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The Organic Composition of Capital and Capitalist Development

Bob Rowthorn and Donald J. Harris

The question of what is the long term *direction* of movement in the organic composition of capital in the course of capitalist development, and what are the causes and determinants of that movement, still remains an unsettled and unresolved issue within Marxian economics. The question is important because the presumption of a persistent increase in the organic composition lies at the heart of the conception of a law of falling tendency of the rate of profit as an essential law of motion of the capitalist economy.[1] It is important also because the magnitude of the organic composition and its direction of change are an expression of the underlying process of technological change as it affects the level and direction of development of productive forces. Propositions about the organic composition of capital must therefore rest upon and presuppose a proper understanding of the form of the process of technological change.

These matters have been discussed in depth and with great insight by Paul Sweezy in various works.[2] This paper seeks to provide a new perspective on the organic composition of capital by viewing it in the context of a generalized tendency of capitalism towards uneven and combined development. Changes in the organic composition may be seen to have definite causes associated with the specific conditions under which development occurs. But these conditions may be such as to raise the organic composition as much as to lower it, depending on specific historical conjunctures. There exists no a priori case for supposing a uniform long-term tendency in one or the other direction.

Decomposing the Organic Composition

For a start, it is necessary to have a clear definition of terms and of the relationships involved. For this purpose, it is useful to construct a simple model which captures essential structural properties of the economy. It is possible thereby to identify sharply the types of changes which underlie movements in the organic composition. As a basis for this construction, we follow the two-department scheme first suggested by Marx.

Accordingly, assume an economy with only two productive sectors. Sector 1 produces means of production of a single type, called "machines." Sector 2 produces consumer goods, also of a single type. To produce one unit of output, each sector uses specified quantities of labor and machines, as indicated in Table 1. Production uniformly takes one period of given duration, say, a year. Machines last for n years. Workers are paid an amount c of the consumption

Table 1

Production Coefficients

	Machine Sector	*Consumer Goods Sector*
Labor	a_1	a_2
Machines	b_1	b_2
Consumer Goods	0	0

Now, define the following relationships.

1. Labor Values:

(1.1) $\lambda_1 = a_1 + \frac{b_1}{n}\lambda_1 = \frac{a_1}{1 - b_1/n}$

(1.2) $\lambda_2 = a_2 + \frac{b_2}{n}\lambda_1 = a_2 + b_2 \frac{a_1}{n - b_1}$

(1.3) $v = c\lambda_2$

2. Technical Composition:

(2.1) $q_1 = b_1/a_1$

(2.2 $q_2 = b_2/a_2 = \mu q_1$, $\mu = \frac{b_2/a_2}{b_1/a_1}$

(2.3) $q = \alpha q_1 + (1 - \alpha)q_2 = [\alpha + (1 - \alpha)\mu]q_1$

3. Organic Composition:

(3.1) $k_1 = q_1\lambda_1 = \frac{b_1}{1 - b_1/n}$

(3.2) $k_2 = q_2\lambda_1 = \mu k_1$

(3.3) $k = \alpha k_1 + (1 - \alpha)k_2 = [\alpha + (1 - \alpha)\mu]k_1$

4. Value Composition:

(4.1) $\omega_1 = k_1/v$

(4.2) $\omega_2 k_2/v = \mu k_1/v$

(4.3) $v = ca_2(1 + \mu k_1)$

(4.4) $\omega = \alpha\omega_1 + (1 - \alpha)\omega_2 = k/v$

The following observations may be made concerning these relationships. The *labor value* of each output λ_i is straightforwardly defined to be the sum of direct ("living") and indirect ("dead") labor employed in its production. The *value of labor power* v is the labor value of the workers' consumption per unit of labor time. The *technical composition* q_i is, as Marx defined it, a measure of the physical amount of constant capital used per unit of labor. In this sense, it may be said to represent the degree of mechanization of the production process. This is a scalar quantity which can be directly summed across sectors to obtain the economy-wide aggregate (weighted by α the proportion of labor employed in each sector) because of the assumption that only one type of machine is used. In a more complex model of production with heterogeneous means of production used in each sector and throughout the economy, the physical quantity of constant capital would be represented as a vector of diverse inputs. In that context a scalar measure of the technical composition strictly defined in physical terms either for the individual sector or for the economy as a whole would become problematical.

