Technical progress and values in Marx's theory of the decline in the rate of profit: an exegetical approach

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Introduction

The concept of the declining rate of profit (DROP) is a cornerstone of Marx's analysis of the capitalist economy. In the vast literature[1] dealing with the subject, the mainstream of interpretation finds the cause of the decline, *cet. par.,* in the increase in the organic composition of capital. These interpretations see DROP as a secular trend; a minority even finds in it one of the primal causes of the inevitable collapse of the capitalist system. We disagree with this view.

The basis for the disagreement lies in our interpretation of the Marxian concepts of the composition of capital, and the relationship between them and the rate of surplus value. Our article argues that: (i) according to *Capital* I, DROP cannot occur as a result of increases in the organic composition of capital, for capitalists will not introduce technological innovations unless these are accompanied by sufficiently compensating increases in the rate of surplus value; (ii) in contradistinction to the view which

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1. The list of books, papers and organized discussions centered around journals, all dealing with the problem of DROP, is too long to be set down here in detail. The long-lasting debates and controversies can be divided roughly into four periods. (1) In the years between the publication of *Capital* III up to the middle of the 1940s the debate concentrated around authors like Böhm-Bawerk, Tugan-Baranowsky, Bortkiewicz, and Grossmann, who raised critical points and reached extreme conclusions. The debates were joined, *inter alia,* by Bauer, Moszkowska, Sternberg, Kuczynski, Dobb, Strachey, Sweezy, and Robinson. (2) In the middle of the 1950s a long discussion was initiated by *Cahiers Internationaux,* Paris, which was later published in part by *Science and Society.* This period also saw attempts to verify DROP by empirical tests, e.g., Gillman, and numerous publications in socialist countries which tended to assert DROP. (3) In the early 1960s an interesting exchange of views was initiated by *Zycie Gospodarcze* and later passed to the official Polish economic journal *Ekonomista.* The debate turned on the main and prevailing interpretations and the ability of the "countervailing factors" to arrest DROP. (4) In the 1970s and to date, the discussion continues in journals like *Social Register, Review of Radical Political Economy, Left Review, Temps Moderne, Science and Society, Cambridge Journal of Economics,* and *Socialist Conference.* The contemporary basis of the debate is much broadened and offers, in addition to the mainstream writers, a spectrum of views that includes Marxists, Sraffians, and their opponents.

maintains that in *Capital* I and III Marx addressed different problems connected with the rate of profit (i.e., 'cycles' and 'trend,' respectively), we believe that Marx wavered between different explanations of the same problem. We argue that Marx had changed, or was in the process of changing, his theory of DROP as it appears in *Capital* III. By the time he published *Capital* I, he had abandoned his earlier analysis which saw DROP as a secular phenomenon and, using a completely different approach (i.e., changes in the value composition of capital), analyzed DROP as a cyclical problem.

We are well aware that we are facing a serious problem. To present interpretations so different from the prevailing and well-known ones forces us, for the sake of clarity of exposition, to deal with the main points of the subject and to avoid discussions with other, previous approaches. We therefore draw the reader's attention to alternative interpretations, similar to and different from ours, in an Appendix, and concentrate here on the exposition of our view. Our argument proceeds along two main lines: we base ourselves on a methodological approach to Marx's work, and on the exegetical evidence of his writings.

Methodology Imposed by the Chronology of Marx's Writings

Marx's economic thinking is collected in a number of volumes and essays not all of which were published or, in fact, edited by himself. Yet it has become customary to accept all of his work as finished products, representing final and conclusive ideas and formulations. This refers in particular to volumes II and III of *Capital,* to the three volumes of *Theories of surplus value,* and even to the *Grundrisse.*[2] We know that Marx viewed these works only as first drafts rather than as finished works and had no intention of publishing them in the form in which they were left upon his death and in which they were later published by Engels and Kautsky. In a letter to S. Schott, dated 3 November 1877, he writes:

> I began to write *Capital* in exactly the reverse order to the one in which it is to appear before the public (having started the work on the third, historical section), with the sole reservation that volume I, which I started last, was at once prepared for the press, while two other volumes remain in the unedited form that every inquiry assumes in its initial state.[3]

2. Karl Marx, *Capital,* vols. I, II, III (New York, 1967), cited as C below; idem, *Theories of surplus value,* vol. II (Moscow, 1968) and vol. III (Moscow, 1971), copyright by Lawrence & Wishart, London 1972., cited as T below; idem, *Grundrisse: foundations of the critique of political economy* (New York, 1973).

3. *Marx-Engels Werke* (Berlin, 1966), 34:307.

Capital I is the last work on economics which Marx published himself (1867)—both the first and second German editions, as well as the translation into French. Since volume I includes almost the entire *Critique of political economy,* which he published in 1859, it is the major work for which he is responsible as author. *Capital* II contains material on which Marx worked first in 1864–65 and to which he returned (according to Engels) in 1868–70 and again in 1877–79, but without completing it. *Capital* III must also be regarded as preliminary. He worked on it in the years 1864–65, but did not return to it again. In 1875 Marx made some relatively short notes on the relationship between the rate of profit and the rate of surplus value which Engels included in chapter 5 of this volume. The preliminary character holds, *a fortiori,* for the three volumes of *Theories* which Marx wrote in 1861–63. We therefore refer in what follows, to volumes II and III of *Capital,* to *Theories,* and to *Grundrisse* as 'manuscripts.'

The above chronology is crucial. From the earlier manuscripts to *Capital* I changes in approach and shifts in emphasis occur. We do not argue, as Böhm-Bawerk does, that these necessarily represent contradictions in Marx's thinking. Rather, we consider the differences between the volumes as indicating different stages in Marx's analysis and in his search for the right answers. His indeterminateness in the earlier works often points to the preliminary character of his analysis.

