

From Marx to the Okishio Theorem: a genealogy

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I. Introduction

In the history of ideas it sometimes happens that insights arise full blown and theories are developed without reference to prior formulations. It is more usual, however, to find that a given theory has antecedents and is based, to a smaller or larger degree, on ideas which preceded it. This is the case with the theory that has become known as the Okishio Theorem. The theorem, named after Nabuo Okishio, was first presented in 1961 in Okishio's paper 'Technical changes and the rate of profit,' and deals with a criticism of the Marxian law of the tendential fall of the rate of profit. In presenting his proof that under capitalism the rate of profit is bound to rise rather than decline, Okishio cites Shibata, who cites Moszkowska, who cites . . . , etc. The argument contained in the Okishio Theorem goes back in a straight line to Tugan-Baranowsky and to Marx himself. Its elements can, in fact, be traced to Ricardo.¹ We intend to show that rudiments of this particular criticism of the Marxian law appear in Marx's own, last-published work, *Capital I*. There, Marx proposes an alternative theory of technical change and accumulation which, like the Okishio Theorem, arrives at a rising rather than falling rate of profit in a capitalist economy.

Marx's theory of the decline of the rate of profit (DROP), as published in *Capital III*, is based on the relative size of the two opposing effects of the introduction of technical changes into the economy. On the one hand, competition and accumulation tend to increase the organic composition of capital C/V —the ratio of constant to variable capital; on the other, innovations tend to raise the rate of surplus value S/V , where S is the total surplus value extracted. Profit in Marx's terms, is equal to surplus value, and the rate of profit π is calculated as $S/(C + V)$, the ratio of surplus value to total cost. The rate of profit can be expressed as $\pi = s/(q + 1)$ and clearly depends on s and q (where $s = S/V$ and $q = C/V$).

Since technical changes are assumed to be labor saving, each new in-

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1. Although the theorem can be traced back to Ricardo we will not do so. Okishio agrees with Ricardo, but disagrees with the Marxian conclusion about the falling rate of profit against which he directs his theorem. Since our intention is to investigate to what extent the theorem appears in Marx, we stop our exploration with him and do not extend it back to Ricardo. We shall, however, point to the Ricardian influence in the analysis that follows.

vestment raises q . In contrast, the increase in s is limited by the length of the workday and the value of labor power. Marx believes the effect of an increase in q to exceed that of a rising s and, therefore, to be the basic cause of DROP.

Many of Marx's followers consider this theory of DROP the central Marxist proof of the collapse of the capitalist system. The theory provoked discussions which extended over decades. It was found wanting—for different reasons—by numerous economists. The main argument was that there could be no increase in q without a sufficient increase in s to stop the fall in π . In recent years the most frequent and fundamental criticism of Marx's law argues that technical changes which increase q do not bring about a fall, but rather an increase in π . This is also Okishio's argument, the historio-theoretical roots of which we trace to Marx.

Proceeding in counter-chronological order, parts II to VI trace the theorem's heritage through Okishio, Shibata, Moszkowska, Bortkiewicz, and Tugan-Baranowsky, respectively. In part VII we discuss our view of Marx's theory of DROP which differs from the generally accepted one. We argue that not only can one find the constituent parts of the Okishio Theorem in Marx, but that Marx would have supported the Okishio result if only he had lived to work out his analysis.

II. *Okishio*

Okishio addresses the central question: Given the two opposing effects of accumulation on the rate of profit, why must π necessarily decline? Why should the impact of the organic composition of capital be stronger than that of the rate of surplus value?

To answer the question, Okishio presents the Marxian argument by introducing a measure of his own $C/(V+S)$, the organic composition of production, in place of the Marxian C/V . The measure expresses explicitly the proportion between indirect and direct (rather than living) necessary labor. The main reason for the introduction of the new measure is to show that its inverse constitutes an upper limit to the Marxian rate of profit: $S/(C+V) \leq (V+S)/C$.

It is clear that even in the most favorable case for the employer where workers are completely unpaid ($V = 0$), the rate of profit cannot exceed S/C —in which case it equals the right side of the inequality. With $V > 0$, the left side must be smaller than the right. The rate of profit, thus, cannot exceed the inverse of the organic composition of production. Moreover, as the introduction of new techniques increases C , it lowers the upper limit of π . Okishio summarizes the Marxian argument: "Therefore, however high the rate of surplus value may become, the rate of profit cannot exceed the upper limit, which itself decreases as time passes by" (1961, 89).

But is Marx right? Okishio rejects the argument and 'improves' on Marx in three ways:

i) He redefines the objective of the capitalists. "Marx thought that capitalists are compelled by competition to introduce new techniques which raise productivities of labor" (p. 91). Okishio objects to this emphasis on productivity and argues that, "in the capitalistic economy, capitalists choose a new production technique, above all, according to cost criterion. Even if there were techniques which increase productivity of labor greatly, they could not be introduced by capitalists, unless they reduce the cost of production" (p. 91).

