

# The falling tendency of the profit rate re-examined

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## Chapter 1 The falling rate of profit theory

Marx predicted that the capitalist system in would breakdown. He used a series of arguments to justify this prediction, among which are the tendency towards the growing impoverishment of the working class, the tendency towards an increasing monopolization of the economic system, the tendency towards the deepening of the class struggle, and especially the tendency towards a long-term decline of the rate of profit.<sup>i</sup> In this first part of the book I will concentrate myself on this last tendency. Marx agreed with the classical economists when he argued that to maintain the average profit rate above a minimum level is a condition for the survival of the capitalist system. This is because capitalism is based on profits and there is no accumulation of capital if there is no profit to feed and stimulate it. When the profit rate falls below a minimum, which is difficult to determine precisely, the capitalists will no longer be motivated to accumulate capital. They will prefer to save their surplus, causing a crisis in the system. Thus, ever since Marx has demonstrated that the profit rate has a long-term falling tendency, the most general theory on the collapse of the capitalism was at hand. When this tendency takes place over a shorter period of time, it could also serve as an explanation for economic cycles, since the cyclical reversion at the peak of the cycle results from the fall of the profit rate and the subsequent reduction in investments.

In this book, I will argue that it is relevant to discuss the long-term falling tendency of the rate of profit.<sup>ii</sup> This tendency becomes confused with the historical triumph of the capitalist system. For this reason, it is necessary to understand this law or tendency not as a means of predicting the next crisis of the capitalist system, or as a necessary and imminent tendency, but rather as a dynamic tendency which is constantly paralyzed by counter-tendencies and marked by contradictory forces, which Marx even listed and analysed. In this way, this law would be the very expression of the dynamics of the process of capitalist accumulation and of the dialectic character that it assumes. Michael A. Lebowitz states this point of view well when he says “the falling profit rate, which emerges out of production and circulation of capital, out of the forces and relations of production of capital, is the ever-present, the inseparable barrier of capital. The falling profit rate is the negation of capital, and, as dialectics tells us, its existence ensures the growth, movement and development of capital”. (1977: 249)

Capitalist economic development is, therefore, the way by which the capitalist system in continuously *overcomes* the falling tendency of the rate of profit. It is the process of accumulation of capital and incorporation of technical progress that intrinsically characterizes the capitalist mode of production. In this dynamic process, the falling tendency of the profit rate is inherent to the process of the accumulation of capital and of the substitution of capital for labour. However, it is counterbalanced by a series of strategies carried out by the capitalist corporations and the capitalist state, among which the capital-saving technical progress is prominent.

Marx works with three basic relationships: the rate of surplus value, the organic composition of capital and the profit rate. The rate of surplus value, or the rate of exploitation, relates the total surplus value, or

profit,  $R$ , to the total wages,  $W$ :  $R/W$ . In accordance with Marx, this rate determines the relation between paid labour and unpaid labour in terms of value. It is the rate of exploitation of workers by capitalists. In terms of prices, it maintains this characteristic and even becomes a basic rate of the distribution of income.<sup>iii</sup> When the wage rate remains constant at the level of the cost of the reproduction of labour, the rate of surplus value depends on the amount of abstract work needed to reproduce the labour force. When the wage rate rises above this level, the rate of surplus value depends on the bargaining power of the workers, which determines the increases in real wages. In aggregate terms, the rate of surplus value can also be understood as the rate of the distribution of income. The higher this rate, the more concentrated will be the income. Given that in this simplified model income is equal to profits plus wages, the rate of surplus value is directly related to the shares of profits and wages in the income.

The organic composition of capital relates constant capital with variable capital or total wages,  $W$ , both variables being measured in terms of flows and not of stocks:  $C/W$ .<sup>iv</sup> Lastly, there is the profit rate, which relates the total surplus value with the total capital, the latter consisting of the sum of constant capital and variable capital,  $C + W$ . Therefore, we can define the profit rate as

$$r = \frac{R}{C+W}$$

For Marx, as for virtually all other classical economists, the profit rate is the key variable of the capitalist system, in that the accumulation of capital depends on it. The end of the capitalism should therefore be related with the fall of the average rate of profit to such a low level that it discourages the capitalists from investing and leads the system in to stagnation and crisis. To demonstrate that the falling tendency of the rate of profit is inherent to capitalism, Marx developed a simple line of reasoning.