The preliminary nature of *Capital* III is graphically described in Engels' preface:

> . . . the work of editing the third volume was essentially different from that of editing the second. In the case of the third volume there was nothing to go by outside of a first incomplete draft. . . . the farther one went, the more sketchy and incomplete was the manuscript, the more excursions it contained into arising side issues whose proper place in the argument was left for later decision. . . . As is only to be expected in a first draft, there are numerous allusions in the manuscripts to points which were to have been expanded upon later, without these promises always having been kept.[4]

In editing *Capital* II and III Engels has, according to M. Rubel, done "à la fois trop et trop peu."[5] We must assume that had Marx had the opportunity to complete these volumes he would have written them so as to make the ideas contained therein a development of and consonant with

4. C III, 2, 3.

5. Rubel writes: "Nous n'aurons garde de lui reprocher aucune infidélité dans l'établissement des textes, et pourtant nous devons souligner le défaut majeur de son enterprise: il donne l'apparence d'œuvres achevées à des pages souvent informes et mal rédigées, matériaux d'un travail dont Marx lui-même disait qu'il fallait encore le compléter, voire l'écrire." (M. Rubel ed., *Karl Marx, Œuvres, Economie II*, Paris, 1968, 1112).

those contained in *Capital* I. To do this he would have had to remove what Engels called the "numerous allusions," and to clarify his final ideas on several essential subjects and link them to the relevant chapters of volume I. We refer specifically to the following problems: (i) extended reproduction with constant composition of capital and unequal rates of profit between the sectors, as given in volume II, to be developed into cyclical extended reproduction with increasing composition of capital and equal rates of profit—so as to fit the basic ideas of chapter 25 of volume I; (ii) the transformation of values into prices of production of volume III, not only as discussed in the famous debate about Marx's shortcomings, but also to clarify the significance of his value theory for the understanding of capitalist society—to suit the ideas of the first chapters of volume I; (iii) the relations between price, market value, market price, and price of production from chapters 9 and 10 of volume III and their monetization—to suit his theory of money in volume I; (iv) the falling rate of profit, which serves as the subject of our article.

Only by solving these problems could Marx accomplish what he labored so long to achieve: a unified analysis of "the process of capitalist production" (*Capital* I), "the circulation and reproduction process" (*Capital* II), the movements of capital as a whole (*Capital* III), and the history of economic thought (*Theories* as the fourth volume of *Capital*).

Therefore, any attempt to complete the half-finished model that Marx left behind must rely less on the posthumously published manuscripts and more heavily on volume I—the volume that must be considered the touchstone for the evaluation of any theory expressed in the manuscripts.

These methodological considerations provide the basis for our analysis of Marx's well-known theory of DROP in the capitalist economy. However, before we turn to DROP, we must analyze the concept of the composition of capital.

The Composition of Capital

The composition of capital is used by Marx to express the relations between the factors of production. Although it is central to his theory of DROP, it serves him in the analysis of a much broader range of problems. These include his theory of value, the introduction of machines and levels of productivity, creation of the reserve army, the theory of capitalist accumulation, the theory of extended reproduction, etc.

Marx defines the composition of capital in *Capital* I. Identical definitions are given in *Capital* III, and in volumes II and III of *Theories:*[6]

The composition of capital is to be understood in a two-fold sense. On the side of value, it is determined by the proportion in which it is

6. C I, 612 ff; C III, 144–45; T II, 275–89, 379–84; T III, 382–96.

divided into constant capital or value of the means of production, and variable capital or value of labour-power, the sum total of wages. On the side of material, as it functions in the process of production, all capital is divided into means of production and living labour-power. This latter composition is determined by the relation between the mass of the means of production employed, on the one hand, and the mass of labour necessary for their employment on the other. I call the former the *value-composition,* the latter the *technical composition* of capital. Between the two there is a strict correlation. To express this, I call the value-composition of capital, in so far as it is determined by its technical composition and mirrors the changes of the latter, the *organic composition* of capital.

Marx initially distinguishes between *technical* relations (TCC) and *cost* relations. The latter he divides into value composition (VCC) and organic composition (OCC).[7] He, thus, clearly differentiates among three kinds of composition of capital.

1. *The technical composition of capital, $k = K/L$*

Here K represents the physical quantity of the means of production and raw materials, and L the entire amount of living labor (paid and unpaid), expressed in number of workers technically necessary to work the means of production.[8] Although TCC measures homogeneous, physical quantities, these may be expressed in some common unit—say, hours required to produce them. Every k represents a given method of production—a techno-productive level characterized by a specific level of productivity:[9]

> . . . the degree of productivity of labour, in a given society, is expressed in the relative extent of the means of production that one labourer, during a given time, with the same tension of labour-power, turns into products. . . . the growing extent of the means of production, as compared with the labour-power incorporated with them, is an expression of the growing productiveness of labour.

2. *The value composition of capital, $w = C_w/V_w$*

Here C_w is the sum expended on inputs of the means of production, and V_w the sum expended to hire the labor-power, paid in the form of wages and salaries:

7. A semantic difficulty must be clarified. The term 'value' in VCC does not refer to the labor theory of value. Rather, it must be understood in the modern sense of referring to non-physical units, e.g., market evaluations. There is no question, however, that OCC expresses the labor theory of value, for it is producto-technically determined.

8. See passages cited in note 6.

9. C I, 622. Cf. also, C I, 210–11, 314–15, 519–20, 604, 644; C III, 60, 102, 108, 145, 205, 212, 216, 222, 226–27, 247, 249, 260–61, 758–59; T II, 109, 596, 415–16; T III, 227–28, 310–11, 365, 382, 385.

$$C_w = p_K K \text{ and } V_w = p_L L$$

where p_K and p_L are the market evaluations of K and L, respectively. VCC, therefore, represents a cost ratio and can change directly through changes in market evaluations of the commodities involved.

$$(\text{VCC} =) \; w = \frac{C_w}{V_w} = \frac{p_K K}{p_L L} = \frac{p_K}{p_L} k \tag{1}$$

Speaking of VCC, Marx says:

> The relative magnitude of the element of price, which represents the value of the means of production only, or the constant part of capital consumed, is in direct, the relative magnitude of the other element of price that pays labour (the variable part of capital) is in inverse proportion to the advance of accumulation.[10]

3. *The organic composition of capital, $q = C_q / V_q$*

This is also an expression of cost relations, though a very particular one. It is determined by k and the productivity levels which it represents, and is independent of all other economic factors. Therefore,

$$C_q = (1/e_K)K \text{ and } V_q \doteq (1/e_L)L$$

where e_K and e_L represent the levels of productivity in the capital-goods and wage-goods producing sectors, respectively; e_K and e_L are measured in units of output per units of input. They are technically determined and are, therefore, expressed in value terms—say, hours:

$$(\text{OCC} =) \; q = \frac{C_q}{V_q} = \frac{1/e_K}{1/e_L} \frac{K}{L} = \frac{e_L}{e_K} k \tag{2}$$