There is no agreement on a strict definition of the *organic composition* and Marx's own use of terms in this area is rather obscure. For present purposes, this relationship is defined here as k_i, the value of constant capital per unit of labor evaluated in terms of the labor value of machines. It is distinguished from the *value composition*, ω, which is the ratio of the components of the total capital in value terms, consisting of constant capital k_i and variable capital v (assuming that wages are advanced). The latter provides a broader measure than either the technical composition or organic composition and incorporates both of them as component elements.

Starting from these definitions, we are now in a position to identify the conditions which underlie changes in these relationships. Marx's argument in this connection may be interpreted to mean that the technical composition of capital q_i ($i = 1,2$) has a tendency to rise continuously in the course of development, because the average worker either operates more machinery or processes more materials per unit of time. We want to examine under what conditions this tendency is likely to give rise to increase in the organic composition k_i and the value composition ω_i, and what is the pattern of development that would generate persistent increase in the aggregate of these variables.[3] For this purpose, we shall assume throughout that the increase in q_i is always accompanied by, and indeed *causes*, a reduction in λ_i. Thus, to estimate what happens to k and ω we must take into account both the increase in q_i and the consequential fall in ω_i.[4]

Let us examine first the machine producing sector. This sector has a number of peculiarities worth mentioning. First, its organic composition, k_i, is related to production conditions in this sector alone and does not depend on production conditions elsewhere in the economy. This is in constrast with that of sector 2 which is related to production conditions in both sectors 1 and 2 as represented

by k_1 and μ. There is in this respect, one might say, a hierarchical relationship among the sectors. This follows from the assumed condition of asymmetry in the production linkages among sectors: one sector produces inputs for itself and the other but uses no inputs produced by the other. This sort of asymmetry could exist in larger production systems, taking the form for instance, of diagonalization of the matrix of production coefficients with positive elements on and above the diagonal and all zero elements elsewhere. As will become apparent, this feature has definite implications for analysis of movements in the organic composition which emerge sharply in this simple case. But, in this respect it only serves to sharpen results which would take a more complex form under general conditions of interdependence among many sectors.

A second point is that k_1 is uniquely related to the parameters b_1 and n which measure respectively the physical quantity of machines per unit output and the durability of machines; but k_1 is independent of the labor coefficient a_1. Thus, a pure labor-saving innovation which reduces a_1 without affecting b_1 or n will increase q_1 but have no effect on k_1. The reason for this is clear. Though the innovation raises q_1 by reducing the coefficient of direct labor, it also has the consequence of reducing λ_1 and these two effects are exactly offsetting so as to leave the magnitude of k_1 unchanged. If innovation is of the type which increases machine-use per unit output ("capital-using"), either through increase in the quantity of machines employed b_1 or in the annual depreciation of machines 1/n, then k_1 will certainly rise along with q_1. But the opposite would be the case if innovation decreases machine-use ("capital-saving"): then b_1 or 1/n will fall and so too will k_1.

A third point concerns the interpretation of k_1. To produce a gross output of one machine, b_1 machines must be employed, of which b_1/n are used up. Hence, the net output of machines equals $1-b_1/n$, and the number of machines employed per unit of net output is $b_1/(1-b_1/n)$. Thus, in sector 1, the organic composition coincides with what is commonly called the "capital-output ratio in real terms". This has a striking implication: a rise in the organic composition occurs in sector 1 if and only if the physical quantity of equipment in use in this sector increases in relation to the net output produced by this sector. Or, to put it differently, if and only if the physical productivity of equipment in sector 1 declines. In the case of sector 1, there is a clear similarity between the Marxian conception of a rising organic composition and the neoclassical idea of "diminishing productivity of capital" or "diminishing returns". However, this similarity is specific to sector 1. It arises from the peculiar fact that this sector is really a "one-good economy" which produces its own means of production. In general, with interdependence in production among many different sectors using heterogeneous inputs, no such similarity exists and the analogy with the neoclassical approach breaks down.