First, it is easy to show that the profit rate depends on the rate of surplus value and on the organic composition of capital. Dividing both terms of the profit rate by  $W$ , we then have in the numerator the rate of surplus value and in the denominator the organic composition of capital:

$$\frac{R}{C + W} = \frac{R/W}{C/W + 1}$$

From this point, we should verify which are the long-term tendencies of the organic composition of capital and of the rate of surplus value. In the short run, the rate of surplus value will naturally vary. In the long run, however, it would be the result of a series of contradictory forces, which would lead to stability or to a slightly rising tendency for this rate. An increase in the rate of surplus value would always be limited by the cost of the reproduction of labour. It could grow in the long run, but this growth would always be less than that of the organic composition of capital.<sup>v</sup>

The tendency of the organic composition of capital to grow is indisputable for Marx. He identifies technical progress or the development of the productive forces, which he considers to be inherent to the capitalist system, as an increase in the organic composition of capital. Per him “this continual relative decrease of the variable capital in relation to constant, and consequently to the total capital is identical with the progressively higher organic composition of the social capital in its average. It is just another expression for the development of the social productivity of labour...” (1894: 212). As the organic composition of capital grows at the same time in which the rate of surplus value remains constant or grows more slowly, the profit rate will necessarily tend to fall.

There are some factors that could determine *counter-tendencies* to the falling rate of profit. Technical progress in the wage goods industry could lower the cost of reproducing labour and consequently raise the rate of surplus value if wages remain constant. On the other hand, the development of capital-saving technology could also reduce rather than increase the organic composition of capital. But for Marx, these phenomena will always be temporary. In the long run, Marx identifies technical progress with mechanization, that is, with technology that saves labour rather than capital. At last, the profit rate will necessarily fall.

An eventual tendency of the rate of surplus value to rise could never compensate the tendency of the organic composition of capital to rise as well. Marx presents us with a logical reasoning for this, using the

concept of the organic composition of production or the capital-output ratio,  $(C + W)/(R + W)$  or  $(C + W)/Y$ . Its inverse is the output-capital ratio, which is a maximum limit for the profit rate.

$$\frac{R}{C+W} \leq \frac{R+W}{C+W}$$

The output-capital ratio will, therefore, always be greater than the profit rate, except in the case where  $W$  is equal to zero. If, for the sake of argument, we admit that the variations of the organic composition of production, or the capital-output ratio, are proportional to the variations of the organic composition of capital, and, according to Marx's assumption, that it is growing, the output-capital ratio (the inverse of the capital-output ratio) would necessarily be falling, and the profit rate, which should always be less, would also fall, as shown in Figure 1.<sup>vi</sup>