Much of the confusion attending the meanings of VCC and OCC is due to the confusing language in which the definitions are couched (". . . in so far as it is determined by its technical composition and mirrors the changes of the latter"). Yet, Marx clearly differentiates between the two compositions. For instance, in discussing the formation of the rate of profit, he writes:

> . . . capitals, which have the same composition technologically speaking, . . . may nonetheless have different compositions owing to different values of the constant portions of these capitals. . . . In other words . . . capitals of equal organic composition may be of different value-composition, and capitals of identical percentages of value-composition may show varying degrees of organic composition

10. C I, 622. See also passages cited in note 6.

and thus express different stages in the development of the social productivity of labour.[11]

What is the relationship between the two cost ratios, VCC and OCC? So long as the ratio of the costs expressed by VCC is equal to that determined by production conditions—and is therefore equal to the labor-value of the cost components in the production process—VCC and OCC are identical expressions of the (technically generated) costs. In that case, $p_K/p_L = e_L/e_K$ and VCC = OCC.

If, however, market forces impinge on the cost ratio, the above equality is disturbed. In this case, VCC is 'liberated' from being determined by the technical requirements; market conditions deviate from production conditions, and VCC departs from OCC. OCC, thus, signifies the *technically necessary* conditions, whereas VCC shows *economically possible* conditions. That is, the former represents the cost relations expressed in value terms, while the deviating VCC represents them in price terms (measured either in labor or monetary units).

Two more points, crucial to our analysis, have to be made. (i) OCC and VCC refer to different time periods. Changes in the former represent changes in the mode of production associated with changes in productivity. These, in turn, bring about changes in values and cost relations. Changes in OCC thus are of a *long-run* character. Market forces, on the other hand, are incapable of changing levels of productivity and values. VCC represents, therefore, temporary, *short-run* changes, i.e., cyclical market fluctuations. (ii) Productivity changes are transmitted directly from TCC to OCC. A change in OCC represents therefore *qualitative* changes and is associated with new values, whereas VCC represents *quantitative,* or market changes.

The tripartite division[12] of the composition of capital is essential to Marx's analysis. It eliminates the confusion between VCC and OCC and is important in the analysis of DROP. The divergence of the market cost evaluation from the producto-technical evaluation[13] represents for Marx the non-adaptability of 'production relations' to the 'production forces.' Taken as a cumulative process, this lack of adaptability in the long run takes the shape of Marx's 'basic contradiction,' while in the short run it creates the so-called 'transformation problem.'

11. C III, 765–66; T III, 386.
12. Unfortunately, despite the explicit definitions of the three compositions of capital and their repeated application by Marx, many of the interpreters—if not most—do not view the concept of OCC as distinct from VCC. We discuss the few who distinguish among the concepts in the Appendix, Note A below.
13. Chapter 10 of C III deals with the determination of 'market values' by production factors, and the possibility of deviations of 'market prices' from the former through the forces of supply and demand.

The Rate of Profit According to Marx

Capital, according to Marx, consists of constant capital C that includes the means of production and raw materials, and variable capital V that represents the value of living human labor-power in the form of wages. Despite the fact that constant capital, which is the reproducible factor, increases labor productivity, it adds to the total value of the product only the value with which it entered the productive process. That is, constant capital contributes only its own value to the productive process; it does not create any new value. Variable capital, on the other hand, enters the productive process as the value of the labor power and creates in it value which exceeds the initial value.[14] The additional value created by V during the production process is 'surplus value' S.[15] The value of the product is, therefore, $C + V + S$.

Marx defines three basic relationships:

(1) the organic composition of capital,[16] C/V;
(2) the rate of surplus value, $s = S/V$;
(3) the rate of profit, $\pi = S/(C + V)$.

The rate of profit can be rewritten as:

$$\pi = \frac{S/V}{C/V + 1} = \frac{s}{q + 1} \tag{3}$$

It is an increasing function of the rate of surplus value and a decreasing function of the organic composition of capital.

In the process of capital accumulation, according to Marx, constant capital increases relative to variable capital, causing an increase in the organic composition of capital.

The rate of surplus value is influenced by four factors: the length of work day l, the intensity of work i, the productivity of labor e_L, and the real wage rate v.[17] We have $s = g(l,i,e_L,v)$, where $\partial s/\partial l > 0$, $\partial s/\partial i > 0$, $\partial s/\partial e_L > 0$ and $\partial s/\partial v < 0$. To simplify the analysis, we assume, as does Marx, that l, i, and v are constant for the system. Thus, $s = t(e_L)$.

14. C I, 193, 202, 204–5, 209–10.
15. Ibid. 193, 209.
16. As we have shown above (p. 597), OCC and VCC coincide under certain conditions, as do the rates of profit calculated from them, respectively. We would therefore have preferred to define the rate of profit in the more general terms of 'composition of capital' so as to make it applicable to both OCC and VCC (and to the two approaches Marx uses in analyzing the rate of profit, as discussed below). Yet, for the sake of familiarity—and at the risk of confusing the reader—we revert here to Marx's way of exposition and drop the subscripts to C and V. It will be clear from the context whether we refer to VCC or OCC.
17. C I, 519–30, 303–7; see also 314–16, 604; C III, 59–60.

The Decline of the Rate of Profit

Marx devotes much of his analysis to the decline of the rate of profit in the capitalist system. However, we find in his writing two different explanations of DROP. The two versions differ not only in emphasis but in principle. One of these is presented in chapters 13, 14, and 15 of *Capital* III and in the relevant chapters of *Theories*. The theory claims that in the capitalist economy the rate of profit declines because constant capital rises relative to variable capital.[18] The decline in the rate of profit manifests itself as a secular tendency despite the short-run effects which may counteract the tendency.[19] We call this the technical approach theory (TAT).

Again, in *Theories,* and extensively in *Capital* I, we find another explanation of DROP that is couched, not in terms of the introduction of additional capital, but rather in terms of the market evaluation of the factors of production. This version focuses on changes, independent from k, in the value composition of capital, which are brought about by market forces. We call this the value approach theory (VAT).

