of the key determinants of the level of investment spending, should be treated as a largely exogenous factor, and determined not by real forces but by conventions and expectations. One year before his death, in a memoranda to the Public Debt Committee, Keynes stated what must be regarded as his final position on the matter quite unequivocally:

> The monetary authorities can have any rate of interest they like . . . Historically the authorities have always determined the rate at their own sweet will, and have been influenced almost entirely by balance of trade reasons and their own counter-liquidity preference (Keynes, XXVII, pp. 390–2).

4 KALECKI

In many central respects Kalecki's views are astonishingly anticipatory. He commenced his *Theory of Economic Dynamics* (1954) as follows:

> Short-term price changes may be classified into two broad groups: those determined mainly by changes in the cost of production and those determined mainly by changes in demand. Generally speaking, changes in the prices of finished goods are 'cost-determined' while changes in the prices of raw materials inclusive of primary foodstuffs are 'demand-determined.' The prices of finished goods are affected, of course, by 'demand-determined' changes in the prices of raw materials, but it is through the channel of *costs* that this influence is transmitted (p. 11).

This is precisely the distinction later drawn by Hicks between 'fix-price' and 'flex-price' markets, and by Okun between 'customer' and 'auction' markets.

Unfortunately, Kalecki's ideas on money and finance were never systematically developed. Moreover the terseness of his style leaves much to the reader's imagination. Kalecki made little use of, and was actively hostile to, neo-Classical analysis, with its concepts of marginal productivity and general equilibrium. He made no use of either utility or production function concepts. Kalecki was concerned with the historical evolution of an economic system through calendar time, without imposing any view that the system would reach some ultimate 'balanced growth' equilibrium position. Like Marx he undertook his analysis at the level of social classes rather than of individuals. Like Keynes he took investment as the driving force of the system, to which savings always adjust.

From his earliest writings Kalecki explicitly regarded interest rates as a monetary phenomenon. He emphatically dismissed the view that they were determined by the interplay of the forces of thrift and productivity.

> The rate of interest cannot be determined by the demand for and the supply of capital because investment automatically brings into existence an equal amount of savings. Thus investment 'finances itself' whatever the rate of interest. The rate of interest is therefore the result of the interplay of other factors (Kalecki, 1954, p. 73).

If investment is the active force, and savings the passive response, how is investment financed? One important but much neglected contribution of Kalecki was his early recognition that decisions to have a higher level of investment expenditure can be affected only if there is an expansion in bank lending. This is necessary to generate the finance required for the increased investment, since the previous level of savings would not be adequate. This same finance problem was faced by Keynes in defense of his liquidity preference against the loanable funds theory of interest, when he was belatedly forced to introduce an additional 'finance' demand for money.

In his discussion banks are seen as not effectively constrained in their lending, and generally able to meet increased demand for loans. In particular money is easily expanded in response to increased plans for investment expenditure. He thus viewed money as endogenous credit or bank money. As such, money does not constitute net wealth, so that Kalecki recognized immediately that the Pigou effect would operate 'only to the extent to which money is backed by gold' (Kalecki, 1944). He also recognized that falling prices and wages would increase the real value of outstanding debts, leading to debtor bankruptcies and possible financial crises.

Kalecki believed that both the creation of money and the terms under which it was created were crucial to the expansion of investment and output (Kalecki, 1971). He argued that the precondition for an upswing to occur was that bank lending rates should not increase too much in response to an increased demand for credit.

> The increase in output [from invention-induced new investment] will result in an increased demand for money in circulation, and this will call for a rise in credits of the Central Bank. Should the Bank respond to it by raising the rate of interest to a level at which total investment would decline by the amount equal to the additional investment caused by the new invention, no increase in investment would arise, and the economic situation would not improve (Kalecki, 1971, pp. 29, 30).

This passage seems clearly to imply that interest rates are directly determined by the monetary authorities. Nevertheless when he explicitly addressed the determination of interest rates, Kalecki told the conventional Keynesian story (Kalecki, 1954, Chs. 6 and 7). He first observed that the level of short-term rates, the renumeration for holding bills rather than money, was the main determinant of the velocity of money held for transactions purposes. He expressed this as $T/M = V(r_s)$, where T is the nominal value of transactions, M the supply of money, V the velocity of circulation and r_s the short-term interest rate. Kalecki then simply inverted this equation, and expressed the determination of short-term rates as a function of the ratio of transactions to the supply of money ($V(r_s) = T/M$). This was simply Keynes' liquidity preference theory.

Kalecki's inference from his inversion that the relation between transactions and money causally determined the short rate is legitimate only if transactions and the money supply can legitimately be viewed as independent – i.e., if the money supply were determined exogenously by the monetary authorities and banking policy, rather than endogenously credit-driven. But this was precisely what he had explicitly denied in his discussion of the business cycle.

Kalecki similarly argued that long-term rates were determined by portfolio balance considerations – i.e., the relative advantages and disadvantages of holding short- and long-term securities. The disadvantage of bonds (c) is their expected capital uncertainty, and the disadvantage of bills (e) is their expected income uncertainty. These must balance out for wealth-owners, so that at the margin $r_L - c = r_s - e$, or rearranging, $r_L = r_s + (c-e)$. This led Kalecki to stress that the long-term rate was a linear function of the short-term rate, so long as c and e were constant. He emphasized that it was the long-term rate which was crucial for investment decisions. However he concluded that since the longer rate did not vary substantially over the cycle, 'it can hardly be considered as an important element in the mechanism of the business cycle' (Kalecki, 1954, p. 88).

As another anticipatory position, Kalecki viewed the cost of finance to firms as rising with the cost and amount borrowed, with the ease of borrowing being related to the size of profits and the wealth of the borrower. This contrasts sharply with the neo-Classical assumption, that competitive capital markets could be viewed as analogous to competitive nonfinancial markets, in the sense that all firms are able to borrow as much as they want at the prevailing rate of interest.

Kalecki's principle of 'increasing risk', properly interpreted, limits the rate of growth of firms, rather than their ultimate size. He concluded that due to the importance of 'increasing risk,' the level of internal finance and so firm profitability had a strong influence on individual firm investment decisions (Kalecki, 1954, p. 96).

> The size of a firm thus appears to be circumscribed by the amount of its entrepreneurial capital, both through its influence on the capacity to borrow capital and through its effect on the degree of risk (Kalecki, 1971, p. 106).

In one of his first papers (1933) Kalecki suggested as a 'crude approximation' that the rate of interest is simply 'an increasing function of gross profitability,' since '*it is known that in the course of the trade cycle the rate of interest rises in the upswing and falls in the downswing*' (Kalecki, 1971, pp. 7, 13, 14). He later stated that 'the process by which banks increase the supply of money deserves to be considered in some detail' (Kalecki, 1954, p. 77). However he failed to carry this out, at least in his published writings. After the above passage he simply confined himself to two short paragraphs presenting the following thought experiment.

> Imagine that banks decide to reduce their cash (reserve) ratio . . . and buy bills. The price of bills will rise and thus the short term rate of interest will fall to that level at which the 'public' will be prepared to add to their current accounts the amount the banks expend on bills. It is of interest to note that the buying of bonds by banks will have similar repercussions (Kalecki, 1954, p. 78).

While at times he viewed short rates as determined by the central bank, unfortunately he never developed explicitly how he viewed interest rates on bank loans as determined, nor the manner in which they were administered by the monetary authorities.

5 KALDOR

Kaldor is important as probably the first English-speaking economist of international stature to have emphasized the critical distinction between a commodity-money and a credit-money economy:

> In the one case money has an independent supply function, based on production cost, while in the other case new money comes into existence in consequence of, or as an aspect of, the extension of bank credit (Kaldor, 1986, p. 22).

Kaldor vividly described his conversion to the position that interest rates are exogenously determined by central banks while the money supply is endogenously credit demand-determined, as follows:

> Friedman's emphatic reassertion of the quantity theory of money – based on a stable demand for money or a stable velocity: the two come to the same thing – was crucially dependent on the quantity of money being really exogenous, determined by the fiat of the monetary authorities quite independently of the demand for it . . . When I first heard of Friedman's empirical findings, in the early 1950s, I received the news with some incredulity, until it suddenly dawned on me that Friedman's results must be read in *reverse*: the causation must run from Y to M, and not from M to Y. And the longer I thought about it the more convinced I became that a theory of the value of money based on a commodity-money economy is not applicable to a credit-money economy (Kaldor, 1986, p. 22).

Kaldor does not state at what date this 'sudden dawning' occurred. What signs are there in his published writings of the date of his conversion?

It should first be noted that Kaldor had long been critical of the excessive powers economists conventionally ascribed to the monetary authorities (see his 1941 review article, 'Pigou on Employment and Equilibrium,' Kaldor, 1960, pp. 82–100.) Kaldor never regarded monetary control as implying that the authorities were able to choose a particular quantity of money. As early as 1939, in 'Speculation and Economic Stability,' he had argued that the interest elasticity of supply of cash balances was very high. He even drew a footnote diagram with an only very slightly upward-sloping money supply function. He then argued:

> [the current short rate is dependent] only on current demand for cash balances (for transactions purposes) and current supply. And since the elasticity of the supply of cash with respect to the short-term rate is normally much larger than the elasticity of demand, the current short-term rate can be treated simply as a datum, determined by the policy of the central bank (Kaldor, 1960, p. 39).

At this stage Kaldor attributed money supply elasticity only to transactions balances. The broad monetary aggregates and the quantity of the base were still viewed as if they were exogenously under central bank control.

> The elasticity of the supply of money in a modern banking system is ensured partly by the open-market operations of the central bank, partly by the commercial banks not holding to a strict reserve ratio in the face of fluctuations in the demand for loans, and partly it is a consequence of the fact that under present banking practices a switchover from current deposits to savings deposits automatically reduces the amount of money in existence, and vice versa (Kaldor, 1960, p. 40).

The orthodox position, that causality runs from exogenous changes in M to Y, is implicitly present in a 1955 paper. He there argued that since the interest rate charged on bank advances was fairly rigid,

> the commercial banks thus regulate the volume of borrowing not through interest variations but through credit rationing; and stricter credit control depends on inducing the banks to reduce the borrowing limits granted to their regular customers (Kaldor, 1964, p. 106).

Similarly his 1958 testimony to the Radcliffe commission supplied no evidence of his appreciation of Y to M causality. In his memoranda Kaldor's arguments for the ineffectiveness of monetary policy relied exclusively on a Keynesian belief in the extreme variability of income velocity: '*The impact of any change in the money supply is not on the level* *of payments at all, but on the velocity of circulation*' (Kaldor, 1964, p. 130). His implicit acceptance of M to Y causality is revealed by his repeated attempts in 1958 to demonstrate the weakness of the M to Y linkage.

> Changes in the money supply do not exert any direct influence on the level of monetary demand for goods and services as such, but only through the consequential changes in interest rates which are induced by them (Kaldor, 1964, p. 134).

Since the possibility of reverse causation is nowhere raised in his testimony, it is not plausible that Kaldor's 'sudden dawning' occurred before Radcliffe (1958).

Nevertheless Kaldor appears to have been already halfway down the road to monetary endogeneity by 1960. In his 'Introduction' to his *Essays on Economic Stability and Growth* (1960), he stated his position on the effectiveness of monetary policy as follows:

> The monetary authorities are not confronted by a unique demand curve for money . . . the nature of that curve and its elasticity will be different according as they choose to regulate the quantity of money directly . . . or whether they wish to regulate it indirectly through varying the Bank Rate and the money market rates (p. 5).

In addition he had also reached the position that short-term rates should be viewed as determined by the central bank.

> In a modern community it is best to regard the short rate of interest rather than the quantity of money as being fixed by the policy of the monetary authority, and the quantity of currency in circulation as being determined by the demand for cash balances by the public (Kaldor, 1960, p. 64).

Kaldor's first published statement outlining the 'reverse causation' argument was in 1970, in a lay criticism written for *Lloyds Bank Review*, 'The New Monetarism' (Kaldor, 1970a). He there first argued that a high correlation between money and GNP does not itself imply any particular direction of causality – e.g., that the supply of money determines the level of income. It could equally be that income determines money, or that both are determined simultaneously by a third factor (Kaldor, 1970a, p. 5). Second, he asked would the strong statistical association survive if one of the variables say, the money supply were controlled? Kaldor then proceeded to argue that, as at Christmas, the money supply always 'accommodated itself' to the needs of trade. Velocity had been relatively stable empirically only because the supply of money had been unstable. With regard to Friedman's argument that the 'money multiplier' was stable, he similarly argued that,

> if variations in the money supply were closely related to changes in the 'monetary base,' this is mainly because the latter has also been 'endogenous' as well as the former (Kaldor, 1970a, p. 12).

Finally he maintained that central banks were in the position of a constitutional monarch, 'with very wide reserve powers on paper, the maintenance and continuation of which are greatly dependent on the degree of restraint and moderation shown in their exercise. The explanation, in other words, for all the empirical findings on the "stable money function" is that the "money supply" is "endogenous," not "exogenous"' (Kaldor, 1970a, p. 12).

Kaldor was immediately and sharply put in his place for his impertinence by Friedman as a neophyte 'Johnny-come-lately' (Friedman, 1970). Friedman asserted that this 'reverse causation' criticism had of course long been known to Monetarists, that in response they had explored the empirical data exhaustively, and that

> The outcome was about as decisive as the answer to any such question can ever be . . . [except insofar as] In a scientific problem, the final verdict is never in (Friedman, 1970).

He stated that he had summarized this evidence exhaustively in a book, 'to which Professor Kaldor refers, but which he apparently has not read' (Friedman, 1970, p. 52).

In his rejoinder in the same issue a somewhat chastened Kaldor contented himself with stating that Friedman had 'made no attempt to refute any of my contentions' (Kaldor, 1970b, p. 54). He listed the five kinds of evidence enumerated by Friedman in support of the independent influence of money on income, and stated that he had in fact dealt with all but one of them (serial correlation of the amplitude of cycle phases), 'mainly because I did not understand it' (Kaldor, 1970b, p. 55).

It is a great puzzle why Kaldor never attempted to develop his criticism of Friedman's empirical results more rigorously (e.g., Hendry and Ericson, 1983), or his argument for reverse causation from income to money more systematically for an academic journal (e.g., Moore, 1988)? He surely was aware of its key importance? Kaldor appears to have severely underestimated Friedman's debating and proselytizing skills, never to have taken him sufficiently seriously, and even to have believed (with much of Cambridge) that he had disposed of Friedman completely. All this at a time when Friedman was successfully converting a large proportion of the US academic and financial community to his Monetarist views!

Kaldor did not return to the issue until 1981 in *The Scourge of Monetarism* (1981). By then he clearly regarded the base as endogenous. He prominently drew a horizontal money supply curve and a downward-sloping demand for money function as a function of interest rates to illustrate that, '*the money stock will be determined by demand, and the rate of interest determined by the Central Bank*' (Kaldor, 1981, p. 24).

Kaldor unfortunately never described the process of how deposit expansion is credit-driven as well as demand-determined. He appears not to have grasped the central role of bank credit expansion in providing the working capital finance necessary for output expansion, so that aggregate demand and output could both grow *pari passu* over time. Similarly he never developed a systematic model of commercial banking in order to provide a microeconomic explanation of why the total money supply should be viewed as endogenous, or why the Monetarist description of high-powered base control was incorrect (Moore, 1988). He contented himself simply with demonstrating that, due to central bank 'lender of last resort' responsibilities, the base was not really a control variable.

6 A MONETARY PRODUCTION ECONOMY

The conclusion that the level of short-term domestic interest rates is established exogenously by central banks as the monopoly supplier of legal tender carries with it a number of important macro analytical and policy implications. One of the most important is a deeper understanding of the forces governing the cyclical growth of aggregate demand (see Moore, 1988).

In monetary production economies, aggregate demand can increase above the level of aggregate income ruling in the previous period only if economic units in the aggregate are net deficit-spenders. Deficit-spending may be financed in one of two ways:

(a) *Expenditure of previously-accumulated money balances*: In this case the money supply is constant. Deficit spending may be internally financed by running down own money balances, or externally financed by borrowing money from other nonbank units. The magnitude of such deficit spending is governed by the amount of previous saving which has been held in the form of an accumulation of money balances. The result of such deficit spending is to increase the transactions velocity of money in the concurrent period. If the deficit expenditures are incurred to purchase currently-produced goods and services, aggregate demand, nominal income and the income velocity of money will all rise as well.

(b) *Expenditure of newly-created money balances*: In this case the money supply increases. Deficit spending is externally financed by additional borrowing from banking institutions. Banks issue additional transactions balances in exchange for the increased supply of borrower IOUs, so that the money supply rises. Loans make deposits. In modern economies loan expansion is ordinarily at the initiative of the borrower, up to a previously-agreed credit limit. Because transactions deposits are generally accepted as a means of payment, these newly-created deposits are willingly accepted by selling units in exchange for real goods and services. Over any time period, whenever deposit balances are increased, this necessarily implies an increase in what may be termed 'convenience-lending' of fiat money to the banking system.

As a result the banking system plays a crucial role in providing the finance necessary for economic expansion to occur. The supply of money is endogenously-determined by the increase in the demand for bank credit, and so is credit-driven. Banks are price-setters and quantity-takers in both their retail loan and deposit markets. They rely on the wholesale markets, where they are price-takers and quantity-setters, to manage their wholesale liabilities and liquid assets in order to ensure an adequate supply of funds and portfolio liquidity. The supply of money also creates its own demand, so that a sort of Say's Law of money operates. Once created, all additional deposits are always willingly held. The money supply is demand-determined, but the demand for money is always equal to the stock of money. The demand for money is a function of current and expected future levels of expenditure, income, wealth, and interest rates, as the conventional view maintains. But since money is always accepted – i.e., 'demanded' in exchange, it is also a function of the supply of money that has previously been created and is currently in existence. Supply and demand for money are thus necessarily *interdependent* (Moore, 1988).

As both Kalecki and Keynes explicitly recognized, the banking system plays the central role in enabling aggregate demand to grow in credit money economies. Banks supply the new money that enables bank borrowers to deficit spend – i.e., to make effective a total current demand for goods in excess of their total current income and wealth claims. New bank loans and deposits must increase if aggregate demand, output, and employment are to grow over time in monetary production economies. The accumulation of bank deposits provides a counterpart increase in 'convenience lending' of fiat money by bank depositors to the banking system. It is this increased lending which finances the increase in bank loans. No income 'multiplier' effect is involved. If the new banks loans are used to finance an increase in real investment, the increase in deposits will automatically imply an equal increase in 'convenience saving.' The *ex post* savings–investment identity is always maintained. So long as excess resources exist, in a monetary production economy investment is never limited by the volitional saving preferences of the community. As most of the above economists recognized, in a closed economy investment determines savings rather than the reverse.

There is no behavioral necessity for interest rates to rise (i.e., 'crowding out') in the expansion phase of the cycle. The behavior of interest rates depends entirely on the reaction function of the monetary authorities to deviations in the outcome of the economy from their macroeconomic objectives. As Kalecki explicitly recognized the policy stance of the monetary authorities is critical. By raising interest rates excessively central banks can restrict or even prevent the expansion of investment and output.

7 CONCLUSIONS

Each of the above economists viewed the rate of interest as a monetary rather than a real phenomenon. Of the four, Kaldor stated most explicitly that the money supply was endogenous, while the level of short-term domestic interest rates was exogenously administered by central banks as the monopoly supply price of additional bank reserves. Before the existence of central banks, the supply price of additional money was largely governed by the level of foreign interest rates, the linkage depending on the stage of financial, institutional, and technological innovation. Countercyclical monetary policy is largely a late twentieth century innovation. It could be argued that Kaldor lived in a period for which there was more compelling empirical evidence for monetary endogeneity and interest rate exogeneity, or what Keynes termed a 'monetary production' economy.

Notes

1. Full employment equilibrium seems to follow naturally, since oversaving and underinvestment is then impossible.
2. Panico (1983) has proclaimed the existence of a contradiction between Marx's conclusions that the rate of interest cannot be based on any natural or material law, and the existence of links between the rate of interest, the rate of profit, the wage rate and the material conditions of reproduction in the financial sector. Marx could not perceive these links since he never worked out his analysis of the credit system and the role played by financial capitalists. But in fact the material conditions of reproduction and the wage rate in the financial sector determine only the spread required for intermediation – i.e., the difference between the banks' borrowing and lending rates. The general level of interest rates remains undetermined, and must be introduced from outside to close the system – i.e., by the monetary authorities, who set the supply price of legal tender.

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14 Money: Cause or Effect? Exogenous or Endogenous?

P. Davidson

Professor Hahn, a distinguished theorist, has recently written: 'The most serious challenge that the existence of money poses to the theorist is this: the best developed model of the economy cannot find room for it' (Hahn, 1981, p. 1).

Orthodox (Walrasian general equilibrium) theory underlies and dominates the discussion of money in the economic literature. Since this theory has no room for money in logical structure, semantic confusion and obfuscations pervades the professional discussions on whether the money supply is exogenous or endogenous and therefore whether changes in the stock of money is a cause or an effect. If it is exogenous it can only be a cause. Since the Monetarist approach of Milton Friedman (1974, p. 44) claims that it 'is a well-developed theory, summarized in the Walrasian equations of general equilibrium', and since in the Walrasian system, as Hahn suggests, there is no role for money, it can only be considered as an exogenous cause. Logically it cannot be an endogenous effect.

Ultimately what is involved is the question of movements along vs. shifts in money demand and supply functions. To a nonacademic economist or policy maker, whether things are interpreted as movements along fixed curves or shifts in curves must seem to be an esoteric tempest in a teapot. This paper, however, demonstrates that these analytical subtleties can have important policy implications.

Before developing the case, however, it should be noted that despite his use of the motto 'money matters' Professor Friedman remains loyal to the general equilibrium's axiom of reals (see discussion of this axiom below). This axiom is the logical reason why Walrasian theorists 'cannot find room' for money, i.e., money is neutral in their theory. This neutrality postulate prevents money from having any long-run permanent effects on real income, employment, and economic growth. For example, Friedman (1974, p. 27) characterizes the Monetarist approach as: 'changes in the quantity of money as such *in the long run* have a negligible effect on real income so that nonmonetary forces are "all that matter" for changes in real income over decades and money "does not matter" . . . I regard the description as "money is all that matters for changes in *nominal income* and for *short-run* changes in real income" as an exaggeration but one that gives the right flavor to our conclusion.'

In contrast to the Monetarist general equilibrium view that money does not affect real outcomes, at least in the long run, Keynes and some Post Keynesians (Kaldor, 1982; Moore, 1983) have striven to develop an alternative model where not only does money play an important and unique role in the real economy, i.e., where money is not neutral in either the short – or long-run, but where also a money economy operates differently from a non-monetary general equilibrium system.

In section 1, a brief outline of the role of money in such a post-Keynesian entrepreneurial, monetary-production economy is outlined. Section 2 indicates that the terms exogenous and endogenous in relation to the money supply have often been used in the literature in sometimes different and sometimes conceptually incompatible manners. This semantic reason is the basis for the Steele–Bootle loggerhead. A taxonomic scheme for distinguishing exogenous vs. endogenous money is therefore developed. With this classification scheme, section 3 is able to distinguish between the two processes for changing the supply of money – the portfolio change process and the income generating-finance process. Finally, Section 4 analyzes the financing of real bills and inflation bills.

1 MONEY'S ROLE

It should have been obvious to Hahn, but apparently is not, that his acceptance of one of the fundamental axioms of neo-Classical economic theory is the reason that there is no room for money in orthodox theory. This axiom, which Hahn argues 'most economists would accept' (1981, p. 34) can be stated as

> the objectives of agents that determine their actions and plans do not depend on any nominal magnitudes. Agents care only about 'real' things, such as goods (properly dated and distinguished by states of nature), leisure and effort. We know this as the axiom of the absence of money illusion, which it seems impossible to abandon in any sensible analysis (Hahn, 1981, p. 34).

What seems 'sensible' to Hahn, however, is absurd if one wishes to portray the role of money in the real world. For this axiom (which Hahn labels 'the absence of money illusion' but is better termed 'the axiom of reals') suggests that *money is neutral*, i.e., that it has no *real* effects. No wonder there is 'no room' for money in an economic theory which tries to 'explain' real changes in the economy but which is built on a postulate that money does not matter.

Keynes, of course, argued that money was not neutral (Keynes, 1973, p. 411) and that in the theory which he was articulating 'money plays a part of its own and affects motives and decisions' (Keynes, 1973, pp. 408–9) in both the long run and the short run! In other words, in a Keynes–Post-Keynesian theory, there is a unique and important real role for money in both the short-run and the long-run – money matters!

Elsewhere I have developed the Post Keynesian analysis which argues that (a) in an economy moving through calendar time and (b) in a world of uncertainty where the future is not merely a result of an ergodic random draw from a given and unchanging probability distribution, while (c) production takes time, the most efficient way to organize production is via forward monetary contracts (Davidson, 1982–83). This creates a need for liquidity – a concept which only has meaning and relevance in a world which does not rely on the axiom of reals (Davidson, 1984) and where the demand for liquidity can affect real expenditures. Liquidity, the ability to meet your contractual monetary obligations as they come due, is the name of the game when we want to discuss a role for money in the real world – and the public's sudden changes in their perceived needs for liquidity, as we have learned again in the stock market fall of October 1987.

Of course, Frank Hahn should have realized the importance of the need for liquidity for meeting nominal contractual commitments and hence its potential effect on real spending decisions, since Arrow and Hahn meticulously demonstrated that:

> the terms in which contracts are made matter. In particular, if money is the goods in terms of which contracts are made, then the price of goods in terms of money are of special significance (nominal magnitudes matter!) This is not the case if we consider an economy without a past or a future. . . . *If a serious monetary theory* comes to be written, the fact that contracts are made in terms of money will be of considerable importance (Arrow and Hahn, 1971, pp. 356–7; italics added).

Moreover, Arrow and Hahn demonstrate (p. 361) that if contracts are made in terms of money [so that money affects real decisions] in an economy moving along in calendar time with a past and a future, then *all existence theorems are jeopardized*. The existence of money contracts – a characteristic of the world in which Keynes lived and which we still do – implies that there need never exist, in the long run or the short, any general equilibrium market clearing price vector.

The Need for Money Contracts

Time is a device which prevents everything from happening at once. Production processes take time and hence the decision to organize production in a certain manner must occur earlier in time than the outcome. If the economic world has, or can have, important non-ergodic circumstances associated with it, then future outcomes of any economic process can never be forecasted with statistical precision at the onset of the process. In an nonergodic environment, people recognize that the future may be unpredictable in any stochastic sense, and hence the sensibility of human beings prevail.

Sensible expectations rely on existing human institutions which have evolved to permit fallible humans to cope with the unknowable. In such a world, the attribute of dignity associated with all human motivation is necessarily geared not to rationality, but to sensibility. In such a world, the institution of fixed money contracts which limit nominal liabilities are an essential adjunct of organizing production processes.

Only if entrepreneurs' monetary liability is contractually limited, *and* if entrepreneurs obtain reasonable assurances from their bankers that they can obtain the necessary financing of their working capital production contractual commitments will their animal spirits be bolstered and their dignity protected sufficiently to undertake the burdensome organization of large scale production. In the absence of money contracts, it is unlikely that entrepreneurs, facing a statistically unpredictable and unknowable future, would undertake large scale, long-lived, complex production processes. By using fixed money contracts for purchases and sales, entrepreneurs can 'control' their cash positions – their cash-outflows and in-flows – even though they recognize they can not predict the future in a statistically reliable sense. If prediction is not possible, then 'control' is essential.

Lower life forms enter into organizational structures for the efficient operation of production and consumption processes (e.g., herds of elephants, schools of fish, colonies of ants, etc.) None, however, utilize contracts and money to achieve their production and consumption objectives. Only *homo sapiens*, who can recognize the passage of time and the fundamental uncertainty of a nonergodic world, use monetary contracts as an essential adjunct to complex interdependent production and consumption processes. Thus, human economic activity has evolved institutions of contracts and money in order to 'assure' legal future outcomes in a nonergodic environment.

In the real world, money is anything that legally discharges a contractual liability under the civil law of contracts. All contracts are calendar time – either spot or forward – oriented. A spot contract designates delivery and payment at the moment of signing, while a forward contract designates a specific future calendar date for delivery and payment. Each party to a forward contract recognizes that the other party, *despite possessing good faith at the time of signing of the contract*, may be unable and/or unwilling to execute the contractual terms at the specified date. Legal enforcement permits each party to have *sensible* expectations that if the other party does not fulfill its contractual obligations, the injured party will be entitled to just monetary compensation.

In the real nonergodic world – unlike the ergodic neo-Classical system – recontracting without penalty whenever a buyer or seller has made an error is simply not permitted. *Forward nominal contracts for sale of goods and services are human institutions devised to enforce money wage and price controls over the life of the contracts*. Business firms and households abhor what neo-Classical economists love – namely a flexible price system and recontracting without penalty.

Money contracts, therefore, attenuate potential conflicts by assuring both parties that even if uncertain future events adversely affect one party's ability to meet its commitments, the other party will have a remedy in law. The existence of contracts, and the means to discharge contractual obligations, i.e. money, affect the real production decisions in a monetary production economy. Moreover, financial institutions which play an essential role in governing the money supply affect the short-run and long-run real outcomes of the economy.

2 EXOGENOUS VS. ENDOGENOUS MONEY: THE CONCEPTUAL FOUNDATIONS

A recurring theme in the long evolution of monetary theory is the dispute whether changes in (bank) money supplies play a causal part in influencing economic activity or whether variations are an effect of economic activity, overcoming the obstacles of barter in an interdependent production economy. The view of money as causal represents a Currency School legacy, descending from Lord Overstone and the charter revision of the Bank of England in the 1840s. Money, viewed as an effect, constituted the core of the 'real bills' Banking Principle doctrine espoused at the time of William Tooke. Precusors abound as Marget's (1938) careful documentation reveals.

In recent times this Currency cause vs. Banking School effect controversy has evolved into a dispute between the Monetarists who argue that the quantity of money supplied is (should be) exogenous and therefore is a *cause* of inflation and the Post Keynesians who, following Keynes (1973, pp. 222–3), believe that changes in the quantity of money supply should be endogenous or an effect, i.e., responsive to changes in the demand for liquidity and hence observed changes in the stock of money are often an endogenous *effect.* Thus cause vs. effect have, in the recent literature become intertwined with the terms exogenous vs. endogenous.

If the money supply is exogenous, as Monetarists believe, then to the extent that changes in quantity of money is associated with changes in the price level it can only play (by definition) a causal role. If the money supply is often endogenous or an effect, on the other hand, then anti-inflation policies aimed at restricting the growth of the money supply will be effective only if they restrict changes in aggregate demand. Thus the theoretical issue of whether money supplies are exogenous or endogenous have important implications for the cause vs. effect role of monetary policy in a modern market-oriented production economy.

Unfortunately, the conceptual basis of the terms exogenous vs. endogenous have not been clearly defined. The participants in the debate have often used and confused two different concepts, (a) the magnitude of the interest elasticity of the money supply function and (b) the independence (stability) of the money supply function.

The Quantity of Money Supplied (Elasticity) Concept

Under the elasticity of supply approach, if, and only if, the *quantity of money* supplied by the banking system is perfectly inelastic with respect to interest rates then money is exogenous. If the quantity of money supplied in the system is less than perfectly inelastic, then money is endogenous. If, and only if, the quantity of money *supplied* is assumed to be always and only determined by policy rules, actions, or other noneconomic forces, then the money supply function must be perfectly interest inelastic. Hence, the only postulated cause of changes in the observed quantity of money is specific policy actions by the Monetary Authority of other noneconomic forces. Thus, (by hypothesis) changes in the measured money supply may be the cause of some economic event, it can not be the result (effect)!

An *exogenous quantity of money supplied* concept must and will be associated with a perfectly interest *inelastic* money supply function in the interest rate vs. quantity of money quadrant as, for example, S_x in Figure 1a. Providing one can properly define what is meant by money, the quantity of (bank) money supplied will be solely and exogenously determined as a policy variable by the Monetary Authority. Any change (shift) in the demand function for money from say D^1 to D^2 in Figure 14.1a will play against the perfectly inelastic or vertical supply function of money (S_x) to induce *pari passu* changes in the rate of interest from i_a to i_b. Thus, in this case, a perfectly inelastic money supply is also associated with an independent supply of money function (i.e. independent of factors affecting the demand for money function).

Contrary to the obvious facts, Monetarists have assumed this extreme case governs the real world. Hence Monetarists have argued for a 'rule' to govern an independent time rate of growth of the *quantity of money supplied*. This rule would shift the perfectly inelastic money supply function solely due to the passage of time and independently of any short run changes in the demand function for money. B. J. Moore has termed those

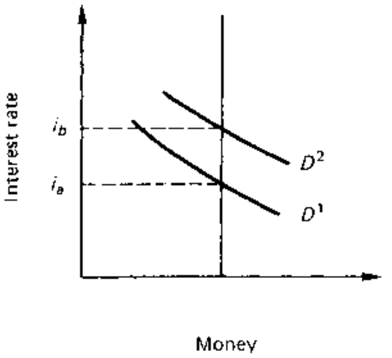

Figure 14.1a

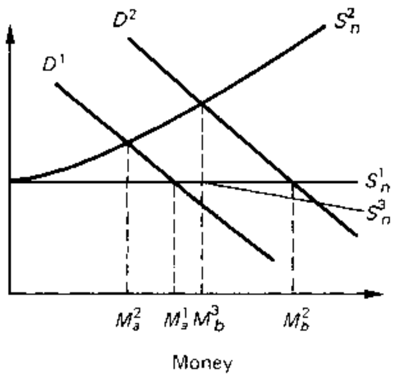

Figure 14.1b

who believed in a Monetarist rule Verticalists.

If an exogenous money supply is defined strictly and solely with an perfectly inelastic money supply function, then any money supply function which either is less than perfectly inelastic must be associated with an endogenous money supply. Consequently, a perfectly elastic (horizontal) supply function such as S^1_n in Figure 14.1b is only one form of money supply endogenity; endogenity can also be associated with an upward sloping, less than perfectly inelastic function (S^2_n in Figure 14.1b) or even conceivably a downward sloping money supply function (S^3_n in Figure 14.1b).

Moore has associated those who believe that the quantity of money supplied by the banking system will alter in response to the demand for money changes as Horizontalists. These Horizontalists, of whom Kaldor (1982) is the prime example, conceive of an endogenous money supply in terms of a perfectly elastic (horizontal) money supply function, S_{n1} in Figure 14.1b. Thus, for the Horizontalists, when the demand for money function exogenously shifts from D_1 to D_2, the quantity of money supplied increase from M^1_a to M^2_b in Figure 14.1b, even if the money supply function has not shifted. But as the above discussion indicates, strict Horizontalists represent only an extreme (or corner position) of those who profess the endogenity of the quantity of money supplied elasticity approach. For example, if S_{n2} in Figure 14.1b is the money supply function then with an exogenous shift in money demand from D_1 to D_2, the quantity of money supplied endogenously increases from M^2_a to M^3_b in Figure 14.1b.

In sum, exogenity vs. endogenity hinges on the magnitude of the elasticity of supply of money. An exogenous money system is only associated with the extreme case of a perfectly inelastic supply function. All endogenous money supply advocates have a less than perfectly inelastic supply function in mind when they argue that observed or measured changes in the quantity of money is normally an effect (of a change in the demand for money), rather than a cause.

The Independent (Stability) Money Supply Function Concept

The other possible view involves whether the *supply function of money* is strictly and always independent of the shift factors which exogenously change the demand function for money or not. This independence (or stability) of the supply function of money is not constrained by the actual elasticity of money supply function at any point of time.

In this stability of supply approach, the emphasis is on the independence vs. the interdependence of the supply function of money *vis-à-vis* the demand function of money. As long as the money supply function is assumed to always be independent of the factors affecting the demand function for money, any independent shift in the supply function must be interpreted as an exogenous change in the money supply which can be a cause but not an effect. On the other hand, as long as the money supply *function* is stable and does not change, observed changes in the quantity of money supplied can not be the *initiating* cause of any economic event.

These Two Views do not Always Provide a Common Ground for Exogenous vs. Endogenous Money Concepts

These elasticity and stability concepts do not necessarily provide a common ground for distinguishing between exogenous and endogenous money as cause or effect. Hence both must be used to provide clear definitions.

If, for example, every time there is an exogenous change in the demand for money such as D_1 to D_2 in Figure 14.2b, if the supply function of money in the system also changes (from S_1 to S_2 in Figure 14.2b), then the money supply function is interdependent and the quantity of money supplied is always endogenous in that it responds to changes in demand for money. (This would be true under the interdependence criteria even if S_1 and S_2 were vertical – as in the elasticity view.) If, however, the money supply function S_1 in Figure 14.2b (or S^1 in Figure 14.2a) remained unchanged while the demand curve shifted from D_1 to D_2, the money supply function is independent (exogenous under the stability view) but the *quantity of money supplied* increases from M_a to M_a^1 and is endogenous under the elasticity approach – just as the Horizontalists claim.

Thus, in this latter view, even if the money supply function is (unchanged) as long as it is not perfectly inelastic with respect to the price (interest rate) variable, an observed or actual (measured) change in the quantity of money supplied to the system is an effect rather than a cause.

These two – elasticity vs. independence – conceptions therefore do not necessarily provide a common ground and are not therefore strictly alterna-

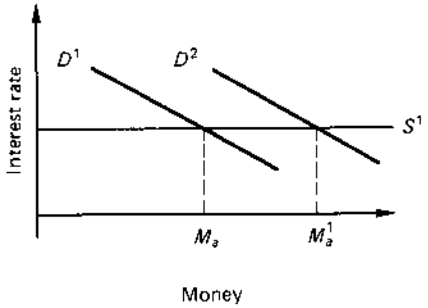

Figure 14.2a

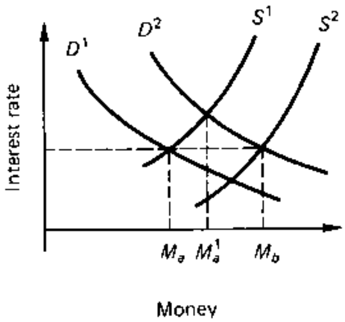

Figure 14.2b

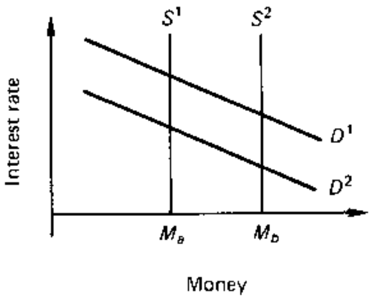

Figure 14.3a

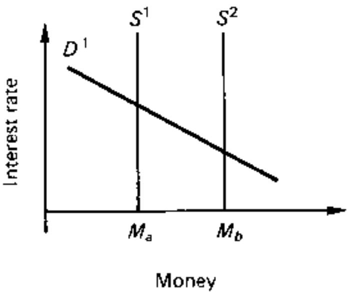

Figure 14.3b

tives for classifying all possible money supply cases as either exogenous or endogenous. A perfectly inelastic *and* always independent money supply function is uniquely associated with an exogenous money supply. In such a regime, any observed change in the quantity of money such as from M_a to M_b in Figure 14.3b must be due to an exogenous (independent!) policy variable shifting the entire supply function from S_1 to S_2 as the demand function shifted from D_1 to D_2. This independent *and* perfectly inelastic supply of money function conception implicitly underlies Monetarists's arguments that the money supply is exogenous for in this case the change in the measured money supply can only be a cause not an effect!

If however, the money supply function is perfectly inelastic (exogenous under the elasticity interpretation) at any point of time, e.g. S_1 in Figure 14.3a, *and* if this vertical supply function shifts concommitently to S_2 every time the demand for money function exogenously shifts from D_1 to D_2, then the money supply function is interdependent and the measured change in the quantity of money supplied from M_a to M_b in Figure 14.3a is an effect due to a change in the demand for money rather than a cause.

Hence, the observed change in the money stock is an *endogenous* quantity of money supply response despite the inelasticity of the money supply function.

Similarly, if the money supply is not perfectly elastic (e.g. horizontal) it is endogenous (under the elasticity interpretation), but if the supply function is unchanged (at say S_{n2} in Figure 14.1b) when the demand for money function shifts from D_1 to D_2 in Figure 14.1b, then money supply function is independent, while any observed changes in the quantity of money supplied (from M_a^2 to M_b^3 always an effect, not a cause. Of course, a less than perfectly inelastic money supply function may also shift when the demand for money function changes, and hence the money supply would be endogenous under either view in this case.

Every elementary principles textbook in Economics stresses the importance of distinguishing between a change in the quantity of a commodity supplied (or demanded), i.e. a movement along a supply (or demand) curve, and a change in supply (or demand), i.e. a shift in a supply (or demand) curve. Most Economic Principles instructors warn of horrendous errors (and failing grades) in any economic analysis of changes in prices and quantities by any freshman who can not distinguish between movements along a curve (changes in quantities supplied or demanded) and a shift in a curve (changes in supply or demand). Yet just such a confusion has hindered the professional discussion regarding the 'quantity of money' and its role in the economy as either cause and/or effect and whether money is exogenous or not.

No wonder that even after a century of discussion, there continues to be considerable debate over this cause vs. effect – and exogenous vs. endogenous – and independent vs. interdependent money supply issue. Since the words and concepts have not been clearly, crisply, and uniquely defined, the various combatents in the continuing controversy often use the same terms to convey somewhat different meanings. Until we get our concepts semantically in order, little progress in the dialogue and discussion over the cause vs. effect role of money can be expected.

For conceptual simplicity and completeness, therefore, differences in conceptualization of the 'money supply' can be distinguished by:

1. the elasticity of the money supply function, i.e., perfectly interest inelastic vs. any interest elasticity; and/or
2. independence vs. interdependence of the money supply and money demand functions.

An *exogenous* money supply then can always be identified as a *causal* factor if it is defined as when either the money supply function is perfectly inelastic *and* when the money supply function shifts independently of the demand for money function. An *endogenous* money supply can be identified as an effect therefore if it is defined as associated either with a less than perfectly interest inelastic money supply function *or* an interdependent shift of the supply function.

3 THE SUPPLY OF MONEY PROCESS REVISITED

For many years, Post Keynesians have been warning that orthodox macroeconomic theorists have not properly depicted the money supply process (e.g. Davidson and Weintraub, 1973; Davidson, 1972). Keynes' (1936, ch. 17) 'essential properties' of money (and all liquid assets) involving a zero (or negligible) elasticity of production of the money commodity immediately determines the market supply behavior of producers of the money commodity in the private sector. If one is to properly specify how observed changes in the supply of money come about, one must relate them to the relevant banking institutions and operations which bring forth money. In the real world, Keynes reminded us at the very beginning of his *Treatise on Money* (1930, p. 3), money 'comes into existence along with debts, which are contracts for deferred payment and . . . offers of contracts for sale or purchase', that is, the supply of money, and debt and production-offer contracts are intimately and inevitably related. For Keynes, money does not enter the system like manna from heaven, nor is it dropped from the sky via a Friedmanian helicopter, (i.e. the money supply function is not always independent of demand factors), nor is it produced from the application of labor to the harvesting of money trees. For Keynes and Post Keynesians, the supply of money in a modern economy can increase only via two distinct money supply processes – both of which are related to contracts, one is associated with endogenous money, the other with exogenous money.

The Income Finance Process

In the first money supply process, which may be called the income generating-finance process, an increased desire to buy more reproducible goods per period – the finance motive (Keynes, 1973, pp. 215–23), (Davidson, 1965, 1978) – induces individuals, firms, governments, and foreigners to enter into additional debt contracts with the banking system. If these contracts are accepted by the banking system without any simultaneous intervention or action by the Central Bank, then the money supply elasticity can not be perfectly inelastic. The additional debts of banks are issued and used to accept and pay for additional offer contracts of producers and workers. In the finance process, therefore, changes in the quantity of money supplied are always endogenous under the elasticity interpretation. If, however, these private debt financing contracts can, on a systemwide basis, only be accepted by private bankers if there is an accommodation by the Central Bank via its lender of last resort function then the institutionally based money supply function will be interdependent if the Central Bankers do their jobs, by permitting an endogenous (less than perfectly interest inelastic) money supply response. If the Central Bankers are to be lenders of last resort to prevent a banking system collapse, all they can control is the bankers' cost of obtaining reserves and hence the interest rate.

In the income generating finance process, an exogenous increase in aggregate demand for goods provokes the demanders for money to initiate the process which increases the quantity of money supplied, as long as banks are willing and able to make additional bank-debt contracts available under the rules of the game (and, of course, it is in the self-interest of bankers to do so). This increase in the measured money supply is used to finance additional orders for producible goods. Depending on the various cost elasticities of the various industries stimulated, increases in real income and prices will expand along with the increase in the endogenous quantity of money supplied.

The Portfolio-Change Process

In the second money supply process, which may be labeled the portfolio-change process, the Central Bank *initiates* the change in the money supply by buying existing liquid assets from the portfolios of the banking system and/or the general public. These sold assets are initially replaced in the banks' portfolios by bank reserves or in the portfolio of the general public by bank-debt contracts as an alternative store of value at a rate of exchange which the sellers find very favorable. In the portfolio money supply process, the initiating cause of a change in the money supply is an explicit, *ceteris paribus*, policy decision on the part of the Monetary Authority to shift the supply function of money at any given rate of interest. Thus the portfolio money supply process always involves an exogenous change in the money supply function.

In the portfolio-change process, changes in the money supply are immediately used by the public as a substitute for securities as a vehicle for transfering purchasing power to the indefinite uncertain future. This independent increase in the money supply function due to open market operations *initiated* by the Central Bank, will increase the demand for real produced goods only via the usual Keynesian effect of lowering the cost of financing the purchasing of durables.

4 FINANCE – REAL VS. INFLATION BILLS

The income generating-finance process demonstrates that the financial system holds the key to facilitating the transition from a lower to a higher level of economic activity. As long as long-duration, mass production processes must be planned ahead if they are to be efficiently organized in any non-slave or non-cooperative economies, then entrepreneurs will require the institution of long duration forward contracts to ensure the cooperation of owners of factor inputs in delivering *on time* factor services and materials according to the production schedule. Since these contractual commitments require monetary payments (cash outflows) to factor owners before the product is sold and sales revenues (cash inflows) are received, entrepreneurs must be assured that they can obtain sufficient finance to meet these production cash outflow commitments. Any inability to obtain sufficient financial commitments today prevents entrepreneurs from initiating production activities, no matter how profitable these production processes are expected to be at a later date when the product is finally sold.

In an entrepreneurial system of organizing production, economic growth requires a banking system that will provide an 'elastic currency' so that the expanding needs of trade can be readily financed. In the absence of a financial system which can provide such an endogenous money supply system, an entrepreneurial, market-oriented, monetary, production economy will find that its best made plans for expansion will be stymied.

Unfortunately, the same banking system which provides a mechanism for the endogenous expansion of the money supply to meet the needs of trade (the real bills doctrine) can not normally distinguish between entrepreneurial increased requirements to finance larger payrolls due to (a) increased employment (at a given money wage) associated with a larger production flow and (b) higher money pay per unit of labor [or other factor] effort (after adjusting for changes in labor productivity) i.e. higher efficiency wages or unit money costs of production. Consequently any banking system designed to provide a financial environment which eases the transition from a lower to a higher level of employment and output is also capable of supporting inflationary forces due to economic, social, and political demands from various groups for higher money incomes in order to obtain, *ceteris paribus*, a greater share of any aggregate output flow. In other words, any financial structure which is appropriately designed to provide an endogenous money supply under the real bills doctrine is simultaneously capable of creating a permissive environment for wage or profit inflation. Any healthy banking system apparatus which meets the needs of trade can be subverted to create an elastic currency of 'inflation bills' rather than 'real bills'. Any deliberate policy aimed at restricting the banking system's ability to issue 'inflation bills' will therefore concurrently limit its ability to supply sufficient real bills to maintain economic expansion.

As modern banking institutions evolved in organizing their loan activities, they essentially evolved a money supply function which would realistically never be perfectly inelastic under the fractional reserve rules of the game.

It is true that in the Marshallian market period analysis all supply are stocks, by definition, and the time interval is too small to permit any flows to enter the diagram, then the Marshallian supply curve must be vertical or perfectly inelastic. Hence if one analysis a market economy under the *assumption* of a Marshallian market period situation, then the money supply function is perfectly inelastic, and the volume of money supplied is, by definition, exogenous. But in such a 'market-period' system, the volume of aggregate supply – or GNP – is also exogenous. Hence one cannot, in this model, show any relationship between changes in the money supply and changes in GNP.

The error occurs when economists try to transfer the market period supply function for money to an analysis where all other supplies have flow characteristics, i.e. goods are producible. Assuming the equivalent of a market-period exogenous – perfectly inelastic – money supply while permitting short-run flows of output not only runs into logical difficulties, but it is a poor description of what happens in the real world where banking systems have been explicitly designed to produce an "elastic" monetary system.

In a textbook world of the process of money creation, of course, it is the exogenous introduction of new reserve assets into the banking system's balance sheet which is the initiating cause of an increase in the money supply, *at any interest rate*. Under these textbook conditions, the money supply function can be conceived of as being perfectly interest inelastic and independent of the money demand function. Only an exogenous change in the aggregate reserve asset position of the banking system can induce a change in the money supply. Unfortunately, this artificial construct has been misinterpreted by many economists as a proper description of current real world banking systems.

Under any fractional reserve system, bankers are motivated to search out borrowers and to expand loans as long as the interest they receive exceeds the interest cost of 'excess' reserves. Hence even in the textbook world of a 'high-powered monetary reserve base', the central bank will always make some reserves available to the banking system – although they may raise the price as they increase the flow. A central bank that did not provide additional reserves – at some cost, of course – would be a contradiction in terms. For the function of a central bank is to operate as the bankers' bank. And just as the bankers' customers will deal with their bankers only as long as they tend, as a rule, to make further liquidity available, as need be; so the bankers will deal with their banker only if the latter is sufficiently accommodating.

Moreover, as long as the Central Bank permits differing reserve ratios for differing bank liabilities, based on their maturity dates, then the banking system has a built in process of endogenous money making – if one includes in a broad definition of money, all the liabilities of the bankers. Hence, especially under a liability management banking system, for example, with a Monetary Authority charged with the responsibility of preventing any systematic liquidity crisis from creating a banking collapse, an endogenous money supply is assured. The only question is the interest rate costs to the banking system of inducing additional reserve assets into their balance sheets during any expansion. As long as there are additional borrowers who are willing to pay the going interest rate or more (at which bankers can make a profit), bankers will have an incentive to expand their loans.

In a liability management context, bankers can, even on a system wide basis, increase the lending power of their existing reserve asset base by paying the public to give up very liquid assets of demand deposits and accepting less liquid bank liabilities – time deposits and even CDs – in return. Since the reserve requirements on the very liquid demand deposits is greater than on the less liquid time and savings deposits even if no additional bank reserves are created, liability management by the banks (i.e. paying the public to switch from more to less liquidity bank liabilities or vice versa) means that the same reserve base can endogenously expand or contract to meet the changes in net demand for new loans by borrowers. Although the net demand deposits of the banking system need not change, and hence the narrowly-defined money supply quantity need not rise, the broader based measure of the money supply will definitely change, while one might observe a change in the velocity of the narrow based measure of money as well.

The Central Bank can moderate the interest elasticity of supply resulting from liability management by providing the banks with an alternative source of bank reserves compared to paying the public to alter the liquidity of its portfolio. Thus in a modern banking – liability management – system, the Central Bank can never prevent some money endogeneity. The Monetary Authority can only increase the elasticity of the money supply function in response to a change in the public's demand for money, or produce an exogenous shift in the money supply function via the portfolio balance process. Consequently, the Central Bank's power to 'lean against the wind' in inflation is much more limited than Monetarists claim.

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15 Change, Continuity, and Originality in Kaldor's Monetary Theory*

M. Lavoie

1 INTRODUCTION

For Harry G. Johnson, perhaps the most famous Canadian economist, Nicholas Kaldor and John Hicks were 'illiterate monetary policy amateurs' (1978, p. 126). It is well known that Milton Friedman (1970) in his response to Kaldor's 'New Monetarism', called him a Johnny-come-lately. In much more diplomatic terms, this was also James Tobin's more recent assessment of Kaldor's involvement in the monetarist debates (1983, p. 36). On the other hand, British authors, such as A. P. Thirlwall (1983, p. 43) and Grahame Thompson (1981, p. 68), have claimed that Kaldor's memoranda on money presented the most effective repudiation of key monetarist assumptions.

My intent is to throw some light on these somewhat divergent opinions. Kaldor's views on domestic money went through three different stages, each distant in time by about ten years. In 1958, Kaldor presented his memorandum to the famous Radcliffe Committee. In 1970, he published his *Lloyds Bank Review* article, which was designed to put a stop to the growing popularity of monetarism in Britain. In 1980, Kaldor had another go at monetarism, in his memorandum to a wide-searching House of Commons committee. This task developed itself into a series of articles (1981, 1981b) and a book (*The Scourge of Monetarism*, 1982), the title of which says it all.

I shall study these three periods in turn. In a further section, I shall have a look at the monetary ideas of other Cambridgian economists, such as Joan Robinson and Richard Kahn, from the 1950s to the early 1970s. This will allow us to understand Kaldor's evolution in a wider context. Finally, I shall survey the importance accorded to the notion of endogenous money by other economists (the so-called reverse-causation argument), particularly with respect to the Friedmanian attack on mainstream economics.

* This paper was also presented at the 1988 meeting of the History of Economics Society in Toronto. I made use of comments by V. Chick (London), A. B. Cramp (Cambridge), D. Laidler (Western Ontario), F. Petri (Siena) and T. K. Rymes (Carleton).

This will be done for both Europe and the United States, looking mainly at the 1960s.

The reader should perhaps be warned that the author has already been convinced of the validity of the concept of endogenous money. The analysis that follows will not attempt to value the merits of Kaldor's arguments in favour of endogenous money.[1] The task which I have assigned myself is to see to what extent Kaldor's arguments have changed or become more complete, and to discover to what extent they can be found in the writings of other authors and critics of monetarism.[2] I am thus attempting to answer two questions: how much have Kaldor's ideas on money changed and how original were Kaldor's views on money?

2 THE EVOLUTION OF KALDOR'S VIEW

The Radcliffe Memorandum (1958)

The main message of Kaldor's memorandum to the Radcliffe committee is that the velocity of money is quite flexible within reasonable bounds. It means that within these bounds, changes in the velocity of money are almost limitless. Thus, Kaldor's major argument against the feasibility of a fine-tuning monetary policy is that economic agents have the ability to create substitutes to money and to economize on their transaction balances.[3] Thus, 'considerable changes in the money supply in relation to the national income can take place without inducing spectacular changes in interest rates' (1964, p. 131). Economic agents, through increases in the velocity of money could evade the attempts by the central bank to control the money stock and influence the economy. Kaldor gives the United Kingdom of post 1955 as an example, where increases in velocity had 'fully compensated for the failure of the money supply to expand *pari-passu* with the rise in prices and income' (1964, p. 129). Nevertheless, Kaldor recognizes that money substitutes may not be devoid of inconvenience and that therefore short-term interest rates may rise (1964, p. 30).

Kaldor's second task is to show that whereas fine-tuning by the monetary authorities is next to impossible, drastic steps in raising the rate of interest will have spectacular effects on the economy (1964, p. 132 and 135). Kaldor's theory is that within a large margin, increases in interest rates only temporarily lead to a postponement of expenditures. Furthermore, as a consequence of the large gap between the required prospective rate of profit and the money rate of interest, small changes in the latter do not restrain long-term investment. However, Kaldor recognizes quite clearly that large increases of the interest rate will have a tremendous deflationary impact. He is opposed to such drastic measures because they can easily be overdone, and because the wide fluctuations in interest rates that those measures induce will create more uncertainty, leading to a higher *average* long-term interest rate. Furthermore, he points out that high interest rates adversely affect the capacity of governments to make their interest payments on accumulated debt (1964, p. 136).

The rest of the memorandum is devoted to the problem of inflation. Again Kaldor takes a quite reasonable position, in light of our recent experience, asserting that huge levels of unemployment should restrain wage demands and inflation, while moderate ones will not do. In the case of a true demand inflation, he falls back on the traditional fiscal policy. In fact, besides the emphasis on limitless changes in velocity and the innocuous impact of small changes in interest rates, Kaldor's presentation is quite traditional. He agrees with the standard Keynesian argument that changes in the money supply only exert their effect through changes in the level of interest rates and that therefore the latter should be controlled rather than the money supply or the credit aggregates. Kaldor puts a lot of weight on open market operations and portfolio effects. He denies that changes in the supply of bank credit has any effect on national income (1964, p. 134). He even states that interest rates result from the pressures of the demand for loans (1964, p. 131, fn. 1)!

To sum up, Kaldor's 1958 memorandum has little links with the full endogenous money theory that he shall develop in the eighties. To oppose the old Quantity theory of money, and perhaps elements of the neo-Classical synthesis, Kaldor relies mainly on the substantial flexibility of the velocity of money. This line of approach was fully adopted by the Radcliffe Report. This led R. F. Harrod (1965, p. 797) (who himself contributed to the memoranda) to say that Kaldor's brief may have had the largest influence on the Committee. Indeed, in his assessment of the Committee's report, Kaldor (1960, p. 19) praises their statement that 'it is impossible to limit the velocity of circulation', while he regrets that the justification for it was downplayed, perhaps to avoid a clear break from the traditional view of the supply of money.

The Lloyds Bank Review Article (1970)

Whereas in the Radcliffe memorandum there was hardly any explicit reference to the Quantity theorists, Kaldor decided in 1970 to write an article titled 'the New Monetarism', which was entirely devoted to the claims of the Chicago school. Faced with the persuasive talents of Friedman, Kaldor countered with his own. According to Kaldor himself, most of the arguments formulated against Friedman in 1970 had already been presented in a series of lectures in 1958 (1978, p. 26, fn. 1). In fact the reverse-causation answer to Friedman's results dawned on him, Kaldor says, in the early 1950s (1982, p. 22).

There are however substantial differences between the Radcliffe brief and the Lloyds Bank paper. In the former, Kaldor had insisted upon the variability of the velocity of money. In the latter, although he does not seem to be impressed whatsoever by the econometric computations of the monetarists, Kaldor appears to accept as a fact the relative stability of the velocity of money.[4] He then assigns himself the task to explain this stability, without having recourse to Friedman's causality from money towards income.

Reversing causation, Kaldor claims that the crux of the issue is that the money supply is endogenous, not exogenous. 'The money supply 'accommodated itself' to the needs of trade' (1970, p. 8). This is where Kaldor innovates, in comparison to his 1958 presentation. Whereas in the Radcliffe memorandum Kaldor underlined what would happen to the velocity of money if the monetary authorities did not cooperate, in 1970 Kaldor claims that monetary authorities cannot but accommodate if they want to keep control upon money creation, unless they are ready to disrupt the whole economy (1970, p. 7–9). This explains why, in Kaldor's view, there have been few financial innovations and no appearance of money substitutes, and why the velocity of money has been fairly stable. Central banks are forced to show moderation in the exercise of power, specially when the interest-elasticity of money is low. Basically, the rate of change of the money stock is influenced by the rate of change of money income.

Kaldor's evidence is mainly anecdotal. His best point is that in Britain high powered money is endogenous since the Bank of England has an agreement with the clearing banks to supply the required reserves (1970, p. 15). Otherwise he gives the Christmas example, where the seasonal increase in the money supply is due to increased spending by the public rather than the reverse. He argues against the significance of Friedman's time lags along lines quite similar to those formally presented by James Tobin (1970) the very same year (1970, p. 10–11). He uses Friedman and Schwartz' own figures to show that increases in the monetary base in the USA, in the 1930s, could not induce increased money supply and activity (1970, p. 12–13).

To sum up, Kaldor still relies heavily on a simplified version of the argument of the highly flexible velocity of circulation. Any successful attempt by the central bank to control the quantity of money will automatically speed up its velocity. For Kaldor, the fact that velocity has not changed shows that central banks have mostly accommodated, perhaps because they can hardly do otherwise. As in the 1958 memorandum, Kaldor does not deny that changes in interest rates will affect investment (or the propensity to save!). But despite Kaldor's claim that money is endogenous, there is hardly any description of this endogeneity mechanism. The process of the appearance of money remains a black box.[5]

The Scourge of Monetarism Papers (1980–2)

The black box of Kaldorian money creation was to be opened ten years after the *Lloyds Bank Review* article. Kaldor's renewed interest in money matters sprung from the demands of a German encyclopedia of economics and a House of Common's inquiry. To criticize monetarism, Kaldor provided empirical evidence against it but also a well-formulated alternative monetary theory, which ran counter to monetarism, neo-Classical synthesis and even Keynes' *General Theory*. The positive heuristics can most clearly be found in an article written with James Trevithick, also of Cambridge, and published once more in the *Lloyds Bank Review* (1981b).

There Kaldor presents what I consider to be the main elements of a theory of endogenous money. First, contemporary and a large segment of past economic systems are based upon credit-money rather than commodity-money. Under credit-money, the supply of money is a reflection of the variations in loan-expenditures. 'An increase in bank lending is necessarily reflected in a corresponding increase in bank deposits, since the increased spending swells the deposits of the recipients' (1981b, p. 7). When expenditures are financed by drawing on the unused portion of an overdraft facility, as is often the case, this process is even more automatic.

Kaldor's first basic proposition is that credit-money is created by borrowing from banks. His basic second proposition is that money is 'extinguished as a result of the repayment of bank debt' (1981b, p. 7). Again, this happens automatically if economic agents are making use of overdrafts, since the rate of interest on loans is always higher than the one on deposits, and since they can always draw on their line of credit. Kaldor (with Trevithick) has thus reasserted the flux-reflux theory of the Banking School.

A straightforward consequence is that there can never be any excess supply of money in the economy. It cannot 'cause' inflation, because any such excess would be used to pay back the overdraft rather than be spent on goods (and increasing aggregate demand). Another consequence is that net money creation thus becomes the difference between two opposite financial flows. Money is analyzed more as a flow than a stock, and as a consequence portfolio effects take a secondary role. Even if these effects are considered, Kaldor reverts to his old 1970 argument, stating that an interest-inelastic demand for money will prevent the central bank from using open market operations to seriously restrain money creation, for fear of destabilizing a financial system based on credit pyramiding.

Kaldor also develops the reverse causality between the money stock and high powered money. The latter is determined by the former. Central banks cannot control high powered money as such. They can only encourage or discourage the accumulation of money and base money by lowering or raising the rate at which they are prepared to provide reserves (1982, p. 25).[6] This is why Kaldor considers that 'a given stance of a monetary policy is best expressed by a chosen rate of interest' (1981b, p. 6), rather than a fixed supply of money or reserves. The elasticity of the money supply, at the rate of interest chosen by the monetary authorities, is infinite. This gave rise to Kaldor's famous graph, where the supply curve of money is horizontal (1982, p. 24).

The Kaldor of the 1980s has somewhat dropped the case of infinitely flexible velocity of money, perhaps to be able to 'demonstrate' that monetary restraints could indeed create some large inconvenience and lead to drastic changes in interest rates and unemployment rates: after all, monetarism is said to be a scourge! It may also be noted that Kaldor, having then fully endorsed an endogenous money theory, has reversed his views upon appropriate monetary control. In the Radcliffe memorandum, when monetary policy had to be applied at all, Kaldor mainly proposed to act upon interest rates. But in his House of Commons memorandum, Kaldor recommends a return to lending controls, to which he was opposed in 1958. Furthermore, he considers reserve ratios to be meaningless (1982, pp. 106–7).

To sum up, Kaldor's opinions on money matters have changed quite substantially between 1958 and 1982, although he is opposed at all times to any form of a Quantity theory of money. But whereas his critiques of the latter initially seem to derive from some standard IS–LM scheme, plagued by rigidities and a highly flexible velocity of money, Kaldor's vision of a monetary economy later drifts towards a much more radical and unorthodox stance, which makes it incompatible with neo-Classical theorizing.

3 THE CAMBRIDGE VIEWS ON MONEY

As it has been recently noted by Jan Kregel (1985, p. 133), money seems to play no role in the Cambridge theories of growth and distribution. It is therefore difficult to believe that there existed some common thread on monetary matters between the major proponents of these Cambridge theories. In this section, I propose to show that to some extent such a thread existed, and I intend to compare it with Kaldor's evolutive view.

Joan Robinson

Although Joan Robinson was mainly enthralled with the capital controversies, she eventually did get into the debate against monetarism. In her *magnum opus*, *The Accumulation of Capital*, she appears to take a rather conventional stance on monetary matters. In particular, she endorses fully Keynes' liquidity theory, while her short-run approach is reminiscent of the

IS/LM Model (1956, ch. 5, 23). In the long-period, she supports Kaldor's position of 1958, since she believes that the supply of money adapts itself to its demand, through innovation and changes of the velocity. The previous *Rate of Interest and Other Essays* (1952) cater similar views. There are however some interesting passages, where the rate of interest is determined by the external balance constraint of the economy. This is basically Kaldor's position in the eighties (1982, p. 24). In the case of a worldwide boom, Robinson adopts a demand-determined supply of money (1952, p. 128). Robinson also underlines the importance of bank advances and the use of overdrafts (1952, p. 21). But all this is rather sparse.

In her critique of monetarism, Joan Robinson predominantly proposes to reverse the causality of the Quantity equation, without giving much argument for this. She expresses her dissatisfaction with the IS/LM analysis and with the use of wealth effects on consumption (1970, pp. 508–9). She uses Tobin's title (1970) to describe the method of monetarism: *post hoc ergo propter hoc* (1970, p. 510). She has abandoned the *standard* liquidity preference theory as she states that 'the main determinant of the level of the interest rates is the state of expectations' (1970, p. 505). This renunciation was to be reasserted ten years later (1982, p. 296).

In my view, Robinson's most interesting remarks come when she explains why Keynes assumed a vertical supply curve of money in the *General Theory*. 'It would have been much simpler to start by assuming a constant rate of interest and a perfectly elastic supply of money. But then his whole case would have been dismissed as a misunderstanding of the orthodox position . . . The concessions which he (Keynes) made to orthodoxy about the rate of interest were used to provide a mollifying version of his system of ideas which turned it back once more into a variant of the quantity theory' (1970, p. 507). The first sentence reflects, ten years in advance, Kaldor's horizontal supply curve of money. The second sentence refers to F. A. Hayek, whose *Prices and Production* (1931) gave some credibility to the Treasury View, and who, as a consequence, was considered to be Keynes' main rival influence.[7] The theme of the last sentence was to become one of Kaldor's major proposition (1982, p. 21).

Thus in these criticisms of Keynes or Keynesianism, Mrs Robinson seems to be way ahead of Kaldor in 1970. But in the rest of her works, the monetary apparatus appears rather traditional. Her dissatisfaction with standard tools is vaguely expressed, and her support of endogenous money is far from being well argued. It seems that she has the proper intuitions but that she cannot get disentangled from Keynes' *General Theory*.

Richard Kahn

Richard Kahn also submitted a memorandum to the Radcliffe committee. What is striking about his brief is that it announces Kaldor's recent theory of endogenous credit-money much better than Kaldor's own contribution to the Radcliffe committee. On the subject of money, it seems that Kahn was a few steps ahead of his contemporaries.

In his 'Notes on Liquidity Preference' (1954), Kahn argues explicitly against the simultaneous equations of the IS/LM model. He blames Keynes for having sometimes pictured the state of liquidity preference as a stable relationship (1972, p. 90). More importantly, he attributes validity to some of the criticisms made by Dennis Robertson against Keynesian liquidity theory. In particular, he agrees with Robertson's statement that most of the expansion of the money supply is due to the banks performing their banking role, i.e. lending money to those 'who want to make productive use of it' (1972, p. 93). Kahn is not yet totally convinced in 1954 that the proper emphasis of a monetary analysis should be put on the flow of bank advances and credit, rather than on the analysis of securities and cash (1972, p. 94). Four more years will be needed for that.

Kahn reverses his priorities in his Radcliffe memorandum. The portfolio aspects of money and standard liquidity preference analysis become minor elements of his presentation, while bank advances take the forefront. With respect to the Quantity theory, Kahn already picks up the reverse-causation argument, as well as the credit-money analysis: 'The quantity of money . . . is an effect and not a cause . . . The Committee should view with suspicion any line of argument which attributes to the behaviour of the supply of money a significance of its own, apart from its relationship with rates of interest and bank advances. This is no mere hair-splitting matter' (1972, p. 147–8). Kahn repeatedly stresses that monetary policy can only be expressed in terms of bank advances and of interest rates on loans. Investment requires bank advances (1972, p. 128).

Elements of analysis, similar to Kaldor's 1958 presentation, can also be found.[8] Most interesting however are Kahn's practical recommendations, which are identical to those of Kaldor in the eighties. Kahn rejects the use of reserve ratios for banks, which he calls an 'indirect and imperfect method of limiting the banks' advances' (1972, p. 150). Kahn thus recommends a direct approach, the regulation of bank advances, which avoids the unreliable and clumsy control of the money supply (1972, p. 151).

In a later work, Kahn underlines again the importance of bank advances for investment and working capital, and he assumes that they arise from overdrafts (1972, p. 229). Kahn's perception of the functioning of the monetary system theory corresponds quite closely to that of the modern proponents of the theory of endogenous money. It could almost be said that the evolution of Kaldor's views was such that he gradually adopted Kahn's approach. In a way, this is not surprising since Kahn had translated Wicksell's *Interest and Prices* (1936), and had been forced to get immersed in the study of pure credit economies by doing so.

At Cambridge or Near Cambridge

While to some economists the ideas contained in the Radcliffe Report or in Kaldor's memorandum seemed to be new and daring, it was not the opinion of A. B. Cramp, who in the 1960s was to become a fellow of Emmanuel College in Cambridge. Cramp (1962) thought that the debates between the Radcliffe and the Quantity theories of money replicated to a large extent the debates between the Banking and the Currency Schools. Despite the fact that economists such as John Stuart Mill had sided against the latter, the Banking School had fallen into oblivion. Economists such as J. M. Keynes had been partly responsible since, while pretending to oppose the Quantity theory, he proposed tools to refurbish it, such as the money/reserve multiplier or large segments of the liquidity preference theory (1962, pp. 13–14).

In a paper published in 1970, a few months after Kaldor's Lloyds Bank article, Cramp draws several crucial distinctions between the modern Quantity theory and 'Radcliffism', which he sees as the proper Keynesian alternative to monetarism (1971, p. 63). Friedmanians attach great importance to monetary stocks, the reshuffling of portfolios by asset-holders, the exogeneity of the monetary base. The analysis stems from a static economy. Radcliffism, on the other hand, emphasizes the flow of credit, the decisions of borrowers and their liabilities. The analysis presumes that the economy is growing (1971, p. 64).

On the subject of money endogeneity and flexible velocity, Cramp is in-between Kaldor's 1958 and 1970 papers. Central banks may attempt to restrict monetary expansion: the velocity of money will then increase and interest rates go up. Usually, however, reserves will be passively provided. 'Monetary policy is a weak tool unless used with such vigor as to court disruption of the financial markets' (1971, p. 74). This, says Cramp, is the lesson that was drawn in the Radcliffe Report and that can be quoted from it.

In his support of the thesis of endogenous money, Cramp is one step ahead of Kaldor. He dismisses explicitly the money multiplier story. 'The causation runs primarily from money stock to high-powered money rather than vice-versa . . . It is not the extra 8 of cash that produces the extra 100 of deposits, but the extra 100 of deposits that requires the central bank to create an extra 8 of cash . . . The extra 100 of deposit liabilities arises from the banks lending an extra 100' (1971, p. 70). The thesis of credit-money, which Kaldor was to develop ten years later, is here succintly but clearly exposed.

Curiously absent from Cramp's analysis, however, is the concept of the overdraft. Cramp being a monetary historian, this omission is surprising since Keynes had described with some care the functioning of overdrafts (1930, pp. 41–3).[9] As it has recently been pointed out by B. J. Moore

(1984, p. 66), the existence of overdrafts, i.e. unused lines of credit which are not regulated and hardly monitored, is a crucial fact supporting the theory of endogenous money. When Keynes tries to extricate himself out of the mess that Ohlin, Robertson and the finance motive got him into, he digs out overdraft facilities as a last-resort argument (Keynes, 1973, p. 223).

It was left to John Hicks, in 1974, to mention the contrast between the standard textbook economy and the overdraft economy, where the analysis rests in the latter on the availability of borrowing rather than on the sale of liquid assets (1974, pp. 50–6). When Hicks came to revise his views on liquidity in 1982, his approach was very similar to that of the contemporaneous Kaldor. His credit-money economy is Hicks' overdraft economy. Hicks believes that Keynes is now too monetarist. Open-market policy is impotent because, while it can fix interest-rates, it cannot control reserves or money since there are no speculative funds held in cash at all (1982, p. 264).

It may thus be said, to sum up this second section, that a certain tradition of the endogeneity of money always existed at Cambridge, but that this tradition, as a consequence of the overriding triumph of Keynes' *General Theory* and Hicks' IS-LM analysis, had been reduced to its vaguest expression. However, under the pressure of the revival of the Quantity theory, Cambridge Keynesians were gradually forced to reassess their acceptance of Keynes' formal presentation of the liquidity preference theory, and they had to search for more precise presentations of their intuitions. While Kaldor undoubtedly put together the most comprehensive statement of a credit-money economy in the 1980s, colleagues of Kaldor at Cambridge were also on the same track. In some instances, they even seemed to be ahead, although lacking Kaldor's persuasion and enthusiasm perhaps.

4 THE REST OF THE WORLD

The United States

This subsection is mainly devoted to Milton Friedman's claim that Kaldor in 1970 was a Johnny-come-lately. James Tobin recently reiterated that claim when he said that 'perhaps more than Kaldor realizes . . . his points [were] made in the debates on monetarism in the United States in the 1960s' (1983, p. 36). Depending from which angle one looks at some of the major monetary debates around 1970 in the US, these assertions may or may not seem to carry much weight. All of the evidence does not point in the same direction; some subjective judgment must be made.

It may be first noted that when Friedman is on theoretical grounds, as is the case in the *Journal of Political Economy* 1972 debate, none of Friedman's critics consider the endogeneity of money as an issue worth discussing.[10] In view of the fact that Friedman (1970) himself recognized without hesitation that monetarism stands or falls without or with endogenous money, this behaviour is rather surprising. Tobin, for one, stated there that the main issue with monetarism is the shape of the LM curve, mainly the interest-elasticity of the demand for money (Gordon, 1974, p. 77).

Opponents to Friedman bring up some version of the endogeneity of money when they discuss empirical results. Endogeneity is discussed, it seems to me, not so much as a theoretical argument, but rather as a ploy, among many others, to diffuse the validity and the impact of Friedman and Meiselman's (1963) or Andersen and Jordan's (1968) single-equation econometric results. Both D. D. Hester (1964, p. 368) and Ando and Modigliani (1965, p. 711–3), in response to the first study, point out that the money supply is not really exogenous. Ando and Modigliani however accept the exogeneity of the monetary base.

Those who criticized the second study, the St. Louis equation, went a bit further. Both De Leeuw and Kalchbrenner (1969) and R. G. Davis (1969) noted that part of the monetary base, currency and borrowed reserves, were endogenous. Both of them, however, recommended the use of non-borrowed reserves in the St. Louis equations, assuming that these were indeed exogenous.[11] Retrospectively we may easily say that their criticism fell short. However, such was the impact of these studies and of a book describing and measuring accomodative actions of the Federal Reserve (Hendershott, 1968), that one of the author of the St. Louis equation decided to devote an article to the so-called 'reverse-causation argument', as indicated by its title (Andersen, 1969). It is also no hasard that C. A. Sims (1972) decided to use money and income for his newly-found 'causality' test.

To his credit, it must be said that Friedman never denied the possibility of reverse-causation. In answer to his critics, he either recognized that a minor part of the movement of the money stock might itself be induced (1965, p. 781), or that the possibility had been seriously considered in his previous studies and that the evidence gathered forced him to reject it (1964, p. 376). This last answer, based mainly on the analysis of leads and lags, prompted James Tobin to write the paper to which I have already referred, *Post hoc ergo propter hoc* (1970), where he demonstrates that within an economy where the money supply is passive and endogenous, variations in autonomous expenditures induce fluctuations in money that lead those of income. Tobin described in equations what Kaldor had put into words.[12] In Tobin's 'ultra-Keynesian' model, the central bank provides just enough reserves to keep the rate of interest constant. The supply of money is thus infinitely elastic at the chosen rate of interest. We are back to Robinson's 1970 sentence and to Kaldor's 1982 diagram.

Tobin's 1970 model is undoubtedly a major formal step towards a theory of endogenous money. It is a much better explanation of Friedman's leads than the reinstatement of Keynes' finance motive which, as we have seen, negates the existence of overdrafts. But Tobin seems to be developing the model for negative purposes not for constructive ones, i.e. he does not attach much importance to it, except as a tool to knock down Friedman. Tobin entertained the idea of money endogeneity because it 'explained many of the pseudo-reduced-form correlations' that boosted monetarism (Tobin, 1983, p. 36).

Quite different, in spirit and in form, is the contribution of Alan R. Holmes (1969). He does not present a model. He wants to show what a central bank does and can do. His basic point is that the money supply and the monetary base are demand-determined and that the Federal Reserve can only fix the rate of interest, whatever its targets. Holmes first underlines that 'banks have on their books a large volume of firm commitments to lend money' (1969, pp. 67–8); they offer overdrafts. Holmes has a complete theory of credit-money, where the causality runs from credits, to deposits, to reserves: 'In the real world, banks extend credit, creating deposits in the process, and look for the reserves later . . . Within a statement week, the reserves have to be there, and in one way or another, the Federal Reserve will have to accomodate them' (1969, pp. 73–4). When less reserves are provided through open market operations, 'interest rates, spreading out from the Federal funds rate, will have been on the rise . . . A switch to money supply as the target of monetary policy would, of course, make no difference' (1969, pp. 74–5). Holmes is in fact telling us that the US financial system, considered by all to be the textbook money-multiplier economy, cannot but behave like a Kaldorian credit economy (or an Hicksian overdraft sector).

Trying to sum up this subsection, it may be said that although the endogeneity of money had been an issue in the debates on monetarism in the US, it was always a minor one. Endogeneity was either omitted or used as means to turn down empirical evidence. It was put forward for destructive uses not for constructive ones. Furthermore, very few authors recognized that endogeneity affected the monetary base as well. The only exception, it seems to me, was Holmes, who was situated within one of the Federal Reserve Banks. One had to wait until 1973 to see in the United States a full-fledge attack against monetarism based on money endogeneity. The authors (Lombra and Torto, 1973), incidentally, do not mention Kaldor.[13]

Continental Europe

I shall focus my analysis of Continental Europe on only three authors, one each from a different country, each at a ten-year interval. They are Friedrich A. Lutz, Jacques Le Bourva and Paolo Sylos Labini.

In his article, written in the summer of 1969, the well-known German economist F. A. Lutz (1971) is concerned with the range of validity of the analysis of the standard money multiplier. He believes, with great circumspection, that it *may* be relevant for textbook economies such as the United States (1971, p. 150). But he has no doubt that the analysis is irrelevant to banking systems such as the German one, where only secondary liquid assets ratio may play a role (1971, p. 146). Lutz's position is thus similar to Hick's 1974 views: overdraft economies are distinct from textbook economies. What is ironic is that Lutz's description of the process of money creation in Germany is identical to the process described by Holmes for the United States. We may thus conclude that both the German and the American banking systems are part of the overdraft sector, which is Hicks' view in 1982!

The most explicit and precise statements of a theory of endogenous money are to be found, in my opinion, in two articles by French economist Le Bourva (1959, 1962). Trying to explain in his 1959 article the reversal of causality between money and prices, something of a tradition in France since Albert Aftalion's *Monnaie, prix et change* (1927), Le Bourva presents a monetary theory which he associates to Knut Wicksell and to the Banking School, and which he contrasts to the Quantity theory and to Keynes' views. Le Bourva's 1959 paper precedes Kaldor's 1981–82 identical presentation. In Le Bourva's model the rate of interest is autonomous, chosen by the banking system, and the supply curve of money is infinitely elastic: he even has a graph with the now standard horizontal supply curve (1959, p. 720). Le Bourva puts much emphasis on the initiative of the firms: their demand for new loans generate new deposits. Money is a dependent variable, usually the result of the activation of the unused portion of existing lines of credit (1959, p. 721). Le Bourva also underlines the importance of money destruction: if there were excess money, it would be used to pay back past loans (1959, p. 723). The only thing really missing from Le Bourva's account is the link between money and high powered money.

This omission is rectified in his 1962 article, where the links between the central bank and the commercial banks are analyzed in detail. Le Bourva's position is that the central bank is powerless unless it decides to impose quantitative limits to credit aggregates. High powered money is otherwise fully demand-determined, although the central bank sets the rate of interest (discount rate, and day-to-day money market). Le Bourva also brings forward a point to be underlined later by Cramp: money is not only a stock, it should also be considered as a flow, specially in the view that all production (which is a flow) must be somehow pre-financed by credit-money. The integration of money to the economic system is done through this pre-financing (1962, pp. 37–8). Again Le Bourva underlines the flux-reflux theory which is so detrimental to monetarist views.

Whereas in Cambridge, economists seemed to have been forced to specify an alternative monetary theory as a result of the invasion of the monetarist ideas, in France a theory of endogenous money was proposed because there existed a vacuum. Indeed Le Bourva thought that the Quantity theory was dying. He thought that the well-known criticisms against it, based on the instability of the velocity of money were accepted by all. Still, he believed that these were trite criticisms. The fundamental objection to the Quantity theory was, in his view, the reverse causality that emerged from the determination of the volume of money (1962, p. 29). As a consequence of all this, Le Bourva did not believe that the monetary policy ought to have any responsibility in the stabilization of the price-level, a position also upheld by the Cambridgians. Besides situations of excess demand for raw materials or agricultural goods, Le Bourva attributed price increases to psychological thresholds inducing wage demands and increased profit margins (to finance new capacity) (1959, p. 730). There is little doubt that Le Bourva considered his monetary theory as a natural companion of the Cambridgian approach since, when he deals with the question of income distribution, he refers to Robinson's *Accumulation of Capital* (1962, p. 52). These links go both ways, however, since Le Bourva's monetary theory is based on the Banque de France view, supported among others by A. Boccon-Gibod, whom Kaldor knew well.[14]

But long before Le Bourva, the hypothesis of a given stock of money had been under heavy criticism from a well-known post-Keynesian. Here is what Paolo Sylos Labini wrote in 1949, after some long discussions with Franco Modigliani.

> This reasoning is based on the assumption that the volume of money is constant . . . Here is the fallacy. The production of means of payment, in the modern economic process, did not and does not depend . . . on the monetary authority . . . It is not true that the firms cannot 'produce' money: they can and do produce it: not directly but through the banks . . . The assumption that the volume of money is constant would seem to be unfounded, or rather, deceptive. Such an assumption creates bottle-necks, required passages, which in reality do not exist. (1949, p. 240)

Sylos Labini goes on, explaining that new credit-money does not represent the savings of anyone, that long-term investments are initially financed by short-term bank loans, and that we are left without a theory of interest. An economy based on an exogenous stock of money, Sylos Labini says, has ceased to exist more than two centuries ago. Almost forty years have elapsed since this point has been made, but it is not yet accepted by all.

It is thus clear, to sum up this subsection, that some economists were dissatisfied from the onset with Keynes' hypothesis of a given stock of money. There existed in Europe a tradition of opposition to the Quantity theory which, at least in the case of France, was well-formalized and well-developed around 1960, and which was not based on the instability of the velocity of money or on the definition of means of payments, but rather on the formalization of reverse-causation arguments. While Kaldor, on that basis, appears as a somewhat latecomer, the same cannot be said of the whole Cambridge tradition since in 1958 Kahn was thinking mainly along the lines presented by Le Bourva.

5 CONCLUSION

I had assigned myself three tasks: to follow the evolution of Kaldor's ideas on monetary matters; to assess the existence of a monetary tradition among the so-called Cambridge authors; to compare the Kaldorian tradition with the criticisms of standard and monetarist theory in the 1960s, both in the United States and in Europe. It is quite clear that Kaldor's initial criticisms of the Quantity theory were based on the possibility of a quasi-limitless flexibility of the velocity of money, and that this was the Radcliffe position. Later, Kaldor adopted a reverse-causation stand, which was eventually developed into a criticism of Keynes' *General Theory* and a full-fledged description of a credit economy with endogenous money. Whereas Joan Robinson seems to have followed Kaldor's own revolution, other Cambridge authors such as Richard Kahn or Anthony Cramp seemed to have preceded it to some extent, emphasizing elements that were to be found in Kaldor's writings ten years or so later. Kaldor was, however, the first to assign a whole article to the question of reverse causation. Although the endogeneity of money had been invoked by several critics of Friedman, it had rarely been considered as a criticism of major importance, probably because all of these critics had some sort of simultaneous causation in mind and because most of the comments were of a statistical rather than of a theoretical nature. On the other hand, economists from continental Europe had long ago recognized the inadequacy of Keynes' or Friedman's presentation of the money supply. Economists from France in particular, perhaps because the Quantity theory had never been a dominating force there, had articulated very early the characteristics of a credit-money economy and its consequences for inflation and monetary policy.

In view of the fact that some famous neoclassical economists have attributed absurd views to Kaldor, it may be worthwhile to clear up the matter. Paul Samuelson writes that the Radcliffe Committee is 'one of the most sterile operations of all time' and that it 'embalmed' the 'stupid view that money does not matter' (1969, p. 7, 9). Robert Solow says that Kahn and Kaldor 'needed to be told that money matters and that shifts in the LM curve can affect real output. They probably still don't recognize that'

(Klamer 1984, p. 135). Both Samuelson and Solow claim that monetarism and an eclectic (neoclassical synthesis) Keynesian economics are the same, or that the only differences are about the elasticity of the curves, which still seems to be Tobin's most recent assessment (1983, p. 36). Monetarism would be a corrective, but only to Cambridge Keynesian economics. What Samuelson, Solow and others do not seem to understand is that an endogenous stock of money (or a limitless velocity), with reverse-causation, if it implies that money does not matter, does not imply that monetary policy is of no significance. Kaldor, the Cambridge authors and proponents of credit-money theories have emphasized time and again that, although the central bank could not fix the supply of monetary aggregates, it could still choose the level of interest rates. The monetary authorities thus always have to take some monetary stance. Monetary policy is a potent tool when drastic steps are taken. But it is also a far too dangerous one, as the recent past can testify, with its huge unemployment rates and indirect government deficits. Cambridgians simply believe that there are less barbarian means to stabilize prices.

Economic theories are said to go in circles. The Quantity theory seems to be reigning, although anti-monarchic movements continuously threaten (the Banking School, the Wicksell–Schumpeter–Keynes episodes, the Kaldorian monetary theory). Sometimes the republican opposition seems to have taken control, only to find out that the revolution has established a monarchist republic. Theories are made more precise when they are to supersede or when they are about to be superseded. They come and go, with controversies and economic circumstances, brought out of oblivion and getting back into it.

Kaldor was opposed to the Quantity theory from the beginning. But his opposition took different and complementary aspects through time. Kaldor first favored the instability of the velocity of money and the appearance of money substitutes when monetary authorities would show some reluctance in accommodating demand. He then accepted as a fact accommodative behaviour and developed his theory of endogenous money, where velocity is stable. The 1980s have, however, been years of disrupted financial markets, unstable velocity, financial innovation and so-called liability management. Several central bankers now complain that innovations render predictions of the money aggregates completely useless (Freedman, 1983). If Harry Johnson's opinion of Kaldor has some validity, i.e. if indeed he was 'a man who rolls with the time fairly fast' (1975, p. 123), Kaldor today might have advocated again a theory where changes in the velocity of money, because of induced innovations, are of primary importance. In fact, this is precisely what he did in his last piece in the field (Kaldor, 1985, pp. 259–60).

Notes

1. See Lavoie (1985; 1986). See also the (1988) book by B. J. Moore.
2. A. P. Thirlwall (1987, ch. 12) has written a chapter surveying and evaluating Kaldor's monetary views. Thirlwall's piece, however, is mainly concerned with policy matters. See Desai (1989) for another independently written assessment of Kaldor's criticism of monetarism.
3. The creation of money substitutes could be considered to be part of the realm of financial innovations, which had been underlined by H. P. Minsky (1957) at that time, and which have again been pushed recently to the forefront (Gedeon, 1985; Rousseas, 1985, 1986).
4. Finding negative money multipliers with resounding correlation, Kaldor comments: 'Which only goes to show what 't' values and R^2 are worth' (1970, p. 6).
5. Although on a side issue, Kaldor mentions the demand for loans as a cause of bank deposits (1970, p. 14).
6. The argument is developed elsewhere (1981, pp. 16–19).
7. In 1970, Kaldor also links Friedman to Hayek: both argue that tampering with the money supply induces painful adjustments (Kaldor, 1970, p. 3).
8. The velocity of money is unstable (1972, p. 147); to control inflation by deflating demand is possible but would require very high unemployment rates; monetary policy is difficult to fine-tune and, because it is unpredictable, often leads to excessive squeezes (1972, p. 139); restrictive measures are often justified by unfavourable balance of payments (1972, p. 148).
9. Cramp's present position is expressed in four articles of the *New Palgrave* (1987).
10. It is mentioned, *en passant*, by Brunner and Meltzer (Gordon, 1974, p. 72) and by Paul Davidson (Gordon, 1974, p. 103).
11. Although Davis (1969, p. 126) adds that one would have then to demonstrate the stability of the relationship between non-borrowed reserves and the money supply.
12. In fact the resemblance is such that one wonders whether Kaldor had seen a draft of Tobin's paper when he wrote his 1970 article.
13. Nor do Davidson and Weintraub (1973), who tackled a similar subject.
14. This I have been told by Professor Jean Weiller. Le Bourva refers to Boccon-Gibod and Berger and to their Banque de France view in his introduction (1962, p. 29). Note that English central bankers of the fifties also held some of these views, which today would be considered non-orthodox (see N. Wulwick, 1987).

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Part V
Business Cycles

16 A Keynesian Business Cycle*

R. H. Day and T. Y. Lin

> the presence or absence of a fluctuation inherent to the economic process is practically and scientifically the fundamental problem. (J. A. Schumpeter, 1935, p. 2)

The Keynesian business cycle follows a straight forward scenario. Begin in an expansion with a rising volume of transactions. Under tight money, interest rates rise. If they rise sharply enough investment is eventually reduced. If this depressing effect is strong enough, a recession is induced by the corresponding fall in aggregate demand; unemployment and excess capacity increase, the transaction demand for money decreases, and the interest rate falls. If the latter influence is sharp enough investment may overcome the depressing influence of excess capacity and low profits. Recovery sets in and the stage is set for a repetition of the story. A dramatic example of such interactions occurred in the early 1980s when the price level was brought under control with tight money policy; interest rates reached unprecedented levels and investment in some sectors came to a virtual standstill. When interest rates eventually fell, the impact on new housing starts and investment was immediate and substantial.

In this paper we show how business fluctuations of this Keynesian type arise in a dynamic version of the IS-LM model. We show first that periodic cycles or deterministic fluctuations that behave like stochastic processes can persist when demand for money and goods have classic 'textbook' forms.[1] We then consider an operational version of the model with plausible parameter values. Examples are given using data for each of three periods (early 1930s, early 1960s and late 1970s). The first example displays a stable, two-period cycle; the second exhibits a two-period cycle with random amplitude; and the third exhibits fluctuations with both erratic periodicity and random amplitude. In order to see how robust these results are we compute the bifurcation diagram for each of the examples for continuous variations in the endogenous demand for investment goods.

* Work on this undertaking by the first author was commenced and initial drafts prepared at the Industrial Institute of Economic and Social Research in Stockholm and at the Netherlands Institute for Advanced Study in 1984. It was completed during the 50th anniversary of *The General Theory*. Discussions with David Lilien and some cogent remarks of an anonymous referee were very helpful in preparing the final version.

This method, which involves comparing the attractors to which trajectories are drawn for various values of the parameters, is a generalization of the method of comparative statics where equilibria are compared for marginal changes in various parameters. Such equilibria represent the 'long run' behavior of an implicit or unspecified dynamic process under the assumption of asymptotic stability. In the nonlinear, explicitly dynamic model under consideration here the long run attractors may be uncountable sets (with positive measure). Nonetheless they are systematically dependent on the parameters of the system even though the latter need not be stable!

One may reasonably ask if such a method is meaningful for a 'short-run' model. Two answers may be given. First, one wishes to know if short-run behavior is 'transient' and would change with the passage of time. Thus, a short-run fluctuations could die out and a stationary state emerge, or erratic fluctuations could converge to cycles perhaps of very high order. Second, and more importantly, some variables are assumed to be fixed because they change relatively slowly in the short-run. We would really like to know how the dynamics are influenced when these 'variables' are in fact allowed to vary. The bifurcation diagram suggests a clue, for if a given kind of behavior is robust and occurs for widely varying values of the fixed variables, then that qualitative behavior is likely to persist in the more general model. Bifurcation analysis is thus a first step in the investigation of less restrictive assumptions.

In actual economies where the money supply itself varies (because of policy changes, international trade, etc.) where echo effects of capital accumulation exist, and where prices are allowed to adjust, the business cycle is very much more complicated than in the model analyzed here. For this reason our model is not likely to be adequate as a basis for econometric analysis without substantial generalization. But the dynamic interaction of interest rates and aggregate demand are part of the story and under some conditions likely to have a substantial influence. The Keynesian analysis, therefore, will surely retain its interest for a long time. Its integration of monetary and commodity sectors in a single coherent framework illustrates with graphic simplicity how empirical properties of supply and demand determine the employment effects of monetary and fiscal policy. That intriguing new insights can still be derived within this 'classic' framework when attention is shifted from the usual comparative static analysis to an explicitly dynamic formulation adds some very new wine to a quite venerable cask.

Benassy (1982, 1984), Bohm (1978) and Malinvaud (1980) provide a basis for believing that a dynamic Keynesian theory may be of more than pedagogical value. In these and in other models involving switching regimes or multiple phase dynamics,[2] economies may be governed by quite different dynamic forces at different stages of development, switching from one phase or regime to another in response to endogenous changes in state. Such models explain why a given set of equations may only be relevant part of the time and only under certain conditions. Thus, one could imagine that under some conditions the Keynesian theory provides a very good approximation when prices are changing slowly and excess capacity persists, while, as conditions change, the economy may escape this Keynesian regime and enter a different one of stagflation or of classic inflation.

The setting of this conference in honor of Nicholas Kaldor is an appropriate place to reconsider the basic Keynesian insights for Kaldor was an ardent champion of Keynes; he was actually more successful in establishing an explicitly dynamic analysis of the business cycle, and he was one of the very first economists to recognize the crucial influence nonlinear relationships can have in determining the qualitative properties of economic adjustments over time. The spirit of the present contribution is in other regards closer to Hicks and Hansen in its explicit incorporation of the role of money and interest. Indeed, in our version of the theory it is precisely this role that induces nonlinearity and all the qualitative results that follow. For this reason, we wish to dedicate this work not only to Nicholas Kaldor but also to John Hicks and Alvin Hansen. All three did so much to establish macroeconomics as a branch of economic science.

1 THE MODEL

Let m, g and ℓ be indexes denoting money, goods and labor respectively. Prices and wages are assumed fixed while real output, Y, and the real interest rate, r, are variable. Denoting D^m and S^m as the aggregate demand and supply functions for money we have, assuming temporary market clearing, the equation for the monetary sector

$$D^m (r,Y) = S^m (r,Y) \equiv M. \tag{1}$$

If the supply of money, M, is exogenously determined as indicated in the right-hand identity, the LM curve is derived in the usual way:[3]

$$r = L^m (Y;M). \tag{2}$$

The aggregate demand curve for goods may be denoted by $D^g(r,Y;G,\mu,\tau)$ where G and τ are government expenditures and the income tax rate respectively and were μ is a shift parameter reflecting the importance or intensity of endogenous investment demand. If the parameter μ is zero then there is no induced but only autonomous investment. If $\mu > 0$ then induced investment enters the picture. Substituting for the interest rate using (2) we obtain the aggregate demand curve

$$\theta(Y;G,\mu,\tau,M) := D^g\,[L^m(Y;M),Y;G,\mu,\tau]. \tag{3}$$

Assuming that supply adjusts to demand with a lag then the difference equation

$$Y_{t+1} = \theta(Y_t;G,\,\mu,\tau,M) \tag{4}$$

describes the progress of aggregate income through time.[4]

The qualitative features usually assumed for the demand for money and goods are that $\partial D^i/\partial r < 0$, $\partial D^i/\partial Y > 0$, $i = m, g$. Under these standard assumptions and given (1) the LM curve is upward sloping. In accordance with usual practice we may assume that the slope of the LM curve is relatively low at low income levels and rises as income rises becoming unbounded as Y approaches a value, say, Y^m.