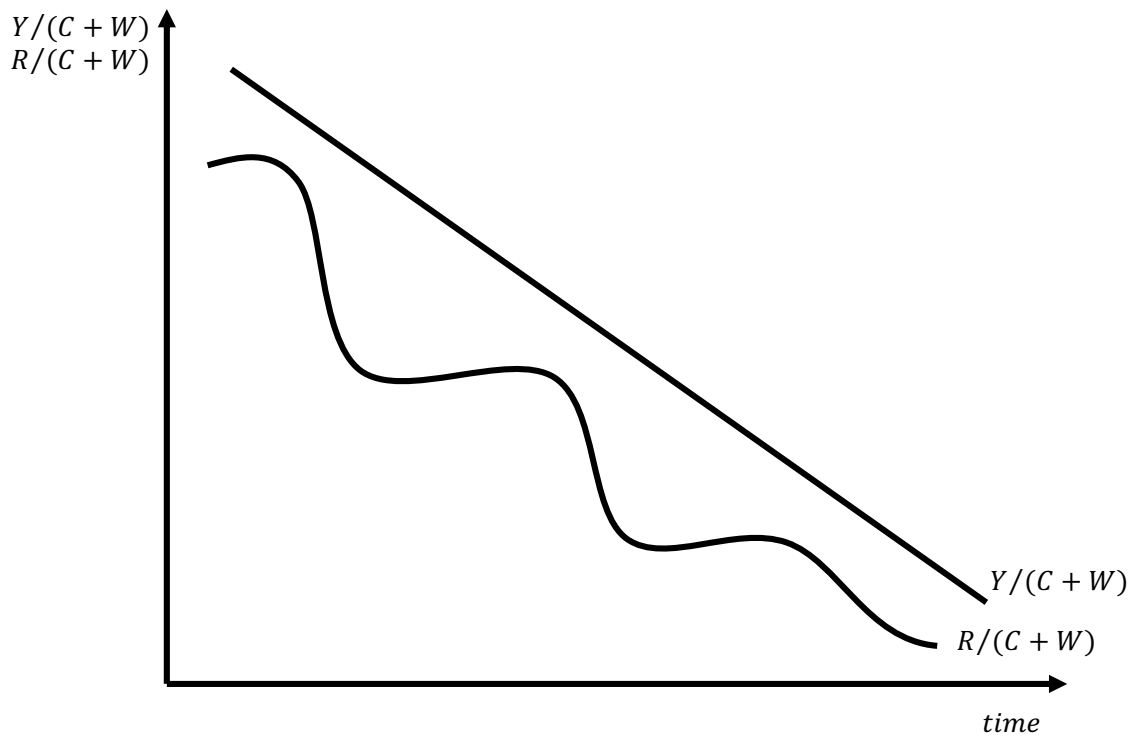
**Figure 1: Profit Rate and Organic Composition of Production**

ENTER HERE FIGURE 1

Of course, this kind of analysis depends on two assumptions: (1) that the output-capital ratio,  $Y/(C + W)$ , is proportional to the organic composition of capital,  $C/W$ ; and (2) that  $Y/(C + W)$  or  $W/C$  are necessarily falling.

The first assumption will only be true if we consider the rate of surplus value,  $S/W$ , and therefore the workers' share of the income,  $W/Y$ , to be constant. This gives us an output-capital ratio proportional to the organic composition of capital multiplied by the wage share:

$$\frac{Y}{C + W} \propto \frac{R + W}{C + W}$$



If we accept as reasonable the empirical or historic assumption that  $W/Y$  tends to be constant, the two remaining variables will then be proportional. However, the assumption that the output-capital ratio is necessarily, or even historically, falling, that is, that the productivity of constant capital is falling, cannot be so easily accepted. It all depends on the kind of technical progress: if it is capital saving, or capital using, or neutral.

Joseph Steindl shows that instead of using the rate of surplus value,  $R/W$ , and the organic composition of capital,  $C/W$ , Marx could have used the profit-product ratio,  $R/Y$ , and the capital-output ratio,  $C/Y$  (ratios that basically correspond to the former). If Marx had done this, he could have more easily shown in a logical way that while the first ratio can grow up to a maximum of 1 (in the limit case in which  $W$  is equal to zero), the capital-output ratio, and therefore the organic composition of capital, can grow infinitely. In these terms, if

$$\frac{R}{C+W} = \frac{R/Y}{(C+W)/Y}$$

And if  $(C+W)/Y$  can theoretically grow infinitely while the limit of the growth of  $R/Y$  is 1, the tendency will be "logically" a falling profit rate. However, it is obvious that this is only one logical possibility and not a necessary result. As Steindl notes, refuting this kind of argument: "The empirical hypothesis on which it is built is not as realistic as Marx doubtless expected. In mature capitalism, the ratio of capital to net product quite probably does not increase at all." (1962: 241) Nevertheless, the economists who adopt an orthodox position in relation to the falling tendency of the profit rate, such as Paul Mattick, David Yaffe and Mario Cogoy, base their arguments mainly on this rational possibility. Using a kind of reasoning that can only show that the organic composition of capital can, logically, grow infinitely, while the growth of the rate of surplus value (measured in the terms proposed by Steindl) is limited by economic laws, Mario Cogoy concludes:

Thus, Sweezy's question, 'Why did Marx feel so sure that the organic composition of capital must rise faster than the rate of surplus value?' is not to be answered with the standard Sweezy answer (because it was so in Marx's time), but by the reply that it necessarily follows from the laws of capitalist production (1977: 64).

But this position is not acceptable. Logical reasoning can help us to understand empirical data, but it *cannot* take their place. If the profit rate depends on the organic composition of capital and on the rate of surplus value, then it is necessary to verify empirically, by looking at history, the behaviour of these

variables. There is no doubt that if the output-capital ratio is falling, the organic composition of capital, given a constant rate of surplus value, will grow and the profit rate will fall. This is a *logical* assertion. But there is nothing to assure us that the output-capital ratio is falling. In Marx's times, when the capital goods industry was still almost artisan, it is possible to imagine that technical progress generally wasted capital. But soon after the industrial methods of mass production were extended to the production of capital goods and from then on, technical progress began to save not only labour but also capital. Since then, the output-capital ratio has not shown any falling tendency.

In the debate between Sweezy and Cogoy, the latter aims at placing the law of the falling tendency of the rate of profit in the centre of the Marxist theory of accumulation and crises. Cogoy wants to see in Marx a theory of economic cycles that is independent from any Keynesian underconsumption theory. The falling tendency of the rate of profit, given its intrinsic and irreversible nature, would be the answer to the problem of the economic cycles. Overproduction would be a result of the fall in accumulation caused by the decline of the profit rate, and not vice versa (Cogoy, 1974: 252-53)<sup>vii</sup>.

It is obvious that cyclical movements are an essential element of capitalist development. But there is *no reason* to disqualify either the theory of the falling tendency of the rate of profit, or the theory of the tendency to the insufficiency of demand, placing them in opposition to each other when explaining the cycle. Even though the second hypothesis should be more plausible, as the movements of the real rate of wages in the period of the cycle is added to it, there is no reason to establish a direct confrontation between the two movements. In fact, insufficiency of demand provokes a reduction in the expected profit rate, and consequently in investment, becoming a determining factor of the cyclical reversion from expansion to recession. On the other hand, it is difficult to admit that the reduction of the expected rate of profit in the reversion process of the economic cycle could be attributed to the factors discussed by Marx when he examines the long-term falling tendency of the profit rate. In the short run, the profit rate falls either because the wage rate increases or because aggregate demand falls. Resulting variations in the technical and organic compositions of capital, derived from technical progress, have little significance when analysing the cycle. The basis for this debate between Sweezy and Cogoy lies in the confusion between the tools for long-term analysis (the law of the falling tendency of the profit rate), with short-term problems (the tendency towards insufficient demand and the wage increase due to the exhaustion of the reserve army). Even though interdependent relations can be established between the two periods, it must be clear that the tendency towards insufficient demand is a short-term problem, central for analysing the movements of the ten-year cycles of the capitalist system, while the theory of the tendency of the organic composition of capital to rise is a long-term question, essential for understanding capitalist accumulation and development.<sup>viii</sup>

In short, the falling tendency of the profit rate can be deduced based on a logical possibility: while the rate of surplus value can grow up to the limit in which the wage rate is zero, the organic composition of capital can grow indefinitely. But this is only a logical possibility that is based on the hypothesis of the necessary decline of the output-capital ratio. However, as we will see later, this decline only occurs if technical progress is capital-using, i.e., if it is identified with mechanization.