TAT holds that competition and the profit motive lead to accumulation of capital which raises constant relative to variable capital. This process, which characterizes the capitalist system, leads to a fall in the rate of profit:

> . . . the gradual growth of constant capital in relation to variable capital must necessarily lead to a gradual fall of the general rate of profit, so long as the rate of surplus-value, . . . remain[s] the same. . . . The immediate result of this is that . . . the gradual growth of constant capital in relation to rate of surplus-value, at the same, or even a rising, degree of labour exploitation, is represented by a continually falling general rate of profit.[20]

Equation (3), $\pi = S/(C + V)$, or $\pi = s/(C/V + 1)$, shows this relationship.

Marx recognized that there are countervailing forces to DROP which would change the trend to a 'tendency.' These counterforces would act in various ways either to slow down the increase in the organic composition of capital or to bring about an increase in the rate of surplus value. All of chapter 14 of *Capital* III is devoted to a discussion of these factors. He says:

> There must be some counteracting influences at work, which cross and annul the effect of the general law, and which give it merely the characteristics of a tendency, for which reason we have referred to the fall of the general rate of profit as a tendency to fall. . . . Thus,

18. C III, ch. 13.
19. Ibid. ch. 14.
20. C III, 212–13; see also 69, 163.

the law acts only as a tendency. And it is only under certain circumstances and only after long periods that its effects become strikingly pronounced.[21]

The second approach (VAT) focuses on the fact that changes in VCC are caused by fluctuations in the factor markets. Such changes do not stem from changes in production. The given technical relationships exist so long as the 'mode' or 'method of production' does not change, i.e. so long as the technical composition of capital and the productivity of labor, which it represents, are given. Although such changes lead to changes in VCC, these are not 'mirrored' in OCC.[22]

Changes in VCC, which stem from fluctuations in market evaluations, are temporary, since they do not cause changes in the methods of production. They, at most, generate substitution among existing methods of production. In contrast, changes in OCC, seeing that they imply new levels of productivity, mean that new, hitherto non-existent methods of production have been brought into use. These are long-run changes which transform production. Marx puts it as follows:

> The organic changes and those brought about by changes of value can have a similar effect on the rate of profit in certain circumstances. They . . . differ however in the following way. If the latter are not due simply to fluctuations of market prices and are therefore not temporary, they are invariably caused by an organic change in the spheres that provide the elements of constant or of variable capital.[23]

Discussion of TAT

From equation (3), $\pi = f(q,s)$, where $\partial\pi/\partial q < 0$ and $\partial\pi/\partial s > 0$. We first consider the influence of q. Any change in C or V, or in both, which brings about a change in q, is equivalent to a technological change that is assumed to be capital intensive. Such a capital-intensive change lowers π so long as we assume s constant. That is the process described in *Capital* III, and generally known as Marx's 'law of the tendential fall of the rate of profit.'

For the law to hold, two conditions have to be met: (i) q must be able to increase without s being affected, and, in case both increase, (ii) the impact of q on π must be bigger than that of s on π. What do we find in the texts? For Marx there is no change in q without a change in productivity:

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21. Ibid. 232, 239.
22. T II, 275–89, 379–84; T III, 382–96; C III, ch. 3, pp. 145, 154, 747 (these correspond to C I, ch. 25, Sections 3, 4).
23. T III, 386.

The growing extent of the means of production, as compared with the labour-power incorporated with them, is an expression of the growing productivity of labour. The increase of the latter appears, therefore, in the diminution of the mass of labour in proportion to the mass of means of production moved by it.[24]

The value of the product thus changes in the opposite direction of the change in productivity. In summary, assuming K and L constant:

$$q = f(C,V), \text{ and } C = C(e_K), V = V(e_L) \tag{4}$$

(Reminder: the subscripts to C and V have been dropped.)

In *Capital* III, chapters 13 and 15, Marx explains the tendential DROP, but only hints at the influence of productivity. The analysis cannot, therefore, be regarded as complete and final; it has to be integrated with what he published in *Capital* I. There the hints are made explicit:

Economy in the use of the means of production has to be considered under two aspects. *First, as cheapening commodities, and thereby bringing about a fall in the value of labour power. Secondly, as altering the ratio of the surplus-value to the total capital advanced, i.e., to the sum of the values of the constant and variable capital* [emphasis added].[25]

Marx did not return to work on the manuscript of *Capital* III. However, already in his initial formulation he is skeptical of the conclusion of TAT. In a much-discussed passage he writes:[26]

The law of increased productivity of labour is not, therefore, absolutely valid for capital. . . . No capitalist ever voluntarily introduces a new method of production, no matter how much more productive it may be, and how much it may increase the rate of surplus-value, so long as it reduces the rate of profit.[27]

The process of accumulation must take place under suitable economic conditions—conditions that must justify the investment in new equipment. Therefore, a precise statement of the economic conditions under which the entrepreneur will invest, i.e. the conditions of profitability, is essential. Marx was aware of the problem. In *Capital* I he formulates what we call the *law of the machine:*

24. C I, 622; see also 314–15, 622–24; C III, 205, 212, 216, 222; T II, 109, 415–16, 596; T III, 311, 365–66.
25. C I, 325; see also 324, 350; C III, 111–13.
26. Marx, in the continuation of this passage, argues that the general behavior of the capitalist class thwarts the rate-of-profit objective of the individual capitalist. We defer discussion of this point to p. 609 below.
27. C III, 262, 264.

The use of machinery for the exclusive purpose of cheapening the product, is limited in this way, that less labour must be expended in producing the machinery than is displaced by the employment of that machinery. For the capitalist, however, this use is still more limited. Instead of paying for the labour, he only pays the value of the labour-power employed; therefore, the limit to his using a machine is fixed by the difference between the value of the machine and the value of the labour-power replaced by it.[28]

No accumulation and, therefore, no increase in the organic composition of capital will take place unless the above condition is fulfilled. The implication of this condition, and what was said above about productivity, is this: for an investment to take place, the addition to C must be less than the amount saved of V: $\Delta C < |\Delta V|$ (where the cost of adding the machine is the change in C, and what is saved in paid human labor is the change in V).

To establish the full impact of the law of the machine on π we must take into account that, according to Marx:

(i) "The development of the productive power of labour reacts also on the original capital already engaged in the process of production."[29] The new technology in the production processes defines a new level of productivity that changes the value of the old capital as well. It is the new value of C which enters into the determination of π.