Next consider the slope of the aggregate demand function,

$$\frac{d\theta}{dY} = \frac{\partial D^g}{\partial r}\quad\frac{dr}{dY} + \frac{\partial D^g}{\partial Y}\,. \tag{5}$$

It can be positive or negative depending on the relative magnitudes of the component terms in (5). Given the conventional LM curve, increases in income from an initially low level do not influence the interest rate very much; the capacity and profit influence of income that underly the positive income effect on aggregate demand will dominate and aggregate demand will be upward sloping. But as income increases enough the interest rate must eventually rise sharply and the negative influence on demand for goods of rising interest rates can then dominate, possibly reducing it. Indeed, if $\partial D^g/\partial Y$ is itself bounded above, and if the interest effect on investment is strong or becomes stronger as rates rise then the possibility of a dominate monetary crowding out effect is the more likely, just as it is the more likely the steeper is the LM curve. If so, then aggregate demand will have a nonlinear profile. In particular it may have a range in which its slope is negative. In such a situation cycles can exist and if the effect is strong enough they may persist. Thus we arrive at the story with which we began. As an historical aside it is interesting to note that because of the inherent properties of demand the problem of bounding expansion and contraction which worried cycle theorists of the time does not arise in a monetary economy with bounded money supply, a point recognized by Modigliani (1986, p. 146).

The model is essentially like those of Metzler (1940), Modigliani (1944) and Samuelson (1948). Samuelson preferred an adjustment story (p. 281–3) while Metzler emphasized the dependence of demand on past income (the 'Robertsonian lag'). From the adjustment point of view our parameter μ will be seen below to act like a 'speed of adjustment' of investment to 'current' (or immediately past) conditions. But this is an extremely crude interpretation and does not eliminate the need for a more sophisticated analysis in which distributed lags are incorporated explicitly. Indeed, it is well known that the solution of nonlinear, discrete time models are sensitive to the length of the time period involved, one of their chief limitations for theoretical analysis. It is the price paid for dropping the equally unrealistic assumption of instantaneous, continuous adjustment when differential equations are used.

To incorporate the old Robertsonian view point not only income must enter with a lag, on grounds that expenditures are made from preceding income receipts, but also interest. Here one might argue that orders for durable consumer goods and capital must be made on the basis of the currently known (average) interest rate, not on the average interest rate that emerges from the current period's market. Again we have a simplified (naive) expectational model at work. Contemporary gluts of office buildings (for example) and occassional over-production of various commodities (petroleum, wheat) all too convincingly suggest that as a *first crude approximation* such a simple expectational model is better than the equally bold simplifying assumption of perfect forsight and other implausable proxies for rational expectations.

In any case strong assumptions must be made if we want to derive a rigorous understanding of the dynamic interactions involved. A referee has noted, however, that at least the standard fixprice assumption underlying (1)–(4) can be relaxed by adding an 'aggregate supply curve' $P = P(Y)$ with $P'(Y) > 0$. In this case (3) would become $\theta(Y) = D^g[L^m(Y,P(Y)), Y, P(Y)]$ and we arrive again at a first order difference equation. This adds some complicating wrinkles to the nonlinear profile of $\theta(\cdot)$ but none of the results possible with the original model are changed in any essential way.[5] In such a model, of course, the aggregate price index is positively correlated with aggregate output.

2 INTRINSIC NONLINEARITY

A negatively sloping aggregate demand function may seem novel but that is only because the standard analysis is always conducted in the IS-LM framework. By using the LM curve to eliminate the interest rate from the demand for goods the nonlinearity we have been considering is readily perceived.

In order to sharpen this point suppose that the demand for money is comprised of separable transactions and liquidity components as shown in

$$D^m\,(r,\,Y)\!: = kY + L(\mathrm{r}), \tag{6}$$

where k is the reciprocal of the transactions velocity of money. $L(r)$ is the liquidity preference function. It is assumed to be downward sloping and bounded below by some minimal rate r^o so that it incorporates a liquidity trap. Also, as is usual, it is assumed that as the interest rate increases, liquidity demand approaches zero. Given these assumptions the *LM* curve exists on the open interval $(0,\ M/k)$ and can be written

$$r = L^m(Y;\,M)\!: = L^{-1}\,(M - kY) \tag{7}$$

which is a positively sloped function. It becomes unbounded at M/k.

Next, assume that the demand for goods is comprised of separate consumption and investment components as shown in

$$D^g\,(\mathrm{r,Y})\!: = E + G + (1-\tau)\alpha Y + \mu I(\mathrm{r}, Y) \tag{8}$$

in which E is the sum of autonomous consumption and autonomous investment demand, α is the marginal propensity to consume, $I(r,Y)$ is the induced investment demand function, μ is the induced investment demand shifter and τ the tax rate as noted above. We assume as usual that $\partial I/\partial r < 0$ and $\partial I/\partial Y > 0$ and that induced investment demand approaches or reaches zero when interest rates get high enough.

Substituting the *LM* curve into the investment function we get the IY function

$$H(Y;M)\!: = I[L^{-1}\,(M-kY),Y] \tag{9}$$

whose slope is

$$\frac{dI}{dY} = \frac{\partial I}{\partial r}\quad\frac{dr}{dY} + \frac{\partial I}{\partial Y}\,. \tag{10}$$

The second term on the right is positive or zero. The first term is negative, a consequence of the assumed forms of the demand for money and investment goods. Since dr/dY becomes unbounded as income increases and because induced investment is choked off when interest rates rise enough, the *IY* function must reach zero at some income, say Y^*. Because of the possible stimulating influence of the income level, induced investment might rise when income increases from relatively low levels. The crucial fact is that it must fall to zero because of the 'crowding out' effect of the transactions demand for cash. (Of course autonomous investment is still positive.) *The implication is that for* $\mu > 0$ *aggregate demand has a nonlinear, tilted-z profile* first lying above the line given by $A + G + (1 - \tau)\alpha Y$ but eventually declining to that line at Y^*.

Substituting (7) into (8) the difference equation (4) becomes

$$Y_{t+1} = \theta(Y_t) := E + G + (1 - \tau)\alpha Y_t + \mu H(Y_t; M). \tag{11}$$

Clearly the investment demand shifter (or investment speed of adjustment parameter) plays a crucial role. If $\mu = 0$ the model boils down to the simplest multiplier story. When μ is positive but small a bell-shaped sliver is added but cannot have much affect. But when μ is large the bell-shape is more prominent and plays an important role in the dynamics.

To see how this happens let us consider specific functional forms for investment and monetary demand that exemplify the Keynesian assumptions already made and which are compatible with examples of investment and money demand often used in texts, for example, Branson (1979) or the earlier Hansen (1949), Ackley (1961) or Bailey (1962). Thus, let

$$L(r) := L^0 = \lambda/r,\ r > 0, \tag{12}$$

where λ is a parameter. If the "transactions" demand is kY where k is a parameter then the LM curve is

$$r = \lambda/(M - kY - L^0) \tag{13}$$

defined as before on the interval $(0, (M - L^0)/k)$. For the investment function use

$$I(r, Y) := \begin{cases} 0 & ,0 \leqq Y \leqq Y' \\ b\,[(Y - Y')/(\xi Y^f)]^\beta\,(\varrho/r)^\gamma & ,Y \geqq Y' \end{cases} \tag{14}$$

where Y', b, ξ, ϱ, β, and γ are parameters. The first multiplicative term in brackets represents the influence of the GNP level on investment when it exceeds a threshold Y'. Here we assume that if excess capacity is sufficiently great there would be no induced investment. Y^f is full capacity output and ξ a proper fraction. The term ξY^f might be thought of as the 'optimal' or 'desired' level of capacity utilization. If the difference between income and the desired level of capacity utilization is less than ξY^f then the investment demand associated with the Keynesian term is reduced. Otherwise it is increased. If $\beta > 1$ then low levels of output have a strongly depressing effect but levels greater than ξY^f have a strongly stimulating influence.

The following Wicksellian term, $(\varrho/r)^\gamma$, where ϱ could be thought of as the real rate of return, has the effect of reducing investment as the interest rate increases. If $r = \varrho$ investment is governed by the capacity utilization term. If r is less than ϱ then the effect is stimulating; if r is greater than ϱ then the effect is depressing. The higher γ is the more pronounced are these influences.

Substituting (13) into (14) we obtain the IY function

$$I = H(Y; M) := \begin{cases} 0 & , 0 \leqq Y \leqq Y' \\ B\,(Y - Y')^{\beta}\,(M - L^{0} - kY)^{\gamma} & , Y' \leqq Y \leqq Y^{*} \\ 0 & , Y^{*} \leqq Y \leqq Y^{\mu} \end{cases} \quad (15)$$

where $B = b(\varrho/\lambda)^{\gamma}\,(\xi Y^{f})^{-\beta}$, $Y^{*} = (M - L^{0})/k$ and $Y^{\mu} = M/k$ are constants. If β and λ *are both larger than unity* then this function has a smooth, 'cocked-hat' shape, first rising gradually, but at an increasing rate, then at a declining rate until a maximum investment is reached at $Y = [\beta(M - L^{0}) + k\gamma Y']/[k\,(\beta + \gamma)]$. Beyond this level investment declines, first at an increasing, then at a decreasing rate approaching zero as income approaches Y^{*}. The very conventional profile of monetary and investment demand implied by these assumptions is shown in Figures 16.1a and b. The investment demand to which they give rise is shown in Figure 16.1c. (The dashed lines in the diagrams illustrate the piecewise linear functional form to be discussed below.)

The GNP adjustment equation (11) becomes

$$Y_{t+1} = \begin{cases} E + G + (1-\tau)\alpha Y_{t} & , 0 \leqq Y \leqq Y' \\ E + G + (1-\tau)\alpha Y_{t} + \mu B\,(Y_{t} - Y')^{\beta}\,(M - kY_{t} - L^{0})^{\gamma} & , Y' \leqq Y \leqq Y^{*} \\ E + G + (1-\tau)\alpha Y_{t} & , Y^{*} \leqq Y \leqq Y^{\mu}. \end{cases} \quad (16)$$

The phase diagram of this equation is shown in Figure 16.2 for four different values of μ. If $\mu = 0$ then of course we have the usual convergent Kahn–Keynes multiplier, and any sequences of output adjustments converges monotonically to the value $(E + G)/[1 - (1 - \tau)\alpha]$. If μ is very small, as shown in Figure 16.2a, then induced investment cannot change this picture very much, and any sequence of output adjustments converges monotonically to an income level somewhat bigger than $(E + G)/(1 - (1 - \tau)\alpha)$. As μ is increased still more, however, the dynamics of GNP can change a very great deal.

Thus, in Figure 16.2b cycles emerge but converge to a stable, stationary state while in Figure 16.2c a stable two period cycle occurs. As μ increases still more this cycle becomes unstable and a stable four period cycle emerges. Smaller and smaller changes in μ lead to a succession of period doubling stable cycles; as each stable cycle emerges its predecessor becomes unstable. This sequence converges to a value, say μ^{c}, such that for values of μ at and above μ^{c} unstable periodic cycles of all orders exist and,

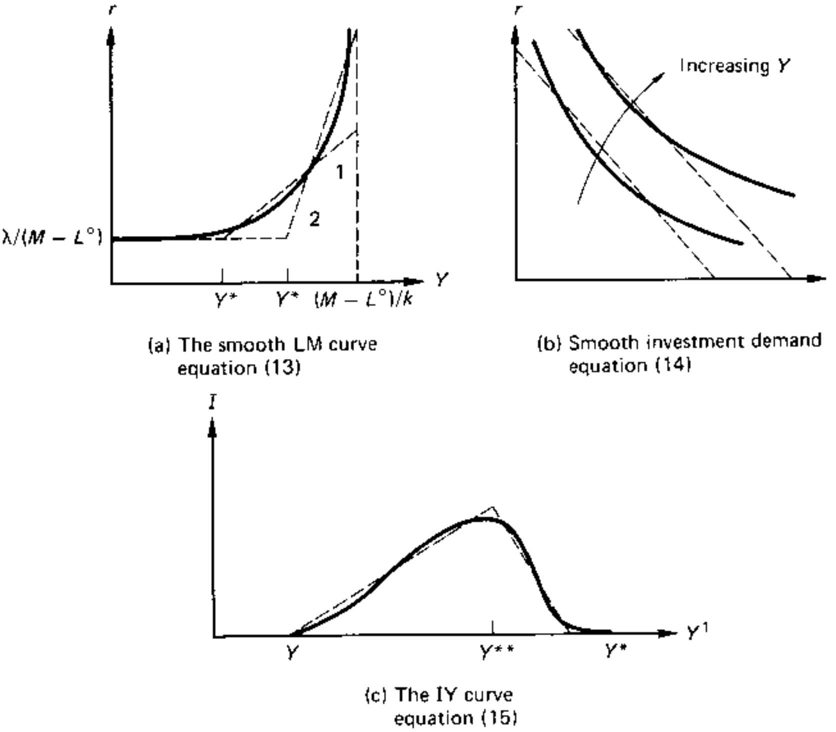


Figure 16.1 The money market and induced investment (the dashed lines indicate piece-wise linear forms)

also, there exists an uncountable 'scrambled set' of GNP levels, any one of which leads to unstable nonperiodic fluctuations. Within that set GNP does not converge to a cycle of any order but wanders in an erratic, more or less random pattern as shown in Figure 16.2d. Day and Shafer (1985) provide a rigorous analysis of this bifurcation story and in a second study (1987) establish sufficient conditions for irregular fluctuations to exist with positive probability for initial conditions drawn at random, a result that shows that chaotic fluctuations are 'observable' in principle and behave like stationary stochastic processes.

We have emphasized that the tilted-z shape of aggregate demand is due to the fact that we are working with the model in reduced form. An alternative interpretation is that aggregate demand is given by the usual, positively sloped linear expenditure function with a shifting, induced investment component. Thus, in Figure 16.3 when income is lower than Y', there is no induced investment. Adjustment in Y below Y' is carried out along the expenditure curve ℓ_0 (from Y_0 to Y_1). When income is greater than Y', induced investment causes ℓ_0 to shift to ℓ_1; in this case the income

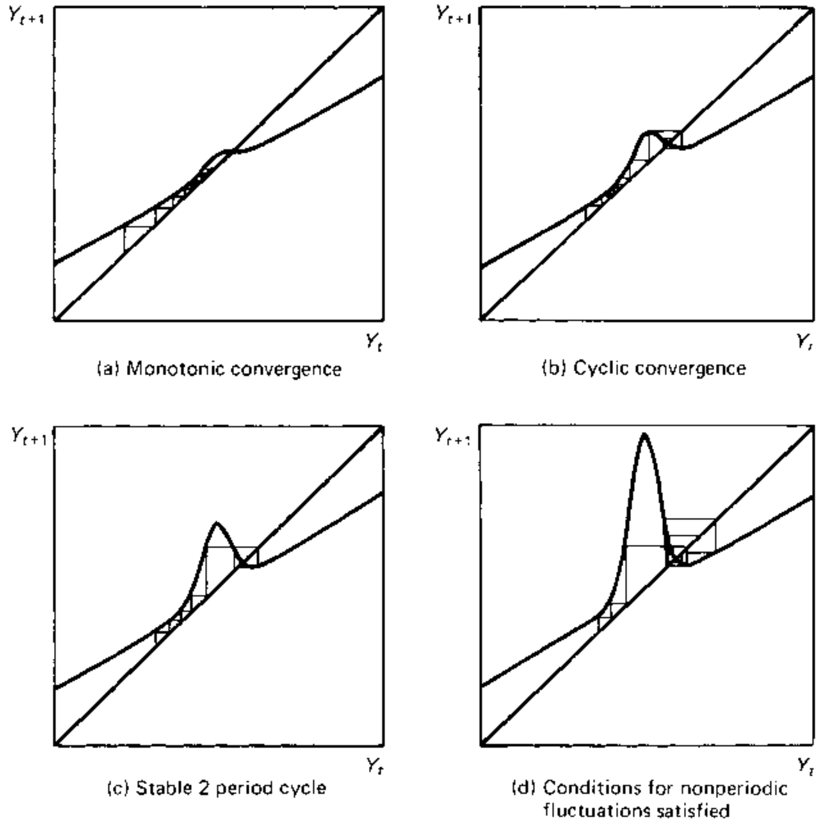


Figure 16.2 Comparative Keynesian dynamics: Qualitative changes caused by shifts in the intensity of induced investment

effect on investment exceeds the interest effect. The effect is the same through Y_5 with the expenditure curve shifting progressively to e_3. At Y_6 the income effect on investment is reduced by the interest effect, so much so that induced investment almost vanishes and the expenditure curve shifts back to the ℓ_0.

One can think of the process as a whole as one in which a sequence of adjustments takes place in aggregate expenditure curves, each of which is stable when taken by itself but which may in fact be unstable when the monetary interaction is explicitly incorporated.

3 PIECE-WISE LINEAR DEMAND

Now consider the case in which each of the basic functions is linear, but introduce nonnegativity restrictions on the demand for money, interest

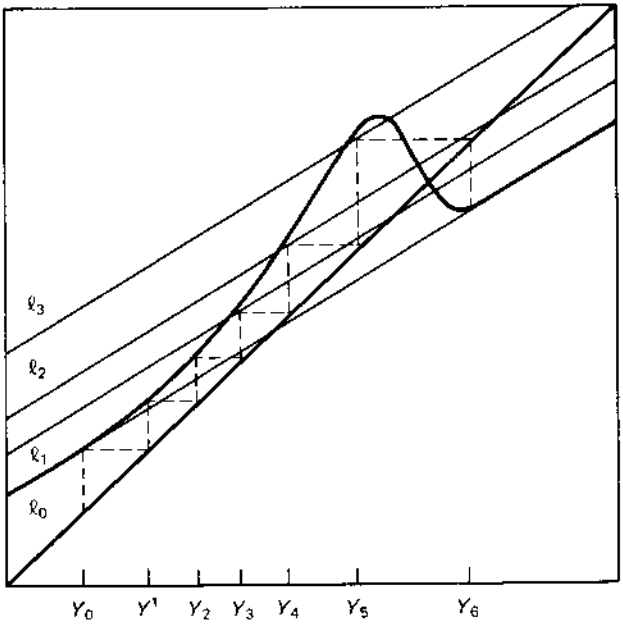


Figure 16.3 The monetary interaction as a shift in expenditure curves

rates and the induced demand for investment goods. Linear functions underly many standard textbook treatments such as Gordon (1978) or Hall and Taylor (1986), quantitative policy analyses such as Hall (1977), and theoretical exegesis such as Smyth and Peacock (1974). Here the nonnegativity restrictions usually ignored in such treatments are made explicit. They imply 'kinked' or piecewise linear shapes for the *IS*, *LM*, *IY* and aggregate demand functions.

The linear demand for money is $D^m(r, Y) = L^0 - \lambda r + kY$ where L^0, k and Y are parameters. Given a fixed supply of money M and immediate money market clearing, $r = r^0 + (k/\lambda)(Y - Y^{**})$ where Y^{**} is the income level at which the interest rate is equal to r^0. If we assume that this value bounds interest from below then the *LM* curve is

$$r = L^m(Y; M): = \begin{cases} r^0 & ,0 \leqq Y \leqq Y^{**} \\ r^0 + (k/\lambda)(Y - Y^{**}) & ,Y^{**} \leqq Y \leqq M/k \end{cases} \tag{17}$$

In what follows we assume that $r^0 = 0$. The piecewise or kinked linear profile of (17) approximates the smooth *LM* curve of the differentiable model of the preceding section as shown in Figure 16.1a. But it must be noted that some parts of the smooth curve are more closely approximated than others.

Suppose investment depends – as in the example of section 2 – on the difference between the marginal rate of return, ϱ, and the real money rate, r, the cost that investors face for financing investment plans so that $I = \gamma(\varrho - r - d)$, where d is a deduction for uncertainty. In the one good economy a unit of capital will yield after one period PY/K, where P is the price of the good. If this flow is capitalized in the usual way then $\varrho = Y/K$. Consequently, $I = \gamma(Y/K - d) - \gamma r$, or taking account of the nonnegativity constraint under the assumption that disinvestment is not important in the short run, we have the investment function

$$I(r, Y) := \max\{0, \beta(Y - Y') - \gamma r\} \tag{18}$$

where Y' is defined by $\beta Y' = \gamma d$ and where $\gamma = \beta K$. If Y' is positive it is a threshold below which excess capacity is so great that orders for investment goods are zero even though interest rates may be very low. Above the threshold Y', income has a stimulating effect. If $Y^{**} > Y'$ then investment is insensitive to the interest rate in the income range $[Y', Y^{**}]$.[6] In what follows we assume that this is true.

Substituting the LM curve (17) into the investment function (18) so as to eliminate the interest rate yields our now familiar '*IY*' relation, that incorporates both 'accelerator' and monetary 'crowding out' effects. It can be written in the form

$$I = H(Y) := \begin{cases} 0 & 0 \leqq Y \leqq Y' \\ \beta(Y - Y'), & Y' \leqq Y \leqq Y^{**} \\ \sigma(Y^{*} - Y), & Y^{**} \leqq Y \leqq Y^{*} \\ 0 & Y^{*} \leqq Y \leqq M/k \end{cases} \tag{19}$$

in which $\sigma = \gamma k/\lambda - \beta$ and where $Y^{*} = ((\gamma k/\lambda)Y^{**} - \beta Y')/\sigma$ is the income level at which investment is driven down to its autonomous level. Given the assumptions made so far it is clear that after reaching the threshold Y' investment increases until the point Y^{**} is reached. Beyond this point monetary feedback becomes important.

Now we are at a crucial point. If $\sigma > 0$ so that

$$\sigma = \gamma k/\lambda - \beta > 0 \tag{20}$$

we shall say that the monetary effect is *strong*. In this case the depressing effect of rising interest given by the first term $\gamma k/\lambda$ exceeds the stimulating influence of rising capacity utilization given by β and aggregate investment declines. In this case investment falls to its autonomous level at Y^{*}.

As shown in Figure 16.1 the present piecewise linear model may be thought of as an approximation to one with smooth, nonlinear functions.

The interval $[0, Y']$ approximates a situation when investment is very low due to extreme excess-capacity. The 'liquidity trap' range of income $[0, Y^{**})$ approximates a region where the interest rate changes very little with changes in Y; the range $[Y^{**}, Y^{*}]$ corresponds to a region where the interest rate is sensitive to growing money demand and the range above Y^{*}, is the area where endogenous investment is severely reduced because of high interest rates.

Substituting (19) into (8) we find that aggregate demand has four branches corresponding to the branches of the investment function. The adjustment equation for aggregate income is therefore found to be

$$Y_{t+1} = \theta(Y_t): \; = \begin{cases} A + aY_t & , 0 \leqq Y_t \leqq Y' \\ B + bY_t & , Y' \leqq Y_t \leqq Y^{**} \\ C + cY_t & , Y^{**} \leqq Y_t \leqq Y^{*} \\ A + aY_t & , Y^{*} \leqq Y_t \leqq M/k \end{cases} \tag{21}$$

where $a = (1 - \tau)\alpha$, $b = a + \mu\beta$, $c = a - \mu\sigma$, $A = E + G$, $B = A - \mu\beta Y'$, and $C = A + \mu\sigma Y^{*}$.

Four examples are shown in Figure 16.4 using different values of the demand shifter μ. The parameters were chosen so that the shapes of the aggregate demand curves are roughly similar to those of the smooth non-linear model described in the preceding section and shown in Figures 16.1 and 2. *It should be noted that in each case the qualitative behavior is also similar*: as μ increases fluctuations emerge; at first they are damped, then stable and then chaotic. In the paper by Day and Shafer cited earlier it is shown how to drive the combination of parameter values leading to stationary states, to cycles of every order and to nonperiodic fluctuations that behave like stochastic processes with positive probability.

Let us emphasize that fluctuations occur in the model only if the usual stability condition is violated. Clearly, the stable multiplier process is possible in which GNP converges monotonically or cyclically to the stationary value given by $Y^s = (C/(1 - c)$. The stability condition is that the absolute value of the slope of the aggregate demand curve, $|c|$, must be less than one. If, however,

$$c = (1 - \tau)\alpha - \mu[\gamma k/\lambda - \beta] < -1, \tag{22}$$

then divergent cycles emerge in the neighborhood of Y^s. Obviously this can happen for a wide range of parameter values compatible with the usual qualitative restrictions. We recall that the inequality can hold, however, only if (20) holds, i.e. only if 'monetary crowding out' occurs in the interest sensitive segment. If *this* is true *then there will always exist* a value of μ say μ^c that satisfies (22) as an equality so that for all $\mu > \mu^c$ the instability

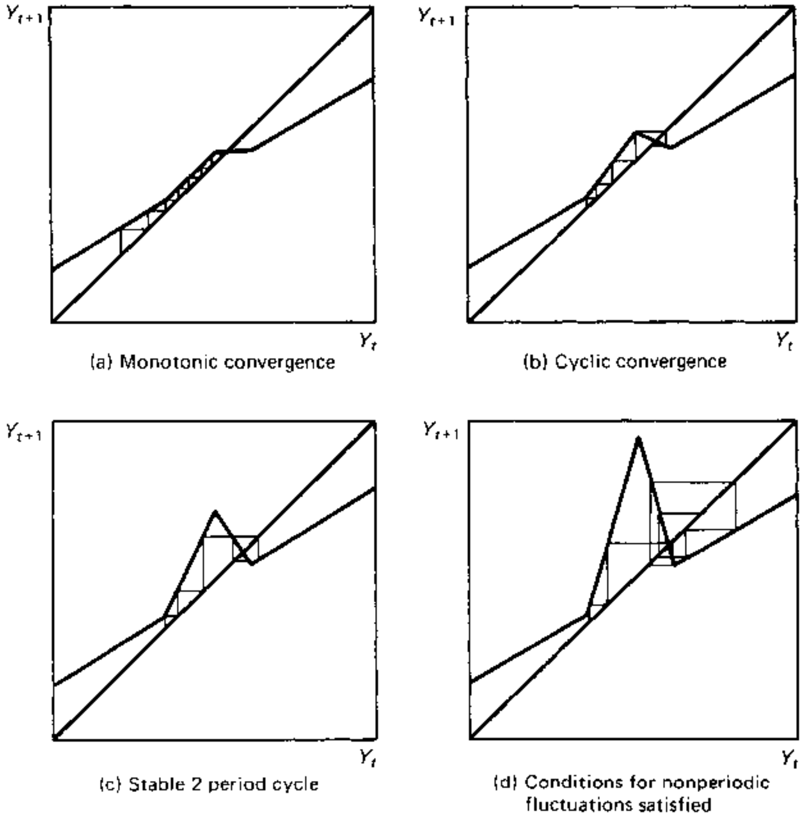


Figure 16.4 Comparative Keynesian dynamics for the piece-wise linear model

criterion is satisfied. In short, *if the monetary effect* (σ) *is strong and if induced demand is important enough then fluctuations of some kind will persist.*

4 COUNTERFACTUAL EXAMPLES

Do such conditions have any plausibility? An answer is complicated by three problems. First, the range of parameter values reported in the literature are quite wide. Second, the fundamental nonlinearities in the model have traditionally been ignored, very likely a contributing factor to the first problem. Third, as noted above, many variables assumed constant in the theory actually vary in the real economy. In order to get a rough idea of the model's relevance we have, therefore, to conduct counterfactual experiments in which the parameters of the model are held fixed at values that are more-or-less appropriate for specific base periods. It must be noted, however, that such an approach cannot get around the second problem, especially with respect to estimates of the LM function, for its slope will depend on which part of the general nonlinear relationship is to be approximated by the positive sloping segment of the piecewise linear model (recall figure 16.1a). Still, it is instructive to look at specific empirical examples.

Over the years alternative values for the crucial parameters have been proposed. This evidence provides a starting point but the ranges reported are surprisingly wide. Hall (1977), for example, estimated an adjusted marginal propensity to consume of 0.36 which, given an average tax rate of 0.2, implies an MPC of 0.45. Standard texts suggest higher values. Branson, for example, gives a value for the MPC of 0.72, while Morley (1983, p. 67) gives a value of 0.65. Ackley (1961) reports values ranging from 0.5 to 0.95 depending on the length of the data series, the independent variables included and the econometric methods used. We shall use a value midway in this range of 0.75. Note, however, from equations (22) or (24) that smaller values increase the possibility of unstable behavior. From this point of view our estimate is conservative.

For the investment function Hall estimated the base values $\beta = 1.36$ and $\gamma = 83.8$. He considered alternative values representing possible fractions of complete adjustment of investment possible within a given year as derived from Jorgensonian investment considerations. This is similar in the present context to a choice of values of μ between zero and one. Hall considered values of $\mu = 0.125, 0.25, 0.50$, and 0.75. If $\mu = 0.25$ then the marginal effect of income on aggregate demand $b = \alpha + \mu\beta = 0.7$. Klein asserted (see Hall, op. cit., p. 121) that it was an econometrically established fact that this effect was instead about 1.5, a value that would imply a μ of roughly 0.6. We shall use this value but have chosen a more conservative value of $\beta = 1.16$.

From (18) recall that $\gamma = \beta K$ so the interest effect on investment increases as capital stock grows, which makes sense because of the growing value of possible capital gains and losses in response to interest rate changes. Using values of capital stock for three base periods to be described below we get values for the marginal effect of interest on investment, γ, of 11, 21 and 27.

Hall also estimated a linear demand curve for money $L^0 + kY - \lambda r$ with $k = 0.135$ and $\lambda = 2$, which gives a slope to the LM curve of $k/\lambda = 0.06$. We have used much lower values for λ which gives the rising portion of the LM curve a much steeper slope than Hall's. But remember, this implies a longer flat portion of the LM curve. Our estimates imply that interest is insensitive (the LM curve flat) over a very wide range of income, but quite sensitive (the LM curve steep) only when income gets very high.

This, of course, is exactly the nonlinearity that helps drive our Keynesian business cycle. If it is really present then ignoring it may strongly bias results. Consider Figure 16.1a. If data were available only for relatively low interest rates the positively sloping segment of LM will appear like line 1. If data during a period of very high interest rates and tight money were used then the LM curve would appear like line 2.

Actually it is now well known that an assumption of linearity in an adjustment equation like (4) will produce econometric estimates that imply stability. Fluctuations due to the intrinsic nonlinearity will be interpreted as the result of stochastic shocks. See Blatt (1978). It is scarcely surprising, therefore, that econometricians since Klein and Goldberger have continued to produce parameter estimates that imply stability. What is clearly called for is an econometric reinvestigation of all the aggregate macroeconomic relationships with an emphasis on identifying fundamental nonlinearities and intrinsic 'randomness'. Such an exercise is beyond the scope of this paper but new methods now under development can and surely should be brought to bear on the issues. See Barnett, Geweke and Shell (forthcoming) and Nelson and Plosser (1982).

An alternative way to gain insight on the relationship between parameter values and stability is to use a bifurcation approach. We can use our 'plausible' values just obtained and then vary them continuously to see what happens. This shifts attention from point estimates to range estimates and to the robustness of cyclic tendencies. This the subject of section 5 below.

Returning now to the task at hand we have left to estimate the level parameters E, Y', Y^{**} and Y^{*}. These can be calibrated to fit any base situation by using the base data for C, I, G, r and M and solving the structureal equations. For example to estimate L^0 we use $L^0 = M + \lambda r - kY$ so that $Y^{**} = (M - L^0)/k$. For purposes of comparison we have used average values of C, I, G, r and M for three widely separated periods: I: 1930–34, the bottom of the great depression, II: 1960–65, a period of stable growth, and III: 1975–78, a period of stagflation. These values are given in Table 16.1.[7]

In order to see what these imply we have translated the parameters into the slopes of aggregate demand in the four regimes as shown in Table 16.2. The slope in the third regime is quite steep in examples I and III which is due in part to the rather steep LM curve in this regime. It must be emphasized, again however, that this corresponds with the assumption of a flat LM curve in the range (Y', Y^{**}) and this range is very wide. In example II the *LM* curve is relatively more flat in its upward sloping range.

The three corresponding aggregate demand functions are shown in Figure 16.5. Numerical trajectories of the three models are shown in Figure 16.6. Figure 16.7 gives the histograms for the simulated time series data. They suggest what might have happened if the assumptions of the

Table 16.1 Parameter values for counterfactual simulations

Parameter	Period I	Period II	Period III
Marginal Prop. Cons. (α)	.75	.75	.75
Average Tax Rate (τ)	.20	.20	.20
Inv. Intensity (μ)	.60	.60	.60
Marg. Prop. Inv.-Y (β)	1.16	1.16	1.16
Marg. Prop. Inv.-r (γ)	10.61	20.83	26.88
Marg. Trans. D-Money (k)	.13	.13	.13
Marg. Liquidity-Money (λ)	.095	.665	.191
Autonomous Con. (E)	32.02	3.63	41.42
Govt. Exp. (G)	46.30	204.90	298.68
Inv. Threshold (Y')	177.28	600.30	936.15
Inv. Maximized (Y^{**})	243.95	821.01	1354.99
Inv. Crowded Out (Y^{*})	250.56	908.95	1383.35
Full Cap Output (Y^{u})	340.00	1180.00	1450.00
Money Supply	81.22	214.13	228.61

Table 16.2

Slope parameter	Period I	Period II	Period III
Slope Ag. Dem. in Regime I & IV (a)	.60	.60	.60
Slope Ag. Dem. in Regime II (b)	1.30	1.30	1.30
Slope Ag. Dem. in Regime III (c)	−7.02	−1.16	−9.74

model were approximated and they indicate the kind of dynamic forces that might be operating within a broader context.

The results are strikingly different. For example I the trajectory of GNP rapidly converges to a two-period cycle. The histograms of GNP values must have two spikes corresponding to those cycle values. For example II a two period fluctuation is present but with irregular amplitudes. The map is ergodic and the support of the measure consists of two invariant intervals. If we let S_1 and S_2 be these two sets, then $S_2 = \theta(S_1)$, $S_1 = \theta(S_2)$ and $S_i = \theta(\theta(S_i))$, $i = 1, 2$. *Thus the model is set-periodic.* The behavior appears something like an ordinary stationary 2 period cycle with a random shock from a finite distribution added. Actually, however, the fluctuation is deterministic! For example III a much more irregular pattern is evident. The fluctuations vary from 2 to 5 periods from peak to peak or trough to trough and with highly irregular amplitudes distributed throughout the entire interval. The histogram also appears to be highly irregular.

It is interesting to note that the fluctuations of GNP relative to its

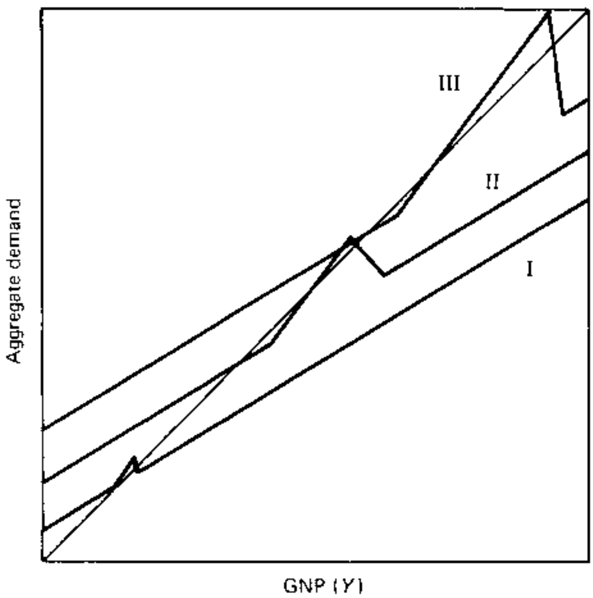


Figure 16.5 Aggregate demand

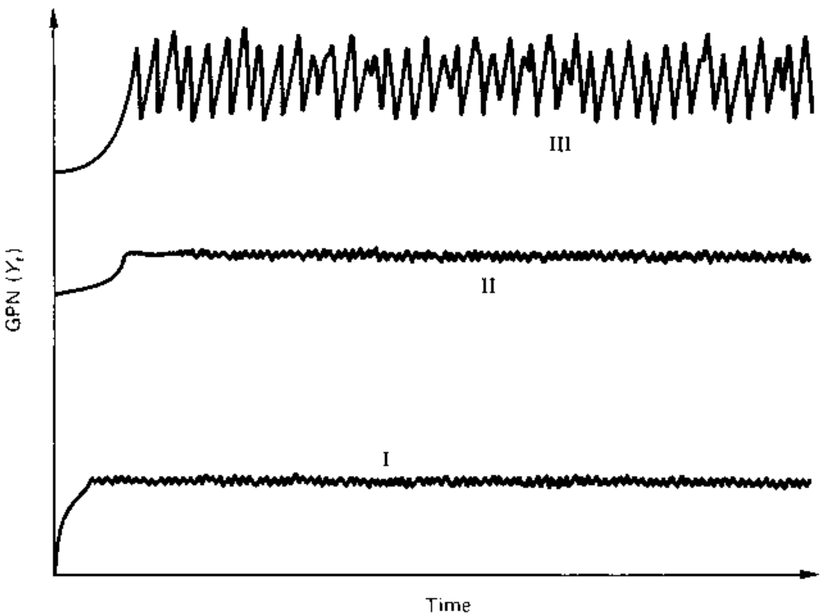
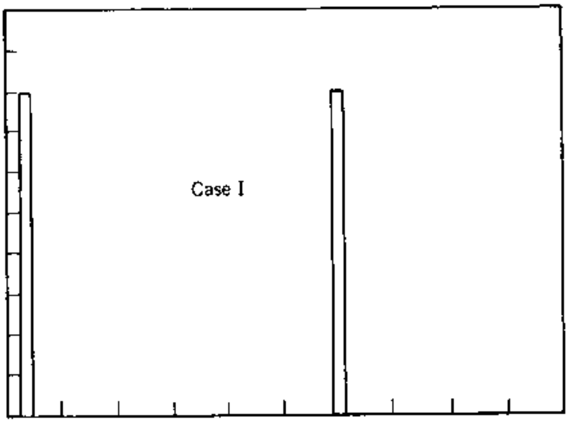
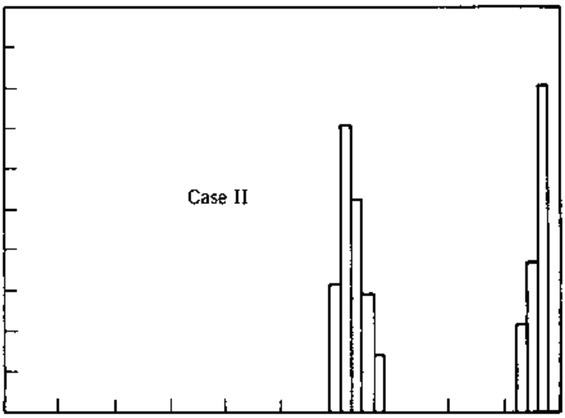


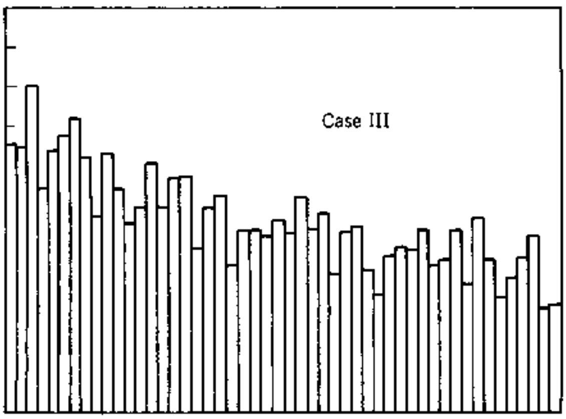
Figure 16.6 Sample trajectories



(a) A stable two-period cycle



(b) A two-period fluctuation with random amplitude



(c) Random period and random amplitude

Figure 16.7 Numerical probability distributions. (In examples II and III the frequencies in 50 equally spaced intervals were obtained from 3000 iterates) average value are greater for periods I and III than for period II which is therefore the relatively more stable period.

5 COMPARATIVE DYNAMICS: THE ROBUSTNESS OF STOCHASTIC BEHAVIOR

How robust are these results? Do they occur just for the parameter values chosen or will similar behavior occur for others? Certainly fluctuations are not necessary. For example if we used Hall's (1977) estimates we would have found values of the slope parameters $a = 0.36$, $b = 0.70$, and $c = -0.71$. Even though the monetary effect is strong, i.e. (20) is satisfied, any cycles must be damped. This is because his value of μ is quite small (equal to 0.25). In such a case fluctuations could be propagated only through the continual impulse of shocks as in the contemporary business cycle models of Lucas and Sargent.

To see what is the scope for instability consider the criterion (20). Our value of β is 1.16. The value for k of 0.13 is not controversial, but both γ and λ, which are the marginal effects of interest on investment and money demand respectively, vary considerably. Using our values for β and k in (20) we find that the monetary effect is strong if

$$\gamma > 9\lambda \tag{23}$$

Evidently, the marginal influence of interest on investment must be relatively much stronger than that for money. (Hall's estimates for γ and λ (of 2 and 83.8 respectively) satisfy this relation and so do ours.)

Now consider (22). Rearranging terms we find that instability occurs if

$$\mu > [1 + (1 - \tau)\alpha]/[\gamma k/\lambda - \beta]. \tag{24}$$

Substituting our 'noncontroversial' values for α, β, k and τ we get

$$\mu > \frac{1.6}{[0.13\gamma/\lambda - 1.16]} = \mu^c \tag{25}$$

as a sufficient condition for persistent cycles. Obviously, if the monetary effect is strong stability will occur for all $0 < \mu < \mu^c$ and cycles or chaos for all $\mu \geq \mu^c$. Using all of Hall's parameters $\mu^c = 0.3$. This is not a large value. Using our own values we get for the three cases, $\mu^c_{\mathrm{I}} = 0.13$, $\mu^c_{\mathrm{II}} = 0.58$ and $\mu^c_{\mathrm{III}} = 0.1$.

Returning to (24) and noting that it can be reexpressed as $[k\mu(\gamma/\lambda) - \mu\beta] > 1 + (1 - \tau]\alpha$ the investment demand shift parameter μ can be interpreted as a proportional increase in the ratio (γ/λ) and β. Remembering that the slope of the LM curve is k/λ it is clear that even if the LM curve is relatively flat in the interest sensitive range *a strong enough marginal effect of interest on investment is destabilizing.*

By varying μ continuously and investigating the nature of the solutions graphically we can determine the influence of shifts in the underlying parameters.[8] Such a bifurcation diagram has been computed using three examples and varying μ continuously.

Values of μ at even intervals of 0.005 ranging from 0 to 1 were picked. For each value the model was simulated for 450 iterates. So as to avoid transient behavior, only the values later than iteration 325 were plotted. The results are shown in Figure 16.8. The shading reflects changes in the density function of values associated with the long run attractor. Where the shading is dark there is a relatively large density and where it is light the opposite is true. Quite astonishing structures appear to emerge indicating a very orderly but very complex dependence in qualitative behavior on the importance of induced investment or on the parameters of money and investment demand.

Two results are especially significant. First, the profile of comparable dynamics is very different in the three examples. Second, especially in example I, but to an extent in example II, qualitative behavior changes drastically from stable periodic to unstable, stochastic behavior and back again through different periodicities. Also striking is the fact that in example III behavior jumps from apparently stochastic behavior directly to a stable stationary state only once when μ becomes small enough.

We have conducted similar numerical experiments for other parameter variations with more or less similar results.

6 CONCLUSIONS

The moral is quite clear: Given a strong monetary effect nonperiodic behavior is not rare, but occurs for a very large class of parameter values. Moreover, a shift in a single parameter influences the qualitative behavior of the business cycle in a very complex manner.

These results hold only for the counterfactual conditions assumed. They only reveal cyclical *tendencies* that may be repressed when prices, capacity and various supply-side effects are allowed to play an explicit role. The fact that fluctuations are highly robust, however, suggests that quite wide swings in other variables could be required to flatten them out. Certainly it is clear that qualitative changes in macro-behavior and random fluctuations in GNP can be induced by intrinsic properties of economic structure without the gratuitous help of unexplained or unexplainable exogenous shocks even if many of the parameters held fixed in the Keynesian model

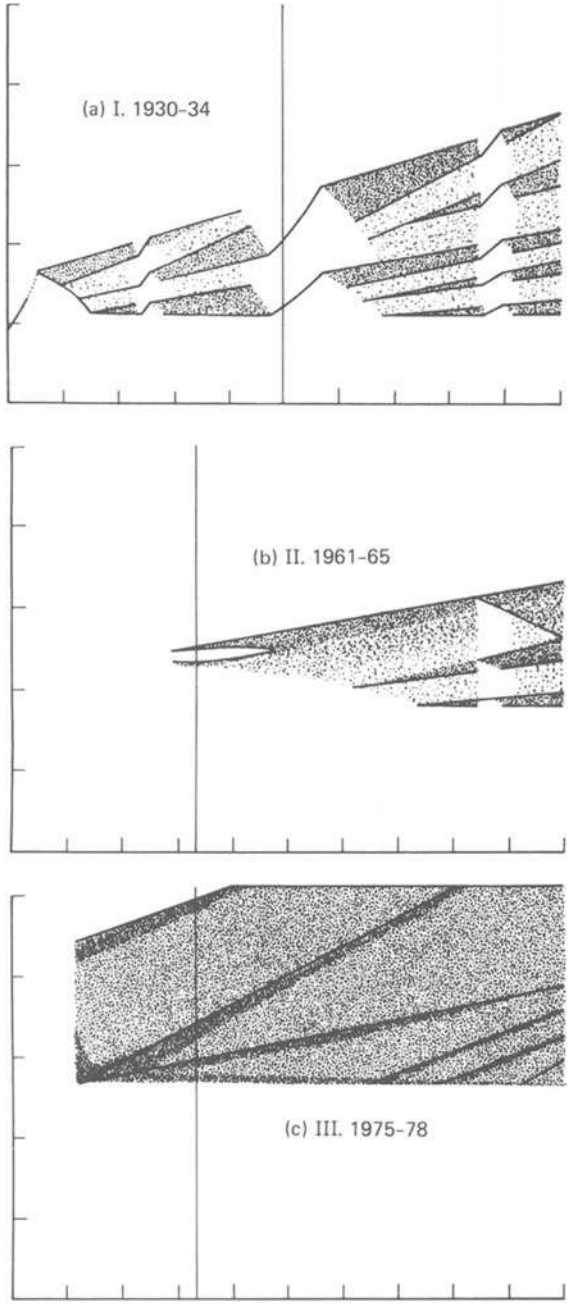


Figure 16.8 Comparative dynamics for induced investment (the vertical line indicates the base value of μ)

are allowed to vary. This possibility will have important implications indeed if subsequent research shows that it also occurs in models in which the strong simplifying assumptions used by Hicks in his classic version of the Keynesian theory have been relaxed and in which parameter values are obtained with appropriate data and econometric techniques. All of that, however, is a task for future endeavor.

In any case we have uncovered properties of the dynamic Keynesian macromodel that have gone unnoticed for the entire half-century since the classic statement of the concepts on which it rests was published. That Keynes' basic ideas, in the rigorous if highly simplified form given them by Hicks, Hansen and Lange, should have such intricate, new, nontrivial implications would seem to be a surprising and fitting testament to their inherent richness and continuing interest.

Notes

1. This statement shall be made precise in due course. We emphasize here that we do not use Kaldor's investment function to obtain a nonlinear business cycle but work strictly within the standard Hicksian version of the Keynesian model. One should of course be reminded that the latter only captures a few salient features of Keynes' insights. But for the reasons outlined below it still seems to be a good starting point for macroeconomic analysis.
2. For a general discussion and examples see Georgescu-Roegen, 1951, or Day and Cigno, 1978, chs 1 and 2.
3. Of course the implicit function theorem must hold for the equation $D^m(r, Y) - M = 0$ which requires in this case that $\partial D^m/\partial Y \div \partial D^m/\partial r$ be continuous and bounded above on a suitable interval.
4. The viability of (4) as an adjustment process depends of course on the maintenance of income levels within the Keynesian regime where a certain level of excess capacity and involuntary unemployment exists. Let $D^e(r, Y)$ and $S^e(r, Y)$ be the demand supply of labor respectively. Then (4) can describe the progress of national income so long as $D^e(L^m Y_t), Y_t) \leq S^e(L^m(Y_t), Y_t)$. If we suppose for simplicity (as did Keynes) that $S^e(r, Y) \equiv L$ where L was fixed this inequality is simplified. It should also be emphasized that excess capacity in plant and equipment must also exist. Let Y^u be the lesser of full employment income and full capacity output. Then viability of the adjustment equation for output requires that $\theta(Y_t; G, \mu, \tau, M) \leq Y^u$. In the static IS-LM model of course the IS curve is obtained by setting $Y = D^g(r, Y; G, \mu, \tau)$ and solving for r in terms of Y. The values of r and Y that satisfy both the IY and IS curves then give the Keynesian stationary states discussed in the standard comparative static treatments. These must also satisfy the viability conditions just given. It is in this sense that the Keynesian stationary state is possible only in an economic disequilibrium where an excess supply of labor exists at positive wages.
5. Indeed, the referee notes that 'under fairly plausible conditions the main effect of some flexibility will be to increase the extent to which higher output requires higher interest rates, which makes it easier to get cycles'. It would be emphasized that in contrast to the early literature mentioned in the text – and much that followed (e.g. Peacock, 1960 or Smyth, 1974) – we do not linearize the

model and focus on local stability. Instead, we retain the intrinsic nonlinearities and provide a global analysis of fluctuations. Other authors such as Benassy (1984) and Schinasi (1982) have also retained intrinsic nonlinearities in the Keynesian model to prove the existence of cycles. Because we reduce our model to a single state variable we can give much stronger results, indeed, a complete characterization of fluctuations. Pohjola (1982) introduces a progressive linear tax function into the linear Peacock and Smyth models. This creates a nonlinearity in the consumption function leading to a chaos result. Here we focus on the normal properties of the demand for money and investment goods and explore the implications of the nonlinearity in aggregate demand that they imply.

6. For this to happen we must have $Y^{**} = (M + \lambda r^0 - L^0)/k > Y'$ or given that $r^0 = 0$, $M - L^0 > kY'$.
7. Because the level parameter estimates depend on the behavioral parameter estimates the possibility of fluctuations depends critically on empirical conditions. *Accurate econometric estimates of structure would therefore appear to be extremely important even if forecasting is virtually hopeless.*
8. Note that a reduction in μ may be thought of as (1) diminishing the depressing effect of interest on investment, (2) reducing the transactions demand (which is the same as increasing the transactions velocity), or (3) decreasing the interest depressing effect on the demand for cash balances. Of course, an increase in μ has the opposite interpretation. One could just as well interpret a change in μ as bringing about all these effects. Thus, let $\mu = \mu_1 \cdot \mu_2 \cdot \mu_3$. Then we could write $\mu(\gamma/\lambda)k \equiv \mu_1\gamma \cdot (\mu_2/\lambda) \cdot \mu_3 k$.

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17 Perfect Foresight Cycles in a Marxian–Keynesian Model of Accumulation With Money*

D. K. Foley

1 INTRODUCTION

The model described here reflects concepts and methods developed in several different traditions of the analysis of capitalist economies.

Classical economic analysis, culminating in the work of David Ricardo (1817), centers on the division of value added in commodity production between wages on one hand and profits and rents on the other. The Classical economists argued that labor is normally available in large quantities to a capitalist economy at a given real wage. Because capitalist methods of production are highly productive, the average laborer produces commodities with a value added greater than his or her real wage, thus providing a profit for the capitalist employer. Workers as a class spend their wages (although individual workers may save at particular times, this saving is counterbalanced by dissaving of other workers), and capitalists save a large proportion of their profits to invest in the expansion of production.

Marx (1967; see Foley, 1986b for a modern exposition of this theory) extends and completes the Classical analysis. He argues that the accumulation of profits by capitalists is motivated primarily by competition rather than by the desire of individual capitalists to consume. Marx insists that capitalist production has to be seen as a circuit, in which a capitalist begins with money, which is spent on labor-power and means of production, in order to produce commodities for sale on the market. This leads to the characteristic Marxian view of capital as the value tied up in goods in process and instruments of production due to the fact that production takes time. To carry out Marx's analysis of production consistently, it is necess-

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ary to assume that the money spent by capitalists at a given moment (capital outlays) result in a flow of finished product distributed in a determinate way over future time. The capital tied up in production on a path of expanded reproduction depends on the shape of the function that describes this time distribution of output. (Foley, 1986a, analyzes this problem in detail for arbitrary time distributions of output.)

Keynes (1936) argues that the capital accumulation may be unstable due to the variability of aggregate demand for commodities made possible by changes in the velocity of money (or, equivalently, of the size of money balances agents choose to hold in relation to spending flows), and motivated by varying estimates of the profitability of production at different times due to anticipated variations in aggregate demand (the accelerator effect). In the context of Marx's model of accumulation, this instability appears as a variability in the velocity of money capital – that is, the money held by capitalists to finance production.

Nicholas Kaldor (1960) and Richard Goodwin (1982) show that a local instability of capital accumulation arising from accelerator effects may, because of the nonlinearities in functions describing economic behavior, be contained by weak stabilizing forces, leading to a cyclical motion of aggregate demand and capital accumulation.

Robert Lucas (1981) and Thomas Sargent (1986) argue that a complete understanding of economic behavior requires an explicit account of the rational basis for individual agents' actions, under the assumption that agents use all the information available to them in making decisions. In the extreme case where information about the path of relevant variables is costless, this requires a model in which agents maximize on the basis of complete knowledge of the future paths of those variables.

In this paper I describe a model of capitalist production that combines these features. Capitalists rationally maximize the growth rate of their capital in an environment where the scheduling of production in relation to aggregate demand influences profitability. As in the Classical–Marxian theory, real wages are constant and the supply of labor is infinitely elastic, and wages are spent while profits are accumulated. Production takes time, and the flow of output from each unit of capital outlays is described by a distribution over time. Each firm faces a downward sloping demand curve for its output, the position of which depends on aggregate demand. It is costly for the firm to increase the velocity of money capital (or, equivalently, to reduce the stock of money held in relation to the flow of capital outlays), so that the firm has an incentive to change the flow of capital outlays from period to period in order to maximize its long-run rate of growth. The firm is assumed to have correct knowledge of the future path of aggregate demand, and hence of the future position of its demand schedule. Money is supplied to the economy by an external agent at a constant and given rate of growth.

In the case where the economy consists of a large number of identical firms, it is possible to demonstrate the existence of an perfect-foresight equilibrium steady-state path of capital accumulation in this model. Furthermore, for some shapes of the distribution function that describes the path of output arising from a capital outlay, and some shapes of the function describing the costs to capitalists of economizing on money balances, there exist perfect-foresight cyclical equilibrium paths of accumulation, arising from the accelerator instability but contained by the nonlinear effects of financial ease and stringency as the economy's growth rate first exceeds and then falls short of the constant rate of growth of money. (This model thus supplies a rational microeconomic foundation for the cyclical paths described in Foley, 1986c, 1987 and 1988.)

2 THE MODEL

Time is divided into periods $t = 0, 1, \ldots$ All quantities are measured in monetary units. An individual firm has money balances M_t in period t, and purchases labor-power and other means of production with capital outlays C_t. I assume that labor and other means of production combine in constant, given proportions to produce output, so that there is no problem of choice of technique for the firm. The unit cost of the dose of labor-power and complementary inputs necessary to produce one unit of output is u_t. Later assumptions will imply that $u_t = u$ will be constant over time.

Capital outlays result in a flow of output over future periods. In order to reflect the cost of increasing the velocity of money capital, I assume that the amount of inputs actually purchased by a capital outlay C is smaller than C by an amount that depends on the velocity of money capital, $c = C/M$. Thus the amount of inputs purchased by a capital outlay C will be $g\,[c]\,C/u = h\,[c]\,M/u$, where $h\,[c] = g\,[c]\,c$. The general shape of the function $h\,[.]$ is shown in Figure 17.1. It begins with slope 1 for $c = 0$, is concave, and reaches its asymptote when $c = \overline{c}$, which may be greater than 1. This formulation of liquidity costs generalizes the cash-in-advance constraint, which posits no costs to increased spending in a period until all the money is spent, that is, until $C = M$, or $c = 1$. The $h\,[.]$ function allows for gradually increasing costs as velocity rises, and also allows velocity to exceed unity. The cash-in-advance constraint is also graphed in Figure 17.1 for comparison with the $h\,[.]$ function.

Output from the capital outlay C_t, will emerge over succeeding periods $t+1, t+2, \ldots, t+\tau$, where τ is a finite integer. The total output from a unit of inputs is 1, and I write $\alpha_1, \alpha_2, \ldots, \alpha_\tau$ for the fractions of the unit of output that emerge in each of the succeeding periods $1, 2, \ldots, \tau$.

$$\sum_{\varkappa=1}^{\tau} \alpha_\varkappa = 1, \text{ and } \alpha_\varkappa \geqslant 0$$

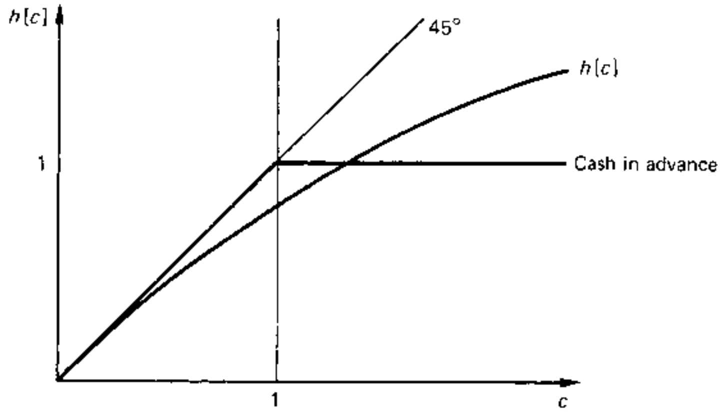

Figure 17.1 The h[.] function and the cash in advance constraint

Then the output that actually emerges in period t, Q_t, arises in the general case from capital outlays in periods $t - \tau$ to $t - 1$, and is given by the expression

$$Q_t = \frac{1}{u} \sum_{x=1-\tau}^{t-1} g\,[c_x] C_x \alpha_{t-x} = \frac{1}{u} \sum_{x=1}^{\tau} h\,[c_{t-x}]\, M_{t-x} \alpha_x \qquad (1)$$

This is the convolution of the function $h\,[c]\,M = g\,[c]\,C$ with the distribution α, centered at the date t.

Output is perishable. In general the firm faces a downward sloping demand schedule in each period, under the assumption that all the firms are monopolistic competitors with differentiated products. In order to simplify this analysis and in particular to keep prices and unit costs constant, I assume that the demand schedule facing the firm has the rectangular shape illustrated in Figure 17.2. The position of the demand schedule is determined by the parameter $\sigma \in [0, 1]$. σ determines the proportion of the firm's output, Q, that it can sell at the price p. Any higher sales will drive the price of the firm's output to zero. This is an extreme version of the kinked demand curve which Paul Sweezy (1939) argued governs price dynamics in an oligopolistic capitalist economy. A more general model would have a less sharply kinked, or continuously differentiable downward sloping demand schedule, and could, as a consequence, exhibit systematic changes in prices over the path of accumulation. With this rectangular demand curve it is clear that firms will always choose to sell σQ at the price p, so that the price of wage goods and inputs to production will be constant. This justifies the assumption that unit costs are constant over time.

These assumptions imply that demand is rationed among firms in

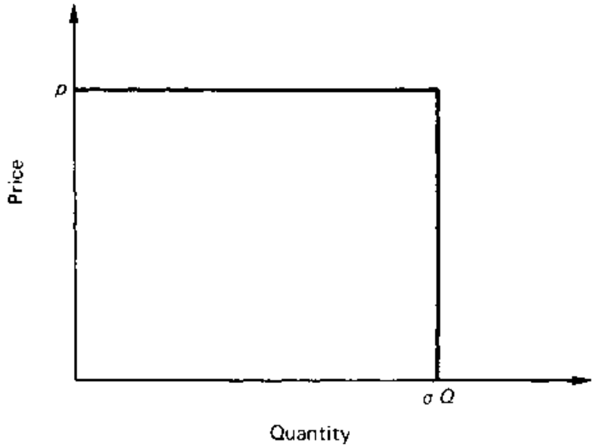

Figure 17.2 The individual firm's demand schedule

proportion to their output in each period. Thus firms have an incentive to produce more than they will be able to sell, in order to maintain their market shares.

If the firm knows the future sequence σ_t, it faces the problem of production scheduling. The sales revenue of the firm in period t, if it has output Q_t, will be $p\sigma_t Q_t$. The cost of this output is uQ_t. The ratio of sales revenue to cost per unit of output is $\frac{p}{u}\sigma_\tau$. Thus the firm has a high profit margin on output that emerges in periods when demand is high, and a low profit margin on output that emerges in periods when demand is low. The opportunity cost of output in period t depends on the velocity of money capital in the periods $t-\tau$ to $t-1$, according to (1). The firm, in the pursuit of high profits and rapid growth, will want to schedule production so as to take advantage of the high profitability in periods of high demand.

To complete the description of the model, I assume that labor is elastically supplied at a given real wage, which is reflected in the unit costs, u, given the price level of output, p. Money is supplied by an external authority – e.g., a government – is assumed to grow at the constant rate θ and is spent initially either by the government or by recipients of transfers on purchases from the firms:

$$M_{t+1} = M_t + \theta M_t \tag{2}$$

The demand for output of the firms arises from workers spending their wages (instantaneously), spending financed by newly created money, and other firms buying means of production. Thus aggregate demand, which is equal to total sales, must be just the sum of aggregate capital outlays C_t and government spending, θM_t:

$$S_t = C_t + \theta M_t \tag{3}$$

If all the firms are alike, this implies that σ must satisfy:

$$p\sigma Q_t = C_t + \theta M_t \tag{4}$$

In what follows we will always consider cases where $\sigma < 1$.

3 THE FIRM'S MAXIMIZATION PROBLEM WITH COMPLETE INFORMATION

The capitalist firm in the classical tradition pursues growth as a goal independent of any other, including the wealth or ultimate consumption of its owners. To represent this idea we need to measure the size of the firm at future points. A natural measure of the size of the firm, if its aim is competitive strength, would be its total assets, but in this model the assets are a heterogeneous bundle of money and capital outlays of different vintages, and it is not obvious how to measure the value of such a bundle consistently. In this paper I take a different tack, and measure the size of the firm simply by its money balances at any period t, and its growth from time 0 to time T by the growth of money balances over the period. For any time horizon T the firm could choose the path of capital outlays that maximizes the growth of its money balances over that horizon. In fact, I will assume that the policy actually chosen maximizes the limit of these growth rates as T becomes indefinitely large, thus expressing the idea that unlimited growth is the goal of the capitalist firm.

Consider first the finite horizon problem faced by the firm. To make this problem well-defined, we have to assume that the initial state of the firm, the vector of capital outlays in the pipeline at time zero and the money balances at time zero, are given. Then the T horizon problem of the firm is:

$$\max_{\{c_t\}} \quad \frac{1}{T} \; ln \; \left[\frac{M_T}{M_0}\right]$$

subject to

$$M_{t+1} = M_t - c_t M_t + p\sigma Q_t$$

$$= M_t\,(1-c_t) + \frac{p}{u}\,\sigma_\tau \sum_{\varkappa=1}^{\tau} h\,[c_{t-\varkappa}]\, M_{t-\varkappa}\alpha_\varkappa \tag{5}$$

given M_0, $h\,[c_t]\,M_t$ for $t = -\tau, \ldots, -1$

If the function $h\,[c] = g\,[c]\,c$ is concave, (5) is a regular concave programming problem. The maximal policy can be expressed in terms of first order conditions involving shadow prices on money balances, $\{\lambda_t\}$:

$$0 = -\lambda_t M_t + \frac{p}{u}\, h'\,[c_t]\, M_t \sum_{\varkappa=1}^{\tau} \sigma_{t+\varkappa}\, \lambda_{t+\varkappa}\alpha_\varkappa \quad t = 0, \ldots \text{T} \tag{6a}$$

$$0 = -\lambda_{t-1} + (1-c_t)\lambda_t + \frac{p}{u}\, h\,[c_t] \sum_{\varkappa=1}^{\tau} \sigma_{t+\varkappa}\, \lambda_{\tau+\varkappa}\alpha_\varkappa \quad t = 0, \ldots \text{T} \tag{6b}$$

$$0 = \frac{1}{T}\;\frac{M_0}{M_T} - \lambda_T \tag{6c}$$

We can write these first order conditions as

$$\lambda_t = \frac{p}{u}\, h'\,[c_t] \quad \sum_{\varkappa=1}^{\tau} \sigma_{t+\varkappa}\, \lambda_{t+\varkappa}\alpha_\varkappa \quad t = 0, \ldots \text{T} \tag{7a}$$

$$\lambda_{t-1} = (1-c_t)\lambda_t + \frac{p}{u}\, h\,[c_t] \quad \sum_{\varkappa=1}^{\tau} \sigma_{t+\varkappa}\, \lambda_{\tau+\varkappa}\alpha_k \quad t = 0, \ldots \text{T} \tag{7b}$$

$$\lambda_T = \frac{1}{T}\;\frac{M_0}{M_T} \tag{7c}$$

Equations (7a)–(7c) together with the original constraints in (5) define the maximal solution to the finite horizon problem. If $h\,[.]$ is concave, the solution to these equations will be the maximal solution to the problem (5).

The solution of this problem has a simple structure.

From (7a) and (7b) we have

$$\frac{\lambda_{t-1}}{\lambda_t} = 1 + \frac{h\,[c_t]}{h'\,[c_t]} \quad - c_t \equiv 1 + r\,[c_t] \tag{8a}$$

Here $r\,[c_t] = \dfrac{h\,[c_t]}{h'\,[c_t]} - c_t$ is the internal rate of return to capital outlays for the firm in period t. As a result, we have

$$\frac{\lambda_{t+\varkappa}}{\lambda_t} = \prod_{t'=1}^{\varkappa} (1 + r\,[c_{t+t'}])^{-1} \tag{8b}$$

We can eliminate λ_t from (6a) or (7a), and express the first order conditions in terms of $\{c_t\}$ alone, giving the Euler equation for this problem:

$$1 = \frac{p}{u} h' [c_t] \sum_{\varkappa = 1}^{\tau} \sigma_{t+\varkappa} \prod_{t' = 1}^{\varkappa} (1+r [c_{t+t'}])^{-1} \alpha_{\varkappa} \tag{9}$$

Clearly the optimal path for a finite horizon T requires $c_t = 0$ for $t \geqslant T$, because capital outlays in those periods contribute nothing to sales or money balances before period T. With these boundary conditions, we can solve (9) backwards as a difference equation to find the optimal path $\{c_t^{*T}\}$ for horizon T. The problem is greatly simplified by the fact that the whole process is first degree homogenous in M and capital outlays together.

In the Appendix I show that if the sequence of growth rates corresponding to the limit of the T-horizon optimal policies has a limit, then the limit of the T-horizon optimal policies will also maximize the limiting growth rate of the firm as the horizon becomes indefinitely large. Thus policies that satisfy the Euler equation (9) over an infinite horizon will maximize the limit of the growth rate of money as the horizon goes to infinity. I will assume that the firm in fact chooses such paths, and that this behavior reflects the Marxian conception of a firm pursuing accumulation for its own sake.

4 FULL MARKET EQUILIBRIUM

In an economy consisting of identical firms of this type, equation (4) determines what the actual level of sales for the typical firm will be for any path of capital outlays. From (4), we have

$$p\sigma_t Q_t = (c_t + \theta) M_t \tag{10a}$$

or, using (5b),

$$\sigma_\tau = \frac{c_t + \theta}{\frac{p}{u} \sum_{\varkappa = 1}^{\tau} h [c_{t-\varkappa}] \frac{M_{t-\varkappa}}{M_t} \alpha_\varkappa} \tag{10b}$$

By replacing σ_t in (9) by (10b), we arrive at the condition for a perfect foresight path for this economy. Any path c that satisfies (9) and (10b) will be a self-fulfilling path for the horizon T, in the sense that c is optimal for the firm given the path σ, and that the path c actually gives rise to σ as the path for demand. Because paths that satisfy the Euler conditions for $T = \infty$ maximize the limiting growth rate of the firm, a path c that satisfies (9) and (10b) for $t = 0, \ldots, \infty$ is a self-fulfilling path as well.

5 STEADY-STATE PATHS

The first step in examining the behavior of this model is to find the steady-state solutions to (9) and (10). These are paths where $c_t = c^*$, a constant, for all t, and as a result $\sigma_\tau = \sigma^*$, a constant, for all t. The firm and the economy grow at a steady, constant rate, which must be equal to θ, the rate of growth of money. Replacing c_t by c^* in (10b), we have

$$\sigma^* = \frac{c^* + \theta}{\frac{p}{u} \sum_{\varkappa=1}^{\tau} h\,[c^*] \frac{M_{t-\varkappa}}{M_t} \alpha_\varkappa} \tag{10c}$$

If M grows steadily at the rate θ, $M_{t'}/M_t = (1+\theta)^{t'-t}$. Let

$$\alpha^*\,[\varphi] \equiv \sum_{\varkappa=1}^{\tau} (1+\varphi)^{-\varkappa}\alpha_\varkappa \tag{11a}$$

for arbitrary φ denote the discounted present value of the vector α at the discount rate, φ, which is the discrete time analog of the Laplace transform of the production distribution α. Then we have

$$\sigma^* = \frac{c^* + \theta}{\frac{p}{u}\, h\,[c^*]\, \alpha^*\,[\theta]} \tag{11b}$$

Notice that we can choose $\frac{p}{u}$ large enough to ensure that $\sigma < 1$.

Substituting (11b) in (9) and noticing that $r^* = r\,[c^*]$ is a constant, we get

$$1 = \frac{p}{u}\, h'\,[c]\, \sigma^* \sum_{\varkappa=1}^{\tau} \alpha_\varkappa \prod_{t'=1}^{\varkappa} \frac{1}{1+r^*} \tag{12a}$$

or

$$1 = (c^*+\theta) \frac{h'\,[c^*]}{h\,[c^*]} \quad \frac{\alpha^*\,[r^*]}{\alpha^*\,[\theta^*]} \tag{12b}$$

or, remembering that $r = (h/h') - c$

$$\frac{\alpha^*\,[\theta^*]}{c^*+\theta} = \frac{\alpha^*\,[r^*]}{c^*+r^*} \tag{12c}$$

As we would expect, since the typical firm invests all of its profits, $r^* = \theta$. As a result, we have

$$c^* = r^{-1}[\theta] \tag{13}$$

Since r [.] is monotonic, c^* is unique.

5 CYCLICAL EQUILIBRIUM PATHS

There will be cyclical equilibrium paths in the neighborhood of the steady-state path defined by (12c), if the system defined by equations (9) and (10) undergoes a Hopf bifurcation for certain parameter values (see Guckenheimer and Holmes, 1983, pp. 156–65). To demonstrate this possibility it is necessary to linearize the system (9) and (10) around a steady-state value, and study the roots of the resulting linear difference equation. If the roots of this linearized system pass across the unit circle and are not nth roots of unity for $n \leqslant 4$ for given parameter values, then the full system (9) and (10) will have cyclical solutions near the critical parameter value.

Let $\hat{c} = \dfrac{c^* - c^*}{c^* + \theta^*}$ be the proportional deviation of aggregate demand from its steady-state level, and $\hat{\sigma} = \dfrac{\sigma - \sigma^*}{\sigma^*}$ be the proportional deviation of the sales rate from its steady-state level. Then, using (11) and (12), which define the steady-state levels, we can linearize (9) and (10) as

$$\hat{\sigma}_t = \hat{c}_t - \frac{c^* + \theta}{(c^* + r^*)\alpha^*[\theta]} \sum_{\varkappa=1}^{\tau} \hat{c}_{t-\varkappa}(1+\theta)^{-\varkappa}\alpha_\varkappa \tag{14a}$$

$$\hat{c}_t = \frac{h'^* r'^*}{h''^*\,(1+r^*)\,\alpha^*\,[r^*]} \sum_{\varkappa=1}^{\tau} \hat{c}_{t+\varkappa} \sum_{t'=\varkappa}^{\tau} \frac{\alpha_t'}{(1+r^*)\,t'}$$

$$- \frac{h'^*}{h''^*\,(c^* + \theta)\,\alpha^*\,[r^*]} \sum_{\varkappa=1}^{\tau} \frac{\hat{\sigma}_{t+\varkappa}\alpha_\varkappa}{(1+r^*)^\varkappa} \tag{14b}$$

Here $r'^* > 0$ is the derivative of r evaluated at c^*, and similarly for h'^* and h''^*. To demonstrate the possibility of cyclical equilibrium paths in the model, let us examine the simplest lag structure, a time delay, where $\alpha_1 = \alpha_2 = \ldots = \alpha_{\tau-1} = 0$ and $\alpha_\tau = 1$. In this case (14) simplifies, eliminating $\hat{\sigma}$, and recalling that $r^* = \theta$, to

$$0 = \left(1 - \frac{1+r^*}{r'^*\,(c^*+r^*)}\right)\hat{c}_{t+\tau} + \sum_{\varkappa=1}^{\tau-1} \hat{c}_{t+\varkappa} + \frac{(1+r'^*)(1+r^*)}{r'^*\,(c^*+r^*)}\,\hat{c}_t \tag{15}$$

If we write $\mu = \dfrac{1}{r'^*} \geqslant 0$ and $\gamma = \dfrac{1+r^*}{c^*+r^{*\prime}}$ (15) has the characteristic equation

$$0 = \varrho^\tau + \frac{1}{1-\mu\gamma}\sum_{\varkappa=1}^{\tau-1}\varrho^\varkappa + \frac{(1+\mu)\gamma}{1-\mu\gamma} \tag{16}$$

Consider, for example, the simple case where $\tau = 2$, so that there is a two-period time delay in production. Then (16) becomes

$$0 = \varrho^2 + \frac{1}{1-\mu\gamma}\,\varrho + \frac{(1+\mu)\gamma}{1-\mu\gamma} \tag{17}$$

The product of the roots is unity when $\mu = \dfrac{1-\gamma}{2\gamma}$, and the magnitude of the roots is increasing in μ. The roots are complex when $1 < 4\gamma\,(1-\mu\gamma)\,(1+\mu)$. When $\mu = \dfrac{1-\gamma}{2\gamma}$ the right-hand side of this inequality becomes $(1+\gamma)^2 > 1$. In the neighborhood of these parameter values the full system (9) and (10) will undergo a Hopf bifurcation, and has cyclical equilibrium paths near the steady state.

On a cyclical equilibrium path of this kind, capital outlays, output, employment, and the internal rate of return (which would be equal to the interest rate if the model allowed for borrowing among the firms) fluctuate together. When firms expect a relatively low level of demand two periods in the future, so that the profit rate they expect on capital outlays in the present is also low, they will reduce their present capital outlays. As a result the velocity of money capital will fall, and the real costs firms experience in managing their financial positions also fall, so that the internal rate of return declines. This reduction of capital outlays reduces aggregate demand in the present, thus fulfilling the predictions made two periods ago about the level of demand in the current period. The expectation of continued cyclical fluctuations in demand levels sustains itself in this way.

This analysis establishes the existence of a cycle, but leaves unanswered the question of whether the steady state around which the cycle develops is itself stable or unstable. The answer to this question depends on whether the bifurcation is supercritical or subcritical – which, in turn, depends on assumptions about the higher order nonlinearities of the difference equation. In this simplified model all the nonlinearities arise from the $h[\cdot]$ function, so that it should be possible to characterize the type of bifurcation in terms of the higher order derivatives of $h[\cdot]$ at the steady state.

6 DISCUSSION

The firms in this economy are motivated entirely by the prospect of capital accumulation. Their production plans and capital outlays are limited only by the availability of liquidity, because they face increasing costs as they try to increase the velocity of money capital. Because their output is perishable and they face downward sloping demand schedules, they have an incentive to produce for the market – that is, when they expect aggregate demand to be strong. As their planned production levels vary, the velocity of money capital and their internal rate of return vary as well.

The ensemble of these firms determine aggregate demand through their capital outlay decisions, on the assumptions that workers' households are passive spenders of wage income. On a steady accumulation path capital outlays grow smoothly, creating the market required to realize production, and the velocity of money capital and the internal rate of return are constant. But even with perfect foresight as to future market conditions it is possible that a cyclical path of accumulation will develop. If firms foresee a fluctuating path of aggregate demand conditions, they will optimize by choosing a fluctuating path of capital outlays, and velocity of money capital. But the fluctuation of capital outlays can produce exactly the path of aggregate demand that the firms foresee. In this case the equilibrium path exhibits regular fluctuations of aggregate demand, the velocity of money capital, and the internal rate of return. This pattern is completely self-consistent in that the firms are behaving optimally in the face of the demand conditions their own decisions create.

This model supplies one rigorous foundation for the view developed in both the Keynesian and Marxian traditions that the capitalist economy tends to suffer from macroeconomic instability due to the positive feedback effects of capital outlays on aggregate demand and aggregate demand on capital outlays. Following Keynes, it emphasizes the role of liquidity in regulating this instability, and points up the weakness of rational expectations in ensuring the macroeconomic coherence of individual firm decisions. Even perfectly informed capitalists may find themselves on a path of self-fulfilling and non-explosive fluctuation of capital outlays and aggregate demand.

Appendix

Let $c^{*T} = \{c_t^{*T}\}$ be the optimal capital outlay policy for the firm given the horizon T, and let c^{**} be a limit of a subsequence of these policies in the product topology as T goes to infinity, which must exist because $c \in [0, \bar{c}]$ in every period. For an arbitrary policy c', let $x'_t = (1/t) \ln (M_t/M_0)$ be the cumulative growth rate of money balances corresponding to that policy up to time t.

Proposition 1: There exists $\lambda^* < \infty$ such that $x_t < \lambda^*$ for any feasible policy.

Proof: The firm cannot sustain a growth rate higher than the rate that would result if it faced no liquidity costs, had $\sigma = 1$ in all periods, and set $c = \bar{c}$ in all periods. But under these conditions the firm has a finite growth rate λ^*.

Proposition 2: If $X = \lim_{t->\infty} x^{**}_t$ exists, there is no policy c' that has $\lim_{t->\infty} x'_t > X$.

Proof: Suppose c' did exist and that the limiting growth rate, $X' > X$. We know, by continuity of the Euler equation, that $|x^{*T}_t - x^{**}_t|$ can be made arbitrarily small by choosing T very large for any given t, because c^{**} is the limit of the c^{*T}. We also have $x'_t > x^{**}_t + \delta$ for some $\delta > 0$ for all t large enough. Now construct a path that follows c' up to time t', and c^{*T} thereafter. We can make $M'_{t'}$ as much larger than $M^{*T}_{t'}$ as we like by choosing T and t' large enough. In particular, we can choose t' large enough that $M'_{t'} > M^{*T}_{t'+\tau}$, by Proposition 1. At time $t'+\tau$ this alternative path must have a larger M than c^{*T}, and the pipeline could be no worse than on c^{*T}, so that on the alternative path $M_T > M^{*T}_T$, which contradicts the assumption that c^{*T} was the optimal path over a horizon T.

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18 Wandering Around the Warranted Path: Dynamic Nonlinear Solutions to the Harrodian Knife-Edge*

A. Shaikh

1 INTRODUCTION

Classical economics conceived of capitalism as an inherently expansive system which was ultimately regulated by its level of profitability. This approach reached its highest development in the works of Marx and Schumpeter, with their portrayal of a system driven by its inner mechanisms along erratic and periodically unstable paths of accumulation (Bleaney, 1976, ch. 6; Garegnani, 1978, pp. 183–5; Shaikh, 1984, section II). In what follows, I will refer to this overall perspective as the classical tradition.

Dynamic analysis of the above sort is typically constructed in terms of various sets of gravitational processes operating at intrinsic speeds ranging from the fairly fast to the very slow. For instance, a discrepancy between aggregate demand and supply produces a faster response than that between aggregate supply (output) and capacity (potential output), because the inventory and production level adjustments associated with the former are fairly rapid in comparison to the fixed capital and capacity level adjustments associated with the latter. This is why aggregate demand/supply adjustments are generally treated as as 'short-run' while the aggregate supply/capacity adjustments are 'long-run'[1] (Kaldor, 1960, pp. 31–3). But the notion of fast and slow adjustments is broader than the conventional macroeconomic distinction between short run and long run, for two reasons.

First of all, the fact that there are fast and slow adjustment processes does *not* imply that these processes lead to corresponding states of equilibrium. For instance, if a discrepancy between aggregate demand and supply generates a response in aggregate production, demand and prices, which in

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turn feed back to modify the initial discrepancy, and so on, in such a way that aggregate supply and demand end up gravitating around a mutual state of balance, this need not imply that demand and supply will end up equal. It is sufficient to imagine that the demand and supply fluctuate endlessly *around* their balance point without ever coming to rest on it. Supply would then approximately equal demand over some average period of oscillation. Yet at any moment of time, each would differ from the corresponding balanced amount. A similar argument could be made for the slow adjustment between supply and capacity. These are the kind of gravitational processes which are implicit in Marx's conception of a balance point as a 'regulating average', as opposed to some attained-and-held 'equilibrium state.[2]

Secondly, the fact that the fast and slow adjustment processes gravitate (orbit) around some regulating averages does not imply, as it does in Kaleckian and Keynesian constructions, that the fast adjustment defines some average *level* of output and employment, so that growth only enters the picture in the slow adjustment process. On the contrary, *growth is a part of the environment of both processes.*[3] The fast adjustment process defines time paths for aggregate demand and supply, not levels, and the slow adjustment process modifies (modulates) these paths in the light of their average results.

Since the fast adjustment process operates within the context of accumulation, the average levels of demand, supply and capacity change over time. The supply and capacity paths therefore define a corresponding path of capacity utilization (the ratio of actual output to capacity). But there is no presumption within the Classical tradition that the fast process will cause actual output to gravitate around capacity. If we think of the fast process as operating in time units called (say) weeks, and the slow one in time units called (say) years, then the fast process will produce an annual level of capacity utilization u which will generally differ from the normal rate u_n (= 1, by construction).[4]

The conclusion that the fast process roughly equalizes aggregate supply and demand, but not aggregate output and capacity, leads automatically to the consideration of the effects of any resulting discrepancy between actual and normal levels of capacity utilization. This is precisely the focus of the slow adjustment process in the Classical tradition, in which the above discrepancy is assumed to react back upon the rate of accumulation, thus altering the paths of actual output and capacity, modifying the initial discrepancy, which feeds back onto accumulation, and so on, all at the relatively slow pace consistent with the longer time horizon inherent in this process.

The Classical tradition implicitly assumed that this slow gravitational process was stable, in the specific sense that it led to the fluctuation of actual capacity utilization around some normal level. With this assumption, the basic groundwork was laid. Aggregate supply was thought to fluctuate around aggregate demand over some relatively fast process, and the resulting average aggregate output around the corresponding aggregate capacity over some relatively slow one. Classical dynamics was then able to concentrate on the properties of the normal capacity utilization path itself, and on the 'magnificent dynamics' arising from the still slower feedbacks between technical change, population growth and long run trends (Baumol, 1959, part I).

We have already noted that some distinction between fast and slow processes is common to all major traditions in economics, most often in the form of a distinction between short run and long run equilibrium states (as opposed to gravitational processes). More interestingly, *all major traditions implicitly or explicitly share the Classical notion that aggregate supply and demand are roughly balanced over some relatively fast adjustment process. Neo-Classical* economics not only assumes that aggregate supply and demand balance in short run equilibrium, but also that this balance point simultaneously corresponds to the short run "full employment" of available industrial capacity and labor power, which in this context means the absence of any involuntary excess capacity or unemployment. Keynesian and Kaleckian theories also typically assume that aggregate supply and demand balance in some short run equilibrium, but insist that this is perfectly consistent with involuntary excess capacity and labor unemployment (Kalecki, 1968, p. 182; Keynes, 1936, ch. 3).

Insofar as Keynesians insist the fast adjustment process balances aggregate demand and supply but not output and capacity or employment and labor force, their overall conclusions are actually very similar to those of the Classical tradition. It is in their respective characterizations of the slow adjustment process, in which any discrepancy between actual and normal capacity utilization feeds back onto the level of accumulation, that a great difference arises. The Classical tradition, as we have already noted, tended to assume that this slow adjustment process was stable. But Keynesians have no such luxury, for Harrod long ago derived 'the rather astonishing' result that the slow adjustment process is very unstable (Baumol, 1959, p. 44). In particular, any initial discrepancy between actual and normal rates of capacity utilization feeds back on accumulation in such a way as to exacerbate the problem: the normal capacity utilization (warranted) path is knife-edge unstable. In spite of many attempts to solve Harrod's problem, it persists to the present day.

In this paper, I will argue that the Harrod's apparently inescapable conclusion is, so to speak, quite unwarranted. The secret to the knife-edge lies in an unnoticed contradiction between his static specification of short run balance and his subsequent attempts at dynamics. As we shall see, once this error is corrected, it is easy to solve the knife-edge problem. The result is a Classical slow adjustment process in which the economy wanders around the warranted path as the actual level of capacity utilization cycles around the normal level. In what follows, we will assume that aggregate demand and supply are roughly equalized over some fast process (as modeled in Shaikh, 1989, 1991), so that like Harrod we may concentrate on the slow process.

2 AGGREGATE DEMAND AND SUPPLY

In keeping with the Harrodian formulation, we will take money prices and wages to be constant, so that all quantities are effectively in real terms. But we begin our accounting with total output and total demand, as in Marxian and input-output accounts, rather than the more familiar net measures of national income accounts, because this will enable us to locate a crucial omission in the conventional definition of the latter.

Since we are ultimately concerned with dynamic analysis, it is important to take note of the fact that production takes time. Following the Classical traditional, we will define the unit of time as being equal to the average period of production. Inputs purchased in period $t-1$ then lead to output in period t. The money value of total aggregate supply Q_t at time t can then be written as the sum of materials costs M_{t-1}, labor costs W_{t-1}, and depreciation DEP_{t-1} on fixed capital, all stemming from inputs used in the actual production of this output, plus the potential profit on production P_t, which is by definition the residual (Robinson, 1966, p. 41; Godley and Cripps, 1983, p. 75, 1). This gives us the standard expression for output

$$Q_t = M_{t-1} + W_{t-1} + DEP_t + P_t \tag{1}$$

In period t, total aggregate demand D_t (sales) will be composed of current capital expenditures on materials M_t, on desired additions to finals goods inventories (desired inventory investment) Iv_t, on new plant and equipment (gross fixed investment) IG_t, and of consumption expenditures on workers' and capitalists' consumption goods CW_t and CR_t, respectively.

$$D_t = M_t + Iv_t + IG_t + CW_t + CR_t \tag{2}$$

Finally, we will define excess demand E_t as the difference between total demand D_t and total normal supply Q_t. Any discrepancy between supply and demand will then be reflected in undesired changes in final goods inventories $UCINV_t$. When excess demand is positive, the final goods inventories will be run down below their desired levels, so that the undesired change is negative. Thus

$$E_t = D_t - Q_t = -UCINV_t \tag{3}$$

Equations 1–3 allow us to derive the standard accounting identity that total output equals the sum of total sales and the undesired change inventories of final goods.

$$Q_t = M_t + Iv_t + IG_t + UCINV_t + (CW_t + CR_t) \tag{4}$$

The left hand side of equation 4 is total output, and the right hand side is its total distribution. Capital outlays for materials M_t, inventories Iv_t, and plant and equipment, IG_t represent gross additions to stocks of productive capital, $UCINV_t$ represents involuntary changes in the stock of final goods, and $CW_t + CR_t$ represent goods transferred to the personal stocks of consumers.

The next step is to derive net output. By definition, net output is the difference between total current output and that portion of capital outlays which represents the equivalent of materials and fixed capital used up in the previous period. But the use of materials in the previous period is M_{t-1}, since that is that amount used up as input into current production. If we designate the corresponding retirements (scrapping) of fixed capital by KR_{t-1}, then from equations 1–4 we can write net output as

$$Y_t = Q_t - (M_{t-1} + KR_{t-1})$$
$$Y_t = (Im_t + Iv_t + If_t + UCINV_t) + C_t \tag{5}$$

where Iv_t, and $UCINV_t$ are as defined previously, and
$Im_t = (M_t - M_{t-1})$ = net investment in materials
$Ik_t = (IG_t - KR_{t-1})$ = net investment in fixed capital
$C_t = CW_t + CR_t$ = total personal consumption

Equation 5 above is simply an accounting identity for net output. It does not assume any immediate or average balance between aggregate supply and demand, since any imbalance between the two is covered by term $UCINV_t$. However, if we *do* assume that there is some fairly rapid process which makes supply gravitate around demand, then on average $UCINV_t = 0$, and the regulating average level of net output becomes

$$Y_T = (Im_T + Iv_T + If_T) + C_T \tag{6}$$

All of the terms in the above expression represent *average* levels of the variables previously defined in period t and now defined over some longer period of time T appropriate to the slow adjustment process. Equation 6 can then be read as the familiar statement that when supply and demand balance on average, net output is the sum of total investment (in parentheses) and total consumption. Moreover, all schools of thought note that this total investment is composed of distinct components. For instance, Quesnay distinguishes between *annual* advances (circulating capital) and the *original* advances (fixed capital), while Smith, Ricardo, and Marx distinguish between additional expenditures for wages and materials (investment in circulating capital) and those for fixed capital (Eltis, 1984, pp. 62, 75, 224; Marx, *Capital*, vol. II, ch. 21). Similarly, Keynes divides total investment into investment in 'fixed, working capital or liquid (i.e. inventory) capital' (Keynes, 1936, ch. 7, p. 75), Kalecki into 'fixed capital investment' and 'investment in [materials and final goods] inventories' (Kalecki, 1954, p. 106–8), Harrod into 'circulating and fixed capital' (Harrod, 1948, pp. 17–18), Hicks into 'fixed' and "working capital" (Hicks, 1965, ch. x, p. 105), and Robinson into investment in 'capital goods, including equipment, work-in-progress, technically necessary stocks of materials, etc.' (Robinson, 1966, p. 65).

Although all schools *note* the difference between circulating and fixed investment, the Classical/Marxian treatment of circulating capital differs in one crucial way from that of the Keynes/Kalecki tradition, in that the former links the purchase of additional inputs to the subsequent production of additional output.[5] This Classical/Marx/Leontief *input-output* link makes a crucial difference to dynamic analysis, because it tells us that while investment in fixed capital and inventories adds to capacity, investment in materials adds to output, so that any analysis of the dynamics of capacity utilization (i.e. of the relation of capacity to output) must pay close attention to the *difference* between the effects of these two components. Note that we are concerned here with the effects, and not the determinants, of these elements of investment.

Let us consider this point in more detail. Net investment in fixed capital If_T represents the change in the stock of plant and equipment. Its effect is to therefore *change aggregate capacity*. Abstracting from technical change, we can follow Marx and Harrod in assuming a constant fixed capital-capacity ratio n = Kf/N, where Kf_{T+1} = the stock of fixed capital and N_{T+1} = normal capacity net output, both at the beginning of period t+1 (end of period t). Then

$$N_{T+1} - N_T = (1/n)\,(Kf_{T+1} - Kf_T) = (1/n)\,If_T \tag{7}$$

Investment Iv_T in final goods inventories is somewhat different, in that it represents the *desired* change in final goods inventories, which will not equal the actual change unless the undesired change $UCINV_T = 0$ (aggregate supply = aggregate demand). Since we are indeed assuming the latter to hold over the average fast oscillation, Iv_T will equal the actual change in final goods inventories V.

$$V_{T+1} - V_T = Iv_T \tag{8}$$

We come now to the least familiar component, Im_T. At the most abstract level, this too is produces a change in a stock – namely in the stock of materials. But there is a difference here. The stock of final goods is aimed at sales, the level of which depends more on buyers than on the firm. Similarly, although net investment in fixed capital builds up capacity, the use of this capacity over its (long and uncertain) lifetime depends on many factors which the firm does not control. But the purchase of materials is another matter. Firms purchase materials in order to produce commodities with them, and this particular decision is largely under the control of the firm. Thus purchases of materials tends to be strongly linked to corresponding flows of output. *This is exactly the assumption underlying Leontief's input-output analysis*, since the observed input-output coefficient are the ratios of purchased inputs to produced outputs. The well-known empirical stability of these ratios is evidence of the strong link between input purchase and output flow. Thus if the input-output coefficient $m = M_{T-1}/Y_T$ is constant, then the effect of investment in materials is to expand output in the subsequent period.

$$Y^{T+1} - Y_T = (1/m)\,(M_T - M_{T-1}) = (1/m)\,Im_T \tag{9}$$

Substituting equations 7–9 into equation 6

$$Y_T = m(Y_{T+1} - Y_T) + (V_{T+1} - V_T) + n(N_{T+1} - N_T) + C_T \tag{10}$$

The presence of input investment $Im_T = m(Y_{T+1} - Y_T)$ on the right hand side of equation 10 is crucial for two reasons. First of all, it tells us that whereas fixed investment expands the capacity to produce the output and inventory investment expands the capacity to sell it, materials investment expands the output itself. Secondly, it shows us that the short run balance between aggregate supply and demand generally defines *a dynamic path, not merely a particular level, of net output Y.*

The above argument implies that any specification of short run output which fails to link input investment with output change implicitly assumes that the corresponding level of regulating output is *constant*. Conversely, any analysis which concludes that 'short run' factors determine a level (as opposed to a path) of output implicitly assumes materials investment is zero. In either case, the constancy of output in the 'short run' artificially displaces the discussion of growth to the 'long run'. What is worse, it also sets the stage for the Harrodian conclusion that growth is unstable, precisely because the very stabilizing mechanism – which arises from the *differential* effects of circulating and fixed investments on output and capacity, respectively – has been excluded from the start.[6]

Hicks' treatment is a partial exception to the rule. He arrives at virtually the same equation as equation 6, albeit from a quite different route. Whereas equation 6 is derived from a consideration of the input–output effects of materials investment, Hicks focuses on the determinants of materials investment, which he ties to the expected change in output. Since short run equilibrium expected output is the same as actual output, materials investment ends up being linked to the future change in actual output. Hicks notes that this immediately implies that short run equilibrium determines an output path, not a level (Hicks, 1985, ch. 11, pp. 108–11). But instead of pursuing the difference between the effects of circulating and fixed investment, he imposes the additional restriction that the former type of investment is *proportional* to the latter, in order to pursue the properties of 'the Equilibrium Path of a Keynes-type model (p. 112). This assumption is then carried over to the 'Harrod-type model' (pp. 118–19). With this step, a crucial stabilizing mechanism is lost to the analysis, and the Harrodian knife-edge emerges.

The stabilizing influence of materials investment can be easily shown. Assume that aggregate consumption is proportional to aggregate net output, $C = cY$, let $s = 1–c =$ the average 'savings' ratio (a constant), substitute into equation 6, and divide through by Y.

$$am_T + av_T + af_T = 1 - c = s = \text{constant} \tag{11}$$

where $am = Im/Y =$ the share of materials investment
$av = Iv/Y =$ the share of inventories investment
$ak = If/Y =$ the share of fixed investment

In the above expression, *am* is the component which leads to a change in output, while *av* and *af* leads to changes in sales and production capacities, respectively. We will assume that *av* is proportional to *am* (this is equivalent to a constant desired inventory/sales ratio, as we shall see later). Since the savings propensity *s* is constant, the sum of the investment propensities must be constant, so that a rise in one component must come at the expense of the others. And with this, we have the means for solving the Harrodian puzzle. Suppose that supply and demand balance around some level of Y which happens to define a level of capacity utilization above normal. This means that fixed investment must rise relative to the trend of output in order to raise the trend of capacity relative to the trend of output. In other words, businesses will adjust their moving capacity targets by gradually raising the fixed investment share *ak*. And as this occurs, *two* things will happen simultaneously: first, the rise in *ak* will accelerate the growth in capacity; second, the concomitant fall in the share of materials investment *am* (since inventory investment is proportional to *am*) will decelerate the growth of actual output. The net result is that the level of capacity utilization will fall back toward normal, rather than spiralling ever upward as in the Harrodian case. Instead of the knife-edge, we have the Classical slow adjustment process.