The two criteria are not synonymous, and the difference between them is crucial to Okishio's argument: "As capitalists' criterion is cost criterion and not productivity criterion, the new production techniques introduced by capitalists do not necessarily raise productivities of labor, though necessarily cut down cost of production" (p. 87).²

ii) He differentiates between basic and non-basic industries. Basic industries are defined as those industries whose products are, directly or indirectly, inputs into wage-goods industries. This distinction is essential for Okishio's argument since the rate of surplus value is determined by the rate of real wages and the productivity prevailing in the wage-goods industries. Given the real wage rate, an increase of productivity in a wage-goods industry, or in an industry "indecomposable" with it, must produce an increase in the rate of surplus value. He says: "If the production technique is introduced in one of the basic industries and the productivities of labor of some wage-goods increase . . . then, given the rate of real wage, the rate of surplus value necessarily increases. But the changes in production techniques in non-basic industries do not influence the rate of surplus value" (p. 88).

iii) He redefines the rate of profit. Instead of using the Marxian economy-wide aggregates of S , C , and V , he defines π in terms of the productivities and prices of the indirect factors, the direct labor inputs, and the price of the output—holding the real wage rate constant. This allows him to apply the rate of profit to his disaggregated three-sector model, and define π in terms of basic-goods industries alone. Hence, although the average wage rate is identical for each of the sectors, it is clear that only basic industries influence the general rate of profit, since only they enter into the cost calculations. A new technique introduced into a non-basic industry has no effect on the general rate of profit.³

How do these emendations assure a rising rate of profit? The introduction of a new technique in a non-basic industry raises the organic composition of capital in that industry—Okishio accepts Marx's assumption that innovations are, in general, capital intensive. Yet, since the output of that

2. We find in Ricardo, chapter 21 'On machinery,' a similar emphasis on the decreasing cost of production: "the discovery and use of machinery may be attended with a diminution of gross produce" (1951, 390).

3. For a similar view, see Ricardo (1951, 118).

industry (i.e., luxury goods) is not an input into the wage-goods industry, it influences neither the cost of production nor the rate of surplus value. Thus, although the effect of the innovation is a rise in the average composition of capital for the system as a whole, it does not cause DROP.

On the other hand, the introduction of an innovation in one of the basic-goods industries will necessarily raise π . Here the cost criterion comes into play: even if an innovation were to increase productivity and thereby, according to Marx, increase the composition of capital, it would not be introduced by the capitalists unless it reduced costs. Okishio states: "Therefore, we must accept the conclusion that every technical innovation adopted by capitalists in basic industries necessarily increases the general rate of profit unless the rate of real wages rises sufficiently" (p. 92).

III. Shibata

Okishio's article opens with the following footnote (1961, 85n): "The idea developed below is found in the unnoticed articles; Kei Shibata: 'On the Law of Decline in the Rate of Profit,' *Kyoto University Economic Review*, July, 1934, and 'On the General Profit Rate,' *ibid.*, January, 1939." We turn to these articles in pursuit of the antecedents of the Okishio Theorem.

Shibata, too, starts from the twofold effect of the introduction of an innovation: the rise in the rate of surplus value and the rise in the organic composition of capital. Most of Marx's critics try to prove him wrong by showing that the increase in s can be of sufficient magnitude to counteract the increase in q and thereby prevent the fall in π . They do this by reference to lower real wage rates or the lengthening of the workday. Shibata elects to join the issue on Marx's own ground: "Marx's contention is concerned with the elevation of the organic composition of capital caused by the increase of productive power, not with the elevation of the value composition of capital from any other causes" (1934, 62). Shibata therefore believes that the only criticism applicable to Marx is one centered on the cases where "the elevation of the organic composition of capital is due to the growth of productive power" (1934, 64).

Shibata, too, divides his system into basic and non-basic industries. He first analyzes the case in which innovations are introduced in non-basic industries (which he calls goods for capitalist consumption), and demonstrates that increases in q of such industries do not bring about DROP. He concludes that, "the organic composition of capital, in so far as it concerns the production of goods for capitalist consumption, is not to be taken into consideration either in the determination of the rate of surplus value (value) or in the determination of the rate of profit (price), no matter what it may be" (1934, 63).

Turning to the basic-goods industries, he introduces changes into his two-sector model which, in each case, increase the organic composition

of the system. He demonstrates that π changes in the direction opposite to the change of prices: The rate of profit falls, remains constant, or actually increases depending on whether prices rise, remain constant, or fall.

Shibata proceeds to show that capitalists invest only in those technical changes that lower prices, or, in his words: "The elevation of the organic composition of capital is, to say the least, possible only where it does not cause a rise in price" (1934, 66). He does this by assuming the same motivation on the part of the capitalists which Okishio later calls the cost criterion: "it is usual for the elevation of the organic composition of capital to take place only where it brings surplus profit by lowering the cost of production—which, in the end, brings about a fall in price" (1934, 67).

Okishio and Shibata use very similar models. Both use three-sector models and differentiate between basic and non-basic goods industries. (Shibata uses money as one of his sectors, but this does not constitute an essential difference.) Okishio uses Shibata's cost criterion, but does not express it in terms of the requirement for prices to decline.

The important feature in Shibata is the emphasis on the connection between productivity and the organic composition of capital—a connection which Okishio deems uncertain and mentions only in passing: "Without statistical investigation, we cannot settle the question, whether production techniques raising productivities of labor increase the organic composition of capital" (1961, 87).