(ii) The new e_L changes the values of the products necessary for the reproduction of the labor power, i.e. the value of the labor power. As e_L increases, fewer hours need to be worked to produce anew the value of the labor power. Thus, the value of V decreases due to an increase in e_L.

(iii) Since the length of the work day is assumed constant, the hours saved by the decrease in V are transferred and added to the 'unpaid hours,' i.e. surplus value S. The decrease in V and consequent increase (of like magnitude) of S, cause $s = S/V$ to increase. Therefore, as labor productivity e_L rises, s increases not only because of the decrease in V but also because of the increase in S.[30]

It is clear that s must therefore exert a bigger influence on π than does q. For $s = S/V$ increases both because its denominator decreases and its numerator increases (by the same amount $|\Delta V|$), whereas in $q = C/V$, the

28. C I, 392; see also 390; C III, 108, 255–57, 262, 265; T II, 557; T III, 341, 366.
29. C I, 604, 209–10, 629.
30. "But hand-in-hand with the increasing productivity of labour, goes, as we have seen the cheapening of the labourer, therefore a higher rate of surplus value, even when the real wages are rising. The latter never rise proportionately to the productive power of labour" (ibid. 604; see also 314–16, 319).

denominator decreases (as in s), but the change in C must be smaller than the change in V. Therefore,

$$\frac{\Delta C}{|\Delta V|} < \frac{\Delta S}{|\Delta V|} \tag{5}$$

If this condition is not met, the investment, according to Marx, is not worthwhile and the new machine will not be introduced. The 'law of the machine' does not deny the increase in q; it only requires that its influence on π be smaller than the influence of s on π.

The 'law of the machine' leads to a necessary conclusion: π cannot fall because of technological reasons, for unless the conditions of the law are met, no new investment will take place under the assumption of rational behavior on the part of the capitalist.

The analysis can be formalized by using the above defined relationships:

$$\pi = S/(C+V), \text{ where } S = S(e_L), V = V(e_L), \text{ and } C = C(e_K).$$

Differentiating totally, to find the change in the rate of profit:

$$d\pi = \frac{\partial \pi}{\partial S} \frac{dS}{de_L} de_L + \frac{\partial \pi}{\partial V} \frac{dV}{de_L} de_L + \frac{\partial \pi}{\partial C} \frac{dC}{de_K} de_K \tag{6}$$

Taking the individual partial derivatives,

$$\frac{\partial \pi}{\partial S} = \frac{1}{C+V} \text{ and } \frac{\partial \pi}{\partial V} = \frac{\partial \pi}{\partial C} = \frac{-S}{(C+V)^2}$$

Substituting into (6)

$$d\pi = \frac{1}{C+V} \frac{dS}{de_L} de_L - \frac{S}{(C+V)^2} \frac{dV}{de_L} de_L - \frac{S}{(C+V)^2} \frac{dC}{de_K} de_K \tag{7}$$

The first two terms are positive, for $1/(C+V)$ and $S/(C+V)^2 > 0$ by definition of the variables, and $dS/de_L > 0$ and $dV/de_L < 0$ by the argument developed above. The part of the total effect of accumulation which operates on V and S via increases in the productivity of labor clearly raises π.

The effect of accumulation which operates on C is more complicated. The direct addition to constant capital has an indirect, opposing effect (via increases in its productivity) which may be larger than, equal to, or smaller than the initial change in C: $dC/de_K \lessgtr 0$. The effect of the third term on the rate of profit is, therefore, indeterminate.

Rewriting equation (7) to collect the second and third terms

$$d\pi = \frac{1}{C+V}\frac{dS}{de_L}\,de_L - \frac{S}{(C+V)^2}\left[\frac{dV}{de_L}de_L + \frac{dC}{de_K}\,de_K\right]$$

we see that the effect on π via S is unequivocal: accumulation, which raises the productivity of labor, increases surplus value and, therefore, the rate of profit. What about the second term? Its sign is determined by the sign of the expression in the brackets. It will be positive if

$$\left|\frac{dV}{de_L}\,de_L\right| > \left|\frac{dC}{de_K}\,de_K\right|$$

This, however, is a statement of the 'law of the machine'. Any accumulation which meets the condition imposed by Marx must raise the rate of profit.

Lemma: A Handwritten Addendum by Marx

We have shown, using Marx's assumptions, that the theory of DROP as developed in the manuscripts of 1861–65 and in particular in chapter 13 *Capital* III does not fit the principles presented in *Capital* I. Was Marx aware of this fact after he published the two German and the French editions of *Capital* I? It is true that chapter 25 does not deal explicitly with the rate of profit. In his work plan, Marx defers this analysis to volume III. However, in a later marginal note to the chapter, handwritten by Marx in his own copy of *Capital* I, which Engels introduces as a footnote in the third German edition (1883),[31] we find proof that Marx considers the analysis of the chapter directly germane to the problem of π. (According to M. Rubel, in private correspondence with one of the authors, the note was penned by Marx no earlier than 1874–75, i.e., at least ten years after the text of volume I was completed.)

This important note attests to the transformation in Marx's thinking relative to DROP as presented in *Capital* III. He writes:

Here note for working out later: if the extension is only quantitative, then for a greater and a smaller capital in the same branch of business the profits are as the magnitudes of the capitals advanced. If the quantitative extension induces qualitative change, then the rate of profit on the larger capital rises simultaneously.[32]

31. C I, 629, note.
32. 'Quantitative' refers to accumulation with constant q, whereas 'qualitative' implies a rising q.

Had the analysis of *Capital* III still been relevant at the date the note was penned, how could Marx have written about the increase of OCC (i.e., 'qualitative changes,' as used in chapter 25) as causing a rise in the rate of profit, rather than a fall therein? The note is evidence that Marx had changed his mind in the matter of DROP and, moreover, intended to continue working in the new direction. It confirms his final rejection of TAT.

It may be objected that we accept five lines in volume I in preference to three chapters in volume III. We consider both as manuscripts, but assign a heavier weight to the later thought, especially since it is consonant with *Capital* I. We do not deny the existence of DROP, but see the reason for it not in the increase in OCC, but rather in changes in VCC—to which we now turn.

Discussion of VAT

TAT, which explains DROP by a rise in OCC, focuses on technological factors. But, although the production process is physical and technological in nature (the production function), the problem of DROP is essentially not a technical one. Marx has an alternative theory as to the relationship between the composition of capital and π—VAT. In this version the changes in the value composition of capital are caused independent of changes in k and are therefore not reflected in OCC.