Although circulating investment is mentioned in most theoretical analyses of growth, it is striking that it disappears from the empirical measures of output in orthodox national accounts. This is basically because modern accounts adopt the convention of treating current purchases of materials M_T as the production costs of current total output Q_T, just as they assume that depreciation of the capital stock equals retirements. Treating the materials component of current production in this way is tantamount to assuming away the production process, since it implicitly assumes a zero time of production. At a theoretical level, the same effect is achieved by substituting M_T for the term M_{T-1} in the definition of net output. This eliminates input investment *Im* from equation 6 and the input investment share *am* from equation 11, which immediately leads to an internal inconsistency in the Harrodian formulation of the problem of dynamics. With input investment *Im* (and its correlate *Iv*) eliminated, equation 6 reduces to the familiar Harrodian equation $Y = If/s$, where *If* is exogeneous to the short run, and where *Y* is now a *stationary* level of output. But then it is logically inconsistent to also use the same expression to define a warranted growth path or any dynamics around it. On the other hand, if we assume that total investment I includes both circulating and fixed investment with the former proportional to the latter, as Hicks does (Hicks, 1985, ch. 11, pp. 108–11) and Harrod implicitly does (Harrod, 1939, pp. 17–18), then we disable the capacity utilization adjustment mechanism. The inevitable consequence in either case is that the slow adjustment then becomes a runaway process.[7] This is precisely what we call the knife-edge.

3 STABILITY AROUND THE WARRANTED RATE OF GROWTH

In this section, we will demonstrate that once net output is correctly specified, the warranted rate is indeed stable. Assume that the desired inventory/sales ratio is constant. Since sales equal output over the average fast cycle, and since the input–output coefficient is assumed to be constant, desired inventory levels are proportional to material inputs so that desired investment in inventories will be proportional to materials investment. Formalizing this and substituting into equation 11 yields

$$Iv_T = vIm_T \; (v = \text{desired inventory/materials ratio}) \tag{12}$$

$$am_T = (s - af_T)/(1 + v) \tag{13}$$

Next, define capacity utilization u_T as the ratio of actual net output to normal capacity.

$$u_T = Y_T/N_T \tag{14}$$

Now consider the determinants of the fixed investment share ak_T. As we noted earlier, in a dynamic environment all variables have trend paths, all targets are moving targets, and all adjustments in targets have to be adjustments relative to trend. Thus when capacity utilization is above normal, firms will be stimulated to raise investment in fixed capital faster than output and hence raise the fixed investment share ak_T, other things being equal. We can formalize this by assuming an investment reaction function in which the rate of change of the fixed investment share af_T is proportional to the degree of over- or underutilization of capacity $u_T - 1$.[8]

$$(af_{T+1} - af_T)/af_T = h(u_T - 1)$$
$$af_{T+1} = af_T + haf_T(u_T - 1) \tag{15}$$

All that remains is to relate the changes in capacity utilization u_T to changes in af_T and u_T. From equation 14

$$u_{T+1} = Y_{T+1}/N_{T+1} = (Y_T/N_T)(Y_{T+1}/Y_T)/(N_{T+1}/N_T)$$

Using equations 7 to get $N_{T+1}/N_T = 1 + (1/n)(If_T/Y_T)\,(Y_T/N_T) = 1 + af_T u_T/n$ and equation 9 to get $Y_{T+1}/Y_T = 1 + (1/m)\,(Im_T/Y_T) = 1 + am_T/m$, using equation 13 to substitute for am_T, and defining $m' = m(1 + v)$,

$$\begin{aligned}u_{T+1} &= u_T(1 + am_T/m)/(1 + af_T u_T/n) = u_T(1 + s/m' - af_T/m')/\\ &\qquad (1 + af_T u_T/n)\\ &= (n/m')[u_T(m' + s) - af_T u_T)/(n + af_T u_T)\\ &= (n/m')[u_T(m' + s) + n - (n + af_T u_T)]/(n + af_T u_T)\\ u_{T+1} &= A[(Bu_T + n)/(af_T u_T + n) - 1]\end{aligned}$$

$$\text{where } A = n/m',\ m' = (1 + v),\ B = m' + s \tag{16}$$

Equations 15 and 16 form a first-order nonlinear (difference equation) dynamical system. For the range of values of the reaction coefficient h in which the system is stable, the growth rate converges to the warranted rate of growth and the level of capacity utilization converges to $u = 1$, for any single departure from this balance path. Moreover, when subject to

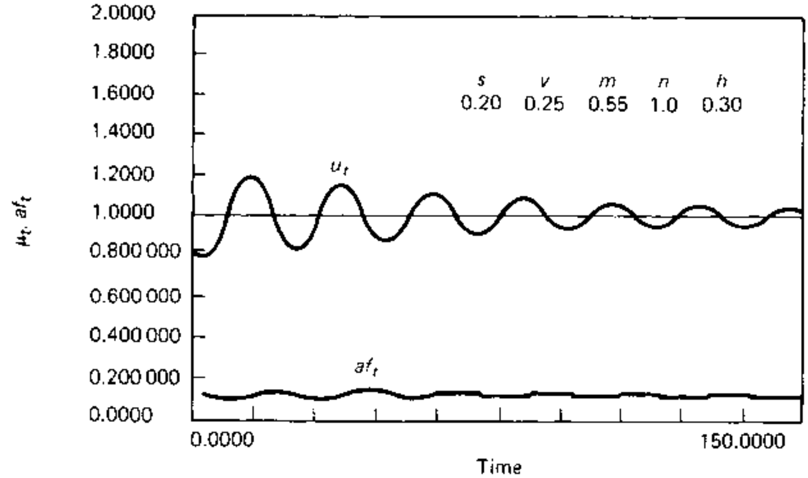

Figure 18.1 u_t and af_t (single shock)

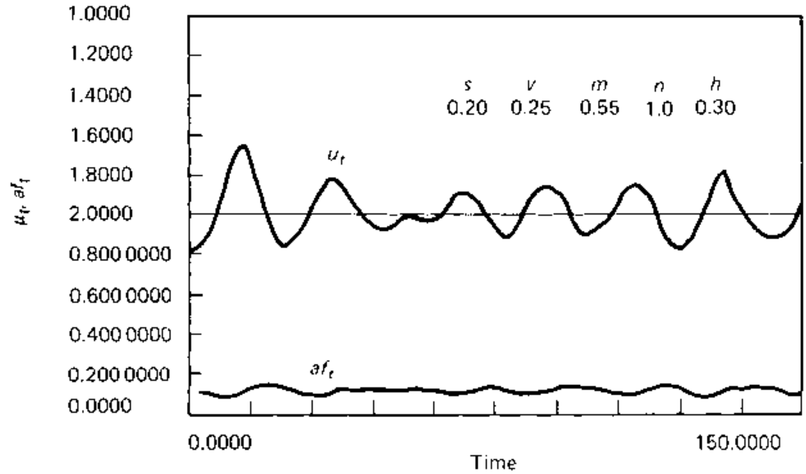

Figure 18.2 u_t and af_t with random shocks

random shocks representing the effects of the 'anarchy of capitalist production', the model ends up wandering around, but never settling down to, the warranted path. Figures 18. 1–3 display the simulated behavior of the model in its stable range, and the Appendix analyzes its structure and stability.

The particular model developed above is only the simplest possible version of a general class of models which can be derived for alternate specifications of the fixed investment reaction function in equation 15. It is

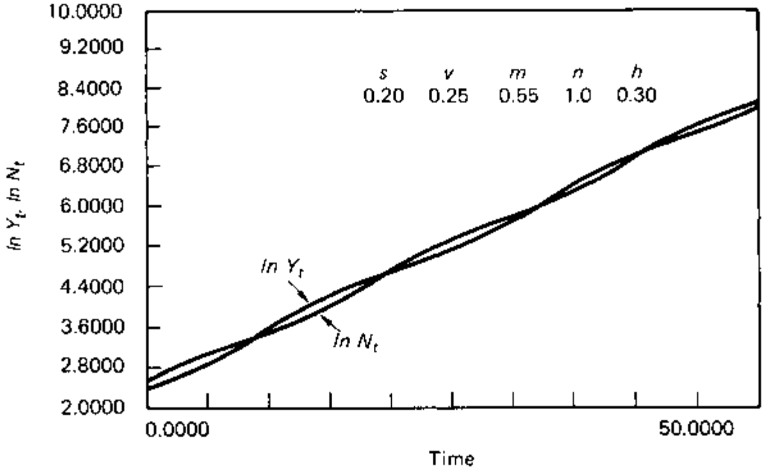

Figure 18.3 Output and capacity

interesting to note that if this very same function is specified in differential equation form, then the model is stable for *all* feasible (i.e. positive) values of the reaction coefficient h, and cyclically convergent for all plausible values (see Shaikh, 1989, appendix, part B). Alternate specifications can even yield limit cycles around the warranted path. What we get, therefore, is an integration of growth and cycle theory which is in the spirit of Kaldor and Harrod. The resulting picture of endogeneously generated turbulent growth is very much in the Classical and Marxian traditions.

Appendix

Equations 15–16 rewritten below constitute a nonlinear difference equation system with the Jacobian J shown below.

$$af_{T+1} = af_T(1-h) + haf_T u_T \tag{15}$$

$$uf_{T+1} = \frac{A(Bu_T + n)}{(af_T u_T + n)} - A \tag{16}$$

$$\mathrm{J} = \begin{bmatrix} 1 - h + hu_T & haf_T \\ \dfrac{-Au_T(Bu_T + n)}{(af_T u_T + n)^2} & \dfrac{AB}{(af_T u_T + n)} - \dfrac{Aaf_T(Bu_T + n)}{(af_T u_T + n)^2} \end{bmatrix}$$

Necessary and sufficient conditions for local stability (where TR = trace, DET = determinant, of the Jacobian evaluated at a critical point)[9] are:

(i) $1 - TR + DET > 0$
(ii) $1 + TR + DET > 0$
(iii) $1 - DET > 0$

Solving for $u_{T+1} = u_T = u$, and $af_{T+1} = af_T = af$ yields two critical points. The first point is $u = 0$, $af = 0$, in which case the Jacobian, Trace and Determinant reduce to

$$J_0 = \begin{bmatrix} 1-h & 0 \\ 0 & AB/n \end{bmatrix}, \; TR_0 = 1 - h + AB/n,\; DET_0 = (1{-}h)AB/n$$
where $A = n/m'$ and $m' = m(1+v)$

and this evidently unstable because condition i is not satisfied.

The second critical point is $u^* = 1$, $af^* = sA/(1+A)$. This represents the warranted path, because from equations 9, 13, and the above value of af^*, the growth rate of output is

$$\begin{aligned} g^*y &= (Y^*_{T+1} - Y^*_T)/Y^*_T = (1/m)\,(I^*m_T/Y^*_T) = (1/m)\,am_t \\ &= (1/m)\,(s - af^*)/(1+v) = (1/m')\,(s - [sA/(1+A)]) \\ &= (s/m')/(1+A) = s/(n+m') \end{aligned}$$

Here, v is the desired final goods inventory/materials ratio, m is the ratio of materials flow (and stock, since we have picked the time period equal to the period of production) to net sales, so that mv is the desired final goods inventory/sales ratio and $m'v = m + mv$ is the ratio of materials and final goods inventories to net sales. But at the above critical point sales equals capacity because $u^* = 1$. Since n is the fixed capital/capacity ratio, $C = n + m'$ is the total capital/capacity ratio. Therefore

$$g^*y = s/C = \text{the warranted rate of growth}$$

For this critical point its Jacobian, TR and DET are

$$J_1 = \begin{bmatrix} 1 & haf^* \\ \dfrac{-(1+A)}{af^*+n} & \dfrac{n}{af^*+n} \end{bmatrix}, \; TR_1 = 1 + n/(af^*+n),\; DET_1 = \frac{h(1+A)af^*+n}{af^*+n}$$

It is easily verified that local stability conditions (i)–(ii) are satisfied for all positive values of h (since m, v, and n are all positive). But for the third condition we need $DET_1 < 1$, which requires that $h < h^* = 1/(1 + A)$.

Notes

1. We may think of the slow adjustment process as operating on the *average* values of the fast adjustment variables (e.g., the propensity to invest in fixed capital is a function of the average level of capacity utilization over the fast oscillation).
2. Marx speaks of 'a cycle of lean and fat years' as the characteristic manner in which an average balance is achieved (*Capital*, vol. III, ch. XII, p. 208). See also Marx, 1970, p. 208.

3. Kalecki's theory typically partitions into short run, in which supply and demand are assumed to balance, medium run, in which he considers the business cycle around a stable level of output, and long run, in which he considers growth (Kalecki, 1959, ch. 14–15 and 1962, pp. 134–5). Keynes also saw 'growth [as] a long-period conception' (Kregel, 1980, p. 100), which led him to stumble over Harrod's notion of a steady advance as part of a growth environment (ibid., p. 99, fn. 5, and pp. 101–2).
4. By normal capacity output we mean the economically feasible capacity, which depends on costs, shiftwork, normal intensity and length of the working day, etc. This is quite different from engineering capacity, which is the technical upper limit to normal capacity. See Winston, 1974.
5. Eltis records that in Quesnay the 'agricultural output is proportional to the *annual* advances or circulating capital', so that additional advances result in additional output (Eltis, 1984, p. 75). Smith and Ricardo generalize this to all production, so that the level of output is tied to the prior expenditures for wages and materials (pp. 92, 224–5). This is why in the Classical tradition 'the rate of growth of circulating capital determines the [rate] of growth of output' (p. 93). Finally, Marx explicitly links the increase in circulating capital $\Delta c + \Delta v$ to subsequent increases in output and hence in surplus value Δs (Marx, *Capital*, vol. II, ch. 21).
6. This point is discussed in more detail in Shaikh, 1991. It is shown there that the Keynesian and Kaleckian short run equilibrium levels of output are static closures of the fast adjustment process.
7. See Shaikh, 1989B for a formal demonstration of this.
8. The term $u_t - 1 = (Y_t - N_t)/N_t$ can either be interpreted as a measure of over- or underutilization of capacity (depending on its sign), or it can be interpreted as a measure of over- or underfulfillment of expectations. In the latter case, we note that the capacity in place at the beginning of 'year' T is really the capacity planned for year T over the prior years in which the currently matured investment projects were initiated. But since investment projects can always be cancelled if it is clear that they are not needed, we could interpret current capacity N_t as an index of *last* year's expectation of this year's output. That is $N_t = (Y^e{}_t)_{t-1}$, where the $t-1$ subscript refers to the year in which the expectation was formed. On this basis, $u_t - 1$ is simply the per cent excess of actual over expected output.
9. Gandolfo, 1985, pp. 127 and 56.

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19 A Dynamical Macroeconomic Growth Model With External Financing of Firms: A Numerical Stability Analysis

R. Franke and W. Semmler

1 INTRODUCTION

In recent times nonlinear macrodynamic models with cyclical behavior have been revived, continuing a tradition starting with Kalecki (1937a, 1937b), Kaldor (1940), Hicks (1950), and Goodwin (1948, 1951). Most of these approaches, including Kaldor's seminal contribution of 1940, have predominantly focused on real economic activities and have neglected the role of money and financial markets. Recently, there have been several papers which, partly arising from Keynesian theory and influenced by Minsky's writings (Minsky, 1975; 1982), have attempted to integrate monetary and financial variables in macrodynamic models (cf. Taylor and O'Connell, 1985; Foley, 1987; Day and Shafer, 1985; Woodford, 1988). Our paper seeks to contribute to this line of research.

Though Kaldor's 1940 article has also been taken as a starting point for studying the interaction of real and financial variables in macrodynamic models (cf. Asada, 1987), we have chosen a closely related but, as we think, in some respects richer point of departure, namely a Kaleckian type of macrodynamic approach to growth. In addition, as Kaldor himself recognizes, his 1940 model where he gives his famous geometric exposition of a nonlinear cycle model is substantially based on Kalecki's work.

One main difference between the two writers concerns the formulation of an investment function. A centerpiece of Kalecki's earlier versions of the business cycle was a specific investment hypothesis (which appears in Kaldor's 1940 model only in a reduced form). When introducing it Kalecki writes:

'the rate of investment decisions is an increasing function of the gap between the prospective rate of profit and the rate of interest' (Kalecki, 1937a:85) and 'the gap between the prospective rate of profit, and the rate of interest, is equal to the risk incurred'. (1937a:84)

In a different article Kalecki (1937b, 1938) refers to the above measure of risk as the 'Principle of Increasing Risk'. Discussing this principle he elaborates the view that entrepreneurs run a greater risk on their own capital the more investment is debt financed.[1] In recent dynamic models this principle of increasing risk was utilized in different formulations (cf. Woodford, 1988; Franke and Semmler, 1989).

Following this Kaleckian tradition of investment theory, in the present paper we use a specification where the difference between the expected rate of return (exclusive of debt and profit tax payments) and the rate of interest enters as argument in the investment function (cf. also Foley 1987, and Taylor and O'Connell 1985). Concerning the financing structure of firms, two cases are considered. In the basic model we assume that firms are solely externally financed through debt and equity issuance. In a generalized version, additionally internal finance through retained earnings is introduced.[2] Given this preliminary characterization, some remarks are necessary before going into details.

The first concerns the financing structure of firms. In our basic model, equity financing is taken as a residual, closing the gap between desired investment and debt issuance. Recent literature on credit or financial constraints (cf. for example Stiglitz and Weiss 1981, Greenwald *et al.*, 1984; Fazzari *et al.*, 1987) stresses that, compared to debt financing, equity financing is more difficult to obtain and more costly. Those considerations may suggest that rather debt financing should become the residual term to close the gap between investment and equity finance. Along with the introduction of internal finance of firms we employ this alternative approach in the extended version of the model. Though it is conceptually a different economy, it turns out that, given the other modelling details, there is no substantial change in its stability properties.

The second remark is related to the firms' desired investment. A variable that takes account of the (expected) utilization of capacity, or other forms of an accelerator type of argument in the investment function, does not appear either in Kalecki's original or in our slightly extended formulation. Recent papers in a Kaleckian framework, for example by Taylor (1988) and Marglin and Bhaduri (ch. 8), propose to add a variable for the utilization of capacity. This is supported by econometric studies where the inclusion of some type of accelerator principle (investment responding to the rate of change of output, the level of output or the change in the utilization of capacity) has been demonstrated to exhibit quite significant explanatory power (cf. Eisner, 1967; Kopcke, 1985; Clark, 1979, to name a few). On the other hand, the arguments entering our investment function are conceptually close to those that constitute Tobin's q, which has also proved to be of empirical importance.[3] Thus, a combination of the three arguments in an investment function, expected rate of return, capital cost and accelerator, seems to be most appropriate. However, we think that the pure form of the investment function and its effects on the whole economic system should first be studied in isolation. After this is well understood, other or additional arguments may be considered. Indeed, we are able to show that the simple investment behavior brings in strong stability tendencies. We may then conjecture that the inclusion of a variable allowing for the utilization of capacity results in different stability properties of our model.

A third remark concerns a more technical question. In the stability analysis worked out in our previous paper (Franke and Semmler, 1988) we have stated the conditions on the behavioral parameters in the (basic) model which lead to the different scenarios: convergence to the long-run equilibrium position, unidirectional or cyclical, or existence of limit cycles. In the present contribution we want to investigate more closely their practical significance. By this we mean that a scenario, though appealing and theoretically possible, may require extreme reaction patterns of economic agents.

Those results are, however, dependent on a numerical specification of the model. Technological data or some key magnitudes as, for example, savings propensities or the degree of firms' indebtedness are not too difficult to obtain. They are taken, or inferred from standard statistical sources of the US economy. The critical point is that we are still left with numerous reaction parameters which are hardly observable. Hence, they cannot be assigned a single value but for each one, at least at the start of the analysis, a whole range of values has to be admitted.

The multitude of *a priori* possible combinations deprives us of any enumerative method (even if for each of our six parameters only three values were considered, we would already have to evaluate $3^6=729$ different economies). Nevertheless, by means of a convenient linearity assumption concerning the functional specification of two behavioral functions, and by calculating and further employing certain critical values of the reaction coefficients, we are able to arrive at some interesting and, to a great extent, definite statements (the complicated calculations cannot be done other than by a computer). Although our procedure makes use of some special features in the model's formulation, the approach here pursued might be of a more general interest. Since in many dynamical models a stability analysis is basically confronted with similar problems, some of our ideas may prove applicable in a completely different context.

The paper is organized as follows. In section 2 we give a short characterization of our basic economic model with financial flows, but a zero retention ratio of firms, so that financial constraints are only indirectly effective.[4] Section 3 presents a method of numerical stability analysis. Section 4 introduces self-financing of firms through retained earnings and gives an analysis of how the dynamic behavior of the system might alter when financial constraints of some kind are more explicitly incorporated into the model. Section 5 draws some conclusions for future research.

2 OUTLINE OF THE MACROMODEL WITH EXTERNAL FINANCING OF FIRMS

In the subsequent part, the basic version of our dynamic growth model will be briefly described. Here we assume that firms finance their investment solely externally. Financial constraints appear only in the form that borrowing is influenced by the level of debt of firms. The model contains two constituent parts: an IS–LM configuration and a dynamic system. The IS–LM part is always in temporary equilibrium, whereas the dynamic part determines the motion of the entire system over time. After the introduction of the model a theorem will be stated characterizing the long-run dynamics.

The Model

The financial relationships in the economy that we are studying can best be described by looking at its balance sheets represented in Table 19.1. There are four groups of agents: the central bank, commercial banks, firms, and wealths holders or rentiers, here denoted as the public. Workers play a passive role. They spend their wages instantaneously and do not own assets.

We begin with firms. K being the physical capital stock, P the price level, let r^g = (gross profits after tax)/PK, and r = (gross profit − iL)/PK stand for the gross and net rate of profit, respectively (i.e. net of interest payments). They are connected by the relation

$$r^g = r + i\lambda \tag{1}$$

where $\lambda = L/PK$ is the degree of indebtedness. We define ϱ as the overall 'state of confidence' and $r^g + \varrho$, $r + \varrho$ as the corresponding expected rates of profit. As will be seen below, λ and ϱ will be the main state variables. The capitalized value of expected earnings per unit of investment, P_K, or the demand price of capital, can then be defined as

$$P_K = \frac{r^g + \varrho}{i} P \tag{2}$$

Table 19.1 Balance sheets in the economy

Assets			*Liabilities*
	Central Bank		
High-powered money	F	D^c	Deposits of commercial banks (interest-free bank reserves)
	Commercial banks		
Bank reserves	D^c	D^o	interest-free deposits from the public
Loans to firms	L	D^i	interest bearing deposits from the public
	Firms		
Capital stock (valued at the demand price)	$P_k K$	L	Loans from commercial banks
		$P_e E$	Equity
	Public		
Deposits with commmercial banks	D^o	W	Wealth
	D^i		
Equity	$P_e E$		

P_K gives us the market value of the capital stock, as opposed to its replacement costs, PK. P_K/P thus resembles Tobin's q. Note, however, that even in a long-run equilibrium position it may exceed unity (in fact, we will ensure that it will). So, the difference $P_K/P - 1$ could be interpreted as the risk premium on non-financial investment.

As for share prices P_e, we make the assumption that their formation is exclusively determined by the variables determining $P_K K$. Excess volatility or bubbles in the stock market are excluded (since they do not seem central for a basic model such as developed here). This translates into the equation

$$P_e E = P_K K - L \tag{3}$$

which is identical to the firms' balance sheet position.

Shares are bought by rentiers. They plan to have their wealth split up into

$$P_e E = eW, \; D^o = d^o W, \; D^i = (1-d^o-e)W \qquad (0<e<1),$$

where e is a differentiable function of the two relevant prospective rates of return, $e = e(r + \varrho, i)$. Naturally, $e_r = \partial e/\partial(r + \varrho) > 0$, $e_i = \partial e/\partial i < 0$.

With these elements we are sufficiently equipped to derive an equation that characterizes market clearing of financial markets. Summing the balance sheets over the whole economy gives $W = F + P_K K$, whereas with

$P_eE = eW$ eq. (3) can be written as $W = (P_KK - L)/e$. Defining $\phi = F/PK$, using eq. (2), and equating the two equations, we finally obtain the LM-equation.

$$e(r + \varrho, i) - (r + \varrho) / [r + \varrho + i(\lambda + \phi)] = 0 \qquad \text{(LM)}$$

Market clearing is brought about by variations of the rate of interest i. λ and ϱ are given in every instant of time, r is determined on the goods markets (see below). On the other hand, ϕ is taken as a constant ratio (which implies that the central bank, via D^c, imposes no restriction on the credit volume of commercial banks – cf. pp. 43–4 in Franke and Semmler, 1989).

Turning to the real side of the economy, we first introduce the investment function of firms. Denoting the planned rate of growth of the capital stock by h, as discussed before we postulate $h = h(r + \varrho - i)$. Of course, $h' = dh/d(r + \varrho - i) > 0$. Below we assume that h can always be financed as well as realized when appearing as demand on the goods markets.

Secondly, rentiers households have to be considered. Their current flow of income consists of immediately distributed net profits of firms, rPK, plus interest payments iD^i, plus profits of commercial banks, $i(L-D^i)$, plus capital gains, $\dot{P}_eE$. To keep the analysis simple, we suppose that the latter are not consumed and completely added to the stock of wealth. Their savings propensity, s_h, thus applies to the sum of gross profits, $(r+i\lambda)PK = r^g\,PK$. As usual, let us take s_h as a constant magnitude $(0<s_h<1)$.[5]

Thirdly, we assume that the excess of government expenditure over taxes and the budget deficit, PG, is solely financed by the creation of base money (cf. Tobin, 1982, p. 178), i.e. $PG = \dot{F}$. As our fourth conceptual assumption we hold the price level constant.[6] In conjunction with $\phi = F/PK$ = const, we can then deduce $PG = \phi PI$ (for $PG/F = \dot{F}/F = \dot{K}/K$). It is not difficult to show that the clearing of goods markets boils down to the IS-equation

$$(1 + \phi)\, h(r + \varrho - i) - s_h\,(r + i\lambda) = 0 \qquad \text{(IS)}$$

To simplify notation, we take r as the equilibrating variable. In reality, it is the level of production. Since, with K given, it stands in a definite relationship to r^g, and then via eq. (2) to r, working with r is only a matter of convenience.

To sum up, with respect to given values of λ and ϱ and treating ϕ as a constant parameter, the IS–LM equations characterize a temporary equilibrium on goods and financial markets. It is brought about by (simultaneous) adjustments of r and i.

To describe the evolution of λ over time, consider the financing of net investment, I. In the basic version of our model there are only two sources, loans from commercial banks and issuing new shares. It thus reads

$$PI = \dot{L} + P_e\dot{E} \tag{4}$$

Firms always stick to $I = \dot{K} = h \cdot K$. As concerns the right-hand side, they primarily decide over the amount they want to borrow, or they accept the margin conceded by the banks. Equity financing consequently becomes a residual magnitude. Borrowing is represented by a function $b = b(r^g + \varrho - i, \lambda)$, which is to govern the growth rate of the stock of firms' loans, $\dot{L}/L$. The signs of the partial derivatives are $b_r = \partial b/\partial(r^g + \varrho - i) \geqslant 0$, $b_\lambda = \partial b/\partial\lambda \leqslant 0$. The change of λ itself is given by $\dot{\lambda}/\lambda = \dot{L}/L - \dot{K}/K$. So we obtain as the first dynamic equation

$$\dot{\lambda} = \lambda\,[b(r^g + \varrho - i, \lambda) - h(r^g + \varrho - i)] \tag{5}$$

It remains to be considered how expectations regarding future profits are affected by the motions of the other variables. This concerns the state of confidence, ϱ. Generalizing a formulation of Taylor and O'Connell (1985) we suppose that ϱ increases when the difference between the net rate of profit and the interest rate is great, whereas ϱ decreases when it is small. The degree of indebtedness, on the other hand, is considered a measure of risk of default, so that a rise of λ will cause ϱ to fall. We propose the following detailed formulation:

$$\dot{\varrho} = v(r - i, \lambda) \tag{6}$$

with $v_r = \partial v/\partial(r - i) \geqslant 0$, $v_\lambda = \partial v/\partial\lambda \leqslant 0$.

In total, our basic economy is fully described by the motions of four key variables: the rate of interest i, the net rate of profit r, the debt asset ratio λ, and the state of confidence ϱ. The dynamics of λ and ϱ is directly governed by the differential equations (5), (6). The determination of $i=i(t)$ and $r=r(t)$ is implicit, as temporary equilibrium solutions of the IS–LM system with respect to given values of $\lambda=\lambda(t)$ and $\varrho=\varrho(t)$. Clearly, changes of $\lambda=\lambda(t)$ and $\varrho=\varrho(t)$ induce changes in the temporary equilibria.

The Dynamics of the System

A thorough analytical study of the dynamic system presented is undertaken in Franke and Semmler (1989). It is subdivided into two steps.

First, it is demonstrated that for any given pair (λ, ϱ) $(0<\lambda<1)$ a unique IS–LM equilibrium $r=R(\lambda, \varrho)$, $i=J(\lambda, \varrho)$ exists. It has the property $r>i$. Incidentally, the ultra short-run adjustment toward it is stable. Since they are needed below, we restate the main findings concerning the partial derivatives of the functions $R(\lambda, \varrho)$ and $J(\lambda, \varrho)$. They are dependent on certain assumptions on the functions $e(\cdot,\cdot)$ and $h(\cdot)$ which we consider reasonable but must omit for lack of space.

$$\begin{aligned}
&\text{(i)} \;\; \partial R/\partial\lambda < 0,\ \partial R/\partial\varrho < 0,\ \partial J/\partial\varrho > 0,\\
&\text{(ii)} \;\; \operatorname{sgn} \partial g/\partial\lambda = \operatorname{sgn}\,[\partial R/\partial\lambda - \partial J/\partial\lambda] < 0\\
&\text{(iii)} \;\; \operatorname{sgn} \partial g/\partial\varrho = \operatorname{sgn}\,[\partial R/\partial\varrho + 1 - \partial J/\partial\varrho] < 0.
\end{aligned} \tag{7}$$

Here, $g(\lambda, \varrho)$ denotes the rate of growth of the capital stock resulting from the corresponding temporary equilibrium. The sign of $\partial J/\partial\lambda$ is indeterminate.

Second, with the aid of the temporary equilibrium functions $R(\lambda, \varrho)$ and $J(\lambda, \varrho)$ it is possible to write equations (5), (6) as a closed dynamic system in the two state variables λ and ϱ. In compact form,

$$\begin{aligned}
\dot\lambda &= U(\lambda, \varrho)\\
\dot\varrho &= V(\lambda, \varrho)
\end{aligned} \tag{*}$$

where

$$\begin{aligned}
U(\lambda, \varrho) &:= \lambda\{b[R(\lambda, \varrho) + \varrho - (1-\lambda)J(\lambda, \varrho), \lambda] - h[R(\lambda, \varrho) + \varrho -\\
&\qquad - J(\lambda, \varrho)]\}\\
V(\lambda, \varrho) &:= v[R(\lambda, \varrho) - J(\lambda, \varrho), \lambda]
\end{aligned}$$

A pair (λ^*, ϱ^*) with $U(\lambda^*, \varrho^*) = 0$, $V(\lambda^*, \varrho^*) = 0$ constitutes a stationary point of system (*), that is, a long-run equilibrium or steady state position of the economy. Under some further assumptions it can be shown to exist and to be unique. Additionally, $\varrho^* = 0$ for reasons of consistency.

The local stability properties of the steady state can be inferred from the system's Jacobian matrix, evaluated at (λ^*, ϱ^*),

$$Q := \begin{bmatrix} U_\lambda & U_\varrho \\ V_\lambda & V_\varrho \end{bmatrix}$$

Six partial derivatives of the behavioral functions are involved. These six reaction coefficients are e_r, h', b_λ, b_r, as well as v_λ, v_r (one of the assumptions just alluded to implies $e_i = -e_r$). In Franke and Semmler (1989, Lemma 7) the entries of Q were calculated as

$$\text{(i)} \quad U_\lambda = \lambda b_\lambda + \frac{i\lambda}{A_F}\{s[A_i\,(e_r) - (r + \varrho)]b_r + [A_2 b_r + A_3]h'\}$$

$$\text{(ii)} \quad U_\varrho = \frac{s\lambda}{A_F} \{[\lambda A_i(e_r) - A_1]b_r + A_1 h'\}$$

$$\text{(iii)} \quad V_\lambda = v_\lambda - \frac{iA_3}{A_F} v_r < 0$$

$$\text{(iv)} \quad V_\varrho = \frac{-1}{A_F} [(1+\phi)A_1 h' + s(1+\lambda)A_i(e_r)]\, v_r < 0 \tag{8}$$

where reference is made to the following abbreviations

$$\begin{array}{lll} \text{(i)} & A_i(e_r) := [r+\varrho+i\,(\lambda+\phi)]^2 e_r - i(\lambda+\phi) & > 0 \\ \text{(ii)} & A_r(e_r) := [r+\varrho+i\,(\lambda+\phi)]^2 e_r - (r+\varrho)(\lambda+\phi) & > 0 \\ \text{(iii)} & A_1 := (r+\varrho-i)(\lambda+\phi) > 0 & \\ \text{(iv)} & A_2 := [(r+\varrho-i)\phi - i\lambda](1+\phi) & \\ \text{(v)} & A_3 := s[(1-\phi)(r+\varrho) + i(\lambda+\phi)] > 0 & \\ \text{(vi)} & A_F := (1+\phi)A_1\, h' + s[A_r(e_r) + \lambda A_i(e_r)] > 0 & \end{array} \tag{9}$$

All values being those of the steady state.

Utilizing these formulae, the effects of different configurations e_r, h', etc., on stability can be studied. Since particularly the expressions for U_λ and U_ϱ are quite complicated, the scope for general statements is limited. We therefore want to attempt a numerical analysis, which is the subject of the next section.

3 NUMERICAL STABILITY ANALYSIS OF THE MODEL

The first step of our numerical study is to determine the steady state values of the complete system (IS), (LM), (5), (6). This is done on the basis of actual data of the US economy. Subsequently measures of reaction intensities are introduced which help to explore the impact of behavioral reactions on the dynamics of the model. After these preparations the computer is employed to study the stability properties of the steady state.

Computation of Steady-state Values of the Model

In order to depict in our model some properties of a real economy, relevant steady state values were computed from data of the US economy for the Year 1977.

Let a be the intermediate goods coefficient, δ the depreciation rate, $u = PX/PK$ the (gross) output-capital ratio, and W/Y the wage share in net value added. Then the following formula can be derived for the gross profit rate before tax, r^{bT}: $r^{bT} = [1-a-\delta/u]\ u\ (1-W/Y)$

For computing the gross profit rate r^g of our model, taxes on business profits have to be deducted. It can be obtained from r^{bT} if we employ some assumptions on firms' tax burdens. Supposing that indirect business taxes (IBT), net of subsidies, are shared by consumers and firms and transfers are shared as well, we define the ratio τ_Π of the corporate tax burden to total profits before tax (PbT) as

$$\tau_\Pi = \{(1-W/Y)IBT+DBT-(1-W/Y)T\}/PbT$$

where DBT is the direct business tax, T transfers and $(1-W/Y)$ is an estimate for the share of profit tax burden of IBT and for transfers received by profit recipients. τ_Π relates r^g and r^{bT} by $r^g = (1-\tau_\Pi)r^{bT}$. For a given growth rate of the capital stock, g, which is roughly 5 per cent in 1977, and the above calculated profit rate after tax, the propensity to save out of disposable profits can be obtained by solving the IS-equation for s_h (with g=h), $s_h = (1+\phi)g/r^g$.

Using actual data from the US economy the following empirical approximations for the steady state values were utilized (1977)[7]:

PX/PK	a	δ	W/Y	τ_Π	r^{bT}	r^{aT}	ϕ	λ	s_h	g
1.9	0.656	0.037	0.68	19.3%	19.6%	15.8%	0.14	0.26	0.36	5.0%

In all what follows, those values remain fixed. The next important question concerns the functional forms of the two behavioral functions $e(\cdot)$ and $h(\cdot)$. We choose the simplest possible approach by postulating that they are linear functions (without an absolute term). They are characterized by reaction parameters E and H, respectively,

$$e(r+\varrho, i) = E\cdot(r+\varrho-i), \quad h(r+\varrho-i) = H\cdot(r+\varrho-i)$$

For fixed values (H, E) we can use the above parameters and calculate the unique equilibrium solution $(r, i)=(r^*, i^*)$ of the IS–LM system. Doing this, we focus only on those pairs (H, E) which lead to a solution with the predetermined growth rate of the capital stock. That is, besides satisfying the IS–LM equations, we demand $h(r+0-i)=g=5\%$ (so, with the other parameter of the table above, the values of r^g, r^{bT}, and PX/PK will not change either). We find that the coefficients H, E which achieve this are approximately related by a linear function,

$$E = 14.167\ H + 1.822, \quad (\text{for H} \geq 0.35)$$

Resulting from an increase in H and E the interest rate i rises from

i=1.23% (with H=0.35) to i=10.01% (at H=1.55, where we terminate the computation). The net profit rate falls, but to a smaller extent, from 15.33 to 13.24 per cent.

For the subsequent stability analysis we want to fix one specific long-run equilibrium position. For this purpose we select a value of the rate of interest, $i=i^* = 2.5\%$ (the actual real interest rate in 1977 was even a little below 2.5 per cent). The values of the coefficients H and E, together with the resulting net rate of profit, are as follows,

$$H = 0.394,\ E = 7.39,\ i = i^* = 2.5\%,\ r = r^* = 15.19\%$$

Since we shall exclusively refer to steady state values, the stars will be dropped henceforth.

Behavioral Functions and Reaction Intensities

In order to analyze the intensity of the reaction of one variable on another, whether it is weak or strong, it is not sufficient to consider the isolated partial derivatives. For one reason, two different behavioral functions might not contain the same arguments – for example, we have in one function $r-i$ as the argument; in another $r^g-i=(r+i\lambda)-i$. On the other hand, the level of the variables can be different, not allowing the variables to be compared. Our steady state growth rate, e.g., is $g=h(r-i)=$ $0.415\cdot 0.1205=.05$, as opposed to the share holding ratio of rentiers, $e=E\cdot(r-i)=7.69\cdot 0.1205=0.927$.

The latter difficulty can be overcome by using elasticities, which relate the percentage change of the dependent variable to a percentage change of the independent variable. The first mentioned problem can be dealt with by choosing one key variable as the independent variable. It does not need to enter directly into all the behavioral functions, it suffices that it be part of a wider expression. All other variables are kept constant and one considers solely the isolated influence of that key variable. In order to make the results comparable one computes the elasticities thus to be defined.

Formally the idea can be made precise as follows. Let f be a behavioral function which depends, among others, on a variable z. z in turn depends on a variable x. We take x as the independent, z as a dependent variable. So $f=f(z, \ldots)$, $z=z(x, \ldots)$, and $f=f(z(x, \ldots), \ldots)$. If we vary the variable x by Δx, inducing a change of f by Δf, the corresponding elasticity is defined as $(\Delta f/f)/(\Delta x/x)$. For infinitesimal changes the elasticity of the function f with respect to the change in x reads

$$\eta_{f,x} := (df/dx)\cdot x/f = [(\partial f/\partial z)(\partial z/\partial x)]\cdot x/f$$

As for the independent variables for our economy, λ and ϱ are the obvious candidates. ϱ, however, is ruled out since it vanishes in the steady state. Instead, let us take the net profit rate r. We can then first compute the corresponding elasticities of the two behavioral functions $e(\cdot)$ and $h(\cdot)$. Because of the linearity assumption the parameter H and E cancel out, so that they are identical:

$$\eta_{h,r} = \eta_{e,r} = r/(r-i) = 1.20$$

This value shows that our specification was not unreasonable.

As for the borrowing function $b(\cdot\ ,\ \cdot)$, two 'true' elasticities with non-cancelling partial derivatives are obtained,

$$\eta_{b,r} = b_r \cdot r/g \text{ (since } b=g \text{ at the steady state)}$$
$$\eta_{b,\lambda} = b_\lambda \cdot \lambda/g$$

With the function $v(\cdot\ ,\ \cdot)$, which determines the evolution of the state of confidence, we run into a difficult problem. Elasticities cannot be defined since $v=0$ at the steady state. So we have to resort to an auxiliary device where, in some way or another, the function v is shifted. A natural shifting term appears to be the value of the profit rate r. We can offer the following interpretation, although we must admit that it is somewhat artificial. Since in a time-discrete world we would have $\varrho(t+1) = \varrho(t) + v(r(t)-i(t),\lambda(t))$, and since ϱ is the difference between the expected and the actual rate of profit, r^e and r, respectively, we can postulate as an adjustment equation in this setting,

$$r^e(t+1) = r(t) + v(r(t)-i(t),\ \lambda(t))$$

Our analysis being restricted to a vicinity of the steady state, we may simplify it further to

$$r^e(t+1) = f(r(t)-i(t),\ \lambda(t)) = r^* + v(r(t)-i(t),\ \lambda(t))$$

In this way we get, for example,

$$dr^e(t+1)/dr\big|_{r^e=r^*} = (\partial f/\partial(r-i))\cdot(\partial(r-i)/\partial r) = v_r,$$

and (with $r=r^*$) we arrive at the following elasticities for the auxiliary function f,

$$\eta_{f,r} = v_r \cdot r/r\ , \qquad \eta_{f,\lambda} = v_\lambda \cdot \lambda/r$$

It is these that we shall employ, but as the reference is obvious we prefer to substitute 'v' for 'f', defining

$$\eta_{v,r} := v_r\,, \qquad \eta_{v,\lambda} := v_\lambda \cdot \lambda/r$$

In technical terms, the purpose of this simple procedure is to obtain a non-zero value that can serve as the denominator in the formula for elasticities. the choice of r might seem arbitrary; however, we can assure that it will only enter the results of section 3.4 below – in a not very essential way.[8]

In order to avoid unnecessary technicalities in the discussion of our results and to give a more substantive interpretation, we will use the mode of expression that for a function, for example, for the borrowing function $b(\cdot\,,\cdot)$, the reaction to r is x times higher than the reaction to λ. This is to say that the elasticity $\eta_{b,r}$ is x times higher than the absolute value of $\eta_{b,\lambda}$.

Furthermore, we will refer to an elasticity of 1 as measuring a normal intensity of reaction. 'Weak' reactions are indicated by values around 0.1, 'strong' reactions by values around 10.

Stable Partial Processes and Interaction Effects

Before the stability properties of the complete system (IS), (LM), (5), (6) are analyzed, it will add to our understanding if we focus first on the stability properties of the partial dynamic processes. This means that one variable is kept constant and the dynamics of the remaining variable is considered.

1. Let us first fix the debt asset ratio, $\lambda=\bar{\lambda}$ which says that debt grows at the same rate as the capital stock ($b=g$). The motions of ϱ are then described by

$$\dot{\varrho} = v[R(\varrho,\bar{\lambda}) - J(\varrho,\bar{\lambda}),\bar{\lambda}].$$

The derivative of the right hand side with respect to ϱ is negative (for all ϱ, see (7,iii). Therefore, this partial process is even globally stable.

2. On the other hand, fix $\varrho=\bar{\varrho}=0$ and consider the dynamic process in λ,

$$\dot{\lambda} = \lambda[b(r + i\lambda + \bar{\varrho} - i,\lambda) - g]$$

where $g = h(r+\bar{\varrho}-i)$, $r = R(\bar{\varrho},\lambda)$, $i = J(\bar{\varrho},\lambda)$.

The derivative of the right hand side, evaluated at the steady state, is the expression U_λ in (8i). For our empirical values the expression there in $\{\ldots\}$ turns out to be positive. U_λ will be negative, and the partial process therefore stable, if b_λ is sufficiently negative. $U_\lambda>0$, on the other hand, means instability. The question is how strong reactions $\eta_{b,\lambda}$ have to be, as compared to those of $\eta_{b,r}$, in order to bring about stability. For a number of values of $\eta_{b,r}$, 'EtaBR', we have calculated in the table below the critical value of elasticity $\eta_{b,\lambda}$, 'CritEtaBL', which has the property that $U_\lambda<0$ if $\eta_{b,\lambda}$ < CritEtaBL. The table below shows that the conditions for the partial process in λ to be unstable must be considered to be quite exceptional.

EtaBR:	0.05	0.01	0.25	0.5	1	2.5	5	10	25	50	100
CritEtaBL:	–0.03	–0.03	–0.03	–0.03	–0.04	–0.05	–0.07	–0.11	–0.23	–0.43	–0.83

The analysis of the two partial processes suggests that there are strong stability tendencies. A general conclusion for the entire dynamic system, however, cannot be drawn yet, since interaction effects of the two variable ϱ and λ can be destabilizing. They might even be dominating.

To have a closer look at this possibility, let us assume $U_\lambda<0$. $V_\varrho<0$ in any case, hence trace $Q < 0$ (Q being the Jacobian defined in section 2.2). Owing to $V_\varrho<0$ the determinant of Q is positive, and thus the steady state is stable, if $U_\varrho>0$. On the other hand, det $Q < 0$ implies instability; the steady state would then be a saddle point. A necessary, though not yet sufficient, condition for this is $U_\varrho<0$, which in turn requires that there be a very strong reaction in the borrowing function to changes in profitability $\eta_{b,r} > 20.18$.[9]

It can furthermore be demonstrated that – with respect to fixed values of the elasticities $\eta_{b,r}>20.18$ and $\eta_{b,\lambda}$ < CritEtaBL ($\eta_{b,r}$) (so that $U_\lambda<0$, see above) – there exists a unique number $C = C(\eta_{b,r},\eta_{b,\lambda})$ such that $\eta_{v,\lambda} < C\cdot\eta_{v,r}$ implies saddle point instability (stability prevailing if the inequality is reversed)[10]

Except for completely irrelevant cases C is negative so that the instability condition becomes

$$|\eta_{v,\lambda}| < |C|\cdot\eta_{v,r}$$

To investigate this condition further, let us accept a strong reaction $\eta_{b,r}=50$. Varying elasticity $\eta_{b,\lambda}$ and calculating the corresponding critical number $C = C(50, \eta_{b,\lambda})$, we can summarize our findings as follows.

- In order that $\eta_{v,\lambda}$ and $\eta_{v,r}$ have roughly the same size, i.e. $|C|$ close to 1, it is necessary that $|\eta_{b,\lambda}|$ is smaller than 1. This is, however, a big discrepancy from $\eta_{b,r}=50$.
- If $\eta_{b,r}$ and $\eta_{b,\lambda}$ have roughly the same magnitude, $|C|$ will be very high, between 100 and 200. The intensity of reaction of the function $v(\cdot\,,\cdot)$ with respect to λ must be much greater than to the variable r.

We summarize that parameter constellations $\eta_{b,\lambda}$, $\eta_{b,r}$, $\eta_{v,\lambda}$, $\eta_{v,r}$ indeed exist which generate not only destabilizing interaction effects, but render them also dominant. On the other hand, they are rather special, so that this interesting phenomenon is of peripheral significance only.

Repelling Steady State

The case of a repelling steady state would be very appealing in the context of our proposed model since it allows existence of non-dampening cyclical behavior. Unfortunately, the conditions for such a scenario are quite peculiar, as we will now show.

We may assume that $U_\varrho>0$, which holds if the reaction of the borrowing function to the change in the profit rate is not too strong, i.e. if $\eta_{b,r}<20.18$.

The critical term is now U_λ. We require positivity of U_λ, and, furthermore, it has to be so large that tr $Q=U_\lambda + V_\varrho>0$ (remember that $V_\varrho<0$) The behavioral parameters responsible for this situation are $\eta_{b,r}$, $\eta_{b,\lambda}$ and $\eta_{v,r}$, not $\eta_{v,\lambda}$ however. In Theorem 5 in Franke/Semmler (1988) it has been demonstrated that in this case det $Q>0$. The steady state would thus be repelling.

Let us have a closer look at the prerequisites generating this scenario. First, studying the partial dynamics of λ in the previous section we have found that $U_\lambda>0$ requires very weak reactions $\eta_{b,\lambda}$. In order to provide favorable conditions for trace $Q>0$, we set $\eta_{b,\lambda}=b_\lambda=0$. This way U_λ is only dependent on $\eta_{b,r}$, which we stress by writing $U_\lambda(0,\eta_{b,r})$. V_ϱ can be decomposed as $V_\varrho=-z\,\eta_{v,r}$ where z is a positive number. tr $Q>0$ is then equivalent to

$$\eta_{v,r} < \text{CritEtaVR} = \text{CritEtaVR}\,(\eta_{b,r}) := U_\lambda(0,\eta_{b,r})/z.$$

Now we can vary $\eta_{b,r}$ and observe the effects on CritEtaVR. The numerical calculations are reported in the table below, where the ratios of EtaBR/CritEtaVR are listed. The figures show the intensities of behavioral reactions for repelling steady state:

EtaBR :	0.05	0.1	0.2	0.5	1	2	5	10	20
EtaBR/CritEtaVR:	40	80	156	361	644	1061	1735	2201	2542

They show that elasticities $\eta_{v,r}$ have to be very small compared to $\eta_{b,r}$ in order to fulfill the condition for repelling instability. Despite the ambiguities that were involved in the definition of $\eta_{v,r}$, in total we still conclude that occurrence of this scenario has to be considered as rather exceptional.

Types of Convergence

The results obtained in the previous section indicate that in the relevant cases the long-run equilibrium solution will be locally asymptotically

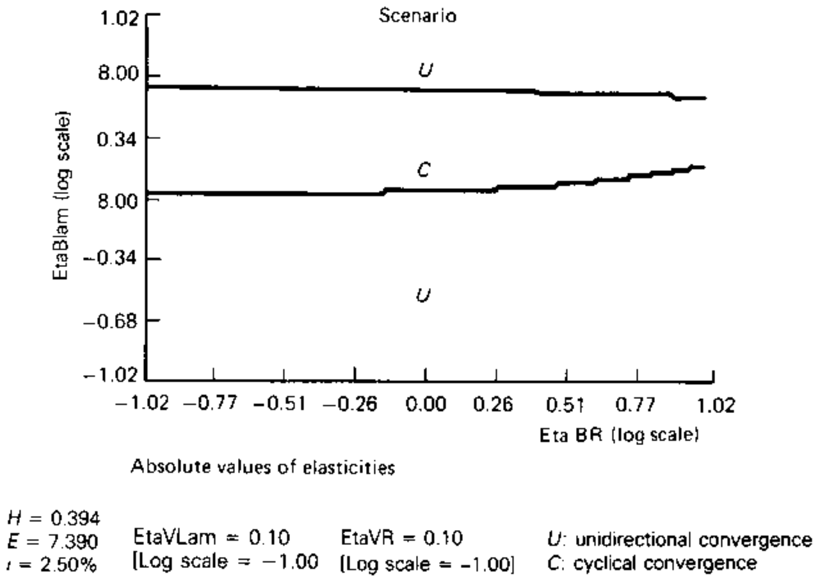


Figure 19.1 Scenario-diagram of convergence for different parameter constellations

stable. Going beyond this statement we want to explore the question how the equilibrium is approached. In the economic sense it may make a difference, for example, for stabilization policy, whether or not the trajectories approach the steady state directly or only cyclically. The answer to this question depends on the sign of the magnitude $(U_\lambda - V_\varrho)^2 - 4\ U_\varrho\,|V_\lambda|$ (which is equivalent to the discriminant $(\text{tr}\ Q)^2 - 4\ \det Q$ in the eigenvalue equation of the Jacobian Q). If this number is positive convergence is direct, if negative we will have an oscillatory movement around the steady state, but finally approaching it. Different from the analysis on stability conditions, now all 4 elasticities $\eta_{b,\lambda}$, $\eta_{b,r}$, $\eta_{v,\lambda}$, and $\eta_{v,r}$ will play a role.

In order to keep the details transparent and to observe an interesting phenomenon, we fix the elasticities that rule the adjustment of the state of confidence, $\eta_{v,\lambda}$ and $\eta_{v,r}$, and compute in the $(\eta_{b,\lambda}, \eta_{b,r})$ parameter space the regions U and C, which represent unidirectional and cyclical convergence, respectively. An example of such a scenario-diagram is Figure 19.1, where we let the elasticities $\eta_{b,\lambda}$, $\eta_{b,r}$ vary between .1 through 1 up to 10. The axes represent log-scale.

On the basis of elasticities $\eta_{v,\lambda} = \eta_{v,r} = 0.1$ we can observe a kind of reswitching phenomenon: keeping $\eta_{b,r}$ fixed and letting $\eta_{b,\lambda}$ increase, we get for low and medium-sized values unidirectional convergence, for stronger reaction intensities, however, cyclical trajectories toward the steady state. A further increase of $|\eta_{b,\lambda}|$ leads again to a unidirectional convergence. This example shows clearly that, even if stability is already known to prevail, a stronger reaction in behavioral functions does not necessarily lead to a faster and unidirectional convergence to the steady state.

We also have studied the scenario-diagrams for other constellations of the underlying parameter $\eta_{v,\lambda}$ and $\eta_{v,r}$. In order to characterize the results in a short-cut form we divide the $(\eta_{b,\lambda}, \eta_{b,r})$-plane, starting from below, in 5 horizontal strips and assign to each of the strips a letter U or C, depending whether predominantly scenario U or C applies. This way Figure 19.1 could be represented by the sequence of letters *UUUCU*. The other results are summarized in the table below. Concerning $\eta_{v,r}$ we have restricted our consideration to the relatively low values from .1 to .5, since starting with $\eta_{v,r}$ =1 the trajectories converge unidirectionally to the steady state, independently of the absolute value of $\eta_{b,\lambda}$, $\eta_{b,r}$ and also $\eta_{v,\lambda}$ (within the range .1 to 10).

	EtaVLam				
EtaVR:	−0.1	−0.5	−1	−5	−10
0.1	*UUUCU*	*(U) CCCU*	*CCCCU*	*CCCCC*	*CCCCC*
0.5	*UUUUU*	*UUUUU*	*UUUUC*	*UUUCC*	*(U) CCCC*

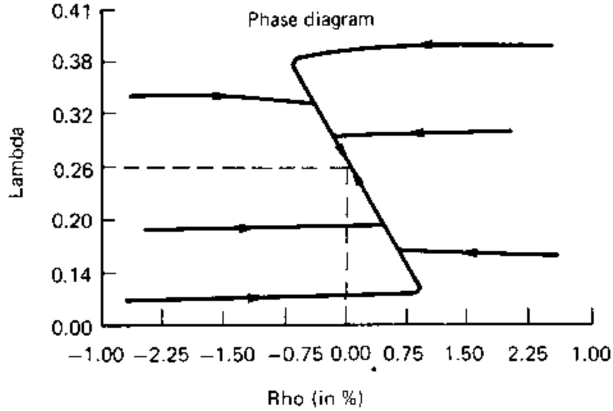
The first letter, for example in *(U)CCCU*, is put in parentheses in order to indicate that scenario U is partially valid in a smaller portion of the strip, whereas for the rest scenario C is encountered.

Despite the strong stability indications that we have obtained we should not forget that the results are only of a local nature. Their significance would be considerably diminished if in a wider distance from the steady state destabilizing tendencies were observed. To check this we study system (IS), (LM), (5), (6) directly and run computer simulations of its trajectories. To this end the type of the two functions $b(\cdot\,,\cdot)$ and $v(\cdot\,,\cdot)$ has to be specified. We choose the simplest form possible, namely

$$\begin{aligned} b(r+i\lambda+\varrho-i,\, \lambda) &= b_r\cdot(r+i\lambda+\varrho-i) + b_\lambda\cdot\lambda + b_c \\ v(r-i,\, \lambda) &= v_r(r-i) + v_\lambda\cdot\lambda + v_c \end{aligned}$$

where b_c and v_c are suitable constants ensuring that $b=g=0.05$ and $v=0$ at the steady state values. Figure 19.2 depicts the trajectories in the (λ,ϱ)-plane of the thus defined dynamical process, with respect to the reported reaction coefficients. It clearly shows that the attracting forces of the long-run equilibrium position are in fact far reaching. In a practical sense we can speak of global stability. Observe that also the type of the local dynamics extends to the outer regions.[11]

We conclude this part of the paper with the remark that Figure 19.2 is by



H = 0.394
E = 7.390 EtaVL = −0.10 EtaVR = 1.00
i = 2.50% EtaBL = −1.00 EtaBR = 1.00

Figure 19.2 Phase diagram of the dynamical system

no means a special case. For all our (not too extreme) variations of the behavioral parameter we have obtained very similar phase diagrams.

4 STABILITY ANALYSIS FOR THE MODEL WITH MODIFIED FINANCE CONDITIONS

It is appropriate to consider the financing conditions of firms more closely. Here we introduce two modifications, which will define a new dynamical system. Subsequently the impact on stability is investigated.

As a first step, we include retained earnings of firms. Out of net profits rPK, firms retain a positive fraction s_f for further investment ($0<s_f<1$, the rest again instantaneously going to shareholders).

Second, we explicitly consider equity financing, P_eE. Since, as generally stated (cf. Stiglitz and Weiss 1981, Fazzari *et al.*, 1987), equity finance seems to be more difficult to obtain and more costly than debt financing, we assume that new shares are issued, at the ruling price P_e, up to a fraction α of total investment. For lack of systematic information on the reaction to the variations of the other variables, we take α as a constant.

Including these two modifications, our finance equation (4) changes to

$$PI = s_f rPk + \dot{L} + \alpha PI \tag{4'}$$

Taking account of the desired growth rate of the capital stock, $h=h(r+\varrho-i)$, after dividing through by PK it reads

$$h = s_f r + (\dot{L}/L)\lambda + \alpha h \tag{10}$$

It follows from this approach that now the growth rate of loans is the residual. That is, our previous borrowing function $b(\cdot\ ,\ \cdot)$ drops out and will be replaced by the constant α, representing the firms' equity policy.[12] These modifications affect immediately the law of motion for λ (eq. (5) in section 2.1). Solving for the growth rate of loans in (10) and substituting it in $\dot{\lambda}/\lambda = \dot{L}/L - \dot{K}/K = \dot{L}/L - h$, leads to

$$\dot{\lambda} = (1-\alpha-\lambda)h(r+\varrho-i) - s_f r \tag{5$'$}$$

Fortunately, the LM-equation remains unaltered. Only the IS-equation changes. Due to the introduction of retained earnings, it now comprises two propensities to save, namely s_h as the propensity to save for rentier households and s_f, the firms' retention ratio (both are constants). One can demonstrate that the new IS-equation becomes:

$$(1+\phi)h(r+\varrho-i) = s_f r + s_h(r^g - s_f r) = s_o r + s_h i\lambda \tag{IS$'$}$$

where $s_o = s_f + s_h - s_h s_f$. Thus, our new dynamical system is made up of eqs (IS′), (LM), (5′), (6).

The analysis of the temporary equilibria, i.e., the pairs $i=J(\lambda,\ \varrho)$ and $r=R(\lambda,\varrho)$ which emerge from equations (IS′) and (LM) can be undertaken in the same way as before. There are only slight differences in the derivatives and, more importantly, they are not sufficient to change the qualitative features stated for our previous model in (7) (i)–(iii) (we omit the details of the proof).

An immediate consequence is that the partial process in ϱ remains stable. As for λ, however, we have now to refer to eq. (5′). Denoting the share of self-financing of firms in total investment by $\sigma = s_f rPK/PI = s_f r/h$, (5′) can be rewritten as:

$$\dot{\lambda} = [1 - \alpha - \sigma - \lambda] \cdot h(r+\varrho-i)$$

$\varrho=\bar{\varrho}=0$ being fixed, though the IS-LM equations σ still depends on λ.

Stability of this partial process prevails, if, for $\lambda>\lambda^*$, the expression in the parentheses $[\cdot]$ turns out to fall short of zero. This is equivalent to the question of whether σ increases with λ or, if $\partial\sigma(\lambda^*)/\partial\lambda<0$ (because, roughly speaking, r rises faster than $g=h$ falls), whether σ drops less fast than λ increases. In general no unambiguous statement is possible. Decisive is the relative intensity of the reaction of the investment function $h(\cdot)$ as compared to the function $e(\cdot)$, which determines the fraction of total wealth being held as equity.

We can, however, make quite a clear statement when again we utilize our numerical specification for the steady state values of i, r and g, as well as the parameter H and E. (With the new savings function, H and E generate a different steady state solution. The differences, however, turn out to be negligible.) Before, we have to fix s_h and s_f. Let us assume $\alpha=.2$. The fraction σ is determined from steady state condition $1-\alpha-\sigma-\lambda=0$, giving $\sigma=0.54$. s_f is then computed from the definition of σ: $s_f=\sigma g/r=0.178$.[13] Solving the new IS-equation for s_h provides us with:

$$s_h = [(1+\phi)g-s_f r]/[(1-s_f)r+i\lambda] = 0.228$$

These values are used for the computation of $\partial\sigma(\lambda^*)\partial\lambda$. The result is a negative value, but with -0.028 it is far below 1 in its absolute value. So we conclude that the partial process in λ is locally stable. Note that this applies independently of the values of the reaction coefficients of the remaining behavioral function $\nu(\cdot\ ,\ \cdot)$ (to wit, one reaction coefficient is implicitly involved: the constancy of the parameter α).

Both partial processes being stable, the next question is whether for the combined motions of λ and ϱ there will still be the possibility of instability. Since $U_\lambda<0$, trace $Q<0$ in any case (notation as above, but U now referring to eq. (5′)). Hence, interaction effects are the only possible source of destabilizing tendencies. With V_λ and V_ϱ continuing to be negative, a necessary condition for them to occur is $U_\varrho<0$ (cf. the discussion on p. 348). Using our numerical specifications, however, we obtain a distinctly positive value for U_ϱ. The solution of the long-run equilibrium of the dynamic system (IS′), (LM), (5′), (6) is thus always locally stable, independently of the values of $\eta_{\nu,\lambda}$ and $\eta_{\nu,r}$.

The latter parameters play only a role when the question is raised of whether the trajectories approach the steady state unidirectionally or cyclically. Since the elasticity $\eta_{\nu,\lambda}$ only appears in the formula for V_λ, one can observe that the discriminant in the eigenvalue equation, i.e. $(\text{tr } Q)^2\text{-}4\det Q$, will be negative for sufficiently small $|\eta_{\nu,\lambda}|$, compared to $\eta_{\nu,r}$. Only in this case motions will be cyclical. Otherwise the steady state is directly approached.

The computational results of either cyclical or unidirectional convergence are depicted in Figure 19.3 for the different constellations of the parameters $\eta_{\nu,\lambda}$ and $\eta_{\nu,r}$. Cyclical convergence appears only in a small subregion of the scenario-diagram, and is rather an exceptional phenomenon.

5 SOME CONCLUDING REMARKS

It is worthwhile to reiterate the main results obtained. From the numerical stability analysis of our basic dynamic macroeconomic growth model, with

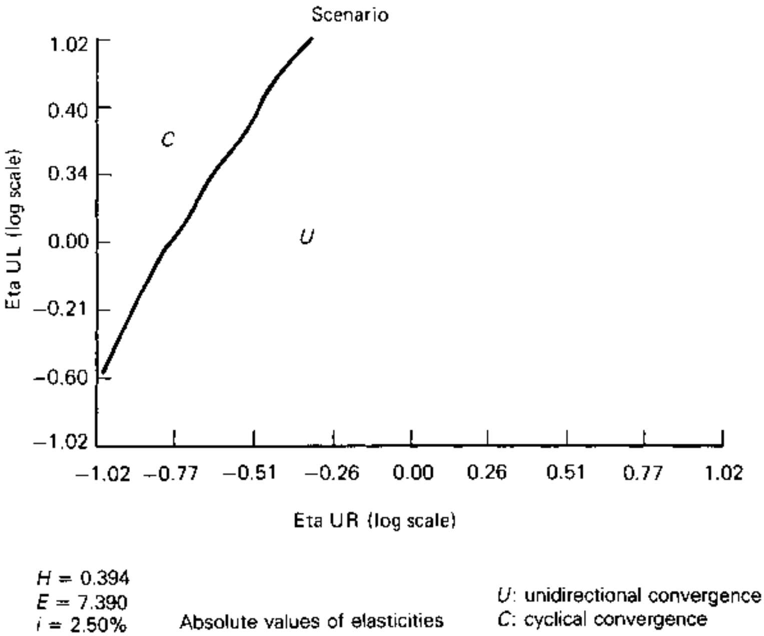


Figure 19.3 Scenarios for the modified finance equation

purely externally financed investments, we can conclude that its long-run equilibrium is locally asymptotically stable provided that the reaction patterns are not too extreme. Reactions in the behavioral functions were captured in our measures of elasticities. We showed that the convergence is unidirectional when the reaction of the state of confidence function $\nu(\cdot\ ,\ \cdot)$ to profit rate changes is medium-sized or strong, i.e., if $\eta_{\nu,\,r} \geq 1$. If the intensity of reaction is weaker cyclical behavior can emerge. The probability that this will occur rises with the increase of $|\eta_{\nu,\,\lambda}|$. In addition, for small values of $\eta_{\nu,\,\lambda}$ and $\eta_{\nu,\,r}$ and arbitrarily fixed values of $\eta_{b,\,r}$ we can find a reswitching phenomenon resulting from variations in $\eta_{b,\,\lambda}$.

The numerical stability analysis proposed above was then applied to an extended version of the basic model with a positive retention ratio of firms and debt financing as a residual, given an upper limit for equity finance expressed by a constant coefficient. Though we have introduced a more explicit finance constraint, expecting an enhanced instability of the conceptionally different economy, the basic stability properties remained unaltered. The constraint regarding equity finance, unexpectedly, brought out even stronger stability tendencies of our model. In most cases unidirectional convergence prevailed; cyclical convergence appearing only in a small region of our parameter space.

Two points are to be mentioned for further research. More explicit financial constraints can be explored in the context of our model. Maintaining a constraint for equity finance, and given a self-financing ratio for investment, banks may also set upper limits for the growth rates of loans, particularly if the economy departs from the steady state beyond a critical value. For example, this may concern acceptable debt asset ratios of firms. This way desired investment, expressed by our function $h(\cdot)$, is directly constrained. The dynamics of such an economy may alter substantially, which has to be one topic in subsequent works of the authors.

On the other hand, a most desirable extension of the model is the inclusion of some kind of accelerator principle in the investment function $h(\cdot)$. As a working hypothesis we may conjecture that a reconsideration of (expected) capacity utilization as an argument in the investment decision of firms, along with other modifications concerning the growth trend in our dynamic macro model, will generate stronger destabilizing tendencies. Clarification and modeling details, however, and all the more an extensive study of the local and global dynamics, has to be left to future research.

Notes

1. For Kalecki, it follows, that even for a constant marginal efficiency of capital the marginal risk rises with the size of investment and the size of the firm. Through optimizing behavior of firms, Kalecki then demonstrates, the marginal risk is equated to the difference of the prospective profit rate and the interest rate, determining thus the optimal amount of investment.
2. The financing structure of firms in the extended version of our model is reminiscent of Kaldor (1966). Kaldor, however, only considers internal finance and equity finance. Our generalized version of section 4 includes internal, equity and debt financing.
3. In econometric studies usually an investment function of the type $I/K_{-1} = a + \Sigma m_s q_{-s} + u$ is tested, where q is the ratio of market value to replacement cost of capital, m the weights for the lags and u an error term (cf. Clark, 1979). Though other forms of investment functions such as the accelerator principle or the accelerator-cash flow approach are demonstrated to be superior in some studies (cf. Clark, 1979; Kopcke, 1985) we still want to explore the dynamics resulting from our proposed investment decision rules. Moreover, the q or the securities-value model could be significantly improved by using the 'marginal ratio that would be really appropriate for decisions about (marginal) additions to capital stock' (Clark, 1979, p. 85). Empirical studies, on this problem, however, are still rare.
4. The details were developed in Franke and Semmler (1988).
5. The flow of savings, $s_h r^g PK$, increases the stocks of D^o, D^i, and $P_e E$. In what proportions is captured by the functions d^o and e introduced above (since d^o has been eliminated in the course of deriving the LM-equation, its role will be only implicit).
6. This leaves aside the (possibly) destabilizing effects of debt deflation. They should be considered at a later stage.
7. The data for budget deficit, sales-capital stock ratio, the growth rate and the

long term debt-asset ratio were obtained from the 'Economic Report of the President' (1984), whereas the saving fraction out of profit flows had to be computed indirectly by means of input-output tables of 1977 as indicated above. Taxes were taken from NIPA-data.

8. Considering the expressions V_λ and V_ϱ in eq. (8), observe in particular that the sign of the determinant of the Jacobian Q is not affected by the scale of v_λ and v_r.
9. It may be interesting to note that with a slightly higher long-run equilibrium rate of interest, $i^*=3$ per cent, U_ϱ could no longer fall short of zero.
10. This proposition can be proved to hold as follows: det $Q=U_\lambda V_\varrho - U_\varrho V_\lambda < 0 \Leftrightarrow - U_\varrho V_\lambda < - U_\lambda V_\varrho \Leftrightarrow v_\lambda - (iA_3/A_F)\, v_r < (-U_\lambda V_\varrho)/(-U_\varrho)$ (since $U_\varrho < 0$, for the other expressions, cf. (8)).
    Now write $V_\varrho=-mv_r$ (m is a positive number). Then the last inequality is equivalent to: $v_\lambda < [(mU_\lambda)/(-U_\varrho) + iA_3/A_F]v_r = :nv_r$. With $v_\lambda = \eta_{v,\lambda} \cdot r/\lambda$, $v_r=\eta_{v,r}$ and $C:=\lambda n/r$ we can conclude that det $Q<0$ is equivalent to $\eta_{v,\lambda} < \eta_{v,r}$. n is positive if $U_\lambda=0$, and n falls if $\eta_{b,\lambda}$ and therefore U_λ falls. Since iA_3/A_F as well as $-U_\varrho$ are very small ($iA_3/A_F = 0.014$ and $U_\varrho = -0.031$) this will happen easily.
11. Note, however, that despite the linearity in the specification of our functions $b(\cdot\,,\cdot)$ and $v(\cdot\,,\cdot)$ the system as a whole is non-linear, because of the non-linearities in the IS-LM equations.
12. There are of course other versions of financing regimes possible. One might, for example, assume that in a wider distance from the steady state investment expenditures are constrained: if firms (have to) maintain the equity financing policy and banks set an upper limit to the growth rate of loans. Such a possibility should be reconsidered at a later stage of research when, in other variations of our modeling approach, more distinct destabilizing tendencies will have been identified.
13. Empirically, for the year 1977, the fraction of self-financing in investment is roughly .6 (cf. Economic Report of the President, 1988, p. 354). Our theoretically computed retention ratio s_f above is 0.178 whereas the actual retention ratio for 1977 is roughly 0.6. The discrepancy seems to result from two effects. First the nominal growth rate for 1977 was 12 per cent (which includes an inflation rate of 7 per cent for the year 1977). The empirical financing ratios are computed in nominal terms. A nominal growth rate of 12 per cent gives, according to our formula above, a retention ratio of 0.45. Second, the empirical computations include in total investment the investment in financial assets (in 1977 about 25 per cent of total investment), whereas in our model investment in financial assets is not considered.

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20 A Working Model of Slump and Recovery from Disturbances to Capital-goods Demand in a Closed Non-monetary Economy

E. S. Phelps*

This paper is one in a series directed toward the construction, with certain modern building blocks, of a non-monetary theory of employment fluctuation in market economies. The closed-economy model here parallels the open-economy model in Phelps (1988). The objective is a plausible theory that helps to account for some or all of the long swings in economic activity over recent decades. In fact, this non-monetary theory has grown out of one of the models used by Fitoussi and Phelps (1988) to account for the 1980s depression over much of the world, a slump that demand-driven models are hard-pressed to explain.

In the past few years a quite different 'real' theory has been developed, principally at Minnesota, Carnegie, and Rochester, that is essentially classical (or neo-Classical or neo-neo-Classical) in character. In that theory, the probability distributions are known to the agents (stochastic equilibrium), there are no informational bars to efficient allocations and the disturbances are accurately perceived when they occur (costless information).

My recent work aims for a modern rather than classical model in which, for one thing, employment contracts must be compatible with incentives under asymmetric information. A consequent characteristic of this line of models is the phenomenon generally termed real wage rigidity, or real wage sluggishness, which sets them apart from those in the classical mold. For reasons of convenience, these models stick with the classical postulates of perfect foresight and centralized auction markets.

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Fittingly enough on this occasion honoring the memory of Nicholas Kaldor, the particular model developed here is identical in certain respects to the one recurringly discussed in Kaldor's famous 1937 exposition of capital theory, notably the feature that only labour produces capital. A sequel to the present paper attempts the obvious extension (Phelps, 1990).

1 GENERAL FEATURES

At every firm, output of the consumer good is subject to a constant-returns-to-scale production function, ϕ, of the neoclassical type. With all firms identical, aggregate consumption-good output, Z_C, is given by

$$Z_c = \phi(K,N_C) \tag{1}$$

where N_C is the number of workers producing the consumer good and K is the whole of the capital stock as we suppose for maximum simplicity that only labor is used to produce the investment good. Inada's conditions, $\phi_N(K,0) = \infty$ and $\phi_N(K,N) > 0$, are often convenient. Letting N_I denote the number of workers producing the capital good and Z_I their output, we postulate

$$Z_I = \gamma N_I, \gamma > 0. \tag{2}$$

Supply of these goods is a function of the real price, p, of the capital good, and the real wage, v. As every firm can produce both goods, employees are everywhere allocated in such a way as to satisfy the first-order conditions for a maximum of consolidated gross profit, $\phi(K,N-N_I) + p\gamma N_I - vN$, where N is the total number of employees activated, subject to the inequality constraint that N cannot exceed the number supplied, $L(v,r)$, where r is the real interest rate, and to the non-negativity constraint on N_I:

	If $N_I > 0$	If $N_I = 0$	
If $N < L$	inadmissible	$\phi_N = v > p\gamma$	
If $N = L$	$\phi_N = p\gamma \geqslant v$	$\phi_N \geqslant \max (v,p\gamma)$	(3)

In short, the opportunity cost of N_C is v or $p\gamma$, whichever is greater, and ϕ_N is driven down to that cost unless both constraints become binding, leaving N_C with no slack for increase.

For simplicity I shall usually take $L(v,r)$ to be a constant, L. Further, I shall impose the welcome restriction that the initial wage is high enough in

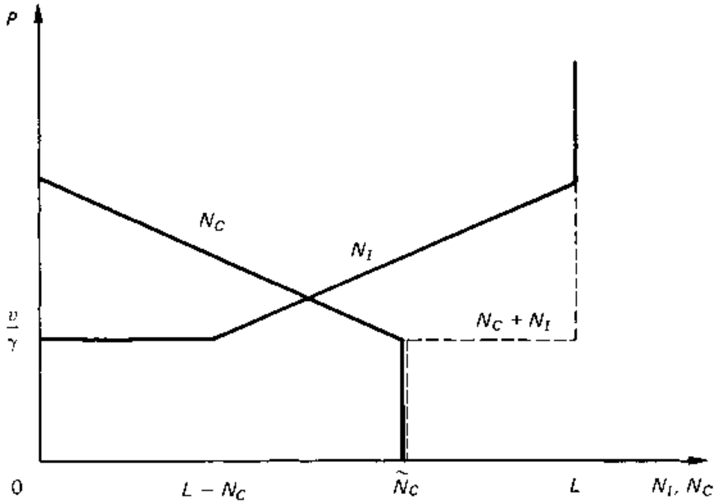

Figure 20.1 Supply curves in terms of labor input

relation to the capital stock that the N_C level, say $\tilde{N}_C$, equating $\phi_N(\cdot)$ to v is less than $L(v,r)$. Without that restriction an initial shock driving N_I to zero might still leave a positive excess total demand for labor. At least at first, then, the lower right-hand possibility does not apply, so that $\phi_N = \max(v, p\gamma)$. Then N_C is given by the inverse $\phi_N^{-1}(K, \max(v, p\gamma))$.

For all (K,L,v) satisfying the restriction, the two 'supply curves', measured in number of jobs supplied rather than output, are those shown in Figure 20.1. The total number of jobs supplied is given by the dashed curve. We suppose that Z_C is not demand-constrained, that a market-clearing equilibrium occurs making N_C equal to $\tilde{N}_C$. Hence the N_I curve's kink at $L - \tilde{N}_C$ rather than at some larger excess-labor level. In equation form, the supply of the capital good is given by

$$Z_I = \begin{cases} 0 & \text{if } p\gamma < v \\ \gamma[L(v, r) - \phi_N^{-1}(K, v)] & \text{if } p\gamma = v \\ \gamma[L(v, r) - \phi_N^{-1}(K, p\gamma)] & \text{if } p\gamma > v; \end{cases} \tag{4}$$

and total active employment is given by

$$N_I + N_c = \begin{cases} \phi_N^{-1}(K, v) & \text{if } p\gamma < v \\ L(v, r) & \text{if } p\gamma = v \\ L(v, r) & \text{if } p\gamma > v. \end{cases} \tag{5}$$

We shall see that when the above restriction holds initially it may continue to hold along the post-shock path found below in which case we need never replace (4) and (5) with their (more cumbersome) unrestricted versions.

The following dynamic equations can now be understood, taking as given for the moment the path of the real interest rate. The dynamics of the capital stock come from exponential depreciation at rate $\delta > 0$ and the supply of Z_I in (4).

$$\dot{K} = \begin{cases} -\delta K & \text{if } p\gamma < \text{v} \\ -\delta K + \gamma[L(\text{v}, r) - \phi_N^{-1}(K, p\gamma)] & \text{if } p\gamma \geqslant \text{v}. \end{cases} \tag{6}$$

We sometimes write $\phi_N^{-1}(\cdot)$ as $\ell(\phi_N)K$ where $\ell(\cdot)$ is the N_c/K ratio, $\ell'(\cdot) < 0$.

The dynamics of the real price of capital come from the arbitrage condition,

$$\dot{p} = (r + \delta)p - R^c(\max(\text{v}, p\gamma)), \qquad R^{c'}(\phi_N) < 0, \tag{7}$$

where R^c, the real rental on capital, can be seen to equal ϕ_K when $\phi_N =$ max (v, pv), and therefore bears the familiar factor-price-frontier relation to ϕ_N and hence to max (v, $p\gamma$). In identifying the actual price change with the expected change we are taking the economy to be on an equilibrium trajectory.

The most expedient dynamics for the real wage turns out to be a variant of Samuelson's gradualist version of supply and demand. If N_I is less than the partial excess supply $L(\text{v}, r) - \phi_N^{-1}(K, \text{v})$, the average wage will be falling. If N_I is greater, so that in fact $\phi_N = p\gamma > \text{v}$, the wage will be rising. And if N_I is equal, the wage will be unchanging. Using (2) and (4), and the constant $\alpha > 0$,

$$\frac{\dot{\text{v}}}{\text{v}} = \alpha \begin{bmatrix} 0 & - [L(\text{v}, r) - \phi_N^{-1}(K, \text{v})] & \text{if } p\gamma < \text{v} \\ L(\text{v}, r) - \phi_N^{-1}(K, \text{v}) & - [L(\text{v}, r) - \phi_N^{-1}(K, \text{v})] & \text{if } p\gamma = \text{v} \\ L(\text{v}, r) - \phi_N^{-1}(K, p\gamma) & - [L(\text{v}, r) - \phi_N^{-1}(K, \text{v})] & \text{if } p\gamma > \text{v}. \end{bmatrix} \tag{8}$$

Simplifying, we have

$$\frac{\dot{\text{v}}}{\text{v}} = \alpha \left[\phi_N^{-1}(K, \text{v}) - \begin{cases} L(\text{v}, r) & \text{if } p\gamma < \text{v} \\ \phi_N^{-1}(K, p\gamma) & \text{if } p\gamma \geqslant \text{v}. \end{cases} \right] \tag{8$'$}$$

The first term is N_c 'demand' and the second term is N_c 'slack supply' obtained by netting N_I from $L(\text{v}, r)$. We shall suppose that the *excess* demand $\phi_N^{-1}(K, \text{v}) - L(\text{v}, r)$ is decreasing in v, like $\phi_N^{-1}(K, \text{v})$.

Looking back, one finds in equations (1), (2), (4) through (7), and (8′) a dynamic system of seven equations in the timepaths of seven variables. These are Z_c, Z_I, N_c, N_I, p, v, and K if we take r as given. Further, the equations (6), (7) and (8′) constitute a self-contained dynamic system in p, v, and K, given r.

It follows from (6), (7) and (8′) that in any stationary state, if such exits,

$$\bar{v} = \bar{p}\gamma \tag{$\bar{8}$}$$

$$\bar{p} = \frac{R^c(\bar{v})}{\bar{r} + \delta} \tag{$\bar{7}$}$$

$$\bar{K} = [\delta + \gamma\ell(\bar{v})]^{-1}\,\gamma L(\bar{v}, \bar{r}), \ell(\bar{v}) \equiv \bar{K}^{-1}\phi_N^{-1}(\bar{K}, v), \tag{$\bar{6}$}$$

where, again, $\ell(\phi_N)$ is the N_C/K ratio, $\ell'(\cdot) < 0$. Since R^c makes the righthand side of ($\bar{7}$) decreasing in $\bar{v}$ while ($\bar{8}$) makes the lefthand side of ($\bar{7}$) increasing in the same variable, $\bar{v}$ is uniquely determined, given $\bar{r}$, and hence the corresponding $\bar{p}$ and $\bar{K}$ are also unique.

2 A POINT OF REFERENCE: THE SMALL OPEN ECONOMY

We take the consumer good of our open economy to be tradable in a perfect world good(s) market. As the capital accumulation equation can be seen to imply, the domestically produced investment good is nontradable. The model could be interpreted as having some imported capital goods as well.

To close the model we suppose that the expected real rate of interest is given by the *ex ante* world real interest rate, and the latter is a constant, r^*, over the indefinite future.

$$r = r^* \equiv \text{constant} > 0.$$

With r thus a parameter equations (6)–(8′) form a complete dynamic system.

We study here the adjustment to a world interest shock in the form of an abrupt upward shift of the parameter r^* when the economy was initially at rest. Figure 20.2 is the key phase diagram. There the ray labeled $v = p\gamma$ is a locus of points at which the excess supply of labor is zero, hence $\dot{v} = 0$; to the right and below, $N_I = 0$ so, unless our appealing restriction that $\phi_N^{-1}(K, v)$ should cease to hold, there is excess supply, hence $\dot{v} < 0$; to the left and above we would have excess demand and therefore $\dot{v} > 0$. The curve labeled $p = R^c\,(\max\,(v,\,p\gamma))(r^* + \delta)^{-1}$, which gives p as a decreasing function of v where $v = p\gamma$ and is flat elsewhere, is the locus of points at

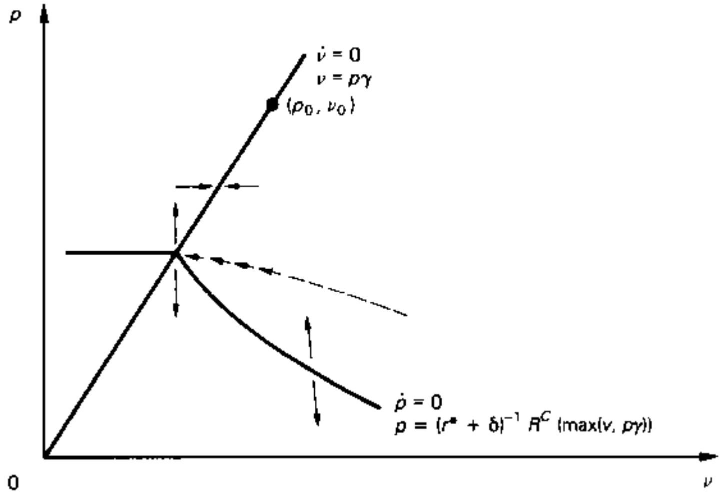

Figure 20.2 Phase diagram for the small open economy

which $\dot{p} = 0$; above the curve, $\dot{p} > 0$, and below, $\dot{p} < 0$. It follows that p and v must take the uniquely determined saddlepath given by the broken curve. The intersection of these curves corresponding to the new r^* gives the new $\bar{p}$ and $\bar{v}$.

Evidently the pre-shock state was at (p_0, v_0) lying on the ray somewhere above the new $(\bar{p}, \bar{v})$ since an increase of r^* lowers the $\dot{p} = 0$ locus and so decreases $\bar{p}$ and $\bar{v}$. At the moment of the interest shock, the saddlepath, which must have passed through (p_0, v_0) prior to the shock, is also lowered to the position shown by the dashed line. The unique solution for the trajectory is a drop of p from p_0 onto the saddlepath, whereupon p recovers monotonically to the reduced $\bar{p}$ and v falls steadily to $\bar{v}$, reaching this point in finite time and thus marking the end of phase 1. Throughout this phase K is steadily falling as the drop of p below $\gamma^{-1}v$ shuts down the capital-goods industry; the shrinkage of the capital stock, far from threatening to revoke the restriction $L(v, r) > \phi_N^{-1}(K, v)$ which held initially, only aggravates the excess labor supply, namely the excess of $L(v, r)$ over $\phi_N^{-1}(K, v)$. On the other hand, this slack is decreased by the decline of the wage, but before this N_C excess supply is closed, I assume, v reaches $\bar{p}\gamma$, which exceeds the level needed to equate $\phi_N^{-1}(K, v)$ single handedly to $L(v, r)$; this means that the above 'restriction' is never violated in this phase.

At the start of the second phase, v and $p\gamma$ having simultaneously reached the level $\bar{p}\gamma$, the capital-good industry springs back into operation. N_I jumps from zero to take up the whole slack left by the consumer-good industry, $L(v, r) - \phi_N^{-1}(K, v)$, and thus to extinguish the excess supply prevailing in phase 1. Hence v is no longer falling. Nor does v begin to rise:

Since v does not fall further, $R^c(\mathrm{v})(r + \delta)^{-1}$ does not rise more, remaining at $\bar{p}$, so the only non-explosive course for p satisfying (7) is to remain at $\bar{p}$ in view of the saddlepath implied by $\partial[p - R^c(p\gamma)(r + \delta)^{-1}]/\partial p > 0$ and indicated by the diverging vertical arrows around the $\dot{p} = 0$ locus; since p does not rise above $\bar{p}$, causing $p\gamma > \mathrm{v}$, no excess demand arises to pull v above $\bar{\mathrm{v}}$. Thus $(\bar{p}, \bar{\mathrm{v}})$ is an absorbing state.

With $p\gamma = \mathrm{v} = \bar{\mathrm{v}}$, equation (6) implies that

$$\dot{K} = \gamma L(\bar{\mathrm{v}}, r) - [\gamma \ell(\bar{\mathrm{v}}) + \delta]K$$

Hence K converges to $\bar{K}$. Note that since $\ell(\mathrm{v})K - L(\mathrm{v}, r)$ is taken to be decreasing in v, at least for all relevant K and r, the decrease of $\bar{\mathrm{v}}$ resulting from the interest shock tends to generate of decline in K, although $L_r > 0$ tends to work in the other direction. Hence, though K arrives pre-shrunk by phase 2, it may shrink more.

3 A CLOSED ECONOMY

In the closed economy the output of the consumer-good producing branch is entirely for domestic consumption and, on the market-clearing premise, is equal to consumer demand. Hence, letting C denote aggregate consumption,

$$\phi(K, N_c) = C. \tag{9}$$

As for consumer demand, the Ramsey model of saving by the single agent is inapplicable here. A mechanical consumption function (in which p or the long-term interest rate figures in some way) would raise questions about the robustness of the ensuing results. Instead I adopt the model by Blanchard (1985) so as to exploit again the convenient specification of exponential mortality already found expedient in portraying the dynamics of the average wage. In this model consumer demand is proportional to the sum of human wealth, H, and nonhuman wealth, W, with coefficient equal to the sum of the rate of time preference, ϱ, and the instantaneous force (or rate) of mortality, m. That is,

$$C = (m + \varrho)(H + W)$$

It follows from the formula for aggregate wealth that its growth is a contest between the individual thrift induced by the interest rate and the positive net loss of nonhuman wealth resulting from the replacement of the wealthy old with the wealthless young:

$$d/dt(H + W) = (r - \varrho)(H + W) - mW$$

Differentiating the former equation with respect to time and using the latter equation then gives Blanchard's equation:

$$\dot{C} = (r - \varrho)C - \mu W, \qquad \mu \equiv m(m + \varrho). \tag{10}$$

In our model, as in Blanchard's setting,

$$W = pK + D(t) \tag{11}$$

where D denotes the stock of public debt, all short-term and an exogenous function of time.

Equations (9), (10) and (11) have added three equations to the seven-equation system of Section 1, and have added the three variables C, W and r to be determined.

It turns out to be possible to solve for the short-term, or instantaneous, rate of interest, r, as a function of the real price, p, the real wage, v, and the capital stock, K. In what follows we will hold constant the stock of debt, D, as well as the other parameters.

Recall that the supply of consumer-good output, given our restriction, is a decreasing function of the 'shadow wage', which was seen to be max (v, $p\gamma$), and an increasing function of the capital stock. More precisely, we may write

$$Z_c = o(\max(\mathrm{v}, p\gamma))K \tag{12}$$

where $o(\cdot)$ is the output-capital ratio in the consumer-good producing branch, with derivative $o'(\cdot) < 0$. Upon substituting the supply of consumption thus expressed for the consumption demand variable appearing in the differential equation (10), and writing ϕ_N in substitution for max(v, $p\gamma$), we obtain

$$Ko'(\phi_N)\dot{\phi}_N + o(\phi_N)\dot{K} = (r - \varrho)o(\phi_N)K - \mu[pK + D(t)]$$

or, upon dividing by $Ko(\cdot)$,

$$\frac{o'(\phi_N)\phi_N}{o(\phi_N)}\frac{\dot{\phi}_N}{\phi_N} + \frac{\dot{K}}{K} + \mu\frac{p + (D(t)/K)}{o(\phi_N)} = r - \varrho \tag{13}$$

Substituting the above formula for r in the system of differential equations in p, v, and K gives a reduced form of our three-equation system with which to analyze the consequences of disturbances to the real wage, the capital stock, and various shocks.

Steady-state Analysis

It follows from (13), above, that the steady-state interest rate, $\bar{r}$, must satisfy

$$\bar{r} - \varrho = \frac{\mu(\bar{p}\bar{K} + D)}{o(\bar{v})\bar{K}}$$
$$= \frac{\mu\bar{v}\gamma^{-1}}{o(\bar{v})} + \frac{\mu D}{o(\bar{v})K} \tag{$\overline{13}$}$$

where the right-hand side is $\mu\bar{W}/\bar{C}$. Provided that we have a meaningful steady state, hence positive $\bar{W}$ and $\bar{C}$, it follows that $\bar{r} > \varrho$ ($\geqslant 0$). In the limiting case, which is not itself admissible, where $\mu \rightarrow 0$, we have $\bar{r} \rightarrow \varrho$, the case analysed by Ramsey. The next paragraphs are directed to the existence and uniqueness of the steady state with positive $\bar{W}$ and $\bar{C}$.

Notice first that ($\bar{7}$), alongside ($\bar{8}$) to determine $\bar{p}$, gives one relationship between $\bar{r}$ and $\bar{v}$. This is

$$\bar{r} + \delta = R(\bar{v})/(\bar{v}/\gamma) \tag{14}$$

Here $\bar{r}$ is decreasing in $\bar{v}$ for two reasons. When $\bar{v}$ is increased, the righthand side of (14) decreases because of the factor-price-frontier relationship, $R'(v) < 0$, and because the rather special model here specifies that $\bar{p}$ increases with $\bar{v}$. The derivative of the relationship given by ($\bar{7}$) and ($\bar{8}$) is

$$d\bar{r}/d\bar{v} = v^{-1}[\gamma R'(\bar{v}) - (\bar{r} + \delta)] < 0 \tag{14$'$}$$

The relationship in (14) is depicted by the negatively sloped curve labelled *FF* in Figure 20.3.

Equation ($\overline{13}$) alongside ($\bar{6}$) and ($\bar{8}$) to determine $\bar{K}$ and $\bar{p}$ give another relationship between $\bar{r}$ and $\bar{v}$. This is

$$\bar{r} - \varrho = \frac{\mu\bar{v}\gamma^{-1}}{o(\bar{v})} + \frac{\mu D}{o(\bar{v})K(\bar{v})} \tag{15}$$

where the function $\bar{K}(\bar{v})$ can be derived from (6) or, as we have done, from the equivalent steady-state relationship

$$0 = R(\bar{v})K + \bar{v}L - o(\bar{v})\bar{K} - \bar{p}\delta\bar{K} \tag{$\bar{6}$a}$$

This equation and $\bar{p} = \bar{v}\gamma^{-1}$ from ($\bar{8}$) make $\bar{K}$ increasing in $\bar{v}$:

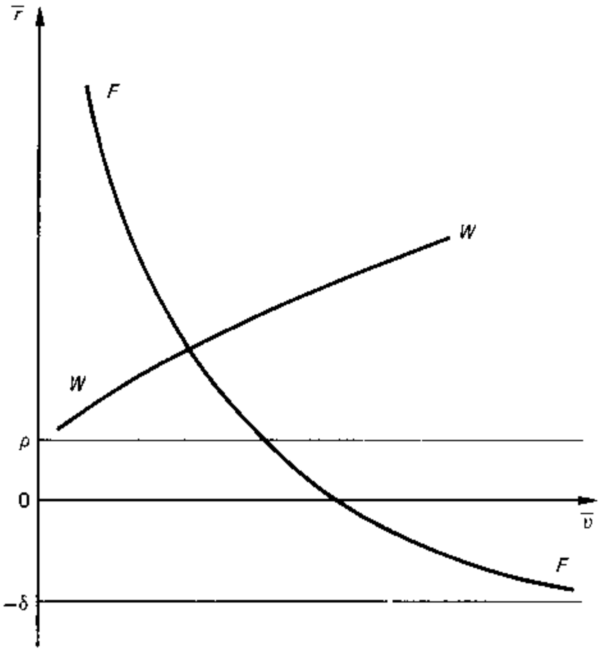

Figure 20.3 Determination of the steady state

$$\bar{K}'(\bar{v}) = \bar{K}_v + \bar{K}_p\bar{p}'(\bar{v}) = \frac{-\bar{N}_c + L - o'(\bar{v})\bar{K} - \bar{\delta}K\gamma^{-1}}{-[R\bar{v}) - o(\bar{v}) - \bar{p}\delta]}$$

$$= \frac{o'(\bar{v})\bar{K}}{\bar{R} - \bar{o} - \bar{p}\delta} > 0.$$

The derivative of the relationship deriving from $(\overline{13})$, $(\bar{6}\text{a})$, and $(\bar{8})$, and summarized by (15), is

$$d\bar{r}/d\bar{v} = \mu\delta^{-1}\, o(\bar{v}^{-1}) - o'\,(\bar{v})\mu\bar{p}o(\bar{v})^{-2} - \frac{(\bar{R} - \bar{p}\delta)o'(v)\bar{K}}{R(\bar{v}) - o(\bar{v}) - \bar{p}\delta} \cdot \frac{\mu D}{(o(\bar{v})K)^2} \quad (15')$$

This result shows that the first term in (15) is unambiguously increasing in $\bar{v}$, as the numerator is increasing and the denominator decreasing. But it also shows that the second term in (15) is decreasing in v – the last term in (15′) when taken with the minus sign is negative – as long as $\bar{v}$ is not so large as to drive $R(\bar{v}) - \delta\bar{v}\gamma^{-1}(= \bar{p}\bar{r})$ negative, which would be inconsistent with a meaningful steady state, as we saw. Hence $\bar{r}$ in (15) will be everywhere increasing in $\bar{v}$ provided that the public debt, D, does not exceed some critical (positive) level. The reason $\bar{r}$ in (15) may over some range be decreasing in $\bar{v}$ for sufficiently large D is that greater v increases consumption supply, $O(\bar{v})\bar{K}(\bar{v})$; for large D, the ratio of debt to consumption supply might be decreased more than the ratio of non-debt wealth to consumption is increased. It can be calculated from ($\bar{6}$a) that

$$d(o(\bar{v})\bar{K}(\bar{v}))/d\bar{v} = (\bar{R} - \bar{p}\delta)o'(\bar{v})\bar{K}(\bar{R} - \bar{o} - \bar{p}\delta)^{-1} > 0$$
$$\text{if } R(\bar{v}) > \bar{p}(\bar{v})\delta.$$

The relationship in (15) is represented by the curve labeled *WW* in Figure 20.3. As it is drawn there it illustrates the case in which $\bar{r}$ is everywhere increasing in $\bar{v}$). If a nomenclature should be useful, we might say that (15) and its associated *WW* curve describe the required steady-state interest rate, while (14) and the corresponding *FF* curve give the available interest rate.

The analysis in this paper will be confined to the case in which the debt, if positive, is not so large as to make *WW* slope downward. Then $\bar{v}$ and $\bar{r}$ are uniquely determined, as in Figure 20.3. To show that a steady state exists it suffices to show that the negatively sloped *FF* starts out at $v = 0$ from an intercept above that from which the positively sloped *WW* starts. Such a gap follows from the fact that as $\bar{v} \to 0$, $R(\bar{v})/\bar{v} \to \infty$ while $(v\delta^{-1} + D)/o(\bar{v}) \to 0$ under the Inada conditions;[1] hence *FF* is asymptotic to the vertical axis while the intercept of *WW* is ϱ. (The reader will see that a 'large' D causes no difficulty for existence as long as *WW* starts out positively sloped and intersects *FF* before *WW* has sloped downward and fallen the line $r = \varrho$. But in such cases there is a risk of more than one intersection, hence multiple steady states, which would be uncongenial to the shock theory of fluctuation being pursued here.)