For Shibata, on the other hand, the introduction of a new technique raises both q and the level of productivity. The rise in productivity becomes an essential feature of the increase in the organic composition of capital.

In his 1934 article Shibata has three footnotes. In them he cites Moszkowska (1929), Bortkiewicz (1907), and Tugan-Baranowsky (1905). We investigate these in turn.

IV. Moszkowska

Natalie Moszkowska published three books: *Das Marxsche System—Ein Beitrag zu dessen Ausbau* (1929), in which she presents her theoretical model; *Zur Kritik Moderner Kristentheorien* (1935), in which she critically discusses various theories of economic crises; and *Zur Dynamik des Spaetkapitalismus* (1943), which sums up the previous two books and applies her model to several actual problems. Unfortunately, none of these important books has been translated into English.⁴

Moszkowska, too, deals with the conditions required for substitution of capital for labor power, the problem treated by Marx in *Capital* I. She,

4. All quoted passages are translated by the authors. A discussion of some of the major points of Moszkowska can be found in Sweezy (1942). We are indebted to an anonymous referee for drawing our attention to the paper by Karl Schoer (1976) where a concise presentation of Moszkowska's analysis concerning the falling rate of profit can be found. Schoer, however, does not deal with the interrelationship between the rate of surplus value and the rate of profit.

like Shibata, emphasizes the crucial importance of changes in the productivity level. The rate of profit declines as a result of technical progress *only* if the increase in the organic composition of capital is not accompanied by a sufficient rise in the productivity of labor. Under capitalism such a rise in productivity is assured because only those machines are introduced into the production process which save more *paid* labor than the cost of the machines.

Moszkowska argues that, although the organic composition increases with technical progress, labor productivity increases as well. The increase in productivity in turn decreases the value and the price of the constant capital and thereby lowers the increase in q . Also, the increase in productivity in the wage-goods industries permits the decline in the nominal wage rate, keeping the real wage constant. This process increases the rate of surplus value. Therefore, both effects of the rising level of productivity affect the rate of profit positively: technical progress causes the rise rather than the fall of the rate of profit (1935, 46).

Okishio's cost criterion is based on this mechanism. It is a restatement of Moszkowska's conditions for the introduction of new machines, i.e., the cheapening of the cost of production.

Moszkowska's encompassing analysis focuses explicitly on the relationship between the rates of growth in the means of production and the productivity of labor. The higher the labor productivity, the (relatively) lower the composition of capital, and the higher the rate of surplus value (1935, 50–52; 1943, 24–25). She defines a limiting case where “the newly introduced machine replaces as much paid labor as it cost” (1929, 37), or where the growth rate of labor productivity (as compared to the growth rate of the means of production) is just enough to prevent DROP (1929, 37, 74). If the rate is below this border line (*Grenzfall*), no new machine will be introduced. Above the limiting case, introduction of the new machine saves more in paid labor than it cost and consequently raises the rate of profit.

Moszkowska analyzes the effects of an innovation by distinguishing the case in which the new technique is introduced simultaneously in all sectors of the economy, from the one in which it is introduced in only one of the three sectors which comprise her model. Each of these cases is analyzed first under the assumption of constant real wage rates (i.e., decreasing nominal wage rates and therefore an increasing rate of surplus value) and then constant nominal wage rates (i.e., increasing real wage rates and therefore a constant rate of surplus value).

If the new technique is introduced simultaneously in the entire economy and labor productivity rises equally in all sectors, then: i) with constant real wages and the rate of surplus value increasing, the rate of profit remains constant in the limiting case and increases in the rest of the cases;

ii) with nominal wages constant and therefore a constant rate of surplus value, the rate of profit falls in the limiting case and remains constant in the rest of the cases. To sum up: with constant real wages the rate of profit cannot fall, while with constant nominal wages it must fall or, at best, remain on its previous level (1929, 71–84): “Accordingly, the ‘law of the tendential fall of the rate of profit’ means that either the rate of profit falls, or the rate of surplus value increases. The fall of the rate of profit as well as the rise of the rate of surplus value is conditional. The rate of profit falls if the rate of surplus value does not rise, or does not rise enough, and vice versa.” (1929, 83–84).

Moszkowska refers to the case in which the new technology is introduced in only one sector as the problem of the partial composition of capital. This corresponds to Okishio’s division between basic and non-basic industries (1929, 42–71). Besides the direct effects on the sector in question, the introduction of new technology has indirect effects which bring about changes (in all cases but one) in the rest of the economy.

Assuming constant real wage rates, if the new technique is introduced into sectors I or II (means of production or wage-goods industries, respectively), the direct effect is a cheapening of the commodities produced in the relevant sector. Since these become inputs into the other sectors, there is an overall, indirect effect on the economy as a whole. Thus, the impact of innovations in either the wage-good or the means-of-production industries is a rise in π and a redistribution of income in favor of capitalists in all sectors. If, however, the new technique is introduced in sector III (luxuries industry), it causes an increase in the real income of capitalists in this sector, but has no impact on the other sectors. It must be remembered that in all these cases, only innovations that meet at least the limiting-case conditions (or Okishio’s cost criterion) are being considered.