When is VCC not determined by k? When the economy is either in the "phase of prosperity" or in the "phase of crisis" of the business cycle. For then, the value composition of capital 'deviates' from the levels of C and V required and fixed by the technical composition. The evaluation of the factors of production in the markets then differs from that derived from and required by the production conditions. In these cases, Marx points to prices as deviating from values. The value composition 'liberates' itself from k and ceases to be identical with OCC. In all other cases, where markets are in equilibrium, the value composition follows, and is determined by k, and is therefore identical to the organic composition.

Marx refers to this process throughout his writings. We quote only one of many possible instances, but draw the reader's attention to several others. In discussing accumulation during the business cycle, Marx writes:

> Either the price of labour keeps on rising, because its rise does not interfere with the progress of accumulation . . . or . . . accumulation slackens in consequence of the rise in the price of labour . . . [and] the price of labour falls again. . . . We see, thus, . . . when the industrial cycle is in the phase of crisis, a general fall in the price of commodities . . . and in the phase of prosperity, a general rise in the price of commodities.[33]

33. C I, 619–20. See also C II, 410–11; C III, 251, 765; T II, 275–83, 379–80, 419; T III, 385–86.

In using VAT to explain DROP, Marx focuses on the independent changes, i.e. changes in the market evaluations of K and L. He assumes a constant k and, therefore, no effect on the organic composition of capital. In *Theories,* volumes II and III, he analyzes in great detail the effects of changes in the relative prices[34] of the factors of production on the rate of profit.[35]

Marx discusses three cases representing, in turn, changes in each of the two factor prices while holding the other constant, and changes in both factor prices (in the same and in opposite directions).[36]

Case A—changes in the price of constant capital, p_K

An increase in p_K raises VCC. The rate of surplus value s is not affected, since the mode of production k is assumed constant. The level of surplus value S either remains the same (if "the mass of total capital advanced . . . increase[s] to employ the same quantity of labour as before"), or decreases (if "the mass of total capital remains the same"). In either case, S decreases relative to $(C + V)$ and π declines. Similarly, a decrease in p_K causes a rise in π.

Case B—changes in the price of variable capital, p_L

An increase in p_L also leads to DROP. The process, however, is more complicated than in the preceding case. For although a higher p_L decreases VCC in the denominator of π it also decreases s in the numerator of the fraction. Since the change in p_L is of equal magnitude in both places, the net algebraic effect must be downward. Similarly, a decrease in p_L causes an increase in π.

Case C—changes in both factors of production

If p_K and p_L are "equally affected," there is no change in the denominator of π. The rate of surplus value, however, changes in the opposite direction

34. In the earlier formulations (*Theories,* II and III), Marx uses the terms 'prices' and 'values' interchangeably. In *Capital* I, the same analysis is couched in terms of 'prices.' Note 36 below cites examples of both formulations.

35. In his analysis of VAT Marx does not refer to changes in prices in individual branches of the economy, but to their effects on the economy as a whole: "To the individual capitalist it makes a great deal of difference whether the increased productivity of labour (and therefore also the fall in the value of labour-power) takes place within his own branch of industry or amongst those which supply his industry with constant capital. *For the capitalist class, for capital as a whole, it is all the same*" (emphasis added; T III, 227–28).

36. T II, ch. 12, (3)C, 275–289, ch. 5, (2), 380–84; T III, ch. 20, (7)C, 217–36, ch. 23, (5), 382–96.

of the movement of the prices due to the effect of the change in p_L.[37] If both prices move in the same direction but "in different proportions," or if they move in different directions, the net effect reduces the different possibilities to Case A or Case B above.

This, then, is what we find in the manuscripts and what Marx incorporates into his later, published, work. In chapter 25 of *Capital* I ("The General Law of Capitalist Accumulation") he presents in detail the economic mechanism of capital accumulation. He focuses on the commodity aspect of labor-power and the workings of the labor market. He introduces the 'law of the machine' and analyzes the counteracting influences of the labor market on it during the process of capital accumulation. We consider this analysis as consistent with and complementing the VAT version of the manuscripts.

The analysis of chapter 25 focuses on two distinct situations. In the first case, accumulation takes place while k is being held constant. With ongoing accumulation, a point is reached where excess demand for labor drives wages up. The only source out of which the higher p_L can be paid is S. This means that s decreases and DROP necessarily follows. But, since "production of surplus value is the absolute law of this mode of production . . . accumulation slackens in consequence of the rise in the price of labour, because the stimulus of gain is blunted."[38] This is the contraction phase of the business cycle. The same process operates in the reverse direction when a slack labor market drives wages down and the subsequent increase in s leads to accumulation and expansion.

In the second instance, accumulation takes place with increasing OCC. Here, the ongoing accumulation leads to two mutually contradictory results. The pressure on the supply of labor raises wages, while the new technology increases the productivity of labor, which, because real wages remain constant, lowers wages. The subsequent effect on accumulation and π is as described in the first case. The important difference is that in the second instance the changes in VCC, which are independent of changes in OCC, counteract changes in the latter and, in fact, overwhelm them.

Although the increase in OCC coupled with the 'law of the machine' would suggest a rise in π, the independent action of VCC causes it to decline. The process, again, operates in either direction.

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37. s may change not only due to the change in p_L but also due to the change in the number of workers. See, for example, T II, 288. Marx does not consider the case in which the price of the output moves in concert with input prices (and the rate of profit therefore remains unaffected). It is a particular and not a general case. p_K and p_L are determined in the capital-goods and consumer-goods producing branches, respectively. Productivity increases in these branches cause decreases in the input prices, while the price of the output may remain constant, or even increase.

38. C I, 618–19; see also 620.

One question remains to be answered: what is meant by "prices" in the preceding analysis? Competition within the branches creates from the costs and prices of the individual firms, each with its own scale and composition of capital, a common market price. The migration of capital from one branch to another (resulting from differences in the rates of profit) creates out of market prices a 'price of production.' This price covers, for each industry, costs and an average rate of profit. The equalization of the rate of profit stops the migration of capital. The price of production, therefore, refers to an equilibrium situation.