It is natural at this point to use ($\bar{13}$) to substitute for $\bar{r}$ in ($\bar{7}$):

$$\left[\frac{\mu(\bar{p}\bar{K} + D)}{o(\bar{v})\bar{K}} + \varrho + \delta\right] \bar{p} = R(\bar{v}) \qquad (\bar{7}\text{C})$$

Equations ($\bar{6}$a), ($\bar{7}$C) and ($\bar{8}$) comprise a system determining K, $\bar{v}$, and $\bar{p}$ in the closed-economy model.

Let us now calculate the disturbances to the steady state caused by a shift in labor supply, L, or consumption demand, as represented by a change in ϱ, or fiscal policy, as represented by a change in D. The resulting system of total differentials is

$$(\bar{R} - \bar{o} - \bar{p}\delta) \quad d\bar{K} + (R'K + L - o'K)d\bar{v} + (-\delta K)d\bar{p} = -\bar{v}dL \qquad (\bar{6}\text{a}')$$
$$0d\bar{K} + \qquad 1d\bar{v} + (-\delta)d\bar{p} = 0 \qquad (\bar{8})$$

$$\frac{-\mu D\bar{p}}{\bar{K}\bar{o}\bar{K}}d\bar{K} + \left(\frac{-o'\mu\bar{p}^2 - o'\ \mu D\bar{p}}{\bar{o}_2\bar{K}} - R'\right)d\bar{v} + \left(\mu o^{-1}\,\bar{p} + \frac{\dot{R}}{p}\right)\,d\bar{p}$$
$$= -\,\bar{p}d\varrho - \mu\bar{p}(\bar{o}\dot{K})^{-1}dD \qquad (7a')$$

The assumption made above that *WW* is everywhere upward sloping together with the negative slope of *FF* is sufficient to make the determinant negative:

$$\triangle = (\bar{R} - \bar{o} - \bar{p}\delta)\bar{p}\delta\ \{\mu\gamma^{-1}\bar{o}^{-1} - o'\ \mu\bar{p}\bar{o}^{-2}\frac{(\bar{R} - \bar{p}\delta)o'\bar{K}}{\bar{R} - \bar{o} - \bar{p}\delta}\cdot\frac{\mu D}{(o\bar{K})^2}$$
$$-\ (\bar{p}\gamma)^{-1}[\gamma R' - (\bar{r} + \delta)]\} < 0 \qquad (16)$$

(Clearly it is necessary and sufficient that *FF* intersect *WW* from above, hence that *WW*, if locally downward sloping, be less steep than *FF*.)

In these terms the comparative-statics results are:

$$d\bar{K} = \frac{-1}{\triangle}\{\nu[\mu\bar{o}^{-1}\bar{p} + \bar{r} + \delta + \gamma\,(\frac{-o'\ \mu\bar{p}^2\,\bar{K} - o'\ \mu D\bar{p}}{\bar{o}\ \bar{o}\ \bar{K}} - R')]dL$$
$$+\ o'K\gamma[\bar{p}d\varrho + \bar{p}\mu(\bar{o}\bar{K})^{-1}dD]\} \qquad (17)$$

$$d\bar{v} = \frac{-1}{\triangle}\ \{\nu[\gamma\mu D\bar{p}/(\bar{K}\bar{o}\bar{K})]dL + \gamma(\bar{R} - \bar{o} - \bar{p}\delta)$$
$$[\bar{p}d\varrho + \bar{p}\mu(\bar{o}\bar{K})^{-1}dD]\} \qquad (18)$$

$$dp = \frac{-1}{\triangle}\ \{\nu[\mu D\bar{p}/(\bar{K}\bar{o}\bar{K})]dL + (\bar{R} - \bar{o} - \bar{p}\delta)$$
$$[\bar{p}d\varrho + \bar{p}\mu(\bar{o}\bar{K})^{-1}dD]\} \qquad (19)$$

An increase of time preference, ϱ, or the public debt, D, reduces $\bar{v}$ and hence increases $\bar{r}$; $\bar{K}$ and $\bar{p}$ fall with $\bar{v}$. These effects are clearly shown by Figure 20.3 where *WW* would be shifted up, causing the intersection to move upward and leftward along *FF*. An increase of effort, L, increases the supply of wealth proportionately less than it increases the supply of consumption, $o(\bar{v})\bar{K}(\bar{v}; L)$, if there is a positive debt. Hence, although $\bar{K}$ is increased, $\bar{r}$ falls as *WW* shifts down; accordingly, $\bar{v}$ and $\bar{p}$ are increased, as (18) and (19) show.

Stability Analysis: Recovery from Capital-goods Slumps

This section studies the dynamics of the economy when it is found that the parameters ϱ, D, L, and so forth are such as to cause the real price of the capital good, p, to be below the constant cost of production, v/γ, so that, as we look in on the economy, capital-goods production is nil and the economy is in a slump. By analysis of the kinds of 'reverse shocks' that could revive the price of capital we can determine the possible sources of a capital-goods slump. (The prime candidates include the disturbances which operate to reduce $\bar{v}$, since the only way that v can fall is through a slump, and the only means to a slump, outside of a rise of v or a fall of γ, is a fall of p.)

The First Stage

In this stage, or phase, in which the economy first finds itself, where $y\gamma < v$, we have, by (6), (7), (8′), and (13),

$$\begin{aligned} \dot{K} &= -\delta K \\ \dot{v} &= vV(v, K) \equiv v\alpha[\ell(v)K - L] \qquad (20) \\ \dot{p} &= [\frac{\mu p}{o(v)} + \frac{\mu D}{o(v)K} + \frac{o'(v)v}{o(v)}V(v, K) - \delta + \varrho + \delta]\, p - R(v) \end{aligned}$$

Hence neither p nor v affects $\dot{K}$ and $\dot{v}$ is unaffected by p. Consequently the corresponding matrix of partial derivatives has zeros above the diagonal:

$$\begin{bmatrix} \partial\dot{K}/\partial K & \partial\dot{K}/\partial v & \partial\dot{K}/\partial p \\ \partial\dot{v}/\partial K & \partial\dot{v}/\partial v & \partial\dot{v}/\partial p \\ \partial\dot{p}/\partial K & \partial\dot{p}/\partial v & v\dot{p}/\partial p \end{bmatrix} = \begin{bmatrix} -\delta & 0 & 0 \\ vV_K & vV_v & 0 \\ (\frac{-\mu Dp}{KoK} + \frac{o'v}{o}V_{Kp}) & (\frac{-o'\mu pW/K}{o^2} + \frac{o'v}{o}V_{vp} - R') & (r + \delta + \frac{\mu p}{o}) \end{bmatrix} \qquad (21)$$

The algebraic signs of these derivatives are

$$\begin{bmatrix} - & 0 & 0 \\ + & - & 0 \\ - & + & + \end{bmatrix}$$

In the calculation of $\partial\dot{p}/\partial v$ the term $\varepsilon'(v)V$, where ε is the elasticity $o'v/o$, is taken to be negligible, which is at least close to being the case in the neighborhood of the steady state.

In the more standard dynamic systems where there is continuous differentiability, one would use a linearization of (20), giving rise to the matrix in (21), to obtain the roots $\lambda_1 = -\delta$, $\lambda_2 = vV_v$, $\lambda_3 = \bar{r} + \delta + (\mu\bar{p}/o(\bar{v}))$, of which the first two are negative and the last positive, and proceed to calculate the implied path taken by K, v and p. But $\dot{K}$ and $\dot{v}$ are not continuously differentiable, and there is the further need to stitch the path taken over the first stage to the evolution of the recovery once $\mathrm{v} = \gamma p$, at which point $\dot{\mathrm{v}}$ and $\dot{K}$ jump with the restarting of capital-goods production.

The approach taken here is to employ the method of undetermined coefficients to calculate the way in which p, v and K move over the first stage, in which $p\gamma < \mathrm{v}$. The price, p, is regarded as a derived function of the state variables, given the parameters.

$$p = u(K, \mathrm{v}; \varrho, D, L) \tag{22}$$

over the first stage. The first task, then, is to solve for the unknown 'coefficients', particularly the derivatives and u_K and u_v. These coefficients appear in

$$\dot{u} = u_K(K, \mathrm{v}; \varrho, D, L)\dot{K} + u_\mathrm{v}(K, \mathrm{v}; \varrho, D, L)\dot{\mathrm{v}} \tag{22'}$$

The procedure used here equates $\partial\dot{p}/\partial\mathrm{v} + (\partial\dot{p}/\partial p)u_\mathrm{v}$ to $\partial\dot{u}/\partial\mathrm{v}$, hence

$$\partial\dot{p}/\partial\mathrm{v} + (\partial\dot{p}/\partial p)u_\mathrm{v} = [\partial\dot{K}/\partial\mathrm{v} + (\partial\dot{K}/\partial p)u_\mathrm{v}]u_K + [\partial\dot{\mathrm{v}}/\partial\mathrm{v} + (\partial\dot{\mathrm{v}}/\partial p)u_\mathrm{v}]u_\mathrm{v}$$

and equates $\partial\dot{p}/\partial K + (\partial\dot{p}/\partial p)u_K$ to $\partial\dot{u}/\partial K$, giving

$$\partial\dot{p}/\partial K + (\partial\dot{p}/\partial p)u_K = [\partial\dot{K}/\partial K + (\partial\dot{K}/\partial p)u_K]\, u_K + [\partial\dot{\mathrm{v}}/\partial K + (\partial\dot{\mathrm{v}}/\partial p)u_K]u_\mathrm{v}$$

Using $\partial\dot{K}/\partial p = 0$ and $\dot{\partial}\mathrm{v}/\partial p = 0$, we find

$$u_K = \frac{(\partial\dot{p}/\partial K)(\partial\dot{\mathrm{v}}/\partial\mathrm{v} - \partial\dot{p}/\partial p) - (\partial\dot{p}/\partial\mathrm{v})(\partial\dot{\mathrm{v}}/\partial K)}{(-\partial\dot{K}/\partial K + \partial\dot{p}/\partial p)(-\partial\dot{\mathrm{v}}/\partial\mathrm{v} + \partial\dot{p}/\partial p)} \tag{23}$$

$$u_\mathrm{v} = \frac{(\partial\dot{p}/\partial\mathrm{v})(\partial\dot{K}/\partial K - \partial\dot{p}/\partial p)}{(-\partial\dot{K}/\partial K + \partial p/\partial\dot{p})(-\partial\dot{\mathrm{v}}/\partial\mathrm{v} + \partial p/\partial\dot{p})} < 0 \tag{24}$$

where u_v is made simpler by the fact that $\partial\dot{K}/\partial\mathrm{v} = 0$.

Similar procedure yields the impact effects

$$u_D = \frac{-\partial\dot{p}/\partial D}{\partial\dot{p}/\partial p} = \frac{-(\mu p/oK)}{r + \delta + \mu po^{-1}} < 0 \tag{25}$$

$$u_\varrho = \frac{-\partial\dot{p}/\partial p}{\partial\dot{p}/\partial p} = \frac{-p}{r + \delta + \mu po^{-1}} < 0 \tag{26}$$

$$u_L = \frac{-\partial\dot{p}/\partial L}{\partial\dot{p}/\partial p} = \frac{-(o'\nu/o)V_L(\nu, K; L)}{r + \delta + \mu p o^{-1}} < 0 \tag{27}$$

With regard to u_K, the numerator in (23) can be shown to simplify to the expression below:

$$\nu V_K o^{-1} \ (o'R - oR') + \frac{o' \ \mu D p \nu V_K}{ooK} - \frac{\mu D p}{KoK}[\nu V_\nu - (r + \delta + \frac{\mu p}{o} \ )]$$

$$= \nu\alpha\ell\{oR(\frac{o'}{o} - \frac{R'}{R}) + \frac{\mu D p}{Kok} \ [K(\ \frac{o'}{o} - \frac{\ell'}{\ell}(r + \delta + \frac{\mu p}{o}])\} > 0 \ ? \tag{28}$$

Although the first term could be of either sign – it is equal to zero in the Cobb–Douglas case, average and marginal product moving in equal proportion – the middle term is unambiguously positive, as labor responds more proportionately than output to a change of the wage, and the last term is positive, certainly in the neighborhood of the steady state. Since the denominator in (23) is unambiguously positive, there is consequently a strong presumption that u_K is positive when D is positive and large. The explanation for this surprising result is that increased K at given ν raises wealth proportionately less than it raises consumption-good supply, and according to (13) the result (at provisionally given p) is a fall of the interest rate. The other influences upon r and hence p all stem from their effects on $V(\nu, K)$, hence the rate at which consumption supply is growing as a result of the downward movement of the real wage. Increased K raises employment, thus slowing the decline of the wage and dampening the growth of consumption, which also operates in (13) to reduce the interest rate and thus raise the real price of the capital good.

Consider now a situation in which ϱ or D, say, has just increased in what had been steady-state conditions. Hence p has just dropped to a level below ν/γ and the capital-goods branch has just shut down. Consequently ν and K will be found to be decreasing. The question we come up against is what p will be doing.

It will simplify matters to reintroduce a restriction that was helpful in analyzing the open-economy case: the wage is never so low in relation to the capital stock that the consumer-good-producing branch singlehandedly brings about full utilization of the labor force, L. Then full recovery from the slump will occur only if the capital-goods branch revives; that is, a point is reached at which ν has fallen in relation to p such that the equality $\nu = p\gamma$ is restored, so that laid-off employees are all recalled to work. Stability, in the sense of a return to full employment – more precisely, an asymptotic approach to the full-employment steady state corresponding to the new parameters, ϱ, D, . . . – therefore depends upon a tendency for ν to fall in relation to p over the first stage, the stage in which $p\gamma < \nu$, equivalently a tendency for p/ν to recover.

The price-wage ratio in capital-goods production, p/ν, is ensured of recovering to the level γ^{-1} if u_K is not positive, contrary to our presumption. In this case, falling ν and K will, in view of (22′), be accompanied by rising p, as well as rising p/ν, since $u_\nu < 0$ and, by hypothesis, $u_K \leqslant 0$. But when $u_K > 0$, (22′) leaves it unclear that p will be rising, as the shrinkage of the capital stock exerts a downward pull, and even unclear that, if falling, p will be falling more slowly than ν so as to bring the recovery of p/ν to the break-even level, γ^{-1}. (This equation and the results for u_ν and u_K imply a necessary condition on D and the other parameters to obtain rising p/ν, of course, but it is not evident that it will hold except when $u_K \leqslant 0$.) However, (20) throws light on the conditions under which p/ν tends to recover:

$$\frac{\dot{p}}{p} - \frac{\dot{\nu}}{\nu} = \frac{\mu p}{o} + \frac{\mu D}{oK} + \frac{o'\nu}{o}(\alpha N - \alpha L) + \frac{\dot{K}}{K} + \varrho + \delta - p^{-1}R - (\alpha N - \alpha L)$$

$$= \frac{\mu p}{o} + \frac{\mu p}{oK} + \varrho - p^{1}R - \left(1 - \frac{o'\nu}{o}\right)(\alpha N - \alpha L) \qquad (29)$$

Before the shock to p or D, the right-hand side was equal to zero at $p = \bar{p}$, as the first two terms then gave $\bar{r} - \varrho$ and $p^{-1}R$ gave $\bar{r} + \delta$. When p drops below the former steady-state level, owing to the shock, $\dot{p}/p$ is reduced, given $\dot{\nu}$ and $\dot{K}$, by

$$\left(\frac{\mu p}{o} + \frac{R}{p}\right)\frac{1}{p}$$

per unit drop of p. Hence the total change of the right-hand side in (29) from its initial value of zero due to a shock, say, $\Delta\varrho > 0$, is approximately

$$\alpha\,(L - N)\,\left(1 - \frac{o'\nu}{o}\right) - \delta - \left(\frac{\mu p}{o} + \frac{R}{p}\right)\left(\frac{-\Delta p}{p}\right) + \Delta\varrho$$

as the result of the jump of $\dot{\nu}$, $\dot{K}$, p and ϱ respectively.
The implication is that for $(\dot{p}/p) - (\dot{\nu}/\nu)$ to turn positive on impact,

$$\alpha\,(L - N)\,\left(1 - \frac{o'\nu}{o}\right) - \delta > \left(\frac{\mu p}{o} + \frac{R}{p}\right)\left(\frac{-\Delta p}{p}\right) + \Delta\varrho \qquad (30)$$

This condition, although not entailed by the model, is theoretically possible. Note that the elasticity, $-o'\nu/o$, is equal to the ratio of labor's share to capital's share, hence a number that is found empirically to be around 2 or

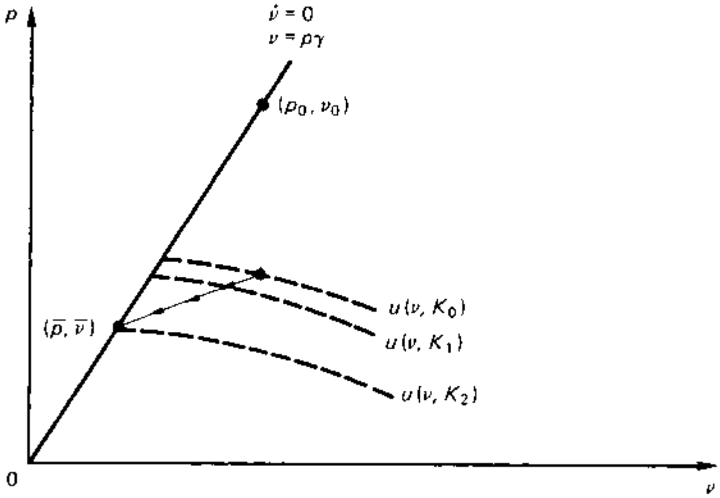

Figure 20.4 Phase diagram for the closed economy

3, so the rate of decline of v may be highly leveraged. Note also that if μ were equal to zero, countrary to the model, the right-hand side would simplify to $(\varrho + \delta)(-\Delta\varrho/\varrho)$, which is positive though smaller than δ; $\mu(> 0)$ makes the right-hand side somewhat larger.

If p/v does begin to recover, this stabilizing tendency may peter out as v falls, since reduced v moderates $\dot{\mathrm{v}}/\mathrm{v}$ and increases R, which reduces $(r + \delta) p - R$ and thus $\dot{p}$. The ongoing decline of v must be increasing N faster than the decline of K is lowering N if the rate of growth of $\ell(\mathrm{v})K$ is positive, hence

$$\alpha(L - N)\left(-\frac{\ell'\mathrm{v}}{\ell}\right) - \delta > 0; \tag{31}$$

Since the elasticity $-\ell'\mathrm{v}/\mathrm{v}$ is equal to $1 - o'\mathrm{v}/\mathrm{v}$, this growth rate must be positive over the period in which the condition in (30) holds. However the analysis here will content itself with the successful case in which p/v recovers in finite time to the level γ^{-1}.

The phase diagram in Figure 20.4 illustrates (with the solid line) the successful trajectory of the real capital-good price, p, from its drop on impact, following the shock from ϱ or D, to its return to the $p\gamma = \mathrm{v}$ ray. Since $u_{\mathrm{v}} < 0$, every dashed-line fixed-K saddlepath is negatively sloped, like the saddlepath for the open-economy case in which the capital stock does not matter because it cannot affect the interest rate. But if $u_K > 0$, as we presume, the dashed-line saddlepath corresponding to the current capital stock will be sliding downward as K is shrinking at the proportionate rate δ. Hence it is possible that the actual trajectory will be positively sloped. Recovery of the capital-goods branch occurs when the trajectory reaches the ray as shown.

The Second Stage

Once the trajectory has regained the ray and so full employment has returned, there is no further motion on the part of v, p and r. The capital-goods branch continues to take up the slack labor left by the other branch. Nevertheless the capital stock may well have overshot or undershot its new steady-state level by the time capital-goods production has resumed; that is, K_2, which is the capital stock at the opening of the second stage, may fall short of or exceed $\bar{K}$. The analysis of $\dot{K}$ in this stage, with its constants v, p, and r, does not differ from the analysis of the second stage in the fixed-interest-rate open economy.

4 CONCLUSIONS

Structuralist models seek explanations of low-frequency employment fluctuations in the long time needed for complete labor-contract adjustment to labor-demand disturbances resulting from supply- or demand-structure shocks. The present paper has presented a working closed-economy model of the structuralist type. The non-Keynesian implications of this model need no comment.

The closed economy model shows a wider range of potential behavior than does the open-economy model, of course. The possibility, demonstrated here, that the decline of the capital stock during the capital-goods slump will drag down the real price of capital by pushing up the rate of interest (through a rather distinctive mechanism) is interesting. It indicates that, following a consumption shock, the real interest rate at first jumps with the shock, then rises more during the capital-stock and real-wage adjustments that constitute a sort of after-shock.

It is apparent that further theoretical and empirical work must be done in order to see how much room we must make for structuralist mechanisms in our explanation of depressions, past and present.

Notes

1. Under the weaker condition that $o(v)$ may approach an upper bound, $\bar{o}$, as v goes to zero, the intercept of WW will exceed ϱ by $\mu D\bar{o}^{-1}$, which, being finite, is still below the infinitely large intercept, so to speak, of FF.

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21 Cyclical Growth in a Kaldorian Model*

P. Skott

1 INTRODUCTION

Are there strong tendencies in *laissez-faire* capitalism toward steady growth at full employment? Are the causes of fluctuations in output and employment to be found outside the economic system or are they intrinsic to the system? The answer to these questions is fundamental to economics and more importantly, to almost all economic and political decision making.

Kaldor's answer to the two questions changed over time. In the 1950s and early 1960s he believed that cyclical fluctuations were intrinsic to capitalist economies but that the trend rate of growth would be equal to the growth rate of the labor force: endogenous forces would keep the economy near full employment. The problem facing the theorist was to provide a theory which could explain both the cycles and the fact that fluctuations appeared to take place at a high average rate of employment.

Subsequently, Kaldor changed his interpretation of the stylized facts and he also came to question the usefulness of one sector models; a distinction should be made between primary and secondary sectors of the economy and spatial aspects should be given far greater prominence. In this paper, however, I wish to consider Kaldor's work on one sector models of a pure capitalist economy and in particular his trade cycle theory and his theories of growth and distribution. His work in this area is of considerable interest in its own right and it may also provide important elements in a rigorous theoretical formulation of Kaldor's later views on cumulative causation.

The paper is in four sections. I first review some problems in Kaldor's own model specification. Section 3 reformulates the Kaldorian theory. The section draws on both the trade cycle model and the growth and distribution theory. A labour market is also included explicitly and some Marxian elements are introduced. The implications of the model are described in section 4, and section 5 contains a few concluding remarks.

* This paper draws on the analyses of money and finance in Skott (1988) and of cyclical growth in Skott (1989). A fuller discussion of these and other issues can be found in Skott (1989a).

2 THE ORIGINAL CONTRIBUTIONS

Growth and Distribution

Kaldor developed his growth and distribution theory in a series of papers published in the late 1950s and early 1960s.[1] The saving function played a key role in this theory. In place of a single average saving propensity, s, Kaldor introduced the differential saving propensities, s_w and s_p, applicable to wage and profit income respectively. This 'semi-classical' saving function permitted a (post) Keynesian determination of the distribution of income:[2] variations in the distribution of income may adjust the average rate of saving so as to bring it into equality with any given share of investment in output.

Kaldor claimed that the saving function also made the warranted rate adjust to the natural rate of growth and thus allowed full employment growth. Similar views have subsequently been repeated by many other writers (see e.g. Jones, 1975, p. 148) but the claim is false. Both saving and investment are, by assumption, functionally related to the share of profits and the output capital ratio, and the equilibrium condition for the product market determines the profit share as an increasing function of the output capital ratio. It follows that the rate of accumulation in Kaldor's model is fully determined by the output capital ratio and in this respect the model thus produces the same conclusion as simple neo-Classical analysis based on a proportional saving function and passive investment. The differential saving function has not provided an extra degree of freedom or, more accurately, the extra degree of freedom has been swallowed up by the Kaldorian distribution mechanism and the introduction of an explicit investment function.

What then accounts for the equalisation of warranted and natural growth rates in Kaldor's model? As in neo-Classical theory the equalisation – and hence the logical possibility of continuous full employment – is accomplished through accommodating variations in the output capital ratio. The only difference is that in Kaldor's case the variations are brought about via the 'technical' progress function' rather than via the choice of technique along a known production function.

The potential variability of the output capital ratio does not in itself explain why continuous full employment should in fact characterize the economy and from a Keynesian perspective Kaldor's full employment assumption represents the most puzzling aspect of the model. Indeed, according to Samuelson the models are worthy of a Jean-Baptiste Say (Samuelson, 1964), p. 345). At one level, however, it is not difficult to understand Kaldor's position. He disliked abstract theorising for its own sake and thought that theory should account for and help us understand the 'stylized facts'. In the 1950s and early 1960s steady growth at full employment seemed a reasonable approximation to actual trends in advanced economies and Keynesian theory ought to be able to explain this observation.

Unfortunately, Kaldor did not succeed in presenting a convincing explanation. Within the logic of his own models there appears to be only one justification for the full employment assumption: variations in nominal wage rates are such that firms choose to expand employment exactly in line with the growth of the labor force.[3] This hypothesis, however, is extremely un-Keynesian: the main theoretical message of the General Theory is exactly that variations in nominal wages are incapable of eliminating involuntary unemployment and securing full employment.

In conclusion, Kaldor failed to provide a convincing theory of full employment growth. Not only did he follow the neo-Classics in *assuming* full employment, the mechanism which equalises warranted and natural growth rates is also similar. The main difference between Kaldor's model and the neo-Classics is that Kaldor has an explicit investment function which serves to determine the distribution of income. The neo-Classics, on the other hand, leave out the investment function and use marginal productivity conditions to determine distribution.

Cycles

One of the most striking stylized facts is the trade cycle. Production and employment exhibit marked fluctuations around the trend, and Kaldor – as well as other post-Keynesians – have argued strongly that cycles and trend should by analyzed together. However, most analytical work has proceeded to analyze trend and cycle separately, and this also applies to Kaldor's classic trade cycle model, Kaldor (1940), which describes cyclical fluctuations around a stationary equilibrium. In spite of its failure to deal with the question of growth, the model has a number of interesting features and it has been the subject of almost continuous attention ever since its publication.[4]

One of the main attractions of the model is that 'it appears to generate self-sustaining cycles without the need for rigid specification of parameters and the use of time lags and initial shocks' (Chang and Smyth, 1971, p. 37). Instead, the cyclical behaviour of the economy is generated by a combination of (i) non-linearities in the investment and/or saving functions and (ii) endogenous shifts in the two functions caused by gradual changes in the capital stock.

The model has been formalized by Chang and Smyth (1971) in a set of two differential equations,

$$\dot{Y} = \alpha\, [I(Y, K) - S(Y, K)] \tag{1}$$

$$\dot{K} = I(Y, K) - \delta K \tag{2}$$

where a dot is used to denote time derivatives. The parameter α is an output adjustment coefficient, δ is the rate of depreciation and it has been assumed that realized investment is always equal to desired ex ante investment.

The system (1)–(2) may under certain conditions (see Chang and Smyth, 1971) produce persistent fluctuations around a stationary equilibrium, and the model can be generalized to cover the case of cyclical fluctuations around an exogenous growth trend (Dana and Malgrange, 1984). But it is not obvious how one could turn it into a model of *endogenous cyclical growth*. Since the original model yields endogenous fluctuations this may seem surprising, but problems arise in the specification of the relations between investment and saving on the one hand and the capital stock on the other.

In a growth context, it is reasonable to assume that both the investment and saving functions are linearly homogeneous in output and the capital stock. This assumption would be in line with most work on saving and investment and, indeed, in line with the specifications used by Kaldor in his theory of growth and distribution. Homogeneity of degree one in the saving and investment functions will, however, lead to steady growth. With homogeneity, equations (1)–(2) can be rewritten

$$\hat{Y} = \alpha/\sigma\,[I(\sigma, 1) - S(\sigma, 1)] \tag{3}$$

$$\hat{K} = I(\sigma, 1) - \delta \tag{4}$$

where $\sigma = Y/K$ and where $\hat{}$ denotes proportional growth rates (logarithmic derivatives). From (3)–(4) it follows that

$$\hat{\sigma} = \alpha/\sigma\,[I(\sigma, 1) - S(\sigma, 1)] - I(\sigma, 1) + \delta \tag{5}$$

and it is readily seen that σ will converge monotonically towards some equilibrium value. The equilibrium – corresponding to $\hat{\sigma} = 0$ – may not be unique: the non-linearities in the saving and investment functions may imply the existence of three equilibria, two stable and one unstable. This result, however, does not affect the result that asymptotically the economy will exhibit steady growth: if the saving and investment functions are linearly homogeneous then the model cannot produce endogenous cyclical growth.

Another, and perhaps equally important, criticism of the model concerns the total neglect of the labor market. In situations of significant unemployment, one may ignore the labor market in short run analysis but it is difficult to see how such a procedure could be justified if the analysis is to be extended to the medium and long term. At the very least one should include an upper bound (the natural rate of growth) on the feasible long run growth rate. Kaldor's model fails to do this. Like the standard Keynesian short run model, it is built around the product market.

3 RESPECIFYING THE KALDORIAN MODEL

Saving and Finance

Kaldor's saving function has been criticized by both neo-Classical and Post Keynesian writers. Thus, Pasinetti (1962) suggested that the different saving propensities should attach to classes rather than to income categories (see also the papers by Salvadori and Abraham-Frois in this volume). In reply Kaldor argued that the important distinction – and that underlying his formulation – is between firms and households and not between different categories of households. According to neo-Classical theory, however, the financial decisions of firms should be of no importance: if firms retain profits then the ownership rights in those firms appreciate in value and this appreciation will enable households to increase their consumption. A rise in retained earnings should therefore – according to the neo-Classics – be offset by lower personal saving.

In view of these criticisms it seems worthwhile to include banks and financial stocks in the model and to consider both the budget constraint of households and firms' finance constraint explicitly.

Banks

Most of current macroeconomics takes the money stock as an exogenous variable. It may be subject to random shocks – a cause of disappointed expectations and possibly of cyclical fluctuations – but banks and endogenous variations in the money stock rarely figure in the story. The exogeneity assumption may have been reasonable for an earlier period in history but in a model of contemporary capitalism it is anachronistic.[5] Today outside money is of little quantitative importance and recent attempts by central banks to control wider definitions of the money supply have met with limited success. A different approach based on a pure Wicksellian system of inside money therefore seems more relevant.

I shall assume that firms may borrow from banks and that they are never quantity constrained in their borrowing. They can borrow as much as they wish at the ruling rate of interest but the rate of interest need not remain constant over time. Households deposit their liquid assets with banks and neither firms not households hold cash. For simplicity, it is assumed that there are no costs involved in banking and that lending and borrowing rates coincide. Banks then have neither costs not profits; interest payments by firms to banks are exactly equal to interest payments received by households.

In recent years the endogenous money approach has been associated mainly with Kaldor and other post-Keynesian writers (e.g. Kaldor, 1982, and the contributions by Moore and Lavoie to this volume), but an infinitely elastic supply of finance at prevailing interest rates need not exclude all monetarist concerns. The desire of firms to borrow will depend on interest rates and, in principle at least, one can conceive of a system where banks adjust interest rates continuously so as to make firms wish to increase their bank liabilities at some given rate. In between the polar cases of constant nominal interest rates and constant growth in the money stock is the more realistic case where monetary authorities do change interest rates over time but fail to control the amount of bank lending. In this paper I shall adopt the assumption that the real rate of interest remains constant. If one has to choose a simple assumption then this assumption appears to fit the stylized facts better than either of the abovementioned polar cases.

Households

Households receive wage income as well as a return on their financial wealth. They own no physical capital goods and their (non-human) wealth is held in the form of money (deposits with banks) and securities. Interest is being earned on the bank deposits, and the return on securities comprises both dividend payments and capital gains. Household incomes are either spent on consumption or used to augment the financial assets.

The desired stocks of financial assets are related to current income flows and the saving/consumption decision adapts to achieve these desired stock flow ratios. Algebraically, this aspect of household behaviour is described as follows,

$$p\,C + vN(\hat{v} + \hat{N}) + M\,\hat{M} = W + (1-s_p)\,P + vN\,\hat{v} + iM \tag{6}$$

$$\alpha\,(P - \delta pK - rM) = q\,N \tag{7}$$

$$\beta\,pY = M \tag{8}$$

where W and P are nominal wages and profits, C is consumption in real terms, N and M are the number of securities and the money stock held by households, v is the price of securities, p is the price of output, and r and i, respectively, denote the real and nominal rates of interest, $r = i - \hat{p}$.

Equation (6) is households' budget constraint, and equations (7)–(8) describe the behavioural assumptions. It is assumed (equation (8)) that the demand for money is proportional to national income and that the demand for financial securities (equation (7)) is proportional to the level of profits net of depreciation and (real) interest payments (i.e. the economy-wide *p/e* ratio is constant over time). This specification has the virtue of simplicity.

It may also have a somewhat neo-Classical flavour: if the level of profits is given then share valuation is independent of firms' pay-out decisions. In fact no important conclusions of the model depend on this precise specification. It would be easy to relate vN to, say, total distributed incomes or total consumption, and this change would not affect the qualitative results of the analysis.[6]

Equations (6)–(8) can be used to derive saving and consumption functions. Substituting (7) and (8) into (6), we get

$$\begin{aligned} pC &= pY - s_p P - vN\hat{N} - M(\hat{Y}-r) \\ &= pY\,[1 + \alpha\hat{N}(\beta r + \delta/\sigma) - \beta(\hat{Y} - r) - \pi(s_p + \alpha\hat{N})] \end{aligned} \tag{9}$$

and hence

$$C/Y = A - B\,\pi \tag{10}$$

$$S/Y = (1-A) + B\,\pi \tag{11}$$

where σ and π denote the output capital ratio and the share of profits respectively and where

$$A = 1 + \alpha\hat{N}(\beta r + \delta/\sigma) - \beta(\hat{Y} - r))$$

$$B = s_p + \alpha\hat{N}$$

The composite parameters A and B are influenced by the growth of output and the output capital ratio as well as by the simple parameters of the system (6)–(8) and thus need not be constant over time. Apart from this modification, the saving/consumption system is similar to the simple Kaldorian specification, and indeed equations (6)–(8) represent a generalized version of Kaldor's neo-Pasinetti theorem, Kaldor (1966).

Firms

In equations (6)–(11) we have taken s_p and $\hat{N}$ as exogenous parameters. Investment, however, needs to be financed and in analogy with the budget constraint of households, firms face a financial constraint,

$$pI = s_p\,P + vN\,\hat{N} + M\,(\hat{M} - i) \tag{12}$$

where P is total profits, i is the nominal interest rate on bank loans and M the amount of bank loans. N is the existing number of securities and v the price of securities.

The parameters s_p and $\hat{N}$ reflect the financial decisions of firms. The choice of s_p and $\hat{N}$ may be subject to additional finance constraints but it is not derived from profit maximation. Indeed it would be difficult to do so. In a simple Modigliani–Miller world, the valuation of an individual firm is independent of its financial structure, and maximisation gives no guidance to the value of s_p and $\hat{N}$. Outside the Modigliani–Miller world, the valuation will be affected by financial decisions, but it is difficult to say exactly how, and in any case socio-institutional and historical factors are likely to be very important in the determination of 'prudent' (optimal) finance.[7] I shall therefore assume that both s_p and $\hat{N}$ are exogenously given parameters and that accommodating variations in bank loans make up the difference between investment expenditure and the sum of retained earnings and new issues.

Production and Investment

Production Lags and Expectations

It is assumed that the production function is of the fixed coefficients type,

$$Y = \min\{\lambda L, \sigma^{\max} K\} \tag{13}$$

Production is not, however, instantaneous. The production process takes time and at any moment the rate of output, Y, is predetermined by past production decisions. Discrete time lags are difficult to handle analytically but the effects of production lags can be approximated within a continuous time framework by assuming that the rate of growth of ouput at time t, $\hat{Y}_t$, is the decision variable at time t. The approximation is close if the production lag is short and the time path of Y is smooth (differentiable). Smoothness, in turn, may be justified by an appeal to the existence of adjustment costs.

Production lags and the predetermined character of Y are relatively unimportant if firms' demand expectations are fulfilled, and Keynesian models usually follow the *General Theory* and assume that this is the case. If, however, animal spirits are given – i.e. assuming that there are no exogenous shifts in long term expectations – then an economy where short term expectations are always fulfilled must evolve along a time path which is consistent with the initial long period expectations. The reason is simple. If firms are consistent in their formation of expectations then short and long term expectations must be mutually consistent. Since animal spirits are assumed constant, firms will revise their initial long term expectations if and only if initial expectations are proved wrong. Given the consistency between short and long expectations this can only happen if short term expectations are disappointed at some point along the time path. Phrasing it differently, since the long period is not an independent entity but merely a succession of short periods, erroneous long term expectations must involve a divergence between expected and actual outcomes in some short period.

The notion of short period equilibrium may thus be of limited use in an extension of Keynesian Theory to cover long run developments: a satisfactory theory of growth and cycles is incompatible with the assumption that short period expectations are always fulfilled.[8] The possibility of disappointed expectations must be allowed for.

What happens if short term expectations are disappointed? Firms have made production decisions in anticipation of a certain level of demand but when output appears, demand turns out to be different, and as a result there must be accommodating adjustments in either quantities or prices. The level of production cannot adjust instantaneously and a quantity adjustment therefore must involve a change in stocks and/or the direct rationing of demand. A particular case of rationing is the lengthening of queues, but although one can point to industries where queues play an important role, instances of quantity rationing are hardly significant in the general picture of capitalist economies. Stocks and stock movements on the other hand are of importance but, if anything, stock movements tend to amplify fluctuations in other demand components over the trade cycle. Leaving out stocks and stock movements should therefore bias the model towards steady growth rather than towards cyclical fluctuations, and with this bias in mind, I shall also disregard stocks in order to simplify the analysis.

Having left out both stocks and quantity adjustments from the model, the accommodation must take place through price adjustments: it is assumed that changes in *prices* will equate flow demand to (the predetermined level of) flow supply. Can price adjustments perform this role? The model contains no real balance effects and proportional changes in wages and prices do not give rise to distributional effects on the level of aggregate demand. The adjustment must therefore be effected via changes in the distribution of income. The equilibrium mechanism is thus identical to the one employed by Kaldor in his distribution theory.

In order for this mechanism to work, two conditions need to be satisfied. First, distribution must be sensitive to price changes. This condition is met since labor market contracts are cast in terms of money wages and it is reasonable to assume that there is neither perfect foresight nor *instantaneous* feedbacks from output prices to money wage rates. The real wage rate and the share of profits in income therefore respond to unanticipated movements in money prices. Secondly, aggregate demand needs to be sensitive to changes in distributive shares, and, in fact, it must be inversely related to the share of profits. The inverse relation is required for stability reasons. Assume that there is excess demand at the initial share of profits. Excess demand means that firms will raise their prices and that the share of profits will increase. Unless the relation between demand and profits is inverse this increase in profits exacerbates the initial disequilibrium, and the ultra short run equilibrium will be unstable. The saving propensity is, as shown above, positively related to the share of profits, and the stability condition is satisfied provided investment is not too sensitive to variations in profitability.

The Output Expansion Function

Returning to the determination of production, we may assume that the rate of expansion of output depends on both the level of demand relative to current production and conditions in the labor market, but that the rate of expansion is never constrained by capital shortages: empirically, excess capital capacity is the normal state of affairs and theoretically the desirability of excess capacity can be explained in terms of strategic entry deterrence (Spence, 1977).

The level of demand is reflected in the actual share of profits. Profit maximization implies that the short run equilibrium price level is determined by marginal cost and demand conditions. Marginal costs are constant (below full capacity) so if the conjectured demand curve has constant elasticity then the short run equilibrium value of the profit share is independent of the level of demand, $\pi = \pi^*$. A high (low) level of demand implies that the ultra short run price exceeds (is below) the short run equilibrium price, i.e. $\pi > \pi^*$ ($\pi < \pi^*$). The higher the level of demand, the higher is the profit share and the faster the desired rate of expansion.

Labor market conditions influence the expansion of output through the effects on the social relations of production. The strength of workers *vis-à-vis* management varies inversely with the size of the reserve army of labor: the threat of redundancy loses its edge as the economy approaches full employment, workers become more militant and more surveillance will be needed in order to prevent shirking.[9] Managerial resources will become occupied by industrial relations issues and both the ability and desire of firms to carry out an expansion of production will be affected. High rates of employment also lead to an increase in the turnover of the labor force and the gross recruitment needs associated with any given rate of expansion are raised at a time when low unemployment makes it difficult to attract new workers. High employment rates thus make it less attractive and more costly to expand production. High employment and high turnover of the labor force, however, allow firms to contract production and employment more rapidly without incurring the costs associated with compulsory redundancies (redundancy payments as well as negative effects on productivity of a deterioration in industrial relations). For positive rates of expansion the cost of adjustment will therefore be an increasing function of the rate of employment and for negative rates of expansion the cost will be decreasing in the rate of employment. It follows that an increase in the rate of employment will depress the desired rate of expansion.

These considerations can be summarized in the following *output expansion function*

$$\hat{Y} = h(\pi, e);\ h_\pi > 0 \quad h_e < 0. \tag{14}$$

where e denotes the rate of employment.

Note that this formulation includes a simple adjustment function as a special case. Let Y^* be the optimal level of output and let the asymmetric speed of adjustment of Y be ν_1 and ν_2 for expansionary and contractionary movements respectively, both ν_1 and ν_2 being dependent on the state of the labor market, $\nu_1 = \nu_i\ (e)$,

$$\hat{Y} = \begin{cases} \nu_1(e)\ (Y^* - Y)/Y & \text{if } Y^* > Y \\ \nu_2(e)\ (Y^* - Y)/Y & \text{if } Y^* < Y \end{cases} \tag{15}$$

Y^*/Y is a function of the profit share, $Y^*/Y = j(\pi)$, and (15) is thus a special case of the output expansion function.

Investment

As regards investment, it is assumed that current investment levels are decided on the basis of expected future levels of demand and production (relative to existing capital capacity). Expected future levels of demand are positively related to current demand and current demand in turn is reflected in the profit share obtained on the predetermined level of current supply. It is therefore reasonable to expect that investment depends on current profitability as well as on the current output capital ratio (the current utilization rate of capital), i.e.[10]

$$\frac{I}{Y} = f(\sigma, \pi);\quad f_\sigma > 0, \quad \frac{\partial S/Y}{\partial \pi} > f_\pi \geqslant 0. \tag{16}$$

where the restriction $\frac{\partial S/Y}{\partial \pi} > f_\pi$ has been introduced in order to ensure the stability of the Kaldorian distribution mechanism, cf. above pp. 387–8.

Equation (16) generalizes the simple stock adjustment principle. Let K^* be the optimal capital stock, $K^* = Y^*/\sigma^*$ and let μ be the speed of adjustment. Then

$$\hat{K} = \mu\ (K^* - K)/K = \mu\ (j(\pi)\ \sigma/\sigma^* - 1) = \sigma f(\sigma, \pi). \tag{17}$$

where we have used $\frac{Y^*}{Y} = j(\pi)$.

4 PROPERTIES OF THE MODEL

Analysis

In addition to the three behavioural equations describing saving, investment and production, we have the following relations:

$$\hat{e} = \hat{Y} - n \tag{18}$$

$$\hat{K} = I/K - \delta \tag{19}$$

$$\hat{\sigma} = \hat{Y} - \hat{K} \tag{20}$$

$$I = S \tag{21}$$

Equation (18) links changes in employment to changes in output. The parameter n is the growth rate of the total labor force and the equation follows from the production function. Equation (19) relates the growth of the capital stock to investment and depreciation (δ), and (20) is a definitional identity. Equation (21), finally, represents the Kaldorian distribution mechanism rather than the standard short run Keynesian equilibrium condition: the rates of employment and output as well as the stock of capital are predetermined, and the equation says that profitability will adjust so as to clear the product market.

The model – equations (11), (14), (16), and (18)–(21) – can be reduced to a two dimensional system of non-linear differential equations,

$$\hat{\sigma} = h(\theta(\sigma, e), e) - \sigma f(\sigma, \theta(\sigma, e)) + \delta \tag{22}$$

$$\hat{e} = h(\theta(\sigma, e), e) - n \tag{23}$$

where

$$\pi = \theta(\sigma, e); \quad \theta_\sigma > 0 \quad \theta_e > 0 \tag{24}$$

is determined by the equilibrium condition for the product market.[10]

It can be shown that for empirically reasonable values of the partial derivatives of $h(,)$ and $f(,)$ the system (22)–(23) has a unique and unstable equilibrium and a limit cycle exists.[11] The limit cycle need not be unique and the precise asymptotic behaviour of the economy may therefore depend on initial conditions. The same qualitative properties of the cyclical fluctuations are, however, shared by all limit cycles and Figure 21.1 can be used without loss of generality to describe the qualitative movement of the economy.

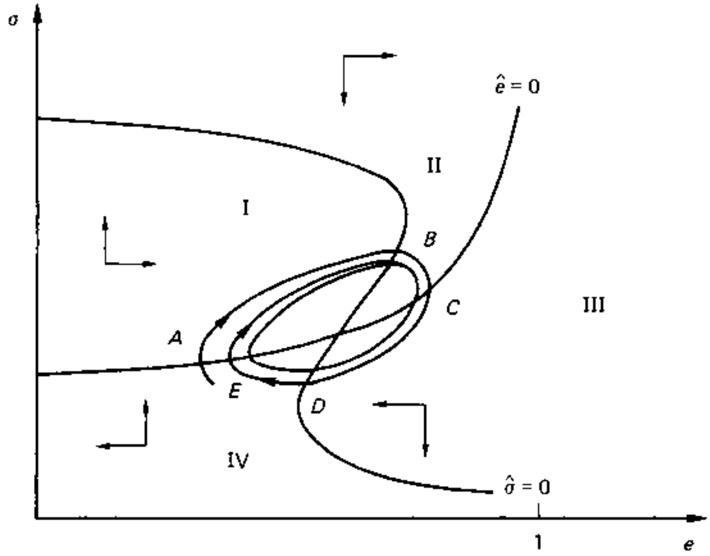

Figure 21.1

Low rates of employment stimulate the expansion of output and employment in the area marked I, and a relatively low utilization rate of capital implies that the growth rate of output also exceeds the rate of accumulation. In II, high levels of employment cause a slowdown in the expansion of output: positive growth is maintained owing to high profitability but accumulation also benefits from high utilization and profitability and as a result the output capital ratio (the utilization rate) is now falling. In III the negative effect of high employment on the rate of expansion is no longer offset by high utilization and profitability, and output and employment are thus declining. This decline and the associated reduction in the strength of workers gradually improve the business climate and stimulate production and employment, and when the economy reaches IV the growth rate of output has come to exceed the rate of accumulation; although employment continues to fall, both the utilization of capital and the share of profits are again increasing.

5 CONCLUDING REMARKS

In the 1950s and early 1960s Kaldor – along with most other economists – thought that cyclical growth at near full employment provided a reasonable theoretical approximation of observable trends in most Western economies. From a Keynesian perspective these 'stylized facts' seemed perplexing: Keynes himself had emphasized the possibility of underemployment equilibrium; Kalecki's writings generally supposed the existence of a substantial reserve army of labor; Harrod had concluded that the warranted growth path was unstable and that the warranted and natural growth rates would only coincide by a sheer fluke; Joan Robinson, finally, was emphatic that steady growth paths in general and golden age paths in particular represented mythical states and not the development of actual economies in historical time.

The apparent incongruity between these theoretical positions and the empirical evidence presented a challenge to Keynesian economics and Kaldor set out to develop a Keynesian theory which could explain the stylized facts. He wanted to demonstrate 'the neo-Classical theory is, at the very least, not indispensable – it is possible to build an equilibrium model using entirely different bricks' (Kaldor, 1980, p. XXV). In this paper I have tried to show that although Kaldor may not have been fully successful, it is indeed possible to build a Kaldorian model of cyclical growth at near full employment.

Notes

1. Kaldor (1956), (1957), (1961); Kaldor and Mirrlees (1962). Unfortunately, the later papers are flawed. The famous Kaldor–Mirrlees model for instance does not even have an independent investment function; the level of investment is passively determined by the amount of saving (see Skott, 1989b). The early prototype model, Kaldor (1957), thus remains the best exposition of Kaldor's growth and distribution theory.
2. The distribution mechanism is similar to Marshallian ultra short run pricing: with given supply, the price of output (distribution of income) adjusts so as to clear the market. In a macroeconomic context, Keynes used the distribution mechanism in *Treatise on Money*, Keynes (1930). Hahn (1972) also relied on this mechanism, and similar views can be found among the classics (see e.g. the discussion of Malthus in Costabile and Rowthorn, 1985).
3. Kaldor's full employment 'proof' in Kaldor (1961) essentially amounts to the assertion that in a developed economy the 'effective bottleneck setting an upper limit to production is labor rather than physical capacity' (Kaldor, 1961, p. 197). Once this assumption has been granted the result follows: the average rate of net investment over long periods will only remain positive if the average utilization rate of capital is close to the desired level, and if labor rather than capital represents the lower limit on capacity, then near-full-employment must characterize the economy. (See Skott, 1989b, for further analysis.)
4. Chang and Smyth (1971), Torre (1977), Varian (1979). Dana and Malgrange (1984), Semmler (1986) are among the recent papers which discuss and generalize the original model.
5. See Chick (1986) for a discussion of the evolution of the banking system and the demands which this puts on monetary theory.
6. An alternative specification is used in Skott (1981) where the demand for both money and securities is related to nominal consumption expenditure.
7. See Wood (1975) for a non-neo-Classical account of the determination of the financial parameters.

8. Some recent work in trade cycle theory appears to be based on the opposite view, (see e.g. Grandmont, 1985, and the articles in JET 1986, vol. 40, No. 1).
9. See Bowles (1985) for a discussion of the effect of unemployment on work effort.
10. The partial derivative θ_σ is positive for $\frac{\partial I/Y}{\partial\sigma} = f_\sigma > \frac{\partial S/Y}{\partial\sigma}$. The justification for the inequality is as follows. The output capital ratio only affects the average propensity to save because it influences the share of depreciation in total income; the share of depreciation in turn affects net profits and hence the price of financial assets; the price of securities, finally, affects saving because of its influence on the valuation of new issues. Using (11) the derivative of S/Y with respect to u is $\alpha\hat{N}\delta/(\sigma^2)$ and new issues form a very small proportion of the stock of securities, $\hat{N} \simeq 0$. It follows that the effect of utilization on saving is weak; in the simple case where $\hat{N} = 0$ it vanishes completely.
11. For details see Skott (1989) and Skott (1989a). As in the Chang and Smyth model, the main condition for local instability of the equilibrium is that output adjusts rapidly relatively to the adjustment speed of capital; i.e. that

$$\frac{\partial\hat{Y}}{\partial\sigma} = h_\pi\,\theta_\sigma >> f + \sigma(f_\sigma + f_\pi\,\theta_\sigma) = \frac{\partial\hat{K}}{\partial\sigma}.$$

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22 Endogenous Credit and Endogenous Business Cycles*

M. Jarsulic

1 INTRODUCTION

Attempts to connect monetary phenomena and business cycles often have been the province of economists who also accepted the Walrasian full employment paradigm. Monetary explanations of business cycles preceded Keynes (cf. Zarnowitz, 1985), and in the post-Keynesian era Monetarists of different varieties have also advanced them. Old style Monetarists (e.g., Poole, 1978) have tried to integrate money into a disequilibrium account of fluctuations. By assuming a demand for money proportional to nominal income, lags in price adjustment, and an exogenous money supply, they depict movements of the money supply as a main source of fluctuations. In this scheme an increase in the money supply, with prices constant, translates into an increase in real demand. This causes an increase in real output, even if markets are initially at the point of Walrasian general equilibrium. However, when perceptions catch up with reality and nominal prices adjust, so will real output. Decreases in the money supply cause fluctuations in the opposite direction. New style Monetarists reject the disequilibrium elements of this story and insist on rational expectations. The assumptions of market clearing and rational expectations are integrated into a monetary theory of cycles by introducing new assumptions about the availability of information. Lucas (1981), for example, suggests that changes in the exogenous money supply cause changes in nominal prices in ways which are only partially understood – i.e., with Friedman's notorious 'long and variable lags.' This makes it difficult for firms to distinguish changes in price levels from changes in relative prices. Optimizing firms react to perceived increases in relative prices by increasing productive capacity. To the extent that changes in the money supply have fooled them, they will have excess capital stock, which will need to be worked off. Hence the pro-cyclical behavior of investment demand under conditions of market clearing everywhere.

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Post-Keynesian economists reject old and new style Monetarism, and have sought an amplified version of Keynes' monetary theory as a theoretical alternative. This has produced a garden variety of ideas, as the review articles of Lavoie (1984, 1985) demonstrate. Two major tenets of this group are the endogenity of the money supply and the importance of credit to the accumulation of capital. These ideas can easily be used to counter Monetarism. If the money supply is endogenous, it cannot be a cause of cycles in the way Monetarists say it is; and if demand for money is related to investment finance, then the demand for money described by the quantity equation is probably wrong.

Such critical results are of course important in themselves. However, it will be the purpose of this paper to show that a particular interpretation of endogeneity, when joined to the concept of effective demand, implies the existence of self-sustained growth cycles under certain conditions. That is, the post-Keynesian account of credit and interest, which has been used to counter Monetarist ideas, itself contains the elements of a theory of capitalist instability which have so far gone unexploited. These points will be made by means of a dynamic model. In the process of developng it, Goodwin's (1982) idea that the normal functioning of capitalism is correctly described by a model of self-sustained growth cycles is extended. The interaction of finance and capital accumulation are shown to be capable of generating growth cycles, just as Goodwin showed that accumulation and reserve army phenomena can do. In addition, the model explicitly considers effective demand, an issue not addressed in many growth cycle models.

2 THE ENDOGENEITY OF MONEY AND CREDIT

Economists seeking to develop a Keynesian view of money and finance have taken two somewhat divergent directions. On the one hand, economists such as Davidson (1972, pp. 246–81) and Robinson and Eatwell (1973, pp. 218–19) have emphasized the importance of bank decision-making in the process of capital accumulation. The willingness of banks to provide the flow of credit needed for increasing the level of investment is viewed as a necessary, if not sufficient, condition for the success of an economy. Thus, in a discussion of the pre-requisites to an expansion of investment Davidson (1972, pp. 279) writes:

> If additional finance is to be obtained, and if the banks are unwilling to create it, then some members of the community must be induced to give up some of their portfolio money holdings in exchange for securities, if entrepreneurs are to carry through their orders of fixed capital goods. Hence the market price of securities must initially fall (the rate of

> interest must rise) . . . Of course the equilibrium level of output in $t + 1$ will be lower and the interest rate higher than if the money supply had expanded in pace with the additional investment demand.

Other economists such as Kaldor (1982) and Moore (1979, 1983, 1985) take a somewhat different view. They tend to treat the money supply as a passive, demand-driven magnitude. Constraints on accumulation exist only to the extent that the cost of reserves – as determined by the central bank – affects the market rate of interest. Central bank willingness to accomodate the banks' needs for reserves is explained by the requirements of policy (Kaldor, 1982, p. 25):

> Whilst monetarists continually emphasize that the Central Bank can or should directly determine the quantity of money, or at least the 'base stock' of money, consisting of bank notes and bankers' reserves (or balances) with the Central Bank, in fact they can do no such thing, as recent experience with the Federal Reserve or the Bank of England shows . . . They cannot prevent either a depletion or an accumulation of 'high powered money' (or reserve money) except by a policy of en- or discouragement – by raising or lowering the rate at which they are prepared to create reserves by discounting (or re-discounting) Treasury bills and bonds. But the Central Bank cannot close the 'discount window' without endangering the solvency of the banking system; they must maintain their function of lender of last resort. Equally they cannot prevent any depletion of Government balances with the Bank of England due to an excess of outgo over inflow from reappearing as an *addition* to high powered bank money – not unless they refuse to honor cheques issued by HMG – which would be a rather drastic step for monetarists to take.

The endogenous money supply is an institutionally generated reality. Central banks cannot control the supply of credit, because they are captives of the banking system. The banking system itself is seen to be responding passively to the wishes of its borrowers.

The empirical evidence on the issue of endogeneity is not decisive. Basil Moore has discussed evidence for passive endogeneity. He has noted (Moore, 1985, pp. 15–18) institutional data consistent with this position: Growth rates of member and nonmembers of the Federal Reserve system are not markedly different, even though reserve requirements for member banks are higher. He has also done econometric work (Moore, 1979, 1983) which shows banks' loans and money supply to be related to money wage changes. His interpretation is that changes in money wages affect demand for working capital, which is translated into changes in the money supply.

While Eichner believes that the supply of credit has endogenous determinants, his empirical work is not consistent with the idea that the Federal Reserve is a purely passive supplier of reserves. In his work (Eichner, 1986, pp. 166–8), the federal funds rate is explained by the ratio of net free reserves to total reserves; and by liquidity pressure, defined as the ratio of total loans to total deposits in the banking system. The first term has a negative impact on the federal funds rate, the second has a positive impact. The results indicate that policy decisions about reserves are important to interest rate determination.

The model developed in the following section explores some implications of assuming that bank behavior, along with credit demand, affects the supply of money and finance. In particular, it shows that bank decision-making – in conjunction with decisions about accumulation – can combine to produce self-sustaining growth cycles. It thus produces additional reasons for viewing the degree of endogeneity of money as an important issue.

3 ENDOGENOUS CREDIT AND THE BUSINESS CYCLE

In order to explore some of the implications of endogeneity and accumulation, let us begin with a model of a closed economy. Let Y be the real value of GNP, and K the real value of the capital stock. Then Y will be determined by the Kaleckian multiplier relation

$$Y = mgK \tag{1}$$

where g is the gross rate of accumulation, and $m = 1/(1-w)$, w being labor's share in Y.

For the purposes of this exercise it will be assumed that w is constant. While this ignores the behavior of income shares over the cycle, it is an acceptable simplification in a model which seeks to isolate the contributions of financial factors to the generation of cycles. It also allows us to ignore pricing and capital theory problems with a slightly clearer conscience. Given these assumptions, the rate of accumulation will be equal to the rate of profit.

To make use of (1) it is necessary to say something about the determinants of g. To do so we will utilize an idea of Kalecki (1971, pp. 105–9) whose work is an important source of inpiration for many post-Keynesians. In his discussion of the principle of increasing risk, Kalecki suggests that there are two significant limitations, given a firm's basic estimate of economic reality, on the capital accumulation it will undertake. They are the value of a firm's existing capital and the existence of increasing risk. The value of capital limits accumulation because internal finance is limited by it and because the market value of a firm's assets, which may be used as collateral, sets a limit on borrowing. Regardless of the interest rate a firm may be willing to pay, there is an upper limit to borrowing because capital needs to stand as security for the loan or bond. Accumulation is further limited by risk in the sense that the larger the expansion of capacity in relation to existing capital, the greater the threat to the existence of the firm if the investment is not profitable, or causes losses. If there has been significant borrowing, failure of the investment may mean failure of the firm. Both these factors make current profits important in determining the possibilities of accumulation. The greater the flow of current profits, the more easily a firm can pay for already existing investments or begin new ones without seeking financing.

Given its estimates of longer-run profitability and its current profitability, the firm will also take into account the current rate of interest. If borrowing, the rate will be a cost of funds; and if not, it will be a measure of opportunity cost. Thus we may represent the desired rate of accumulation by

$$g^d = a + b^*g - cr \tag{2}$$

where g^d is the desired rate of accumulation, r is the rate of interest, and a, b^*, and c are positive constants.

The positive value for a reflects a 'normal' period in a capitalist economy, in which the longer-term prospects of profits are secure enough that, unless current profits fall low enough and the rate of interest rises high enough, there will be positive desired expenditure on capital goods. The term in g represents the influence of profitability, since with constant income shares the rate of profit will equal the rate of growth.

To determine movements in g, the difference between g^d and current g will be put in a partial adjustment framework of the form

$$\dot{g}/g = n(g^d - g) \tag{3}$$

with n a positive constant.

This formulation has some highly desirable properties from an economic point of view. It acknowledges the difficulties of adjusting actual to desired capital stock. Since for many capital goods there are notable order and construction lags, this is an important concession to reality. Also, by writing the investment function in this way, it is impossible for any positive pair of interest and growth rates to induce a negative value for g. This is a necessary attribute for any sensible description of the behavior of gross rates of accumulation. While it is certainly possible to describe the motion of g in more complex ways – reducing, for example, the tendency of deviations to produce larger responses with higher growth rates – there is value in keeping the constituent elements as simple as one can.

Given a value of $b^* > 1$, and assuming without loss of generality that $n = 1$, equation (3) can be written as

$$\dot{g} = g(a + bg - cr) \tag{4}$$

where $b = b^* - 1 > 0$.

As it stands, however, (4) is still an inadequate representation of the determinants of g, since it implies that any rate of accumulation is possible. We need to take account of capacity limitations. To do so we will include a negative term in g^2 in (4) to obtain

$$\dot{g} = g(a + bg - cr - dg^2) \tag{5}$$

This puts an upper limit to the rate of accumulation since there is a maximum value of g for which $\dot{g} > 0$. At higher values of g, $\dot{g}$ will certainly be negative.

To model the interest rate a financial sector must be added. For present purposes the central bank, commercial banks, and firms will be the actors in that sector. Commercial banks will determine the real supply of credit according to the supply of reserves provided by the central bank, the rate of interest they can earn on loans, the risk involved in making loans, and the legal and institutional constraints on their use of reserves. This gives a supply function of the form

$$C^s = C\, r^{\alpha}(Y)^{\beta} \tag{6}$$

An increase in C reflects an increase in reserves or a financial innovation by the banks. While C can grow over time, there will be constraints: central banks need to be concerned about inflation and its effect on the functioning of the financial system, and they need to preserve bank profitability. An increase in α represents an increase in central bank accomodation to market conditions, or an increase in bank responsiveness to market conditions. If there were complete accomodation, r would be fixed and α would be infinite. We assume rather, in line with the theoretical work of Davidson and empirical work of Eichner, that accomodation is partial so that α is finite and the rate of interest does vary. A larger value for Y indicates a higher level of profits, and may be taken by banks as an index of the soundness of firms. An increase in β signals an increased risk aversion by banks.

The real demand for credit will be given by

$$C^D = (Y)^{\gamma} r^{-\varkappa} \tag{7}$$

The term in Y represents both transactions demand and finance demand, since Y is a function of gK. The interest rate terms reflects the willingness of business and households to economize on transactions balances, and represents liquidity preference considerations. The model is closed by assuming that the credit market clears

$$C^S = C^D \tag{8}$$

To study the dynamics of this system we need to see how the rate of interest moves through time. Differentiation of (6) gives

$$\dot{C}^S/C^S = \varepsilon + \alpha\dot{r}/r + \beta(\dot{g}/g + g - \delta) \tag{9}$$

where $\varepsilon = \dot{C}/C$, δ is the depreciation rate. Equation (7) gives

$$\dot{C}^D/C^D = \gamma(\dot{g}/g + g - \delta) - \varkappa\dot{r}/r \tag{10}$$

Using (1), (9) and (10) gives the dynamics of r in the form

$$\dot{r} = r(\lambda_1\dot{g}/g + \lambda_1 g - \lambda_2) \tag{11}$$

where $\lambda_1 = (\gamma - \beta)/(\alpha + \varkappa)$, and $\lambda_2 = (\varepsilon + (\gamma - \beta)\delta)/(\alpha + \varkappa)$. With $(\gamma - \beta) > 0$, r will begin to increase when the sum of $\dot{g}/g$ and g are large enough. Since this is the case in which we are interested, and since a positive value is necessary to a positive g, r fixed point for the system, we will assume this expression is positive.

A phase diagram can be used to analyze the behavior of the system given by (4) and (11). As is shown in the Appendix, if a is suitably restricted and the inequality $(2b+1) > 4d(\delta + \varepsilon/(\gamma-\beta))$ obtains, the phase diagram will correspond to that in Figure 22.1. There are four fixed points in the system. The one of interest is at the intersection of the $\dot{r} = 0$ and $\dot{g} = 0$ isoclines, labeled point A. Its stability properties can be discovered from the Jacobian matrix

$$J = \begin{bmatrix} \partial\dot{g}/\partial g & \partial\dot{g}/\partial r \\ \partial\dot{r}/\partial g & \partial\dot{r}/\partial r \end{bmatrix} \tag{12}$$

As is shown in the Appendix, $Tr(J) = (1-\lambda_1)bg^* + 2(\lambda_1-1)dg^{*2} - \lambda_1 a$ and

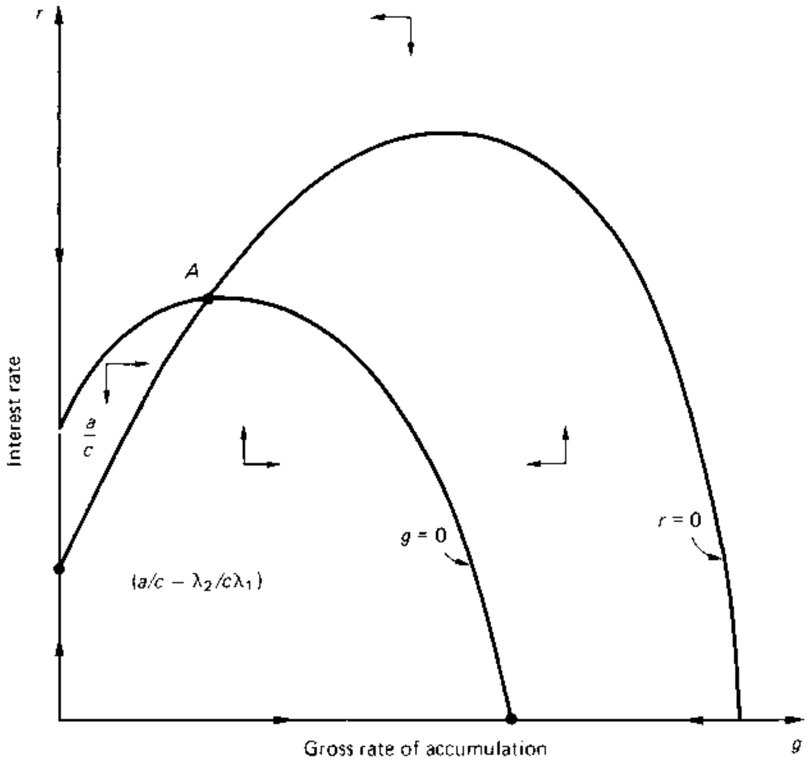
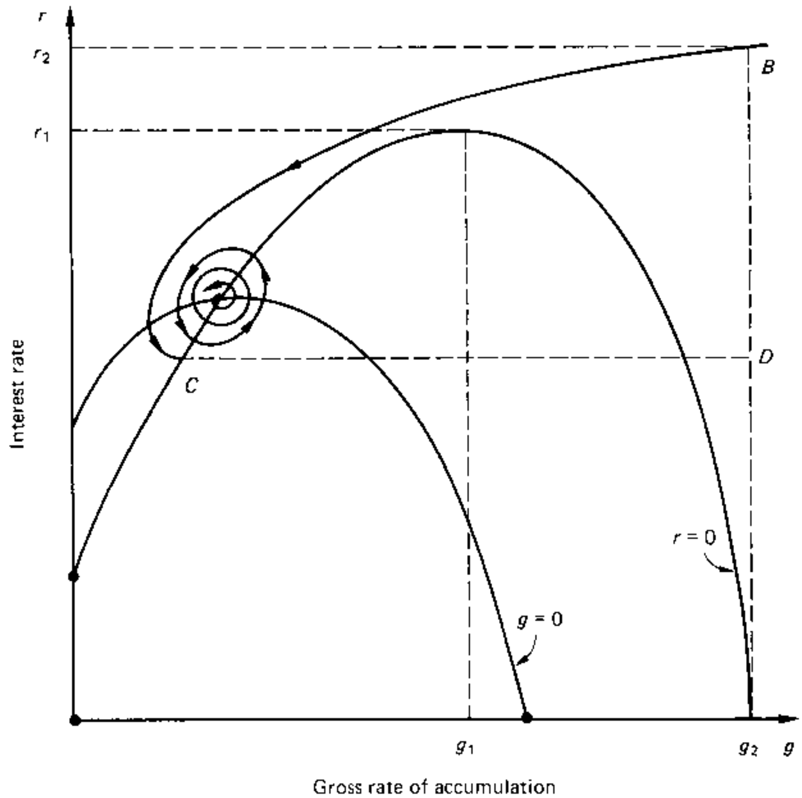


Figure 22.1

Det(J) = $\lambda_1 cr^*g^*$, where $g^* = (\delta + \varepsilon/(\gamma - \beta))$ and $r^* = (a + bg^* - dg^{*2})/c$ are the values of g and r at the fixed point A. Since Det(J) > 0, the fixed point will not be a saddle point. It will be unstable when Tr(J) > 0.

Several combinations of parameters can produce instability, making the effects of parameter changes complex. Note that when $\lambda_1 < 1$, $Tr(J) > 0$ is equivalent to $(bg^* - 2dg^{*2}) > \lambda_1 a/(1-\lambda_1)$; and when $\lambda_1 > 1$, $Tr(J) > 0$ is equivalent to $(bg^* - 2dg^{*2}) < \lambda_1 a/(1-\lambda_1)$. Hence if $\lambda_1 < 1$, an increase in b, reflecting an increasing impact of profitability on investment, will make instability more likely. (Note that b can increase and the maximum rate of growth can remain constant if the coefficient a is correspondingly reduced.) Reductions in λ_1, caused for example by increases in α or $\varkappa$, will have the same effect. If $\lambda_1 > 1$, however, increases in λ_1 and decreases in b will increase the likelihood of instability.

When A is an unstable point and the isoclines are as drawn, it can be shown (see Appendix) that the system will generate a limit cycle around the fixed point. A limit cycle is a closed orbit on which motion is self-sustained, and to which neighboring trajectories will be attracted in this



$r_1 = a/c + b^2/4dc \quad r_2 > r_1$
$g_1 = (1 + b)/2d$

Figure 22.2

case. The limit cycle for this model will be qualitatively like the one drawn on Figure 22.2. Hence, under the conditions described, the interaction of aggregate demand and the financial sector combine to cause self-sustaining fluctuations in the rate of capital accumulation and the rate of interest.

The economic processes involved in generating such cycles can now be examined. When real and financial factor parameters are appropriately configured, the economy will not be stable at the equilibrium point. However, upward and downward explosiveness does not occur when the economy is displaced from this point. When there are upward movements in the rate of accumulation, there are increases in the demand for credit. Although there are regions where growth rates are increasing and interest rates are falling, because potential credit supply is growing faster than demand, conditions in the credit market ultimately change. Demand grows faster than potential supply at the going rate of interest, which causes that rate to rise. This eventually causes the growth rate to decline. The decreases in the growth rate do not induce collapse. After the growth rate has declined sufficiently, so does the rate of interest. This relieves negative pressure on accumulation, as opportunity costs decline. In itself, this would not prevent collapse in a world where effective demand is an issue. Indeed, what prevents total collapse of aggregate demand in this model is the assumption that long-term investment plans remain steady. That is, the positive value of the coefficient a assures that once the interest rate has declined sufficiently, existing accumulation will again have positive accelerator effects.

The phase diagram in Figure 22.2 shows that the model generates a lagged pattern of responses between interest rates and accumulation rates. As the system traverses the cycle orbit, there are segments where the growth rate falls while the interest rate continues to increase. These lags come from the partial adjustment permitted by the investment function, as can be seen from equation (11). For example, when the sum of g and $\dot{g}/g$ are large enough to induce increases in r, it will take time for the negative effects of higher interest rates to reduce the sum.

In summary it might be said that the oscillatory behavior generated by this model comes from the interaction of real and financial factors. Interest rates determine upper and lower turning points in conjunction with accelerator effects. The financial sector makes its contribution to the cycle not as a source of shocks, but by being sufficiently but not infinitely accomodating in the upturn, and by aiding the process of accumulation in the downturn. Thus the idea of endogenous credit creation can be used to construct a plausible, non-Monetarist account of business cycles. The interested reader might compare these results to those of Foley (1987), who has produced similar interactions in a simulation model with trade credit; and to those of Rose (1969), which is neo-classical in orientation and derives its dynamics from disequilibria in goods and money markets.

4 CONCLUSION

The implication of this exercise is that the existence of an endogenous, but not purely passive, money supply has important implications for the understanding of capitalist economies. When the idea of endogenous credit is linked to the theory of effective demand, it is possible to construct examples of business cycles which are endogenously generated and self-sustaining. This extends the range of Goodwin's original growth cycle analysis, since it suggests that monetary, as well as reserve army factors, can interact with investment decisions to cause fluctuations. It also indicates that policy solutions are likely to be more complex than static models with exogenous money supplies usually suggest. The interaction of financial and industrial capitalists need not cause the economy to converge to a happy equilibrium. It may be the case that a goal of containing inherent instability, rather then actually exerting control, is the best to which policy-makers can aspire.

Appendix

1 Construction of phase diagrams

For the two isoclines to have the shape displayed in Figures 22.2 and 22.3, it is necessary that g_1, the value for $\dot{g} = 0$ isocline when $r = 0$, be less than g_2, the value of g for the $\dot{r} = 0$ isocline when $r = 0$. That is, the solution for g from $a + bg - dg^2 = 0$ must be less than the solution for g from $[a - \delta - \varepsilon/(\gamma-\beta)] + (b + 1)g - dg^2 = 0$. Also both values of g must be positive.

A sufficient condition for $g_2 > g_1$ is that $(2b + 1) > 4d(\delta+\varepsilon/(\gamma-\beta))$, which also assures that nonnegative value of g_2. It can be seen that the value of g_1 will be positive always.

Also, in Figure 22.2 and the maximum of $\dot{g} = 0$ is drawn a greater than the maximum of $\dot{r} = 0$. It can be shown that this is also a consequence of the sufficient condition for $g_2 > g_1$. The maximum of $\dot{g} = 0$ occurs when $g = b/2d$. Hence the value of r at $g = b/2d$, along the $\dot{g} = 0$ isocline, is $r_1 = [a + b^2/2d]/c$. The value of r at $g = (b+1)/2d$, along the $\dot{r} = 0$ isocline, is $r_2 = [(a + (b+1)^2/2d) - (\delta+\varepsilon/(\gamma-\beta))]/c$. To have $r_2 > r_1$ requires that $(2b+1) > 2d(\delta+\varepsilon/(\gamma-\beta))$. This condition will be satisfied so long as the sufficient condition for $g_2 > g_1$ is also satisfied.

To have $(a/c - \lambda_2/\lambda_1 c) > 0$ requires $a > g^*$.

2 Stability of fixed point A in phase diagrams

To examine the local stability properties of fixed point A in Figures 22.2 and 22.3, we need to apply the linearization theorem to the system given by equations (4) and (11). This allows us to treat the elements of the Jacobian

$$J = \begin{bmatrix} \partial\dot{g}/\partial g & \partial\dot{g}/\partial r \\ \partial\dot{r}/\partial g & \partial\dot{r}/\partial r \end{bmatrix}$$

evaluated at the fixed point as if they were coefficients of a linear system. Some calculation shows that

$$J = \begin{bmatrix} bg - 2dg^2 & -cg \\ r([b+1]\lambda_1 - 2\lambda_1 dg) & -\lambda_1 cr \end{bmatrix}$$

At point A, the equilibrium value of g is $g^* = (\varepsilon+(\gamma-\beta)\delta)/(\gamma-\beta)$, and that of r is $r^* = (a+ bg^* - dg^{*2})/c$. Hence $Tr(J) = (1 - \lambda_1)bg^* + 2(\lambda_1 - 1)dg^{*2} - \lambda_1 a$ and $\text{Det}(J) = \lambda_1 crg^*$. Since $\text{Det}(J) > 0$, A will not be a saddle point. If $Tr(J) > 0$, it will be unstable.

3 Relation of stability conditions to geometry of isoclines

Note that $Tr(J) > 0$ implies that $b > 2dg^*$ when $\lambda_1 < 1$. In this case the phase diagram is as drawn in Figures 22.2 and 22.3, since $b > 2dg^*$ implies $(2b + 1) > 4dg^*$, a sufficient condition for $g_2 > g_1$ and $r_2 > r_1$. When $\lambda_1 > 1$, the conditions $Tr(J) > 0$ and $(2b + 1) > 4dg^*$ together will make A an unstable point in the phase diagrams. We will assume that one of these two sets of conditions are being met.

4 Proof of the existence of a limit cycle

The existence of a limit cycle for this model can be demonstrated by geometric argument. Let $\Phi_t(g(t), r(t))$ be the evolution operator for the system (4), (11), where the operator is defined as a function of the form $(g(t), r(t)) = \Phi_{t-t^*}(g(t^*), r(t^*))$. Knowing the explicit form of Φ_t would require solving (4), (11). However, the qualitative behavior of Φ_t can be seen from the phase diagram of the system. For our purposes we are interested in the trajectory $\{\Phi_t(g_1,r_2)|t > 0\}$ in Figure 22.3, which will ultimately intersect the $\dot{g} = 0$ isocline at some point to the right of the vertical axis as shown. This point is labeled C. Now in the closed bounded set given by the curve BCD – minus the open set containing the locally unstable region around point A – there are no fixed points; and it is impossible for a trajectory within the set to exit, since trajectories of a continuous system cannot cross each other. Hence by the theorem of Poincare–Bendixson (Arrowsmith and Place, 1984, pp. 109–10), this closed, bounded positively invariant set contains a limit cycle. A limit cycle is a closed orbit on which motion is self-sustained. There may be more than one such cycle. At least one orbit will be attracting.

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Part VI
Theory of Growth

23 Change and Continuity in Kaldor's Thought on Growth and Distribution

F. Targetti

Many will agree that one of Kaldor's most outstanding theoretical contributions was his theory of growth and distribution, which he illustrated by means of models for the years 1957–62.[1] His interest in the matter did not end with this period, however, even though his subsequent research was not simply a continuation of his earlier work but revealed a change of view. Even in the fields where his work had already made him famous, Kaldor, as a true scientist, was dissatisfied with the results he had obtained hitherto and continued to extend the scope of his research.

The purpose of this paper is to compare Kaldor's theory of growth and distribution of the 1950s and 1960s (which will be referred to as Kaldor–1) with that of the 1960s and 1970s (referred to as Kaldor–2).

However, whereas Kaldor–1 is a theoretical whole in which the theories of distribution, growth and technical progress are admirably combined in a single model, the theoretical contributions of Kaldor–2 were never developed into anything approaching that level of synthesis. As he himself wrote a few months before his death: 'the development of my theoretical ideas by no means came to an end with the work on growth models. Since 1965 they have changed very drastically, though I have not been able to present the results (though perhaps I might still be able to do so in the future) in the comprehensive form of a "model"'.[2]

In Kaldor–1 the theory of growth and distribution can be synthezised by the Cambridge equation and by the technical progress function. The former of these determines the rate of profit, given capitalist propensity to consume in relation to the rate of growth; the latter determines the natural rate of growth *à la* Kaldor as a function of entrepreneurial dynamism.

I shall not dwell on the 'vexata quaestio' of the validity of the Cambridge equation when the saving propensity of wage-earners is greater than zero. What I wish to emphasize instead is that the conclusions of Kaldor–1 are based on three hypotheses: (1) the existence of only one sector (i.e. the industrial sector), which is considered as a homogeneous whole (single-sector model); (2) free competition; (3) full employment. Kaldor–2 rejects all three of these hypotheses as unrealistic and rejects also the latter two as postulates for the 'long run'. The temporal framework used by Kaldor for his analysis is neither the short run, which lacks sufficient space for analysis of technological changes, nor the very long run, to which he considers his previous theory, in its most rigorous formulation by Pasinetti, to have been confined.[3]

The main modifications that Kaldor introduces to render his theory more consistent with the characteristics of a modern industrial system are four in number: the first relates to his introduction of the hypothesis that there exist firms of different technological structure within the same industry; the second is his distinction, within the same industry, between leader-firms and follower-firms; the third is the presence in the industrial sector of increasing returns to scale; the fourth is his sub-division of the economic system into (at least) two sectors: the competitive agricultural-extractive sector and the oligopolistic industrial sector.

1 FIRST MODIFICATION

We start, as was Kaldor's usual procedure, from a 'stylized fact' – in this case, the permanence in time of firms of different levels of productivity within the same industry. Kaldor is unable to find a satisfactory explanation of the cause of this phenomenon, however he dwells on its effects on the distribution of income. The constancy of a range of productivities within the same industry is perfectly compatible, in Kaldor's view, with another 'stylized fact', commonly known as Okun's law,[4] according to which a 1 per cent increase in employment is associated with a 2 per cent increase in output. Thus, average productivity is an increasing function of employment (a result very similar to one of the versions that has been given of the Kaldor–Verdoorn law). It is a result, however, that is in contrast with the differential theory of profit shares, a theory first formulated by Rüstow in his doctorial thesis in 1926. Kaldor only became aware of Rüstow's work during the 1950s and honestly acknowledged both publicly and privately[5] that the German economist's thesis contained many of the ideas he himself had developed in the 1950s. In addition to the ideas common to both, Rüstow propounded a differential theory of profit shares. This Kaldor–2 viewed with sympathy,[6] although it conflicted with Okun's law.

The differential theory, in fact, states that, since in every industrial structure there are firms with different levels of unit costs, there exists a single value of the aggregate share of profits which enables the last worker to be hired by the least efficient firm. With an increase in demand and employment an inframarginal firm becomes profitable and the overall share of profit increases. An increase in employment is thus positively associated with an increase in the share of profit and negatively with labour productivity, which is in contrast with Okun's law and the Kaldor–Verdoorn law.

For Kaldor, these two theses can only be reconciled by abandoning the assumption that the distribution of inputs among firms or establishments obeys the law of optimum allocation, (i.e. of cost minimization) obtained by using the best plant available. It is necessary to presume instead that, under conditions of imperfect competition, the reaction of the market will differ according to whether variations of demand are gentle or sharp. During the recession phase of a normal business cycle all firms suffer from a drop in demand and the reduction of utilized capacity is more or less proportional, whereas during the recovery phase productivity increases, because the increase in the output and the decrease in average unit cost is divided among all the firms and is not concentrated in the marginal firms. Okun's law thus applies. Should there be a drastic reduction in output, however, the least efficient firm or part of the establishment is put permanently out of production. Thus Rüstow's differential theory applies.

There still remains the problem, however, that acceptance of the differential theory of profit shares entails acceptance of a positive relationship between demand and price level. This Kaldor rejects if it is not connected with the mark-up policy of the leader-firm.

2 SECOND MODIFICATION

In the Kaldor–1 models changes in prices are caused by changes in the aggregate demand. Over the next twenty years, however, Kaldor's ideas in this regard would change. In the industrial sector, conditions are oligopolistic. Hence prices do not depend on demand; neither does demand depend on prices: demand depends on income, and prices on costs. Once this general frame of reference has been established, however, many questions concerning the functioning of the non-competitive system remain unanswered.

A statement that prices are determined by costs is an over-simplification. It may be true with regard to the dynamics of prices, but it is not so with regard to the price level which at a certain moment any firm may set by increasing its costs. The device of the 'kinked curve' can explain why the prices and mark-up are rigid, but not why prices are at the level they are in relation to the costs. In order to explain the price, and thus the position of the kink, it is necessary to posit the existence of a firm (or a group of firms) which plays the role of leader. This 'representative firm' is not necessarily the most efficient or the least efficient; it is simply the one which, in collusion with or independently of the other firms, 'sets the price', and is then followed by the others.

Setting the price means establishing the mark-up. Kaldor rejects the Lerner and Kalecki idea that this is given by $e/(e-1)$ – where e is the point elasticity of the curve (not kinked) of demand. And he does so for two reasons. The first is that a firm does not know its demand curve, the existence of which presupposes that the prices of the other firms are given or identical to those of the firm that sets the price. The second is that a firm in a dynamic situation does not maximize current profit but the rate of growth of profit.

In order to maximize the rate of growth of the output and thus of the profits, the leader-firm has to pursue two contrasting objectives: on the one hand the choice of a mark-up sufficiently low to permit maintenance of the desired structure of market shares, and, on the other, the choice of a mark-up sufficiently high to maximize the increase of its own stock of capital and to minimize the recourse to external financing.[7] In fact, excessive recourse to external borrowing renders the financial structure of the firm fragile and exposed to an increasing risk of take-over bids or of dependence on the financing decisions of the banks (this is Kalecki and Minsky's idea of increasing risk).

In conclusion, therefore, the price set by the leader-firm is determined by the need to increase the stock of capital from internal sources without at the same time losing shares of the market.

3 THIRD MODIFICATION

A very controversial aspect of the Kaldor–1 models relates to the hypothesis of full employment. At the Corfu Conference of 1958 he sought to explain why, in his opinion, a model (1) confined to a single sector (2) with constant returns to scale and (3) with investments induced by the growth of income, has only one dynamic equilibrium of growth which goes with full employment. Although he did not subsequently change this opinion, he did modify the hypotheses. Once, when questioned by me on this assumption, he replied: 'in my models full employment was a silly assumption'. In order to deal with a non-full employment model of growth, he gradually modified the hypothesis of constant returns to scale and of one single sector.

With regard to returns to scale, it is of interest to note that it was to this aspect that Kaldor dedicated his first studies after graduating from the LSE fresh from the teaching of Allyn Young. He subsequently paid less attention to returns to scale, until his interest revived in the mid-1960s.

During the 1960s, Kaldor explained Verdoorn's law (which he considered applicable only to the manufacturing sector) with reference to the increasing returns to scale of this sector. This gave rise to his stimulating, controversial and always fiercely-debated theses concerning growth differences among countries.[8]

During 1970s, the increasing returns to scale were the main argument in

Kaldor's criticism of the theory of equilibrium.[9] During the 1980s, he associated increasing returns to scale with the theory of under-employment equilibrium.

In an article written in 1935 on 'Excess Capacity',[10] Kaldor had argued against Chamberlain that, without barriers and with constant returns to scale, market forces would lead to a competitive situation, even if there was product differentiation. This article was rediscovered by Weitzman, who stated that 'with a sufficient divisibility of production the unemployed are induced to create, on a level of scale proper to them, the exact replica of the economy in full employment from which they have been excluded'.[11] This led Kaldor to claim that if, when he had written the article in 1935, the Keynesian concept of equilibrium of under-employment had been known, he would have added that, with infinite divisibility of the factors, the free action of economic forces leads the system to a stable full employment.[12]

It may well be that this extreme opinion was occasioned by the satisfaction Kaldor derived from the belated discovery of one of his most important contributions, because, even with constant returns to scale, there may be a lack of demand for investments caused by a change in expectations with regard to an uncertain future. However, this does not exclude the possibility that the presence of increasing returns to scale may be a further cause of unemployment in addition to the Keynesian one. Furthermore, it may also provide a valid explanation for the *persistence* of unemployment in a growing economy.

4 FOURTH MODIFICATION

In the Kaldor–1 models, autonomous expenditure, from which the natural rate of growth à la Kaldor derives, was the rate of investment deducible by the equilibrium point on the technical progress function.

In the 1960s Kaldor increasingly transferred his attention from internal autonomous expenditure to external autonomous expenditure represented by the dynamics of export of manufacturing goods. In fact, according to Kaldor, both internal components of demand (i.e. for consumption or for investments) are 'induced'. (It should be noted that this idea is also fundamental to the model on which the New Cambridge School based its policy.) For Kaldor–2, the maximum rate of growth of a country is given by the ratio between the rate of growth of exports and the elasticity of imports to income. This holds for a single country and for an open economy. However, if the economy is closed or if the model is applied to the world economy, this autonomous expenditure disappears. And, to handle these cases (closed economy or world economy), Kaldor introduces his fourth modification, where he divides the economic system into two sectors: the primary sector and the manufacturing sector, which we shall call agriculture and industry.

Each of these two sectors depends on the other in a dual fashion: as a market for its products and as a market for the purchase of the means necessary for its own productive activity. In agriculture, because of the shortage of land, there are diminishing returns to scale which are counterbalanced by the technical progress introduced by investments of capital. Thus, the accumulation of capital and land-saving technical progress both proceed at the same rate. By contrast, in the industrial sector, output is obtained by means of paid labour, and wages are spent mostly on the purchase of agricultural products. In agriculture, the amount of capital goods that can be purchased is determined by the difference between the amount of agricultural output and the amount self-consumed. In industry, the production of capital goods generates profits and hence the income necessary to finance it. Investment decisions depend on the expected demand for the products in the sector. This latter arises from the reinvestment in the sector of a part of the sector's production and by the demand coming from the agricultural sector. A change of the demand in the industrial sector entails a change in the output of the sector, while a change of demand in the agricultural sector entails a change in monetary prices.

This model, where the two sectors have different technological characteristics and different market structures, gives rise to a two-stage analysis. The first stage concerns assessment of the conditions of the dynamic equilibrium of growth of the system as a whole;[13] the second relates to analysis of the stability of the equilibrium.

If we use p to stand for the terms of trade between two sectors (that is, the quantity of primary products given in exchange for a unit of industrial production), the rate of growth of the primary sector g_a will be an inverse function of p, and the rate of growth of the manufacturing sector g_m will be a direct function of p. The situation of equilibrium determines the exchange relationship between the two sectors p^* that must obtain if they are to grow at a rate of g^* (equal for both), this being the maximum growth rate of the one sector that is compatible with the maximum growth rate of the other. At a growth rate of g^* the two sectors grow without demand or supply constraint. Demand exogenous to the industrial sector is thus endogenous to the system as a whole. A position of equilibrium exists in principle (as in Harrod–Domar), although is necessary to verify whether it is stable. The position of equilibrium reflects the complementarity of the two sectors. The stability of the equilibrium, on the other hand, is to be analyzed on the basis of the different hypotheses of behaviour of the two sectors. The difference of behaviour is responsible for the structural instability of the equilibrium. If the parameters change, the terms of trade

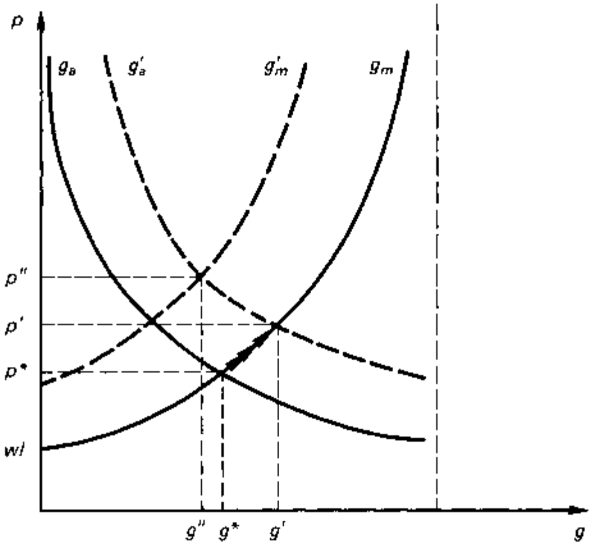

Figure 23.1

do not always perform the equilibrating function that should render the growth rates of the two sectors compatible.

The terms of trade perform the equilibrating function when the shifts in the growth functions of the two sectors are moderate; if they are sharp the outcome may be very different.[14] A sharp shift to the right of the curve g_a, caused for example by a major technical advance in agriculture, leads to a considerable increase in the supply of primary products. If there exist private wholesalers or public institutions with sufficient 'finance' available to enable them to buy larger quantities at (monetary and real) prices which are slightly lower, but which are such that they induce the industrial sector to purchase more primary products, there will be an increase in p and, at the same time, an increase in the growth rate of the industrial sector (a move along the curve g_m): this new position of equilibrium will be at higher values of g^* and p^*. If these conditions of finance do not exist and the wholesalers postpone buying primary products while they wait for the (monetary) price of these products to drop further,[15] the income of the agricultural sector drops, demand in the industrial sector drops, thus inducing pessimistic expectations in this sector with a consequent diminution in the process of investment (along Keynesian lines). The result will be a shift to the left of the curve g_m. The final outcome could be a lower equilibrium growth rate in both sectors, g''. The model is also able to illustrate the more complex phenomenon of stagflation,[16] as well as provide a theoretical basis for the proposals which Kaldor advocated from

1964[17] until his death concerning the reform of the international monetary system by means of the institution of an international currency, the injection and the withdrawal of which into the international market should be governed by the growth and fall in the stocks of primary products held by the international monetary authorities. In this way growth would be assured to the international economic system free from inflationary or deflationary tensions.

5 CONCLUSIONS

As we have seen, Kaldor's thought concerning growth and distribution underwent substantial changes over thirty years. Nevertheless, despite these changes, there is an underlying continuity in his thinking on certain matters.

Kaldor was a thinker in the great English tradition of political economy, one who benefited from the influences of Smith, Ricardo, Marx and Keynes. From Adam Smith he inherited his interest in the connection between the dynamics of the economic system and technical progress (which took the form of the technical progress function in Kaldor–1 and of increasing returns to scale in Kaldor–2). From David Ricardo he inherited his constant interest in the distribution of income among the classes and his interest in the sector producing with decreasing returns to scale as the only true final constraint on growth. In fact, in the two-sector model the maximum rate of growth of the system is given by land-saving technical progress.[18]

From Marx and Keynes he inherited his interest in the possibility of crises (or 'market failures'). Although this is evident in the two-sector model of Kaldor–2, it was not so in the growth models of Kaldor–1, however it should not be forgotten that at the Peking Conference in 1956 he gave several reasons why the equilibrium rate of growth in his model might not be achieved or perpetuated.[19] There is also a convergence between Marxian ideas of unequal development and Kaldor's idea that increasing returns to scale are responsible for cumulative differences in the growth rates of areas and countries.

From Keynes, Kaldor also inherited two principles which permeated the whole of his thought. The first of these is that the labour market determines monetary wages but not real wages, and that a reduction in wages does not have beneficial effects on employment. This result is reinforced by the introduction of increasing returns to scale, by means of which not only a drop in money wages but also in real wages does not lead to higher employment. The second Keynesian influence relates to the determinant of the growth of the output which, in the mature industrial societies, is to be found in an autonomous component of effective demand; it thus follows that a shortage of savings or of capital (depending on whether the analysis is static or dynamic) is not a constraint on economic growth, whereas what might constitute a constraint is the lack of 'finance'.

Notes

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18. Kaldor once said to me: 'I don't understand why when I speak about my theory in America I find so little interest in my ideas about the importance of land-saving technical progress.'
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24 Technical Change, Growth and Distribution: A Steady-state Approach to 'Unsteady' Growth on Kaldorian Lines*

H. D. Kurz

1 INTRODUCTION

One of Bert Brecht's *Geschichten vom Herrn K.* goes like this. A man who had not seen Herrn K. for a long time greeted him with: 'You haven't changed at all!' 'O' said Herr K. and grew pale.

Nobody could possibly say the same about Nicholas Kaldor, the economist. One of his most engaging qualities was the readiness with which he was prepared to recant his former opinions, if new theoretical results or additional empirical evidence deemed it necessary. Kaldor at the beginning of his academic career fell victim to 'the almost hypnotic power of Walras' system of equations', and then, after the publication of the *General Theory*, became 'an easy convert to Keynes' (Kaldor, 1986a, pp. 6–7). In terms of economic method Kaldor expressed a growing disenchantment with the deductive *a priori* method and pleaded for the adaptation of the tools of theoretical analysis to solve practical problems (see, for example, Kaldor, 1976, pp. viii–xiii). There is no single field of economic analysis to which Kaldor contributed where his opinion remained unaffected and constant, just as there are altogether few fields to which he did not contribute something of importance.