As it stands, the above argument tells us little about the actual behaviour of k_1 as the economy develops. It could rise or fall, depending on the exact nature of

technical progress. For instance, if there occurs a great wave of innovatory investment in sector 1, output per worker may rise dramatically with a relatively small increase in the physical amount of equipment per head. In this case k_1 will fall. This is quite likely to be the case in the early phase of a long-wave, when there is a stock of radical inventions waiting for implementation. Towards the crest of a long-wave, however, when the stock of radical inventions is largely exhausted, the situation will be very different. To produce a relatively small increase in output per worker will then require a considerable investment and, as a result, k_1 may rise. This example provides some indication of what may happen to the organic composition in the course of a long wave as the stock of inventions becomes gradually exhausted. It also gives substantive meaning to the idea that investment may become less productive in the course of expansion, hence to the idea of "diminishing productivity of investment". Now, although plausible, such an argument may not always hold in practice. It may not be true that investment opportunities are exhausted in this way in the course of expansion. And, even if they are, the result may not always be a decline in the productivity of investment, as conventionally measured, or a rise in the organic composition. Moreover, even if the organic composition does rise in the expansionary phase of individual long waves, the above argument still tells us nothing about its behaviour over a much longer period of centuries during which a number of such long waves may occur. In this latter context, there is simply no reason to suppose that the physical productivity of investment in manufacturing industry (which is the arena to which this analysis properly applies) will suffer a *permanent* decline. Marx himself provided no such reason, and neither has anyone else.

There is one special case which deserves special mention because of its historical importance. Consider an economy in the early stages of industrialization where machines are still made largely by hand. Analytically, we may represent such a situation by assuming that $b_1 = 0$. This implies, of course that both $q_1 = b_1/a_1 = 0$ and $k_1 = b_1/(1 - b_1/n) = 0$. Now, suppose that mechanization begins in the machine-making sector itself, so that machines are used to make machines. Denote by b_1^* and l_1^* the amount of machinery and labor, respectively, required to produce one unit of gross output in the new situation, and suppose that machines have a lifetime of n^* years. Clearly, $a_1^* > 0$. Hence, for the new technique, the technical composition $q_1^* = b_1^*/a_1^*$ is positive, and so too is the organic composition $k_1^* = b_1^*/(1 - b_1^*/n^*)$. Thus, in the transition from hand-made to machine-made machines, the organic composition in the machine-making sector rises from zero, or near zero in practice, to some positive amount. This is the one case in which mechanization in this sector *always* involves an increase in the organic composition. However, once the machine-making sector is already mechanized, further mechanization may be accompanied by either a rise or fall in the organic composition, depending on the exact nature of technical progress.

The preceding discussion concerns the situation viewed from the standpoint of the machine-making sector. Consider now the sector 2 which produces consumer goods. Here, one obvious feature, already mentioned above, stands out. The organic composition in sector 2 depends on production conditions in sector 1, but not the other way around. This one-way effect operates through the labor value of machines used in sector 2. Given q_2, any change in production conditions in sector 1 which reduces the labor value of machines has the direct effect of reducing k_2. If, as assumed, q_2 tends to rise, then this effect in turn serves as a countertendency. Consequently, the direction of change in k_2, as the outcome of both such tendencies, remains ambiguous depending on which is the stronger of the two.

A second feature of sector 2 can be seen from further consideration of k_2. It is evident that $k_2 = \mu k_1$, where μ is a "structural coefficient" representing the ratio of technical compositions in the two sectors. Thus there are two sets of factors which underlie movements in k_2. One is the process of technical change in sector 1 insofar as it affects movements in k_1. Such movements have a direct one-way effect on k_2 and, other things being equal, on the aggregate organic composition k. In this respect, movements in k_1 may be said to play a distinctive role in the overall movement of k. The other is the process of *uneven development* of production conditions in the two sectors as represented by changes in the structural coefficient. In particular, given k_1, it is the ratio of technical compositions which matters for determining movements in k_2. Hence, it is their relative rate of change which matters. If the technical composition in both sectors increased at the same rate there would be no change in k_2 except for that due to changes in k_1. Note that uneven development in this sense may serve either to reinforce the effect of movements in k_1 on 2, hence on the overall movement of k, or to counteract it. Therefore, the ambiguity in the direction of movement remains, depending on the specific underlying pattern of technical change.