The cyclical DROP, on the other hand, characterized by VCC, expresses by its very nature a disequilibrium situation of an accumulating, expanding economy. Prices of production are therefore not applicable to the analysis of the process of DROP. Market prices, which are unique for the same goods, do not include in all cases equal rates of profit. (Thus, every price of production is a market price, but not every market price is a price of production.) For the analysis of a disequilibrium situation like DROP, market prices are the relevant ones. (See the discussion in *Capital* III, chapter 10). In contradistinction to the comparative statics of prices of production, they express not only the phenomenon of DROP but also the mechanism leading to it.

The Choice Between TAT and VAT—Trend and Cycles

The two approaches to the problem of the rate of profit are contemporaneous in the theoretical development of Marx. They appear side by side in the manuscripts of the same period (1861–65), and are presented as alternative explanations. The manuscripts bear witness to the difficulties Marx encountered in sorting things out in his mind (and on paper) and his problem of accepting either of the approaches as the final theory at this point in his intellectual development.

Marx's indecision as to which of the two approaches to consider as the explanation of DROP is clearly demonstrated by repeated reversals of position. On the one hand, he carefully develops the technical approach to DROP and unequivocally rejects VAT as an alternative theory:

> The rise and fall in the rate of profit—insofar as it is determined by the rise or fall of wages resulting from the conditions of demand and supply (in the labour market) . . .—has as little to do with the general law of the rise or fall in the profit rate as the rise or fall in the market prices of commodities has to do with the determination of value in general.[39]

39. T III, 312.

Further on he admits both approaches as possible explanations of equal weight:

> The ratio between the different elements of productive capital is determined in two ways: *First,* by the organic composition of productive capital. . . . This can only change as a result of a change in the mode of production which alters the technological relationship between the two parts of capital. . . . *Secondly,* however, if one assumes that the organic composition of capitals is given . . . then the *value ratio* can change although the technological composition remains the same [emphasis in the text].[40]

In other places in the manuscripts, he specifically focuses on the value approach as the explanation for the decline in the rate of profit:

> The change in value . . . acts like a change in the organic composition of capital and changes the relative value of the component parts of capital, although the method of production remains the same.[41]

Or, again, in discussing excess capital and excess population:

> . . . there would be a steep and sudden fall in the general rate of profit, but this time due to a change in the composition of capital not caused by the development of the productive forces, but rather by a rise in the money-value of the variable capital (because of increased wages) and the corresponding reduction in the proportion of the surplus-labour to necessary labour.[42]

In view of these two different approaches, exegetes have several choices: reject both interpretations as contradictory and therefore, both false; accept both interpretations as referring each to a different problem (in this case to trends and cycles); or choose one explanation in preference to the other. Since in our view, the theory as presented in *Capital* III is not a natural continuation of the principles of *Capital* I, we have chosen the last alternative. We view DROP as referring solely to a cyclical rather than a secular phenomenon, or to both.

Before we conclude, we must address two arguments in favor of 'trend.' The first of these might argue that the passage we quoted, i.e., that "no capitalist ever voluntarily introduces a new method of production . . . so long as it reduces the rate of profit," was taken out of context. For the passage continues and argues that if the new technology is adopted by the sector as a whole, competition and market forces will bring about "a fall

40. T III, 382–83. For the same juxtaposition, explicitly expressed, see also T II, 380–81.
41. T II, 288.
42. C III, 251–52. See also, C II, 410–11; T II, 228.

in the rate of profit . . . which is, therefore, independent of the will of the capitalist."[43] We do not see a contradiction in this analysis to the argument we are advancing. If the new method of production is generally adopted, not only prices but also costs of production decrease. The problem, thus, revolves on whether prices will fall enough faster than costs to drive down the general rate of profit. We believe, that each successive investment is evaluated on its merits. Competition may indeed drive down the rate of profit from that accrued to the initial investor (Schumpeter's 'innovator') and dissipate the extra profits, but the process will come to a halt when the marginal capitalists discover that for them the 'law of the machine' does not hold. In addition, it is important to note that Marx, in this passage, abstracts from changes in the rate of surplus value imposed by the new technology. It is clear that the rate of surplus value can rise sufficiently to prevent the rate of profit from falling. It is exactly this prerequisite for investment which we call the 'law of the machine.' Finally, since the analysis of DROP in the above-quoted passage deals with competition (i.e., market forces), it belongs to the second approach to the theory of DROP, VAT.[44]

The second argument maintains there are limits to the increases in the rate of surplus value which might ultimately constrain the compensating process and cause the rate of profit to fall. In a well-known passage, Marx talks about "impassable limits" to surplus value.[45] The passage refers, however, to absolute surplus value (which obviously cannot be increased by lenghtening the working day beyond a point fixed "by nature always less than 24 hours"), rather than to relative surplus value, with which we are concerned. That the passage deals with the former is evidenced by its being found in Part III—"The Production of Absolute Surplus-Value"— and by the numerical examples following it.

Again, in *Grundrisse,* where he does address himself to the relative rate of surplus value, Marx argues that "surplus value rises, but in an ever smaller relation to the development of the productive force."[46] But, here again, Marx deals with only part of what constitutes the rate of profit. He does not consider, in that passage, the influence of the rising productivity on the value of the constant capital and, therefore, the relationship between s and q that is the core of our argument. We agree with Marx's analysis in *Capital* III, which comports with his analysis in *Capital* I, that

> the increase in labour productivity consists precisely in that the share
> of living labour is reduced while that of past labour is increased, but

43. See passage cited in note 27.
44. It is difficult to believe that Marx would advance a theory of secular DROP based on the workings of competition, which so many of his interpreters find in the above passage. After all, this is exactly Adam Smith's argument which Marx set out to disprove.
45. C I, 305.
46. *Grundrisse,* 340.

in such a way that the total quantity of labour incorporated in that commodity declines; in such a way, therefore, that living labour decreases more than past labour increases.[47]

This description characterizes investments that meet the criterion of the law of the machine and that will, therefore, be undertaken.

We are thus led to accept VAT (or the cyclical nature of DROP) on several grounds: (i) on the evidence of the chronology of Marx's works, which span a period of over ten years of work and represent the (sometimes painful, as seen by the repeated rewriting) search for an explanation to the problem; (ii) on the evidence of the Marxian analysis, which requires the 'law of the machine' in order to tie changes in productivity to the phenomenon of the rising organic composition of capital and the latter's influence on the rate of profit; and finally (iii) on the evidence of the marginal note revealing Marx's own mature reflections in the matter of DROP.