A case in point is his approach to the problem of growth and distribution. In the late 1950s and early 1960s Kaldor elaborated what was to

* Some of the ideas contained in the present paper have been presented on various occasions, in classes at the New School for Social Research and the University of Bremen, in a seminar at the Department of Economics of the RWTH Aachen in November 1986 and in conversations I had with several friends and colleagues. I benefitted particularly from discussions I had with P. Garegnani, H. Hagemann, P. Kalmbach, A. Lowe, E. J. Nell, S. Parrinello, N. Salvadori and J. Steindl. I am grateful to A. Bhaduri, G. C. Harcourt and I. Steedman for helpful comments on an earlier draft of this paper. It goes without saying that the responsibility for the views expressed in this paper rests entirely with the author.

become known as the 'neo-Keynesian' growth theory.[1] However, the development of his theoretical ideas on the issue had by no means come to an end with this work. From the mid-1960s onwards they changed rather drastically as he gradually perceived serious shortcomings in his earlier contributions. Although Kaldor was not given the opportunity to put his thoughts into the coherent and comprehensive form of a 'model', it is clear from his writings exactly where he considered the 'neo-Keynesian' model to be most assailable. His list of major shortcomings reads:[2]

First, the model lacks 'microeconomic foundations', to use modern phraseology. That is, it needs to be supplemented by an analysis starting at the level of the single decision-making unit and in particular a theory of how prices are determined in competitive and oligopolistic conditions, respectively. Second, the model presupposes some kind of exogenous limits to economic expansion in terms of a given 'natural' rate of growth, to which the rate of accumulation and growth is taken to become 'attuned'. Hence it is assumed, that, as a rule, the economic system is resource constrained rather than demand constrained. Yet this is not a valid assumption for analysing an open advanced capitalist economy, the resource endowment of which (except for natural resources) cannot be considered as exogenously given. In particular, there is no evidence in support of the view that there was a lasting limitation of post-war growth in Western Europe due to an insufficient labor supply. Because of worldwide existing reserves of labor power, regional bottlenecks can, and indeed were, overcome by changes in the participation ratio or workers' migration. Third, the neo-Keynesian growth model is a single sector model which treats all productive activity as if it exhibited the same characteristics, i.e. those typical of the secondary sector of the economy. However, there are fundamental differences in technology, market structure and competitive conditions between this sector and the primary and tertiary sectors. Furthermore, sight is lost of the fact that these sectors are largely complementary to each other. In particular, it has to be taken into account that the 'Keynesian' manufacturing sector is dependent on a 'non-Keynesian' primary sector, whether domestic or foreign, both for its inputs and for the growth of effective demand for its output. Fourth, due to economies of scale in manufacturing, the process of industrial development is subject to the principle of 'circular and cumulative causation'.

The purpose of the present paper is to follow up a few of Kaldor's suggestions within the framework of an exceedingly simple macroeconomic model. It is not claimed of course that the model is a faithful representation of what Kaldor had in mind.

Unless otherwise stated, the argument will be developed in terms of the following assumptions. The closed economy produces manufactured products only. There are only two classes, workers and capitalists, and two kinds of incomes, wages and profits. There are two kinds of workers, 'manual' workers and 'supplementary' or 'overhead' workers. While manual workers are employed in proportion to the level of production, overhead workers are employed in proportion to the capital stock in existence. Both kinds of workers are, for convenience, assumed to be paid the same wage rate. In accordance with Kaldor's later writings we shall assume that there is no lasting limitation of economic expansion due to an insufficient supply of either of the two different kinds of labor. The level of production is determined by aggregate effective demand, which, in a closed economy without state, consists of consumption demand and investment demand. While all wages are spent on consumption, a given and constant fraction of profits is saved. The rate of depreciation of plant and equipment, which is equal to the drop-out rate, depends on capacity utilization. The latter is given by the ratio of actual production to productive capacity. Since it is assumed that production will not be constrained by the supply of labor or raw materials, productive capacity is proportional to the available capital stock. For the sake of simplicity we shall retain the convenient premise of constant returns to scale throughout the economy. Changes in average labor productivity are therefore either due to changes in the degree of capacity utilization, given the technical conditions of production, or to changes in these conditions, given the degree of utilization. Prices of manufactured products are determined by mark-up pricing. This implies that the real wage rate is ascertained once the mark-up (and thus the 'degree of monopoly') is given.

The attentive reader will have noticed that the premises underlying the present analysis show a markedly Kaleckian flavour. This is hardly surprising, given the fact that over time Kaldor's position in important respects tended to become closer to that of Kalecki's. Here attention can be drawn to the following passage which may also serve as a key-note to the subsequent investigation: In manufacturing markets 'uncertainties concerning the future growth of demand mainly affect the degree of utilization of capacity; it pays the manufacturers to maintain capacity in excess of demand and keep the growth of capacity in line with the growth of demand. They are in a position to do this precisely because in the absence of keen price competition their profits will be large enough to finance new investment on a continuing basis. Prices are changed too, but these [changes] happen mainly as a result of changes in costs' (Kaldor, 1986b, p. 193).

The structure of the paper is as follows. Section 2 presents the basic model of production and expounds the relationship between the real wage rate, the realized rate of profits and the degree of capacity utilization inherent in it. Section 3 is devoted to an analysis of the long run. Subsection (1) expounds the savings function chosen and in some detail alternative specifications of the investment function. The latter concept is introduced in order to be able to carry out a couple of thought experiments, which may be of some help to understand certain aspects of the process of growth and distribution. The analysis is in terms of steady-state equilibria characterized by triples consisting of the growth rate, the real wage rate and the degree of capacity utilization. In sub-section (2) a typology of sets of steady-state equilibria, or 'growth regimes', is presented. According to the shape of the relationship between the equilibrium values of the rate of growth, the wage rate and the level of utilization we shall distinguish between what will be called the 'Keynesian', the 'overaccumulation', the 'underconsumption' and the 'neo-Classical' regime. Section 4 is dedicated to an analysis of different forms of technical progress and their impact on the growth performance of the system. Sub-section (1) raises the question whether a study of steady states will help us to come to grips with what Kaldor called the 'stylized facts' of macroeconomic history. Sub-section (2) deals with different forms of technical progress; it is shown that these may involve shifts between different growth regimes, given the savings and the investment function. This finding, it is argued, may contribute to an explanation of the experienced pattern of 'unsteady' growth. The model is then used to deal with a particular case: the so-called 'micro-electronics revolution'.

2 WAGES, PROFITS AND CAPACITY UTILIZATION

Let us start with an exposition of the simple macroeconomic model of a closed economy without state which will provide the analytical framework of the following discussion. Let Q be the level of gross output, p the price level, K the stock of capital in existence, d the rate of depreciation, which is assumed to be equal to the rate of drop-out of equipment,[3] π the rate of (net) profits, a the input of 'manual' labor necessary per unit of output, b the quantity of supplementary or 'overhead' labor employed per unit of capital, and w the uniform money wage rate. Hence we have

$$Qp = (d + \pi)Kp + waQ + wbK. \tag{1}$$

Dividing through by Qp gives

$$1 = (d + \pi + \omega b)K/Q + \omega a, \tag{2}$$

where $\omega = w/p$ is the real wage rate. The capital-output ratio K/Q observed at any given moment of time may be conceived as reflecting both a technical and a demand element, i.e.

$$\frac{K}{Q} = \frac{K}{Q_c}\frac{Q_c}{Q} = \frac{v}{u}\ , \tag{3}$$

where Q_c is output capacity, v is the capital-capacity ratio and u the degree of capacity utilization. Depreciation will be assumed to consist of two components, one autonomous, the other positively related to capacity utilization:

$$d = \delta + \varepsilon u, \quad \text{where } 1 > \delta, \varepsilon > 0 \quad \text{and } \delta + \varepsilon < 1. \tag{4}$$

Taking into account (3) and (4), (2) becomes

$$1 = (\delta + \pi + \omega b)v/u + \varepsilon v + \omega a. \tag{5}$$

Solving for π:

$$\pi = [1 - (\varepsilon v + \omega a)]\frac{u}{v} - (\delta + \omega b). \tag{6}$$

(6) gives the $\pi - \omega - u$ *frontier*, that is, the locus of all combinations of the rate of profits, the real wage rate and the rate of capacity utilization compatible with the system of production under consideration. The frontier is depicted in Figure 24.1, with u attaining its maximum level $u = 1$ in the origin of the π and the ω-axes.

Setting $\pi = 0$ gives a relationship between what may be called the *break-even degree of utilization* $\hat{u}$ and the real wage rate,[4] i.e.

$$\hat{u} = \frac{(\delta + \omega b)v}{1 - (\varepsilon v + \omega a)}, \text{ where } \frac{d\hat{u}}{d\omega} > 0 \text{ and } \frac{d^2\hat{u}}{d\omega^2} > 0. \tag{7}$$

Clearly, for any given (feasible) level of the real wage rate (rate of capacity utilization) the rate of profits is an increasing (decreasing) linear function of the rate of capacity utilization (real wage rate), i.e.

$$\frac{\partial \pi}{\partial u} = \frac{1 - (\varepsilon v + \omega a)}{v} > 0, \quad \frac{\partial^2 \pi}{\partial u^2} = 0$$

and

$$\frac{\partial \pi}{\partial \omega} = - \frac{au}{v} - b < 0, \frac{\partial^2 \pi}{\partial \omega^2} = 0.$$

The maximum rate of profits is given by

$$\pi_{\max} = (1/v) - \delta - \varepsilon$$

and corresponds to $u = 1$ and $\omega = 0$. The maximum real wage rate

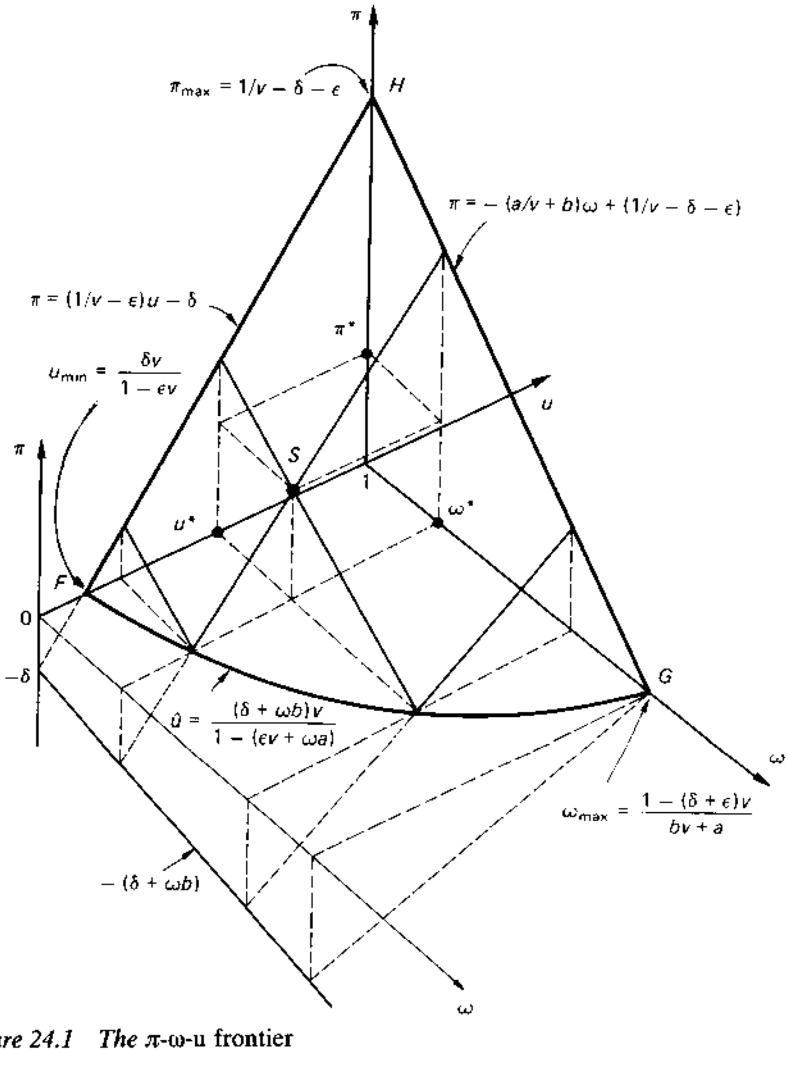

Figure 24.1 The π-ω-u frontier

compatible with a non-negative rate of profits is obtained by setting $\hat{u} = 1$ in equation (7):

$$\omega_{max} = \frac{1 - (\delta + \varepsilon)v}{bv + a}.$$

For a given real wage rate and a given degree of utilization the rate of profits is determined. For example, with $\omega = \omega^*$ and $u = u^*$ the rate of profits realized per unit of capital installed is equal to π^*.

Another way of displaying the relationship between the two distribution variables and the degree of capacity utilization is in terms of *iso*-ω, *iso*-u and *iso*-π curves (see Figure 24.2). Figure 24.2(a) shows π as a function of u for alternative (feasible) levels of ω; both the slope of the function and the intercept with the negative branch of the π-axis increase with rising levels of ω. Similarly, Figure 24.2(b) plots π against ω for alternative levels of u, and Figure 24.2(c) ω against u for alternative levels of π.

Before we turn to an analysis of the working of the investment-savings mechanism in the long run, it is worth pointing out that due to the existence of fixed labor inputs in the model presented average labor productivity, $q = Q/L$, is an increasing function of capacity utilization, i.e.

$$q = \frac{u}{bv + au}, \tag{8}$$

where $dq/du > 0$ and $d^2q/du^2 < 0$.[5]

Now we come to long-run analysis. The method adopted is that of *comparative dynamics*. Our main concern will be with alternative steady-states of the simple economy under discussion.

3 THE LONG RUN

In this part the assumption of a given technique characterized by coefficients a, b, v, δ and ε and that of a real wage rate given from outside the system will be retained. Both assumptions will be relaxed in the subsequent part, which is concerned with an analysis of different forms of technical progress and their impact on the long run dynamics of the model.

(1) Accumulation and Growth

To begin with, let us write the savings function

$$S = s\pi K, \tag{9}$$

with s, $0 < s \leqslant 1$, as the fraction of net profits that is saved,[6] in the form

$$\sigma = \frac{S}{K} = s\pi = s\{[1-(\varepsilon v + \omega a)]\,\frac{u}{v} - (\delta + \omega b)\}, \tag{10}$$

where σ is the planned savings-to-capital ratio. The savings function is

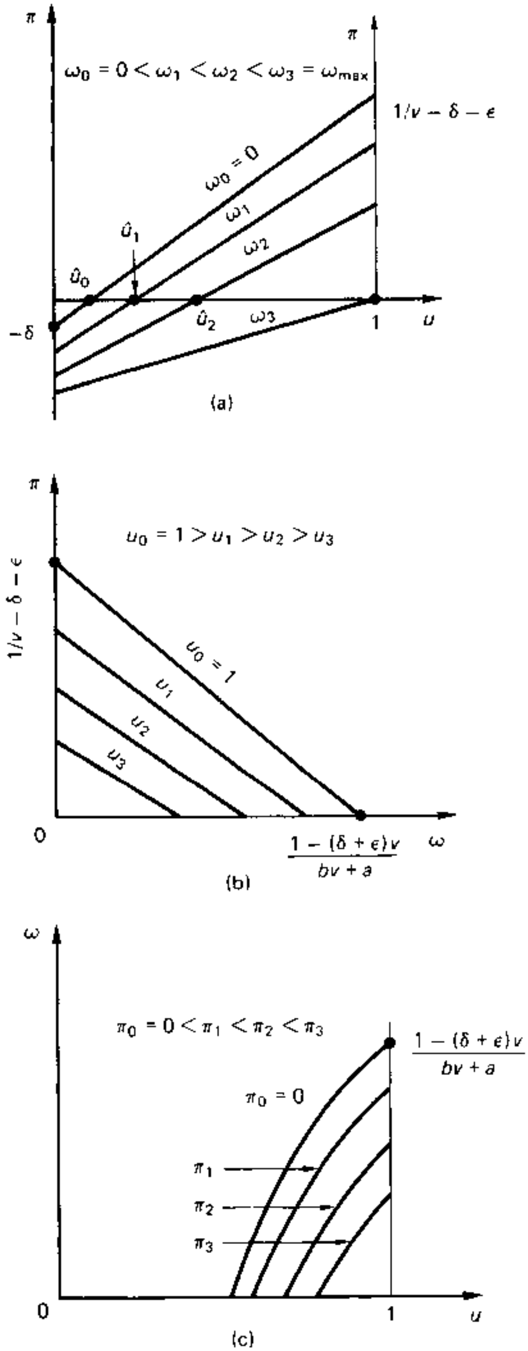
π
π
ω0 = 0 < ω1 < ω2 < ω3 = ωmax
1/v − δ − ε
ω0 = 0
ω1
ω2
ω3
û1
û0
û2
−δ
1
u
(a)
π
u0 = 1 > u1 > u2 > u3
1/v − δ − ε
u0 = 1
u1
u2
u3
0
1 − (δ + ε)v
bv + a
ω
(b)
ω
π0 = 0 < π1 < π2 < π3
1 − (δ + ε)v
bv + a
π0 = 0
π1
π2
π3
0
1
u
(c)

Figure 24.2

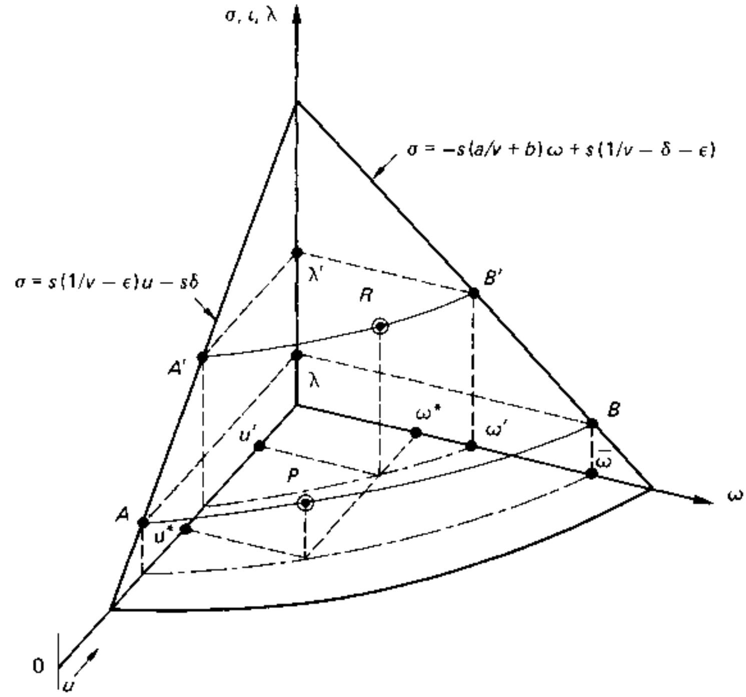

Figure 24.3 The savings function and steady growth

illustrated in Figure 24.3, which is easily derived from Figure 24.1 by multiplying each value of π by the given savings ratio out of profits, s.

Next we turn to an avowedly much more difficult and disputed bit of analysis: the modelling of investment behavior. Clearly, an investigation of the factors affecting the long-run levels of investment is of crucial importance to any theory of accumulation. Yet it is doubtful that our efforts in this direction will ever lead to a sensible representation of investment behavior in terms of a functional relationship between the time rate of accumulation on the one hand and a few determinants and parameters on the other.[7] Joan Robinson on account of the presently unsatisfactory state of economic knowledge dismissed the idea: 'We have not got far enough yet to put it into algebra' (1962, p. 101). Kaldor, at times, appears to have been less pessimistic. The fact however that he constantly revised his own theory of investment is indicative of the difficulties involved.[8] The search for a proper specification of a thing called 'investment function' is indeed reminiscent of the search for a will-o'-the-wisp. Despite the reservations expressed, we shall in the following start from the assumption of a given investment function.

The simplest way of approaching the problem is by taking the rate of capital accumulation, $\imath$, as given exogenously by the 'natural rate of growth' (i.e., the rate of growth of the labor force in efficiency units), λ:

$$\imath = \frac{I}{K} = \lambda. \tag{11}$$

This was Kaldor's procedure in his early contributions to the neo-Keynesian theory of growth and distribution (cf. Kaldor 1956, 1957 and 1958, reprinted in 1976). Steady-state equilibrium then requires

$$\sigma = \imath = g, \tag{12}$$

where g is the steady-state rate of accumulation which is equal to the rate of growth of the economy. We see from Figure 24.3 that with $g = \lambda$ there exist infinitely many steady-state solutions, the locus of which is given by the curve AB. Fixing the real wage rate involves the determination of a particular steady state from the set of feasible ones. For example, with $\omega = \omega^*$ the steady state we are in search of is indicated by P; the corresponding equilibrium degree of capacity utilization is u^*.

As is well known, Kaldor, in his contributions just mentioned, did not close the system in terms of a given real wage rate. He rather assumed full capacity utilization, i.e. $u = 1$, and treated the real wage rate as the dependent variable which has to take care of the adjustment of σ to the predetermined rate of growth of the system. Thus in the case depicted in Figure 24.3, the equilibrium wage rate corresponding to the given rate of growth, λ, is $\omega = \bar{\omega}$. It comes as no surprise that under these circumstances a higher rate of growth, λ', is of necessity associated with a lower real wage rate, ω', since there is no excess capacity to accommodate a more rapid expansion of the economy. In contradistinction to the Kaldorian theory, in the alternative approach sketched above a 'rise' in the rate of growth need not lead to a fall in the real wage rate. This is illustrated by the new steady state R, which is characterized by the same real wage rate ω^* combined with a higher degree of utilization u'.[9]

A more interesting kind of modelling investment behavior conceives the rate of capital accumulation as a function of the expected rate of profits, which, for convenience, is set equal to the current rate, and the current degree of capacity utilization. If, for simplicity, we express this function in linear form, we have

$$\imath = \alpha' + \beta' \pi + \gamma' u, \tag{13}$$

where both α', β', and γ' are positive parameters. α' represents autonomous net investment (as a proportion of the capital stock). With regard to

$\beta'\pi$ it suffices to notice that high current profitability will normally favour optimistic expectations as to future profitability; provide large internal funds for accumulation; and facilitate the acquisition of external funds. $\gamma' u$ postulates an independent positive impact of higher levels of utilization on investment, that is, one which does not exert its influence through its effect on the rate of profits. This term may be viewed as some reflection of the idea underlying the famous principle of the accelerator. According to another interpretation (cf. Steindl, 1952, pp. 10–12), firms in given competitive conditions for a variety of reasons aim at the preservation of a certain margin of excess capacity; hence if $(1-u)$ should fall below the desired margin, firms tend to speed up the pace of accumulation. (Since in what follows we shall not pursue this latter idea we may abstain from reformulating (13) so as to render it consistent with the concept of a planned margin of idle capacity.)

Investment functions of the form (13), or of similar forms, have been used by authors such as Kalecki, Steindl and also Kaldor.[10] In what follows, we shall adopt a variant of it. The modification proposed is motivated by the fact that in (13) the influence of income distribution on the one hand, and effective demand on the other on the level of investment is somewhat blurred.[11] In order for a clear-cut distinction between the two different types of influences to obtain, it is close at hand to refer back to the concept of the *mark-up*. As is well known this concept occupied a central role in Kalecki's analysis; interestingly, it was also advocated by Kaldor in some of his later writings.[12]

Indeed, as Steindl (1987) has pointed out, theoretically the function of the mark-up is to enable us to distinguish between those changes in profits which follow from a firm's power to charge higher prices in relation to cost and those which merely result from variations in the level of capacity utilization. In the simple model expounded in the above, prime costs consist of wages of manual workers only. Hence the equation reflecting the price setting behavior of firms reads

$$p = (1 + \mu)wa, \tag{14}$$

where μ is the mark-up. Dividing by p gives

$$1 = (1 + \mu)\omega a, \tag{15}$$

with $\mu\omega a$ as gross profits (including depreciation and the wages of overhead workers) in real terms per unit of output. Clearly, fixing the mark-up involves ascertaining the real wage rate, and *vice versa*. The Kaleckian 'degree of monopoly' as a 'pure' measure of the going balance of power in the conflict over the distribution of income is defined as $\mu/(1 + \mu)$. Because of (15) we have

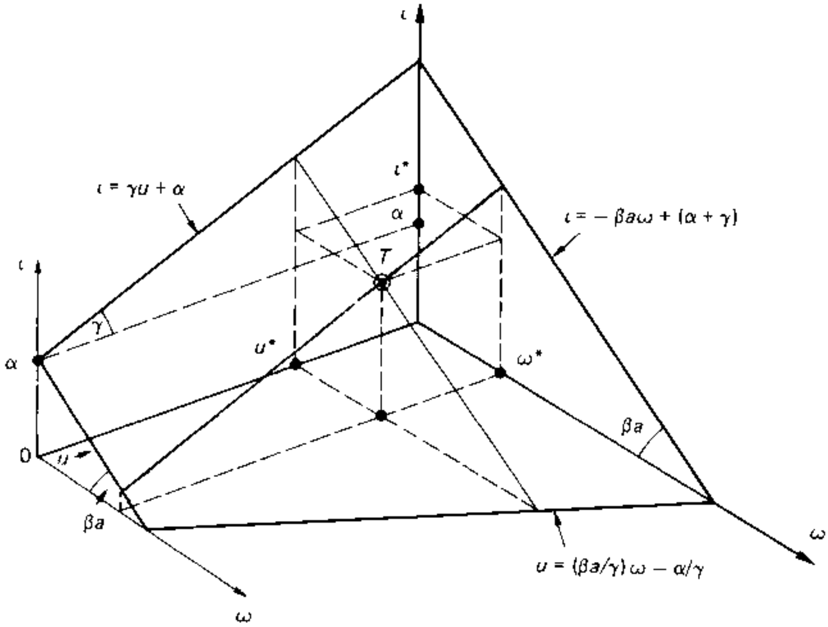

Figure 24.4 The investment function

$$\frac{\mu}{1 + \mu} = 1 - \omega a. \tag{16}$$

We may now replace (13) by an expression which relates investment to $\mu/(1 + \mu)$ instead of to π. Taking into account (16), we may write:

$$\iota = \alpha - \beta\omega a + \gamma u, \tag{17}$$

where α, β and γ are non-negative constants. This (crude) investment function is illustrated in Figure 24.4. With $\omega = \omega^*$ and $u = u^*$, for example, the desired rate of accumulation will be ι^*; see point T in Figure 24.4. Special cases of (17) characterized by particular numerical values assigned to parameters α, β and γ may be discussed at will. Here it suffices to notice that a larger β (γ), other things being equal, decreases (increases) ι for any given value of ω (u), given the value of u (ω). Unless otherwise stated, we shall in what follows develop the argument in terms of (17).

We are now in a position to determine the set of steady-state equilibria implied by the savings function (10) and the investment function (17). Setting σ equal to ι yields

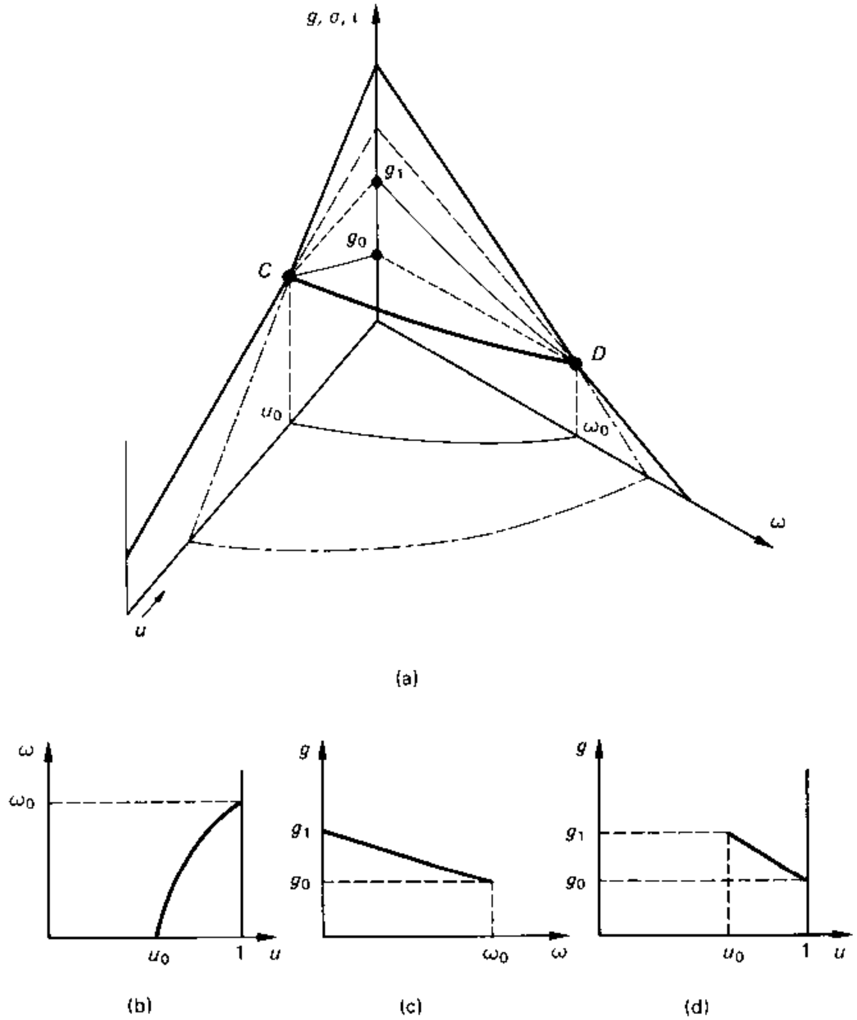

Figure 24.5 The locus of steady-state equilibria (regime of 'overaccumulation')

$$u = \frac{\alpha - \beta\omega a + s(\delta + \omega b)}{[1 - (\varepsilon v + \omega a)]\frac{s}{v} - \gamma}. \tag{18}$$

A particular constellation of the two functions is illustrated in Figure 24.5(a); the locus of steady states is given by the line of intersection *CD*. Figures 24.5(b)–(d) contain projections of this locus on the $\omega - u$, the $g - \omega$, and the $g - u$ planes, respectively.

Before proceeding with the general argument, it deserves to be mentioned that the 'stability' of the steady-state equilibria requires the savings function to be intersected by the investment function from above as in Figure 24.5. We shall assume throughout this to be the case.[13]

After these preparatory considerations we may now develop a typology of 'regimes' of steady-state equilibria, or, for short, of 'growth regimes'.

(2) Typology of Growth Regimes

Depending on the exact shape of the investment function in relation to the savings function we get different loci of sets of steady-state equilibria. These may be grouped together in so-called growth regimes; Table 24.1 characterizes the three relevant types of regimes, border cases excluded.

Table 24.1

		$dg/d\omega$	dg/du	$du/d\omega$
	I	−	−	+
Regime	II	+	+	+
	III	−	+	−

Regime I: This regime is illustrated in Figure 24.5. For a given value of α it presupposes relatively large values both of β and γ.[14] A low level of the real wage rate, that is, a high mark-up, and thus low levels of consumption imply a high rate of accumulation, which however is associated with a low degree of capacity utilization. We may refer to this case as the *regime of overaccumulation*, or, for short, the *O*-regime.[15]

Regime II: Here β and γ assume relatively small values, given α. An illustration is provided by Figure 24.6. High real wages are both favourable to capacity utilization and the growth of the system. Moreover, as can be seen from (8), average labor productivity is positively related to the level of utilization of productive capacity. Conversely, low growth, low productivity and large margins of idle capacity are associated with low real wages, that is, high levels of the mark-up. Typically, this is the *regime of underconsumption*, or, for short, the *U*-regime.

Regime III: In comparison to regime I this case is characterized by still larger values both of β and γ, given α. Accordingly, the locus of steady-state equilibria may look like the one depicted in Figure 24.7. The rate of accumulation and growth as well as the degree of capacity utilization are negatively related to the real wage rate. A freak case apart, under these circumstances a state of full capacity utilization ($u = 1$) is not attainable. Given these features, we may, for convenience, speak of the *Keynesian regime*, or, for short, the *K*-regime.[16]

Interestingly, the same features as those of regime III can be obtained

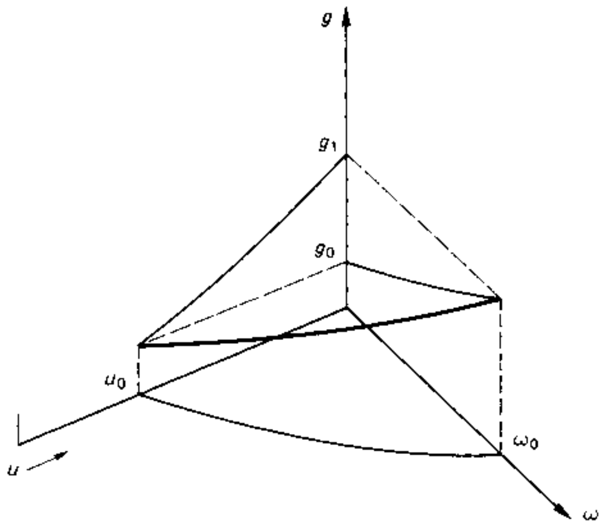

Figure 24.6 Regime of 'underconsumption'

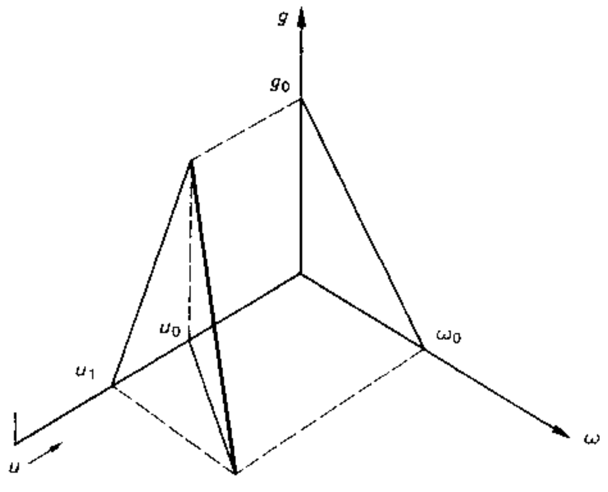

Figure 24.7 The 'Keynesian' regime

with a slightly modified investment or savings function. However, the graphical representation of this 'twin' case looks completely different (see Figure 24.8). While growth and utilization are inversely related to the real wage rate, this regime allows full capacity growth (at ω_o in Figure 24.8). In the case under consideration the elasticity of growth and utilization with respect to changes in the real wage rate is relatively large. Since opinions to

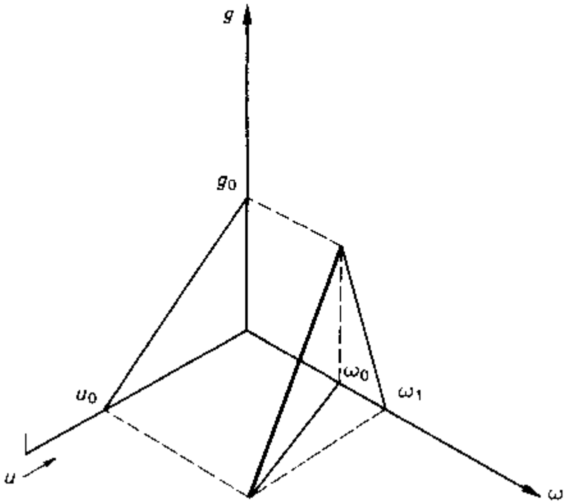

Figure 24.8 The 'neo-Classical' regime

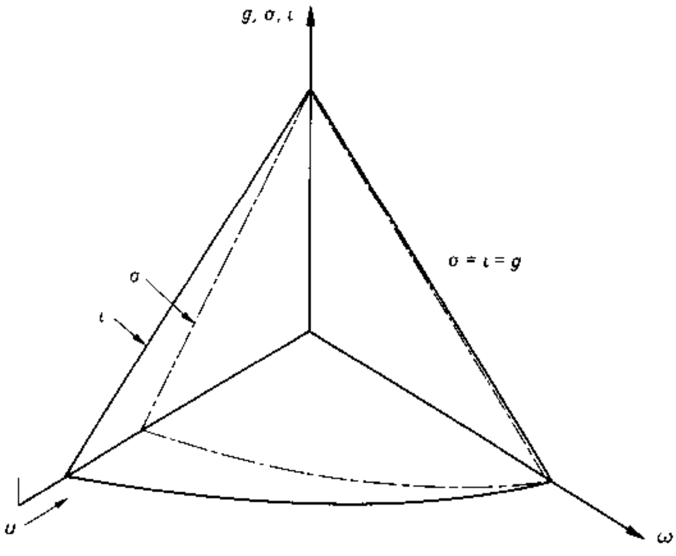

Figure 24.9 The 'Kaldorian' regime

this effect are prominent among neo-Classical economists, we may speak of the *neo-Classical regime*, or, for short, the *N*-regime.

To conclude this section, we may come back to Kaldor's neo-Keynesian theory of growth and distribution. Within the framework of the present model, the Kaldorian theory emerges as a particular case characterized by an intersection between the investment and the savings function along the relationship between σ and ω at $u = 1$ (see Figure 24.9). Such a constellation, which may be christened *Kaldorian regime*, results for example with the following special kind of investment function:

$$\iota = s\pi + \psi(1 - u) = \psi + s\pi - \psi u,$$

where $\psi > 0$. (As to Kaldor's closure of the system, see the preceding section.)

Next we come to an analysis of different forms of technical change and their impact on the steady-state solutions to the model under consideration.

4 TECHNOLOGICAL CHANGE, DISTRIBUTION AND GROWTH

Within the confines of the simple model presented, technical progress is reflected in variations in the socio-technical coefficients of production. In what follows we shall, for simplicity, develop the argument in terms of *once for all* variations in one or several of these coefficients. Our main concern will be with comparisons of entire pre- and post-technical change growth regimes on the one hand and particular pre- and post-technical change steady-state equilibria on the other.

(1) Steady States and 'Stylized Facts'

The main thrust of the argument is the following. Technical change, by affecting the conditions of production, of necessity affects the savings function (10) and possibly also the investment function (17).[17] Since the impact on the two functions will be different and depend on the particular form of technical change contemplated, technical change will generally give rise to a new set of steady-state equilibria. More importantly, starting from a given regime of growth, technical change may involve a *shift* to a different regime.

We may pause here for a moment and turn briefly to the methodological position underlying most of Kaldor's earlier contributions to the problem of growth and distribution. As is well known, Kaldor was of the opinion that a study of steady states will help us to understand what he used to call the 'stylized facts' of macroeconomic history of advanced capitalist countries.[18] Now it was Hicks who contended: 'In the "golden age" of the sixties, as it appears in retrospect, a steady-state model seemed often to be acceptable as an approximation to reality: in the darker days that have followed it is less appealing' (1985, p. 10). A similar opinion has been expressed by Kaldor on various occasions.[19] However, in the light of what has been said above it is not clear that this is so. Indeed, the finding arrived at within the framework of pure steady-state analysis that technical change may 'erode' and eventually 'transform' a given growth regime, is perhaps of some use to explain a striking feature of the recent past: the remarkable slowdown of growth of output as a whole and of labor productivity, or, more generally speaking, the experienced pattern of 'unsteady' growth. As should be clear from what has been said, an important cause of this pattern is to be sought in different forms of technical progress dominating consecutive historical periods and giving rise to a succession of vastly different growth regimes.[20]

As to comparisons of particular steady-state equilibria before and after technical change, the question arises which equilibria to select from the feasible sets. Taking the mark-up as given from outside the system and in the first place assuming it to remain unaffected by technological innovations,[21] it follows from (15) that the real wage rate must rise in proportion to the rise in the productivity of direct or 'manual' labor, that is,

$$\frac{d\omega}{\omega} = - \frac{da}{a} \tag{19}$$

For a given initial level of the real wage rate (corresponding to the given mark-up) and a given increase of direct labor productivity, the post-technical change level of the real wage rate is uniquely determined.[22] It needs to be stressed, however, that the sole purpose of the postulated 'real wage-mechanism' is to provide us with a bench-mark against which the effect of *changes* in income distribution, conceived as variations in the 'degree of monopoly', on the (steady-state) performance of the system can be dealt with.

The ground is now prepared for an analysis of various forms of technical progress. Since with altogether five coefficients of production the number of different forms to be distinguished is already quite large, and because the 'mixed' forms may be constructed by way of combining 'pure' forms (of technical progress and 'regress'), we shall focus attention mainly on the latter.

(2) Different Forms of Technical Progress

We begin with a discussion of the only pure form of technical progress which affects both the investment and the savings function.

(i) Direct labor saving technical progress. A reduction of coefficient a moves both the point of intersection of the savings function (10) and that of the investment function (17) with the ω-axis further away from the origin, whereby the latter move is relatively larger. The implication of this for possible shifts between growth regimes is illustrated in Figure 24.10. The arrows indicate that in the present case the change of regimes is anti-clockwise. Thus, starting from a K-regime, an increase in manual workers'

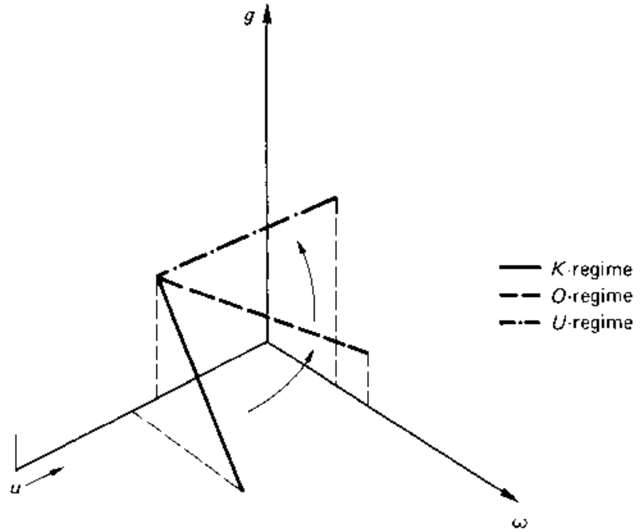

Figure 24.10 Direct labor saving technical progress

productivity will at some point entail a shift to the *O*-regime and eventually to the *U*-regime; while with an *N*-regime ruling initially, the system will stay in it, with the regime's features becoming ever more pronounced. (The latter case is not depicted in Figure 24.10.) In short, arranging the four regimes in a circle, the case under consideration can be put as follows:

$$\begin{array}{cc} K & N \\ \downarrow & (\uparrow) \\ O \rightarrow & U \end{array}$$

As to a comparison of distinct equilibria before and after the occurrence of direct labor saving technical progress, we best start from (18), which, for convenience, will be rewritten in the following form:

$$u = \frac{\alpha + s\delta - \beta\omega a + s\omega b}{z} \tag{18'}$$

where z stands for the denominator in (18). Differentiating (18') with respect to a,

$$\frac{du}{da} = \frac{\partial u}{\partial a} + \frac{\partial u}{\partial \omega}\frac{d\omega}{da}$$

and taking into account the postulated wage adjustment rule (19) yields

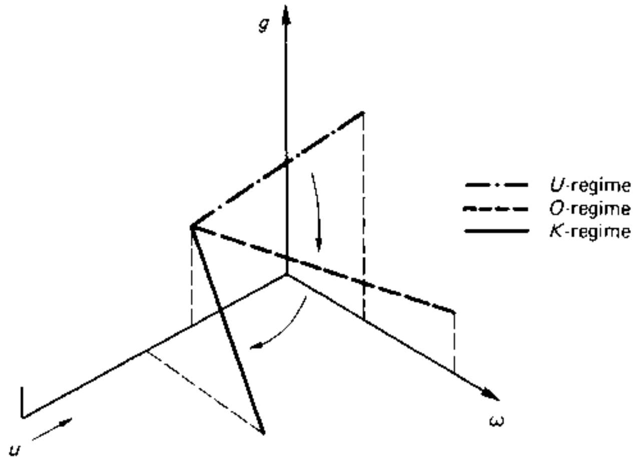

Figure 24.11 Overhead labor saving technical progress

$$\frac{du}{da} = - \frac{s\omega b}{az} < 0.$$

Inserting (18′) in (17) and differentiating with respect to a gives

$$\frac{dg}{da} = \frac{d\iota}{da} = - \frac{\gamma s\omega b}{az} < 0.$$

It follows that in the post-progress equilibrium both the degree of utilization and the rate of accumulation and growth will be larger; the increase in the two variables depends, among other things, on the initial level of the real wage rate.[23]

(ii) Overhead labor saving technical progress (organizational change). Economizing on overhead labor, that is, a reduction of coefficient b, affects the savings function only: its point of intersection with the ω-axis moves further away from the origin. As is shown in Figure 24.11, in this case the shift of regimes is clockwise, i.e. exactly the opposite of what it was in the case of technical progress which saved manual labor. Put briefly:

$$\begin{array}{cc} K & N \\ \uparrow & (\downarrow) \\ O \leftarrow & U \end{array}$$

According to the particular wage adjustment rule postulated, overhead labor saving technical progress, by assumption, is of no import for the level of the real wage rate. Hence the comparison between the pre and the post-progress equilibrium has to be carried out in terms of a given and constant wage rate. Differentiating (18) and (17) with respect to b gives

$$\frac{du}{db} = \frac{s\omega}{z} > 0 \quad \text{and} \quad \frac{dg}{db} = \frac{\gamma s\omega}{z} > 0. \tag{19}$$

As was to be expected from the discussion of possible changes in growth regimes, a drop in b depresses capacity utilization and growth. This is to be explained basically in terms of the loss of consumption demand, which is larger, the larger is the ruling real wage rate. Due to the fall in capacity utilization the reduction in overhead labor costs per unit of output and the increase in total labor productivity are somewhat smaller than what could be expected on the basis of the decrease in b alone.

(iii) Capital stock saving technical progress. A fall in v increases both π_{max} and ω_{max} and decreases $\hat{u}_{min}$ (see Figure 24.1). Hence the π-ω-u frontier and consequently also the savings function (see Figure 24.3) shift, so to speak, towards the observer. In order to get an idea of the direction of change of regimes implied by capital stock saving technical progress, it is perhaps best to go to the extreme and assume that v vanishes. In this case $\hat{u}_{min}$ would tend to zero and ω_{max} to $1/a$, while π_{max} would tend to infinity. This consideration makes it clear that regimes tend to change clockwise:

$$\begin{array}{ll} K & N \\ \uparrow & (\downarrow) \\ O \leftarrow & U \end{array}$$

Comparing two single equilibria gives

$$\frac{du}{dv} = \frac{y(1-\omega a)}{(vz)^2} > 0 \text{ and } \frac{dg}{dv} = \frac{\gamma y(1-\omega a)}{(vz)^2} > 0,$$

where y stands for the numerator in (18). Accordingly, with a given and constant real wage rate both the degree of capacity utilization and the rate of accumulation and growth are negatively affected by a decline in the capital-to-capacity ratio. The explanation of this result is to be sought in the fact that, broadly speaking, the kind of technical progress under consideration, while leaving the propensity to invest unaffected, tends to increase the overall propensity to save. The effect of capital stock saving progress (and, for that matter, of overhead labor saving progress as well) is thus similar to the one associated with a *ceteris paribus* increase in s. As is well known, an increase in s would give rise to the famous 'paradox of thrift'.

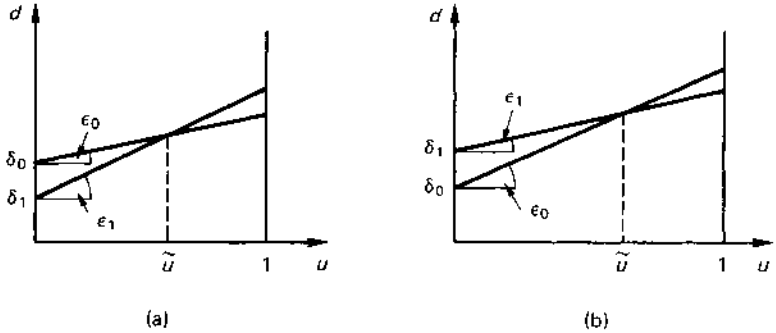

Figure 24.12 Capital flow saving technical progress

(iv) Capital flow saving technical progress. Other things being equal, a fall in δ or ε implies a lengthening of the lifetime of capital goods, i.e. a decrease in the rate of turnover. It can easily be seen with regard to figures 24.1 and 24.3 that the effects of this form of technical progress are, generally speaking, comparable to those of capital stock saving progress. In particular,

$$\frac{du}{d\delta} = \frac{s}{z} > 0 \quad \text{and} \quad \frac{dg}{d\delta} = \frac{\gamma s}{z} > 0$$

and

$$\frac{du}{d\varepsilon} = \frac{\varepsilon y}{z^2} > 0 \quad \text{and} \quad \frac{dg}{d\varepsilon} = \frac{\gamma \varepsilon y}{z^2} > 0,$$

respectively. More interesting cases emerge if δ and ε move in opposite direction. In Figure 24.12(a) [24.12(b)] it is assumed that δ falls (rises) from δ_0 to δ_1, while ε rises (falls) from ε_0 to ε_1. Clearly, in such a case we could speak of technical *progress* if and only if the realized level of capacity utilization would be smaller (larger) than $\tilde{u}$.

The pure forms of technical progress may now be joined to give a set of *mixed forms* of unambiguous technical progress. However, as the last case discussed already indicates, there is a further set of mixed forms to be taken into account. In fact, it is a characteristic feature of important technological innovations that they combine a fall in one or several of the coefficients of production with a rise in one or several of the remaining ones. Thus it has been argued, for example, that the process of increasing mechanization in the early phases of the Industrial Revolution brought with it an increase in manual laborer's productivity associated with an increase in the capital-capacity ratio. In cases, in which inventions involve contrary movements of some coefficients, the question arises whether and when these inventions become innovations. In what follows it will be assumed that this question is decided in terms of whether or not the vertically integrated labor coefficient, ℓ, that is, the quantity of labor needed directly and indirectly per unit of output, falls,[24] where

$$\ell = a + b(K/Q) + d(K/Q)\ell$$

which gives, taking into account (3) and (4),

$$\ell = \frac{au + bv}{u - (\delta + \varepsilon u)v} \tag{20}$$

As is clear from (20), within the framework of the present model the choice of technique problem cannot generally be considered to be decided in terms of the technical conditions of production alone: it is the degree of capacity utilization which matters, too. The latter, however, reflects a multiplicity of influences, such as the state of income distribution and savings and investment behavior, to name but those which have been incorporated, however provisionally, in the present analysis. In particular, there is the possibility that, assessed in terms of the degree of utilization associated with the existing technique, a new technique proves superior, while in terms of its own characteristic steady-state degree of utilization it turns out to be inferior. In what follows we shall, for simplicity, set aside the complications just mentioned and assume that the particular forms of technical change under consideration fulfil the criterion of a decreasing quantity of labor 'embodied' in the composite product, i.e. $d\ell < 0$.

Before we proceed, it is worth making the following observation. A stylized fact of recent economic history which is beyond dispute is the continuing growth in capital per worker, or capital intensity, k. In terms of our model, k is given by

$$k = \frac{K}{L} = \frac{K}{Q}\frac{Q}{L} = \frac{vq}{u} = \frac{v}{au + bv} \tag{21}$$

Expression (21) makes it clear that an increase in k can be effectuated by means of a variety of constellations concerning variations in a, b, v and u. For example, v may stay constant, while a and b fall, with the fall in b outweighing (in terms of its effects) the fall in a. The result of such a scenario is illustrated in Figure 24.13, where it has been assumed that the system was originally in a U-regime and is now pushed into an O-regime. With the level of wages initially at ω^* the corresponding growth rate of the system is g^* and the degree of utilization is u^*. If consequent upon

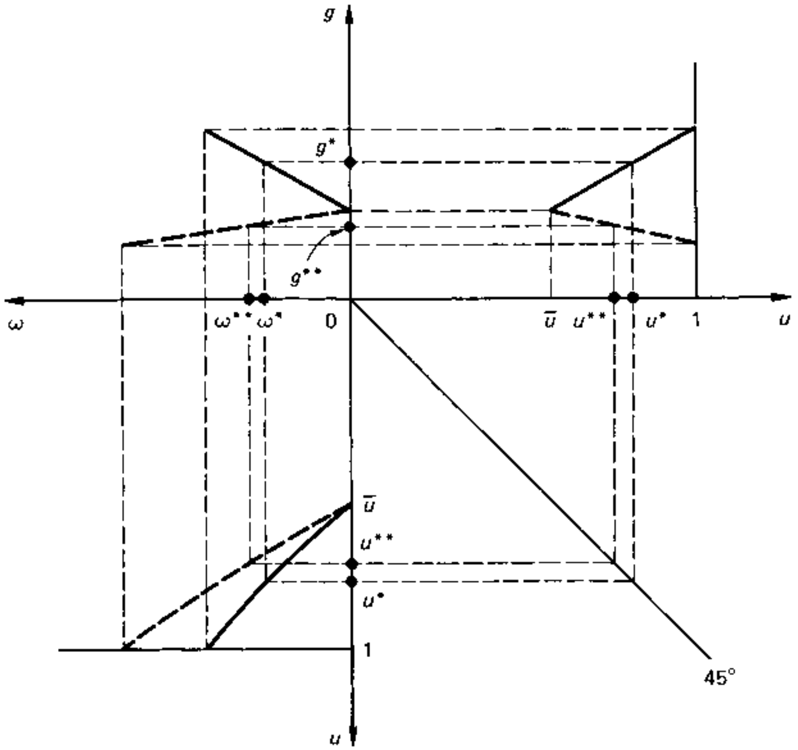

Figure 24.13 ——— *before* / ------- *after* } *technical progress*

technological change wages happen to rise according to (19) up to ω**, the rate of growth will fall to g^{**} and capacity utilization to u^{**}. This change in the state of things will be reflected in a higher capital-output ratio, which will rise from v/u^* to v/u^{**}. In the present case, employment would suffer both from labor saving technical progress and from the deceleration of growth.

Next the more difficult question would have to be addressed whether there exists some broad correspondence between certain theoretical constellations on the one hand and particular historical economic constellations on the other. In particular, it would be interesting to see whether certain stylized facts of recent economic history can be approximated by means of a succession of growth regimes. It hardly needs to be emphasized that the attempt to 'explain' the actual course of events in terms of the present model or some variant of it has to proceed with the utmost caution and circumspection.

Presently, one of the most controversial issues in public debate is the impact of the so-called 'microelectronics revolution' on the economic performance of the system and particularly on (un)employment.[25] While there is no general agreement as to the direction and magnitude of change of the coefficients of production entailed by the introduction and diffusion of computer-based methods of production, it is frequently held that the new technique is both labor and capital saving.[26] Furthermore, as regards its labor saving character, it is contended by several authors that, expressed in terms of the above model, a substantial decrease in coefficient a is accompanied by an increase in b, notwithstanding such apparent trends as progressive office automation. As regards the capital saving character it is claimed that both v and ε and possibly even δ tend to decrease. Hence, translated into the analytical scheme of the present paper the micro-electronics-based technical change is seen to be reflected in counteracting tendencies: while the conjectured variations in the second set of coefficients are in favour of a clockwise change of growth regimes, those in the first set suggest the opposite. Which of the two tendencies will prevail is of course a question that cannot be answered other than empirically. The conflicting opinions on the employment consequences of the 'microelectronics revolution' entertained by the compensation optimists on the one hand and the compensation pessimists on the other, could thus be reinterpreted within the framework of the present analysis in terms of (i) different estimations as to the socio-technical characteristics of the new technique relatively to the old one, and (ii) different views of savings and investment behavior.

Notes

1. The other author who alongside with Kaldor is to be considered a founder of the neo-Keynesian approach to the theory of growth and distribution is of course Joan Robinson. It deserves to be mentioned, however, that the versions of the theory advocated by Joan Robinson and Nicholas Kaldor differ in important respects. Joan Robinson was particularly critical of Kaldor's opinion 'that a theory of growth should be based on the hypothesis of full employment' (Kaldor, 1960, p. 12). To her the suggested generalisation of Keynes's short-run analysis to the long run in terms of the assumption of full employment of labor appeared to be fundamentally mistaken: 'The argument of the *General Theory* . . . cannot be true at each moment of time and yet untrue "in the long run"' (Robinson, 1962, p. 14). As we shall see in a moment, Kaldor himself later accepted this objection and withdrew his original opinion. For a discussion of several variants of the neo-Keynesian approach, see Hacche (1979) and Marglin (1984).
2. See Kaldor (1976, pp. xxvi–xxviii) and Kaldor (1986a, pp. 20–3); cf. also Kaldor (1978, pp. xxi–xxv).
3. See, however, Bhaduri (1972) and Steindl (1979) who show that in a growing

economy depreciation will generally be greater than the drop-out of plant and equipment.

4. See also Steindl (1987) who in a Kaleckian framework interpretes the break-even degree of utilization as a measure of the degree of monopoly which, in long-run analysis, is preferable to the conventional measure in terms of the mark-up.
5. As is well known, in short-run analysis the productivity gain associated with an increase in output is known as 'Okun's Law'; for a discussion of this law see Kaldor (1985, pp. 45–7).
6. In accordance with Kaldor's approach to the theory of savings, s may be viewed as being mainly a reflection of firms' retention policy; cf. Kaldor (1966 reprinted in 1978).
7. For a discussion of some of the problems related to the attempt to reduce the theory of investment to an 'investment function', see Eatwell and Milgate (1983, pp. 126–7). See also the critical remarks on the issue by Committeri (1987).
8. A brief summary of his various attempts to tackle the problem of investment demand is given in Kaldor (1978, pp. x–xiv).
9. As was pointed out earlier, Kaldor assumed full employment. Apart from the fact that this view can at best be considered an illegitimate generalisation of a particular historical exprerience, it is worth mentioning that the full employment assumption is difficult to reconcile with the further assumption of downward flexible real wages. Steindl has pointed out that 'looking at the post-war experiences of various countries . . . it seems doubtful whether profit inflation played any important and lasting role. In fact, it seems that after full employment had been established for some time there was a strong force acting against an increase in profit margins' (1985, p. 59). In another place Steindl's comment on Kaldor's theory was even more succinct: 'A surprising feature of the theory is that full employment or overfull employment is supposed to favour a shift to profits' (1979, p. 6). See also Kurz (1990a).
10. See also more recently Rowthorn (1981), Amadeo (1986) and Dutt (1986).
11. It deserves to be mentioned that basically the same criticism is put forward by Marglin and Bhaduri in their contribution to this volume.
12. See, for example, Kaldor (1972 reprinted in 1978).
13. For a more detailed discussion of different aspects of the problem of stability in models of the kind referred to in the present paper, see Committeri (1987); see also Kalmbach and Kurz (1988).
14. Clearly, the investment function may lie below the savings function for high levels of u. This would be the case with investment being highly elastic with respect to ω.
15. Of course, it is not claimed that the regimes under discussion are to be considered faithful representations of the different theories of accumulation, whose labels will be used for christening purposes.
16. As is well known, Keynes in the *General Theory* (1936) was of the opinion that a higher level of net investment and thus a higher rate of accumulation is of necessity tied to lower real wages, which will be brought about by prices rising relatively to money wages. However, in response to several critics Keynes later retracted this view (cf. Keynes, 1939). Hence the label used above is meant to refer loosely to the Keynes of the *General Theory*. (For a discussion of some of Keynes's opinions on the issue within a two-sectoral model, see Kurz, 1990b.)
17. It could of course be argued that technical progress has a more direct influence on savings and investment by modifying the parameters s, α, β and γ of the

functions or even the functions themselves; see, for example, Rowthorn's attempt to capture this kind of influence on investment by adding *ad hoc* an extra term to investment function (13) (Rowthorn, 1981, p. 23). Since the relationship between different forms of technical progress and different patterns of investment behaviour has not yet been sufficiently investigated theoretically and empirically, we shall retain (17).

18. See, for example, Kaldor (1961, pp. 177–8). See also the instructive discussion in Hacche (1979, Part IV).
19. See, for example, Kaldor's general introduction in Volume I of his *Collected Economic Essays* (1976).
20. It is of course not implied that technical change is the only explanatory variable, nor that it can be treated as being purely exogenous. Hence no concept of technological determinism is advocated. For a more comprehensive account of the growth performance of advanced industrialised economies in the post-war period, see Steindl (1979, 1985); the case of the West-German economy is dealt with by Riese (1984). See also Bombach (1985) and Maddison (1987).
21. Clearly, many technological (and organisational) innovations are explicitly designed to render possible a more efficient use of labor power and a better control of the labor process. Hence innovations generally tend to alter the balance of power between capital owners on the one hand and workers and trade unions on the other. However, for reasons similar to those mentioned in footnote 17, we shall, in what follows, try to keep the speculative element of the analysis within overseeable limits.
22. It goes without saying that an important implication of the assumption of a given degree of monopoly is that the real wage is not responsive to forms of technical change other than the one reflected in variations in coefficient a.
23. It should be noticed that with s constant a higher (lower) rate of accumulation is of necessity associated with a higher (lower) rate of profits.
24. As is well known, this is the conventional criterion applied by many authors from the times of the classics right up to the present day. In our simple model this criterion is equivalent to the criterion of cost minimization. However, as the recent controversy in the theory of capital has shown, in multisectoral models this is not generally the case.
25. For a treatment of this problem in terms of a dynamic input-output-model with special regard to the West-German economy, see the research carried out by the research unit *Technologischer Wandel und Beschäftigung* at the University of Bremen.
26. In what follows I heavily rely on Peter Kalmbach's expert knowledge, which he kindly put at my disposal.

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25 A Kaldorian Saving Function in a Two-sectoral Linear Growth Model

H. Hagemann

1 INTRODUCTION

In retrospect, Kaldor saw the fundamental shortcomings of the post-Keynesian growth and distribution models on which he concentrated his analytical work in the 1950s and the early 1960s rooted in the fact that all these models were one-sector models.[1] Instead he advocated a two-sectoral model as the basis for gaining a thorough understanding of the nature of the growth and distribution process in a developed capitalist economy. Already the young Kaldor (1938) in a pioneering paper had pointed our attention to the facts that complementarity between equipment and labor is characteristic for modern technique and that full employment not only presupposes a certain level of real income (effective demand) but also a certain composition of production between consumption and capital goods because of the specificity of most equipment.

In a pathbreaking article Kaldor (1956) rejected neo-Classical distribution theory and offered an alternative 'Keynesian' theory of distribution for the long run in a growing economy. Although Kaldor himself emphasized 'the very fact that investment goods and consumer goods are produced by different industries, with limited mobility between them' (Kaldor, 1956, p. 99), the question of the effects of changes in the parametric propensities to save out of wages and profits in a twosectoral or multisectoral model has not played a major role in the subsequent discussions, despite the numerous and still continuing controversies caused by Kaldor's original paper. So it is characteristic that Brems (1979) in his comparison of 'alternative theories of pricing, distribution, saving, and investment' discusses the neo-Classical and the post-Keynesian model on the common basis of the one-good assumption: *after* the Cambridge controversies in the theory of capital taking place in the 1960s and early 1970s, and notwithstanding the fact that he is discussing the question if a 'Wicksell Effect' will emerge. Kaldor in 1956 was not only aware 'that the value of particular capital goods in terms of final consumption goods will vary with the rate of profit, so that, even with a *given technique* v will not be independent of P/Y' (explicitly ignoring this point) but also that 'in fact the whole of the

Keynesian and post-Keynesian analysis dodges the problem of the measurement of capital' (p. 98). Amazingly in the '30 years of Kaldor's distribution theory' this problem hardly played a role despite the parallel debate on the theory of capital.

A notable exception from the normal procedure of discussing the Kaldorian saving function in connection with the one-good assumption has been Hicks (1965), who in a widely neglected chapter (XV) dealt with the question of factor shares in growth equilibrium on the basis of a two-sectoral fixed-coefficient model. In his last years Kaldor often pointed out his close friendship with Hicks in their common LSE years and the role Hicks played in Kaldor's realizing of the shortcomings of Hayek's doctrines as the major presupposition for his easy conversion to Keynes after the publication of the *General Theory*.[2] Kaldor also emphasized that despite the spatial separation and the independent development of their thinking there had been continued convergences – sometimes at unexpected points – in their economic theories, as shown, for example, in Hicks' *Capital and Growth*. Hicks for his part stated to be 'entirely in agreement with Kaldor as long as we stick to the theory of Growth Equilibrium' (Hicks, 1965, p. 145).

In this paper we will introduce a Kaldorian saving function into a twosectoral fixed-coefficient model as it was developed by Hicks (1965), Spaventa (1968, 1970) and Harris (1973, 1978). For Kaldor the main constraints on income distribution in a capitalist economy were the growth rate and the propensities to save out of profits and wages. Our present concern is to examine the dependence of the rate of profit, the factor share of profits in total income, the ratio of investment to output and the capital-output ratio upon the growth rate of the economy and the two saving propensities.

Kaldor's distribution theory describes a way in which full employment may be maintained in the presence of changes in investment and the overall average propensity to save, with different propensities to save out of profits and wages and flexible distributive shares assuring that aggregate demand is held at the appropriate level. Proceeding like Hicks from the fact that Kaldor's theory of distribution is only acceptable as a long-run theory we focus our attention on the comparison of economies which are in long-run equilibrium. Thus, if we analyse the consequences of a change in the growth rate or the propensities to save, we compare steady-state paths showing the implications for growth equilibria which differ only in the growth rate or the values of the saving propensities assumed. The technique of production is by assumption the same between any two growth equilibria. This detailed comparison of various economies growing on a steady-state path very often is called "comparative dynamics". But since the 'dynamic' character may indeed be questioned (the uniformity of growth excludes structural change), steady growth may be regarded as semi-stationary, so that Bliss' term of 'comparative statics of semi-stationary growth' comes more to the point. 'The word 'static' reminds us that there is no implication of an actual move from one equilibrium to another through time.'[3]

In section 2 we employ the simplest model of production possible which still retains a characteristic feature of real economies, namely production of heterogeneous commodities by means of commodities and labour, i.e. circular interdependence. Special attention will be given to the two cases of a Kaldorian saving function and the role the saving behaviour plays in connection with the Keynesian equilibrium condition of saving-investment equality in constituting a relationship between the rate of profit and the growth rate, thereby providing a direct link between income distribution and capital accumulation. Whereas in section 3 different growth equilibria are compared for the special case of a 'classical' saving function, i.e. when the propensity to save out of wages is zero, in the comparison of alternative steady-state growth paths in section 4 the assumption is made that the propensity to save out of wage income is positive. In both sections we focus attention on the implications of changes in saving and the growth rate on factor shares and the values of the investment-output- and the capital-output ratio. Special interest is given to the major modifications compared to the results in a one-sectoral model. In the final section 5 we summarize our results and discuss some limitations of the model.

2 THE PRICE SYSTEM, THE QUANTITY SYSTEM AND THE ROLE OF SAVING BEHAVIOUR IN A TWOSECTORAL LINEAR MODEL

In our simple twosectoral linear model two commodities are produced in the economy: a capital good ('machines'), produced by means of labor and itself, and a consumption good ('corn'), produced by means of labor and machines. A given technique is represented by the matrix of interindustry coefficients A and by the column vector of direct labor coefficients l:

$$A = \begin{bmatrix} a_{11} & 0 \\ a_{12} & 0 \end{bmatrix} \qquad l = \begin{bmatrix} l_1 \\ l_2 \end{bmatrix}$$

Each technique is thus characterized by four coefficients: a_{11} and l_1 denoting the inputs of machines and labour per unit of machine produced, a_{12} and l_2 denoting the inputs of machines and labour per unit of corn produced. Competitive equilibrium in a capitalist economy implies that firms in both sectors obtain the same rate of profit on the value of invested capital. Assuming an economy with no government sector and no foreign trade, neglecting depreciation[4] and taking the consumption good as the numéraire, this leads to the following *price equations*:

$$a_{11}\, pr + l_1 w = p \tag{1}$$

$$a_{12}\, pr + l_2 w = 1 \tag{2}$$

The price system yields two unique relationships between the wage rate w and relative prices p, on the one hand, and the rate of profit r, on the other, both fully identified by the four technical coefficients.

$$w = \frac{1 - a_{11}\, r}{l_2\, [1 + a_{11}\, (m-1)\, r]} \tag{3}$$

$$p = \frac{l_1}{l_2\, [1 + a_{11}\, (m-1)\, r]} \tag{4}$$

As is well known, in the very special case of identical machine-labor ratios in both sectors ($m=1$) the wage-profit relationship is linear and relative prices are invariant with distribution, i.e. the labour theory of value holds. In all other cases the 'prices of production' vary with the rate of profit. Not surprisingly, it will turn out that the relation between the machine-labor ratios in the two sectors $m=a_{12}\, l_1/a_{11}l_2$ also plays a decisive role in the dependence of factor shares and the values of the investment-output ratio and the capital-output ratio from changes in the growth rate and the propensities to save.

We go on now to introduce the relations governing output, employment, and accumulation in our 'book of blueprint-model'. If we assume that the economy is in a steady state and grows at a constant rate g and if we normalize the system by considering the ratio of all quantities to total labor employed we get the following *quantity equations*:

$$a_{12}c \quad + a_{11}\, qg = q \tag{5}$$

$$l_2 c \quad + l_1\, qg \;= 1 \tag{6}$$

Expressing all quantity variables as functions of g we get two unique relationships between consumption per head c and the total machine-labor ratio q, on the one hand, and the rate of growth, on the other:

$$c = \frac{1 - a_{11}\, g}{l_2\, [1 + a_{11}\, (m-1)\, g]} \tag{7}$$

$$q = \frac{a_{12}}{l_2\, [1 + a_{11}\, (m-1)\, g]} \tag{8}$$

Whereas the c–g relationship is dual to the w–r relationship, the q–g relationship, though not identical, is similar to the p–r relationship, i.e. has the same signs of the derivatives.[5]

The price equations and the quantity equations, even together, do not suffice to determine the whole system. As is well known, some assumption about *saving* is needed to serve as a bridge between them. The postulation of a saving function in connection with the Keynesian equilibrium condition of saving-investment equality constitutes a relationship between the rate of profit and the growth rate. There remains one degree of freedom in the whole system: given *either* the growth rate *or* the rate of profit, all price and quantity variables as well as the *combined price-quantity variables* like

(a) the capital-labor ratio	$k = p(r)q(g)$,
(b) the value of net output per man	$y = c(g) + gk$
(c) the capital-output ratio	$v = k/y$
(d) the profit share	$P/Y = rk/y$
(e) the investment-output ratio	$I/Y = gk/y$

are then simultaneously determined.

Introducing a *Kaldorian saving function*, net savings per man equal

$$S/L = s_w\, w + s_p\, rk, \tag{9}$$

where s_w and s_p denote the propensities to save out of wages and profits respectively, with $1 \geq s_p > s_w \geq 0$. Net investment per man is

$$I/L = gk \tag{10}$$

From equations (9) and (10) we get the following r–g–relationship:

$$r = \frac{g}{s_p} - \frac{s_w\, w}{s_p\, k} \tag{11}$$

When the propensities to save out of the two different categories of income differ, the r–g relationship in general depends on the distribution of income as well as on technology. The growth-profit relation is independent of the technical methods of production only in the special but popular case, when the propensity to save out of wages is zero.[6] For this 'classical' saving function equation (11) reduces to

$$g(r) - s_p\, r(g) = 0. \tag{11'}$$

With view to causality formula (11′) is the more neutral than the Cambridge equation. Our formulation of equation (11′) reflects the fact that there exists a two-sided relationship between profits and investments or income distribution and capital accumulation. The equilibrium analysis forms an open model which could be closed either by a theory explaining the rate of profit (or the wage rate) or by a theory explaining the growth rate.

But in the Kaldorian Theory of Distribution there is a clear causality. 'The basic assumption of all Keynesian theory is that Investment . . . is determined independently of current savings. But since in equilibrium, savings must be equal to investment, it is the decisions concerning capital expenditure which will determine the level and/or the distribution of incomes, and not the other way round' (Kaldor, 1960a, p. 122). Kaldor would have us assume that a neo-Keynesian model is closed by the exogenously given growth rate and that it is the 'warranted' rate which adjusts itself to the 'natural' rate through an appropriate change in the share of profits. Thus, using the assumption that the natural rate is exogenously given, the Cambridge equation $r=g/s_p$ shows that the rate of profit in a state of balanced growth is determined by the propensity to save out of profits.[7] Kaldor's answer to the Harrod-Domar dilemma presupposes the basic inequality of a 'Keynesian' theory of distribution $s_p > I/Y = vg_n > s_w$ to be fulfilled. Then, within certain limits, there will exist a ratio of profits to income, P/Y, ensuring that the overall propensity to save is exactly that required to equate the warranted rate of growth s/v to the natural rate of growth g_n.[8]

3 THE SPECIAL CASE OF THE CLASSICAL SAVING FUNCTION

As we have seen from equation (11′) the special case of a Kaldorian saving function with $s_w = 0$ simplifies things considerably since it leads to a relationship between the rate of profit and the rate of growth which is independent of the technology. In models with the causality of the Cambridge equation the rate of accumulation and the propensity to save out of profits are the independent variables which determine the rate of profit on capital and other endogenous variables. Our next task is to compare growth equilibria with the same technique but with a different rate of growth or a different propensity to save out of profits. How do these parametric changes of $g_{(n)}$ or s_p influence the values of the endogenous variables in growth equilibrium?[9]

The question can easily be answered for the rate of profit. Differentiation of equation (11′) leads to

$$\delta r/\delta g = \quad 1/s_p > 0 \text{ and} \tag{12}$$

$$\delta r/\delta s_p = -\,g/s_p{}^2 < 0 \tag{13}$$

This means that for the range of validity of the post-Keynesian model a higher rate of growth is associated with a higher profit rate (with a constant propensity to save out of profits) whereas a higher propensity to save out of profits is associated with a lower rate of profit (with a constant g), which can be interpreted as the reciprocal side of a widow's cruse theory in a growth theoretic setting. Since the wage rate is a monotonically decreasing function of the rate of profit we get $\delta w/\delta g < 0$ and $\delta w/\delta s_p > 0$.

More interesting is the analysis of the differences in the factor share of profits in total income, the investment-output ratio and the capital-output ratio. Whereas in the case of the classical saving function the profit rate is independent of the technical methods of production, this does not hold for the factor shares in total income. If g is given we get the following equation[10] between the profit share and the rate of profit:

$$\frac{P}{Y} = \frac{m\, a_{11}\, r}{m\, a_{11}\, r(1-a_{11}r)[1+a_{11}(m-1)g]} \tag{14}$$

Inserting $r = g/s_p$ in equation (14) we get:

$$\frac{P}{Y} = \frac{a_{11}\, mg}{s_p + (1+s_p)\, a_{11}(m-1)g - a_{11}^{\,2}\, (m-1)g^2} = \frac{a_{11}\, m\, g}{D_g} \tag{15}$$

with[11]

$$\frac{\delta(P/Y)}{\delta g} = \frac{a_{11}\, m\, s_p + a_{11}^{\,3}\, m\, (m-1)\, g^2}{D_g^{\,2}} > 0 \text{ and} \tag{16}$$

$$\frac{\delta(P/Y)}{\delta s_p} = \frac{[1 + a_{11}\, (m-1)\, g]\, a_{11}\, m\, g}{D_g^{\,2}} < 0 \tag{17}$$

The signs of the derivatives show that the direction of change of the equilibrium value of the share of profits in total income is independent of the relation between the sectoral machine-labor ratios m. Whereas equation (17) like (13) indicates a kind of reciprocal side of a widow's cruse theory, equation (16) seems to show that the post-Keynesian distribution mechanism in general contains a share of profits increasing with the growth rate.[12]

How do parametric changes of g or s_p influence the equilibrium values of I/Y and v? The ratio of investment to output in growth equilibrium is

$$\frac{I}{Y} = s_p\, \frac{P}{Y} \qquad \text{with} \tag{18}$$

$$\frac{\delta(I/Y)}{\delta g} > 0 \qquad \text{and} \tag{19}$$

$$\frac{\delta(I/Y)}{\delta s_p} = \frac{a_{11}^2\, g^2\, m(m-1)(1-a_{11}\, g)}{D_g^2} \gtreqless 0 \text{ for } m \gtreqless 1 \tag{20}$$

Contrary to the share of profits, the direction of change of the equilibrium value of the investment-output ratio with parametric variations of s_p depends on the relation of the sectoral machine-labor ratios. For example in the case $m > 1$ ($m < 1$), i.e. when the machine-labor ratio in the production of corn is higher (lower) than in the production of a machine, with a given rate of growth of labor supply (and in the efficiency of labor of the Harrod-neutral type) a lower propensity to save out of profits implies a higher rate of profit. Since the machine-intensity of the consumption good sector is higher (lower), the price of corn relative to the price of the machine increases (decreases), i.e. with corn as numéraire the value of capital per man *pk* decreases (increases). Because of the positive (negative) price-Wicksell effect a lower s_p implies a lower (higher) investment-output ratio. This result contradicts with Kaldor's original hypothesis that 'the ratio of investment to output, can be treated as an independent variable, invariant with respect to changes in the two savings propensities s_p and s_w' (Kaldor, 1956, p. 95). As we can see from equation (20) outside the one-good world this hypothesis would only be correct in the special case of identical sectoral machine-labor ratios, in which relative prices are independent of distribution.

Kaldor soon realized that the central Keynesian hypothesis of the independence of investment from saving is not adequately expressed by an exogenously given ratio of investment to output and gave up his original assumption. There are good reasons to proceed from the premise that entrepreneurs control the flow or volume of investment only, whereas the investment-output ratio depends on the income effect of the multiplier process and is thus the result of a multiplicity of influencing factors not all controlled by the investors.[13] Whereas in a private-enterprise economy no automatic mechanism exists which guarantees to keep accumulation going on at the appropriate rate for full employment in the long run, the Kaldor of the late 1950s and early 1960s based his theory of growth and distribution on the hypothesis of full employment. This hypothesis excludes that the rate of capital accumulation could be treated as an independent variable,[14] rather in the 'Cambridge' theory of distribution 'I/Y and $\dot{K}/K$ are *not* exogenously given, but are themselves determined by the condition that the capacity to employ labor should grow at the same rate as the labor supply. If, as a result of more 'deepening', or a capital-using bias in technical progress, more investment is required to secure this, I/Y will rise, and the share of profits will rise sufficiently to generate the extra savings required' (Kaldor, 1970, pp. 5–6). Thus for Kaldor the investment-output ratio is a dependent variable which in long-run equilibrium equals the natural rate of growth times the capital-output ratio.[15]

In Kaldor's long run model with no excess capacity existing to accommodate higher levels of investment demand, distribution must bear the brunt of adjusting aggregate demand to supply. But as soon as one admits that excess capacity (and unemployment) may occur, and that output rather than distribution may respond to aggregate demand, there is nothing to prevent output, rather than distribution, from performing the role of equilibrating investment and saving not only in the short but also in the long run.[16]

Finally we come to the capital-output ratio which in our model equals

$$v = \frac{P/Y}{r} = \frac{a_{11}\, m\, s_p}{D_g} \qquad \text{with} \tag{21}$$

$$\frac{\delta v}{\delta g} = \frac{a_{11}^2\, s_p\, (m-1)(2a_{11}\, g-1-s_p)}{D_g^2} \lesseqgtr 0 \text{ for } m \gtreqless 1 \tag{22}$$

and

$$\frac{\delta v}{\delta s_p} = \frac{a_{11}^2\, g\, m\, (m-1)(1-a_{11}\, g)}{D_g^2} \gtreqless 0 \text{ for } m \gtreqless 1 \tag{23}$$

As with the share of profits and the investment-output ratio there are two distinguishable components of the difference in the capital-output ratio between different equilibria: a *price effect* and a *composition effect*. The first reflects the difference in the price of the machine associated with a difference in the profit rate. The second expresses the different composition of output and stock of machines per man associated with a different growth rate or saving behaviour of profit receivers. The overall difference in the value of the capital-output ratio is the outcome of both the price and the composition effect.[17]

Equations (22) and (23) show that Kaldor's assumption of a constant capital-output ratio only holds in a onesectoral model or in the special case $m = 1$. When in so many representations of the post-Keynesian model a constant capital-output ratio is assumed, it is the consequence of the fact that, openly or tacitly, one of these two special cases is presupposed. Although Kaldor himself was aware of the fact that in general the capital-output ratio cannot be considered independent of income distribution, it may be conjectured that he made the assumption that v is invariant to P/Y, because he thought 'that technical innovations . . . are far more influential

Table 25.1 Comparison of equilibria

Variable		$m > 1$	$m = 1$	$m < 1$
r	$\delta r/\delta g$	+	+	+
	$\delta r/\delta s_p$	−	−	−
$\frac{P}{Y}$	$\delta(P/Y)/\delta g$	+	+	+
	$\delta(P/Y)\delta s_p$	−	−	−
$\frac{I}{Y}$	$\delta(I/Y)/\delta g$	+	+	+
	$\delta(I/Y)/\delta s_p$	+	0	−
v	$\delta v/\delta g$	−	0	+
	$\delta v/\delta s_p$	+	0	−

on the chosen v than price relationships', but immediately ruling out this potential influence, too, by the assumption that technical innovations are '"neutral" in their effects'.[18]

In Table 25.1 our results on the influence of the growth rate and the propensity to save out of profits on the equilibrium values of different variables in the special case of a Kaldorian saving function with $s_w = 0$ are summarized.

The table shows that even in the special case of a classical saving function which simplifies things considerably because the profit-growth relation is independent of technology, the sign of the last three derivatives depends on the relative sectoral machine-labor ratios, i.e. a technological parameter.

4 THE GENERAL KALDORIAN SAVING FUNCTION

'If s_w is positive the picture is more complicated' (Kaldor, 1956, p. 96). Whereas in the case of the classical saving function the steady state profit rate can be inferred directly from the natural rate of growth and the propensity to save out of profits, which are both regarded as exogenously given parameters, in the more general case of a positive propensity to save out of wages the rate of profit also depends on the chosen technique, among its determinants may be the rate of profit itself. We now focus attention on the major modifications concerning the influence of the rate of growth and the propensities to save on the equilibrium values of the rate and the share of profit, the investment-output and the capital-output ratio.

Inserting (4) and (8) into (11) we get the following profit-growth relationship:

$$r = \frac{s_w + a_{11}(m-1)\, s_w\, g - a_{11}\, m\, g}{a_{11}\ \{s_w\, [1+a_{11}\ (m-1)\ g] - ms_p\}} \tag{24}$$

Differentiating with respect to g, we get:[19]

$$\frac{\delta r}{\delta g} = \frac{a_{11}^2\ m\ [ms_p\ (1-s_w) - s_w\ (1-s_p)]}{N^2} \gtreqless 0 \text{ for } m \gtreqless m^* \tag{25}$$

with

$$m^* = \frac{s_w\ (1-s_p)}{s_p\ (1-s_w)}$$

As to be expected in most cases a higher rate of profit is associated with a higher rate of growth in equilibrium (with constant propensities to save out of profits and wages). But contrary to the case of a classical saving function this no longer holds when the relation between the sectoral machine-labor ratios is equal or smaller than the critical value m^*.[20]

When the machine-labor ratio in the production of machines is far higher than in the production of corn, there might exist the case where the steady-state rate of profit falls with a parametric increase of g because the price effect. (For a higher rate of growth being accommodated a constant share of income saved has to command more machines, i.e. the price of machines has to be lower. With $m < 1$ this requires a fall in the steady-state rate of profit.) dominates the effect induced by a change in the overall saving ratio. (With a Kaldorian saving function in equilibrium a higher rate of growth is associated with a higher saving (investment) ratio if a higher rate of growth is also associated with a higher share of profits.) The price effect can only occur when the r–g relationship depends on the technical methods of production. Whereas with $m > 1$ both effects work in the same direction, with $m < 1$ the price effect counteracts the saving ratio effect. Both effects exactly neutralize each other for $m = m^*$. For $1 > m > m^*$ the saving ratio effect dominates, for $m < m^*$ the price effect dominates.

Differentiating equation (24) with respect to s_p and s_w we get:

$$\frac{\delta r}{\delta s_p} = \frac{[s_w\ (1-a_{11}\ g) - a_{11}\ mg(1-s_w)]\ a_{11}\ m}{N^2} \lesseqgtr 0 \text{ for } m \gtreqless m^{**} \tag{26}$$

with $m^{**} = \dfrac{s_w\ (1-a_{11}\ g)}{(1-s_w)\ a_{11}\ g}$

$$\frac{\delta r}{\delta s_w} = \frac{a_{11}\ m\ [1+a_{11}\ g(m-1)]\ (a_{11}\ g-s_p)}{N^2} < 0, \tag{27}$$

since $s_p > a_{11}\ g$.

Before commenting on these results we should also look at the corresponding equations for the share of profits. Inserting (24) into (14) we get

$$\frac{P}{Y} = \frac{s_w\,(1-a_{11}\,g) - (1-s_w)\,a_{11}\,mg}{a_{11}\,g(m-1)(a_{11}\,g-1) - [1+a_{11}g(m-1)]\,(s_p - s_w)} \tag{28}$$

with the derivatives[21]

$$\frac{\delta(P/Y)}{\delta g} = \frac{a_{11}(m-1)\{[ma_{11}^2g^2(1-s_w)]+s_w(a_{11}g-1)^2\}+(s_p-s_w)a_{11}m}{Z^2} > 0 \tag{29}$$

for $m \geqslant m^*$

$$\frac{\delta(P/Y)}{\delta s_p} = \frac{[1 + a_{11}\,g(m-1)]\,[s_w(1 - a_{11}\,g) - (1 - s_w)a_{11}\,mg]}{Z^2} \lesseqgtr 0 \tag{30}$$

for $m \gtreqless m^{**}$
and

$$\frac{\delta(P/Y)}{\delta s_w} = \frac{[1 + a_{11}\,g(m-1)]^2\,(a_{11}\,g - s_p)}{Z^2} < 0 \tag{31}$$

Kaldor once emphasized that: 'I grasped the full significance of the widow's cruse analogy only when I realized that the savings of workers and salary earners must have a *negative effect* on the profits of businesses (in the aggregate).'[22]) Whereas this statement is confirmed in our two-sectoral model with a general Kaldorian saving function, this does not hold for Hicks' statement, made in a paragraph where he explicitly discussed the case $s_w > 0$: 'The rate of profit will tend to fall as a result of *any* increase in *any* saving propensity. But this does not mean that the share of profit will necessarily fall. It may do, but it may not' (Hicks, 1965, p. 178; my italics). Instead, as we can see from equation (26), for a relation of the sectoral machine-labor ratios smaller than the critical value m^{**} the equilibrium rate of profit *increases* with a parametric increase in the propensity to save out of profits. A comparison of equations (26) and (30) shows that the direction of change of the profit share with parametric variations of s_p (and a given natural rate of growth) is *exactly the same* as the direction of change of the rate of profit. Contrary to the case of the classical saving function not only the share of profits but also the rate of profit *can* increase with the propensity to save out of profits. Therefore, whereas we agree to Hicks' statement 'that, even when one is only comparing growth equilibrium paths, the propensity to save [out of profits] . . . does not have any clear-cut bearing upon factor distribution' (Hicks, 1965, p. 180), we disagree with his following statement: 'An increase in saving (however distributed) must indeed tend to diminish the *rate* of profit; but (even so) its effect upon the *share* of profit is quite uncertain.'

Our analysis also shows that the simple logic of Brems (1979), that doubling the propensity to save out of profits is found to halve the share of profits in post-Keynesian models of the Kaldor type, does not carry over to a more general model but is the consequence of an oversimplified model with only one good and a classical saving function.

From equation (29) it follows that for $m < m^*$ the direction of change of the share of profits with a parametric change in the natural rate of growth is indeterminate; the critical m-value, where the sign of the derivative changes, depends on a_{11}, s_p, s_w, and g itself. Thus it *cannot* be said that the post-Keynesian distribution mechanism *in general* contains a share of profits increasing with the growth rate. It has to be doubted whether the contradictory case (at least in more complex models than our two-sectoral one) is so extreme an exception that one needs not take much account of it.

How do parametric changes of g, s_p and s_w influence the values of the capital–output- and the investment–output ratio in growth equilibrium? Inserting equations (28) and (24) into the identity $v \equiv P/Y \cdot 1/r$ we get the steady-state value for the capital–output ratio

$$v = \frac{a_{11}\,\{s_w[1 + a_{11}\,g(m-1)] - s_p\,m\}}{Z} \tag{32}$$

Differentiating v with respect to g leads to

$$\frac{\delta v}{\delta g} = \tag{33}$$

$$= \frac{a_{11}^2(m-1)[-a_{11}^2 g^2 s_w(m-1) + (s_p m - s_w)(2a_{11}g - 1) - s_p m(s_p - s_w)]}{Z^2} \begin{matrix} < \\ = \\ > \end{matrix} 0$$

for $m \geqslant 1$
$1 > m \geqslant m^*$

Because of $s_p > a_{11}\,g$ a higher growth rate is associated with a lower capital–output ratio for $m > 1$ and a higher capital–output ratio for $1 > m \geqslant m^*$. For $m < m^*$ the direction of change of the capital–output ratio is indeterminate. In this range the question how v varies with a parametric change in the natural rate of growth again depends on the concrete values of a_{11}, s_p, s_w and g itself. Thus, contrary to the case of a classical saving function, it is not guaranteed that 'a higher rate of growth, by raising the output of capital goods in terms of consumption goods, will *raise* the capital/output ratio whenever the rate of growth of output capacity is higher' (Kaldor, 1960b, p. 180).

Differentiating v with respect to the two saving propensities leads to

$$\frac{\delta v}{\delta s_p} = \frac{a_{11}(m-1)(1-a_{11}g)[a_{11}mg(1-s_w)-s_w(1-a_{11}g)]}{Z^2} \gtreqless 0$$

$$\text{for } m^{**} \gtreqless m \gtreqless 1 \tag{34}$$

and

$$\frac{\delta v}{\delta s_w} = \frac{a_{11}[1+a_{11}g(m-1)](a_{11}g-s_p)(m-1)(a_{11}g-1)}{Z^2} \gtreqless 0 \text{ for } m \gtreqless 1 \tag{35}$$

Since $I/Y = gv$ we easily get the investment–output ratio in growth equilibrium by multiplying equation (32) with g.

$$\frac{I}{Y} = \frac{a_{11}g\{s_w[1+a_{11}\,g(m-1)]-s_p\,m\}}{Z} \text{ with} \tag{36}$$

$$\frac{\delta(I/Y)}{\delta g} = \tag{37}$$

$$= \frac{a_{11}^2(m-1)g(s_p-s_w)[a_{11}mg(1-s_w)-s_w(2-a_{11}g)]+a_{11}(s_p-s_w)(s_pm-s_w)}{Z^2}$$

Closer analysis shows that for the direction of change of the investment–output ratio with parametric changes in g (and given s_p and s_w) the same holds as for the capital–output ratio, i.e., e.g., for $1 > m < m^*$ the sign of the derivative is *a priori* indeterminate.

Starting from $I/Y = gv$ and differentiating with respect to the two saving propensities we get

$$\frac{\delta(I/Y)}{\delta s_p} = g\,\frac{\delta v}{\delta s_p} \gtreqless 0 \quad \text{for } m^{**} \gtreqless m \gtreqless 1 \tag{38}$$

and

Table 25.2 Comparison of equilibria

		$m > 1$	$m = 1$	$m < 1$				
	Variable			$m > m^{**}$	$m = m^{**}$	$m > m^{*}$	$m = m^{*}$	$m < m^{*}$
	$\delta r/\delta g$	+	+	+	+	+	0	−
r	$\delta r/\delta s_p$	−	−	−	0	+	+	+
	$\delta r/\delta s_w$	−	−	−	−	−	−	−
P	$\delta(P/Y)/\delta g$	+	+	+	+	+	+	?
—	$\delta(P/Y)/\delta s_p$	−	−	−	0	+	+	+
Y	$\delta(P/Y)/\delta s_w$	−	−	−	−	−	−	−
I	$\delta(I/Y)/\delta g$	+	+	+	+	+	+	?
—	$\delta(I/Y)/\delta s_p$	+	0	−	0	+	+	+
Y	$\delta(I/Y)/\delta s_w$	+	0	−	−	−	−	−
	$\delta v/\delta g$	−	0	+	+	+	+	?
v	$\delta v/\delta s_p$	+	0	−	0	+	+	+
	$\delta v/\delta s_w$	+	0	−	−	−	−	−

$$\frac{\delta(I/Y)}{\delta s_w} = g \frac{\delta v}{\delta s_w} \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad \text{for } m \begin{matrix} > \\ = \\ < \end{matrix} 1, \tag{39}$$

i.e. the sign of the derivative of the investment–output ratio always equals the sign of the corresponding derivative of the capital–output ratio. Table 25.2 gives an overview on our results how parametric changes in the exogenous variables g, s_p and s_w influence the endogenous variables r, P/Y, I/Y and v in growth equilibrium for the case of a general Kaldorian saving function. Comparing these results with the results of our comparative equilibrium analysis for the special case of a classical saving function we can immediately see the important modifications which come in with a positive propensity to save out of wages.

In his discussion of the long-run adjustment mechanism which is set in motion by changes in the parametric propensity to save, Brems (1979) emphasized the contrast between neo-Classical models, in which adjustment is exclusively effected by changes in the capital–output ratio, and post-Keynesian models, in which the burden of adjustment is imposed on the distributive shares. Mückl (1984) pointed out that sensitivities of the capital–output ratio and the share of profits to changes in thriftiness are generally determined by the existing production technology and that the simple antithesis of Brems is the consequence of the fact that only the two special cases with an elasticity of substitution $E_s = 1$ and $E_s = 0$ are discussed. He stressed that apart from these two special cases the adjustment is effected by both the capital–output ratio and the profit share, but he still kept the extreme assumptions of a model having only one good and a classical saving function.

Our analysis reveals that even with $E_s = 0$ some of the simple truths do not carry over to the two-sectoral model and still less to the case with a general Kaldorian saving function. Kaldor was to a large extent aware of the problems arising from price-Wicksell effects but he explicitly ignored them when he mentioned among the limitations of his original model 'that the capital/output ratio, v, should not in itself be influenced by the rate of profit, for if it is, the investment/output ratio Gv will itself be dependent on the rate of profit' (Kaldor, 1956, p. 98).

5 CONCLUDING REMARKS

In his critique of Findlay's attempt of reconciling the neo-Classical theory with the 'Keynesian' distribution theory Kaldor (1960b, p. 179) argued that Findlay's method 'depends on a special assumption on the relative capital intensity of the capital–goods and the consumption goods trade'. As our foregoing analysis shows, complications arise with $m < 1$, i.e. when the Uzawa condition is not fulfilled and price-Wicksell effects play an important role. This does not surprise anybody being familiar with the Cambridge debate in the theory of capital.

Setting the stage in the context of the growth debates of the 1960s and the debates in the theory of capital of the sixties and early 1970s our long-run comparative statics may be a "fossil" and not only Joan Robinson emphasized the irrelevance and futility of comparative statics. For example Hicks, who himself developed and elaborated our kind of analysis, recently pointed out: 'In the "golden age" of the sixties, as it appears in retrospect, a steady-state model seemed often to be acceptable as an approximation to reality: in the darker days that have followed it is less appealing' (Hicks, 1985, p. 10). Again, concerning this important methodological issue, there had been a strong convergence between the development of Kaldor's and Hicks' thinking, as can be seen from the elder Kaldor's (1985, pp. 61–3) highly critical remarks on steady-state analysis and the nature of time.

This has to be contrasted with the earlier work of Kaldor whose 'stylized facts' served to make steady-state analysis 'an interesting subject' (Dixit, 1976, p. 8). Solow has pointed out that the steady state is at least 'not a bad place for the theory of growth to start' (Solow, 1970, p. 7), but, of course, it is a dangerous place for it to end. That there is no automatic self-adjusting mechanism in a capitalist economy to ensure steady growth at full employment has not only be clearly shown by the 'real economic forces' but is also the central issue in the traverse analyses developed by Hicks (1973) and Lowe (1976), in which historical time and no longer logical time in the sense of Joan Robinson matters.[23]

On the other hand, Marglin's important book, in which large space has been devoted to savings, has recently shown that comparative statics is not a completely useless exercise. The comparison of economies with permanently different characteristics has a role to play as a standard of reference and an ingredient in a dynamic theory. Of course, one has to be aware of its limitations, e.g. that the comparison of steady-state equilibria, differing only in the values of the growth rate or the saving propensities assumed, loses much of its significance if the stability of the steady states cannot be shown. But with view to the very often far-reaching conclusions still drawn from the introduction of the special case of the Kaldorian saving function into a one-good model, our attempt to show the implications of a relaxation of these assumptions might have some sense, considering Kaldor's emphasis on the importance of a two-sectoral model.