Moszkowska elaborates on an analysis used about twenty years earlier by Bortkiewicz, whom she cites and with whom she engages in critical discussions repeatedly in her writings. In her model, each innovation proceeds in two phases. The first deals with the single entrepreneur who introduces the innovation. Since he reduces his costs, but pays prevailing wages and sells at prevailing prices, he earns a transitional *Extraprofit*. The second phase encompasses the effects of the spread of the new technology on the introducing sector and the economy as a whole. The effects depend, as we have seen above, on the specifics of the innovation—such as the sector in which it is introduced—and the assumption made as to the behavior of wage rates.

V. Bortkiewicz

Most of the criticism leveled by Moszkowska against Marx’s law is anticipated by L. von Bortkiewicz. In several papers published during

1906–1907, in which he deals mainly with the transformation problem, he also addresses the theory of DROP. In this paper, we restrict our attention to the points relevant to the Okishio Theorem. According to Bortkiewicz, in Marx the rate of profit can change without any changes in the value of labor power or, correspondingly, in the rate of surplus value. Only changes in the organic composition of capital affect the rate of profit. The theory connects a rising composition of capital with rising labor productivity. Specifically, given constant real wages, an increase in the organic composition of the total social capital causes DROP. Marx considers this the case which prevails in reality (1907a, 36).

Bortkiewicz accepts Marx's assumption that innovations are labor saving (i.e., rising q) and cause the decrease in the quantities of labor necessary to produce commodities. He argues, however, that "under capitalistic production, this . . . [increase in labor productivity] constitutes merely a necessary, but not a sufficient, condition for the introduction of the new means of production" (1907a, 39). The capitalist must expect an equal or higher rate of profit before deciding to introduce a new machine. "Not productivity, but profitability, is here decisive." Thus, capitalism itself guards against DROP. This, again, is an early expression of Okishio's cost criterion.

In his model, Bortkiewicz refutes Marx's argument by starting with the identity

$$1 = (1 + s)U \quad (1)$$

where s is the rate of surplus value, as used above, and $U = V/(V + S)$ is the proportion of labor embodied in the goods produced. (Bortkiewicz calls U Marx's necessary labor or value of labor power.) The identity shows the division of the workday (here set = 1) into necessary labor-time U and surplus labor-time sU . Surplus labor-time, though, depends not only on the rate of profit and U , but also on the average turnover period, δ . Bortkiewicz therefore sets $s = \delta\pi$ (where $\delta = (C + V)/V$) and expresses the initial situation (before the introduction of the new technology) by:

$$1 = (1 + \delta\pi)U \quad (2)$$

The final stage (after the introduction of the new technology) has the corresponding primed magnitudes δ' , π' , and U' (where $U' < U$ because of increased labor productivity, and $\delta' > \delta$ because of the lengthening of the process of production):

$$1 = (1 + \delta'\pi')U' \quad (3)$$

To determine the direction in which the rate of profit changes, Bortkiewicz compares π' and π while holding the other variables constant. He accomplishes this by defining an intermediate stage in which general prices

remain the same although innovating capitalists have already realized the labor-saving $U'-U$, and have, by virtue of having invested in the new technology, extended the turnover period from δ to δ' . These innovating capitalists earn an additional profit though the general rate of profit has not yet changed. Bortkiewicz represents the intermediate stage by:

$$1 > (1 + \delta'\pi)U' \quad (4)$$

He argues that capitalists clearly do not invest unless this inequality is fulfilled, for otherwise they would expect to lose from the new technology.

A before and after comparison of equations (3) and (4) shows that π' is greater, rather than smaller than π and this refutes Marx's line of argument (1907a, 40).⁵

Bortkiewicz ascribes Marx's wrong conclusion to a double error. First, it is wrong to connect a change in the rate of profit with a change in prices. Marx argues that, although the innovating capitalist may earn an extra profit, the overall cheapening of the prices of output due to competition (coupled with the increase in the organic composition) lowers the overall rate of profit (C III, 264–65). This is wrong because "the potential price movements affect the capitalist's product to the same degree as they affect his outlay"—a fact Bortkiewicz incorporates into the above formulas (1907a, 40). The second error flows from the wrong calculations Marx ascribes to the capitalists: "Marx is guilty of a gross confusion of value-calculation and price-calculation" (1907a, 41).

How much of Bortkiewicz do we find in Moszkowska's analysis? Bortkiewicz expresses his cost criterion in only very general terms in inequality (4) above. Moszkowska, on the other hand, analyzes at some length the relationship between the increase in the productivity of labor and that of constant capital required to assure a rise in the rate of profit. However, if we respecify Bortkiewicz' model so as to include the two rates of change explicitly, we find Moszkowska's results implicit in his model.

Let α stand for the rate of growth of δ (and therefore a proxy for Moszkowska's rate of growth of constant capital), and β for the rate of decline of U (and therefore a proxy for Moszkowska's rate of growth of labor productivity). Then

$$\delta' = (1 + \alpha) \text{ and } U' = U(1 - \beta) \quad (5)$$

Insert (5) into (4) and express the intermediate stage in terms of the rates of change:

$$1 > [1 + \delta\pi(1 + \alpha)]U(1 - \beta) \quad (6)$$

5. Neisser (1931, 76–79) points to an algebraic error in the analysis and shows that the increase in π , though possible, is not necessarily assured as Bortkiewicz argues. We are indebted to an anonymous referee for drawing our attention to Neisser's paper.