Conclusion

'Obituaries,' written in recent years about the law of the decline in the rate of profit, are over a hundred years too late. They demonstrate the judgment, arrived at by some at the end of a long debate, that DROP is neither inevitable nor, in fact, possible. We argue that Marx himself laid to rest, not the problem of DROP, but his 'technical approach' to it. Using Marx's own analysis we show in a different way—by means of his 'law of the machine'—what has recently come to be known as the Okishio Theorem (see below, the Appendix, Note B).

We believe that the rate of profit fluctuates, because of changes in the value composition of capital, according to the market phases of accumulation. In Marx's terminology, this can be expressed as a contradiction between the forces of production (OCC) and the relations of production (the market forces of VCC). Marx is logically compelled to accept VAT, for if he is interested in arguing that DROP is a unique phenomenon, characteristic of capitalism, he has to find the reasons for the decline in the specific features of that form of economic organization. The production function (Marx's 'productive forces') cannot serve for this purpose because it is not limited to the capitalist system. Only 'production relations,' unique to capitalism, are connected to the structure and organization of the economy: markets, and social relations between the owners of the factors of production.

A secular trend may, in fact, exist; but, if it does, it is not caused by the increase in the organic composition of capital.

47. C III, 260–61.

APPENDIX

NOTE A

The distinction of the three kinds of composition of capital used by Marx in connection with DROP, which we consider central to the theory, was recognized to various degrees by Moszkowska,[48] Shibata,[49] Okishio,[50] Morishima,[51] and others. Among the few who fully integrate the three concepts of the composition of capital into the theory of DROP are Fine,[52] Fine & Harris,[53] Weeks,[54] and one of us.[55]

We differ from Fine, Harris, and Weeks substantially, however, in regard to both the meaning and significance of value and organic compositions. Fine and Harris (and Weeks, who accepts their definitions and bases his work on them—*Capital and exploitation,* 199) define the value composition as the composition of capital that is affected by the changes in productivity and, therefore, represents the new sets of values of commodities and factors of production. Organic composition, on the other hand, is defined as that composition of capital in which the growing amount of the constant capital—expressed in original values—directly reflects the increase in the means of production, i.e., in the technical composition (*Rereading "Capital,"* 59, 60; *Theories of the capitalist economy,* 117). In other words, costs are expressed in old but higher values, whereas revenues are expressed in new and lower values.

We find it difficult to accept this interpretation for a number of reasons. We find no evidence in Marx, nor any reference to such evidence in Fine, Harris, and Weeks, (a) that Marx considers the organic composition as expressing "old values" and the value composition as "new values"; (b) that it is the value composition that absorbs the changes in values brought about by the rising productivity. On the contrary, we find that the defini-

48. Natalie Moszkowska, *Das Marxsche System, ein Beitrag zu dessen Ausbau* (Berlin, 1929); idem, *Zur Kritik moderner Krisentheorien* (Prag, 1935); idem, *Zur Dynamik des Spätkapitalismus* (Zurich, 1943).

49. K. Shibata, 'On the law of decline in the rate of profit,' *Kyoto University Economic Review* 8.1 (1934); idem, "On the general profit rate,' *Kyoto University Economic Review* 14.1 (1939).

50. N. Okishio, 'Technical change and the rate of profit,' *Kobe University Economic Review,* no. 7 (1961); idem, 'Notes on technical progress and capitalist society,' *Cambridge Journal of Economics,* no. 1 (1977).

51. M. Morishima, *Marx's economics* (Cambridge, 1973).

52. Ben Fine, *Marx's "Capital"* (London, 1975); idem, *Theories of the capitalist economy* (New York, 1982).

53. Ben Fine and Laurence Harris, 'Controversial issues in Marxist economic theory,' *Socialist Register* (London, 1976); Fine and Harris, *Rereading "Capital"* (London, 1979).

54. John Weeks, *Capital and exploitation* (Princeton, 1981).

55. S. Groll, *Input relations, production function, and employment in Marx's economic model* (Giv'at Haviva, 1969); idem, *A general equilibrium model of Marx's economic theory,* (Tel-Aviv, 1974, in Hebrew); idem, *Marx's composition of capital and the producer's equilibrium theory* (Giv'at Haviva, 1977).

tion in *Capital* I, 612, which they quote in support of their interpretation, explicitly mentions the organic composition as the one which absorbs the changes in values determined by the increase in productivity.

A second point of disagreement hinges on the question of what determines the organic composition; and what exactly does it 'mirror'? Fine and Harris argue (notes 53 and 54 above) that it is the new quantities of capital in the technical composition, whereas we see the answer in the new productivity levels imposed by the new production technology on the economic sectors and value system. We reason that since the organic composition uses V which represents only the paid part of the labor force, it cannot reflect changes in the quantity of the whole labor force, L, as used in the technical composition.

NOTE B

There are other criticisms of the theory of DROP which do not base themselves on *Capital* I as we do. The best-known of these is represented by the Okishio Theorem. Although our conclusions are similar to Okishio's, so far as TAT is concerned, our approach to the problem of DROP and final conclusions differ from his. Okishio calculates the rate of profit in terms of 'prices of production.' But DROP refers to cyclical disequilibrium situations and therefore should be analyzed by the use of market prices rather than equilibrating prices of production. Secondly, Okishio overlooks the fact that his "cost criterion" is explicitly contained in Marx's 'law of the machine' and is therefore relevant to the discussion in *Capital* I. Moreover, although he recognizes the possible influence of rising wages on DROP, he fails to provide a mechanism connecting them to the accumulation process. He therefore ignores the cyclical nature of DROP.

It is of more than historical interest to note that the "cost criterion" which constitutes the core of Okishio's criticism goes back to Marx himself. Okishio credits the idea of Kei Shibata (note 49 above). Shibata was anticipated by Natalie Moszkowska (note 48 above), who, in turn, was preceded by Ladislaus von Bortkiewicz (1906 and 1907)[56] and by M. v. Tugan-Baranowsky (1901),[57] who started the entire discussion.

56. L. Bortkiewicz, 'Value and price in the Marxian system' (trans. from German), *International Economic Papers*, no. 2, (London, 1972), 36–40.

57. M. v. Tugan-Baranowsky, *Studien zur Theorie und Geschichte der Handelskrisen in England* (Jena, 1901).