Notes

1. See e.g. Kaldor (1978, p. XXI).
2. See e.g. Kaldor (1980, p. XI), Kaldor (1986a) and Kaldor (1986b, p. 7). See also Harcourt (1988).
3. Bliss (1975, p. 71). As Lowe (1976) has shown on the basis of a three-sectoral linear model, such adjustment paths or 'traverses', caused by changes in the exogenously given rate of growth of labor supply or by nonneutral technical progress, are not generally possible without a phase of unemployment and/or excess capacity.
4. For a substantiation of the implication to neglect depreciation see Hicks (1965, p. 135) who also points out that one does not need to distinguish between fixed and circulating capital as long as one sticks to the comparison of different growth equilibria.
5. Duality ceases as soon as there are two or more consumption goods and a change in the structure of consumption takes place.
6. For the other class of saving behavior normally considered, when savings are *proportional* to national income, we get $r = g/s - w/k$.
7. Pasinetti (1962, 1974) has shown that, in long-run equilibrium, the rate of profit is determined by the natural rate of growth divided by the capitalists' propensity to save s_c, independently of the workers' propensity to save even when the propensity to save out of wage income is positive.
8. It should be noticed that only the very special case of a "superclassical" saving function with $s_w = 0$ and $s_p = 1$, in which the rate of profit equals the growth rate ('golden rule of accumulation'), can secure that *any* rate of growth will find its appropriate rate of profit. On the other extreme is the case of a proportional saving function and a technique with $m = 1$ in which we have the knife-edge problem, i.e. there is only a single growth rate that can be accommodated by the given saving behavior. For a graphical exposition see Spaventa (1970, p. 140).
9. This section is partly based on the work of my friend and colleague Peter Kalmbach (1972, pp. 170–8).
10. Equation (14) is similar to Hicks' (1965, p. 173) 'price-quantity curve' in which

the ratio of the wage and the profit share, is a function of the rate of profit. The Hicksian concepts of the 'price-quantity curve' and the 'saving curve' are also used by Morishima (1969, pp. 34–40). For a graphical exposition of the determination of the factor share of profits in equilibrium see Hicks and Morishima.

11. For the share of profits to be positive the inequality $s_p > a_{11}g$ has to be fulfilled. With this condition fulfilled $\delta(P/Y)/\delta g$ will be positive even for $m < 1$.
12. For Kalmbach (1972, p. 174) this is an important result (which, as we will see in section 4, does not hold in general when s_w is positive). The Kaldor mechanism ensures that the warranted rate of growth will adjust itself to the natural rate through a change in the overall propensity to save via a change in the share of profits. That most authors associate a higher g with a higher P/Y is the consequence of the fact that they are either making the one-good assumption and/or arguing for the special case of a classical saving function which makes the $r-g$ relation independent of the technology.
13. Kurz (1985) has shown in a multisectoral linear model that, in general, '*the*' multiplier and thus '*the*' investment–output ratio doesn't exist. Rather they depend on the system of production in use, income distribution, the propensities to save and the consumption patterns of profit and wage receivers as well as on the physical composition of investment demand.
14. 'In the fixed-coefficient version of Kaldor's model, "animal spirits" disappear altogether, and the role of the investment-demand function is completely taken over by the assumption of full employment.' Marglin (1984, p. 157).
15. Inserting $I/Y = gv$ in Kaldor's famous equation for the determination of the share of profits in income (see equation 2 in Kaldor 1956, p. 95) we get (for given g and v): $P/Y = (gv - s_w)/(s_p - s_w)$.
16. The fact that Kaldor frequently revised the investment function in his models indicates the difficulties of formulating investment behavior in an adequate manner for a theory of accumulation. For an instructive overview of the different versions of Kaldor's investment function see Hacche (1979, ch. 13).

    Contrary to Kaldor, Kurz (1986) goes as far as to argue that in the long run changes in the level of output must bear the brunt of adjusting savings to investment and that changes in distribution are less important in the long run than in the short run. See also the contribution of Kurz to this volume.
17. When the technique of production is different, the picture becomes more complicated because of the presence of a third effect: the *substitution effect*. Since the type of machine between different techniques may differ, the price and composition effects are no longer sharply distinguishable. For a more detailed analysis of these three effects in a two-sectoral linear model see Harris (1973 and 1978).
18. See Kaldor (1956, p. 98).
19. N is the denominator of equation (24).
20. 'The lower the rate of growth, the lower the rate of profit, and the higher the real wage' (Hicks 1965, p. 147). Hicks' statement which is correct in the context he has made it – the case of the classical saving function – thus does not carry over to the general case.
21. Z is the denominator of equation (28).
22. Kaldor (1980, p. XXIV). See also Kaldor (1986b, p. 18).
23. For a more detailed analysis see Hagemann (1987).

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26 International Debts and Deficits: A Kaldor–Pasinetti Model

H. Gram

1 INTRODUCTION

Three solutions have been proposed to the problem of reconciling Harrod's 'warranted' rate of growth with the 'natural' rate of growth of the effective labor force so as to maintain full employment in long period equilibrium.[1]

The first, offered by Solow, Swan and others, relies on the neo-Classical principle of substitution: the capital–output ratio, v, adjusts in such a way as to bring the warranted rate, s/v, into line with the exogenous natural rate, n, starting from any initial equilibrium of supply and demand. For many, this theory was thoroughly discredited as a result of the capital theory controversy which established, among other things, that there is no systematic, inverse relationship between the capital–output ratio and the rate of profit.

A second solution, offered by Kaldor, Kahn, and Robinson, focuses instead on the effect of differences in the distribution of income on the overall propensity to save, s. Given fixed propensities to save out of profits and wages, an equilibrium of savings and investment can occur, but only for a *limited* range of growth rates. This less sanguine conclusion does not depend on assumptions concerning the rigidity of the capital–output ratio, which can vary in ways inconsistent with the postulates of neo-Classical production theory.[2]

A third solution to the Harrod Problem is set forth by Steedman and Metcalfe (1979). Allowing for international capital flows, they show that a country can grow at a rate different from its autarkic warranted rate by disposing of excessive savings ($s/v > n$) through the accumulation of foreign assets or by supplementing insufficient savings ($s/v < n$) through international borrowing. The essential point of the analysis is that the trade balance must adjust to the requirements of equilibrium growth at some arbitrary, feasible rate, n. If the interest rate (taken as exogenous on the assumption that the analysis applies to a small open economy) exceeds the growth rate, a creditor nation enjoys a trade deficit in steady-state equilibrium, consuming the excess of foreign interest income over and above the steady-state accumulation of foreign assets. A debtor nation must generate a trade surplus to cover the excess of interest payments over new borrowing. Only if the growth rate exceeds the interest rate will a creditor have a trade surplus and a debtor a trade deficit in long-period equilibrium.

A number of neo-Classical theorists have taken up the question of the relationship between debts and deficits in models of the Solow–Swan type. Under neo-Classical assumptions concerning the substitutability of capital for labor, Gale (1974) and Ruffin (1979) arrive at conclusions similar to those reached by Steedman and Metcalfe: in an efficient steady-state equilibrium (where the interest rate exceeds the growth rate) a country is either a creditor with a trade deficit or a debtor with a trade surplus.[3] Ruffin provides a theorem on 'stages in the balances of payments' as part of a convergence argument. In his model, the path of the trade balance has a cyclical component suggesting the possibility that, during the transition to an efficient steady state, a creditor may have a surplus and a debtor may have a deficit on trade account for some finite period of time.[4]

A paper by Bhaduri (1987), though not concerned with steady-state models as such, complements Steedman and Metcalfe's analysis. Bhaduri shows that, if the ratio of the trade balance to the level of output is treated as a parameter rather than as a variable, a small open economy will necessarily fall into a permanent 'debt trap' unless the trade balance *improves* (as output increases) by *more* than the level of investment multiplied by the difference between the internationally determined interest rate and the autarkic warranted growth rate. Bhaduri's analysis also implies that solutions to the Harrod Problem for which the trade balance is an *increasing* function of the growth rate are unstable. This limits the range of growth rates of the effective labor force which can be accommodated in Steedman and Metcalfe's model through the disposal of 'surplus full employment savings in foreign lending or . . . [the augmentation of] deficient savings through foreign borrowing.'[5]

In the present paper, we extend the analysis set forth by Steedman and Metcalfe to take account of differences in the propensities to save out of wages and profits along Kaldorian lines while invoking the conditions for stable wealth shares first noted by Pasinetti (1974). Thus, we combine the second and third approaches to the resolution of Harrod's Problem. By way of simplification, however, we set aside the considerable complications that arise when the capital–output ratio is a variable. For the purposes of our analysis, we also hold constant the share of wages (and hence profits) in domestic *output*. We make this assumption deliberately in order to show that, because the level of foreign assets (or liabilities) is a variable, the distribution of *income*, inclusive of international interest payments, is also a variable. Still, the effect of variation in interest payments on the overall propensity to save (which depends on who the borrowers and lenders are) may not be sufficient to guarantee the existence of a solution to the model.

We conclude therefore by interpreting this result as an implied constraint on the wage (and profit) share.

A main difference between our model and Steedman and Metcalfe's is that the interest rate, rather than being given from outside the model, is determined by the requirement (in a two-country model) that the foreign assets of one country's workers are the foreign debts of the other country's capitalists. Our main result is that this requirement sharply limits the range of growth rates consistent with a positive interest rate not greater than the profit rate in either country. For given values of the model's parameters (which include the share of wages in the value of domestic output), there may not be a growth rate consistent with long-period macroeconomic equilibrium. A second result is a generalization of the Pasinetti Theorem concerning the share of domestic capital (and of total assets) owned by workers in each country.

2 THE MODEL

We follow Pasinetti in assuming that workers have a single propensity to save, s_w, which applies to wage income and interest income, whether derived from the ownership of domestic capital or foreign capital.[6] Claims to ownership of domestic and foreign capital, on which interest is paid, must therefore be regarded as perfect substitutes. Capitalists, on the other hand, save a (higher) proportion, s_c, of the profits they receive net of the interest paid to domestic and (in the case of a debtor country) foreign workers. Thus, if a country is a creditor, it is the workers who have acquired interest bearing claims which are serviced by foreign capitalists in the debtor country.[7]

The interest rate, uniform across countries, is lower than the profit rate which, in general, differs between countries. Profit rates, in turn, are lower than capitalists' rates of return in each country.[8] With a uniform rate of growth,[9] the latter will differ when capitalists' savings propensities differ, according to the Pasinetti Theorem.[10] No capitalist would be willing to hold bonds bearing an interest rate less than the rate of return available at home. Thus, only workers lend and only capitalists borrow in the international capital market.

The formal relations of the model are set out as follows. In the creditor country, investment plus the trade balance plus the inflow of interest payments is equal to savings by workers and capitalists. In an obvious notation:

$$\begin{aligned} I + B + F = g(K + Z) &= s_w(W + iK_w + iZ) + s_c r K_c \qquad (1) \\ &= s_w(W + iK_w + iZ) + s_c(\pi K - iK_w) \end{aligned}$$

where the domestic capital stock is $K = K_w + K_c$, and π is the overall rate of profit: a weighted average of the interest rate, i, and the capitalists' rate of return, r, with weights equal to shares of ownerships, K_w/K and K_c/K.

Note that the growth rate times the stock of foreign assets, gZ, is equal to the trade balance, B, plus the inflow of interest payments, $F = iZ$. Thus, $B = (g - i)Z < 0$ indicates a trade deficit for a creditor country when the interest rate exceeds the growth rate.

In the debtor country, distinguished by an asterisk, equation (1) is written in a slightly different form to reflect the fact that, on the one hand, the workers' income from property is restricted to interest on that part of the domestic capital stock to which they have acquired claims, while, on the other hand, part of the domestic capital stock is now owned by foreign workers to whom domestic capitalists pay interest. Taking account of the fact that the creditor's assets are the debtor's liabilities, so that $B + F = gZ = -gZ^* = -(B^* + F^*)$, it follows that:

$$I^* - B - F = g(K^* - Z) = s_w^*(W^* + iK_w^*) + s_c^* r^* K_c^* \tag{2}$$
$$= s_w^*(W^* + iK_w^*) + s_c^*(\pi^* K^* - iK_w^* - iZ)$$

where $K^* = K_w^* + K_c^* + Z$, and π^* is the overall rate of profit, a weighted average of i and r^*, with weights equal to shares of ownership, $(K_w^* + Z)/K^*$ and K_c^*/K^*.

In addition to (1) and (2), the assumption that wealth shares are constant in long-run equilibrium requires that flows of savings by workers and capitalists in both creditor and debtor countries, divided by their respective assets, are all equal to the common growth rate, g. Thus:

$$g = s_c r K_c / K_c = s_c^* r^* K_c^* / K_c^* \tag{3}$$

$$g = s_w(W + iK_w + iZ)/(K_w + Z) = s_w^*(W^* + iK_w^*)/K_w^* \tag{4}$$

Equations (3) yield the capitalists' rates of return, $r = g/s_c$ and $r^* = g/s_c^*$.[11] Equation (1) and the first equality in (4) yield an initial expression for the workers' share of ownership of the domestic capital stock in the creditor country:

$$K_w/K = (g - s_c\pi)/(g - s_c i) \tag{5}$$

This share is positive and less than unity if $i < \pi < r = g/s_c$. Similarly, for the debtor country, equation (2) and the second equality in (4) yield:

$$K_w^*/K^* = (g - s_c^*\pi^*)/(g - s_c^* i) - (Z/K^*) \tag{6}$$

We now eliminate π and π^* from (5) and (6) in order to show how our results differ from those obtained by Pasinetti (1974) for a closed economy model and from those obtained by Steedman and Metcalfe (1979) in the context of an open economy model with a uniform propensity to save. Substituting $g = s_c r$ into (1):

$$K_w/K = \frac{s_w(W/Q)}{(g - s_w i)v} - Z/K \tag{7}$$

Equations (5) and (7) yield:

$$Z/Q = \frac{s_c - gv}{g - s_c i} - \frac{(s_c - s_w)g(W/Q)}{(g - s_w i)(g - s_c i)} \tag{8}$$

where $v = K/Q$ is the capital/output ratio.[12]

Similarly, substituting $g = s_c^* r^*$ into (2):

$$K_w^*/K^* = \frac{s_w^*(W^*/Q^*)}{(g - s_w^* i)v^*} \tag{9}$$

Equations (6) and (9) yield:

$$Z^*/Q^* = \frac{s_c^* - gv^*}{g - s_c^* i} - \frac{(s_c^* - s_w^*)g(W^*/Q^*)}{(g - s_w^* i)(g - s_c^* i)} \tag{11}$$

Finally, we eliminate W/Q from (7) and (8), and W^*/Q^* from (9) and (10) to obtain expressions, alternative to (5) and (6), for the workers' shares of ownership of the capital stock in the creditor and debtor countries, respectively:

$$K_w/K = \frac{s_w(s_c - gv)}{(s_c - s_w)gv} - \frac{s_c(g - s_w i)(Z/Q)}{(s_c - s_w)gv} \tag{11}$$

$$K_w^*/K^* = \frac{s_w^*(s_c^* - gv^*)}{(s_c^* - s_w^*)gv^*} + \frac{s_w^*(g - s_c^* i)(Z/Q^*)}{(s_c^* - s_w^*)gv^*} \tag{12}$$

The only difference between the two expressions (apart from the sign of the second term in (12) which reflects the use of Z rather than Z^*) is the switching of capitalists' and workers' propensities to save in the numerators of the second term in each equation. This is due to the fact that workers are

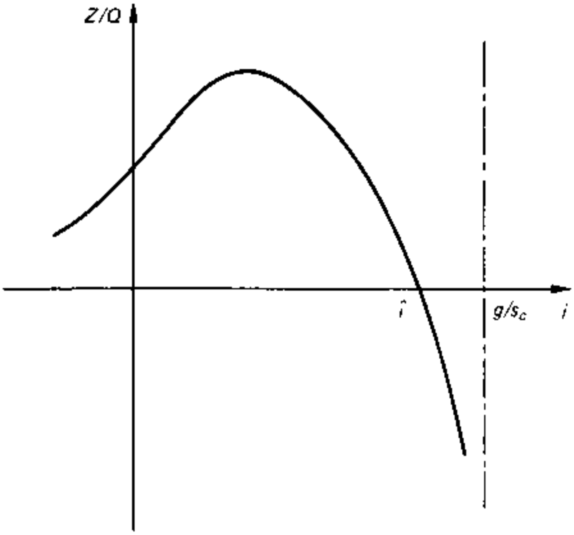

Figure 26.1

international creditors in the home country and capitalists are international debtors in the foreign country. The second term in each equation captures the effect of external debt on the workers' shares of ownership of the domestic capital stock. In a closed model, only the first term would be present, as shown by Pasinetti (1974). Thus, in comparison with a closed economy, the workers' share of the domestic capital stock is *lower* in the creditor country and *higher* in the debtor country because of the existence of international debt.

Figure 26.1 provides a sketch of the relevant branch of equation (9) showing the relationship between the foreign asset to output ratio and the rate of interest.[13] If the home country is to be the creditor, as we have been assuming in our discussion, it is necessary that the equilibrium interest rate fall short of the critical value, $\hat{i}$, in Figure 26.1.[14] Equation (11) has the same form as (9). The graph of Z^*/Q^* is shown in Figure 26.2, drawn to illustrate the case in which $\hat{i}^* < 0$.

In order to find an equilibrium interest rate, we impose the requirement that home country assets, Z, equal foreign country debts, $-Z^*$, and assume, for convenience only, that $Q = Q^*$.[15] The equation obtained from $Z/Q = - Z^*/Q^*$ is a third-order polynomial in i.[16] It can be shown (by numerical methods) that for arbitrary savings propensities, wage shares, capital/output ratios, and growth rate, there may or may not exist a positive interest rate less than the overall profit rate in each country such that Z/Q in Figure 26.1 is equal to (the negative value of) Z^*/Q^* in Figure 26.2.

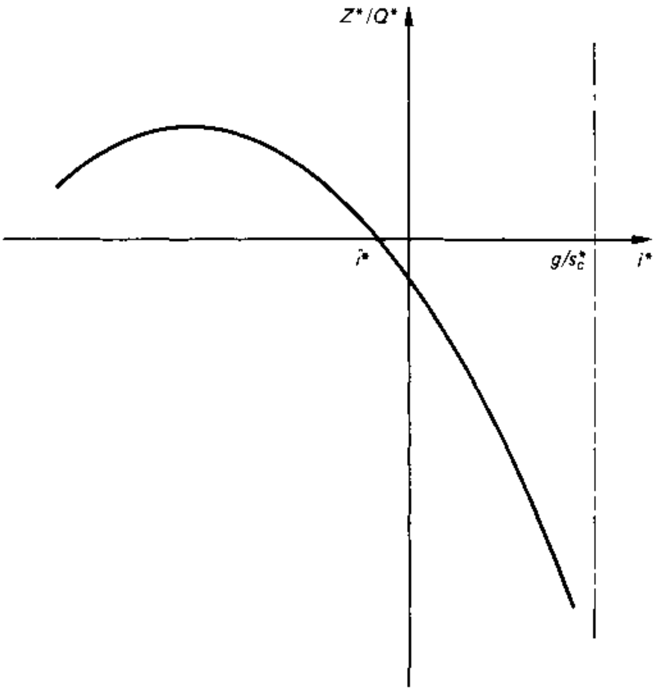

Figure 26.2

Suppose savings propensities, capital output ratios, and wage shares are as follows:

$s_c = 0.6$	$s_w = 0.1$	$s_c^* = 0.5$	$s_w^* = 0.1$
$v = 4$	$v^* = 5$	$W/Q = 0.7$	$W^*/Q^* = 0.6$

In the home country, the overall profit rate is $(1 - W/Q)/v = 7.5$ per cent and, in the foreign country, it is $(1 - W^*/Q^*)/v^* = 8$ per cent. The capitalists' rates of return in the two countries depend on the growth rate. If the growth rate is 4.6 per cent, these rates of return are $g/s_c = 7.7$ per cent in the home country and $g/s_c = 9.2$ per cent in the foreign country.[17] In this case, the model admits a meaningful solution. Formally, there are three solutions for i: 6.8 per cent, 8 per cent, and 46 per cent. Only the smallest of these satisfies the condition that the overall profit rate in each country is a weighted average of the interest rate and the capitalists' rate of return. Moreover, the interest rates for which $Z/Q = 0$ and $Z^*/Q^* = 0$ are 7.3 per cent and 5.1 per cent, so that only the smallest solution for the interest rate, 6.8 per cent, falls between these critical values. In that event, the home country is the creditor and the foreign country is the debtor, as the structure of equations (1) and (2) assumes.[18] The ratio of foreign assets (liabilities) to domestic output is 0.99 for the home (foreign) country. In the home country, workers own 19.8 per cent of the domestic capital stock, whereas, in the foreign country, they own 30.6 per cent. (Under autarky, these shares are 45.2 per cent and 29.3 per cent, respectively.) The workers' share of *total* assets is 35.8 per cent in the home (creditor) country and 38.2 per cent in the foreign (debtor) country.

The solution to the above example is quite sensitive to the growth rate. Given the specified parameter values for savings propensities, wage shares, and capital–output ratios, there is no meaningful solution for the rate of interest when the growth rate falls outside the interval (4.5 per cent, 5.67 per cent).[19] The additional requirement that the interest rate exceed the growth rate reduces this interval to (4.5 per cent, 4.97 per cent). Only then are workers in the creditor country able to consume part of their interest income while maintaining the rate of growth of foreign assets.[20]

The conclusion one might be tempted to draw from Steedman and Metcalfe's model is overly optimistic, namely, that any feasible growth rate larger than si (where s is the overall propensity to consume and i is the *exogenously* determined interest rate) can be accommodated, through borrowing or lending on the international capital market. The debts of one country are the credits of some other country, and, in our simple two-country formulation, this requirement may preclude a solution to the Harrod Problem along the lines suggested by Steedman and Metcalfe.[21]

These results suggest an alternative interpretation of the model consistent with Kaldor's emphasis on the importance of the distribution of income in the process of growth. If a particular growth rate is to be achieved, the share of wages in the value of domestic output as well as a country's debtor–creditor status, and hence its trade balance, must adjust to the requirements of macroeconomic balance. In our example, a growth rate of 3.5 per cent *would* be possible if the home country's wage share were increased from 0.7 to 0.8 and if the foreign country's wage share were increased from 0.6 to 0.75.[22] The equilibrium interest rate in this case is approximately 3.9 per cent and the home country's ratio of foreign assets to domestic output is approximately 0.83. (Workers' shares of ownership of the domestic capital stock and of total wealth change to 43.5 per cent and 53.3 per cent, respectively, for the home country, and 48.3 per cent and 57.9 per cent, respectively, for the foreign country.) Thus, when the growth rate is 3.5 per cent, too high a profit share rules out macroeconomic balance.

3 CONCLUSIONS

For given savings propensities and capital output ratios, it has been shown, in the context of a simple two-country model, that arbitrary wage shares and investment shares (equivalently, arbitrary but feasible profit rates and a common growth rate) may not be compatible. Compatibility is defined by four conditions: (1) equality between investment plus the current account and total domestic savings; (2) constant shares of ownership of assets; (3) a common positive interest rate not greater than the profit rate in either country; and (4) a recognition of the identity between the assets of one country and the liabilities of another. (In steady-state equilibrium, the last condition, together with equal growth rates and interest rates, implies an equality between one country's trade deficit and the other's trade surplus.) Specifying wage shares in addition to savings propensities and capital–output ratios may make it impossible to find any common growth rate for which a meaningful interest rate exists. When such a growth rate does exist, it will generally fall within a narrow range of values. It follows that, in order to sustain a rate of accumulation appropriate to the growth of the effective labor force, international borrowing or lending will provide only a partial answer to the problem of deficient or excessive savings. Kaldor's emphasis on the importance of income distribution therefore remains a central element in the reconciliation of warranted and desired growth rates.

Incidental to our discussion has been the further result that the workers' share of ownership of the domestic capital stock will be smaller (larger) in the creditor (debtor) country than it would be in a closed economy under conditions of the Pasinetti Theorem.

Finally, there is no guarantee that, when a meaningful solution for the interest rate exists, it necessarily exceeds the growth rate. If $i < g$, workers in the creditor country are worse off than under autarky since they are devoting more of their income to the accumulation of foreign assets than they are receiving back in the form of interest payments.

Within the very limited framework of our model, the main analytical problem which remains to be considered concerns some notion of the stability of equilibrium. In a steady state, the ratio of the current account surplus to the flow of domestic savings is positive for the creditor and negative for the debtor. As Bhaduri (1987) has shown, in a model which can be reduced to a steady–state formulation similar to the one used by Steedman and Metcalfe (1979), such an equilibrium may or may not be stable. Bhaduri's stability condition can be shown to imply that the trade balance to output ratio is a decreasing function of the rate of growth (Gram, 1988). Otherwise, steady–state equilibrium appears to have the property of a 'knife-edge' as in Harrod's original formulation. It remains an open question whether Bhaduri's result for a small open economy carries over to the present model in which savings propensities differ and where the interest rate is an endogenous variable.

It cannot, of course, be claimed that a steady–state model of international debts and deficits has more than a tenuous relevance to the pressing problems facing the current system of world trade and payments.

Still, it is important to confront the rather optimistic conclusions reached, for example, by Roy Ruffin (1979) in the context of a neo-Classical growth model of the Solow–Swan type, generalized to account for international capital movements. In such a framework, capital movements refer to reallocations of the world's productive capacity from countries where the marginal product of capital is low to countries where it is high. All countries benefit from such a reallocation. Capital exporters receive interest payments whose real value exceeds the output they no longer produce as a result of the fact that *less* of their capital is located at home. Capital importers are also better off because the extra output they now produce as a result of having *more* capital located in their country exceeds the real interest payments they make to foreigners. This increase in income then results, via the increase in savings, in higher equilibrium stocks of capital per worker in both countries. In a two-country model, the effect is to lower the world marginal product of capital to a level intermediate between its autarkic values and to raise real incomes everywhere.[23] Both countries are better off for having equalized, and reduced, the relative scarcity of capital.

Setting aside any doubts as to the meaning of reallocating the world's stock of productive capacity,[24] it is evident that the neo-Classical argument is subject to the criticism that it relies on the existence of an inverse relationship between the capital–output ratio and the rate of profit. The fact that no satisfactory theoretical foundation exists for such a relationship provides a compelling reason for going back to the beginning, as it were, to investigate the properties of Keynes–Harrod type models of the kind set forth by Steedman and Metcalfe (1979) and Bhaduri (1987). Taking account of differences in savings propensities along Kaldorian–Pasinettian lines and, in particular, recognizing the requirement that one country's debts are another country's assets, has been the contribution of this paper to that larger endeavor.

Notes

1. For a succinct treatment of the Harrod Problem, see Eltis (1987).
2. See, for example, Gram (1976) and Harris (1978, Ch. 4).
3. See Green (1972) for a detailed analysis of the inefficient case in which the growth rate exceeds the interest rate. Discussion of this case was prompted in part by Gale's interpretation of his general equilibrium model with imbalance of trade for the case of two groups of workers (skilled and unskilled) as opposed to two separate countries. 'Our result then says that under suitable assumptions about savings there will be an equilibrium price configuration in which the wages plus savings of skilled workers exceeds the value of what they produce, while that of unskilled workers is less than the value of what they produce. Thus, the skilled workers will end up getting more than their share of the pie. This could happen without the unskilled workers being aware of the

fact that they could "block" this unfair distribution of goods by "seceding" from the economy' (Gale, 1971, p. 147).

4. This is not formally established, however. See Ruffin (1979, pp. 840–1).
5. Steedman and Metcalfe (1979, p. 217). For a detailed analysis of the formal relationships between Steedman and Metcalfe's model and Bhaduri's model, see Gram (1988).
6. The extensive literature on the Pasinetti Theorem includes models in which workers save a higher proportion of their interest income than their wage income. In a recent paper, Pasinetti (1989) has argued that, on one interpretation, reflecting the presence of a higher rate of tax on profits than on wages, this assumption should be reversed: the *net* propensity to save out of wage income will exceed the *net* propensity to save out of interest income. Kaldor considered the high propensity to save out of profits as a characteristic of the behavior of corporations as opposed to the behavior of a particular class of individuals whose only source of income was profit. (See Kaldor, 1966.)
7. We are not claiming any realism for the assumption that only workers lend and only capitalists borrow on the international capital market. Our purpose is rather to take a preliminary step towards generalizing to an open economy an important aspect of the basic framework underlying the Pasinetti Theorem, namely, the idea that savings by workers implies a distribution of profits between capitalists and workers. This occurs within and between countries in our simple model.
8. Because profit is divided between interest payments and capitalists' income, the profit rate is a weighted average of the interest rate and the capitalists' own rate of return, the weights being given by shares of ownership of the capital stock.
9. We make this assumption in order to rule out the case in which the interest rate is exogenous to the small, slower-growing economy in long period equilibrium. The interest rate is therefore dependent on all the parameters of the model.
10. See equation (3) below. Pasinetti (1974, p. 142) has argued that only the thriftiest capitalists can survive in long-run equilibrium. Here, we attempt to show how two groups of capitalists can survive even though their savings propensities differ. Admittedly, the two groups are separated in the sense that only interest bearing assets sold to workers are considered, as opposed to direct foreign investment.
11. Note that $s^*_c > s^*_w$ and $r^* = g/s^*_c > i$ imply $i < g/s^*_w$. From (2), written as:

$$s^*_w W^* + (s^*_c r^* - s^*_w i)K^*_c = (g - s^*_w i)(K^* - Z) \tag{2'}$$

it then follows that $K^*_c > 0$ implies $K^* > Z$. Therefore net wealth in the debtor country is positive if capitalists continue to exist. This is true *a fortiori* in the creditor country. For a slightly different argument, see Steedman and Metcalfe (1979, p. 225, n. 3).

12. Note that $Q = W + \pi K$ or $\pi v = 1 - (W/Q)$, whereas income is equal to $Q + iZ$. If $s_c = s_w$, equation (8) simplifies to the result obtained by Steedman and Metcalfe (1979, p. 215).
13. The relevant branch occurs over the range, $0 < i < r = g/s_c$. The complete graph of equation (8) has three branches with two vertical asymptotes at g/s_c and g/s_w, one horizontal asymptote coincident with the horizontal axis, and (depending on the value of the interest rate corresponding to $Z/Q = 0$) two extreme points or none. By setting $Z/Q = 0$, it is easily shown that the external assets to output ratio is equal to zero at:

$$\hat{i} = g/s_w - \frac{(s_c - s_w)g(W/Q)}{s_w(s_c - gv)} < g/s_c < g/s_w$$

Note that the $\hat{i} < g/s_c$ if and only if investment exceeds what the capitalists would have saved out of total profits if all such profits had accrued to them – i.e., if and only if $s_c\pi K < gK = I$. This condition is satisfied on the assumption that the capitalist's rate of return $r = g/s_c$, exceeds the general rate of profit, π. It follows that the graph of Z/Q cannot cut the horizontal axis betweeen the vertical asymptotes and therefore has the form given in Figure 26.1. Note also that, because a positive wage share implies $1 > rv$, $g = s_c r$ implies $s_c > gv$. Therefore Z/Q remains positive as i approaches minus infinity.

14. See n. 13 above. Given $s_c > gv$, it is easily shown that $\hat{i}$ is positive or negative as $s_c\pi K + s_w W$ exceeds or falls short of investment. This information alone does not determine whether a country is a creditor or a debtor in steady state equilibrium, as Figures 26.1 and 26.2 and our numerical example make clear.
15. We thus ignore Q/Q^* as a determinant of the interest rate. Absolute country size is not, however, irrelevant and, where a solution to the model does not exist, variations in Q/Q^* may provide the basis for one.
16. By setting $s_w = s^*_w$, *or* $s_c = s^*_c$, this cubic in i is reduced to a quadratic. If both restrictions on savings behavior are imposed $Z/Q = - Z^*/Q$ yields a linear relation in i.
17. Most of the numerical values given are approximate.
18. In this example, $\hat{i} > 0$ (as shown in Figure 26.1), indicating that, when $g = 4.6$ per cent, the share of investment, gv, falls short of $s_c\pi v + s_w(W/Q)$ which is the autarkic share of savings on the assumption that s_c applies to total profits as opposed to profits net of interest payments to workers (see nn. 13 and 14). The same is true of the foreign country (unlike the case shown in Figure 26.2). This excess of the autarkic share of savings over the investment share is greater, however, in the home country, which is the creditor in long-period equilibrium.
19. For growth rates less than 4.5 per cent, the smallest solution for i is larger than $r = g/s_c$. For growth rates larger than 5.6 per cent, the smallest solution for i is negative and the next largest solution is again larger than g/s_c.
20. In the example, there is a critical rate of growth (4.97 per cent) for which $i = g = 4.97$ per cent. Trade is then balanced because the creditor's capital outflow (import of securities by workers) is just equal to its foreign interest income.
21. It is easy to show that the crucial difference between our formulation and Steedman and Metcalfe's is not the difference in savings propensities of workers and capitalists, but rather the requirement that the assets of one country are the liabilities of another. Thus, in our two-country example, suppose the *uniform* propensity to save in the home country is 0.3 and, in the foreign country, 0.2, and suppose that capital–output ratios and wage shares are unchanged. The growth rate must exceed 5/90 or 5.5 per cent to satisfy the requirement that the interest rate is positive; and it must fall short of 7.5 per cent in order for $s - gv$ to remain positive, given that $s^* - gv^*$ is negative within the interval, 5.5 per cent $< g <$ 7.5 per cent.

    It may also be noted that, as g increases through this interval, the interest rate also increases (from zero to 25 per cent). In the example in the text, a higher growth rate is associated with a *lower* interest rate because π is given and $r = g/s_c$ increases with g. Because the profit rate is a weighted average of the interest rate and the capitalists' rate of return, it follows that the interest rate *must* be lower when the growth rate is higher unless the weights change significantly. (These weights are the ownership shares which vary with g, i, and Z/Q, as shown in equations (11) and (12).) The differing results in these examples suggest that there may be certain critical savings propensities for which i is invariant to changes in g, but this is only a conjecture.

22. The range of feasible growth rates is sensitive to wage shares. If our example is altered by *reducing* the wage share in the home country to 0.75 from 0.7, there is no growth rate for which the home country is a creditor *and* i exceeds g. A growth rate of 5 per cent, however, does yield a ratio of external assets to output of 10.3 per cent for the home country and an interest rate of 2.7 per cent $<$ 5 per cent. The creditor country is running a trade surplus, but only for the purpose of allowing its external assets to grow faster than the interest rate without any long-run benefit for the workers who own those assets (see n. 3 above).
23. Ruffin (1979, p. 386).
24. There is, of course, a huge neo-Classical literature on precisely this problem. And, indeed, for a static allocation theory, it is entirely natural to think of international investment as a movement of factors. See, for example, the survey by Ruffin (1984). Occasional reservations are sometimes expressed by the contributors to this literature. See the brief comments by Ronald Jones on 'the optimal location of already existing capital equipment' (Jones, 1967, pp. 37–8).

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Part VII
Empirical Evidence on Post-War Growth

27 Kaldor's Growth Theories: Past, Present and Prospects for the Future

R. Boyer and P. Petit

All during his life, Nicholas Kaldor touched and investigated an impressive number of areas within economic analysis. Every economist knows his path breaking papers on speculation, non-linear models of the business cycle, his alternative theory of distribution, and so many other topics on taxation and economic and monetary policy. However, growth and development theories had been a recurrent theme for him all throughout his life. Around a basic core analysis, Nicholas Kaldor continuously revised his precise views about the factors limiting growth, whereas his hypotheses have been challenged. Still more, the breaking down of previous growth trends in the 1970s and the uncertain prospects about a recovery in the 1990s bring new questions into the cumulative causation model.

The present paper is built as a tribute and critical assessment of Kaldor growth theory and aims at suggesting that it still provides very stimulating insights and analytical tools for any economist analysing the present state of advanced capitalist countries. First the intellectual biography of Nicholas Kaldor and the main characteristics of his basic growth theories are presented (Section 1). But one of the weaknesses, often stressed, relates to his reduced form analysis. Therefore, in a second step a structural form of the model has to be presented. In fact, the distinction between the factors explaining for productivity increases (i.e. the productivity regime) and the demand generating mechanisms (i.e. the demand regime) allows both analytical clarity and a more general analysis (Section 2). Does this framework overcome the instability of the Kaldor-Verdoorn relations, which many empirical studies exhibit? It is then shown that the econometric evidence available is mitigated, using either long run US data or cross national comparisons (Section 3). Finally, a further deepening of the seminal analysis about the cumulative growth model is proposed, in order to cope with the challenge of the 1990s: is a renewal of fast and steady growth possible? (Section 4).

1 BACK TO KALDOR'S GROWTH THEORIES: STRENGTHS AND WEAKNESSES

Let us briefly present the various models proposed by our author and then focus upon the founding principles of the explanation, without duplicating other surveys (F. Targetti, 1988, 1989; A. P. Thirlwall, 1987; T. Michl, 1985).

A Recurring Theme, an Ever-adapting Framework

During the 1930s, Nicholas Kaldor made his first contribution to economic theory by studying the concepts of equilibrium, imperfect competition, the influence of wages upon employment, and by reinterpreting and generalizing the message of Keynes' General Theory. Therefore, he analysed mainly short and medium run equilibrium: using a Keynesian reflation policy, can full-employment be steadily maintained? On the contrary, is not the cycle an intrinsic feature due to the mutual adjustment of profit and investment?

In fact, one of his first papers on growth theory seems to have been published in 1954, unfolding a series of other contributions all through the three subsequent decades. Perceptive of political agenda and basic economic facts as he was, Nicholas Kaldor could not ignore that after World War II the macroeconomic problem had drastically changed. Given the control by the State of short run fluctuations, is long run growth possible? Quite originally, he developed path breaking models compared with the so-called post Keynesian growth theory worked out by Harrod and Domar.

In the 1950s, Nicholas Kaldor (1957) proposed *a theoretical model of growth*, challenging the neo-Classical distinction between factor substitution along a given production function and the general shift of this function due to technical change. In this first formalization, the technical progress function relates productivity improvements to the size of the investment sector. Simultaneously, he provided another mechanism for explaining factor prices: in his 1956 paper on alternative theory of distribution, the share between wage and profit plays the same role as technical substitutability within the R. Solow (1956) seminal paper on growth theory. These ideas are extended and refined in the subsequent 1962 paper jointly written with J. Mirrless.

These papers could have launched an original brand for Keynesian growth theory, but it was not the case due to earlier criticisms and the progressive surge of neo-Classical growth theory. A decade later, Nicholas Kaldor addressed a *more empirically oriented issue*: Why is the United Kingdom growing so slowly? Once again, he provides a quite different answer compared to E. F. Denison's (1987) views about the famous issue: why do growth rates differ? In his 1966 paper, Kaldor still focuses upon the role of technical change, but gives a more applied explanation of growth differentials. He combines three major hypotheses. First, the manufacturing sector is the engine of growth, setting the pace for others including the services. Second, *dynamic increasing returns* to scale are the major factors explaining manufacturing productivity improvements. Third, the limiting constraint for this cumulative growth is the scarcity of human resources to be incorporated into the manufacturing sector. According to this model, the early decline of agriculture would be the main reason for the poor British performance, whereas on the contrary France, Italy and Germany have benefited from a fast shift of working population from agriculture towards the manufacturing sector.

But this was not at all his final view. During the 1970s, he kept permanently revising some of his previous hypotheses. A lively debate took place, challenging both the empirical relevance given (the statistical tests seem to be shaky as noted by B. Rowthorn (1975)) and the theoretical framework itself: were not diverging growth rates the outcome of a catching up effect? But the major changes in Kaldor's views derive from the tendency to stick to the evolutions observed during the 1970s. It was clear that the rising unemployment challenged the view according to which labor scarcity was limiting manufacturing and therefore economy wide growth. Consequently, he put forward successively three new hypotheses.

Looking at the rising external imbalances opposing surplus to deficit countries, Nicholas Kaldor then proposed that *structural competitiveness* is indeed the limiting factor, extending previous models by W. Beckerman (1965) and A. P. Thirlwall (1987). The 1981 paper published in *Economie Appliquée* gives a suggestive account for the corresponding model: national growth is set according to the evolution of export and import propensity. A more sophisticated analysis, including the role of increasing returns to scale generally confirms the same conclusion (R. Boyer, P. Petit, 1984). The Cambridge Economic Policy Group (1980), F. Cripps (1978) provided an international model according to which the world macroeconomic evolutions were set by the economic policy adopted by surplus countries. Then comes a second explanation by Nicholas Kaldor when he observed the decline of Keynesian ideas and the surge of conservative policies. Austerity measures by the Japanese and German governments would explain the large increase in world unemployment rates from the mid-1970s to the mid-1980s.

Therefore, according to a typically Keynesian idea, growth would depend upon *the economic policy* followed by the leading countries. Last but not least, our author proposed a third alternative hypothesis. In his 1976 paper on 'Inflation and recession in the world economy', he put forward the impact of a *lagged reaction of primary products' supply* to previous changes in relative prices. Roughly speaking, he proposed the equivalent of a long wave Kondratief model: when manufacturing growth speeds up at the end of the boom, a scarcity of primary and raw materials appears, inducing a worsening of the terms of trade detrimental to the manufacturing sector. Consequently, its rate of profit declines, levelling off the investment, and therefore aggregate demand and production; as most raw product markets are flex prices, the previous evolution is halted and spurs a down-swing. Simultaneously, the new production capacities previously built in the primary sector prepare the next recovery.

Clearly enough, just as John Maynard Keynes, Nicholas Kaldor expressed various views on the very same issue about growth theory. Nevertheless, let us now extract the core of his analysis.

The Cumulative Growth Model: The Basic Hypotheses

The model originated in A. Young's (1928) seminal paper on increasing returns. According to A. Young, A. Smith's famous law stating that the division of labor depends upon the size of the market should be understood broadly as implying the existence of increasing returns to scale for the industry as a whole. The originality of A. Young's argument was to stress the fact that this characteristic was not simply the result of the existence of firms with increasing returns to scale (a very real possibility for all that), but was also due largely to the appearance of new products and new modes of production made possible by the size of the markets. For sure, a market implies purchasing power, but also a series of productive activities linked by a network of exchanges. The *extension of a market* may start a chain reaction. In the first instance, it makes possible an *increased division of labor* in the production process concerned, which opens the way for the introduction of new machines, which in turn develop new markets and speed up the scrapping of obsolete production processes. All the activities linked by the market help to yield increasing returns and 'change becomes progressive and propagates itself in a cumulative way', to use Young's own terms.

A. Young seemed therefore to add to Adam Smith's principle that, reciprocally, the extent of the market depends upon the division of labor (which amounted to restore the over criticized Say's law). But as noticed by N. Kaldor (1972), A. Young saw clearly that the combination of Say's law with Adam Smith's theorem was not enough to ensure that 'change becomes progressive and propagates itself in a cumulative way'. To tell more on demand induced by changes in the organisation of production would have required the bases of Keynesian economics. G. Myrdal (1957), who coined the term *circular and cumulative causation*', was not more explicit on the subject; he used the model to account broadly for the widening gap between rich and poor countries.

When N. Kaldor (1966) first referred to cumulative causation (then qualified as 'process of interaction between increases of demand induced by increases in supply and increases in supply generated in response to increases in demand') as a means to analyse the causes of the slow rate of economic growth in the UK, he mainly stressed the role of increasing returns in manufacturing sectors. The empirical P. J. Verdoorn's (1959) law, which related productivity gains with demand growth, was exhibited as inescapable evidence of these increasing returns. The model was made more explicit in further works (N. Kaldor (1970), (1972)) where account was given of both the effects of productivity changes on demand and the origin of the exogenous changes in demand which could launch the whole process of cumulative growth.

A basic explanation of demand inducement by productivity change relied on J. Hicks' (1950) 'super-multiplier', which showed that under certain assumptions "both the rate of growth of induced investment, and the rate of growth of consumption, become attuned to the rate of growth of the autonomous component of demand, so that the growth in an autonomous demand-factor will govern the rate of growth of the economy as a whole' (N. Kaldor, 1970, p. 146). The major role of the autonomous component of investment was therefore underlined in the early Keynesian tradition. Only in the late 1960s was the *role of exports* fully acknowledged as an autonomous demand-factor able to govern overall economic growth rates (as suggested by W. Beckerman's 1965 export led growth model and reckoned by N. Kaldor, 1970). But exports themselves depend both on an exogenous factor (the growth rate of world demand) and on an endogenous factor: the "efficiency wages" (i.e. the index of money wages divided by the index of productivity) as defined by J. M. Keynes and reported by N. Kaldor, 1970, p. 147).

Leaving this export relationship, it requires the simultaneous presence of a number of favourable factors to link the productivity gains (i.e. supply changes) with demand growth. N. Kaldor underlines the need for a passive monetary system (letting the money supply grow with credit demand), and for merchants who are ready to adjust their stocks so as to maintain prices. The conditions for a big enough 'elasticity of demand, to supply changes are stringent, and renders 'the 'self-sustained growth' . . . a fragile thing' (N. Kaldor, 1972, p. 196).

A Clarifying Device: A Two-sided Causality

Not withstanding the various specifications set out by Kaldor (on the sectoral dimension of the process or on demand formation), we can see the cumulative causation model as basically combining two assumptions, saying respectively:

1. That demand growth q favours productivity gains pr.
2. That productivity gains pr induce expansion of demand q.

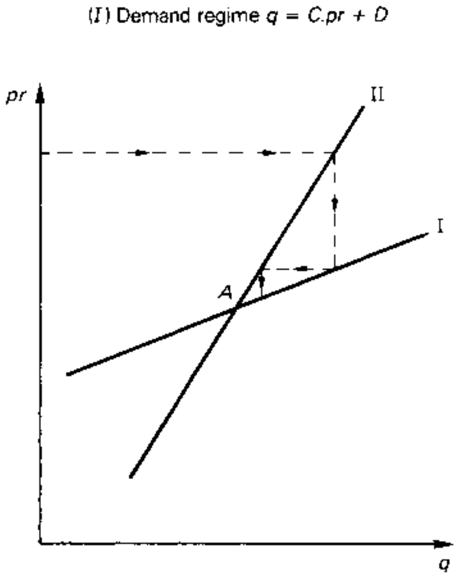


Figure 27.1 A stable equilibrium

The first assumption expresses a positive relationship between growth rates q and pr where the causation runs from q to pr ($pr = f(q)$) and conversely in the second assumption the causation goes from pr to q ($q = g(pr)$).

Even in this simplified version, the cumulative causation model can lead to a great variety of configurations where the economy moves accordingly towards larger or smaller, steady or unsteady, growth rates.

Figures 27.1 to 27.4 illustrate this diversity so as to stress the consequence of the various laws of productivity (how productivity gains are obtained) and demand (how productivity gains generate demand growth). This decomposition of the reduced form of the conventional Kaldor–Verdoorn relation brings some clarity into some of the controversies raised by Nicholas Kaldor's writings.

1. A cumulative process of growth, if to be sustained on a permanent basis, derives from the *structural compatibility of a demand regime and a productivity regime* (Figure 27.1). The stability condition calls for a limited sensitiveness of demand to productivity, for any given elasticity of productivity with respect to growth.
2. This generalized model explains why such a process might never occur for a specific economy, for example if the income distribution mechanisms do not fit with the productivity regime (Figure 27.2). This gives an insight with which to address Myrdal's issue: *why some economies do*

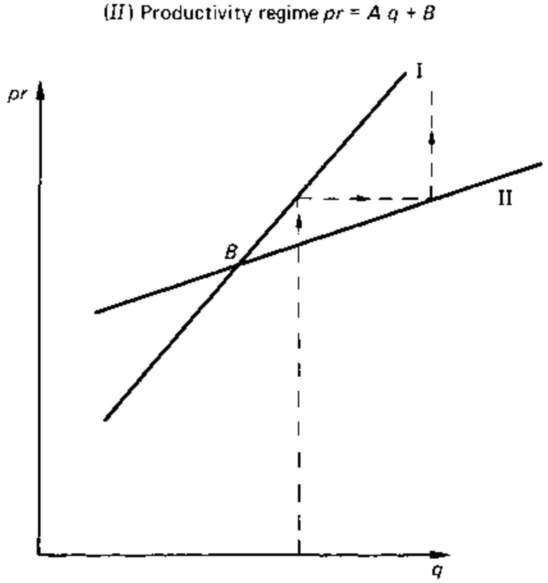


Figure 27.2 An unstable equilibrium

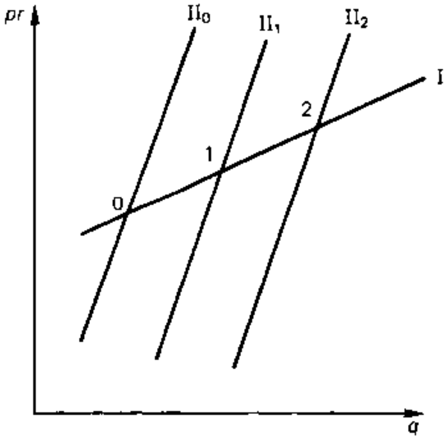


Figure 27.3 Can the Kaldor–Verdoorn relation be estimated by simple least squares?

not experience a cumulative growth as older, industrialized capitalist countries did?

3. The objection by B. Rowthorn (1975) about the difficulties in estimating Kaldor–Verdoorn relations can be answered. The estimated relation will correspond to the required productivity regime function if the shifts

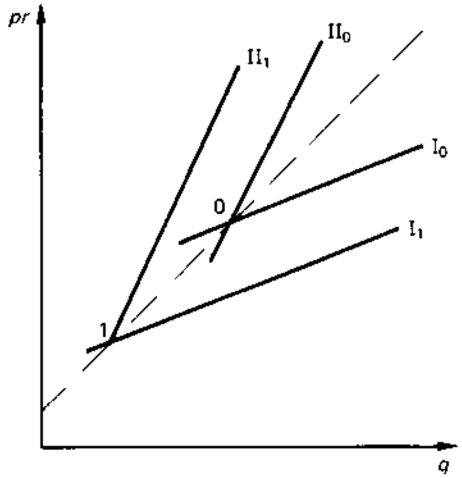


Figure 27.4 The general case: the need for a complete estimation

occuring in the economy are affecting only *the demand regime* (Figure 27.3).

4. In the general case, structural changes modify both productivity and demand regimes. Therefore, the conventional single equation estimates lead to a biased elasticity of productivity with respect to growth (Figure 27.4). Since cumulative evidence supports such an hypothesis, *the apparent instability of the Kaldor–Verdoorn relationship* finds a quite natural explanation.

The cumulative causation model has therefore to be more rigorously framed into a complete set of structural equations, as done for instance by H. D. Kurz (1990). Here, one has to explicitly state the different steps and variables contributing, in each case, to the obtainment and the diffusion of productivity gains.

2 TOWARDS A FULLY-FLEDGED STRUCTURAL MODEL

Let us now consider in more detail the theoretical grounds and empirical bases for both relationships between demand and productivity. Endogenous and exogenous variables have to be brought in to account for each specific equilibrium. The schematic form, presented above, considered only exogenous changes in productivity gains and demand growth to assess the stability of the current growth path. The real world is submitted to a large variety of exogenous changes across time and to a great diversity among countries. Empirical tests have therefore to rely upon explicit models accounting, as much as they can, for these differences. We shall first consider how demand growth stimulates productivity gains.

A generalization of the Kaldor–Verdoorn Law:
The Notion of Productivity Regime

According to Nicholas Kaldor's own writings, as well as the huge literature about technical change, many mechanisms may lead to an ex post positive relationship between productivity trends and growth rate in the medium long run. But how to disentangle so many interrelated factors? Just for simplicity's sake, five different mechanisms might be at work in modern capitalist economies.

1. As far as *static increasing returns to scale* are concerned, the size of the equipment in some manufacturing industries is a key factor in unit cost formation: the larger the size, the lower the cost. Such a relationship is clearly operating in process industries, in which for instance, the cost varies with the surface, whereas capacity and therefore productivity grows with the volume. Therefore, the elasticity of production with respect to inputs should be around ⅔. This feature could be captured by a conventional variable in industrial economics, i.e. *minimum efficiency scale* (MES).
2. But according to A. Smith and A. Young or even A. Marshall, the returns to scale are not limited to the internal organization of the firm, but express themselves too by the *deepening of the division of labour* due to the expansion of the market. By nature, this link between average productivity and market size can only be reaped at the macro level of the whole economy. From a formal point of view, this could be expressed either by a static relation between the absolute level of productivity and total production (for example in a cross section analysis), or by a dynamic link between productivity trends and demand increases (to be used in time series). This is precisely the conventional Kaldor–Verdoorn expression. Nevertheless three other mechanisms can deliver such a relationship.
3. The previous mechanism could be obtained only via labour division and changes in human skills, whereas many monographs and much statistical evidence suggests that some *technical advances are embodied* into specific equipment and machine tools. Two sub-hypotheses have to be combined in order to explain accordingly an ex-post close relationship between productivity and growth. First, following W. Salter (1960) and many macroeconometric models which retain a vintage analysis of capital, average productivity should depend upon the size of investment which brings up to date technologies and upon the rate of scrapping. Second, investment decisions should be related to demand

expectations, themselves formed according to past sales, and scrapping set according to the pressure exerted by real wage increases. A priori, such combination of hypotheses could contribute to a positive relationship between productivity and growth.

4. Another source of dynamic increasing returns to scale has been put forward by many monographs, managerial investigations (Boston Consulting Group), and has been taken into account in growth theory, for instance by K. Arrow (1962). *Learning by doing* and, by extension, *learning by using*, do provide mechanisms according to which the repetition of tasks, as well as of managerial problem solving, spurs invention and innovation by workers and managers. The cumulativeness of such a process is usually captured by adding an endogeneous improvement of total factor productivity into conventional production functions. This factor is measured by an index of cumulated past production, at the micro or macro level. Analytically, this is not exactly similar to productivity-growth relationships, but the flavour is quite similar indeed.
5. A final insight can be added: empirical studies have suggested that *innovative activity is enhanced by buoyant demand outlook*, according to a demand driven view of technical change (E. Mansfield, 1961; Schmookler, 1966). Therefore, on one side productivity growth benefits from innovation, on the other side the very success of the growth process spurs innovation. This virtuous circle between innovation and demand therefore exhibits another root for a possible Kaldor–Verdoorn function. Similarly, along a given socio-technical paradigm and trajectory, (G. Dosi et. al., 1988), the probability of success of any RD expenditure is the higher, the larger the available stock of knowledge deriving from previous innovations. Again, a form of cumulativeness is embodied into such a formalization.

Then, *an aggregate productivity regime* can be generated by combining the previous five mechanisms and elaborating a complete system. The initial reduced form $pr = pr(q)$ can thus be split into the following system:

$$\begin{cases} pr = F(q, Q, I/Q, \text{MES}, \text{INNO}, \ldots) & (1) \\ I/Q = G(q, PRO/PQ, \text{INNO}, \ldots) & (2) \\ \text{MES} = H(Q, \ldots) & (3) \\ \text{INNO} = J(\text{STOCKINNO}, q, \text{RD}, \ldots) & (4) \end{cases}$$

with Q level of production, q its growth rate, I the level of investment, INNO an index for innovation, MES minimum efficiency scale, PRO/PQ the share of profit in value added, RD the current expenditures in Research and Development. The first equation gives the main factors for productivity increases (growth, size of the market, investment rate, minimum efficiency scale, innovation). The second explains the rate of investment by demand growth, profit share and innovation. The third one gives the minimum efficiency scale as a function of the size of the market, whereas the fourth one describes current innovation with respect to past stock of knowledge, demand growth and RD expenditures. This system leads to the following reduced form for the productivity regime:

$$pr = pr\ (q, Q, \mathrm{RD}, \mathrm{PRO}/P.Q, \ldots) \qquad \text{(I)}$$

Such a framework has a clear advantage: a separate analysis of the various mechanisms can be made and the relative contributions of each of them investigated. Still more, each socio-technical system is probably characterized by an original mix, combining capital embodiment, learning by doing, innovation, static increasing returns to scale and so on. Conversely, any breaking down of such a system might explain the breaking down of the previous productivity regime equations.

This seems precisely to have taken place during the 1970s in most OECD manufacturing sectors. Converging evidences (T. Michl, 1985; R. Boyer and P. Petit (1981), R. Boyer, P. Ralle, 1986) oppose two periods. Before 1973, even a crude econometric test exhibits a close relationship between productivity trends and growth (Figure 27.5a). The result is quite at odds with standard neo-classical theory which basically assumes an exogeneous technical change. But then, the Kaldor–Verdoorn relation should be horizontal, whereas the upward slope is obvious, even when slowly growing (United Kingdom) and highly growing (Japan) manufacturing sectors are included. After 1973, this clear relationship vanishes (Figure 27.5b).

Most institutional and empirical studies suggest a key hypothesis: the transition from one technological system to another (Cf. Freeman, 1984). The shift in the productivity regime would be the expression of such a structural change. This suggested generalization along Kaldorian lines seems to cope with one of the major objections addressed to the 1966 formulation. But now the cumulative causation model has to deal with the complementary relation about demand generating mechanisms.

The Impact of Productivity Upon Income and Demand: Demand Regimes

Productivity increases can act upon the various components of demand either through price effects or through changes in wages and profits. Therefore, in order to explain the link between productivity and demand, one needs to account first for the parting of productivity gains between price or distribution changes, and second the impact of these price and income effects on the various components of demand. Households' consumption, C, firms' investment I, net exports X–M define the components

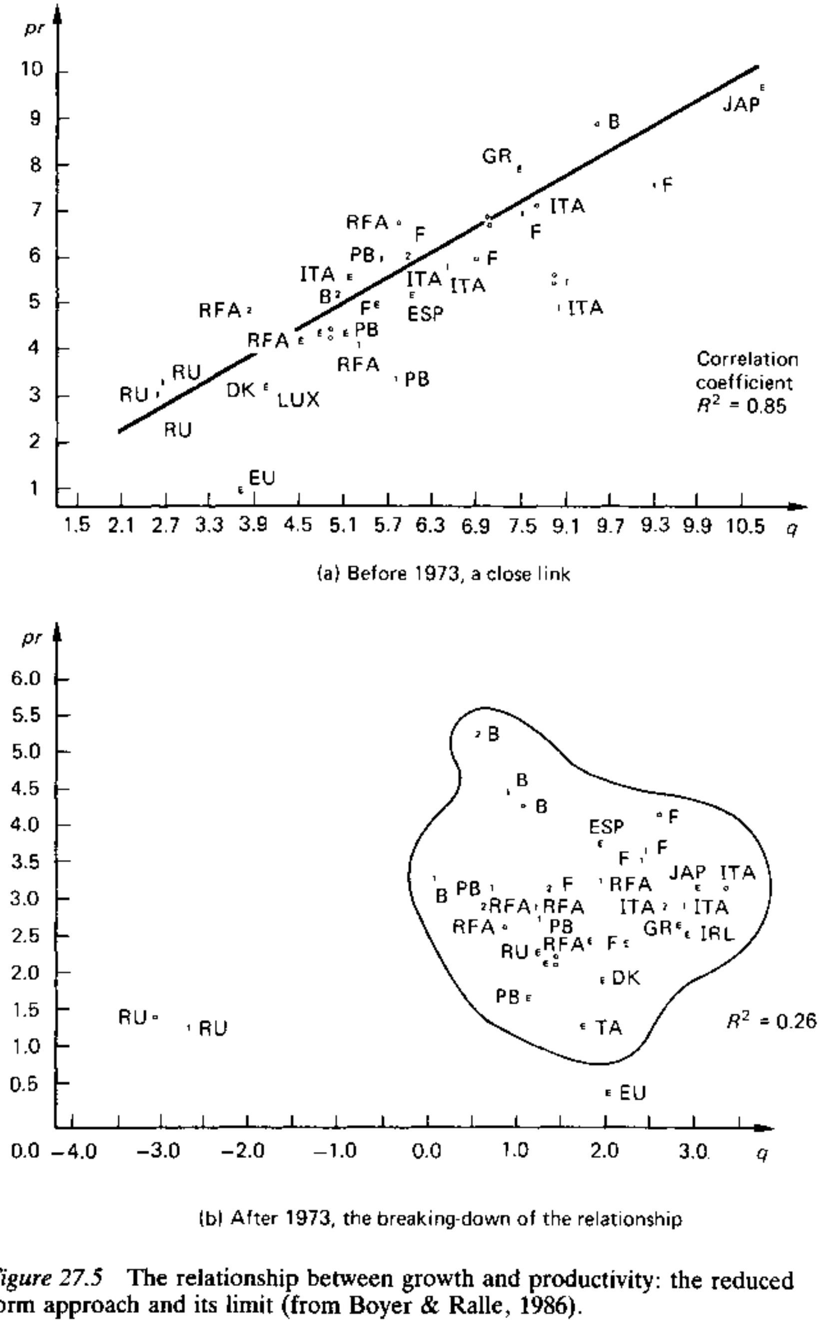


Figure 27.5 The relationship between growth and productivity: the reduced form approach and its limit (from Boyer & Ralle, 1986).

of demand Q (in constant terms and ignoring public expenditures). According to rather conventional hypotheses, let us propose the following structural equations, in which each capital letter labels a variable expressed in absolute levels, while the same lower-case letter describes growth rates.

$$\left\{\begin{array}{ll} Q = C + I + (X-M). & (5)\\ C = c.(N.RW) + g & (6)\\ I/Q = a.(PRO/P.Q) + b.q + d & (7)\\ X - M = e\,.\,QW + f\,.\,Q + h(P - PW) & (8)\\ NW = k.PR + l\,.\,P + o & (9)\\ P = m\,.\,(SN/PR) + r.\,PW & (10)\\ RW = NW/P & (11)\\ PRO/P.Q = 1 - (SN/PR) & (12)\\ N = Q/PR & (13) \end{array}\right.$$

$$q = q(pr, gw, pw, \ldots) \qquad \text{Demand regime reduced form} \qquad \text{(II)}$$

Aggregate production (5) varies according to effective demand, a rather Keynesian and kaldorian hypotheses. Household consumption (6) derives from the real wage (RW) and the employment level. It would be a minor difficulty to add a positive propensity to consume out of profit (H. Hagemann, 1990), but the model will be kept as simple as possible. The rate of investment (I/Q) (7) is linked jointly to the profit share and the rate of growth, the relative intensity of these two factors distinguishing between Keynesian (b $>$ 0 and a $\approx$ 0) and classical regimes ($b \approx 0$, $a > 0$) of investment. The shift could be made endogenous (S. Marglin, 1990). Net exports (8) are related to the trends in world and home demand (QW and Q) as well as to a price competitiveness factor, comparing domestic and foreign prices. The nominal wage (9) is the outcome of a double indexation, with respect to productivity increases and inflation. In the following discussion, the degree of indexation with respect to productivity will play a major role in generating various demand regimes. The general level of prices (10) is set according to a mark-up applied to labor unit cost, given the world prices. The three last equations define respectively real wage (11), the share of profit (12) and the employment level (13).

From this complete system of structural equations, one derives an aggregate demand function, which can be conveniently summarized by *a demand regime reduced form* (function (II). Basically, it describes the impact of any given productivity trend upon demand generation. It shows the variety and complexity of the transmission mechanisms, which are crucial to any analysis of the self reinforcing adjustment of technical change and demand, i.e. the core of the A. Smith-A. Young-N. Kaldor views about the growth process. But precisely, the conditions on the elasticity of demand (N. Kaldor, 1972) can now be addressed. On one side, for a given regime the demand may shift according to international and exogeneous changes. On the other side, in the long run, the very dynamic of the system might lead to significant changes in some crucial parameters, basically productivity sharing between wages and profits, the degree of openness and the competitiveness of each national economy.

Keynesian Versus Classical Demand Regimes

Previous investigations (R. Boyer, 1988) have exhibited *four configurations* according to the combination of two main mechanisms: the degree of indexation of wage with respect to productivity and the relative influence of demand and profit upon investment decisions. The corresponding framework is here extended to an open economy, therefore adding a competitiveness term in the analysis. In this simple model, the role of profit upon investment on one side, that of unit cost upon net exports on the other side are similar, which eases such a generalization (Figure 27.6).

1. *A pure Keynesian demand regime* comes out when wage indexation is sufficiently high, whereas accelerator effects outrun the profit motive in setting investment levels and the national economy is not submitted to any strong external pressure. Then quite intuitively, aggregate demand increases with productivity (Configuration 3). Implicitly at least, such a configuration can be labelled as Keynesian, since it fits quite well with the conception of General Theory and Nicholas Kaldor's writings. Similarly, it has some connection with the Fordist regime, put forward by the 'régulation' approach in order to explain the unprecedented post-World War II growth (R. Boyer, 1989). Section 3 gives some empirical evidences about this period.
2. *An hybrid Keynesian demand regime* associates a high indexation of wage with a strong profit motive and/or external competitiveness pressure. Under such circumstances, the negative influence of productivity upon profit, and therefore investment and net exports, is not balanced by consumption growth. Therefore, the demand is now decreasing with productivity (Configuration 4). This case seems representative for the advanced capitalist economies during the 1970s, when a spreading internationalization and the levelling of profit and investment exerted a strong pressure upon the previous keynesian demand regime. This hypothesis is tested in section 3.
3. *A pure classical demand regime* is obtained when a low degree of indexation of wage with respect to productivity prevails. Then, if productivity increases, unit costs are lower which enhances net exports, while profit share rises and spurs investment. In that case, these positive effects are strong enough to balance the negative impacts upon real

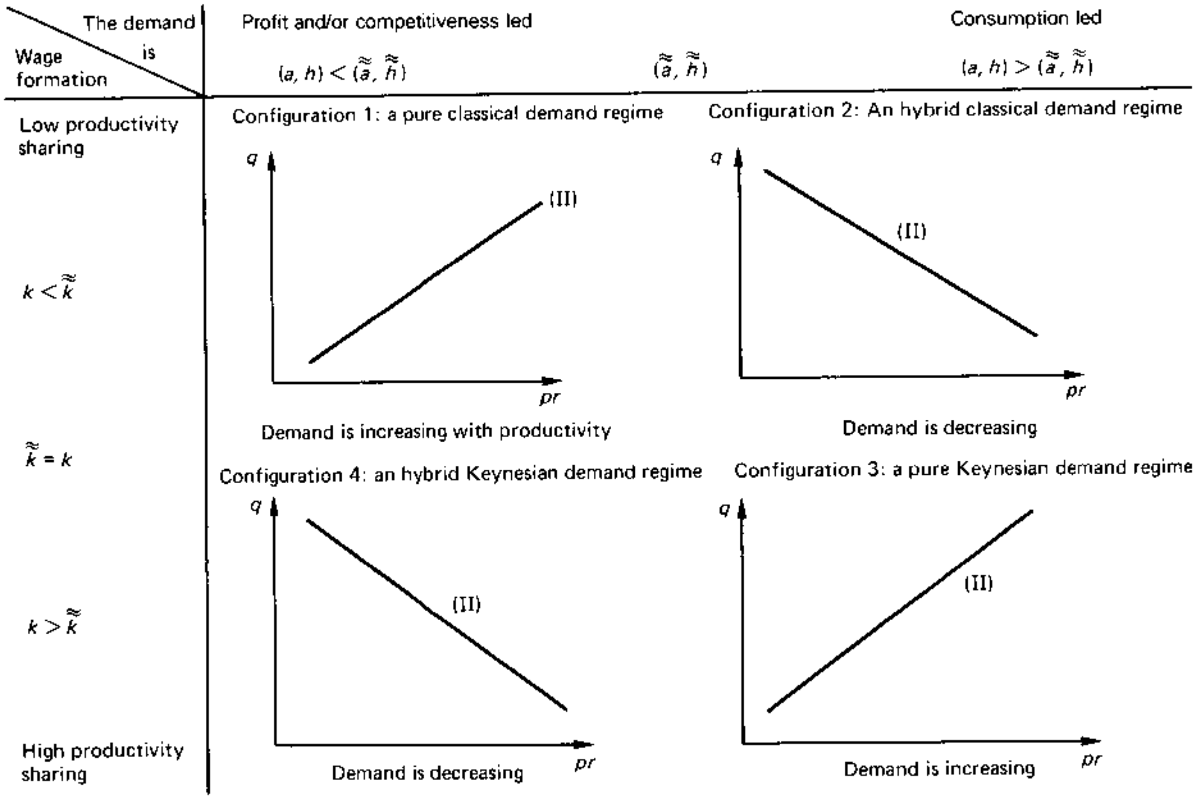


Figure 27.6 The different demand regimes

wage and consumption. Consequently, the demand regime is again upward sloping (Configuration 1). Let us note in passing that Configurations 3 and 1 lead to the same reduced form equation, in spite of contrasted mechanisms for productivity diffusion.

4. *An hybrid classical demand regime* corresponds to the last configuration available: the investment is mainly demand driven and the national economy slightly or not at all open to foreign competition, but wage-earners don't benefit from a sufficient indexing with respect to productivity. The demand regime is therefore declining with productivity (Configuration 2). Again, this case and the hybrid Keynesian demand regime exhibit clear similarities, even though the structural characteristics are at odds. This hybrid classical demand regime apparently prevailed in the US during the inter war years (R. Boyer, 1988, C. Leroy, 1988).

How does this framework enlighten post World War II growth and crisis? Does it solve some of the puzzles which hindered the initial cumulative causation model? It is now time to address more empirical issues: what is the relevance of this generalization?

3 FROM GROWTH TO CRISIS: A CHALLENGE TO THE GENERALIZED KALDOR'S MODELS

Any empirical test of such a framework has to face very specific constraints and requisites. Initially N. Kaldor (1966), and then F. Cripps and R. Tarling (1973), used simple regression upon cross-national long run average rates from main macroeconomic variables. But strong objections have frequently been raised (B. Rowthorn, 1975): is there any reason for the model to be universal? How to solve the simultaneity problem between employment, demand and productivity? Do not the results rely too much on extreme case such as Japan and UK? A priori, historical time series should be used in order to take into account national specificities. But sufficiently long series have to be available, which in fact restricts most of the econometric studies to the US economy. Even in that case, it turns out to be very difficult to disentangle two very different mechanisms explaining a positive correlation between growth and productivity. *In the short run*, the well known *productivity cycle* takes place: when the economy recovers, productivity is booming and conversely declines during down-turn. Traditional employment functions incorporate such a pattern (R. Brechling and P. O'Brien, 1967). *In the medium-long run*, quite different mechanisms explain such a correlation: the role of investment, dynamic increasing returns to scale, learning by doing, now play a prominent role (see above section 2). Econometric tests on annual data usually mix these two mechanisms (C. Leroy, 1988). Therefore, it might be prefered to build medium term data, smoothing out cyclical patterns and then to estimate the model on this new set of variables (L. Caussat, 1981).

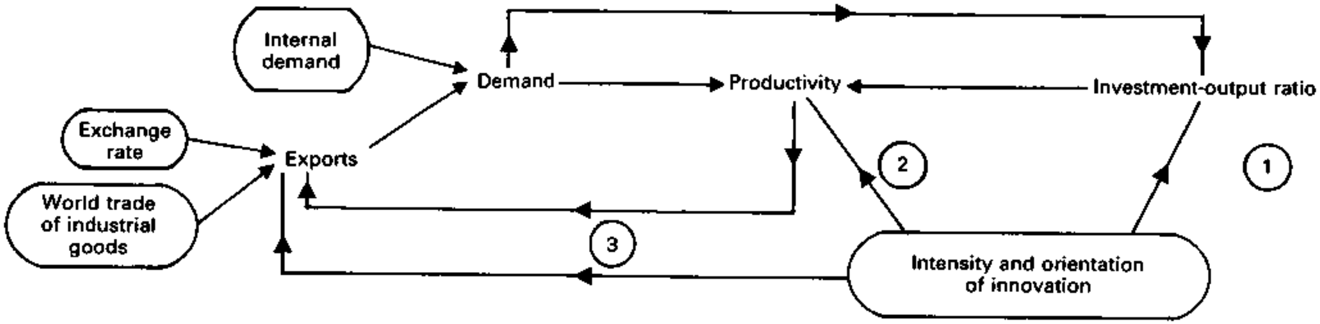
Given these caveats, let us summarize briefly the major conclusions suggested by the various available studies. First, the generalized KALDOR's growth model is used in order to explain growth differentials between major European countries until the Seventies. Then, an extension of this model will be estimated in order to understand long run growth for the United States manufacturing sector. Finally, the changes in the productivity regime will be investigated and simultaneously some hypotheses about the shift in the demand regime will be tested for main OECD economies, using the more recent data for the Eighties.

A Cross-section Analysis for European Manufacturing: A Correct Fit Until the Crisis

Attempts to disembody the respective effects of capital formation, work organization and technical change have brought some more backing to the cumulative causation model, if restricted to manufacturing industries (A. Parikh, 1978). Thus, pooling cross-section and time-series data for six European countries, R. Boyer and P. Petit (1981) show that a four equation formulation of the cumulative model is rather consistent to account for average productivity differentials over four business cycles during the period 1960–76. The model, summarized in Table 27.1, includes an employment relation and an investment function which helps to distinguish between the effects tied to capital formation and those due to work organization and endogeneous technical change. Innovations variables stand for the exogeneous part of productivity advances. Three main results have to be stressed:

1. The *apparent elasticity of productivity* with respect to growth turns out to be around 0.60. Nevertheless, this ex post estimate derives from two different mechanisms: pure increasing return to scale (around 0.57) and the impact of investment and the acceleration mechanisms (about 0.03), as shown by combining the equations (1), (2), (5). This global estimate is basically consistent with most of the available direct estimates.
2. The *demand regime* – obtained by using relations (3) and (4) – is slightly upward sloping. Given the elasticity of export with respect to productivity and the impact upon aggregate demand, the slope is around 0.18. Therefore, any exogeneous shift in the productivity regime raises output growth but lowers significantly the employment level. The competitive motive is not strong enough to balance the direct and mechanical negative effect of technical change upon the employment trends.

Table 27.1 A first estimation of a cumulative causation model for six European manufacturing industries: 1960–76 (extract from Boyer and Petit, 1981)



$$
\begin{array}{lllllllllllll}
n & = & 5.6 & - & 0.43 & \times (I/Q) & + & 0.54 & \times q & + & 0.002 & \times \mathrm{RAT} & - \; 0.27 \; \times \mathrm{ORINNO} \\
 & & (3.7) & & (4.4) & & & (4.5\;) & & & (0.03) & & \quad\;\; (1.6) \\
I/Q & = & 12.4 & + & 0.26 & \times \; q & + & 1.3 & \times \mathrm{INNO} & + & 1.7 & \times \mathrm{BELG} & - \; 1.8 \; \times \mathrm{R.U} \\
 & & (11.0) & & (1.9) & & & (2.7) & & & (3.1) & & \quad\;\; (2.7) \\
q & = & -\,0.4 & + & 0.32 & \times \; x & + & 0.56 & \times \mathrm{D} & & & & \\
 & & (0.9) & & (6.9) & & & (12.9) & & & & & \\
x & = & 4.6 & + & 0.57 & \times \; pr & - & 0.37 & \times \mathrm{Change} & + & 0.026 & \times \mathrm{ORINNO} & \\
 & & (1.2) & & (1.9) & & & (2.4) & & & (0.5) & & \\
pr & = & 100 & \multicolumn{10}{l}{\times [-1 + (100 + q) / (100 + n)] \approx q - n}
\end{array}
$$

(1)
(2)
(3)
(4)
(5)

Estimation method: full information maximum likelihood method as given in TSP.
(Growth rates are average annual growth rates over cycle.)

1. ENDOGENEOUS VARIABLES	
n	Growth rate of industrial employment
I/Q	Ratio of investment to added value in current prices
q	Growth rate of added value in constant prices
x	Growth rate of volume of exports of industrial goods
pr	Growth rate of productivity (added value in constant prices per man employed)
2. EXOGENEOUS VARIABLES	
RAT	Share of machinery in total investment
ORINNO	Percentage of process innovations in the total of innovations, ten years before common values for the five industries
INNO	Ratio of RD expenditures (military excepted) to GNP (both in constant prices) five years before
R.U.	Dummy variable for UK industry, to account for the weakness of the investment ratio in that country
BELG	Dummy variable for Belgium
Change	Growth rate of the exchange rate (i.e. the value of national currency in US dollars); this variable expresses partly the effect of the differences in financial capacities between countries.
D	Growth rate of volume of total demand.

Sources: OSCE (1980) except for Change and RD: see Boyer and Petit, 1981.
Data: Average annual rates over four periods 1960–65, 65–69, 69–73, 73–76, 6 European manufacturing industries.

3. The statistical fit is rather satisfactory given the simplicity of the structural model which has been estimated. At the confidence level of 10 per cent, the returns to scale are significantly superior to 1, which seems to contradict a basic hypothesis of general equilibrium theory, as well as standard neo-classical growth models.

All these results bring a clear support to N. Kaldor's views, while replying to earlier criticisms about the bias towards a reduced form approach and the shakiness of econometric tests. Nevertheless, this generalized model is not without clear shortcomings. On one side, international heterogeneity is not totally explained, since dummy variables for Belgium and UK had to be added. Again the validity of a unique and universal model can be challenged. On the other side, internal demand has been kept exogeneous, which skips aside the sensitivity of demand with respect to productivity. In order to overcome these two limits, let us now turn towards another data set.

A Model for US Manufacturing: Merits and Limits

In a very stimulating, but alas unpublished working paper, L. Caussat (1981) has elaborated and estimated a cumulative causation model for the American manufacturing sector from 1899 to 1976. In order to abstract from short run fluctuations, he built aggregate data smoothed over the 18 cycles which took place in United States during this period. Simultaneously, very long series about patenting allows two original measures for innovative activity (INNO1, INNO2) to be included in the employment, investment and external trade equations. Furthermore, the real wage is now endogeneous and reacts to productivity variations. The very building of data over a whole cycle makes sure that the estimates capture medium-long run mechanisms and not the short run productivity cycle. Three major results emerge (Table 27.2):

1. The existence of *increasing returns to scale* cannot be rejected at a very high confidence level. Again, the ex post elasticity of productivity with respect to growth is around 0.5, as exhibited by both relation (1) and (4). With respect to the previous model, two other factors contribute to productivity increases. Firstly, machinery and manufacturing building have opposite effects upon employment: the former enhances productivity, while the later spurs employment. Therefore investment, according to its composition, has both productivity and capacity effects. Secondly, innovation plays a significant but modest role in productivity improvement, directly via labor saving biases, indirectly in stimulating investment in machinery.

2. *The demand regime* is clearly upwards sloping, since now the real wage reacts to productivity according to an elasticity around 0.3 (equation (3)). Simultaneously, the ratio of export to import is strongly sensitive to productivity advances with an elasticity about 2.65 (equation (2)). Therefore aggregate demand now increases by 0.43 per cent when productivity is raised by 1 per cent (equations (5) and (6)). Consequently, any exogeneous upwards shift in the productivity regime, enhances growth but seems to destroy employment. Again, a desindustrializing bias of technological change emerges: when innovation speeds up, as far as the model is correct, the absolute and relative levels of manufacturing employment decreases.
3. *The statistical fit* is rather good, as shown by the very high significance level of most variables. The basic mechanisms cannot be rejected, on the evidence of three quarters of a century in American history. Nevertheless, the simulations somehow mitigate such a positive assessement. Of course, the major fluctuations in growth rates are well captured by the model (Graph 3), especially during the interwar period. Nevertheless, after 1965, one notes a large discrepancy between observed and theoretical values for manufacturing value added. The discrepancy is rather impressive for productivity (Graph 4). After 1965, the model predicts a mild acceleration, whereas American manufacturing has experienced a very significant slow-down.

Therefore, *a rather contrasted picture* comes out. For any follower of Kaldorian ideas, the acceptance of the cumulative growth model is seemingly strengthened. Quite on the contrary, many others might challenge the relevance of this model: after all it does not solve the American productivity puzzle that it intended to enlighten. Nor did E. F. Denison (1987). But as D. Gordon (1990) pointed out, the Kaldorian system probably exhibits too much cumulation and too little disaccumulation. The British manufacturing industry in the 1980s would provide quite similar diverging trends: high productivity rate, but moderate sales growth. Basically, scrapping and modernizing via rationalization are not dealt with by the Kaldorian model, an evident drawback indeed in analyzing the 1970s and 1980s.

The stability of the model in the long run is therefore challenged. Two other studies seem to confirm some major changes occurring in the American economy. After the Second World War, wage formation seems to have shifted from mainly competitive to administered, with an explicit sharing of expected productivity increases (R. Boyer, 1988; C. Leroy, 1988). After the mid-1960s, the productivity regime shifted downward by 1.5 per cent, and this slow-down cannot be accounted for by most of conventional factors. In this respect, the estimation of a two sections model (M. Juillard,

Table 27.2 A Second estimation of a cumulative causation model for the American manufacturing sector over 18 cycles from 1899 to 1976 (extract from L. Caussat, 1981).

1. Estimates

$$n = -\underset{(0.72)}{0.35} + \underset{(8.52)}{0.5}\,q - \underset{(2.38)}{0.02}\,m - 1 + \underset{(3.04)}{0.06}\,c - \underset{(2.67)}{0.08}\,\mathrm{INNO1} \quad (1)$$

$$tc = -\underset{(2.46)}{6.97} + \underset{(10.82)}{2.65}\,pr + \underset{(4.05)}{0.16}\,\mathrm{INNO2} \quad (2)$$

$$s = \underset{(2.83)}{0.8} + \underset{(7.72)}{0.3}\,pr + \underset{(62{,}56)}{1.06}\,p + 0.43 \quad (3)$$

$$m = -\underset{(3.94)}{4.71} + \underset{(13.32)}{1.96}\,q + \underset{(2.21)}{0.21}\,\mathrm{INNO1} \quad (4)$$

$$d = \underset{(1.95)}{1.06} + \underset{(44.29)}{0.82}\,W + \underset{(11.55)}{0.13}\,m \quad (5)$$

$$q = -\underset{(1.72)}{0.26} + \underset{(14.90)}{0.05}\,tc + \underset{(76.51)}{1.05}\,d \quad (6)$$

$$pr = (1 + n)/(1 + q) - 1 \quad (7)$$

$$w = (1 + s)(1 + n)/(1 + p) - 1 \quad (8)$$

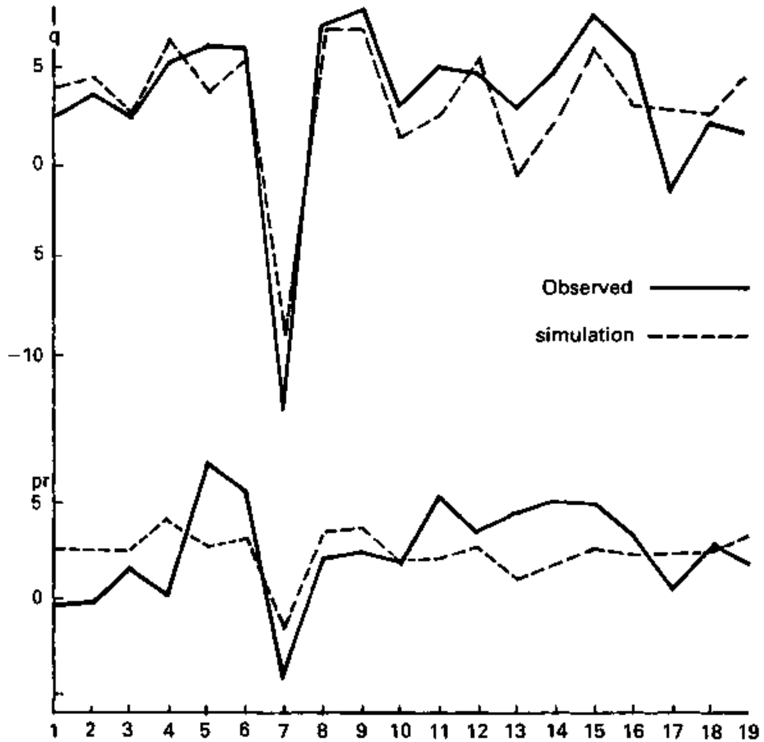
2. Notations

	Same notations as Table 27.1.
m	Volume of machinery delivered to manufacturing
e	Volume of construction for manufacture
INNO1, INNO2	Lagged variables over American patents
tc	Rate of evolution of the ratio export/import
s	Nominal wage
W	Total wage bill

3. Simulation results

Graph 3: Manufacturing value added (annual rate)

Graph 4: Labour Productivity



1988) does confirm this conclusion, already reached by the growth accounting method (E. F. Denison, 1987). Still more, the real wage undergoes an equivalent slowing-down after 1972. Again it cannot be explained by the traditional factors such as the rise in unemployment or the decay in the bargaining power of the labor unions.

Clearly, even for a single country, the generalized Kaldorian model is *not stable in the long run*. Does this conclusion emerge too from a cross section analysis among OECD countries?

A Cross-national Analysis: the Breaking-down of the Productivity Regime in the 1970s

After a decade of slow growth and large unemployment in most industrialized countries it appears that some relationships, at the core of the cumulative causation model, do not hold any more or have shifted noticeably. The alteration of the Kaldor–Verdoorn law is itself a central example. The linear relationship between demand and productivity growth rates does not account for the recent slower growth in demand and productivity (see Figure 27.5). This result stems from different international comparisons pooling cross sections and time series (cf. T. Michl, 1985; R. Boyer and P. Ralle, 1986; P. Petit, 1986) or from time series econometric studies allowing for simultaneity problems of estimation (V. G. Stavrinos, 1987).

P. Ralle (1988) has adopted a similar strategy and has estimated both productivity and demand regimes for ten European economies, Japan and US. The model is therefore extended from manufacturing to other industries, such as services. The theoretical reasons for such a generalization are to be carefully discussed (P. Petit, 1988). In any case, the sample from 1960 to 1987 has been split into three sub-periods: 1960–73, 1973–79, 1979–87. Of course, given the limited data, the econometric results are somehow shaky, whereas the linearisation of the basic model is not without drawbacks, even if very useful in order to analytically solve the model. The main concern is about the stability/instability dilemma (Table 27.3).

1. The heyday of *a typical Kaldorian model* seems to have occurred from 1960 to 1973 (Table 27.3.A). Quite all the basic hypotheses are confirmed. The increasing returns to scale are significant and rather impressive (around 1.7). The indexing of wage with respect to productivity is complete and plays a major role in effective demand dynamism. The investment reacts both to demand and profit share, but this ratio is kept sensibly constant due to the perfect indexation of wage. Consequently, the simplified cumulative causation model is a good approximation for a more complete formalization: the demand regime is quite insensitive to

productivity (Graph 5). Therefore the Kaldor–Verdoorn equation can be estimated by a simple least squares procedure.

2. *This model breaks down after* 1973 (Table 27.3.B). First, the productivity growth equation looses significance: increasing returns are lower, but research and development per capita seems to play a more important role in international productivity differentials. This is another evidence for a possible change in the productivity regime. But the demand regime itself is drastically modified: investment growth differentials cannot be explained by any of conventional variables, whatever profit, demand, or real interest rates. The stability of productivity sharing cannot be rejected, but the previous changes deliver a new demand regime, downwards sloping (Graph 6). As for the previous period, the influence of net export cancels out and therefore has been excluded. Therefore, it is difficult to check the shift from a pure Keynesian demand regime to a competitive and profit led regime or any hybrid case.
3. *Not any clear model has yet emerged in the 1980s* (Table 27.3.C). The productivity regime is puzzling indeed: basically, productivity is independent from any conventional factor. Even RD expenditures play a modest and not very significant role. The demand regime is surprising too. On one side, the accellerator mechanism takes place again, whereas the role of profit becomes significant. No problem with consumption, but contrary to a widely held view, real wage indexing would not have declined – but this might describe a spurious result. Adding up these various changes, the global demand regime comes out as downward sloping (Graph 6). If the exogeneous variables of the early 1980s were kept constant, the model would forecast a growth rate around 2.8 per cent per year, and a recovery in employment around 1.3 per cent per year, a rather optimistic view which might be challenged.

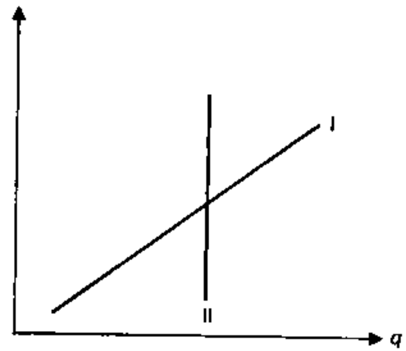
Two opposite conclusions can be drawn from the previous exercice. Either the econometrician will argue that the misspecification of the model tested explains the apparent instability of the generalized Kaldorian model, or a 'régulationnist' approach would emphasize that such instability is a real phenomena, deriving from the structural character of the present crisis: numerous institutional evidences support the hypothesis about the demise of post World War II growth model. In any case, Kaldor's ideas do bring fresh and genuine hypotheses, in analyzing contemporary capitalist economies.

Table 27.3 A third estimation of a cumulative causation model for twelve OECD economies over three periods (extract from Ralle, 1988)

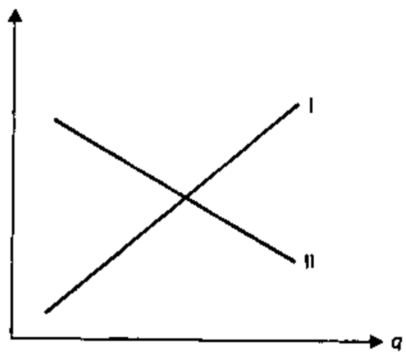
A. 1960–73: A typical Kaldorian model

$$
\begin{array}{llllllll}
(1) & pr & = & -\ 0.32 & +\ 0.69q & +\ 0.06rd & & \\
 & & & (-0.3) & (3.0) & (0.07) & & \\
(2) & i & = & 5.03 & +\ 1.37q & +\ 2.07\ (pro/q) & -\ 1.36\ r & +\ 4.62\mathrm{IRL} \\
 & & & (1.6) & (4.4) & (2.2) & (2.1) & (3.1) \\
(3) & c & = & -\ 0.46 & +\ (sr+n) & & & \\
 & & & 2.0 & & & & \\
(4) & w & = & 0.31 & +\ 1.02pr & +\ 2.17\mathrm{GRE} & & \\
 & & & (0.7) & (9.4) & (3.9) & & \\
(5) & (pro/q) & = & 1.73 & (q - sr - n) & & & \\
 & & & (2.4) & & & & \\
(6) & q & = & 0.85c & +\ 0.15\ i & & & \\
(7) & n & = & q - pr & & & &
\end{array}
$$

Graph 5



Graph 6



B. 1973–79: The breaking down

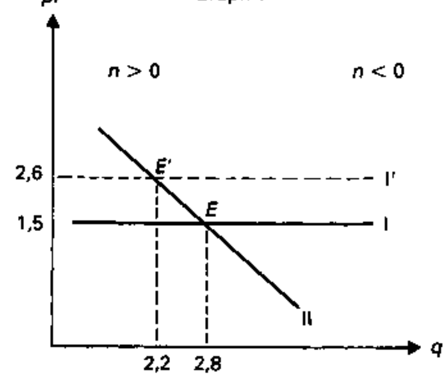
$$
\begin{array}{llllll}
pr & = & 0.21 & +\ 0.40q & +\ 0.15rd \\
 & & (0.4) & (2.0) & (4.2) \\
i & = & 0.58 & -\ -0.08r & +\ 5.39\mathrm{IRL} \\
 & & (1.7) & (-0.6) & (4.6) \\
c & = & -\ 0.12 & +\ (sr+n) & \\
 & & (-0.5) & & \\
sr & = & 0.56 & +\ 0.76pr & +\ 1.66\mathrm{GRE} \\
 & & (1.7) & (4.7) & (3.5) \\
(pro/q) & = & 2.78(q - sr - n) & & \\
 & & (3.4) & & \\
q & = & 0.85c + 0.15\ i & & \\
n & = & q - pr & &
\end{array}
$$

C. The 1980s: No clear substitute to the previous model

$$
\begin{array}{llllll}
pr & = \underset{(1.8)}{0.82} & + \underset{(1.8)}{0.26rd} & & & \\
i & = \underset{(-2.5)}{-3.86} & + \underset{(3.7)}{2.56q} & + \underset{(2.6)}{1.10}\ (pro/q) & - \underset{(-0.9)}{0.17r} & - \underset{(-2.1)}{2.80\mathrm{IRL}} \\
c & = \underset{(2.1)}{0.49} & + (sr + n) & - \underset{(-2.6)}{2.00}\ \mathrm{IRL} & & \\
sr & = \underset{(-3.9)}{2.12} & + \underset{(5.8)}{1.73pr} & + \underset{(1.4)}{0.32n} & + \underset{(4.6)}{3.11\mathrm{GRE}} & \\
(pro/q) & = \underset{(2.6)}{0.99}\ (q - sr - n) & & & & \\
q & = 0.85\ c + 0.15i & & & & \\
n & = q - pr & & & &
\end{array}
$$

$$
\begin{array}{llll}
\mathrm{I} & pr & = 1{,}5\% & \\
\mathrm{II} & q & = 3{,}8 & - 0{,}6\ \mathrm{pr}
\end{array}
$$

Graph 7



$$
\begin{array}{lll}
qE & = & 2{,}8 \\
nE & = & 1.3
\end{array}
$$

4 REINVESTING GROWTH THEORY ALONG KALDOR'S SEMINAL CONTRIBUTIONS

It is time now to summarize the main conclusions and to suggest an agenda for future researches. By itself the variety and the quality of the contribution to the conference 'Nicholas Kaldor and mainstream economics' is a testimony upon his long lasting influence. Let us propose the following statements and prospects, given our own previous research.

1. Nicholas Kaldor's vision about growth becomes now more and more relevant. When he first opposed the overemphasis of general equilibrium theory about short run phenomena and proposed the cumulative causation growth model as an alternative, his impact on mainstream economists was quite small indeed. Paradoxically enough at the end of the 1980s, very numerous and distinguished scholars now consider *growth theory* as a key agenda, and still more *increasing returns* as a necessary ingredient for any relevant formalization. P. Krugman (1981), R. E. Lucas (1988), P. Dasgupta, J. Stiglitz (1986), P. M. Romer (1986), R. Day (1987), have all worked at rejuvenating the basic hints in the tradition of A. Smith, and A. Young. One can only regret N. Kaldor having been right too early with respect to academic profession.
2. Of course, his various models, *if very stimulating, were far from perfect.* Most of them were under-specified, some basic hypotheses have continuously been changed from period to period in order to cope with the various phases of modern capitalist economies. Therefore he never converged towards a central theory and formalization, which would have defined a clear and fully-fledged alternative to the elegant, but poorly relevant, general equilibrium theory. Similarly, the statistical tests provided by Nicholas Kaldor and his followers were sufficient for pointing out some major stylized facts, but not necessarily to convince modern macroeconomists and sophisticated econometricians. Still more, the precise roots of increasing returns to scale are more suggested than totally elucidated, whatever the sympathy one might have with this hypothesis. Nicholas Kaldor launched a research agenda, but until recently only few scholars have been devoting their time in exploring it.
3. After and among many others (A. P. Thirlwall, 1987; F. Targetti 1988, P. Skott, 1988; H. Kurz, 1990; D. Gordon, 1990), the present paper has put forwards a *generalized model* form along a Kaldorian vision about long run growth. Basically the idea is simple enough: first, to define a *productivity regime* which generalizes the too crude Kaldor–Verdoorn reduced form approach; second and symmetrically, to build a *demand regime*, which describes the impact of productivity increases upon income distribution and demand generation. The viability and stability

of any institutional and technological organization is up to the compatibility between these two regimes. Even if kept analytically very simple – excluding for example any strong non-linearity – the corresponding models shed some interesting insights about post-World War II growth, for US as well as for major European or OECD countries.

4. Nevertheless, *this framework has encountered its own limits*, typically during the last decade. First, there is an intrinsic difficulty in estimating such models. Either, one assumes the universality of the same growth model all across advanced capitalist economies, and therefore estimates a cross-section model (the specificity of most, or at least of some national trajectories, points then to a major shortcoming of such an hypothesis), or alternatively, one supposes the invariance through time of the cumulative causation growth model, which then contradicts some basic hints about the structural changes which have occured both in productivity regime (the slowing-down in the US manufacturing sector during the mid-1960s) and in the demand regime (new trends in wage formation and external trade in the Seventies). The available econometric studies do suggest some *national specificities*, as well as the occurrence of *structural changes through time*. This might explain why Nicholas Kaldor sequentially changed his view about the factors successively limiting growth: labor scarcity, external constraints, lagged adjustment of primary products supply . . .
5. Therefore, *a rejuvenation of the Kaldorian model* has to be undertaken. First should be discussed the *general vision* according to which the growth process derives from the interplay of technical changes with institutions governing income and demand formation. Second, the roots and conditions of *various productivity regimes* have to be investigated via converging research, monographical and statistical, which would associate scholars in technical change and the macroeconomists, combine cross sectoral and national studies with long run time series analyses. Third, *the demand regime* seems to undergo some significant changes in the 1980s. For instance, investment dynamics still defines a puzzle for most analysts, whereas it plays a key role in any modelling of demand and technical change. Similarly, external trade is harder and harder to formalize, in spite of (or due to) large swings in relative prices, exchange rates and the growth differentials. The hypothesis of a shift from a consumption-led to a competitive-led demand regime has therefore to be carefully checked.
6. To conclude, *an ambitious research agenda* could combine the experience and analytical tools of a large spectrum of social scientists: specialists in engineering, economists of technological change, macroeconomists of Keynesian-Kaldorian style, institutionnalists and 'régulationnists' could add up their projects. First, in order to converge towards a clear and analytically rigourous basic model of cumulative growth. Second, to

undertake an investigation in long run history, in the light of such a model. Finally, to assess the viability and stability of the recovery and growth process, which has been initiated since the mid-1980s.