Suppose now technical change starts first in the consumer-goods sector so as to raise the technical composition q_2 in that sector while production conditions in the rest of the economy remain virtually stagnant. This reduces the labor value of consumer goods, λ_2, but has no effect on the labor value of machines, λ_1. The organic composition in sector 2 will therefore rise and, with it, if the distribution of employment remained the same, the aggregate organic composition. Correspondingly, the value composition also rises. Evidently this unambiguous result is due to the specific historical pattern of uneven development assumed to be operating in this case. But as soon as technical change breaks out in sector 1, no matter what specific form it takes, an additional factor comes into play due to the associated changes in k_1 and λ_1. This will tend systematically to alter the previous result, either reinforcing it or counteracting it depending on the specific form of technical change.

So far as movements in the aggregate level of the variables are concerned, an

additional factor which must be taken into account is the weight of the different sectors as represented here by the proportion of employment in each sector. These weights are unlikely to remain constant in the development of the economy and must be considered to vary in specific ways in accordance with the underlying process of technical change itself and with the uneven development of the different sectors. In this connection, it is reasonable to suppose that, as the extension and elaboration of the machine-making sector proceeds along with the growing "mechanization" of the production process, the weights will shift in favor of the machine sector. That change, taken by itself, will affect the aggregate variables, the direction of this effect depending on whether $\mu \lesseqgtr 1$.

The preceding analysis makes it clear that even in the simplest model, there are complex changes taking place in the economy which may drive the organic composition of capital in one direction or another. Taken by itself, the organic composition as an aggregate measure (likewise the value composition) gives no information as to exactly what those changes are and how their specific combination differs from one period to another. It is therefore necessary to "go behind" this measure or to decompose it, in seeking to understand those changes. When that is done, some significant results follow.

First, we infer that it is the specific pattern of uneven development taking place in the individual sectors and their combination through the interdependent structure of the economy that determines the overall movement of the organic composition. In this respect we may say that the movement is determined by the underlying process of *uneven and combined development*. Suppose, for example, that technical change in the sectors producing means of production fails to keep pace with technical change in the sectors which use those means of production. The unit values of means of production will rise *relative* to those of output in general, and the result willl be an increase in the organic composition. Such uneven development is frequently ignored in Marxist discussions of the falling rate of profit, yet it was an element in Marx's own conception of this problem, and is often very important in practice.

A second factor, revealed by this analysis, which may account for a rising organic composition, is the conventional one of declining investment productivity. This was referred to by Keynes as the "declining marginal effeciency of investment" and by the neoclassicals as the "declining marginal productivity of capital." This factor derives from the possibility that it may become more difficult to raise labor productivity, and to do so may require the use of ever larger doses of fixed capital. In no matter what sector it occurs, and for whatever reasons, such a decline in investment productivity will tend to increase the organic composition both in the sector itself and, possibly, in other sectors which depend on it. Many Marxist versions of the falling profit rate theory are of this variety. Although differing from the neoclassicals as to exactly why productivity is declining, they share with them the notion that such a decline is

what explains the falling profit rate.[5]

In what follows we argue the case for significance of uneven development as a factor determining movements in the organic composition in the actual historical course of capitalist development. Brief attention is given to the question of what role diminishing productivity of investment might play in that process.

The Development of Capitalism

The basic general point to be made here is that any analysis of the historical development of capitalism must recognize that capitalism develops unevenly. This is so in two distinct senses.

First, capitalism comes into existence initially in certain particular sectors and regions, and in an environment of non-capitalist relations of production with which capitalist producers must interact for the purpose of securing some of their requirements of production and consumption. Only by a subsequent process of expansion and development does capitalism subordinate these non-capitalist spheres. Even today this process is by no means complete.