Substitute $\pi = S/(C + V)$, $\delta = (C + V)/V$, and $U = V/(V + S)$ into (6) and solve for β :

$$\beta > \frac{\alpha}{\alpha + k} \text{ where } k = \frac{V + S}{S} \quad (7)$$

This inequality reproduces in essence the relationship between the rates of change analyzed in great detail by Moszkowska twenty years later: For any given level of labor productivity, there exists a $\beta < \alpha$ sufficient to prevent DROP. This is her limiting case which arrests the fall of the rate of profit. If β rises relative to α , the rate of profit increases. Furthermore, as labor productivity increases (i.e., k decreases) the percentage growth in productivity necessary to maintain condition (7) rises.

Moszkowska's partial composition of capital, which she analyzes in many of her arithmetic cases, also has its origin in Bortkiewicz. As is well known, Bortkiewicz pointed to Marx's error in calculating the transformation of values into prices. Moreover, he showed that this error misled Marx into an erroneous specification of the factors which determine π , and thereby affected Marx's theory of DROP. Marx claims that, given the rate of surplus value, the rate of profit is determined by the totality of all the lines of production, i.e., the total social organic composition of capital. In contrast, Bortkiewicz shows that only those compositions of capital that belong to sectors which determine the components of costs are relevant. Only the sectors involved in producing the means of production, or the products that go into real wages enter into the calculation. Agreeing completely with Ricardo (1951, 132) he writes: "the rate of profit depends only on those amounts of labour and those turnover periods which concern the production and distribution of the goods forming the real wage rate. . . . The rate of profit cannot possibly be affected by the conditions of production of those goods which do not enter into real wages" (1907a, 32. See also 39, 49; 1907b, 209).

By avoiding Marx's errors, Bortkiewicz proves that the rate of profit can remain unchanged despite changes in the organic composition of capital in the luxuries industry, and conversely, that it can change in spite of a constant social composition of capital. He concludes: the origin of profit is clearly located "in the wage-relationships and not in the ability of capital to increase production. For if this ability were relevant here, then it would be inexplicable why certain spheres of production should become irrelevant for the question of the level of profit" (1907a, 33).

Marx's basic error in the theory of DROP lies in neglecting the specific relationship between the productivity of labor and the rate of surplus value. Productivity determines the decrease in cost, but the rate of surplus value determines the increase in profitability.

In his analysis of DROP, Bortkiewicz uses the distinction between basic

and non-basic industries, and redefines the rate of profit as Okishio did more than fifty years later. He cites, *inter alios*, Tugan-Baranowsky who, to our knowledge was the first to criticize Marx's law of the decline in the rate of profit.

VI. *Tugan-Baranowsky*

Michael v. Tugan-Baranowsky's analysis was published in Russian and is not available in English.⁶ We base ourselves on the German translation (1901) of the second, revised Russian edition which appeared in 1900.

Tugan-Baranowsky questions Marx's law while accepting the validity of the labor theory of value. He argues that the former was not a necessary conclusion of the latter. Therefore, it is possible to accept labor as the substance which creates value, while agreeing with non-Marxist theories that reject the distinction between living and past labor in the creation of profit: "The theory of labor value by no means leads to the assumption of a necessary connection between the organic composition of capital (in Marx's terms) and the level of the rate of profit" (1901, 208).

Tugan-Baranowsky points out that Marx himself recognizes the absence of this relationship in individual firms or sectors of the economy. The theory of transformation of values into prices and the equalization of the general rate of profit by means of competition, is based on the assumption that profit in the various sectors of the economy is independent of their organic compositions. Profit for the individual capitalist is determined by the magnitude of his capital, and not by the share of the variable component thereof. Two capitals of equal magnitude contribute equal profits despite differences in their compositions. Tugan-Baranowsky, in agreement with Marx, quotes the well-known passage:

So far as profits are concerned, the various capitalists are just so many stockholders in a stock company in which the shares of profit are uniformly divided per 100, so that profits differ in the case of the individual capitalists only in accordance with the amount of capital invested by each in the aggregate enterprise, i.e., according to his investment in social production as a whole, according to the number of his shares. [C III, 158]

The total social profit, on the other hand, depends solely on the magnitude of the surplus value, which, in turn, depends on the magnitude of the variable component of the social capital. Thus, any change in the rate of profit must, *ceteris paribus*, be due to a change in the social composition of capital.

It is this *ceteris paribus* condition which Tugan-Baranowsky attacks. He

6. Quoted passages are translated by the authors.

points to the productivity of labor as the main feature of the organic composition of capital—a relationship that we have encountered repeatedly in subsequent writers. He emphasizes the influence of labor productivity on the rate of surplus value and constant capital (p. 210). In contradistinction to Marx, whom he accuses of having neglected this influence by assuming a constant rate of surplus value throughout, Tugan-Baranowsky argues that the relative decrease of variable capital which accompanies each technological improvement has no negative influence on the rate of profit. On the contrary, in general, any substitution of machine labor for manual labor, which increases output, also raises the rate of profit. Referring to Marx's completely untenable, imaginary law, Tugan-Baranowsky concludes: "On basis of the labor theory of value we arrive at the conclusion that the replacement of workers by machines not only does not cause a falling, but causes rather a rising, rate of profit" (p. 215).