This would probably be the best tribute to Nicholas Kaldor. To stick to the major transformations occurring in modern capitalist economies, to elaborate relevant models, then derive key insights for economic policy, these are the major issues at the top of the agenda. At least for any economist who does not believe to the universal and permanent self-equilibrating mechanisms, conventionally associated to pure markets. As some generals and strategists who prepare the last war and therefore lose the next one, the economists understand the Thirties better than they cope with today's challenges! Nicholas Kaldor would urge us to address to the largely genuine present structural crisis and to innovate, not to repeat his own findings.

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28 Kaldor's Macro System: Too Much Cumulation, Too Few Contradictions

D. M. Gordon

The late Lord Nicholas Kaldor made seminal and pivotal contributions to our understanding of the sources and character of trend and cycle in advanced capitalist countries. And yet we still lack a firm basis for evaluating the relative usefulness or explanatory power of Kaldor's ideas. This paper attempts to provide one foundation for such an evaluation, constructing and evaluating the properties of a macroeconometric model of the US economy which embodies the central features of Kaldor's macro system.

1 INTRODUCTION

Kaldor's own contributions to the literature on trend and cycle concentrate in two areas – growth dynamics and productivity growth. In neither area have his ideas been subjected to the kinds of empirical tests which might properly assess their absolute or comparative advantages.

The theoretical properties of Kaldor's growth models have been intensively investigated.[1] But, by its nature, the exercise of long-period growth modelling is insufficient to analyze the sources and character of trend and cycle in advanced economies. Definitionally, growth models do not evaluate the relative impact and importance of 'exogenous' influences on the internal dynamics of those models; it is not infrequently the case, for example, that the usefulness of growth models for understanding the behavior of actual advanced economies, in the concrete, rests entirely on what one assumes about trends in technical progress, the rate of growth of the labor force, or investors' animal spirits. Growth models are comparably inattentive to the interaction between long-period and short-period dynamics, since the dynamic properties of growth or cycle models turn out to depend almost entirely on the specific values one postulates for their adjustment parameters and since the long-period analysis, by itself, provides no clues about the actual values of those parameters.

Kaldor's proposals about productivity growth, eventually codified as 'Kaldor's Growth Laws', have also been vigorously explored and debated.[2]

While I have found this discussion stimulating and provocative, I am underwhelmed by its empirical explorations. Most of the literature pursues relatively compact single-equation tests of the basic postulates of Kaldor's Growth Laws. A few studies have sought to embed Kaldor's proposals about productivity growth in a simple simultaneous-equation system. (See for example, Parikh, 1978.) But even in those somewhat richer analyses, the analysis considers only the interactions between output growth and employment growth, failing to explore the possibility that both are symptomatically conditioned by other possible 'engines of growth' such as predetermined influences on investment, consumption, or distribution. The empirical literature on Kaldor's Growth Laws would be compelling if it compared the explanatory power of those 'Laws' with other possible explanations of the growth of output and employment and/or located those Laws in the context of a more fully-articulated macro-model in which a wider variety of interaction effects could be explored.

In order to try to overcome some of these limitations in the prevailing literature, this paper reports on an alternative path toward the evaluation of Kaldor's macro system. I have sought to construct, estimate, simulate and evaluate a reasonably complete macroeconometric model of the postwar US economy which builds as faithfully as possible on the internal logic and dynamics of Kaldorian macro-economics.[3] This approach contains the potential – although much could slip 'twixt the cup and the lip – of assessing, in the case of at least one advanced economy, the relative empirical validity and power of a Kaldorian approach.

The paper has two main sections. The first outlines the underlying logic of the macroeconometric model presented here, details its specification and estimation, and reports on some provisional simulations for the postwar US economy. The second seeks to provide some basis for comparative evaluation by contrasting the results of the Kaldor model with an alternative left macro model, constructed on a few apposite macroeconomic principles, which can help highlight the essential contours of the Kaldor model's behavior.

I should warn the reader in advance about the relatively critical conclusions to which this exercise impels me. Some of the central elements of a Kaldorian system do not appear to me to be very promising. Both their logic and the performance of this model suggest that they were infused with too wishful a perspective on the macro-dynamics of advanced capitalist economies, implicitly (and sometimes explicitly) projecting the possibility of endogenously-generated growth without limits through continued demand stimulation. This perspective led to increasing emphasis by Kaldor on the principles of 'cumulative causation' in dynamic economies. But it also led, one suspects, to a one-sided emphasis on the prospects for cumulation of growth and a short-sided inattentiveness to the internal barriers to sustained accumulation in a capitalist economy.

I would have hesitated to impose such critical views on this commemorative occasion had I not personally (though only briefly) experienced Kaldor's own zest for debate and critical discussion. This evaluation of Kaldor's macro system is presented in appreciation of that zestful spirit.

2 A KALDORIAN MACROECONOMETRIC MODEL

This section presents the results of a quarterly macroeconometric model of the US economy, estimated and simulated for the period from the early 1950s through the late 1970s. The model seeks to embody what seem to be the essential elements of Kaldorian macroeconomics, relying when in doubt on the more general contours of the post-Keynesian perspective with which Kaldor's approach seems most compatible.

Methodological Guidelines

Since I do not consider myself a Kaldorian, I cannot claim either to represent or to "know" the essence of Kaldor's macro system. Nor am I a Kaldor scholar, steeped in the texts and lore of his evolving views.

And yet, the model developed here attempts to remain as faithful as possible to the general orientation and specific detail of his macro analysis. When in doubt, I have relied for guidance on Kaldor's most recent general formulations, published as *Economics without Equilibrium* (1985), and the articles published from a recent symposium on Kaldor's Growth Laws, particularly the excellent general analysis provided by Kumaraswamy Velupillai (1983).

In order to provide the clearest possible indication of interactions between trend and cycle, I have chosen to construct a quarterly macroeconometric model. Although the additional detail and fluctuation provided by quarterly data are hardly necessary to assess a model's ability to generate variable trends of growth in output and productivity, cyclical dynamics are much better revealed in quarterly than in annual detail and thus provide a more meaningful opportunity to study a model's cyclical properties.

Rather than creating a system in which only or primarily output and employment growth are highlighted, further, this model seeks to endogenize as many basic macro dimensions as necessary in order to highlight the underlying logic and dynamics of Kaldor's system. If one is interested in tracing the interactions between investment and output, for example, it becomes necessary to treat both variables on a comparable basis within the structure of such a system. This approach seems particularly consistent with Kaldor's later emphasis on the importance of evolution through time, since Kaldor appears to have argued that everything is endogenous *within* one's analytic frame of reference and nothing is predetermined to that analytic domain *except* our historical legacies. 'The only truly exogenous factor', Kaldor wrote (1985, p. 61; emphasis in the original), 'is *whatever exists at a moment of time*, as a heritage of the past.'

Structural Logic and Dynamics

This model attempts to integrate the logic both of Kaldor's general approach to economic growth and of the somewhat more specific propositions embodied in Kaldor's Growth Laws.

Kaldor's general approach to growth revolves primarily around the interaction between demand-driven investment and distribution-regulated consumption. (See Salvadori, this volume; and Targetti, this volume.) It appears reasonable, more specifically, to concentrate the demand-side analysis in the model on the determinants of consumption and fixed investment.[4] The level of consumption is modelled as a separable function of the level of (disposable) wage-and-salary income and of (disposable) capital income. Investment is analyzed at the first level of approximation through a multiplier/accelerator model, with investment being driven by both the level and the change in aggregate output (constrained by the condition that savings equals investment or gross output equals gross income).

In order to capture the logic of Kaldor's Growth Laws, it is necessary to focus on changes in wages, prices, and productivity. Fortunately, Kaldor provides reasonably clear guidelines for this part of the exercise. (See also Skott, this volume; and Boyer and Petit, this volume.)

1. Prices, it seems clear, should be modelled as a relatively constant markup over unit costs, as also in Kalecki. Kaldor makes much of the apparent empirical regularity that 'prices maintain a fairly constant relationship to costs.' (1985, p. 53) And he strongly rejects the neoclassical emphasis on the influence of variable demand intensity on prices. 'Changes in selling volumes', he argues (1985, p. 53), 'are only likely to cause price changes when they are the result of the appearance of new sources of competition, not when they are part of a general change in demand'. For Kaldor, we can safely assume, the effects of these new sources of competition would be reflected indirectly through more rapid productivity growth, manifested through a declining rate of change of unit costs, not directly through a variable markup.

2. It is tempting to vest Kaldor's macro system with a strictly post-Keynesian approach to wage change, in which wages are purely trend-determined and independent of variations in the level of employment or unemployment.[5] But because I am interested in the closest possible investigation of the interaction between trend and cycle in Kaldorian macro, I think it would be slightly unfair to Kaldor to rob his model of any

endogenous illumination of short- and medium-term cyclical fluctuations in wages. I have therefore chosen to treat the rate of change of nominal wages in this Kaldorian model as a function both of trended wages and prices and of fluctuations in the employment share.[6]

3. We get perhaps the clearest guidance on the determinants of productivity growth. Given Kaldor's emphasis on increasing returns and given the logic of the rest of his system, the rate of productivity growth is fundamentally conditioned by the rate of output growth, the essence of what Thirlwall summarizes (1983, p. 350) as Kaldor's Second Law. The specific interactions among exports, manufacturing output and the aggregate economy will be explored in subsequent paragraphs on Kaldor's Growth Laws.

If these elements provide the central contours of a Kaldorian macro system, it is equally clear what does *not* fundamentally regulate its structural and dynamic properties. Neither prices nor interest rates play the kind of regulatory role in which they are heroically featured in neoclassical economics. Given Kaldor's later emphasis on the endogeneity of money, it seems equally clear that financial markets do not themselves play a pivotal role.[7] Nor do supply-side determinants of the rate of profit "matter," since we can safely assume (a) that the rate of profit does not drive investment and (b) that changes in the profit share are conditioned fundamentally by the rate of productivity growth, itself determined by the rate of output growth, and not by other 'supply-side' factors. (See Marglin, 1984, *passim*, for a useful analysis of some of these emphases and elisions in Kaldorian and post-Keynesian models.)

What of Kaldor's Growth Laws? While much of the discussion in the literature has focused on cross-sectional comparisons of national growth rates, it is nonetheless possible to derive a version of Kaldor's Growth Laws for the behavior of a single economy over time. Based on the recent clarifications and syntheses reviewed by Thirlwall (1983), one can summarize Kaldor's views with some confidence:

Given the likelihood of increasing returns to scale and a relatively fixed capital-output ratio, productivity growth is determined by output growth. Within that framework, Kaldor further argues, output growth and productivity growth in manufacturing are pivotal – since the likelihood of scale economies (through the division of labor) appears greatest in industrial production. The scale of manufacturing output in any given advanced economy, moreover, is likely to be conditioned by the relative growth of that system within the larger global economy and is therefore likely to be especially sensitive to the rate of growth of export demand. But relative export growth is itself likely to be conditioned by relative rates of growth of unit costs and therefore, given our presuppositions about prices and wage determination, by relative rates of productivity growth.

This results, therefore, in the possibility of 'cumulative causation'. Given any initial starting point, a dynamic economy can continually enhance its dynamism and relative market shares, without obvious endogenous limits, over the medium-run. Labor supply is presumed to be growing sufficiently rapidly both to prevent runaway wage growth and to permit continual labor absorption into the relatively more dynamic manufacturing sector. We are led to assume, in general, that neither government policy nor investors' spirits, exogenously affecting the rates of growth at which such an economy can stably reproduce itself, are inconsistent with both sustained (reproducible) growth and the scale economies upon which cumulative causation can build.

Although a variety of alternative scenarios are possible within the structure of this model, it is obviously tailor-made for the sorts of social-democratic policies which Lord Kaldor, the Labour Party adviser, championed. If an economy is straggling on a relatively stagnant growth path, activist governments may push it toward a more exhilarated trajectory by stimulatory fiscal policy and protection against import competition. If wages inexplicably become burdensome, a social contract through incomes policies should suffice. Should bankers become restive or lose their enthusiasm for the project, the growth process will generate its own money supply and the central bankers need merely target interest rates at sufficiently low levels not to impede investment or borrowing. (See Rousseas, 1986, on these policy requisites.) If prices are problematic, running inadvertently into Kaldor's equivalent of a Robinsonian 'inflation barrier', then government policies should merely intensify their efforts to promote output growth in order to bring the rate of productivity growth back into its appropriate relationship with the trended rates of growth of prices and wages.

In short, as Velupillai concludes (1983, p. 469), 'it is possible to achieve the "high-wage, high-employment" capitalist economy that many social democratic governments seem to have as their aim. . . .', Kaldor did admit, toward the end of his life, that "inflationary expectations" might have tossed a few monkey wrenches into the system. Reflecting on the glowering pessimism which the 1970s engendered, Kaldor wrote (1985, p. 78) that 'my own feeling is that the major new element of the 1970s was inflationary expectations, and the volatility of expectations, not those relating to consumer prices and the cost of living but to the prices of staple products, raw materials, and energy, which directly or indirectly enter into costs'. And yet, these problems were exogenous to the internal logic of (his view of) capitalist economies and did not seem to require revision of those views. Crude materials price volatility could and should be managed by international buffer stocks policies, while the wage-price accelerations which they might trigger could and should be managed by public-sector incomes policies guidelines and more explicit private-sector productivity bargaining.

And so, the theoretical and policy logic of Kaldor's belief in cumulative causation remained essentially firm and unyielding, at least in his writing, until the end. Was his faith warranted?

Model Specification and Estimation

I report here on the specification and estimation of a macroeconometric model designed at least provisionally to address this question. Because of space constraints in this volume, I shall skimp here – both in text and in appendix – on reporting some of the nuts-and-bolts of model construction but shall try to provide just barely enough detail so that the essential logic of the model is sufficiently transparent for the purposes of discussion and argument.

The model's complete specification is detailed in the Appendix, with equations organized by type and numbered sequentially within that structure. A separate listing summarizing variable notation follows the model. In reporting specification here, I shall reproduce the equations and equation numbers from the Appendix, preserving that numbering scheme and therefore introducing equations with apparently arbitrary equation numbers in the flow of the text which follows. (Hypotheses about the signs of the coefficients are listed in the model outline in the Appendix and in the equations reproduced below in the text.)

The model builds upon the stochastic determination of nine principal endogenous variables: on the supply-side, the levels of aggregate real output ($\underline{Q}$) and employment (H) and the aggregate rates of change of prices ($\dot{p}$), wages ($\dot{w}$), and real hourly output ($\dot{\underline{q}}$), with the rates of change of manufacturing output ($\dot{\underline{Q}}_m$) and productivity ($\dot{\underline{q}}_m$) providing an underlying source of regulation; and on the demand-side, the levels of real investment ($\underline{I}$) and consumption ($\underline{C}$). In order to help manage the econometric problems of non-stationarity in time-series estimation and in order to help clarify the interaction of trend and cycle, I have normalized all of the components of aggregate demand on potential output (Y^*), permitting the analysis of trends in output, investment and consumption *relative to* a normalizing trend. These normalized variables are defined as (X_i/Y^*). Normalized aggregate output is thus defined as (Y/Y^*) and denoted as ϕ; reflecting that notation, all normalized aggregate variables are written with a ϕ as subscript, as in I_ϕ. Real variables, measured in constant 1982 prices, are denoted by a line under the variable (e.g., $\underline{X}_i$).

Five other important variables are determined stochastically: In order to permit an internally consistent dynamic relationship to emerge between distribution on the supply-side and the demand-side, it is necessary to express income from capital (R) as a function of the wage share of output (ω). In order to test for the dynamic effect of productivity growth on net export growth, it is further necessary to allow for the (at least partly) endogenous determination of real imports ($\underline{O}$) and real exports ($\underline{X}$) through the partial influence of the terms of trade (p_τ). And in order to permit an internally consistent relationship between the rate of growth of (gross) output and the (gross) capital stock, it is further necessary to explain movements in depreciation expenditures (d).

The rest of the central relationships of the model are determined through identities. Many of these identities are necessary simply to transform back and forth between the levels and rates of change of variables; to save space, therefore, I have collapsed these in the Appendix into single generic equations for the levels and rates of growth of the designated variables. I review the logic and importance of a few of the other identities below.

Since Kaldor's Growth Laws highlight the role of manufacturing, I begin a brief review of the specification of the principal equations in the model with the manufacturing sector.[8] In order to highlight the potentially distinct importance of exports in conditioning manufacturing output, the rate of growth of real manufacturing output is expressed as a separable function of the rate of growth of real domestic output ($\dot{\underline{Q}}^N$) and of both exports and imports; manufacturing output lagged one period is also included in order to take account of sluggish adjustment. (Here and in subsequent equations, potentially lagged effects of the independent variables are estimated through distributed lags, denoted as $\sum_S$):

$$\dot{\underline{Q}}_m = \alpha_{22} + \alpha_{23}\dot{\underline{Q}}^N + \alpha_{24}\dot{\underline{Q}}_m + \sum_S \alpha_{25s}\dot{\underline{X}}_{t-s} + \sum_S \alpha_{26s}\dot{\underline{O}}_{t-s}$$
$$\alpha_{23}, \alpha_{24}, \alpha_{25} > 0, \alpha_{26} < 0 \tag{14}$$

Manufacturing productivity growth is then determined both (a) as a function of the rate of change of capacity utilization in manufacturing ($\dot{\phi}_m$) and of the manufacturing utilized capital–labor ratio ($\dot{\underline{k}}_m^*$) and (b) by (a distributed lag of) past rates of growth of manufacturing sales:

$$\dot{\underline{q}}_m = \alpha_{18} + \alpha_{19}\dot{\phi}_m + \alpha_{20}\dot{\underline{k}}_m^* + \sum_S \alpha_{21s}\dot{\underline{L}}_{m_{t-s}} \qquad \alpha_{19}, \alpha_{20}, \alpha_{21} > 0 \tag{13}$$

In order to allow for tests of Kaldor's strong assertions (1985, p. 67) that 'with an increase in the division of labor, capital and output grow together', it is further necessary to include two subsidiary stochastic relationships (equations (15) and (16)) in which the rate of growth of the manufacturing capital stock is a function of the level and the rate of growth of (normalized) manufacturing output and the rate of capacity utilization in manufacturing is itself a function of the level of aggregate utilization.[9]

I have introduced relatively inclusive specifications of the determinations of prices, wages, and productivity change in order to try to capture the essential elements of Kaldor's central propositions.

1. Price change is determined strictly as a function of the rate of change of unit costs, reflecting the hypothesis of a constant markup. I have decomposed unit costs into two separable elements, unit labor costs and unit materials costs, and have further decomposed unit labor costs into the algebraically separable components of price change, nominal wage change, and productivity change (at least partly in order to test for equality in the coefficients on these respective variables):

$$\dot{p} = \alpha_{14} + \alpha_{15}\dot{\omega} + \alpha_{16}\dot{p}^{e} + \alpha_{17}\dot{\underline{\xi}}_{z} \qquad \alpha_{15}, \alpha_{16}, \alpha_{17} > 0 \tag{11}$$

where $\dot{\omega}$ in turn equals $[(\dot{\omega} - \dot{p}) - \dot{\underline{q}}]$ (eqn [12]). Reflecting Kaldor's later interest in expectational effects, I have also allowed the expected rate of inflation, $\dot{p}^{e}$, to enter [11] as well.

2. The rate of change of nominal wages is expressed simply as a function of the expected rate of inflation and of (a distributed lag of) the employment rate (η), itself defined ([7]) as the ratio of aggregate employment to the total (predetermined) labor supply:

$$\dot{w} = \alpha_{11} + \sum_{S} \alpha_{12s}\, \eta_{t-s} + \alpha_{13}\, \dot{p}^{e} \qquad \alpha_{12}, \alpha_{13} > 0 \tag{7}$$

3. Productivity growth is determined by two kinds of determinations: Trend determinations are expressed as a distributed lag function of (predetermined) manufacturing productivity growth, while cyclical fluctuations are conditioned by variations in the aggregate rate of capacity utilization and the utilized capital–labor ratio:

$$\dot{\underline{q}} = \alpha_{30} + \alpha_{31}\dot{\phi} + \alpha_{32}\dot{\underline{k}}^{\phi} + \sum_{S}\alpha_{33s}\, \dot{\underline{q}}_{m_{t-s}} \qquad \alpha_{31}, \alpha_{32}, \alpha_{33} > 0 \tag{17}$$

All that remains on the supply side is the determination of the levels of employment and output. Typically, one or the other is determined stochastically while the second of the pair is then determined algebraically through their joint relationship with the level of productivity. In order to leave more room for comparative evaluation of traditional Kaldorian presuppositions about each, I have allowed both variables to be determined stochastically with an adjustment mechanism to reassert internal algebraic consistency within the model.

On the output side of the pair, I have followed Kaldor's suggestions about both stock-adjustment mechanisms (1985, pp. 32–3) and target output levels (ibid., pp. 49–53) and proposed aggregate output as a function of adaptive adjustment to expected sales levels and existing inventory stocks. This allows an approximate linearized specification in which real targeted output ($\underline{Q}^{\tau}$) is a function of lagged levels of output and inventories and of the current level of sales:

$$\underline{Q}^{\tau} = \alpha_1 + \alpha_2 J + \alpha_3 \underline{Q}_{t-1} + \alpha_4 \underline{V}_{t-1} \qquad \alpha_2, \alpha_3 > 0, \alpha_4 < 0 \tag{1}$$

On the other side of the pair, the level of hours hired (H) is adaptively adjusted to the expected level of output:

$$H = \alpha_8 + \alpha_9 H_{t-1} + \alpha_{10} Q \qquad \alpha_9, \alpha_{10} > 0 \tag{5}$$

Once hours are determined, employment levels are mediated by average hours per employee per unit of time, itself determined exogenously in this model although it could also be endogenized.

The relationship between actual (rather than targeted) output and actual employment is then regulated by the realized (actual) level of productivity: Given actual hours and actual productivity, actual realizable output is determined by an identity (eqn. [2]) and firms are then allowed to adjust adaptively, in choosing final output, to the difference between targeted and realizable output ($Q^{\tau}-$Q) in the previous period. (See equations [3], [4]).

Two principal specifications constitute the core of the demand–side of the model.

1. Real consumption is determined as a function of the level of real disposable income from wage-and-salary employment ($\underline{Y}^d_W$) and separably of the level of real disposable income from capital ownership ($\underline{Y}^d_R$) – including dividends, interest income, proprietors' income and rent. With all term normalized, we have:

$$\underline{C}_{\Phi} = \beta_1 + \beta_2 \underline{Y}^{d}_{W}{}_{\Phi} + \beta_3 \underline{Y}^{d}_{R}{}_{\Phi} \qquad 0 < \beta_3 < \beta_2 < 1 \tag{21}$$

The essence of Kaldor's celebrated hypotheses about differential propensities to save is that we would expect a hierarchy of magnitudes between the two slope coefficients in [15]: $0 < \beta_3 < \beta_2 < 1$, with β_3 relatively close to 0 and β_2 relatively close to 1.

2. Kaldor states explicitly in his early work that the rate of investment should be viewed as determined by both the change in the normalized 'rate of growth of income' and the 'change in the rate of profit over the previous period' (cited in Vellupilai, 1983, p. 458) In the present context, and rendering this formulation consistent with traditional Keynesian/post–Keynesian formulations, this would imply:

$$\underline{I}^{n}_{K\Phi} = \beta_4 + \beta_5 \phi + \sum_{S} \beta_{6s} \dot{\phi}_{t-s} + \sum_{S} \beta_{7s} \dot{r}_{t-s} \qquad \beta_5, \beta_6, \beta_7 > 0 \tag{24}$$

In implementing this formulation, however, I was unable to confirm that β_7 was significantly different from zero in any among a wide variety of formulations. For further purposes, therefore, I dropped the last term in

[24] and relied on a much simpler multiplier/accelerator formulation for all subsequent estimation and simulation.

One last significant demand–side specification is necessary to round out this application of Kaldor's Growth Laws. If a given country's trade shares are likely to expand, through the process of cumulative causation, in response to that country's prior success at enhancing its productivity growth, then foreign trade components must be shown to be responsive to movements in (relative) unit labor costs. Because data on relative unit labor costs are not available on a consistent basis before 1960, I have relied on an indirect formulation of this final connection: (normalized) exports and imports are determined, other things equal, by movements in the terms of trade (with opposite signs); the terms of trade are themselves a function, *ceteris paribus*, of the domestic rate of inflation; which in turn is a function of the rate of productivity growth.

$$\underline{Q}_\Phi = \beta_7 + \beta_8 \underline{Y}_\Phi + \beta_9 p_\tau \qquad \beta_8 > 0,\ \beta_9 < 0 \qquad (25)$$

$$\underline{X}_\Phi = \beta_{10} + \beta_{11} \underline{Y}_{x\Phi} + \beta_{12} p_\tau \qquad \beta_{11}, \beta_{12} > 0 \qquad (26)$$

$$\dot{p}^\tau = \beta_{13} + \beta_{14} \dot{p} \qquad \beta_{14} > 0 \qquad (28)$$

This provides a channel through which improved productivity can improve net trade performance and help reproduce the positive feedback dynamics upon which Kaldor's notions of cumulative causation rest.

With these specifications under our belt, we are finally in a position to review the model's core dynamic structure in ways which highlight its correspondence to Kaldor's conceptions of growth and cumulative causation: Assume that this economy had been operating at a relatively low level of capacity utilization and then that a new social democratic government initiated a vigorous program of demand stimulation and short-term import protection. Then $\underline{G}_\Phi$ and $\underline{X}^n_\Phi$ rise in (30), partly through (25) and (27). This stimulates manufacturing output growth (14), especially because of the differentially stimulative effects of export demand in equation (14), and through that channel, eventually enhances manufacturing productivity growth (13). Aggregate productivity growth begins to rise (17), providing room for enhanced wage growth (as a result of the effect of rising employment rate in (10)). As long as the enhanced productivity growth is greater than the augmented wage growth resulting from employment expansion, then inflationary pressures will be contained (11).

The second-order effects on aggregate income cannot be fully predicted *a priori*. Investment will clearly rise with the exogenous increases in capacity utilization. Consumption may or may not increase depending on the relative magnitudes of the coefficients in equations (10), (11) and (17). On the one hand, as long as productivity growth is more rapid than wage growth and inflation declines by correspondingly comparable decrements, the wage share is likely to fall, leading to a shift from wage income toward capital income and a relative decline in consumption. At the same time, real wages will obviously rise. Depending on the relative rates of growth of the wage share and real wages, as well as the relative magnitudes of β_2 and β_3 in (21), real (normalized) consumption may or may not decline. In any event, it is presumed unlikely that consumption would decrease more than investment would increase (largely because of the expectation that the wage share would not fluctuate with very wide amplitude), allowing for a continued expansion and sustained cumulative causation.

Along this sustained expansionary path, what might cause cyclical fluctuations? As constructed, indeed, the model contains relatively few sources of sharp cyclical fluctuation. There may be counter-cyclical movements in net exports and government purchases in (30), of course, but the latter are not modelled and the former are not likely to be substantial (given the continually enhancing effects of productivity growth). Two principal sources of cyclical fluctuation remain. Depending on the relative magnitudes of β_5 and β_6 in the investment equation (24), there may be an oscillatory investment cycle. And depending on possible non-linear effects of the employment rate on wage growth or of price expectations on both price and wage growth, there may be regular cyclical fluctuations in the wage share (12). In general, however, this is not a model whose operations would be expected to generate very sharp cyclical fluctuations.

Though fairly compact and desperately schematic, the model is relatively complete. It also succeeds in endogenizing most of the critical macro variables with which we might have reason to be concerned, providing an opportunity for the model's dynamic properties to reveal themselves fairly completely through within period-of-estimation simulation.

One notable omission in the model is the monetary sector. I have included a monetary sector in a more or less corresponding formulation of the general post-Keynesian perspective. But for this exercise it seemed simpler to 'erase' it. Since Kaldor strongly emphasizes the accommodation of the money supply to output growth, it is unlikely that interest rates will display much fluctuation. And since I am allowing residential investment to be determined exogenously in this formulation, there is no locus in which interest rate fluctuations are themselves likely to have much effect.

The model was estimated over five complete business cycles from 1951.3 through 1978.4.[10] I sought to estimate and simulate it over complete cycles in order to allow it to encompass full cyclical dynamics where possible. I stopped the period of estimation at the late 1970s cycle in order to provide room for *ex post* simulation exercises into the 1980s.

Because all of the stochastic equations included endogenous independent variables, all equations were estimated with two stage least squares, deploying all exogenous and lagged endogenous variables as first-stage instruments.[11] All equations were corrected for evidence of autocorrelation where necessary, with no time-series adjustment involving anything more complicated than first- or second-order ARMA specifications.

Because of space constraints I shall not present or review in detail the actual results of this estimation. Two general results seem important.

First, I was able to confirm almost all of the Kaldorian hypotheses. In almost all the equations, all sign hypotheses were confirmed and all estimated coefficients were statistically significant.

The exceptions to this general empirical support involved the constituent equations of Kaldor's Growth Laws. While OLS estimates provide reasonably strong support for the effect of lagged manufacturing productivity growth on aggregate productivity growth (eqn. [17], neither OLS nor 2SLS estimates confirm the direct link from manufacturing sales growth to manufacturing productivity growth (13) or the differentially fulsome effect of export growth on manufacturing output growth (14).[12] The problem in the manufacturing productivity growth equation flows from my cantankerous inclusion of the utilized capital–labor ratio, which is highly significant. Kaldor afficionados could argue that since investment in manufacturing is itself a function of output growth, Kaldor's Second Law is indirectly confirmed. The problem remains, however, that both investment and output growth in manufacturing might themselves be conditioned by other prior effects.

Second, the estimated magnitudes of some of the most salient coefficients largely confirm the general thrust of Kaldor's emphasis on cumulative causation.

1. The coefficients in the consumption function (21) are properly arrayed, with β_3 only at 0.127 and statistically significant only at the 10 per cent level (on a one-tailed test) while $\beta_2 = 0.496$.
2. The counter-balancing effects of productivity growth and wage growth on inflation are strongly confirmed, with the estimated coefficients on those variables in (7) insignificantly different from each other.
3. Exports appear to be sensitive to movements in the terms of trade, providing a window of opportunity for domestic productivity growth to enhance relative trade expansion.
4. The employment rate has relatively strong (positive) effects on nominal wage growth, underscoring the possibilities of high-employment/high-wage expansionary paths.

Model Simulation

I simulated this model for the four full business cycles from 1956.1 through 1978.4. I should note that this is an unusually stringent test of a model's properties, since it involved fully endogenous dynamic simulation over

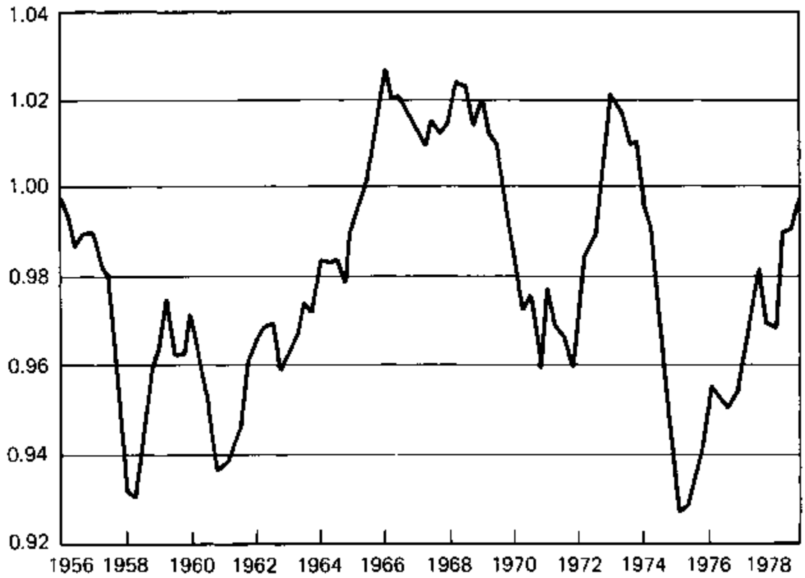

Figure 28.1 Aggregate capacity utilization (ratio of actual to potential output, US, 1956.1–1978.4)

92 quarters, with relatively few important exogenous variables available to steer it through its paces.[13]

In all of the simulation comparisons which follow, I concentrated primarily on the model's simulation of normalized aggregate real output, expressed as the rate of aggregate capacity utilization ($\phi \equiv Y/Y^*$). Figure 28.1 provides a graph of the movement of actual capacity utilization over the period of simulation to provide a benchmark for comparison.

In the first simulation of the model as specified and estimated, its dynamics of cumulative causation carried it away on an increasingly explosive non–oscillatory path. By 1974 the economy had soared so high that the model could no longer be solved. Figure 28.2 provides a plot of actual and simulated capacity utilization from this runaway simulation, with the graph truncated at 1971.4 to keep its visual proportions within tractable limits.

The most powerful piston of the runaway locomotive? In the 2SLS estimates of the equation for aggregate productivity growth, the coefficients on $\dot{k}^\phi$ and $\dot{\phi}$ (α_{27} & α_{28} in [17]) sum to 1.09, involving such strongly increasing returns to scale that the model simply fails to contain its own exuberance.

I therefore sought to 'tame' the model by partial disengagement of trend from cycle. I separated the equation for aggregate productivity (17) into

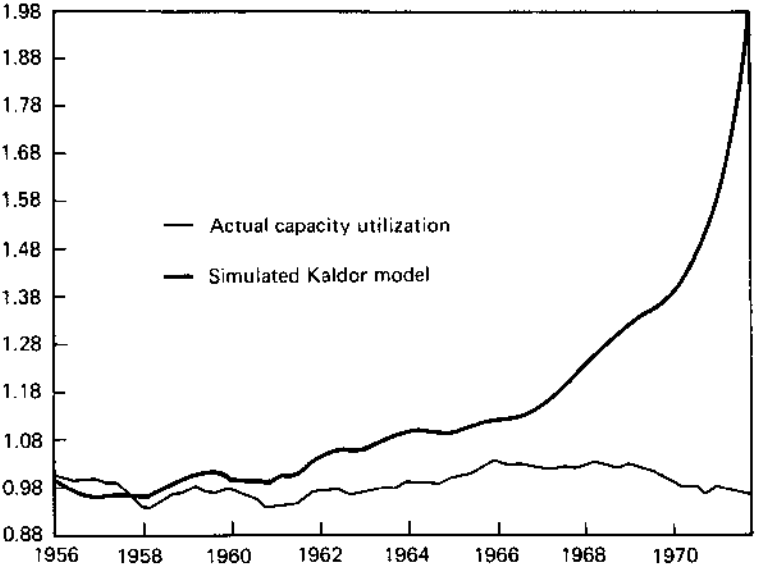

Figure 28.2 Runaway cumulation (aggregate capacity utilization: actual and simulated Kaldor model, US, 1956.1–1971.4)

two equations, one for trend and one for cycle, in three steps (see eqns. [17a]–[17c] under the 'Modified Kaldor Model' heading):

1. I calculated 'trend productivity growth', $\underleftarrow{\dot{q}}$, as an eight-period backward moving average of actual productivity growth; $\underleftarrow{\dot{q}}$ was itself estimated stochastically as a function of trend changes in capacity utilization and the utilized capital–labor ratio, calculated algebraically in the same manner, and an eight-period distributed lag on manufacturing productivity growth (17a).
2. Given predicted trend productivity growth on the basis of this equation, I then algebraically calculated the predicted level of contemporaneous productivity growth which was consistent with this trend and the seven preceding actual values for aggregate productivity growth. This provided an estimate of 'expected' current-period productivity growth on the basis of previous trends, expressed as $\underline{\dot{q}}^e$ (17b).
3. I then regressed actual current productivity growth on expected productivity growth and on the deviations of current capacity utilization and the utilized capital–labor ratio from their respective trends (17c).

These separable estimated equations confirm their rationale, since each of the two stochastic equations achieves considerable explanatory power and almost all the coefficients are strongly significant with the expected

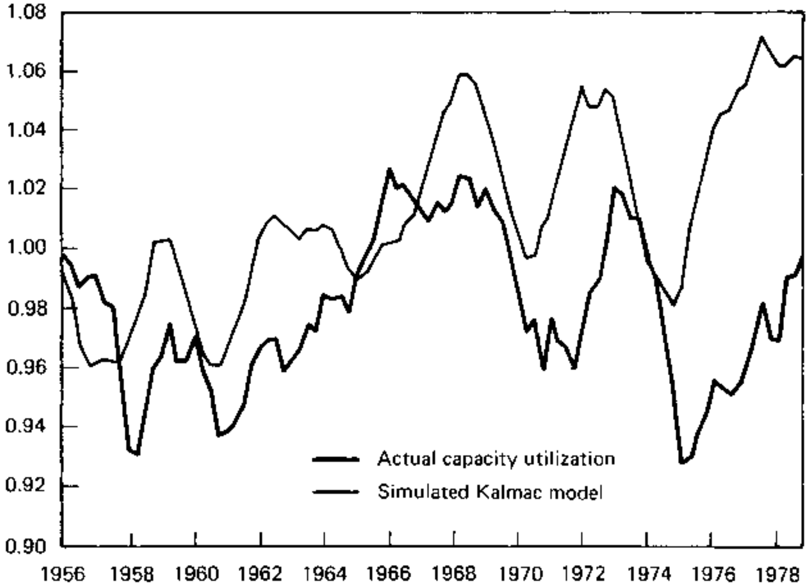

Figure 28.3 Cumulative causation (aggregate capacity utilization: actual and simulated Kalmac model, US, 1956.1–1978.4)

signs. The implications for Kaldor's Growth Laws are anomalous: While the effects of trended manufacturing productivity growth on trended aggregate productivity growth are now very strong and statistically significant at better than the 1 per cent level, providing much clearer evidence for that linkage than in the previous exercise, it is simultaneously the case that expected current-period productivity growth, $\underline{\dot{q}}^e$, is statistically *insignificant* in the equation for actual current-period productivity growth, suggesting that the links between trend and cycle have been severed altogether.

The model nonetheless behaves more manageably. The sum of the coefficients in the actual productivity growth equation drops from 1.09 to 1.00 and the model is now capable of dampening its own exhilaration, allowing dynamic simulation for the full period through 1978.4. Figure 28.3 graphs actual and simulated capacity utilization for this modified Kaldorian macro model, now officially designated for further reference as Kalmac.

Although the model now 'works', it nonetheless substantially fails to reproduce the actual behavior of trend movements in capacity utilization and, correspondingly, of real output growth over the four simulated cycles. Table 28.1 presents the actual and simulated average (annualized) rates of growth of real output over the full period and the four separate cycles.

While actual real output growth varies considerably through the expansion and contraction of the postwar long swing, the Kalmac simulation

Table 28.1 Actual and simulated average annual real output growth (Kalmac model, US, 1956.1–1978.4)

Row	*Time Period*	*Actual*	*Kalmac*
(1)	1956.1–1978.4	3.21%	3.50%
(2)	1956.1–1959.2	2.14	2.96
(3)	1959.2–1966.1	4.31	3.52
(4)	1966.1–1973.1	3.17	3.94
(5)	1973.1–1978.4	2.64	3.26

Source: Author's calculations based on Kalmac simulation results.

captures relatively little of this shift in trend. While the ratio in Table 28.1 of *actual* peak expansion growth to that for the 1970s stagnation (row (3) divided by row (5)) is 1.63:1, for example, the corresponding ratio for the Kalmac simulated value is only 1.08:1. As the graph for the Kalmac model in Figure 28.3 also suggests, the amplitude of its simulated cycle is more modest than for the actual economy. While the coefficient of variation of actual real output growth for the whole period was 1.25, for example, the coefficient of variation of Kalmac real output growth was 0.90. The coefficient of variation of simulated real output growth was substantially lower than its actual value, moreover, for each of the four separate cycles.

These results therefore seem to illustrate the general dynamic properties of the Kaldorian system, with its strong emphasis on cumulative causation. But simulation performance is relative, not absolute. Who's to say that any other internally consistent macro model could do any better? The growth-and-cycle literature constantly highlights the difficulty of endogenously generating variable trends. Is it possible to mirror the long swing behavior of the postwar US economy with any greater accuracy than the Kalmac achieves?

3 AN ALTERNATIVE MACROECONOMETRIC MODEL

I summarize in this section the construction, estimation, and simulation of an alternative macroeconometric model. It differs from the Kaldor system primarily in highlighting the potential importance of endogenous barriers to accumulation, of internal contradictions generated by the accumulation process itself. As such, the model bears a mostly neo-Marxian imprint. Within that orientation, the model more specifically reflects recent explorations of the institutional and power relationships conditioned by an existing social structure of accumulation.[14]

I extend considerable apologies to the reader for the scratchiness of this section. The model is very preliminary, prematurely extracted from my work-in-progress. It does not so much embody my own considered contributions to the construction of an alternative macro system as it serves very hastily to illustrate the possibilities of an alternative and apparently promising approach to the macroeconometric exercise to which Lord Kaldor has unwittingly been subjected. At best, this alternative can serve simply as a benchmark by which to highlight some of the one-sidedness of the Kaldorian system.

Model Specification and Estimation

I present here simulation results for an alternative macroeconometric model, hereinafter designated as Altmac. The model was constructed with exactly the same skeleton and scale as Kalmac over exactly the same period. It is precisely identical in almost all respects, sharing as much as possible with the Kaldorian model in order to facilitate comparison.

Five (and only five) behavioral equations differ between the models (see equations (A24), (A17), (A11), (A10), and (A5) in Appendix under 'Alternative Macro Model' heading):

1. Reflecting classical and Marxian inclinations, the investment equation (A24) adds a term for expected (relative) profitability, expressed as a (separated) distributed lag of the after-tax corporate rate of profit – calculated from the same wage share formulation as in Kaldor equation (8) – normalized on the after-tax cost of borrowing. This relative profitability component of the investment equation is added, not substituted, otherwise retaining the exact structure of Kalmac (24). (See Gordon, Weisskopf and Bowles (1990) for discussion and explorations of such an investment function within the SSA framework.)

2. The productivity growth equation (A17) implements a provisional quarterly application of the 'social model' of productivity growth presented in Weisskopf, Bowles and Gordon (1983). In this quarterly version the social determinants of productivity growth added to the formulation in Kalmac (17) include quarterly estimates of an augmented vector of all of the 'social variables' included in our previous work – specifically including changes in approximate measures of the cost of job loss, the industrial accident rate, and an index of worker resistance; the second derivative of average hourly spendable earnings; and our measure of the 'intensity of innovative pressure' based on the business failure rate. (See Gordon (1988b) for a somewhat more complete and robust version of this same kind of specification.) In order to maintain as much consistency of specification with the final (modified) version of the Kaldor model as possible, I estimated a 'decomposed' productivity growth equation, with a first equation for trended productivity growth and a second equation for current actual productivity growth.

3. The inflation equation (A11) supplements the Kaldor approach by relaxing the assumption of a constant markup, allowing the rate of change of prices to vary with both variable demand intensity (through the rate of change of capacity utilization) and supply-side quantity constraints (through the rate of change of an index of bottlenecks in deliveries). (See Gordon (1988a) for detail on derivation and performance of this kind of approach.)

4. The wage change equation (A10) embodies two differential emphases. It applies the more general neo–Marxian emphasis on adaptive adjustment to deviations from trended wages, outlined most recently by Marglin (1984, chs 5, 19). It also translates onto the wage bargaining process some of the 'social determinants' of capital–labor relations highlighted by our previous analysis of productivity growth. (See Gordon, 1988a, for further detail.)

5. The hours equation (A5) embodies two substantially different notions about labor demand. It explicitly embodies a stock adjustment approach to 'labor hoarding', reflecting the likelihood of rigidities interfering with the smooth covariation of output and employment. (This aspect of the hours equation is largely based on Fair, 1984.) And it also allows for relative factor price effects which both neo-Classical and neo-Marxian labor economists would be more likely to tolerate theoretically than post-Keynesians. (See Michl (1987) for reflections and evidence from a more post-Keynesian perspective.)

6. All three key cyclical equations – for changes in prices, wages, and productivity – further embody a symmetrical partial disengagement between trend and current (cyclical) values, helping highlight the role of longer-term institutional factors in all three equations. All three also pay specific attention to some of the specific contours of capital–labor relations in the postwar SSA – such as the long steel strike of 1959–60 and the wage-price 'jawboning' exercises of the mid-1960s. While a Kaldorian macro economist would hardly object on principle to the inclusion of these additional institutional determinations, I have bothered to add them here simply in order to highlight the importance of shorter-period institutional effects as well as the 'long-period' SSA determinations.

These substitutions do not constitute the basis for a fully–articulated macroeconomic alternative. But they at least serve to highlight three important dimensions of difference with Kaldor's approach: (1) a more classical approach to investment, emphasizing the importance of relative profitability as a determinant of accumulation; (2) more complexly-structured 'social' models of prices, wages, and productivity; and (3) an approach to labor demand in which relative factor prices are allowed to play a role.

All of these additional hypotheses receive strong empirical support. Each of the additional variables and effects added to the Kaldorian equations reveal coefficients with the expected signs and statistically significant coefficients. A couple of differences in results are particularly intriguing in view of the simulation properties which the Kalmac exhibits. In the current (actual) productivity growth equation (A17), specifically, two differences in results are striking. The trend productivity growth variable now has a large and strongly significant positive coefficient (at 1 per cent) while the sum of the coefficients on utilization and the utilized capital–labor ratio drop from 1.0 to 0.66.

Simulation Results

The Altmac model was simulated for exactly the same period by exactly the same dynamic simulation procedure as for the Kalmac. Figure 28.4 graphs the results, displaying a much closer tracking of actual capacity utilization and, most noticeably, a much greater capacity to follow the long-swing pattern of actual utilization – successfully shifting from the boom years (through 1966) to the subsequent period of stagnation.

Figure 28.5 graphs the two simulations on the same figure, providing a closer comparative glimpse of the contours of the two models' dynamics. Although the patterns in the graph are a little difficult to discern, it emphasizes the much sharper trend breaks (after 1966) in the Altmac simulation.

Tables 28.2 and 28.3 provide more comparative detail on the models' performance. By every conceivable measure, the Altmac reveals better simulation properties than the Kalmac, capable of generating trend movements and amplitudes of cyclical fluctuation much closer to the actual behavior of the economy than the Kalmac achieves:

1. The Altmac simulation much more accurately captures the stagnation of the late 1960s and 1970s. As we saw above, while the ratio of *actual* peak expansion growth to the 1970s stagnation (row (3) divided by row (5)) is 1.63:1 and the corresponding ratio for the Kalmac simulated value is only 1.08:1, the ratio for the Altmac 1.54:1.
2. It is also better able to track both the increase in (trended) real productivity growth from 1956.1–1959.2 to 1959.2–1966.1 and its subsequent slowdown after 1966: While real productivity growth simulated by the Altmac follows the boom and stagnation pattern of the actual data, its simulated values in the Kalmac display a perverse pattern, slowing to the 1959.2–1966.1 cycle and then rising to relatively higher levels during the two subsequent cycles.
3. The Altmac is also much better able to capture the combination of trend and cycle represented by annual variations in aggregate capacity utilization: By all of the measures in Table 28.3, for example, its dynamic simulation performance is roughly 2.5 times more 'accurate' than the Kalmac's.

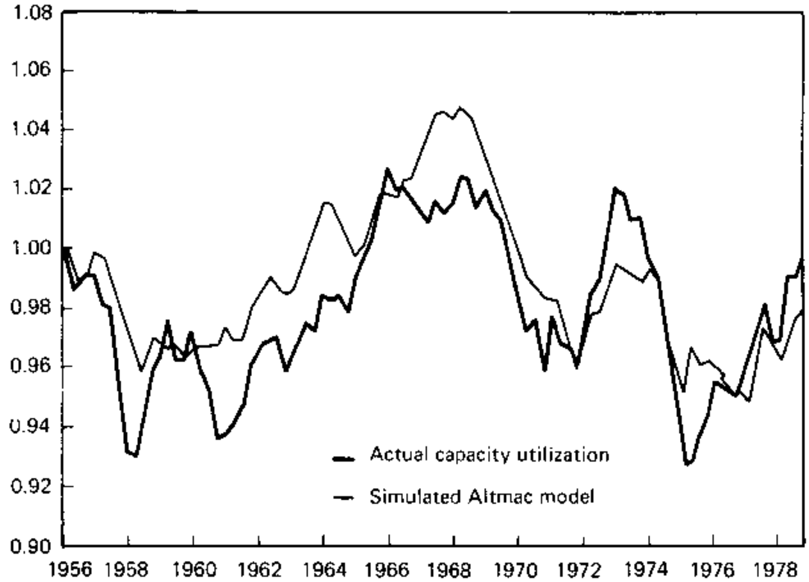

Figure 28.4 Endogenous boom and bust (aggregate capacity utilization: actual and simulated Altmac model, US, 1956.1–1978.4)

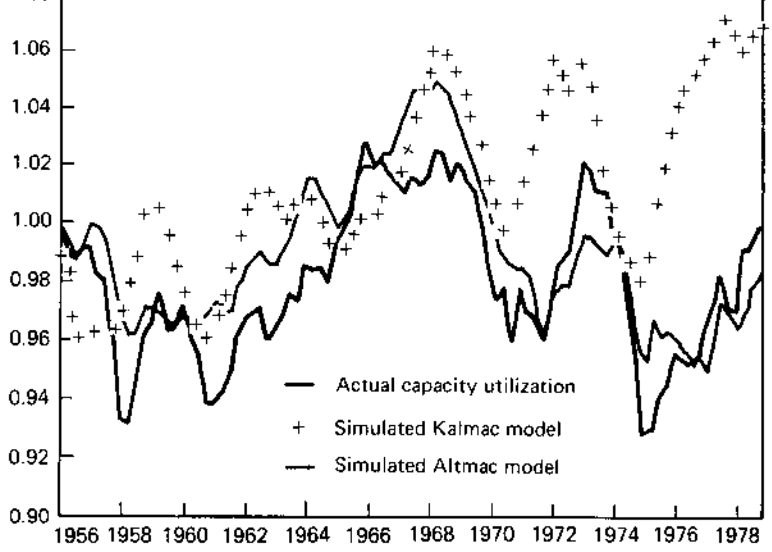

Figure 28.5 Comparing models of the 'long swing' (aggregate capacity utilization: actual and simulated values for Kalmac and Altmac models, US, 1956.1–1978.4)

Table 28.2 Comparison of Kalmac and Altmac models: actual and simulated average annual real output growth and trended productivity growth, US, 1956.1–1978.4

	Time period	Real output growth Actual	Kalmac	Altmac	Real productivity growth* Actual	Kalmac	Altmac
(1)	1956.1–1978.4	3.21%	3.50%	3.14	1.32	1.65	1.51
(2)	1956.1–1959.2	2.14	2.96	1.94	1.32	1.61	1.69
(3)	1959.2–1966.1	4.31	3.52	4.32	2.01	1.38	2.57
(4)	1966.1–1973.1	3.17	3.94	2.90	1.12	1.96	1.14
(5)	1973.1–1978.4	2.64	3.26	2.80	0.78	1.61	0.54

* Real productivity growth figures are for trended productivity growth, estimated as eight-year backward moving average an actual productivity growth.
Source: Author's calculations based on Kalmac & Altmac simulation results.

Table 28.3 Comparison of simulation performance Kalmac and Altmac models, US, 1956.1–1978.4

Comparison	*Kalmac*	*Altmac*
Root-mean-squared % error	4.84%	1.88%
Theil's inequality coefficient	0.023	0.009
Simple correlation, actual/sim.	0.332	0.819

Detailed comparison of the *sources* of these differences in performance lies beyond the space and time constraints posed by the conference volume exercise.

It may nonetheless be possible to clarify at least one of the most important differences in dynamic structure between the two models. We can pursue this comparison by exploring the two models' conceptualization of the relationship between the wage share and the level of aggregate capacity utilization.[15]

Figure 28.6 provides a graphical representation of these differences. The top graph reflects a Kaldorian/post-Keynesian conception of the relationship between distribution and utilization, while the bottom panel reflects a relatively more classical or neo-Marxian approach.

The shapes of the curves in the top panel follow directly from Kaldorian/post-Keynesian formulations: the wage share is likely to be a non-negatively-increasing function of utilization, as a result of the influence of the employment rate on wages; while utilization is likely to be a positive function of the wage share, as a result of the influence of the distribution of income on consumption (and the absence of notable

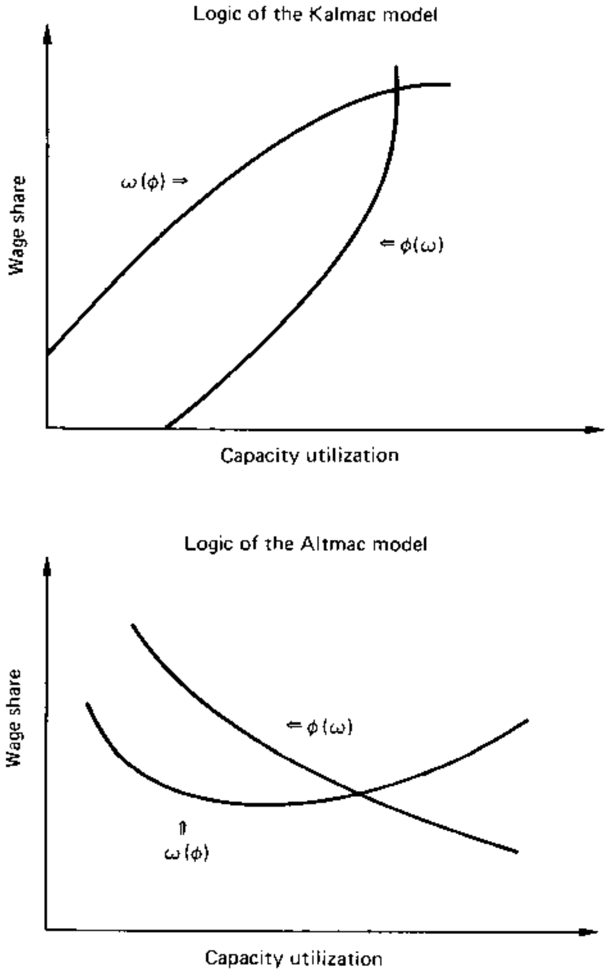

Figure 28.6 The wage share and capacity utilization

negative feedback effects on investment). The top panel unequivocally generates a monotonically positive expansion curve denoting the actual (reduced-form) relationship between the wage share and capacity utilization, since movements in neither or both curves is capable of generating a negatively-sloped composite relationship.

The shapes of the curves in the bottom panel reflect a neo-Marxian emphasis: The $\omega(\phi)$ curve reflects the idea of a 'reserve-army' cyclical relationship between unit labor costs and aggregate utilization, while the $\phi(\omega)$ curve reflects the predominantly negative effects on investment resulting from the model's profit-driven investment function. The bottom

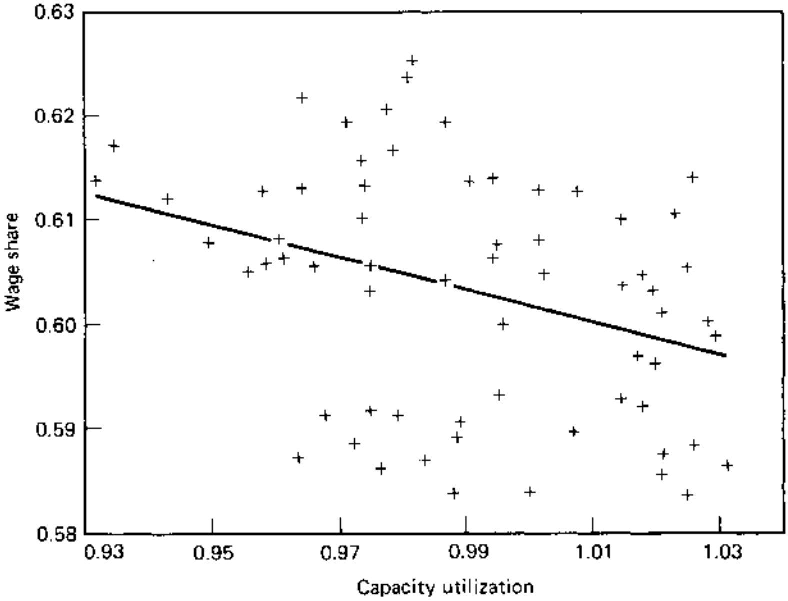

Figure 28.7 Observed wage-share utilization frontier (plotting actual wage share against actual utilization, US, 1962.3–1978.4)

panel allows for either positive or negative composite, relationships depending on the relative positions of the two curves and the relative importance of shifts in each.

Which representation is more accurate? Figure 28.7 graphs the observed relationship for the US economy over the period of simulation, with a simple regression line fitting the data superimposed on the graph.[16] Figure 28.8a graphs the simulated relationship generated by the Kalmac for the relationship between the wage share and utilization, while Figure 28.8b provides the same visual representation for the Altmac; a simple regression line is also drawn on each graph to trace the slopes of the composite (simulated) relationships. The differences in their structural dynamics seem relatively stark in this graphical summary. Which pattern better abstracts from all the noise in Figure 28.7? I presume that the stronger simulation performance of the Altmac might lean us toward Figure 28.8(b) as a more promising representation of the relationship between distribution and growth in at least one advanced capitalist economies; the similarities of the slopes of the fitted curves in Figures 28.7 and 28.8(b) further suggests the greater plausibility of the Altmac's rendering of structural dynamics.

I close with a final round of apologies. The structure and construction of both models, but particularly the alternative, is far too provisional to

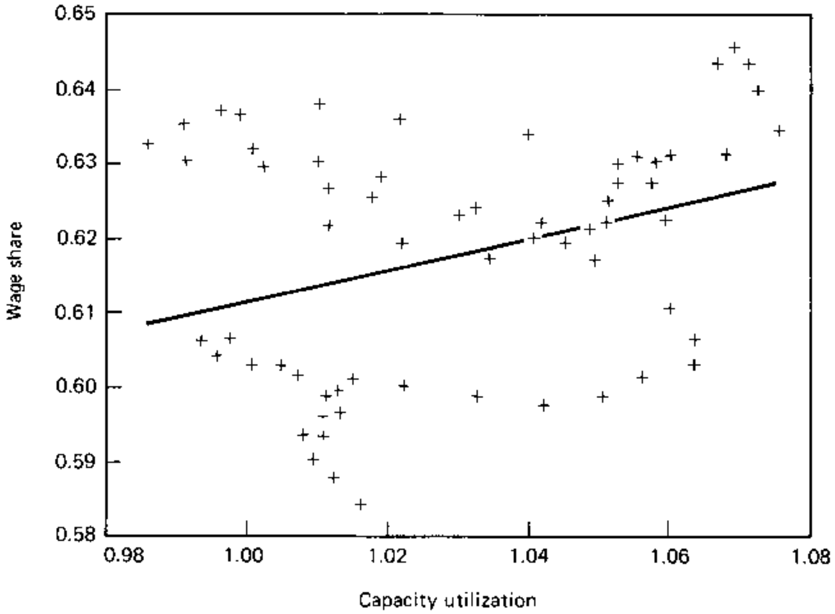

Figure 28.8(a) Kalmac model wage-share utilization frontier (plotting predicted wage share against predicted utilization, Kalmac model, US, 1962.3–1978.4)

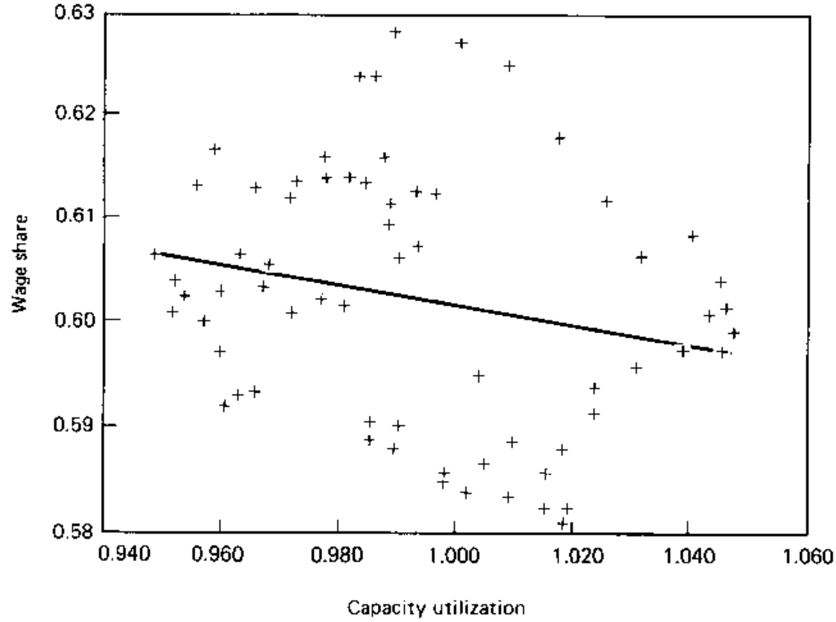

Figure 28.8(b) Altmac model wage-share utilization frontier (plotting predicted wage share against predicted utilization, Altmac model, US, 1962.3–1978.4)

warrant any strong or unyielding conclusions. Oh so provisionally, however, I would reaffirm my initial hunches that Kaldorian macroeconomics places too much emphasis on cumulation and pays too little attention to endogenous barriers to accumulation. Is this a case in which wishfulness is the parent of cumulation?

Appendix: Kaldor Model Structure and Notation

'Supply Side'

$$\underline{Q}^{\tau} = \alpha_1 + \alpha_2 \underline{J} + \alpha_3 \underline{Q}_{t-1} + \alpha_4 \underline{V}_{t-1} \qquad \alpha_2, \alpha_3 > 0, \alpha_4 < 0 \tag{1}$$

$$\underline{Q}^{\alpha} = H/\underline{q} \tag{2}$$

$$\underline{Q}^{o} \equiv \underline{Q}^{\alpha} - \underline{Q}^{\tau} \tag{3}$$

$$\underline{Q} = \alpha_5 + \alpha_6 \underline{Q}^{\tau} + \alpha_7 \underline{Q}^{o} \qquad \alpha_6, \alpha_7 > 0 \tag{4}$$

$$H = \alpha_8 + \alpha_9 \underline{Q} + \alpha_{10} H_{t-1} \qquad \alpha_9, \alpha_{10} > 0 \tag{5}$$

$$N = H/\bar{H} \tag{6}$$

$$\eta \equiv N/L \tag{7}$$

$$\omega \equiv (wH)/p\underline{Q} \equiv w/p\underline{q} \tag{8}$$

$$r^{a} \equiv [(1-\omega)\bullet(Q/K)](1-t_{\pi}) \tag{9}$$

$$\dot{w} = \alpha_{11} + \sum_{S} \alpha_{12s}\eta_{t-s} + \alpha_{13}\dot{p}^{e} \qquad \alpha_{12}, \alpha_{13} > 0 \tag{10}$$

$$\dot{p} = \alpha_{14} + \alpha_{15}\dot{\omega} + \alpha_{16}\dot{p}^{e} + \alpha_{17}\dot{\xi}_{z} \qquad \alpha_{15}, \alpha_{16}, \alpha_{17} > 0 \tag{11}$$

$$\dot{\omega} \equiv (\dot{w} - \dot{p}) - \dot{q} \tag{12}$$

$$\dot{\underline{q}}_m = \alpha_{18} + \alpha_{19}\dot{\phi}_m + \alpha_{20}\dot{\underline{k}}_m^{\phi} + \sum_{S}\alpha_{21s}\dot{\underline{J}}_{m_{t-s}} \qquad \alpha_{19}, \alpha_{20}, \alpha_{21} > 0 \tag{13}$$

$$\dot{\underline{Q}}_m = \alpha_{22} + \alpha_{23}\dot{\underline{Q}}^{N} + \alpha_{24}\dot{\underline{Q}}_{m_{t-1}} + \sum_{S}\alpha_{25s}\dot{\underline{X}}_{t-s} + \sum_{S}\alpha_{26s}\underline{O}_{t-s} \qquad \alpha_{23}, \alpha_{24}, \alpha_{25} > 0, \alpha_{26} < 0 \tag{14}$$

$$\phi_m = \alpha_{27} + \alpha_{28}\phi \qquad \alpha_{28} > 0 \tag{15}$$

$$\dot{K}_m = \alpha_{27} + \alpha_{28}\phi + \sum_{S}\alpha_{29s}\dot{\phi}_{t-s} \qquad \alpha_{28}, \alpha_{29} > 0 \tag{16}$$

$$\dot{\underline{q}} = \alpha_{30} + \alpha_{31}\dot{\phi} + \alpha_{32}\dot{\underline{k}}^{\phi} + \sum_{S}\alpha_{33s}\dot{\underline{q}}_{m_{t-s}} \qquad \alpha_{31}, \alpha_{32}, \alpha_{33} > 0 \tag{17}$$

$$W_T \equiv w \bullet H \tag{18}$$

$$W^{Z} \equiv (W_T + W_a) \bullet (1 - t_{\omega_f}) - W^{O} - W_o \tag{19}$$

$$R = \alpha_{34} + \alpha_{35}\omega \qquad \alpha_{35} < 0 \tag{20}$$

'Demand Side'

$$\underline{C}_{\phi} = \beta_1 + \beta_2 \underline{Y}^{d}_{w\phi} + \beta_3 \underline{Y}^{d}_{r\phi} \qquad 0<\beta_3<\beta_2<1 \tag{21}$$

$$\underline{Y}^{d}_{w} \equiv \{[(W^{z} + W_o + W_a) - (T_{\omega\ell} + T_{\ell}) + Y^{tp}]/p_{Y}\}/Y^{*} \tag{22}$$

$$\underline{Y}^{d}_{r} \equiv [(R - T_{\times})/p_{Y}]/Y^{*} \tag{23}$$

$$\underline{I}^{r}_{\phi} = \beta_4 + \beta_5\phi + \sum_{s}\beta_{6s}\dot{\phi}_{t-s} \qquad \beta_5, \beta_6 > 0 \tag{24}$$

$$\underline{Q}_\phi = \beta_7 + \beta_8 \underline{Y}_\phi + \beta_9 p_\tau \qquad \beta_8>0, \beta_9<0 \qquad (25)$$

$$\underline{X}_\phi = \beta_{10} + \beta_{11} \underline{Y}_{x\phi} + \beta_{12} p_\tau \qquad \beta_{11}, \beta_{12}>0 \qquad (26)$$

$$\underline{X}^n_\phi \equiv \underline{X}_\phi - \underline{Q}_\phi \qquad (27)$$

$$\dot{p}_\tau = \beta_{13} + \beta_{14} \dot{p} \qquad \beta_{14}>0 \qquad (28)$$

$$\underline{d}_\phi = \beta_{15} + \beta_{16} \underline{K}_{\phi_{t-1}} \qquad \beta_{16}>0 \qquad (29)$$

$$\phi_J \equiv (\underline{Y}/\underline{Y}^*) \equiv \underline{C}_\phi + \underline{I}^m_{\kappa\phi} + \underline{G}_\phi + \underline{X}^n_\phi + \underline{d}_\phi + \underline{I}^n_{r\phi} \qquad (30)$$

$$\underline{Y} \equiv \underline{Q} \qquad (31)$$

$$\Delta \underline{V} \equiv \underline{Y} - \underline{J} \qquad (32)$$

$$\phi \equiv \phi_J + \Delta \underline{V}_\phi \qquad (33)$$

Definitions

$$\dot{X}_i \equiv \partial X / \partial t \qquad X_{i\phi} \equiv X_i / Y^*$$

$$X_i \equiv X_{i_{t-1}} \bullet (1 + \dot{X}) \text{ for } \dot{p}, \dot{w}, \dot{q}, \dot{Q}, \dot{q}, \dot{K} \qquad k \equiv K/H$$

$$X_i \equiv X/p \qquad k^\phi \equiv k \bullet \phi$$

$$X_i \equiv \underline{X}_i \bullet p \qquad \tilde{X}_i \equiv X_i - \underleftarrow{X_i}$$

Modified Kaldor Model

$$\underleftarrow{\dot{\underline{q}}} = \alpha_{30} + \alpha_{31} \underleftarrow{\dot{\phi}} + \alpha_{32} \underleftarrow{\dot{\underline{k}}}^\phi + \sum_s \alpha_{33s} \dot{\underline{q}}_{m_{t-s}} \qquad \alpha_{31}, \alpha_{32}, \alpha_{33}>0 \qquad (17a)$$

$$\dot{\underline{q}}^e \equiv \underleftarrow{\dot{\underline{q}}} - \sum_7 (.125 \cdot \dot{\underline{q}}_{t-s}), \; s = 1, \ldots, 7 \qquad (17b)$$

$$\dot{\underline{q}} = \alpha_{36} + \alpha_{37} \dot{\phi} + \alpha_{38} \dot{\underline{k}}^\phi + \sum_s \alpha_{39s} \dot{\underline{q}}_{m_{t-s}} \qquad \alpha_{37}, \alpha_{38}, \alpha_{39}>0 \qquad (17c)$$

Substitute Equations for ALTMAC *Model*

$$\underline{I}^m_\phi = \beta_4 + \beta_5 \phi + \sum_s \beta_{6s} \dot{\phi}_{t-s} + \sum_s \beta_{17s} (r^a{}_{t-s} / i_o) \qquad \beta_5, \beta_6, \beta_{17}>0 \qquad (A24)$$

$$\dot{\underline{q}} = \alpha_{30} + \alpha_{31} \dot{\phi} + \alpha_{32} \dot{\underline{k}}^\phi + \alpha_{40i} \dot{P}_i \qquad \alpha_{31}, \alpha_{32}, \alpha_{40}>0 \qquad (A17)$$

$$\dot{w} = \alpha_{11} + \sum_s \alpha_{12s} \eta_{t-s} + \alpha_{13} \dot{p}^e + \alpha_{41} \tilde{w}_{t-1} + \alpha_{42i} \dot{P}_i \qquad \alpha_{12}, \alpha_{13}, \alpha_{42}>0 \alpha_{41}<0 \qquad (A10)$$

$$\dot{p} = \alpha_{14} + \alpha_{15} \dot{\omega} + \alpha_{16} \dot{p}^e + \alpha_{17} \dot{\xi}_z + \alpha_{43} \dot{\phi} + \alpha_{44} \Phi \qquad \alpha_{15}, \alpha_{16}, \alpha_{17}, \alpha_{43}, \alpha_{44}>0 \qquad (A11)$$

$$H \equiv \alpha_8 + \alpha_9 \underline{Q} + \alpha_{10} H_{t-1} + \alpha_{45} \dot{w} + \alpha_{46} \dot{p}_\kappa + \alpha_{47} (H/H^*)_{t-1} \qquad \alpha_9, \alpha_{10}, \alpha_{46}>0, \alpha_{45}, \alpha_{47}>0 \qquad (A5)$$

Variable Notation Conventions

A		a		Δ	Difference		*Superscripts*
B		b		Θ	Dummy var.	a	after-tax
C	Consumption	c		Π	Profits	o	adjusted
D		d	Depreciation	Σ	Summation	τ	targeted
E		e		Φ	Index of cycle	e	expected
F		f				ϕ	adj. for util.
G	Govt. purchs.	g		α	Behav. coeff.	N	domestic
H	Hours	h		β	Behav. coeff.	d	disposable
I	Investment	i	interest rate	∂	Derivative	*	potential
J	Sales	j		η	Employ. rate	n	net
K	Capital stock	k		μ	Mark-up	α	actual
L	Labor force	l		π	Profit share		
M		m		ξ	Unit costs		*Subscripts*
N	Employment	n		τ	Time trend	π	profits
O	Imports	o		ϕ	Capacity util.	Z	intermediate gds
P	Power/Social Vars.	p	Price(s)	ω	Wage share	m	manufacturing
Q	Output	q	Productivity			a	accruals
R	Capital income	r	Profit rate			ω	payroll
S	Savings	s				ϕ	normalize on Y^*
T	Taxes	t	Tax rate			τ	terms trade
U	Unemployment	u	unempl. rate			$\varkappa$	capital
V	Inventories	v					
W	Wages	w	Wage rate				
X	Exports	x	Generic var.				
Y	Income	y	Generic var.				
Z	Intermd.goods	z	Z intensity				

Notes

1. For some of Kaldor's major statements on growth dynamics, see Kaldor (1957, 1962, 1970). For two useful recent reviews of Kaldor's contributions, see Marglin (1984), especially 155–7; and Velupillai (1983).
2. I have relied heavily on the excellent symposium on 'Kaldor's Growth Laws' presented in the Spring 1983 issue of the *Journal of Post Keynesian Economics*, especially Thirlwall (1983).
3. With all due respect to the late Lord Kaldor, I have not undertaken such an ambitious exercise solely for the purposes of this conference volume. I am currently pursuing a longer-term project of constructing a relatively large macroeconometric model of the postwar U.S. economy, based on a 'left' economic perspective, in order to compare the usefulness of neoclassical, post-Keynesian, and neo-Marxian macroeconomics and in order further to locate and evaluate recent contributions evolving broadly under the umbrella of the 'social structure of accumulation' approach. This ongoing work made it possible to undertake the exercises reported in this paper without too much distention. For a recent progress report, see Gordon (1988b).
4. While most growth models actually focus on the interactions between savings and investment, it is more convenient in a macroeconometric context to analyze the interaction between consumption and investment since the two components, along with other 'exogenous,' determinants of final demand, sum

to total product and therefore jointly determine the demand-side properties of the model.

5. For discussion of the independence of wages from the level of unemployment within the Post-Keynesian perspective, see for example Appelbaum (1979) and Michl (1987).
6. On the domain of long-period analysis, this is unlikely to compromise some of the most important emphases in Kaldor's models: Since employment is a steady function of output; labor supply is treated as exogenous; wages will vary with the employment rate; and prices will vary, other things equal, in direct proportion to variations in wages; real wages are unlikely to change over the cycle, other things equal, as a result of changes in nominal wages. It will continue to be the case, therefore, that the wage share will be jointly determined by the long-period relationship between savings and investment and by dynamic effects of output growth on productivity growth, preserving the long-period relationship between demand and distribution which seems essential to Kaldor's approach.
7. For useful discussion of Kaldor on endogenous money, see Rousseas (1986, especially ch. 5) and Lavoie (this volume).
8. In order to simplify the exercise, I have relied throughout on simple linear specifications of all of the principal stochastic equations. It is my provisional impression that this dimension of simplification in the exercise is not essential to the properties of the model since all of Kaldor's principal hypotheses receive empirical support in the estimation of the equations (see below). One important issue which is glossed by this simplification, however, is the extent of increasing returns to scale in manufacturing or the aggregate economy; I discuss this issue in reporting on the results of the estimation.
9. Those of strong post-Keynesian persuasion may be choking at the sight of an aggregate index of the capital stock introduced through the capital-labor ratio in this and the aggregate productivity growth equation. In order to test for interactions between other determinants of investment and output growth in affecting productivity growth, however, it becomes necessary, for better or worse, to allow an aggregate capital-labor ratio to appear in the productivity growth equations. I would happily debate the legitimacy of this egregious importation, although I think it is a side issue and that this specification does not much affect the behavior of the model as reported below.
10. Some equations were estimated for periods beginning somewhat after 1951.3 as a result of long lags or problems with data availability.
11. One exception to the inclusion of lagged endogenous variables as instruments: I did not include lagged variables from simple identities determining either the rate of change or the new level of a variable in the current period.

    I have not yet, in this stage of my work, tested for evidence of contemporaneous correlation in the residuals of the equations estimated by two-stage least-squares; I plan to review the need for and sensitivity to systems-estimation methods at a slightly more completed stage.
12. It could be that the latter failure – to find a differentially expansive effect of exports on manufacturing output – may simply reflect the fact that this model was estimated for the United States, over a period during most of which trade dependence was not yet very accentuated. If specified and estimated for the UK, to which Kaldor made special reference, the results could conceivably be quite different.
13. The principal exogenous variables in the system are aggregate labor supply, government spending, and the various flows and rates of government taxation.

14. For discussion of some of the principal macro implications of these explorations, see Bowles, Gordon, and Weisskopf (1987, 1989) and Gordon (1988b).
15. This kind of exercise has been highlighted by a number of recent discussions in the left macro literature. See, for example, Marglin and Bhaduri (1989). See also Gordon (1988b) for some similar kinds of comparisons.
16. These graphs in fact begin in 1962.3 rather than 1956.1. I chose to start then (rather than at the beginning of the period of simulation) simply because this helps focus on the stagnation period, after 1966.1, during which the possibility of a difference between the Kalmac, with its failure to capture the downturn in aggregate performance, and the Altmac, which appears more adequately to track that stagnation, seems greatest. I chose 1962.3 specifically because it is the last mini-peak before the final peak of the boom in 1966.1.

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29 Disembodied Technical Progress: Theory and Measurement

S. Nagy

1 THEORETICAL CONSIDERATIONS

Disembodied technical progress is a factor of growth that appears in all kinds of growth models. As a matter of fact, in neo-Classical growth models it is the only type of technical progress since it lays in the foundation even of the different, sometimes rather complicated types of embodied technical progress.

Kaldor's new model of economic growth represents a major departure from the class of neo-Classical growth models because it gives 'explicit recognition to the fact that technical progress is infused into the economic system through the creation of new equipment, which depends on current (gross) investment expenditure' (1970, p. 343). This relationship is reflected in his well known technical progress function which expresses 'a relationship between the rate of change of gross (fixed) investment per operative and the rate of increase in labour productivity on *newly installed* equipment' (1970, p. 343).

In his model Kaldor allows also for the existence of disembodied technical progress saying – in a footnote – that 'in addition to "embodied" technical progress there is some "disembodied" technical progress as well, resulting from increasing know-how in the use of existing machinery' (1970, p. 346), but he assumes that it is just counter-balanced by the decline in the physical efficiency of already existing machinery that takes place with age.

As we can see Kaldor 'assumes away' disembodied technical progress but he does not exclude its existence, although through this assumption he makes it difficult or impossible to measure the effect of disembodied technical progress on output.

However, if this assumption is slightly modified by saying that the effect of disembodied technical progress overcompensates the decline in the physical efficiency of the existing machinery, we are free to set out to use Kaldor's technical progress function also to measure the effect of disembodied technical progress; this is what I am trying to do in the present paper. It is all the more justified to do so because in the actual computations newly installed capacities are considered and the total capital stock does not appear here as a separate variable.

Disembodied technical progress as a separate factor of growth also appears in Kalecki's theories. In his theory of the capitalist economy a factor '*d*' is defined to express the adaptation of the firm to the given level of technology through innovations. These innovations are embodied in the volume of usual investments. In his theory of the socialist economy a factor '*u*' is defined which reflects the effect of disembodied technical progress in the growth of the whole economy.

However, Kalecki gives a different interpretation to this factor in case of a capitalist or a socialist economy. He maintains that in a capitalist economy '*u*' reflects the effect of changes in demand on the degree of capacity utilization. Therefore, it cannot be regarded as an independent variable. In a socialist economy, however, where we have full capacity utilization – he says – '*u*' expresses the effect of organizational technical progress which does not require substantial capital inputs.

My interpretation of disembodied technical progress in the present paper is very close to Kalecki's with one difference that is very important. In the computations to be presented below I set out from Kalecki's assumption concerning disembodied technical progress as an independent factor of growth in the socialist economy.

The empirical findings, however, suggest that in a socialist economy of our days, i.e. in the Hungarian economy, even the growth rate of disembodied technical progress moves with the course of the general investment cycles: disembodied technical progress accelerates simultaneously with the upswing in the investment cycle and it decelerates with the downturn in the investment activity, the latter of which is being caused as a rule by state intervention to prevent even more serious disproportions in the economy.

2 MEASUREMENT OF DISEMBODIED TECHNICAL PROGRESS IN THE SOCIALIST COUNTRIES

The availability of long time series in constant prices has made it possible to obtain empirical estimates with the application of Kaldor's technical progress function for Hungary and a number of Eastern European countries.

In the case of Hungary the growth rate of disembodied technical progress has been found to vary in the range of *3.0–3.5 per cent per annum* in the period between the years 1950 and 1986.

In an international comparison with other Eastern European countries this puts Hungary into an average position which corresponds to her general level of economic development (see Table 29.1).

If these growth rates are plotted against the corresponding levels of

Table 29.1 The growth rate of disembodied technical progress in the individual Eastern-European countries, per cent, 1951–82

Poland	0.8
Soviet Union	1.2
German Democratic Republic	2.2
Czechoslovakia	2.4
Hungary	3.8
Roumania	5.2
Bulgaria	5.4

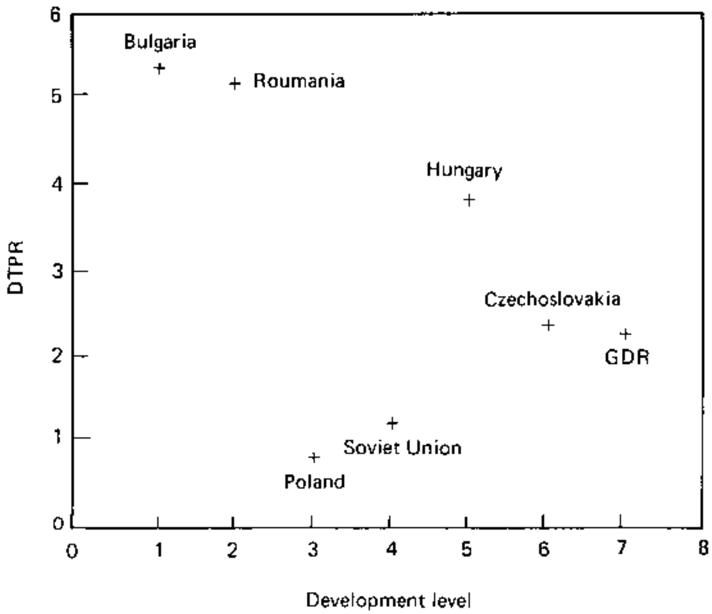

Figure 29.1

development an interesting chart is obtained which indicates an inverse relationship between the growth rates of disembodied technical progress and the general level of economic development, at least for the group of countries included in this sample.

This can be interpreted so that the growth rate of disembodied technical progress reflects among other things, the so called 'catching up effect'. This means that this growth rate is higher in case of countries with a lower than average level of development (Bulgaria, Roumania) and correspondingly it is lower in case of countries with a higher than average level of development (Czechoslovakia, German Democratic Republic). Poland and the

Table 29.2 Growth rates of disembodied technical progress by periods in Hungary

1950–60	2.5
1960–70	4.1
1970–80	3.2
1950–80	2.5
1950–84	3.4

Table 29.3 Growth rates of disembodied technical progress by branches of the Hungarian economy, per cent, 1970–78

Industry	6.9
Construction	6.1
Agriculture and forestry	4.5
Transport and communication	4.2
Trade	6.7
National economy, total	5.0

Soviet Union constitute exceptions, although for various reasons in this respect.

It is another hypothesis, to be verified later, that variations in the growth rates of disembodied technical progress among countries could be explained in terms of differences in the ICOR levels.

The percentage share of disembodied technical progress among the various factors of production also varies over time on average around 30 per cent. Let me quote for comparison corresponding figures from Denison's book (1967): the same shares for United States, German Federal Republic, United Kingdom and Belgium were found to be 43, 10, 32 and 25 per cent per annum in the years 1950–62.

The empirical studies and computations carried out on the basis of Hungarian data have proved that *the growth rate of disembodied technical progress is not constant over time*, as against the basic underlying assumption of the vast body of literature on growth economics.

The computations carried out for the various periods of the last 30–35 years of Hungary's economic development have produced estimates for the growth rate of disembodied technical progress which significantly differ from one another.

Similarly, there have been found significant differences in the growth rates of disembodied technical progress among the main branches of the Hungarian economy (see Table 29.3).

Differences among the corresponding growth rates have been found to be even larger among the various branches of industry.

Table 29.4 Growth rates of disembodied technical progress by branches of industry 1970–78

Mining	2.6
Electric energy industry	7.9
Metallurgy	4.4
Engineering	7.3
Construction material industry	5.7
Chemical industry	9.4
Light industry	5.7
Food processing	5.2
Industry, total	6.9

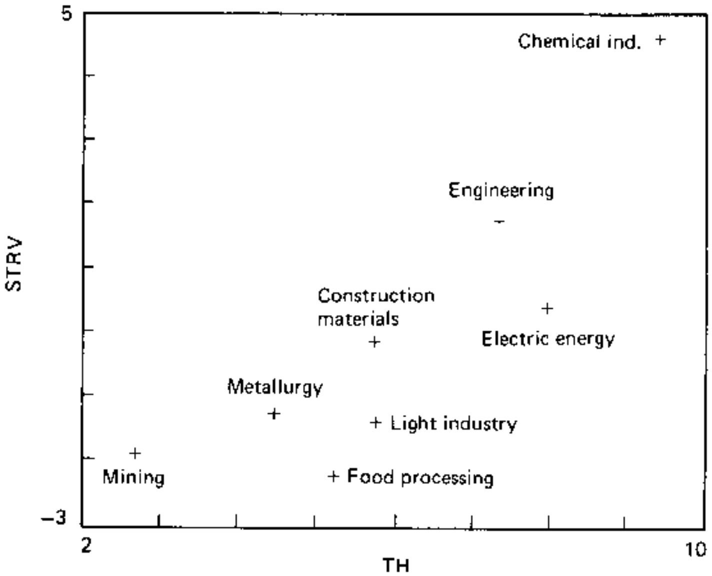

Figure 29.2 The connection between the growth rates of disembodied technical progress and structural change in the Hungarian Industry, 1970–78

Notes: TH – the growth rate of disembodied technical progress
STRV – a measure of structural change.

These differences in the growth rates of disembodied technical progress among the individual branches of industry are closely correlated with the structural transformation within the industry. On the scatter diagram above it can be seen that an increase in the relative shares took place only in those branches of industry in which the growth rates of disembodied technical progress was found to be higher than average.

It is interesting to note that this scatter diagram can be best approximated by a second order parabola. On the basis of this it could be calculated that over this period under examination only those branches of industry have increased their shares within the industry as a whole in which the growth rate of disembodied technical progress exceeded the level of 6.1 per cent per annum. (Technically this is the lowest value of the parabola.)

Incidentally, this value gives another estimate for the average growth rate of disembodied technical progress in the Hungarian industry. These two values (6.9 per cent from the table on the preceding page and 6.1 per cent from the parabola fitted to the actual observations on the scatter diagram) give us the right to say that the rate of growth of disembodied technical progress was around 6–7 per cent per annum in the Hungarian industry in the period between 1970 and 1978.

3 DISEMBODIED TECHNICAL PROGRESS AND CHANGES IN THE SYSTEM OF ECONOMIC MANAGEMENT AND CONTROL

Among the factors of disembodied technical progress observed in the Hungarian economy one of the most important is the transformation of the system of macro-economic management and control of the economy, i.e. the elaboration and introduction of the new economic mechanism (NEM).

These changes are most easily measured in the period between 1968 and 1978, because from 1978 to 1984 a restrictive economic policy course was implemented which makes it difficult to measure any change in the field of disembodied technical progress, although the transformation of the system of economic management and control also continued in this period.

The working hypothesis in these computations was that the transformation and modernization of economic management and control leads in the end to an increase in the efficiency of the economy as a whole and therefore an acceleration of disembodied technical progress is reflected in its higher growth rate.

In the first approximation the computations seemed to prove the above hypothesis: over the last 35 years the growth rate of disembodied technical progress was the highest in the period between 1968 and 1978 (see Table 29.5).

However, a deeper analysis of this period between 1968 and 1978 has shown that important factors other than the transformation of the economic management and control system were also at work contributing to an acceleration in the growth of the national income or at least to the maintenance of the high growth rates of the previous periods.

Of these factors I would like to mention two here: the investment cycles

Table 29.5 The growth rate of disembodied technical progress by periods, per cent

1950–67	4.2
1968–78	5.0
1978–84	3.0
1950–84	3.4

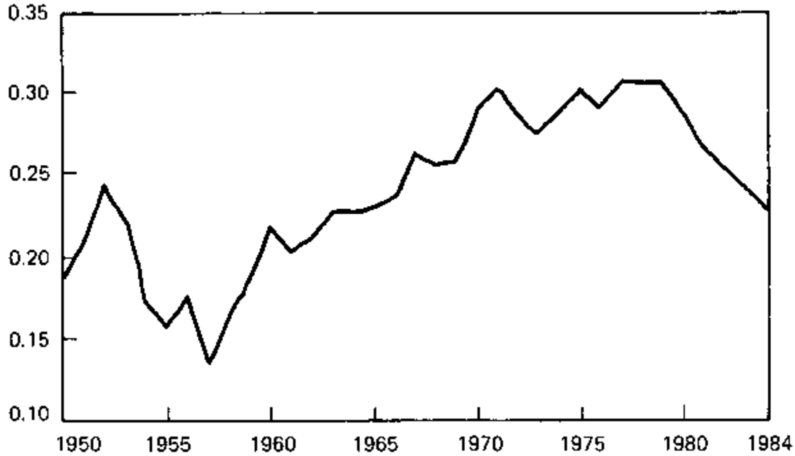

Figure 29.3 Capital-output ratio, Hungary, 1950–84

which took place in the years 1968–71 and 1976–78, respectively, and the accompanying import cycles, both characteristic of the development of the Hungarian economy. In the following I am going to analyze more closely the role played by the investment cycles in the acceleration of disembodied technical progress. For this purpose let us examine the movement of the overall capital-output ratio over time in the period between 1950 and 1984.

It can be seen that the steepest rise in the capital-output ratio took place just in the period between 1968 and 1978 and on average it was the highest in these years over the whole 35 year period. This suggests some kind of relationship between investment intensity of economic growth, the capital-output ratio and the rate of disembodied technical progress.

This statement seems to be supported by the following scatter diagram where the growth rates of investments are plotted against the growth rates of disembodied technical progress for various sub-periods. The main trend of the observations suggest a positive correlation between the two factors under investigation, which means that the acceleration in the growth of disembodied technical progress took place parallel with the acceleration of

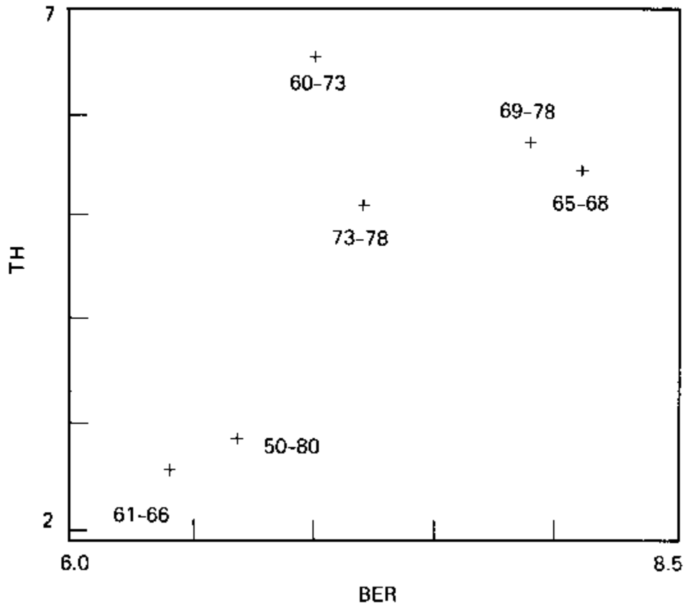

Figure 29.4 The connection between the growth rates of disembodied technical progress and investments

Notes: BER – annual compound growth rate of investments
TH – annual compound growth rate of disembodied technical progress

capital accumulation, the investment activity in the Hungarian economy as a whole (see Figure 29.4).

4 A PLAUSIBLE EXPLANATION OF EMPIRICAL FINDINGS

The first point that can be made here is that as apart from Kaldor's assumption concerning disembodied technical progress, i.e. its effect being counterbalanced by the decline in the physical efficiency of the existing machinery, disembodied technical progress is in fact a measurable variable characteristic of the level of development of a given country.

Moreover, the rate of growth of disembodied technical progress is not constant over time but it moves parallel with the investment cycle, which can be regarded as the main factor of the cyclical behaviour of the Hungarian economy as a whole.

This latter phenomenon can be explained in a complete accordance with Kaldor's theory of technical progress, his technical progress function. For according to some authors (Hahn and Matthews, 1970), from a formal point of view Kaldor's technical progress function can be regarded as an extention of the traditional Cobb–Douglas production function in a particular direction.

The basic underlying assumption of the Cobb–Douglas production function is that the elasticity of output with respect to the capital stock, the slope of the function $\{\partial(\dot{Y}/Y)/\partial(\dot{K}/K)\}$ is constant in all circumstances, whereas Kaldor has it varying with $\dot{K}/K$, i.e. with the speed of capital accumulation, the investment activity. In other words, it means that the higher the growth rate of investment activity, the higher the efficiency of the new capacities put into operation.

The same seems to apply to the growth rate of disembodied technical progress. It reaches its maximum when the investment activity is at the peak level, when the investment cycle hits the ceiling, and it subdues when investment activity is cut back by administrative measures in order to prevent ever more serious imbalances in the economy. (Classical examples for this are the years 1971 and 1978 in the economic history of Hungary.)

This phenomenon creates a curious paradox in the resource constrained socialist economies. The benefits of disembodied technical progress disappear just in the period when they are most needed, i.e. after the investment activity was curbed down and there was more room and need for benefits not requiring vast capital outlays. To a certain limited extent this can be counter-balanced by 'public efforts, public promotion', but the fact remains that non-capital intensive methods are spreading mostly at the time of the upswing in the investment cycle.

Thus, the central role played by the investment activity in the cyclical movement of the economy as a whole is also supported by the empirical findings of the present investigation, since even the disembodied technical progress – a rather neglected child of growth economics – seems to be governed by the investment activity, at least in the case of the Hungarian economy.

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Part VIII
Economic Policy and Economic Systems

30 Nicholas Kaldor as Advocate of Commodity Reserve Currency

A. G. Hart

1 INTRODUCTION

Nicholas Kaldor is widely (and I think correctly) seen by economists as the most prominent and persuasive supporter of the proposal for an international Commodity Reserve Currency system (for short, 'CRC') in the second (post-German) generation of its advocates. He was very much aware of the work of the pioneers in the first generation – Benjamin Graham and Jan Goudriaan – and would not have countenanced any claim that he had *founded* a CRC movement. But he put CRC in the context of economic development problems, and made clear the essential fact that its logical form is not CRC monometallism but CRC/gold bimetallism.

Kaldor's advocacy of CRC goes back to 1948, when he was a member of the United Nations Commission of Experts which produced *National and International Measures for Full Employment*, and continued into the 1980s. It should be said in the same breath, however, that Kaldor always favored measures for improving the terms of trade of Third World primary producers, even at the cost of encouraging monopolistic measures to restrain production. At the end of his life, he let this concern override his advocacy of CRC. In a posthumous article, he mentioned CRC only in a footnote, and reverted to the Keynesian scheme for an 'International Commodity Control Authority' (for short, 'ICCA').

2 KALDOR'S POSITION AS OF 1964

Kaldor's strongest statement in favor of CRC was in a submission to the United Nations Conference on Trade and Development in 1964 – printed among Kaldor's published papers. Kaldor sketches the history of the UNCTAD document in his preface.[1]

This document grew out of a conference on international monetary problems in 1963 at Bellagio, where Jan Tinbergen and I found ourselves supporting Kaldor's effort to persuade participants to endorse CRC. When Kaldor was in New York at the end of that year, and was looking ahead to the UNCTAD meeting of 1964, we decided to put our views on paper for UNCTAD consideration.

Kaldor was in fact the sole draftsman of the UNCTAD submission, even though its stated authorship was 'A. G. Hart, N. Kaldor and J. Tinbergen'. Though he stated in his preface that the paper 'owes as much to Hart's ideas as to my own', Kaldor never let me insert a single sentence in my words! He had unlimited patience, however, for suggestions that proposals should be improved at some point, or that some sequence of ideas could be clarified. It may be that I pushed him further toward insistence on a basket of fixed composition than he would have gone in an individual uttterance.

Main Elements of the 1964 Proposal

The crucial feature of the CRC plan (in the 1964 submission as well as in earlier and later CRC versions) is the proposal to adopt as a monetary 'metal' a 'bundle' (in today's semantics a 'basket') of primary commodities – with fixed physical composition and with a fixed price for the basket as a whole, but with full scope for changes in prices by individual commodities. This arrangement would be administered by a multinational agency (presumably the International Monetary Fund or a successor body) through a standing offer to buy or sell at permanently posted prices as many baskets as private parties or governments chose to sell or buy.[2]

In the submission to UNCTAD, rather detailed proposals were offered. It was suggested that the IMF 'should establish its own currency – let us call it the "bancor" – which after an initial "buildup period" should be convertible into (a) gold, (b) a bundle of commodities consisting of the thirty or so or so principal commodities in world trade which combine a high degree of standardization with reasonable durability in storage'.[3]

The suggested rules for convertibility were framed in terms of dealings between IMF and 'member countries'. For gold, member countries would be entitled to buy from IMF at 1 per cent above the bancor parity or sell to IMF at 1 per cent below parity. For commodity baskets the corresponding range would be 2 per cent (or perhaps 3 per cent) above or below par.[4]

Contact with private markets as well as with national monetary authorities was contemplated, however.