## Chapter 2

### Organic composition of capital and wages

As we have ever seen, the profit rate will fall, given a constant rate of surplus value, if the organic composition of capital increases. Thus, the problem is to verify whether the organic composition of capital has the tendency to increase as Marx postulated. Or, in other words, it is essential to know whether the output-capital ratio, which changes as the organic composition of capital changes, has the falling tendency; or, in other words, whether technical progress can be identified with mechanization, as Marx claimed. It is not enough to simply identify technical progress with the increase in the organic composition of capital. It is necessary to verify what kind of technical progress is taking place, if it is neutral, labour saving or capital-saving, and what happens to the wage rate. But, before examining the different types of technical progress, we should look more closely at the organic composition of capital and the wage rate.

#### 1

First we will look at the problem of the wage rate in relation to the organic composition of capital. Although Marx made a distinction, he finally established a strict correlation between the organic composition and the technical composition of capital, as he assumes a constant wage rate. This strategy allowed the identification of the mechanization process, which has a technical nature, with the growth of an economic variable such as the organic composition of capital. The rate, which theoretically should change while the process of accumulation takes place, is the capital-labour ratio or the technical composition of capital,  $C/L$ . Although the tendency of the capital-labour ratio to rise is debatable, we will assume here that this tendency exists.<sup>ix</sup> Considering the wage rate to be constant,  $w$ , and given that total wages depend on the wage rate and the employment level,  $L$ ,

$$W = \bar{w}L,$$

the technical composition of capital will be proportional to the organic composition of capital. If one increases, the other will grow at the same rate.

$$\frac{C}{L} \therefore \frac{C}{wL}$$

Although this assumption of a constant wage rate is implicit in the basic arguments of Marx in favour of the tendency of the organic composition of capital to rise, it is *inconsistent* with the hypothesis of a relatively constant rate of surplus value, given increasing productivity. In fact, Marx could only identify the incorporation of technical progress (or the “development of the productive forces”, per his terminology) with the substitution of capital for labour (mechanization), and this one with the increase in the organic composition if wages were constant. On the other hand, if the wage rate is constant, and if there has been an increase in the productivity of labour,  $Y/L$ , the rate of surplus value will necessarily rise.<sup>x</sup>

In fact, assuming that these variables are continuous functions of time, if  $(\frac{\dot{Y}}{L})$  is the rate of the growth of productivity and  $(\frac{\dot{w}}{L})$  the rate of the growth of the wage rate, and if the former is greater than the latter, then

$$\left(\frac{\dot{Y}}{L}\right) > \left(\frac{\dot{w}}{L}\right)$$

we will have that the product-wage ratio and, therefore, the rate of surplus value would necessarily be increasing:

$$\frac{Y}{W}, \text{ then } \frac{R}{W}$$

If we abandon the assumption of a constant wage rate, the proportionality between the technical composition and the organic composition disappears. Due to the increase in the wage rate, even if the capital-labour ratio increases, the organic composition of capital can be stable or even decline. And, so, any direct relation between the increase of the organic composition of capital and technical progress, the substitution of capital for labour, and the increase in productivity ceases to exist. As we will see in Part III of this book, around 1870, when the wage rate eventually showed a tendency to grow, it became clear the strong downward pressure on the organic composition of capital, which then probably compensated any possible growth of the technical composition of capital, and technical progress turned neutral.

## 2

It is important to distinguish the organic composition from the technical composition of capital. The organic composition relates the constant capital with the number of workers employed in reduction,  $L$ , while the technical composition of capital can be expressed by the capital-labour ratio:  $C/L$ . Some economists, such as Mario Cogoy, confound the organic composition of capital with the technical because, as the latter is not affected by wage increases, it apparently (although not necessarily) tends to grow, confirming Marx's assumption that the organic composition of capital is growing. Joan Robinson makes the same mistake, but for other reasons. Concerned with being consistent with her theory of capital, she prefers to distinguish two kinds of capital:  $K$ , the value of capital given for a certain volume of profit and a discount rate for this profit, and  $C$ , the stock of capital in terms of the dead labour incorporated in capital goods.