Second, within production activities already established on a fully capitalist basis there is a recurrent pattern of uneven development. This is associated with the process of technological change, the evolution of new production sectors and regions and retardation of older ones, the concentration of capital, and so on.

Our basic thesis is that long term movements in the organic composition of capital can be understood only with reference to this dynamic of uneven and combined development.

The fact that technological change and sectoral expansion rates of different industrial sectors is highly uneven is readily apparent from cursory examination of the historical record. Viewed in broad terms, one can distinguish a number of phases occurring over the past two centuries:

1. Early 19th century: fast technical progress in consumer goods production, slow progress in transport and production of means of production.
2. Middle 19th century up to World War I: transport revolution, more advanced techniques of production in making means of production.
3. World War I to the present: consumer goods dynamism accompanied by dynamism in production of means of production. Underlying details of these broad trends have been well documented in a large number of studies. These studies confirm the existence of a general pattern of unevenness in the dynamsim of technological change as between different sectors of the economy of any given country, as well as differences in timing and sequencing of changes across countries.[6] The recent work of Chandler is of special interest and relevance in this

regard.[7] In a comprehensive overview of United States experience, this work shows that, in the period examined, the technological change occurs at first more slowly in production than in distribution. In both cases, the change derives from prior changes in transportation and communication infrastructure. The revolution in production itself waits upon the invention and application of machinery. Machine processes first revolutionize the "mass production industries" through an increased rate of "throughput" (economies of speed). This has the noted consequence of raising capital per worker in those specific industries. But the possibility of achieving high rates of throughput depended on the basic technology of the existing production processes in different sectors of the economy. Consequently, in certain sectors where there were obstacles to the use of machine technology, mechanization was delayed and those sectors (such as agriculture, construction, mining, and metal working) remained relatively "retarded," some even until today. The revolution in the metal working and machine making industries, when it did come, was especially dramatic and far reaching.

Viewing this particular experience, as well as the more general picture, one could say that in the early period means of transport were very expensive and this tended to raise the organic composition of capital via the cost of raw materials. This effect was compounded by another arising from the relations of trade between capitalist and non-capitalist producers and the uneven development of the two spheres. In particular, insofar as labor productivity rose faster in capitalist production units than in non-capitalist units due to the greater technical dynamism of the former, this would have tended (under market competition) to shift the terms of trade against capitalist producers, specifically for raw materials and food items versus manufactured goods. Even so, there is a certain ambiguity here in the overall effect, at least as regards the value composition of capital, since raw materials enter in the numerator and food in the denominator of that relation. Similarly, the subsequent revolution in transport was an important factor in cheapening food and raw materials. Again, this would have had a dual and ambiguous effect on the value composition while serving to couteract any prevailing tendency for the organic composition to rise.

The process of mechanization of industry, or the transition from *manu*facture to *machino*facture, is typically identified with a rising tendency of the organic composition of capital. This is the process that Marx himself was closely concerned with and keenly observed.[8] It is now commonly recognized to have been marked by a rise in capital values associated with increased use of machinery, increased throughput, and the like. Nevertheless, it must also be recognized that this process itself was an uneven one. Moreover, that unevenness accounts both for the tendency of capial values to rise and for the operation of forces systematically tending to lower capital values. As regards

the latter, what is of crucial significance is the development and transformaton of the metal working and machine making industries (the so-called capital goods industries). Though the process of transformation may have been delayed in these sectors relative to others, when it does come it has a powerful and continuing impact throughout the entire economic structure.[9] In general, once a fully elaborated and articulated capital goods sector becomes fully established on the basis of modern technology and scientific management techniques, then a process of continuous improvement in labor productivity becomes built into the system, systematically lowering values and prices of capital goods.