VII. *Marx*

The lines of criticism of Marx's theory of DROP, which culminate in the Okishio Theorem, are directed against the law as it appears in the third volume of *Capital*. It is legitimate to ask how many of the ideas contained in the criticism can be found in Marx himself, and whether the arguments advanced by the various critics we discussed do not lead to results already contained in Marx.

The essential ideas of the Okishio Theorem are: i) that a cost criterion rather than a productivity criterion best explains capitalist behavior; ii) that a distinction between basic and non-basic industries must be made—a distinction which severs the intimate connection between increases in the organic composition of capital and the rate of profit; and iii) that technical innovations and improvements in cost-producing industries lead to an increase rather than a fall in the rate of profit.

We find all these elements which constitute the criticism of DROP thoroughly covered and integrated into the analysis in volume I of *Capital*. We discuss them in turn:

i) Marx deals with the concept of the cost criterion in chapter 15, where he states the necessary conditions for the introduction of new technologies into the production process. He writes:

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. [C I, 392]

One could call this Marx's machine criterion, or better, his law of the machine. The quote states explicitly that machines are introduced for the purpose of cheapening the product. This includes the cheapening of inputs, for they, too, are considered products. Embodied labor is already materialized in the various means of production. The same is true for paid living labor, whose cost of employment is expressed in values or prices of the products necessary for its reproduction.

Marx, however, is even more specific and states not only the purpose, but also the conditions for introducing the new technologies: "less labour must be expended in producing the machinery than is displaced by the employment of that machinery." Two pages before the quoted passage occurs, he explains that, when a machine saves as much labor as it costs, there is only a transposition of cost, and therefore no economic rationale for change. (In C III, 261–62, Marx provides a numerical example demonstrating such a case.)

Taken together the purpose of investment and the conditions specified above make it clear that the decrease of cost is a direct target of the increase in constant capital by the individual capitalist. However, the general improvement in production causes a general cheapening of both constant and variable capital for all users. On the one hand, the cheapening of the means of production moderates the increase in the organic composition of capital, while the cheapening of wage goods, given a constant real wage rate (assuming, with Marx, that commodities sell at their values or prices of production), makes possible the increase in the rate of surplus value. Both affect the rate of profit positively. Thus, Okishio's cost criterion flows into Bortkiewicz's profitability criterion. Both are contained in Marx's analysis (C I, 319, 325, 604–5, 621, 624).

ii) As to the distinction between basic and non-basic industries: One can find in Marx numerous places where he does not differentiate between the sectors of the economy in the creation of surplus value. On the other hand, we find instances where the distinction which plays such a prominent part in the Okishio Theorem is clearly recognized. We take this as additional evidence of Marx's ongoing search for solutions to the problems he faced in closing his system, and of the existence of stages in his intellectual development.

Okishio writes: "Non-basic industries cannot take part in determining the general rate of profit but only passively accept the general rate of profit determined among basic industries" (1961, 93). Marx, too, realizes that the rate of surplus-value is determined solely by the production techniques

of the basic industries and explicitly states that "an increase in the productiveness of labour in those branches of industry which supply neither the necessities of life, nor the means of production for such necessities, leaves the value of labour-power undisturbed" (C I, 315. Also 319, 604 and 629). Moreover, he connects the distinction between the sectors directly to the rate of profit: "[Increased productivity in the luxuries industries] . . . cannot have the slightest influence on wages, on the *value* of labour-power, since these articles do not enter into the consumption of the workers. . . . Therefore, [it] has no influence on the rate of surplus-value nor, consequently, on the rate of profit insofar as this is determined by the rate of surplus-value" (T III, 349. See also 350).

In his paper, Okishio makes an important distinction: "while production techniques in non-basic industries have no influence upon the general level of profit, they are concerned whether the general level of profit itself exists or not" (1961, 94). He says: "But it is wrong to say that production techniques in non-basic industries have no relation to the general rate of profit at all" (1961, 93).

Marx, too, we believe, recognizes this distinction. He expresses it as follows: "the rate of profit in [the luxuries] sphere enters into the equalisation process of the general rate of profit just as much as that in any other sphere" (T III, 350. See also T II, 423). Marx addresses here the process by which the surplus-value of the non-basic industries is transferred to the rest of the economy. (This levelling process by Marx—as well as Okishio's existence—is accomplished by the adjustment of relative prices of the sectors' commodities. This adjustment redistributes the amount of profits until equal rates of profit prevail in all sectors.)

There is no dispute that non-basic industries contribute to the existence of the rate of profit: The basic industries provide *all* the inputs the economy uses. The rate of profit is calculated as overhead on the costs of these inputs. Therefore, both the means-of-production and the wage-goods used in the non-basic sector are already included in the outputs of the basic sectors.