> The IMF should undertake to maintain at all times parity between bancor and the world free market price of gold, if necessary through open market sales of gold . . . Parity between bancor and the current market price level of the commodities in the commodity bundle should in principle be assured by arbitrage operations of private traders . . . Since, however, ordinary businesses are not in the habit of operating in many markets simultaneously . . . it is suggested that IMF should set up its own marketing unit which would engage in open market operations in

various commodity markets whenever the market value of commodities included in the bundle moves outside the officials margins.[5]

To be in a position to make good its selling offers, IMF would have to accumulate a sufficient reserve of baskets before full operation could start. The working of CRC would differ sharply between the initial 'buildup period' and the ensuing operating period.

Commodities in the CRC reserve would be stored, bought and sold at points along their normal trading routes. The IMF would be responsible for storage costs and for the maintenance of quality, which would entail turning inventories over.

During the buildup period, operations in each commodity would be guided by a target volume stated in tons, and by a 'declared value' per ton based on the commodity's recent market history. The target tonnage for each commodity would be a stated percentage (reflecting volume in international trade) of an aggregate target volume.[6]

Revisions in the List of Commodities

Once the accumulation process was completed, IMF was to 'declare the final composition of the commodity bundle and the bancor value of the commodity unit'.[7] Such a determination could not be made earlier because buying prices would vary during the buildup period, and because it might not be feasible to meet quantity-targets for all commodities included.

Even after the 'final' composition was set, two types of alterations in the composition of the basket were contemplated in the submission. One would be a periodic revision of the weights of individual commodities at intervals of five years, 'in order to keep the composition of the bundle in reasonably close relation to the pattern of world trade'.[8] The other would be the *exclusion* from the basket of any commodity if its price 'rises by 50 per cent or more above its latest "declared value" prior to its incorporation'.[9]

Relations of CRC/Bancor to National Currencies

The submission proposed an option for relations between the IMF's bancor and the currencies of member countries. Countries 'should be free either to maintain a fixed rate of exchange of their own currency in terms of bancor (which they should be free to adjust from time to time in accordance with agreed procedures) or a freely variable rate'.[10]

Whether the price level of primary products would display an uptrend or a downtrend relative to wage rates and finished-goods prices confronting private parties would thus depend on the exchange-rate policy of member countries as well as the course of markets for primary products.[11]

3 BENEFITS CLAIMED FOR CRC

The need for CRC was seen as arising from the convergence of two deficiencies in the world economic structure – (a) the lack of durability of the 'gold exchange standard' set up by Bretton Woods, and (b) the lack of a mechanism to stabilize and expand the world economy in a way compatible with adequate development of Third World countries dependent on primary-product exports.

Escape From an Untenable to a Sustainable Standard

On the side of monetary standards, Kaldor and his co-authors perceived clearly by 1964 that 'the creation of reserves through the "gold-exchange standard" is essentially a transitory phenomenon: it can only happen when a currency which was traditionally very "strong" becomes a "weak" one (through persistent balance of payments deficits), and whilst the "weakness" is still regarded as a temporary phenomenon by the reserve-currency holders.'[12] The proposed gold/CRC bimetallic system was presented as a much more sustainable standard than the gold-exchange setup under Bretton Woods.

Development Prospects

On the side of development, Kaldor was much concerned – and so were Tinbergen and Hart – with the recurring payments difficulties and related developmental setbacks on Third World countries dependent on primary-product exports. It was quite evident that if all these countries suddenly developed strong and steady production of gold, their payments problems might vanish. Such a gold situation not being in sight, CRC offered an equivalent.[13] This way of visualising CRC was further developed in A. G. Hart, 'The Case for and against Commodity Reserve Currency.'[14]

On the side of stabilizing mechanisms, CRC was recommended as a way to correct an asymmetry in the world market mechanism: the lack of 'any appreciable forces at work . . . in causing *manufacturing production to expand* in response to increased availability of primary products . . . While any given rate of expansion of primary production may be more than is required to support the industrial expansion of the countries which are *already fully industrialised*, it can be viewed as "excessive" only if we ignored [*sic*] the possibilities of accelerated industrialisation in all those areas which still have large labour reserves in the agricultural sectors, and whose industrialisation could be stepped up very considerably under favourable conditions. If an acceleration of agricultural production fails to induce an acceleration of industrial production, it is primarily because it fails to generate the necessary increase in effective demand.'[15]

World-wide Stabilizing Effects

In a world perspective, CRC was presented as offering a general economic stabilizer to limit the intensity of depressions and set up barriers to inflation. The relevant passage in the UNCTAD submission deserves quotation at length:

> 'The transactions which bring new gold into the system *yield income* to the producers. This fact, as Ricardo emphasized, introduces a stabilizing factor into the world economy. If monetary expansion is excessive, the resulting inflationary drift tends to raise the cost of producing gold and thus to slow down the growth of the monetary stock. If gold production is insufficient, the lag in the monetary stock tends to depress prices and business activity; hence the production of gold becomes more attractive and tends to expand. If only this stabilising effect had worked fast enough and on a large enough scale, it would have been a powerful factor in securing steady expansion of the world economy. But historically the low elasticity of the supply of gold, and the small volume of annual production in relation to the stock of gold and to the total income from all activity, made this mechanism much too weak to serve the purpose.'[16]

Thus:

> "To include commodities which represent the bulk of the world's primary production in the symmetallic standard means multiplying Ricardo's stabilising influence by a large factor. This is not only (or mainly) because such monetarisation would yield an annual increment of reserves (and thus a contribution to community income earned from the increment of reserves) that is several times as large as could be expected from the production of gold (unless the price of gold were raised to fantastic levels). A far more important consideration is that the income-stabilizing effect of the monetary standard applies not merely to that part of the output of the standard commodities which is added to the reserve, but to the *entire output* of these commodities.[17]

Offsets to Costs

Prospective gross costs of storage and administration were viewed in the submission as substantial – perhaps of the order of $200 million annually after allowing for the costs which would be incurred by governmental and private price-support schemes in the absence of CRC.[18] But the benefits – in the nature of economic externalities – described just above were expected to be overwhelmingly larger than these costs.

A major cost factor, not dealt with explicitly as such, is yet handled with great skill in the CRC design of the UNCTAD submission. This is the social startup-cost entailed by the *buildup* of a reserve stock of commodities.

If carried out in a period of tight markets for primary commodities, such a buildup would be at the cost of pulling raw materials out from under the activities they serve, reducing employment and production worldwide. Besides, accumulation of stocks at such a time might be at the cost of intensifying hunger when the 'tight market' reflected poor crops of grains and the like. On the other hand, a buildup which took the form primarily of acquiring excess stocks already in being (notably in the hands of governments and of whatever buffer-stock organizations may exist) can be managed without disruption of productive use or of human nutrition.

This important aspect of cost is dealt with in the submission by proposals for slowing down or even reversing the accumulation of CRC stocks if markets become tight during the initial buildup period.[19]

Furthermore, the submission adopted a proposal of Benjamin Graham – the substitution of futures contracts for physical holdings of commodities when spot prices exceed futures, as it apt to be the case when crops are bad or when producers of minerals and the like are expanding capacity to meet excess demand.[20]

4 ICCA VERSUS CRC

How should we interpret Kaldor's ultimate abandonment of Commodity Reserve Currency, and his shift to advocacy of an International Commodity Control Agency? Was ICCA a novelty which bowled Kaldor over? Did Kaldor decide he had detected technical flaws in CRC which would make it unworkable? Did Kaldor shift the weights he attached to various cost-benefit aspects of the proposed reform? Did Kaldor somehow yield to political pressure?

Since Kaldor himself did not announce his conversion, but simply put forward an article in which CRC was not mentioned but ICCA occupied center stage, much is left to surmise rather than direct observation. There are important clues, however, in his final article published in 1986, in his preface to the 1964 *Essays*, and in the letter of 1972 addressed to Hart.

Early Exposure of Kaldor to ICCA

Far from coming to Kaldor is his last years as a novelty, ICCA must have come to Kaldor's attention early in his career – as a proposal from John Maynard Keynes which was hinted at in a Keynes article of 1938, formulated in British postwar-planning work in 1942, and 'first became known . . . with the release of wartime Government papers under the 30-year rule and their subsequent publication in Keynes' *Collected Writings*'.[21]

Kaldor refers to discussions involving Dennis Robertson and Roy Harrod, and must at some stage have been in Keynes's confidence about ICCA. It appears that the plan to present this proposal at Bretton Woods was vetoed by the British Ministry of Agriculture, and the economists concerned presumably felt some obligation not to go outside official channels. But Kaldor would surely not have let such a Keynes proposal fade out of his mind.

Kaldor's Attitude Toward Restrictionist Schemes

In 1964, when explaining the context of the papers in his second volume of *Essays on Economic Policy*, Kaldor described the situation as of the early 1950s in bleak terms:

> The failure to secure stable prices or markets for primary producers by means of either international buffer stocks or multilateral contracts left only one avenue open: the creation of producer cartels which influence prices through direct regulation of supplies coming onto the international market.[22]

Kaldor evidently felt serious misgivings about restrictionism. But: 'When, however, I came to review this problem afresh after a ten-year interval, this type of agreement appeared to me the only promising method of arresting the steady deterioration of the terms of trade of the primary producing countries.'[23]

Chapter 17 of his *Essays*, written in 1962, explored the 'necessary prerequisites for the successful operation of agreements of this type', and concluded reluctantly that the necessary mechanism was 'not one that is politically likely to be a "starter" in most producing countries'.[24]

Kaldor 'thus came to the conclusion that if the problem is to be solved, it must be tackled on entirely different lines – by a multi-commodity buffer-stock scheme that is directly linked with the creation of an international reserve currency'.[25] CRC thus came to the fore as a *faute de mieux* proposition, though one advanced with considerable enthusiasm. He advocated CRC as 'the one method of generating expansion [of the world economy] through 'favourable' balance of payments situations which does not require anybody to get into debt as the counterpart to the creation of added reserves'.[26]

Individual Commodities in a Modified CRC, as of 1972

The Kaldor/Hart wrangle of 1972 arose from Kaldor's effort to stretch CRC in directions which would put the administering body in the position of using its power to create reserve money to manage the prices of individual commodities. In his letter to Hart dated 29 February 1972, Kaldor says on his first page: 'I am sorry that you have now "permanently" dropped the idea of a Commodity Reserve Currency because I have become far more attracted to it.' But on the second page we read:

> I have become sceptical of the symmetallic idea of combining certain commodities into a bundle, partly because of the extra cumbersomeness of the operation of such a scheme, and partly also because violent changes in the supply and demand of any one commodity should be allowed to lead to an adjustment in the price of that commodity, rather than induce compensating changes in other commodities.
>
> 'In this connection, I fail to see why you now regard the creation of buffer stocks for [each of] the twenty or thirty major commodities as being 'an unmitigated disaster – which fortunately is clean off the map of the politically possible.' I would assume of course that the IMF would make *all* the purchases necessary to keep the prices of the stabilized commodities stable in terms of SDR's, but I would have ground rules according to which the IMF's buying and selling prices for individual; commodities would be adjusted upwards or downwards in accordance with a five-year moving average of their stock/turnover ratio in relation to the average stock/turnover ratio for all commodities.
>
> I simply cannot see what you mean when you say that the IMF 'would get into a position where at least some commodities would overflow buffer stocks and deliver resounding price crashes.' Just as in the case of the gold standard, the IMF would have an unlimited obligation to issue SDRs against commodities and not a limited one, so buffer stocks could never be 'overflown' [*sic*].

Plainly there was an issue of principle involved. Benjamin Graham had held forth as one of the central virtues of CRC that its working did *not* hinge on the success of restriction of output – in contrast to single-commodity schemes where growth of output was a threat, and success of price policy hinged upon deterrents to production. Kaldor himself, as we have seen, wanted a mechanism by which expansion of world-wide primary production should be a force to stimulate the use of primary products. In the position described in Kaldor's letter, IMF would clearly have to resist the growth of some commodity stocks by encouraging the organization of output.

The Final Shift to ICCA

In his posthumous article, Kaldor finally stepped out of the role of CRC advocate.[27] His final comment on CRC, in a footnote, was that 'a scheme of this kind revealed inherent problems of its own which are absent in a simpler scheme consisting of separate buffer stocks . . . for the various commodities; also, it would have been highly complicated to operate'.

In the Keynesian scheme as described by Kaldor, 'the expenditure of the Commodity Control Agency [would be] directly financed by the issue of new international currency, in other words, by SDRs'.[28] The ICC 'would set up buffer stocks for all the main commodities, operated for each particular commodity by a subsidiary organization run on identical principles'.[29] How such a setup would be 'simpler' than a CRC, and how it could be safeguarded against monopolistic influences on the 'subsidiaries' and against piling up of useless surpluses like the European 'mountain of butter' it would be hard to explain.

Kaldor's essay was designed as the show-piece of a symposium in *World Development* on 'Commodities in Crisis'.[30]

The emphasis of the symposium, and hence of Kaldor's paper, was not on finance. But surely Kaldor must have been moved by indignation over the way in which IMF handling of the international debt crisis of the 1980's was frustrating development and creating mass unemployment in the Third World. He may well have sensed poetic justice in a scheme which would constrain the IMF (as creator of international reserve money in the form of SDRs) to undo the effects of its debt-management policies.

Notes

1. Kaldor, N. (1964) *Essays*, Preface, p. xvii. The catchwords (like 'Preface') attached to my references are intended to help sort out the numerous and somewhat contradictory ideas presented by Kaldor at various times.
2. Kaldor, N. (1964) *Essays*, UNCTAD, pp. 146–7.
3. Kaldor, N. (1964) *Essays*, UNCTAD, p. 146.
4. Kaldor, N. (1964) *Essays*, UNCTAD, pp. 155–6. Present-day CRC advocates would recommend a much wider band between posted buying and selling prices for commodity baskets.
5. Kaldor, N. (1964) *Essays*, UNCTAD, pp. 156–7. It should be noted that on p. 147, it was proposed that 'Bancor should be exclusively a deposit currency, and only the central banks of member countries should be entitled to hold bancor balances with IMF.' The links with the private markets would therefore entail an obligation of central banks to sell and buy bancor drafts in connection with private transactions with IMF.
6. Kaldor, N. (1964) *Essays*, UNCTAD, pp. 147–51. The suggested target for the aggregate was about 30 per cent of a year's world trade in primary commodities. But because many primary commodities would be ineligible to enter the basket because of lack of standardization or storability, the targets *for those included* were to be of the order of a full year's trading volume – perhaps a quarter of a year's production.
7. Kaldor, N. (1964) *Essays*, UNCTAD, p. 153.
8. Kaldor, N. (1964) *Essays*, UNCTAD, p. 157.
9. Kaldor, N. (1964) *Essays*, UNCTAD, pp. 154–5. This proposal is illuminated

in the course of an 'explanatory comment' (p. 161, footnote): The 400 per cent rise in the price of sugar in 1962 raised the price index of 30 commodities by 20 per cent, and under CRC would have called for a decline of over 5 per cent in the price index for the other 29 commodities.

10. Kaldor, N. (1964) *Essays*, UNCTAD, p. 157. The proposal included 'a penalty on members who deliberately keep the market value of their own currency low through open market *sales* of their own currency over prolonged periods.
11. See Kaldor, N. (1964) *Essays*, UNCTAD, pp. 167–8.
12. Kaldor, N. (1964) *Essays*, Preface, p. xii, footnote. Cf. the corresponding remarks in the *Essays*, UNCTAD, p. 134.
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31 Kaldor on International Economic Policy

S. Dell

It is a privilege for me to have this opportunity of paying tribute to Lord Kaldor for his immense contributions to the ideals of international cooperation. The very same generosity of spirit that had led him to associate himself with Sir William Beveridge in working on plans for full employment for Britain prompted him also to look far beyond the problems of Britain to the international economic objectives of the United Nations. He was indeed a United Nations man. Not only did he work for the United Nations in many different capacities, but his theoretical writings on world trade, development and the international monetary system as well as the technical assistance missions that he undertook to many different countries made an enormous reputation for him throughout the world, a reputation for trenchant analysis of the world's ills and for brilliant advocacy of strategies for dealing with them. And his work was invariably permeated by a desire to reduce inequity and inequality in the economic relations among nations as well as in the internal economy of each country, rich or poor, developed or underdeveloped.

It is difficult to do justice to his contributions in the international field in the limited time available to us here, and I can do no more than touch upon a very few examples. One of his lesser known but most important works was a United Nations document entitled 'National and International Measures for Full Employment' (United Nations, 1949). This document will not be found in his collected works for the simple reason that he had four collaborators, namely John Maurice Clark, Arthur Smithies, Pierre Uri and Ronald Walker. As secretary of the group, however, I can vouch for the fact that Professor Kaldor inspired the entire report, which was unanimous, and, at the request of the group, supplied something like 97 per cent of the text.

The report was written between October and December 1949 at the high point of the postwar collective commitment to full employment but at a time of uncertainty created by the first postwar recession and the unsettling circumstances leading up to the devaluation of sterling. The report was a superb exposition of the national measures required for the achievement and maintenance of full employment, but it was particularly noteworthy as the first exercise of its kind in examining the character and degree of international cooperation required to create an economic environment conducive to full employment worldwide.

The report's recommendations for international action were designed to achieve three main purposes:

1. to create a workable system of international trade and the conditions for eliminating excessive trade barriers and for the full restoration of currency convertibility;
2. to accelerate the economic development of the underdeveloped areas of the world;
3. to prevent the international propagation of fluctuations in effective demand (ibid. p. 87 para. 183).

One of the key recommendations was that the World Bank should be authorized to borrow from governments and to make loans to governments for the purposes of general development, as distinct from project loans. This recommendation foreshadowed the World Bank's so-called policy-based lending of today, but Lord Kaldor did not favor the kind and degree of conditionality currently applied to such lending by the Bank.

With regard to preventing the propagation of a cumulative process of economic contraction, the report recommended that each country should undertake to stabilize its own external currency disbursements on current account in the event of a decline in its own demand for foreign goods and services. This could be achieved in part through measures to stabilize the prices of basic commodities in terms of national currencies. In addition it was recommended that

> 'each government should accept the responsibility, within a permanent and systematic international scheme, of replenishing the monetary reserves of other countries concurrently with, and to the extent of, the depletion of those reserves which results from an increase in its own reserves induced by a fall in its demand for imported goods and services, in so far as this fall is caused by a general decline in effective demand within its own country' (ibid. pp. 95–6, para. 202).

This scheme was to be operated by the IMF.

The specific modalities of this scheme were less important than the fact that it called for far-reaching measures of inter-country cooperation of a kind that was not yet in evidence at the time of the report but which are somewhat more realistic in terms of the international relationships and interdependence of today.

Alongside his concern with problems of full employment and economic growth in the industrial countries, Lord Kaldor applied his extraordinarily creative mind to the problems of developing countries. It was natural that he should have found himself very much in sympathy with the structuralist school that was active in the Economic Commission for Latin America under the leadership of Raul Prebisch. In 1956, Prebisch invited Professor Kaldor to spend three months with the Commission in Santiago, a visit that was extremely productive for all concerned. Professor Kaldor delivered a series of lectures on economic development to the Commission staff that provided a starting point for deep discussion of ECLA's theoretical and practical work, notably on growth, inflation, and domestic and external constraints. As an example of his own approach to these problems, he undertook a study of the economic development of Chile that Prebisch and his staff found completely congenial. As the conclusion of this study pointed out, no lasting cure of the inflationary tendencies of Chile could be found either in stricter monetary and credit policies or even in administrative reform which secured more effective taxation of the upper classes. 'The lasting cure for the inflation', wrote Professor Kaldor (1964 p. 277), 'can only be found through a more rapid increase in food availabilities – either through a more rapid increase in the productivity of agriculture (which in turn hinges upon the reform of land tenure) or a more liberal policy of importing foodstuffs from abroad.'

Professor Kaldor also gave his support to the terms of trade theory that had been advanced by Prebisch. There was, and still is, a certain tendency in the economics profession to take a somewhat condescending attitude towards the Prebisch thesis, on the grounds that his statement of the thesis allegedly lacked rigor, or that his analysis of the historical facts was mistaken. Professor Kaldor swept all this aside. In a paper on the terms of trade written for the Latin American Commission in 1963 (1964, pp. 112–15) he pointed out that the sellers of primary commodities suffer from two important handicaps in comparison with the sellers of manufactures. The first is that, by and large, the primary producers are 'price-takers', whereas industrial producers are 'price-makers'. A fall in demand for manufactures leads directly to a reduction of output, while any reduction in prices occurs only indirectly and incidentally. A fall in demand for primary commodities, on the other hand, leads directly to a fall in prices and only indirectly to a restriction of output in so far as producers are induced to lower their output.

The second handicap suffered by primary producers is that, while the benefits of technical progress in manufacturing are largely retained by the producers in the form of higher real wages and profits, the benefits of technological progress in primary production are largely passed on to consumers in the form of lower prices. These factors were responsible for the downward trend in the terms of trade of developing countries. Professor Kaldor therefore advocated international agreements for the regulation of the export and production of primary commodities.

Only a few months separated the Kaldor paper on the terms of trade from his collaboration with professors Hart and Tinbergen on a paper for the first conference of UNCTAD held in 1964. The paper was entitled 'The

Case for an International Commodity Reserve Currency' (1964, pp. 131–77). What had happened during the months between the writing of the two papers was that on going into the matter further, Professor Kaldor had come to the conclusion that no scheme of quantitative export regulation was likely to succeed for more than a temporary period, because without some built-in mechanism for changing the distribution of export quotas in favor of low-cost producers, any agreement was likely to be exposed to steadily increasing stress which would cause it to break down sooner or later.

One of the most startling and engaging characteristics of Lord Kaldor as a person was his readiness to change his mind without a moment's hesitation if he encountered new evidence that appeared convincing. One never felt with him, as with other people, that once his mind was made up there was no point in arguing. He was very formidable indeed in argument, but even when he was at his fiercest, one always felt that he was open to persuasion. He later decided that even the joint paper on the commodity reserve currency did not really provide a practicable approach, and he therefore changed his mind again and adopted a modified form of the proposal that was more in line with the International Commodity Control proposed by Keynes.

Since Professor Hart is delivering a separate paper on the proposal for a commodity reserve currency, I shall not trespass on his territory, especially since he was a co-author of the proposal. There are, however, two points of a general character that need to be made in the present context.

The first is that it was a critical element in Lord Kaldor's approach to the subject (1983) that a commodity reserve currency, or a commodity stabilization scheme financed by SDRs, would lead to the stabilization not only of commodity markets but of the world economy as a whole. It would, moreover, secure the highest sustainable rate of economic growth for the world as a whole – i.e. the highest rate of world industrial expansion that the growth of supplies of primary products would permit. This would occur because if primary products were in excess supply there would be an increase in investment in stocks of these commodities that would generate a corresponding increase in the rate of growth of demand for industrial products; the converse would hold true in case of a shortage of primary products. In his view, moreover, it was not labor or capital that was the ultimate constraint on growth but the supply of primary products, and stabilization of the commodity markets would encourage the maximum expansion of commodity output.

The second point is that Lord Kaldor had been sceptical all along about the viability of an international paper currency without commodity backing. Although this was one of the few issues on which his thinking about the international monetary system was ultra-orthodox, it was not because he himself saw any theoretical necessity for commodity backing. But he foresaw, quite correctly, that the world's bankers would never feel really comfortable with an unbacked paper currency at the international level, and that they would prefer to hold one or more of the key currencies such as the dollar. On this he proved to be absolutely right, and the Group of Ten has now openly raised the question whether the SDR has any future at all as an international reserve currency. This is despite the solemn commitment of governments in the IMF Articles of Agreement to cooperate with the Fund in making the SDR 'the principal reserve asset in the international monetary system' (Article XXII).

Lord Kaldor was very critical of the IMF for its stabilization policies and particularly for the methods by which IMF programs were and are determined. For anyone who is familiar with his extensive writings on monetarism, the nature of that criticism would not come as any surprise. For him, the monetary approach to the balance of payments employed by the Fund was anathema, as was the pinpoint monetary targeting involved in IMF conditionality. He recognized, of course, the attraction of being able to set straightforward performance criteria in the form of precise monetary targets that could be readily monitored by the IMF. He could even sympathize with the idea of establishing as objective a basis as possible for determining whether member countries that had entered into stand-by arrangements with the Fund were performing sufficiently well to qualify for the successive phased drawings on lines of credit set up by the Fund under these arrangements.

But Fund programs needed more convincing justification than that of convenient targeting. The wellbeing of entire communities was at stake, and this should not, he felt, become a hostage to the monetarist fallacy.

Lord Kaldor's sympathies were therefore on the side of the Group of Twenty-four, the developing country caucus in the IMF. He was always ready to place his time and efforts at the disposal of the Group of Twenty-four, and he was sorely missed by the Group when they came to work on their recent report, published in June of this year, on "The Role of the IMF in Adjustment with Growth." The Group had hoped to meet with him, but that was not to be. Although he was not directly involved in the preparation of that report, the influence of his past thinking and writings is apparent.

His last major paper for the Group of Twenty-four was submitted in April 1982 and was entitled 'The Role of Devaluation in the Adjustment of Balance of Payments Deficits', (Dell, 1987, pp. 557–67). The paper is included in the second of three volumes recently published by North-Holland containing the complete collection of the Group of Twenty-four papers up to 1986. It is a short but highly instructive paper that is almost impossible to sum up briefly. One of his main points is that the justification for devaluation depends on the assumption that it is capable of changing the critical price and wage relationships within a country in an effective manner, even when domestic fiscal and monetary policies are incapable of bringing about these results. But, as Lord Kaldor points out, it cannot be taken for granted that the internal distribution of income, which is the outcome of complex political forces, can be effectively changed by devaluation. It is more likely that a large-scale devaluation will cause an internal price upheaval (at the cost of a great deal of additional inflation) which will end up by reproducing much the same price relationships – between prices and wages and between internal and external prices – as prevailed before the devaluation.

I am painfully aware of the fact that there is much that I have had to leave out of this brief account. Although the studies of Lord Kaldor's efforts to promote tax reform in the Third World are extraordinarily rich in their insights into the problems of these countries, it would have been all but impossible to attempt to sum them all up. Moreover, Lord Kaldor himself had done the job in his Introduction to Volume I of his *Reports on Taxation* (1980), and had left little room for anyone else to add to what he said there. If he felt any temptation to gloss over the obstacles and frustrations that his efforts had encountered, he rejected that temptation completely. "While I have not changed my views on the analytical plane', he writes, 'I have become far more sceptical of the possibilities of improving the distribution of income and wealth through taxation, or of introducing effective reforms when these are perceived, in anticipation, as affecting adversely the interests of the property-owning classes.' It is a sobering conclusion that illustrates, once again, Lord Kaldor's scrupulous honesty with the reader and with himself.

When future generations look back to this period and the struggle of the Third World to throw off centuries of underdevelopment, Nicholas Kaldor will always be remembered as having been in the front rank of those who challenged the complacency of the conventional wisdom and who pointed the way forward to overcoming hunger and poverty throughout the world.

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32 Capitalism, Socialism and Effective Demand

Edward Nell

Comparing capitalism and socialism, it is important to remember that no actual economy is purely one type or another: all are mixtures bearing traces of their national histories, international relations and political compromises. Nevertheless, analytical study is best carried out at an abstract level in terms of pure types; prominent features of actual economies will be identifiable as belonging to one system or another and the logic of these features can be traced in the abstract system of which they are a part, where they have free play and full scope. We will treat capitalism and socialism as such abstract systems, and in doing so will draw on a central theme of Kaldor's later years, the distinction between 'demand-constrained' and 'resource-constrained' systems, developed implicitly by Kalecki, but first explicitly defined by Kornai. This distinction requires replacing the scarcity-based theory of value with a Classical approach in which manufacturing prices are largely invariant to changes in demand.

Since this chapter was first drafted the Berlin Wall has come down and real world socialism collapsed with it. What will emerge in the former socialist states is likely to differ from Western capitalism and will certainly not resemble what flourished, if that is the word, behind the Wall. Yet the theme of this chapter may still be pertinent, for the relation between demand and capacity is likely to differ between capitalism and any form of socialism.

DEFINITIONS

A capitalist economy is one in which some own the means of production while others do not; capitalist production generates a surplus through the employment of wage labor, and competition establishes a common ratio of surplus to the value of the means of production used. This is the rate of profit, and every capitalist system is characterized by a 'normal' rate of profit, (expressed in the rate of interest on money) which makes it possible to calculate the 'amount of capital' in any sector or industry by capitalizing its net income stream. On this basis, therefore, economic activities can be bought and sold. Capitalist enterprises compete with one another, and liquid capital funds conferring ownership of or claims against such enterprises will actively seek out those with the highest rates of return. Hence there is constant pressure to increase the surplus – i.e., to raise productivity.

Under capitalism the ownership and distribution of wealth is given, and the system generates pressure to operate the means of production most efficiently (productively). By contrast, under socialism the efficiency and productivity of the means of production are assumed, but private ownership is abolished and the system seeks to distribute the gains most fairly, taking account of both the general interest and the interests of all. Ownership is vested in bureaucracies supposedly representing the general interest,[1] run in accordance with an overall plan, and income is distributed in proportion to productive contribution, modified by subsidies to those with special needs. Investment is planned to bring about balanced growth at the highest rate consistent with planned consumption. Job security and a basic standard of living are guaranteed to all. Capitalism is regulated by prices and the rate of profits, socialism by quantities and the rate of growth.

Both capitalism and socialism are essentially monetary systems: capitalist profits do not count until they are realized in money and socialist incomes must be both paid and spent, before any judgement of fairness can be rendered. Since prices are realized in money, in neither system does the money wage – fixed by the wage bargain in the labor market – therefore determine the real wage. In both systems production and distribution are carried out at least partly through market processes – wages are paid and spent, accounts are kept of purchases and sales – although the markets work differently, and the socialist markets are not competitive. Further, in both systems production is largely concentrated in the hands of giant bureaucratic organizations, with easy access to funds and well placed to lobby the government. And in each a privileged class or stratum can be identified.

These similarities and differences in the organization of production are fundamental, but do not explain many of the most obvious contrasts between the systems. For this we have to consider each system's characteristic mode of operation – in particular, the way each builds and uses productive capacity. The contrast begins at the most basic level: under capitalism it is a strategic individual decision (made by each firm and dictated by competition) that the firm must carry an appropriate level of reserve capacity. Under socialism, it is a collective decision (dictated by the goals of the program) that all available capacity must be used to the fullest. Each aspect of this contrast must now be explored.

DEMAND IN RELATION TO CAPACITY

Capitalism is competitive, so firms must build and carry extra productive capacity for precautionary or strategic reasons; a firm must be able to keep up with its competition, so when markets are growing rapidly, it must be able to expand production (and also capacity) to keep pace. If it could not, but its competitors could, it would lose its market share, while the competitors would reap economies of scale, leaving it a relatively high-cost producer. (In a slowdown, firms must take care in cutting capacity, lest they suddenly need it again.) Markets also fluctuate: a firm that holds its capacity to the level of average demand will be unable to service peak demand and will lose customers to those who can deliver at any time. Markets grow irregularly and firms must be poised to take advantage of new openings, especially since idle capacity can be adapted to turn out product variations for new or specialized markets. If some carry such capacity and others do not, the carriers will have an advantage at the expense of the others. Firms with reserve capacity will be able to adapt it and plunge right into the new venture; firms without any reserves will be able to enter only after completing a construction project. Firms with reserve capacity can adapt the reserve plant to new product design, while continuing to serve their normal market with the old; firms without reserves will have to shut down their operations to adapt. Competition for market shares thus requires carrying reserve capacity. (But firms will keep inventories and stockpiles trim, adjusted to current demand levels.)

Reserve capacity, however, is not *excess* capacity; yet it is the latter that is implied. Competitive planning on the part of each firm requires it to choose the amount of reserve capacity needed to defend its desired market position – the largest share it can reasonably hope to secure and defend. Each firm will thus select and build reserve capacity, and the aggregate level of reserve capacity will be the sum of these plans. But only some firms will achieve their desired market positions – winners imply losers – and the rest will be carrying too much capacity.[2]

Under socialism, by contrast, the Plan will normally try to meet large objectives with limited resources; it will try to reconcile competing claims by assuming that output can be expanded. Hence there will be pressure both to produce at full blast from existing capacity and to increase productive capacity as fast as possible. Given these pressures, enterprises will be chronically short of capacity in relation to total demand and, fearing shortages, will stockpile raw materials, inputs, equipment, and other supplies.

Each system thus operates in a characteristic manner. Capitalist competition calls for reserve capacity, whether to seize an opportunity or to repel a market invader; but such capacity must be matched by reserve labor, which can be mobilized quickly. Otherwise the extra capacity will prove useless and the costs of carrying it wasted. However, hoarding labor would be prohibitively expensive; instead the system itself tends to generate a labor reserve through regular increases in productivity, combined with a tendency to weakness in aggregate demand. Such reserves make it easier to keep wages within bounds and to maintain labor discipline. Further, the smooth functioning of the system depends upon labor's willingness to accept capital's decisions about employment, job definitions and working conditions; the existence of reserve labor strengthens capital's hand. Given widespread reserve capacity and labor, however, investment will normally be held back until an innovation, providing a competitive edge, can be introduced.

Socialism, on the other hand, is committed to meeting everyone's needs, and so requires a full effort in current production; no reserves can be held back. Such an effort makes it easier for the authorities to grant increases in pay and to support efforts to expand in all spheres – moves which strengthen the hand of authority and improve its image. It also means that capacity will appear insufficient everywhere; investment will therefore be called for throughout the economy.

Stating the contrast schematically, under capitalism money wages will tend to be kept as low, and prices as high, as possible; under socialism, wages will tend to drift as high, while prices will be held as low, as possible.[3] Capitalism constrains real wages, in order to increase profits; socialism lets them expand in order to achieve social objectives. Under capitalism, investments must be withheld until the time is ripe; under socialism, investment must be pushed forward as rapidly as possible. Given this pattern of investment, and that real wages largely determine consumption, aggregate demand in capitalism will tend to lie below, and in socialism above, productive capacity.

In the Kaldor–Kornai terms noted earlier, capitalism is 'demand-constrained' – i.e., productive capacity will normally exceed aggregate demand; whereas socialism is 'resource-constrained' – meaning that aggregate demand will normally exceed productive capacity. The two systems work differently, and set up different incentives.

CHARACTERISTIC INCENTIVE PATTERNS

Each system's mode of operation sets up characteristic incentive patterns, which fit together into a definite style and tend to reinforce the initial condition of demand excess or scarcity. To begin with growth: under capitalism the presence of near-universal excess capacity (required as a strategic reserve for competitive reasons) dampens the inducement to invest, in the absence of technological improvements. Capitalist economies tend to build capacity sluggishly, punctuated by strong bursts of expansion, usually stimulated by innovation. Weak and/or uncertain investment, in turn, tends to keep capacity utilization low. By contrast, under socialism, near-universal shortages, engendered by the attempt to run all productive processes at full potential, strengthen the inducement to invest, which in turn further intensifies the pressure of demand on capacity. Socialist economies build capacity rapidly and regularly, but fail to innovate or to produce high quality. Output growth in capitalism chiefly comes from technical progress, in socialism from adding capacity.

A shortage of demand in relation to capacity tends to intensify competition; sales are uncertain since demand is less than capacity – a firm's market could always be lost to competitors. Hence cost-cutting and quality enhancement will be important – perhaps competitively necessary – to attract and keep a share of the limited market. Technical progress in regard to both products and processes is therefore stimulated by the characteristic situation of capitalism, and accounts for a large part of the growth of output.

Such technical development will be of the kind analyzed by Adam Smith and Charles Babbage – separation of function and division of labor. Tasks and designs are simplified, clarified, broken down and made more precise, so that tasks and skills are carefully matched and products fit proposed uses. Expensive skilled labor/equipment will not be used for tasks that unskilled workers can perform; this follows from demand shortage and from uncertainty. Costs must be kept down, in order to compete for the scarce demand; products not adequately designed for their proposed uses will not be competitive.

By contrast, the excess demand characteristic of socialism means that neither product improvement nor cost-cutting are necessary to make sales; indeed, sometimes good quality is not even required. When shortages are severe enough, practically anything will be absorbed by the market. But generalized shortage sets up pressure for innovations that can meet several needs or perform several functions at the same time – two birds with one stone. In the face of chronic shortages, jobs must be accomplished without the proper tools or materials, which provides an incentive for redesigning products and equipment, and redefining jobs; equipment and work teams must be adapted to multiple functions. So technical progress takes the form associated with the Pentagon:[4] functions are combined, rather than separated, and tasks are multiplied instead of divided. These innovations are often admirable – Swiss army knives, vegematics – but they seldom reduce costs in the long run, for a breakdown in any one function usually incapacitates the whole, so that all functions must be scrapped or shut down for repairs. Thus as functions are added, breakdown/repair costs are *multiplied*.

Similarly, since a shortage of demand means competition for sales, costs must be kept down by driving hard bargains. Companies will therefore ride hard on money wages; for the same reasons they will try to keep other material and input costs down. Moreover, they will insist on quality for money, since sloppy work or poor quality inputs can mean uncompetitive, unsaleable products. Socialist enterprises, on the other hand, do not feel such pressure to keep costs down and quality high. Even with declining quality they can sell their products, and rising costs, though a nuisance, will seldom interfere with the enterprise's plans for expansion, since given the widespread shortages, virtually any reasonable expansion plan will be approved: neither prospective nor realized profitability governs or constrains investment. Capitalism hands out harsh penalties – too liberally, for they fall on many who do not deserve them; socialism hands out easy rewards – also too liberally, for they accrue to many who have done nothing to deserve reward.

These arguments must be treated carefully: it does not follow that capitalism will generate progress and turn out high quality goods, while socialism will stagnate, drowning in junk. Producing high quality goods is one important way of competing; introducing marketable innovations is another. But producing cheap goods with hard-to-detect flaws is also a good strategy, as is covering up dangerous defects, pandering to unhealthy desires, building in obsolescence, and distributing advantageous misinformation through advertising. Socialist enterprises must meet Plan requirements and deadlines, but are under no competitive pressures to sell. Hence, although they may let quality decline and costs rise, for example, Socialist publishers can concentrate on culturally significant works, rather than best-sellers. Socialist medical care could be delivered to those who need it, rather than those who can pay for it – although it might arrive too late. The contrast may be less between high and poor quality goods than between, say, classics that fall apart and are delivered late, and swiftly produced, elegantly marketed trash.

At the risk of generalizing too easily, the argument can be put schematically: under capitalism waste is generated by 'commission,' by actions deliberately undertaken – to produce unnecessary or harmful goods, to add unnecessary features to products, to take expensive but socially wasteful actions to sell, market or promote. By contrast under socialism, waste is generated by 'omission,' by actions deliberately left undone or overlooked or neglected – failing to control costs, keep discipline in production, keep a check on quality, distribute effectively, inform the market adequately, and so on. Socially wasteful goods that sell, or activities that promote sales, are not penalized under capitalism – but failure to sell is; omitting to control costs and quality is not penalized under socialism – but failing to meet the production quota is.

Technical progress in capitalism takes the form prescribed by Adam Smith and Charles Babbage – separation of function, and division of labor; costs are cut and productivity enhanced. Socialist conditions, however, imply shortage of capacity rather than demand, and the incentives to technological innovation differ accordingly. Technical progress takes the form of combination of function and tasks are multiplied, rather than divided. Everything becomes more complex – and breakdowns more expensive.

MULTIPLIER ANALYSIS

Now let us compare the economic working of two industrial economies, each using mass production technologies, but one mode of operation being capitalist, the other socialist. Products and productive equipment are standardized. Worker skills are required, though jobs are also standardized, and the pace of work is set by the machinery; costs are kept down and economies of scale are realized by large plants and long production runs. Prices have to cover current production costs and contribute to meeting the fixed monetary costs incurred in setting up the mass production plant. In both systems normal or long-run prices of manufactured goods will be inflexible, determined by reproduction costs and a mark-up. The differences will lie in the way the mark-up is set. Costs and outputs of primary goods (non-produced means of production and basic consumption – farm and fish products, minerals, raw materials, oil, etc.) will fluctuate in both systems, leading to temporary market price changes in capitalism and variations in subsidies in socialism. In neither system, however, do prices reflect relative scarcities.

Prices are important, however, and they serve a significant economic function – the same in both systems. At their normal levels they reflect the requirements of reproduction and distribution; when exchanges take place at the correct long-term prices, distribution will be accomplished and reproduction will be made possible. Let A be an input–output matrix, L the vector of labor input, p, the price vector, r, the rate of profit and w the real wage. Then, if A has certain properties

$$p = (1 + r)Ap + wL$$

will give the prices and the rate of profit, if the normal or long-run real wage is determined by bargaining, custom and social pressures.[5]

Such prices would not normally be affected by aggregate shortages or excesses, nor would variations in them tend to correct such aggregate imbalances. (Hence the claim that aggregate demand imbalances are due to price or wage 'rigidities' cannot even be entertained.)

In a capitalist industrial economy additional investment spending increases employment in the capital goods sector, leading to an increased wage bill, the proceeds of which are then spent on consumer goods, leading to increased activity in their production: investment spending thus causes consumption spending to move in the same direction. But the reverse does not hold; a decline in consumption spending need not always have the same – or, indeed, any – general effect on investment.

In a socialist industrial economy additional investment spending means intensifying the excess demand for capital goods. Since in general changes in the intensity of excess demand lead to attempts to change output in the same direction, when excess demand for capital goods increases, overtime work will rise, equipment will be overworked more, breakdowns and accidents will rise, etc. All these effects imply additional wage income, the spending of which will further increase the demand pressure on consumer goods. Changes in excess investment demand thus generally cause changes in the same direction in excess consumer demand. But as in capitalism, a decrease in excess consumer demand need have no effect on excess investment demand. Suppose, for example, that a rise in consumer prices relative to fixed money wages caused excess consumer demand to fall to zero; no productive capacity would thereby be released which could be transferred to the capital goods sector. (This point will be important when we come to the question of reform in socialism.)

In both capitalist and socialist economies the principal injections into aggregate demand are gross investment, I, current business spending (energy, consumption by overhead labor, office expenses), B, government spending, G, and exports, E. To get total demand these injections (measured in normal prices) must be multiplied by an expression which takes account of taxes, imports, saving out of wages, the wage rate and the productivity of labor (Nell, 1988, Ch. 5, Appendix). Let the coefficients be $t = t(w)$, $m = m(w)$, and $s = s(w)$, where these show the additional taxes, imports and savings that take place when aggregate income (output) increases as the result of additional employment, prompted by additional demand. Hence they are each positive functions of the real wage: even if the marginal tax (import, saving) ratio to individual income were constant, a higher income would mean higher taxes (imports, savings) when an individual changed from unemployed to employed. Moreover, there are good reasons to think that all three may be progressive in both systems. Hence aggregate demand can be written:

$$[I + B + G + E].\ 1/\{1 + t + m - (1 - s)\ wn\}$$

where t, m, and s are all increasing functions of the real wage, w.

Aggregate productive capacity is given by the capital stock, measured at the given normal prices, multiplied by the productivity of the system. This last depends on the normal average ratio of capital stock to the labor force, and on the number of workers required per unit of output, on average. Aggregate capacity can therefore be written very simply:

$$K.\ 1/(k.n)$$

where K is the total capital stock, k is required capital per worker, and n is labor force per unit of output. Both these coefficients must be measured at established or normal prices.

Now consider these expressions in the light of the earlier discussion. Characteristically, capitalism will find itself with excess capacity, socialism with excess demand (Nell, 1988, Chs 5, 8). Hence,

For capitalism:

$$[I + B + G + E].\ 1/\{1 + t + m - (1 - s)\ wn\} < K.1/\ (k.n)$$

For socialism:

$$[I + B + G + E].\ 1/\{1 + t + m - (1 - s)\ wn\} > K.1/\ (k.n)$$

However, care must be taken interpreting these, for they are not the same. When demand > capacity, the multiplier cannot work properly because additional workers cannot so easily be hired, although existing workers can work overtime and sometimes additional shifts can be added. But the rate at which wages are paid and respent is likely to change as output rises above capacity. With this in mind let us compare the two.

Under capitalism, the existence of excess capacity requires firms to compete for the scarce demand, by cutting costs and improving products. Hence n will tend to decline, increasing the expression for aggregate capacity, while reducing the multiplier. The gap between capacity and demand thus tends to widen. However, competition may force firms to increase w in proportion to the decline in n, offsetting the impact of increased productivity on the multiplier. But t, m, and s are all increasing functions of w; hence the multiplier will still tend to decline and the gap widen. In any case, however, if overall productivity increases by x per cent, the new level of income is $(1{+}x)Y$; if wages rise in proportion and are wholly spent on consumption, its new level will be $(1{+}x)C$. So the new level of demand will be $I + (1{+}x)C < (1{+}x)Y$; excess capacity increases.

The competitive pressures arising from demand scarcity will tend to reduce normal investment and business spending – or at least increase their variability. Rising productivity increases capacity under conditions in which excess capacity already exists; this will dampen I. Increased efficiency in the use of energy, labor and materials will cut into B, and as superior or more cost-effective equipment designs become available (so that k falls) the reductions will affect I and G as well. Exports are affected in the reverse way: if product or equipment designs improve, and costs are cut, then exports become more competitive and may increase; otherwise, the pressures tend to reduce each of the major injections, intensifying stagnation.

This pattern is reversed under socialism. Excess demand – a state of generalized shortage – creates incentives to push production to the extreme. The basic ambitions of the system require pushing production to the limit, and there are inbuilt tendencies leading to further excess. Demand pressure can arise from the attempt to establish fair levels of pay and appropriate differentials, especially between different ranks in both enterprise and state hierarchies. Fairness requires granting regular pay increases when productivity permanently improves as a result of worker efforts; but if a certain kind of blue-collar pay increases in pace with productivity growth, relativities and hierarchical differentials will be eroded, and to preserve them the pay of other workers, including management and white-collar pay, must rise. Localized increases in productivity can thus give rise to generalized increases in pay, and consequently in consumer demand.

This can take other forms. New capital goods are normally more productive than old. Productivity thus rises as a function of investment; however workers using the new and more productive goods are normally exercising the same skills, often in the same jobs, as workers in the old. Fairness therefore demands that they be paid the same. If pay rises with productivity for workers using the new goods, and then, out of concern for fairness, rises for workers using the old, demand will increase more than productivity.

As a consequence of demand pressure, bottlenecks develop, older and outmoded facilities are utilized, workers put in longer hours and make more mistakes, so that productivity falls – i.e., n rises. As facilities are pushed harder, previously retired equipment will be brought back into production, and inappropriate equipment will be adapted, all of which will tend to raise capital used per worker, k. (This is very much in line with the traditional view that costs rise as production facilities are pushed beyond a certain limit). Hence, as k and n rise, aggregate capacity declines, while the increase in n raises the multiplier, expanding aggregate demand; both effects tend to widen the gap.

Scarcity of demand in capitalism promotes product improvement: a better mousetrap attracts the market. Excess demand – generalized shortage – on the other hand, implies a seller's market leading, after a time, to product deterioration and to delays and inefficiency in services. Product improvement/deterioration is often represented as an increase/decrease in the productivity of inputs, which here would be a further decline/rise in k and n, compounding the effects already noted.

As in the capitalist case, both the presence of the gap and the tendency for it to widen, due to its effects on productivity, will lead to pressures on the spending plans of enterprises. Shortages of capacity in relation to demand are a signal to increase the pace of investment spending, to try to bring new capacity on line as fast as possible. Shortages of inputs will lead enterprises to stockpile inventory. Inefficient operation will lead to larger than necessary business expenses; hence both I and B will increase. The same will hold for G: in the face of generalized shortages and inefficient operation, the government will have to increase its activities, expand its facilities and stockpile scarce items. Again, the impact on exports will be different. If costs rise and the quality of goods declines, exports will tend to fall. By the same token, the propensity to import is likely to rise. Moreover, if selling is easy in the domestic market, but competitive internationally, enterprises will prefer to focus on the domestic scene.

For closed economies, then, in capitalism the tendency to stagnation is reinforced by competition, while socialist markets tend to intensify shortages.[6] Capitalist pressures tend to stimulate technical progress in the form of cost-cutting and product improvement; socialist pressures tend to foster inefficiency, cost-overruns and quality deterioration. Capitalist economies deliver services to those with money – which tends to create a buyer's market; socialist economies to those with need – a seller's market. So, again, the quality is better under capitalism. For open economies, these conclusions must be modified by noting that the effect on exports (and perhaps imports) will tend to run in the opposite direction in each case: capitalist incentives stimulate exports, socialist ones weaken them. Neither capitalist nor socialist systems are *radically* unstable; capitalism tends to stagnate, socialism to run shortages, but both tendencies meet countervailing pressures and stay within limits. One source of such pressures is external trade, but others can be found within the domestic economy itself.

THE ROLE OF THE INFORMAL SECTOR IN THE TWO SYSTEMS

Informal Sector Activities

Under capitalism if the level of demand falls too far below capacity activity can be expected to increase in the 'informal sector.' This phrase covers the provision of illegal products and services – drugs, liquor, tax-free cigarettes, prostitution, gambling, etc. – but also the production of basic goods and services on an ad hoc basis, usually using an earlier technology, and traded in barter. In a severe slump, activity in the informal sector will tend to rise, providing subsistence and additional income for the unemployed or partially employed. Such increased activity results from efforts by workers and entrepreneurs to search out and service latent demand: the initiative comes from the supply side. Insofar as these efforts attract money that would otherwise have been saved or put into financial speculation they clearly add to effective demand and therefore tend to offset stagnation. (Since informal sector activities tend to be highly labor-intensive, even when spending on them displaces other goods, demand will be boosted, since the multiplier in the informal sector will be higher.)

In socialism, by contrast, as shortages intensify, unsatisfied demand will look for new channels, and a black market can be expected to develop in strongly needed services and goods, which will divert activity and resources into the most profitable channels. Since enterprises are in the best position to do this, the emergence of the black market may help to overcome serious production bottlenecks. Improvements and innovations may also be generated, both increasing productivity and absorbing demand. The initiative here comes from the demand side. The informal sector in socialism will thus also move countercyclically, tending to limit the intensification of shortage.

One interesting contrast should be noted. Although the informal sector in capitalism arises in part as a response to conditions of scarce demand, it is itself (at least its illegal part) a seller's market: Consumers take what drugs, cigarettes, etc. they can get – they are not in a position to shop around, the police see to that. A contrasting symmetry can be seen in socialism. The black market arises in response to generalized shortage, but is itself a buyer's market. Unless the quality is good, no one will take the risk of buying illegally.

Self-Employment and Enterprise Labor Markets

In both systems the informal sector is a special case of 'self-employment,' which must be understood in relation to the predominant enterprise or corporate labor market. Self-employment means working with small-scale technology and high fixed real costs (including self-/household consumption needs). Variable costs will generally be low. Thus when demand is high, so that prices drift up, (lowering real wages in corporate employment), unit costs will be low due to the large volume and earnings will be significant. Self-employment will respond positively to demand; hence a shortage economy provides a generally favorable environment, but for the same reasons in reverse, demand scarcity will be disastrous. This needs to be explored more closely.

In both capitalism and socialism, operating with given techniques, the enterprise labor market will be dominated by movements in aggregate demand. The influence of the real wage on employment comes through the effect of wages on consumption spending – higher real wages permit higher consumption causing higher employment in the consumer industries and in their suppliers. The basic relationship is the multiplier, which, simplified, can be written as[7]

$$N = n/(1-wn)\mathrm{I}$$

Here we group B with I, assume all wages are spent, and neglect govern-

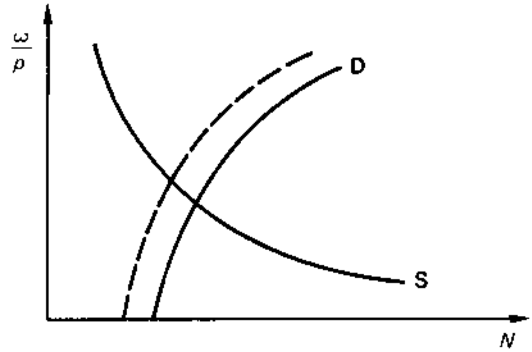

Figure 32.1 Capitalist enterprise labor market

ment and the rest of the world. Taking n and I as fixed, let w vary and consider the effects on N:

$$dN/dw = In^2 / (1-wn)^2 > 0$$

and

$$d^2 N/dw^2 = 2In^3 / (1-wn)^3 > 0$$

Increases in w increase employment, and the higher w is initially, the greater will be the impact on N of a given change in w. The real wage–employment relation is therefore a curve rising from a positive intercept (nI, when $w = 0$) to approach the maximum w, $1/n$, asymptotically.

Now consider supply. Assume that households are determined to maintain a certain conventional standard of living. At high wages, the breadwinner will work a normal work week; at lower wages, he will put in for overtime, then add a part-time job. At still lower wages, other members of the family will enter the market, first for part-time, then for full-time work, and so on. In the extreme case the curve will be a rectangular hyperbola where proportional cuts in the real wage will just be matched by proportional increases in the hours of work offered. Putting these two curves together gives just the opposite of the conventional picture: a rising demand for labor and a falling supply (Figure 32.1). A change in the level of investment spending will shift the labor demand curve; a lower level of I creates unemployment, and to eliminate this will require a *rise* in the real wage; similarly a higher level will require a fall. Clearly such a labor market will not be able to adjust so as to eliminate unemployment.[8]

Self-employment under capitalism comes under pressure whenever demand is weak, because of the danger of not being able to meet fixed costs. In a slump, however, when legitimate opportunities have dried up, there

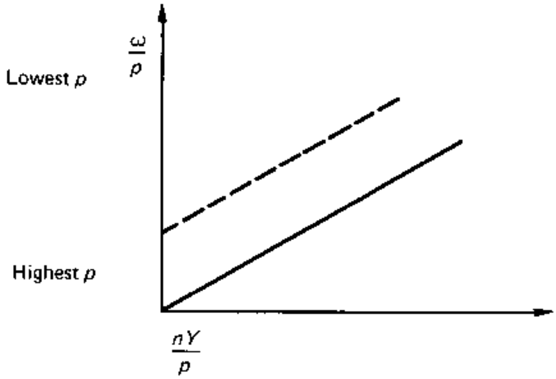

Figure 32.2 Socialist enterprise labor market

may be a shift into extra-legal self-employment, where unsatisfied demand can still be found. The risks inherent in such activities will be made more acceptable by the absence of alternatives.

The enterprise labor market in socialism likewise has no tendency to adjust easily. Given that the economy is operating under shortage conditions, the multiplier mechanism will be partially inhibited, since employment levels cannot easily vary. Nevertheless there is a positive relationship between the real wage and the demand for labor. Starting from a given level of (excess) aggregate demand in money terms and a given money wage, allow for a progressive relaxation of price controls. As controls are weakened, prices rise and the real wage falls. With higher prices, fewer items will be bought for the same monetary expenditure, and so fewer (additional) workers will be needed; thus as prices rise (real wages fall) the excess labor demanded declines. In Figure 32.2, the line rises from left to right, starting to the right of the origin, but because the multiplier is inhibited, it will not have the curvature of the capitalist function.

However, this does not necessarily imply a diminishing of the labor shortage. For the willingness to supply labor must also be considered, and this, in turn, depends significantly on the relationship to the black market. Putting this in terms of demand pressure, when the black market is strong (aggregate demand at a peak) workers will tend to opt for self-employment, but when it is weak they will devote their time to normal enterprise activities. Thus when demand rises (shifting the labor demand function to the right), money prices will also be driven up, so enterprise real wages will fall and the labor supply will shift from enterprises towards self-employment; hence enterprises will face an increased labor shortage, even though the overall goods shortage may decline. When demand weakens, prices will tend to fall back to normal, real wages will be high and

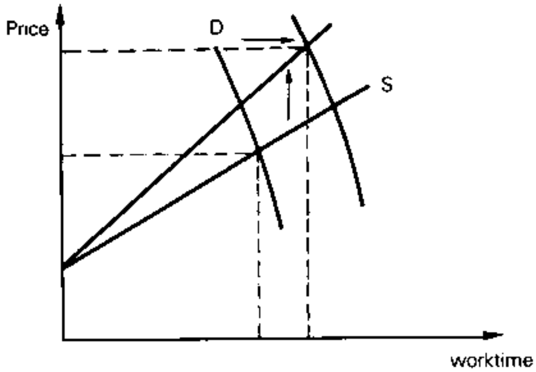

Figure 32.3 Capitalist boom

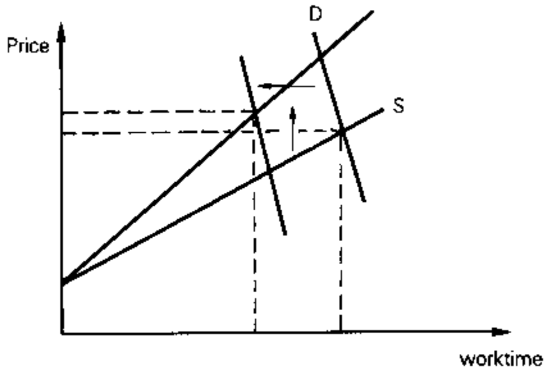

Figure 32.4 Capitalist slump

the labor supply will tend to return to enterprises, although the shortage will remain.

This can be seen in a set of diagrams (Figures 32.3 and 32.4). Plot the price of the service or product of self-employment against the worktime and effort. (This is demand for a commodity, not for employment, in contrast to the enterprise labor market, with which self-employment interacts.) Demand will be largely price-inelastic over a significant range; supply, on the other hand, will rise from some positive price. Now let us look at what happens in booms and slumps, first in capitalism, then in socialism – bearing in mind that in a capitalist boom demand still remains below capacity, just as it stays above it in a socialist slump.

In a capitalist boom the inelastic demand curve for the output(s) from self-employment will shift out, while the general pressure of demand, creating attractive jobs in the corporate sector, will cause the self-employment supply function to swing upwards (Figure 32.3) – that is, to

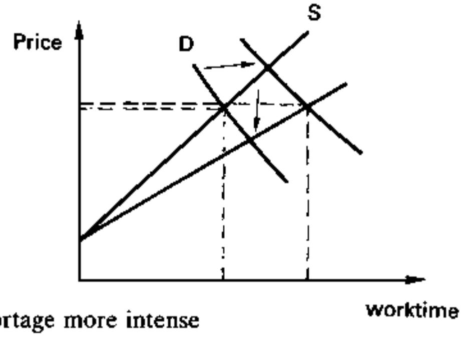

Figure 32.5 Shortage more intense

call forth any level of self-employment effort, the price of the product must increase by a given percentage, this being a function of the expansion and therefore increased opportunities in the enterprise sector. The net effect will be to increase price, but the consequences for worktime will be indeterminate, although the impact will most probably be small. In a slump, however, the effects will be quite pronounced. Demand will shift in, but again the supply curve will swing upwards; the price of the product must increase by a given percentage, this time because of the increased risk of business failure, which must be offset by an increased margin for insurance (Figure 32.4). In between boom and slump, of course, will lie periods of normal operation, in which self-employment, like any other investment, will be governed by expectations of profit on normal sales, (modified by the utility from being one's own boss). Over the cycle, however, prices for services and products from self-employment will tend to drift up and remain high, while volume will expand little (if at all) during booms, and will contract during slumps. Taking boom and slump together, the self-employment sector will tend to shrink – witness the family farm in the 1980s.

More or less the opposite holds true for socialism. In a boom the demand function shifts out, but the supply curve will swing *down*, as households shift time and effort to self-employment; a lower margin will suffice to call forth self-employment, since opportunities for self-employment are better, due to the intensification of shortages. The effect on price will be indeterminate, but volume will rise. In a slump the demand curve shifts in, real wages rise, and labor will be willing to return to the enterprise sector; but opportunities there may be fewer, so the supply curve to self-employment may not change much. Over the cycle, prices of self-employment products and services will tend to be steady, but volume will increase in booms and decline comparatively little in slumps, tending to rise over time. The self-employment market tends to flourish under conditions of excess demand, and decline in the face of demand scarcity (see figures 32.5 and 32.6).

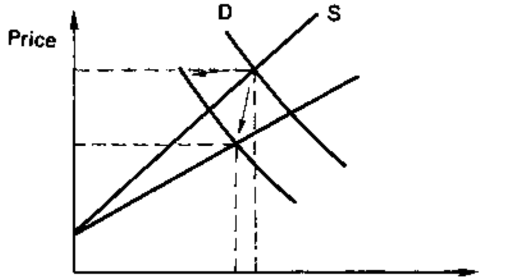

Figure 32.6 Shortage less intense

GROWTH CYCLES

Both systems have built-in tendencies to exacerbate their characteristic condition – stagnation and shortage, respectively – and both tend also to generate offsetting influences in international trade and in the informal sector. But the offsetting influences examined so far have been are external to the interaction between the creation of aggregate demand and the building of capacity. That interaction, which determines the extent of excess capacity or shortage, itself tends to preserve the gap between demand and capacity, allowing it to fluctuate, but keeping it within limits. This can be shown by examining simple interactions between two variables – investment and excess capacity for capitalism, investment and shortage for socialism. In each case we will find a cyclical pattern, confining the variation within limits. Admittedly, these models are too simple and abstract to be realistic, but the forces portrayed are present in each system.

Capitalism

The mode of operation is demand-constrained, which implies that $K/v - I/z \geqslant 0$ – i.e., $I/K \leqslant z/v$, where $z = 1 - wn$, w being the real wage and n the labor requirements per unit output, and v the capital–ouput ratio. Growth will always be below (or at most equal to) the level that would just balance aggregate demand and total capacity. Excess capacity is always present and exerts a dampening influence on the ability of investment to grow, where investment should be understood here to mean investment spending. Why build more capacity when what already exists is underutilized? On the other hand, investment spending generates technical progress, which increases potential output, and thus increases excess capacity. So the growth of excess capacity depends positively on the level of investment, while the growth of investment depends negatively on the level of excess capacity. This looks like the foxes and rabbits problem: let us set it out.

First consider the inhibiting effect of excess capacity on the growth of investment. Let excess capacity, x, be defined in percentage terms as

> $[K/v - I/z]/(K/v) = 1 - g_a/g_w = [g_w - g_a]/g_w = x$, where g_w is the warranted rate, z/v, and g_a the actual rate, I/K.

Each firm will choose its target capacity in the light of its expectations as to the growth of its markets: since the markets are interconnected, these choices can be combined to imply a rate of expected market growth, which we may call g, and which for reasons outlined earlier, lies below (or at most equals) z/v. But because of overbuilding and the need for reserves, the firms' choices taken together will imply normal excess capacity, which will tend to dampen investment growth, reducing it below the collectively expected rate of market growth. To maintain long-run balance, the growth of investment must match g, but firms will tend to reduce their commitment to expand their construction plans in proportion to the excess they already have. The current level of investment spending has been adjusted to expected market conditions; but when this gives rise to excess capacity, firms will trim the expansion of investment in proportion to their unused plant and equipment. Capital construction will continue to be governed by normal expectations, but its *acceleration* will be adjusted in proportion to excess capacity. Thus we can write,

$$dI = gI - axI, \text{ where } 0 \leqslant a \leqslant 1$$

If $a = 1$, then the growth of investment will be reduced in proportion to the full amount of excess capacity; if $a = 0$ excess capacity will have no effect – investment will grow at the same rate as capital. In between, investment will grow more slowly than capital, but not as slowly as the excess capacity would warrant. Hence,

$$dI = [g - ax]\mathrm{I}$$

The growth of investment varies inversely with the level of excess capacity.

Now consider the growth of excess capacity in relation to the level of investment. Technical progress will increase in proportion to the level of investment. If wages rise with productivity technical progress will leave the multiplier unchanged, but will increase output per unit of capital – i.e., reduce v, and so raise g_w. Hence $dg_w = tg_w = bg_a$, where t is the rate of technical progress (i.e., $dY = tY$; since $v = K/Y$, and $g_w = z/v = zY/K$, $dg_w = (z/K)dY$), which can be taken as proportional to the level of investment (i.e., $t = bI/K = bg_a$), where $0 \leqslant b \leqslant 1$. Next, note that $dg_a)$, $= g_a(dI/I - g_a)$, and that when $I = 0$, $dx = -hx$, where $-h$ is the proportional rate of scrapping underutilized capacity, due to age and/or obsolescence; then, given x as above, after manipulation

$$dx = g_a/g_w[bg_a - (dI/I-g_a) - hx$$

$$dx = g_a/g_w[g_a(1+b) - dI/I] - hx$$

Substituting, this becomes

$$dx/x = \{g_a/(g_w-g_a)\ [g_a(1+b) - dI/I] - h$$

So the rate of growth of excess capacity depends on the difference between the actual rate of growth (adjusted for technical progress) and the desired rate, multiplied by the ratio of the actual rate to the difference between it and the warranted rate – and then adjusted by subtracting scrapping.

The dynamic system is completed by noting the two additional equations, already implied in the discussion:

$$dg_w/g_w = bg_a$$

and

$$dg_a/g_a = dI/I - g_a$$

These equations define a dynamic system with some affinities to a Goodwin–Volterra cycle, except that it has four variables (dx/x, dI/I, g_a and g_w) instead of two. An analytic solution is not easily found, but computer simulation shows that cycles of various kinds will be generated with plausible values of the constants.

This confirms that a system of capitalist demand scarcity will normally contain inherent limits. Even if the economy is closed, and no opportunities exist for a black market, the system itself will tend to see that the development of stagnation will reverse itself – and also that there will be no escape from stagnation. The system both creates and limits the amount of excess capacity. The result is a cycle that takes place entirely in the realm of demand scarcity. Now consider the other system.

Socialism

In general, $I/z - K/v \geqslant 0$, that is, $I/K \geqslant z/v$, intended growth exceeds or just equals warranted growth. Excess demand or shortage is the general condition; output is already at full capacity and demand is still unsatisfied – *in general*. Effective demand for consumer goods exceeds the available supplies, so that queues form in all shops. Order books for capital goods lengthen. But output can be further increased only by operating above the normal level, which in turn can be done only at the expense of higher costs and lower productivity. A given level of shortage implies a proportional level of such extra costs, delays, etc. Hence, although a condition of shortage implies an *incentive* to expand investment more rapidly, it also implies an *ability* to do so less rapidly, and the greater the level of shortage, the more pressure there will be on productive facilities.

As in the case of excess capacity, shortage can be defined as a ratio,

$$s = [I/z - K/v]/(K/v) = g_a/g_w - 1 = [g_a - g_w]/g_w$$

Shortage is the difference between the income pressure in the system and its productive capacity, considered in relation to productive capacity, which can be expressed as the difference between intended growth minus warranted growth over warranted growth.

Investment must be understood not just as spending, but as output of capital goods. When the system is already operating at normal full capacity, the multiplier cannot generate secondary incomes in the usual way, through hiring more workers and using idle capacity; instead overtime, overutilization, running down inventory, and extra shifts (possibly at the expense of maintenance) will be required – and these will generate costs that will reappear as income and spending. But this will happen only if the output is actually being produced. In the capitalist case, investment meant spending: here it must be understood as output.

In the absence of shortage, investment would grow at the same rate as the capital stock, the growth of which in turn will be governed by the Plan. If the Plan's proposed rate of growth (not to be confused with the earlier symbol for government spending) is G (which for reasons already given will exceed, or at best equal, g_w), then dI would equal GI. The presence of generalized shortage, however, will cause investment growth to fall below that rate as capacity is overworked and bottlenecks accumulate. The capital goods sector will be unable to expand its output in accordance with the Plan and the bottlenecks and shortages will make it difficult to complete projects on schedule. Demand pressures will lead to the production of outputs in the wrong proportions for investment; goods will not be useable because complementary goods are not available in the correct proportions. There is an exact relationship here. With a given technique, there is a unique maximum growth rate; when the system is not producing the output corresponding to this,[9] it can grow only at a lower rate. Putting this another way, we know from growth theory that the maximum rate of growth is reached when the 'own-rates' of surplus (output minus direct plus indirect use as input, divided by direct plus indirect use as input) for every basic good are equal. (Let the qs indicate output levels, and the as be input coefficients: then $q_1/[a_{11}q_1+a_{21}q_2+\ldots+a_{n1}q_n] = q_2/[a_{12}q_1+a_{22}q_2+\ldots+a_{n2}q_n]$ $=$, etc.) But the outputs, and embodied productive capacities, of the various basic goods will respond differentially to demand pressure. Hence as shortage intensifies demand pressure will move the system away from the 'turnpike' proportions, in which the own rates are equal. Some will rise, responding to demand pressure, which necessarily causes others to fall, since the available labor force will provide a constraint. But the sustainable rate of growth is set by the *lowest* of the own-rates among the basic goods. Hence the effective increase in investment will be reduced by demand pressure. These difficulties can reasonably be assumed to be proportionate to the level of s; hence investment output will be reduced in proportion to s. If the proportionality factor is A, then AsI will be the shortfall, which must be subtracted from GI. Hence,

$$dI = [G - As]I$$

The rate of growth of investment is inversely related to the level of shortage.

Given s as defined above, and defining t' as technical regress, the percentage decline in productivity as a function of the level of investment, where $dY = t'Y$ and $dg_w = zdY/K = t'zY/K = t'g_w$. As before, $dg_a = g_a(dI/I - g_a)$, so that, as a preliminary we see,

$$ds = g_a/g_w[dI/I \quad -g_a - t']$$

where, of course, t' is negative.

Then, assuming the decline in productivity to be directly proportional to I, $t' = BI/K = Bg_a$, where B is a negative number between 0 and 1. Bearing in mind that when I falls to zero shortages will decrease due to the absence of demand pressure (since projects will be completed, and productivity will rise to the planned levels, so that capacity will increase), at a rate H:

$$ds = g_a/g_w[dI/I - (1+B)g_a] - Hs$$

and substituting,

$$ds/s = [G - As - (1+B)g_a]\{g_a/(g_a - g_w)\} - H$$

So the rate growth of shortage equals the desired rate of growth, adjusted for the pressures created by shortage, and reduced by rate of increase of capacity, all multiplied by the ratio of the actual growth rate to the difference between actual and warranted growth, and finally reduced by the normal rate of expansion of capacity.

To complete the dynamic system we note that,

$$dg_w/g_w = Bg_a$$

and

$$dg_a/g_a = dI/I - g_a$$

These equations now define a cycle which lies entirely in the realm of excess demand. The general format can easily be seen. High investment will cause rising shortages, and higher shortages will lower the growth of investment; and when investment reaches an average level, shortages will have risen to their maximum. But the declining level of investment will now bring shortages down to their average level at the point where investment hits its minimum. Shortages will continue to decline, permitting investment to turn up, so the cycle will repeat. An analytic solution is not available, but computer simulation shows various cycles of the sort described.

As in the case of capitalism and demand scarcity, socialism sets limits on its characteristic excess demand: it will never disappear, but it will never reach unmanageable levels either. Each system works within definite boundaries, even though there are no 'floors' or 'ceilings.' Nor does either system ever operate at normal full employment, or grow at the warranted rate. Of course, these two models are greatly oversimplified; but they deal with a central issue – the relation between the capacity-creating and demand-generating aspects of investment – and they show that this relationship can create cyclical behavior while remaining entirely on one side or the other of the balanced or warranted rate of growth.

INFLATION

Inflation has different but symmetrical causes in the two systems. In a demand-constrained economy, inflation originates in changes in costs; in a resource-constrained economy inflation arises from the effects of demand or changes in demand. In short, a demand-constrained system has cost inflation, a resource-constrained system has demand inflation.

In a demand-constrained economy inflation is the market process by which it is determined which groups shall bear the burden of increased costs. In a resource-constrained economy inflation is the market process by which it is determined which groups shall bear the burden of the shortages. We will spell this out, taking the capitalist economy first.

When a cost increases (say, oil imports rise in price) the various industries using oil pass along as much as they can in higher prices. Consumers thus face a rising cost of living, and so demand higher wages and salaries, further raising costs to business, which in turn are passed along again in price increases, to the greater extent possible. But while business will try to pass cost increases along, and workers will try to recoup cost of living increases in higher pay, their ability to do so will depend on their respective market positions. Not all businesses and not all groups of workers will succeed (indeed, it could even happen that none are wholly successful), but in general some will do better than others. Those who are relatively most successful, round after round, will escape most of the costs, which the least successful will have to bear. As prices and wages rise, however, the burden is lessened in real terms, and the wage–price spiral peters out when the reduced burden has been distributed between business and labor in proportion to their inability to pass it along.

The process can be illustrated with a single-equation model. Let k stand for means of production per unit (aggregate) output, and n for labor per unit output, with m as the aggregate mark-up. \$ will be the price of capital goods, w, the money wage rate and p the money price index of output. Initially,

$$mk\$_{(t-1)} + mnw_{(t-1)} = p(t-1)$$

\$ then increases and p is increased accordingly, w remains fixed:

$$mk[\$_t - \$_{(t-1)}] = p_t - p(t-1)$$

However, once prices go up, households respond by demanding wage increases to compensate:

$$[w_t - w_{(t-1)}]/w_{(t-1)} = x[p_{(t-1)} - p_{(t-2)}]/p_{(t-2)}$$

where $0 <$ or $= x <$ or $= 1$.

The parameter x indicates wage-earners' market power; if $x=0$ they are not able to raise the money wage at all, and the full burden of the cost increase will fall on them; if $x=1$ they are able to keep pace fully with price increases, and the wage–price spiral will continue until the original ratio $\$/w/p$ is re-established. Any value in between means that workers can keep up partially, but will end up bearing the larger share of the burden. (In a labor-dominated system workers might be able to keep up fully with any cost increases, but business would be able to raise prices only a fraction; interchange the ws and ps in the equation.) In any event the wage–price spiral comes to an end when the burden, reduced by inflation, is distributed.

In a resource-constrained context inflation will result from the impact of an increase in excess demand – e.g., a rise in investment; prices will be bid up by the competition for the scarce goods as consumers and enterprises try to shift the burden of the shortage to those who cannot afford higher prices. But as prices rise workers will demand pay increases, and enterprises in turn will increase output prices as their costs rise. Some groups of workers and some enterprises will be relatively successful, but those in weaker market positions will do poorly, and will end up bearing the burden of the shortages, reduced by the effects of the general price increases. Here, however, the Kaleckian dictum, 'workers spend what they get, capitalists get what they spend,' must be adapted and considered.

Workers can spend more only if they receive pay rises; enterprises, however, will collectively get back whatever they collectively spend – from each other for capital and intermediate goods, from consumers spending their wages on consumer goods. In the nature of things, then, enterprises will keep up with demand pressure.

Let us suppose that some input in short supply is bid up in price, to ration supplies to those who can afford them. Enterprises using the input then try to pass the costs along; enterprise spending in the aggregate returns to them. Households respond to the higher prices by demanding wage increases. If they get them, their wages return to enterprises in the form of receipts from consumer goods sales. To the extent they fail to keep up, real wages are reduced, and workers bear the burden of the shortages. A corollary is that real supply and effort will tend to shift away from the consumer goods sector to production for interenterprise transactions. (Trying to reduce demand pressure by cutting back money wages could backfire if, in anticipation, enterprises intensified this shift.) Such processes may be open or suppressed.

In both economic systems inflation is a market response to an external shock, whose function is to determine who will bear the burden – of the cost increase in capitalism, of the increase in shortages in socialism. In each case, the rise in prices and wages reduces the burden to be distributed, while shifting it to the weakest, those least able to pass along or keep up with the increases. The more evenly matched the market positions of the various players, the longer the process will continue, and the lower the final burden to be distributed.

MODES OF OPERATION

Capitalism and socialism have traditionally been defined as modes of production – meaning ways of organizing and controlling the means and processes of production, so as to appropriate the resulting surpluses. This traditional approach does not explain either capitalism's combination of wasted capacity and unnecessary products with innovative dynamism or the corresponding mix of high capital construction, shortages and frustration apparent in socialism. To deal with these problems we have studied the characteristic modes of operation of the two systems, demand-constrained and resource-constrained, respectively, showing that what has been interpreted as the 'instability of the warranted rate of growth' can be better understood (when recast to take account of productivity changes) as the set of pressures that separate these two modes of operation. (The mode of operation reflects the mode of production, of course, but is not determined by it in any simple way. The US economy operated in a resource-constrained mode during World War II, for example.)

The influence of the characteristic mode of operation pervades the economic sphere and colors all aspects of it – and much beyond as well.[10] Expectations of enterprises as to prices, quantities, revenues, and capital values will all be formed on the assumption of normal demand scarcity or normal shortage. Households will likewise plan careers and education of children with an eye to the normal state of the labor market. Public bodies will shape their expenditure and capital construction plans on the basis of the normal conditions of operation. Even the agenda of public policy and the issues in political debate may be shaped more by the mode of operation than by the mode of production.

In comparing capitalism and socialism it is common to counterpose bureaucracy and the market; socialism is said to be bureaucratically planned, and therefore inefficient, whereas capitalism is a market economy, therefore efficient, except where monopolies and oligopolies have introduced distortions. Market and bureaucracy are seen as two opposed and incompatible forms of organizing economic activity. Nothing would be further from the truth: modern capitalism is highly bureaucratic, and contemporary socialism is equally obviously a market economy, though this has been much misunderstood. Both systems are bureaucratic and both are planned through state agencies, although the nature and objectives of the planning are different. But all industrialized, mass production economies so far have been run by bureaucracies; no alternatives have yet proved workable on a large scale. Moreover, all modern economies are market economies: the market may be planned by the state or administered privately or through some mixture of state and private, but it is still a market – goods are produced for sale; ownership changes hands through monetary transactions; monetary income (arising from property or from work) confers the power to consume. But the mode of operation of a market system can be demand-constrained or resource-constrained, and that is what makes the difference.

The idea that economies have a characteristic mode of operation, either demand- or resource-constrained, runs counter to most current economic thinking. On the one hand it is assumed that aggregate demand in capitalist societies can and often does reach or surpass the level of full employment (mistakenly identified with full capacity). On the other, the problem of shortage in socialism is widely held to be due to inefficiency and slackness in production – 'soft budget constraints,' in Kornai's phrase (Kornai, 1986; Davis and Charemza, 1989). According to this view, for political and administrative reasons, bureaucratic socialism is unable to enforce budget constraints; enterprises consequently, feel no compulsion to be efficient: they will suffer no penalty for being unprofitable or for making costly and unwise investments. Hence as bureacrats try to expand their territory, careless of costs, they will bring about inefficiency and general shortages. This argument has it exactly backwards. Shortages result from excess demand, which in turn leads to inefficiency, since everything produced can easily be sold; budget constraints are soft because the incentives to expand are strong, not the other way around. Costs are ignored because of the intensity of demand (what could be 'softer' than the budget constraint of a large American corporation: perhaps the budget constraint of a Savings and Loan?). It is competition for scarce demand, not restrictions on current or capital spending, that stimulates cost-cutting.

As for capitalism and demand, during the entire post-war period the US economy only twice exceeded its potential output level, and each time only for a short period. (Nor is 'potential output' full capacity, in the sense that demand above that level would cause generalized shortage.) Of course, West Germany and Japan, and others, often operated at or near full employment, as conventionally defined. But these were all open economies with a high ratio of trade to GNP and a strong balance of payments position; they were thus able to draw on the excess capacity and labor reserves elsewhere in the capitalist world. So, though expansionist, they never functioned as shortage economies.

The 'mode of operation' thus refers to the system as a whole; it determines the character of the system – and, in particular, the incentives which govern market behavior. It follows that a system must be one or the other: demand scarcity and supply shortage cannot easily be mixed without losing the distinctive virtues of each. These basic incentive patterns, in turn, affect innovation and productivity and thus react back on the system, in ways which give rise to cyclical growth.

POLICIES

When faced with excessive demand scarcity, capitalism's response has been government intervention, to raise the level of demand and to control prices. This has to be planned and coordinated with the private sector and is usually understood to be supplementary: it is supposed to make the system work better. The private sector is dominant, and the activities of the government cannot undermine this; intervention should not displace or compete with private sector production, or even pre-empt potential private activity, unless a strong case can be made that private activity will undermine general welfare. Direct government production must normally be confined to strictly public goods; if something is even *privatizable*, there will be political pressure to keep government away from it.

Interventionist spending should be flexible; it may have to be increased or decreased at short notice; it must be possible from time to time to redirect it from one sector or region to another. The purchases it represents therefore cannot be essential to the operation of the government; interventionist spending must be inessential and non-privatizable.

Military and aero-space spending (which developed for largely political reasons) fit very well. The products at least the larger items) *cannot be marketed privately*, and cannot be produced without the active participation of the government. (And they are 'inessential' not just in the sense that everyone hopes they will never be used, but that they do not enter into either production or consumption, so for the economy it doesn't matter whether they are finished and delivered this year or next.[11])

Government spending is essential to limiting unemployment and excess capacity, but there are many other policy instruments – other forms of spending, 'automatic stabilizers,' taxes, subsidies, monetary policies, social programs and, of course (usually kept as a last resort) direct controls. All of these are designed to control unemployment and inflation, to set the levels and offset the side-effects, and to induce the economy to move in desired directions. In addition, of course, regulation is needed to prevent fraud, and the marketing of saleable but dangerous products.

This complex – and much-debated – array of capitalist policies stands in marked contrast to the socialist world. There do not appear to be any consistent and well-thought-out policy packages for managing shortage, for adjusting the level of demand pressure, or coping with the many side-effects for example, on quality, work effort and other incentives).

Socialist government and military budgets should have the opposite impact of their capitalist counterparts – increasing productivity or capacity, without adding to incomes. Thus the use of the Chinese Red Army in the construction of dams, or in reclaiming land, the Cuban literacy campaign and similar mass activities which improve skills or construct infrastructure while adding minimally to demand have exactly the right impact; Soviet deficits, on the other hand, are exactly wrong.

Yet instead of developing appropriate policies for managing shortage and its side-effect, the favored course for socialist systems has been to try to introduce market 'reforms.' These seek to develop competition, spurring technical progress, within the framework of a planned economy. Soft budget constraints are to be hardened by market pressures, bringing efficiency and responsiveness to profit incentives. Besides incentives, the market provides a way to test new products and new processes; its advantage over bureaucratic testing is that it is anonymous and objective. And the market provides a simple and automatic way to curb excess demand – when demand is excessive, let prices rise. This will cut real wages, or real investment spending, and therefore reduce pressure on industry. Market reforms, of course, will have to be coordinated with the responsibilities of the planning system.

There are serious problems with these proposals. First, a major effect of price flexibility and relaxation of controls will be to promote self-employment. A second consequence of price flexibility will be inflation of the kind outlined earlier. Thirdly, these price changes are not consistent with the ideal of fairness: price increases to ration shortage are regressive and will be likely to create political tensions. Fourthly, price flexibility reduces (or shifts the impact of) shortage, but it does not create demand scarcity. Hence it will not create the characteristic incentive patterns of Western market systems. In particular, it will not put any pressure on the worst firms, since they will still be able to sell whatever they produce. Nor, as we have seen, will the labor markets adjust to eliminate shortages.

Market reforms, because they incorrectly attribute the cause of shortages to supply inefficiency and/or to incorrect prices, fail to address the real problems, which are macroeconomic in origin. What is needed are policy instruments to manage and control the degree of shortage, on the one hand, and to offset its detrimental effects on incentives, on the other. And the failure to develop these may be socialism's most serious problem.

CONVERGENCE

In connection with reform it is sometimes argued that expanding the planned area of capitalism and the market area of socialism will lead the two systems to converge to a mixed economy, operating at full employment and possessing the best characteristics of both.

But the planned area of capitalism is not resource-constrained; it is constrained by the availability of finance, which leads to the same pattern of incentives in regard to technical progress, but does not imply the efficient use of scarce resources. Nor is the market area of socialism demand-constrained. Without shortage of demand there will be no competition for sales; hence encouraging the money motive may simply promote corruption. Socialist technical progress is combinatorial – making limited resources do many jobs; in a capitalist context it tends to become corrupted into creating baroque forms. Capitalist technical progress consists in cutting costs through efficient usage; in a socialist context it tends to become corrupted into cutting corners.

The virtues of each system, technical innovativeness and full use of economic resources, respectively, depend on the mode of operation of the system as a whole. These can therefore not be developed in a mixed system. Not so the vices and defects appropriate to each – alienation and corruption on the one hand, and technical regress and bureaucratic abuse on the other. A mixed system could easily end up with the worst of both worlds, but it cannot have the best.

EXTERNALITIES AND POLITICAL PRESSURE

Each mode of operation generates incentives in certain directions and not in others, and each systematically creates side-effects with economic consequences. When these become sufficiently damaging it may be desirable or necessary to alter or redesign the mode of operation.

Capitalism keeps costs down, in among other ways, by systematically overlooking the public costs of damage to the environment. Capitalist incentives also lead to systematic distortions of information, the concealing of scientific and technological breakthroughs, and the corruption of product development – making things that will sell rather than things that will work and/or last. When these effects become seriously damaging, reform movements are provoked, and take action through the political process.

In much the same way socialism leads to parallel but symmetrically opposite problems: sloppy work, to TVs that explode, to large mistakes frozen into the bureaucratic routine and to an inertia that inhibits change (and also, in the scramble for output, to environmental damage). But until now political repression has prevented the development of effective specific reform movements.

When these effects (in either system) cause a political/social movement among the affected populations that will potentially harm the firms/ bureaucracies more than preventing or cleaning up the problems will cost, the system will usually judge that it is time for reform. But this judgement will normally come well after the point where the additional damage to the environment or population exceeds the cost of prevention of further abuse. Moreover, new externalities often interact with existing ones: rather than combining additively, they may combine multiplicatively – and it may take time for their effects to show. Thus their effects may be especially strong, but relatively easy to conceal or overlook.

Neither system has developed fully effective ways of coping with its own shortcomings, although capitalism has gone much further; each tends, often without acknowledging it, to try to borrow from the other, hoping for a taste of its virtues. Capitalism wants full employment and fairer distribution, and needs to be able to plan and administer environmental and other controls. Socialism needs quality control, innovation, and ways of breaking through bureaucratic inertia. But each has tried to adapt aspects of the other's approach without understanding how this conflicts with its own mode of operation, and without appreciating that the borrowed institutions can bring their own problems.

CONCLUSIONS

The inherent dynamism of the capitalist market system turns out to be a *macroeconomic* phenomenon: it results from a systematic scarcity of aggregate demand. And the shortages of socialism are not due to inefficiency or to soft budget constraints or to any other microeconomic factors; they likewise have macroeconomic causes. The characteristic micro-behavior of each type of economy has its foundation in that system's macroeconomic mode of operation.

This in turn implies that a dynamic market economy cannot, in principle, allocate scarce resources optimally. For if it did, it would be resource-constrained, and so not dynamically competitive. Optimal allocation, it seems, is not consistent with a competitive capitalist system. Uncertainty, on the other hand, is necessarily pervasive, since demand scarcity implies that firms can never be sure of their markets. Conventional price theory, concerned with optimal allocation under conditions of market certainty, would thus, paradoxically, seem more at home in socialism.

Planning for optimal allocation is the central feature of socialism, since it can arrange for the full and best use of all its resources. Such a plan also eliminates uncertainty as to markets; but the price is technological stagnation. Each of these modes of operation has strengths and weaknesses unique to it, and they cannot easily be combined. Government intervention in capitalism runs the danger of upsetting the rule of competition and diluting the effects of demand scarcity. But policy intervention has become sophisticated and effective. Market reforms in socialism contradict the rule of fairness in allocation and distribution. So far they have proved ineffective, and may simply be tentative steps towards restoring capitalism. Borrowed elements may help to mitigate the extreme effects of the system, but they are stopgaps. Capitalism has faced its characteristic problems and the Keynesian approach, with help from Kaldor, has developed ways of coping. Nothing comparable appears to have emerged for socialism; it has tried to borrow from capitalism, instead of creating policy instruments that fit its own nature.

Notes

1. Of course, in practice socialist bureaucrats will develop interests of their own, sometimes conflicting with the Plan, just as capitalist managers develop interests separate from (and sometimes opposed to) those of the firms they manage. (And in either system the interests of the firm, as a particular institution, may clash with more general interests, as embodied in the shareholders, or the Plan.) These are important questions but not central to the issues here.
2. Suppose a firm deliberately chose a less ambitious market position than its competitive place warranted, and so opted for a correspondingly lower level of reserve capacity. Could it thereby avoid the possibility of carrying excess reserves? Only if by aiming lower it could guarantee certainty of hitting its target, and maybe not even then. Suppose a similarly well-endowed competitor also aimed lower, and for the same segment of the market. (The two top middleweights both enter the welterweight division.) The uncertainty arises because competition is a battle, and the winners cannot be predicted, any more than the winners can in a sporting contest. In any such struggle the contenders must be prepared to defend their home territories if they lose, and to take possession of new territory if they win. This last, especially, requires carrying a purely speculative reserve.

Each firm can calculate the pricing and investment plans of the representative, average firm, and can thereby determine the amount of additional capacity it should build to maintain its market share. But this determination is subject to two kinds of uncertainty: the future expansion of the market can be estimated only within a range, and the exact impact of technological improvements on costs and output can be only approximately judged. Let us suppose that no firm has any definite technological or managerial advantage, so that no one has an incentive to try to improve their market position. Nevertheless, they will have to decide whether to build for the high demand and low technical progress estimates, or for the low demand and high technical progress ones – i.e., whether to err on the side of overbuilding, or on the side of underbuilding.

Consider the strategic position of a representative firm *vis-à-vis* the rest of the firms:

		AR Underbuild	*AR* Overbuild	
RF	Underbuild	-1 \ -1	$-L$ \ 0	$g > -1$
	Overbuild	g \ 0	$-x$ \ $-x$	$-x > -L$

If 'all the rest,' *AR*, underbuild, and *RF* also underbuilds, the result will be unsatisfied demand, creating room for entry, so that both *RF* and *AR* will suffer losses (-1) due to new competitors. If *AR* underbuilds and *RF* overbuilds, then *RF* makes a gain (g) since it increases its share. If *AR* overbuilds and *RF* underbuilds, *RF* suffers a substantial loss in market share $(-L)$. If *AR* overbuilds and *RF* also overbuilds, *RF* suffers only a small and uncertain loss $(-x)$ due to carrying excess capacity, which may be partly offset by economies of scale.

The best strategy for *RF*, therefore, is to overbuild, or build ahead of demand. This applies to every firm taken successively in isolation, and considered against all the rest. Hence there will be a tendency to excess capacity.

3. This is not a statement about intentions. Socialist managers would probably like to keep the lid on money wages no less than their capitalist counterparts, and they would certainly like to stimulate productivity. But they lack the tools; the system encourages wage drift, and fails to provide incentives for hard work and innovation.
4. Perhaps the most familiar and striking examples of such baroque technological innovation are to be found in the US military (cf. the Multi-Role Combat Aircraft, or nuclear submarines). But the space program also provides fine examples – not least the shuttle – and a study of Soviet military and space technology will also provide specimens, to say nothing of Soviet tractors – two models to do everything. (Incidentally, this illustrates the point that actual systems are usually a mixture of corporate planning and competitive markets. The US military industrial complex is a planning system embedded in market arrangements, just as Soviet agriculture has embedded a limited market system in a planning regime.)
5. To assure a unique, positive solution the matrix must be square, non-negative and irreducible. The rate of profit is derived from the Frobenius root, prices from the characteristic vector. The rate of profit is therefore not a price: it is a

measure of the surplus. The real wage and the rate of profit will be inversely related (Sraffa, 1960; Pasinetti, 1977). The price equation can be extended to take account of fixed capital, joint production (of which fixed capital is a special case) and rents for non-produced means of production. When these are included, however, there will arise cases where demand may appear to play an important role, theoretically, in establishing prices (Schefold, 1989: Steedman, 1988). But these cases revolve around the question of 'the choice of technique', an issue taken over from the neo-Classical framework. In practice, however, techniques are not 'chosen' in the abstract from a 'book of blueprints;' they evolve historically, under market-generated pressures. Given the techniques embodied in plant and equipment, and in human labor skills, at any time, and given the real wage – the normal and expected standard of living – normal prices and the normal rate of profit will be independent of demand.

Note that

$$q = (1+g)\,A'q + cL' \Rightarrow q = cL'\,[1-(1+g)A']^{-1}$$

gives the quantities, q, associated with growth rate, g, for a given level of average per capita consumption, c. If $w = c$, then $r = g$, and q and p will be the corresponding left- and right-hand characteristic vectors.

6. There is an affinity here with the famous Harrod–Domar instability claim regarding the warranted rate of growth. That rate just balances aggregate demand and aggregate supply; it is the rate of growth that will keep entrepreneurs just satisfied. But a small deviation from it in either direction will be self-augmenting. This contention, which appears to show that capitalist growth is seriously unstable, has given rise to a great deal of controversy (Morishima, 1975; Kregel, 1987). But the claim and the controversy are seriously misplaced: the warranted rate is not a potential, satisfactory balanced growth path for an actual economic system; no capitalist system has ever grown fro any time at the warranted rate. Capitalism never operates at or above full capacity – it *always* operates with a margin of *excess* (not just reserve) capacity. (World War II is the exception that proves the rule: the Allied economies were planned and developed shortage economies.) The warranted rate is not an achievable target; instead, it is a *dividing line*, separating two contrasting *modes of operation*. The same economic system cannot cycle around the warranted rate – first below it, then at it, then above it, and so on. Below the balancing point, the system operates one way, generating one pattern of incentives and results; above it, an altogether different pattern holds. The discussion of the Harrod–Domar claim – Morishima termed it 'the Harrodian avalanche' – has always been curiously inconclusive. The logic is both simple and powerful, but capitalist growth is not that unstable, giving rise to attempts to find mechanisms that would restrain the centrifugal forces. The argument here is that the original problem was miscast: when reinterpreted, the difficulties vanish.
7. Conventionally, the multiplier depends on the marginal propensity to save out of household income, and it is normally assumed (in theory) that business distributes all income to households, and in practice, that it is *as if* they did – i.e., that business treats retained earnings as household would have, had those funds been distributed to them. These assumptions are seldom explicitly argued, and, in general, are not justifiable. (Marglin, 1984; Nell, 1988). However, there are even more serious issues: both withdrawals and injections into the spending stream originate on the business side of the social accounts. Withdrawals are not necessarily savings, if by savings we mean the accumula-

tion of long-term financial assets. By distinguishing withdrawals and savings, it is possible to express the multiplier in terms of the *cost structure* of business – the multiplier can be shown to depend only on variable costs (that is, the wage bill and other inputs) (Nell, 1988, Ch. 5, Appendix). When other inputs are neglected, and sectors are aggregated, we obtain the formula in the text.

8. There may not exist a single aggregate labor supply function. Different social groups and segments of the labor market may have different patterns of response to their real wages. Certainly some groups may show a positive response: in such a market both labor demand and supply functions would have a positive slope, resulting in well-known adjustment difficulties.
9. The maximum rate of growth of the system (with given technique, assumed to be embodied in its plant and equipment), will equal the maximum rate of profit, but will be attainable only if outputs are in the proportions that will produce a physical net surplus consisting of the same goods in the same proportions as the aggregate means of production (Pasinetti, 1977, pp. 208–12; Abraham-Frois and Berrebi, 1979). In any other proportions the system must grow more slowly, and the sustainable rate will be set by the *smallest* of the physical own-rates of surplus of the basic commodities generated by production in those proportions.
10. The respective systems of international trade work the same way. The Western system puts the burden of adjustment on the weaker nations that run deficits; surplus nations do not have to adjust. To restore balance of payments equilibrium basically requires austerity and unemployment, thereby lowering imports. Thus demand will be lowered throughout the system, until the deficit nations are all either in balance, or at an acceptable level of imbalance. The Comecon system financed deficits: planners tried to achieve balance, but if an imbalance arose the Soviet Union would finance it; no austerity measures were required.
11. Military spending generates demand without adding to capacity or providing consumable goods. It is therefore an ideal (but totally wasteful) supplement to demand. Unfortunately (but not accidentally) it produces at high cost, and stimulates technical progress in directions that will generally not be helpful in market competition – for the good and simple reason that the consumers have no competitive choices, and no effective ways of expressing their displeasure. The military– industrial complex is a planned/bureaucratic *finance-constrained* system with no scarcity of demand – whatever it produces will be acceptable and cost-overruns will be managed. It tries to achieve many objectives with limited resources, and faces no penalties from disaffected users, a combination of incentives tending to result in baroque technological development.

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