At the same time, capitalist domination of production in previously non-capitalist spheres becomes more widespread, subordinating these activities to the dictates of capitalist rationality, competition, and technological change. This must have the consequence of cheapening relative values of the commodities thereby affected. This process is, however, by no means complete. There are still areas in the world capitalist system in which pre-capitalist relations remain entrenched. Within the advanced countries these are mainly in the service sector (e.g.: retail distribution, the legal system, medicine, etc.). Moreover, the demand for many of these services expands in the course of development. They can therefore act as a drag on the system. This will be revealed as a shift in the terms of trade in favour of services against goods. Moreover, it is not simply a question of capitalist versus non-capitalist relations of production. Even in the clearly capitalist services, productivity growth is often much slower than in manufacturing. The same is true even *within* manufacturing and other spheres of goods production where *administration* is often more difficult to revolutionize than the actual transformation of materials. This shows up in practice as an increase in the proportion of total cost absorbed by administration and other similar overheads. This tendency is especially observable in really dynamic economies like Japan. Here, the arguments of Kaldor about dynamic economies of scale in manufacturing may be found to be quite relevant.[10]

In addition to survivals of old forms of production in the service sector (artisan style, petty traders, etc.), there are also major sectors *created* by capitalist development which are shielded from competition and this contributes to their lack of dynamism. Of these, the most important are the so-called community services (education, health, public administration) most of which are either run by the state or funded by the state. In general, these community services enjoy a monopoly and are shielded by competition. Moreover, they usually provide free or heavily subsidized services (or dis-services!) whose cost is payed by the taxpayer rather than by the direct consumer. As a result, these services are not subject to the law of value as there is no spontaneous economic mechanism which regulates them and forces them to adapt. From this, among other factors, arises the now well recognized problem of the "fiscal crisis of the state."[11]

Typically, Marxists have analyzed the various activities listed above (administration, private and public services) in terms of the distinction between productive and unproductive labor. Whatever may be the advantages or disadvantages of this approach, it seems to us much more enlightening and fruitful to analyze them in terms of uneven development. In fact, what one could say is that a rising organic composition of capial, if and when it occurs, is merely one specific expression of a more general pattern of uneven and combined development. Similarly, the fiscal crisis of the state and all the problems associated with rising service costs are another expression of this more general pattern.

Natural resources, raw materials, and energy play a special role which can also be integrated into this conception. The idea of diminishing productivity of investment is commonly supposed to apply in this particular context, that is, in the context of "limited resources." Now it can be readily granted that there are serious ecological limits to the long-term growth of the world economy. There *are* limited sources of supply of particular raw materials and energy. Their production conditions are subject in some meaningful sense to diminishing returns. But the existence of such diminishing retunrs has always to be considered as being *relative* to a given pattern of use and to a given technology. As such, it constitutes a problem when the volume of demand associated with a particular pattern of use under existing technology runs ahead of what can be produced with that techonology at existing costs and prices. Under these conditions, costs and prices tend to rise. They rise even more sharply, going beyond any relaion to values in such cases, because of the monopoly structure of ownership and property relations peculiar to such commodities. The altered structure of prices and values occurring in those circumstances may in turn generate a tendency for the organic composition of capital to rise. This tendency is then the outcome of the underlying disproportionality in the development process. But, typically, that situation also has built into it mechanisms by which an adjustment takes place both in the pattern of demand and in the existing technology so as to create substitute products (as, for instance, in the case of synthetic fibers) and to shift demand to available and newly created alternatives. This adjustment takes place in part through the response of capitalist producers to the profitable investment opportunities created by the situation of limited supply itself. It is also, in part, the result of deliberate policies of the state. There may, of course, be significant lags in the adjustment process, of long or short duration depending on the peculiar characteristics of particular technologies, on limitations in the scientific principles available to be deployed, and on the social and political changes that are required. There may be a prolonged crisis before the "supply limits" are lifted or until the system adjusts. The admustment itself may entail significant structural transformations. But the adjustment has usually occurred, and in finite time, in all significant cases from past development of capitalism.

Whether there are absolute and insuperable barriers to be hit upon in the future seems not a matter of worthwhile speculation.

Conclusion

The preceding discussion suggests that any tendency for the organic composition of capital to rise (and, associated with this, a falling tendency of the rate of profit arising from this cause) is (1) a historically contingent circumstance associated with and derivable from a general process of uneven and combined development taking place within capitalism, (2) not a "general law" derivable from the inner logic of capital.