Moreover, the luxury-goods industries are capitalistic in nature and, like the basic industries, manage their affairs so as to seek profits. They therefore contribute to the existence of profit in the economy.⁷ Marx is even more explicit: "Insofar therefore as increasing productivity in the luxury industry reduces the *number of workers* which a certain quantity of capital employs, it reduced the *amount of surplus-value*, hence all other circum-

7. Michio Morishima (1973, 53) credits Okishio (1963) with the proof that a positive rate of surplus value is a necessary and sufficient condition for the existence of a positive rate of profit. Morishima calls this the Fundamental Marxian Theorem "because it asserts that the exploitation of labourers by capitalists is necessary and sufficient for the existence of a price-wage set yielding positive profits or, in other words, for the possibility of conserving the capitalist economy."

stances remaining unchanged, it reduces also the *rate of profit*" (T III, 350).

It is interesting to note that Okishio explains Marx's failure to distinguish between basic and non-basic industries on the grounds of "his lack of thoroughness in the analysis of the so-called transformation problem. . . . [This] is related to the Marxian formula: the general rate of profit = $m/(c+v)$ " (1961, 95). Although there is no question that Marx committed a serious mistake by leaving his *C*'s and *V*'s in their value terms when he calculated prices from values, the transformation problem is only peripheral to the discussion of the falling rate of profit. Even a correct calculation would not disprove the analysis in chapter 13 of *Capital* III.

iii) Finally, we come to the question of the falling or rising rate of profit. In *Capital* III, Marx undoubtedly presents a theory of DROP caused by an increase in the organic composition of capital. In *Capital* I, however, we find this theory essentially abandoned and replaced by one which sees the cause of DROP not in the rise of the organic composition but rather in the increase of the rate of surplus value due to market forces.⁸ The question therefore arises as to whether the third volume or the first volume should be considered as the ultimate formulation of Marx's ideas.

Different strands of our analysis, ultimately all connected, lead us to the conclusion that *Capital* I should be taken as the decisive expression of Marx's view on the behavior of the rate of profit. Sweezy's dictum (1942, 11) that, "discussions of methodology in economics, as in other fields, are likely to be tiresome and unrewarding" notwithstanding, we start with some brief methodological considerations.

For Marx, the rate of profit which constitutes the driving force of capitalist behavior is determined by the interaction of two equally important factors: the rate of surplus value and the organic composition of capital. In actual operation, in their influence on the rate of profit, these factors are not separable. Still, despite the fact that "economic phenomena are not viewed separately from one another, by bits and pieces, but in their inner connection as an integrated totality" Marx first analyzes each factor in its purity, keeping the other constant, before he integrates them into a complex whole. In this, he follows the methodological approach he describes in *Capital* III (p. 58).

The analysis in *Capital* III is thus a partial one. In chapter 13, where he deals with the law of the falling rate of profit, Marx analyzes the influence of an increase in the organic composition while making the heroic assumption of a constant rate of surplus value. (At most, he allows *s* to rise insufficiently to counteract the influence of a rising *q*.) In chapter 14, he refers to the increase in the rate of surplus value as one of the counteracting

8. For a more complete analysis of this point see our 1987 paper.

factors to his law, but not a determining one. In chapter 15, where he analyzes the contradictions of the law, he assigns a more essential role to the rate of surplus value; still, it remains a counteracting factor which can only restrict or slow the activity of the law but cannot negate it. Marx does not devote as much space to the partial analysis of the rate of surplus value (with the organic composition of capital held constant) though he does present several cases incorporating this assumption in chapter 5.

By forgetting Marx's methodological approach many of his interpreters are misled into accepting the results of the partial analysis of chapter 13 as final. The need to integrate the partial analyses was correctly emphasized by R. Rosdolski (1977, 398–411) and R. Meek (1967, 129–142). Indeed, according to Sweezy (1942, 102n), the absence of such integration (or the clarification of the interrelationship between s and q) causes the indeterminacy of the rate of profit in Marx's analysis.

Marx provides this integration in *Capital* I. There, he focuses on labor productivity as the factor common to both the organic composition and the rate of surplus value, and analyzes the impact of productivity on the mutual relations between them. In the accumulation process, both the organic composition and the rate of surplus value increase: q rises by the addition of means of production, and s by cheapening the value of products which determine the value of labor power (Cf. e.g., C I, 604, 623). The relative strengths of these two effects and their influence on accumulation and the rate of profit are given by what we called above the law of the machine. Because of the condition imposed by this law, the positive effect of the increase in the rate of surplus value on the rate of profit exceeds the negative effect of the increasing organic composition.

Capital I closes the argument we find in *Capital* III, and changes the predicted impact of accumulation on the rate of profit.

A second line of argument concerning the impact of new technology can be briefly stated. Marx views the development of technology, expressed in his forces of production, as the lever for human progress (e.g., C III, 262). To assert that an increase in the organic composition inevitably results in a falling rate of profit blurs Marx's positive view of the role of technology. Barriers to the development of society are not technological, but are imposed by production relations. These are not contained in the organic composition but expressed in the theory of surplus value and the impact of market forces. These two are much more comprehensively integrated into the theory of accumulation in chapter 25 of *Capital* I than in the relevant chapters of *Capital* III.