The supposed tendency towards rising organic composition of capital, if and when it appears, is ultimately brought to a halt by the very process of capitalist development itself, insofar as that process entails

1. successive and successful incorporation into capitalism of spheres of economic activity that were previously operated on a non-capitalist basis.
2. elaboraton and consolidation of a full-fledged capital goods industry having a built-in capacity to reduce values of produced means of production.
3. adjustment processes induced by the underlying disproportionalities that the development process generates.

If these arguments hold, then it makes no sense to propose one type of effect, that of a rising organic composition of capital, as the dominant and fundamental tendency, while the other effect which counteracts it is supposed to be a merely incidental and accidental countertendency. Such an approach amounts to pure mystification.

Finally, the arguments presented here lead us to question whether the concept of the organic composition of capital itself is a meaningful expression of the complex and diverse conditions and the changes occurring in them over time that this concept is supposed to measure. Like all such one-dimensional measures of a complex reality, it may disguise much more than it actually reveals.

We end up, then, with the conclusion so succinctly expressed by Sweezy four decades ago: "Behind the rising organic composition of capital lies the process of capital accumulation, and it is here that we should look for forces which tend to depress the rate of profit."[12]

Notes

1. For an analysis of the relationships involved in this conception, see D. J. Harris, "Accumulation of Capital and the Rate of Profit in Marxian Theory," *Cambridge Journal of Economics*, 7 (September/December, 1983), pp. 311-330, and "Are There Macroeconomic Laws? The "Law" of the Falling Rate of Profit Reconsidered," in *The Economic Law of Motion of Modern Society: A Marx-Keynes-Schumpeter Centennial*, M. J. Wagener & J. W. Drukker, eds., New York: Cambridge University Press, 1985.
2. See, for instance, P. A. Sweezy, *The Theory of Capitalist Development*, New York: Monthly Review Press, 1956, Chapter 6; *Modern Capitalism and Other Essays*, New York: Monthly Review Press, 1972, pp. 127-146; "Some Problems in the Theory of Capital Accumulation," *Bulletin of the Conference of Socialist Economists*, No. 6 (Autumn, 1973); *Four Lectures on Marxism*, New York: Monthly Review Press, 1981, pp. 46-54.
3. We ignore the unusual and uninteresting case of a reduction in q_1.
4. This was recognized by Marx in arguing that mechanization in the machine-making sector brings with it its own countertendency: on the one hand, it increases the number of machines used per worker in this sector; but, on the other hand, it reduces the unit value of these same machines. He goes so far as to suggest that "the mass of the elements of constant capital may even increase, while its value remains the same, or falls." But, without further argument, he dismisses this possibility as occurring only "in isolated cases." See, *Capital*, Volume III, New York: International Publishers, 1968, p. 236.
5. This is the interpretation given to E. Mandel's falling profit rate theory in R.E. Rowthorn, *Capitalism, Conflict, and Inflation*, Austin: University of Texas Press, 1980, Chapter 4.
6. For a relevant discussion of European experience, see I. Svennilson, *Growth and Stagnation in the European Economy*, Geneva: United Nations Economic Commission for Europe, 1954. For evidence on the longer-term experience of the world economy, see D. S. Landes, *The Unbound Prometheus*, Cambridge University Press, 1969; W. A. Lewis, *Growth and Fluctations 1870-1913*, London: Allen and Unwiin, 1978; W.W. Rostow, *The World Economy, History and Prospect*, Austin: University of Texas Press, 1978.
7. See A.D. Chandler, Jr., *The Visible Hand, The Managerial Revolution in American Business*, Cambridge, Ma.: Harvard University Press, 1977.
8. See *Capital*, Volume I, New York: International Publishers, chapter 15.
9. For a discussion of these effects see, for instance, N. Rosenberg, *Perspectives on Technology*, Cambridge University Press, 1976, Chapter 1 and 8.
10. See N. Kaldor, *Causes of the Slow Rate of Growth of the United Kingdom, An Inaugural Lecture*, Cambridge University Press, 1977.
11. On this, see J. O'Connor, *The Fiscal Crisis of the State*, New York: St. Martin's, 1973.
12. P. A. Sweezy, *The Theory of Capitalist Development*, p. 105. This was originally published in 1942.