The third argument concerns the chronology of Marx's writings. We know that the two German and the French editions of volume I were published by him in the period 1867–1875. The third volume was published by Engels in 1894, from Marx's notebooks, written in 1864–1865. Except for a few added remarks, the manuscript was never revised or corrected

by Marx. He himself did not consider it suitable for publication. In a letter to S. Schott written as late as November 3, 1877 he states: "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 remained in that rough state typical of all research at its beginning" (MEW 34, 307).

Additional evidence about the incomplete state of the manuscripts is implied by Engels' statement in a letter to P. Lavrov (April 2, 1883) that Marx had "always kept the state of his work a secret" (MEW 36, 3). Had Marx been ready to publish, he would surely have asked his friend to assist him in the enterprise. Engels says as much in his letter to A. Bebel (August 30, 1883): "You ask how it happened that even I was kept in the dark about how far advanced the thing was? Very simple: had I known, I would not have given him a moment's peace until the work was completely finished and printed" (MEW 36, 56).⁹ Engels, in his preface to the third volume (written October 4, 1894), is quite explicit: "In the case of the third volume there was nothing to go by outside a first extremely incomplete draft" (C III, 2).

Why then the question as to which of the volumes represents Marx's final views? Regrettably, at one point in the Introduction, Engels leaves the impression, undoubtedly *sans volens*, that the manuscripts were in much better shape than they actually were and required only "finishing touches" (C III, 3). The mistaken impression that volume III was written after volume I is reinforced by Engels' practice of referring readers in the later volumes to passages in volume I. We agree, though, with Oakley (1983, 125–6) that, "Although he was not explicit about the incomplete state of the analysis with which he worked or about his reasons for choosing the material that he did, careful readers of Engels' prefaces to both volumes could not miss the state of disarray of the manuscripts. They could consequently draw their own conclusions about the status of the texts that followed." Still, although we do not necessarily agree with the less charitable view of M. Rubel (1968, 1112) that Engels has left a wrong impression,¹⁰ we do hold with Mandel that, in view of the *posteriority* of volume I to the incomplete drafts of volumes II and III, "It is therefore Volume I which allows us the best insight into Marx's view of capitalism" (Introduction to *Capital* I, 1977, 31).

As we have stated above, we find in volume I (chapter 25, 'The general

9. This also explains why Marx did not find it necessary to repudiate the analysis of volume III: his rough draft (*Rohentwurf*) was not made known until after his death.

10. "Nous n'aurons garde de lui reprocher aucune infidélité dans l'établissement des textes, et pourtant nous devons souligner le défaut majeur de son entreprise: il donne l'apparence d'oeuvres 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."

law of capitalist accumulation') a theory which combines an increase in the organic composition of capital and a *rising* rate of profit. A fall in the rate of profit is still possible, of course, but according to this later analysis it is caused by rising wages. Does this constitute an abrupt volte-face from Marx's previously held position?

The two positions are not diametrically opposed. We do not see in them a contradiction between the first and third volumes—as does Boehm-Bawerk—but see them as representing different stages in Marx's intellectual development, each characterized by emphasis on a different process. Already in the manuscripts we find Marx dealing with the question of rising wages and the rate of profit. Yet there, the emphasis is still on the organic composition as cause of DROP. In volume I we find a different emphasis. Early in the period in which he worked on that volume (1865), Marx engaged in a debate with a Citizen Weston (1985, 108). The debate presages his emphasis on market forces. He argues that "the general rise in the rate of wages will ultimately result in nothing else but the general fall in the rate of profit." In volume I he completes the analysis of this process.

Marx does not deal explicitly with the rate of profit in volume I. He extends his analysis of market forces to the rate of surplus value. In this connection, though, a striking note whose significance has been generally overlooked (including by all the authors we discussed) is of interest. We refer to a marginal note, handwritten by Marx in his own copy of volume I, approximately in 1875, and published by Engels in the third German edition, in 1883. The note reads: "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" (C I, 629).

It is significant that Marx added this note to chapter 25, 'The general law of capitalist accumulation,' for this is the chapter where market forces are extensively analyzed and where the organic composition appears. If the analysis of the third volume had still been relevant at the date the note was penned, how could it be possible for Marx to talk about the increase in the organic composition as causing a rise in the rate of profit rather than a fall therein? The note is evidence not only that Marx had changed his mind in this matter, but—more importantly—that he intended to continue working in the new direction.¹¹

In summary, we do not argue that Marx denies the possibility of DROP, but rather that he does not see increases in the organic composition of capital as its cause. We conclude that the Okishio Theorem did not appear

11. In response to his publisher, Marx hints at the possibility of "reworking [volume I] the way I would have done it now, under different circumstances." See letter to Danielson, December 13, 1881 (MEW 35, 247).

parthenogenetically; its constituent elements and its conclusion can already be found in Marx.

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Shortly after Marx's death, Engels wrote in his preface to the third edition of *Capital* I: "It was Marx's original intention to re-write a great part of the text of Volume I, to formulate many theoretical points more exactly, insert new ones and bring historical and statistical materials up to date" (C I, 23).

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