On the other hand, to calculate the rate of profit, Robinson considers difficult but necessary to measure total capital in terms of stock, which Marx defines in terms of flow as being equal to constant capital plus variable capital ( $C + W$ ). In these terms, she includes the subsistence goods of the workers in 'c' and then transforms it into a stock variable,  $C$ . By doing this,  $W$  disappears from capital. Or better, when  $W$  is manipulated this way, it is reduced to  $L$ , and the organic composition of capital is defined as being equal to  $C/L$  (Robinson, 1978: 5-6). It is unwise to alter Marx's concepts, be it for proving that he was correct, as in the case of Mario Cogoy, or for becoming more consistent with another theory, as in the case of Joan Robinson.

It is important to point out that those who, as Joan Robinson, use  $K/L$  or  $C/L$  to define the organic composition of capital, do not intend to be taking it as the technical composition of capital. For these authors, there are two possible concepts for the organic composition of capital:

- 1) the organic composition per value,  $C/W$ , which, transformed in terms of price, would be  $K/W$ ; and
- 2) the relation between dead labour and live labour, already expressed in terms of price as being  $C/L$  or  $K/L$ .

The first variation, per Philippe Van Parijs, should be called the "textbook variant" and the second the "modern variant" (1980: 3). Despite the disparaging name given to the first concept, it seems that it is obviously more in agreement with Marx's thinking, and we will continue to use it. By doing this, we can also have a clear distinction between the organic composition of capital and the capital-labour ratio.

The capital-labour ratio approximates the technical composition of capital because, for Marx, the technical composition would always be measured in terms of physical units: both by the number of working hours and by the means of production utilized. As this is impossible to measure in aggregate terms, we use measurements in monetary terms of  $K$ . In these terms, the technical composition of capital will be identified, for all practical purposes, with the capital-labour ratio:

$$\frac{K}{L}$$

Marx knew perfectly well that the productivity of labour was more directly related to the technical composition than to the organic composition of capital. The following passage clarifies both his insistence on relating the tendency of the organic composition of capital to rise with the increase in

productivity (the basis of his thesis on the falling rate of profit) and the reservations he had for measuring productivity by the increase of the organic composition of capital, especially when there was a variation in the wage rate. Marx asserts:

In effect, the value-composition of a capital invested in a branch of industry, that is, a certain proportion between the variable and constant capital, always expresses a definite degree of labour productivity. As soon, therefore, as this proportion is altered by means other than a mere change in the value of the material elements of the constant capital, or a change in wages, the productivity of labour must likewise undergo a corresponding change. (1894: 51).

Mario Cogoy tries to skirt around the problem by making a distinction between the value composition of capital and the organic composition of capital. To do this, he bases himself on the passage of *Capital* in which Marx, after defining the two rates, states:

I call the former the value-composition of capital, 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, 1867: 612).

Per Cogoy, when the value composition does not reflect the modifications of the technical composition, there would be no strict correlation between the organic composition and the technical composition of capital (1974: 238-39). This is a forced and unnecessary interpretation. Its intention is that the organic composition of capital is directly proportional to the technical composition, and therefore, always growing, while the value composition of capital could no longer be proportional due to the variations in the wage rate. In my point of view, the organic composition of capital for Marx is synonymous with the value composition of capital. It is the ratio between constant capital and variable capital, as he often repeats, and not the ratio between constant capital and the employed labour force. The latter ratio is measured by the technical composition of capital. It is not by quoting Marx, which can be open to various interpretations, that one can modify the concept of the organic composition of capital, which for him was so clearly defined throughout *Capital*.

Strangely, in this distinction between the organic composition of capital and the value composition, fundamentalist representatives of Marxism such as Cogoy move toward the economists from Cambridge, who systematically criticize the law of the falling tendency of the profit rate. For the fundamentalists, it would be useful to distinguish the two rates in order to sustain the "logical hypothesis" that the organic composition of capital would always be increasing at the same rate as the technical composition. For the Cambridge school, the value composition of capital (the textbook concept) is distinguished from the organic composition of capital (the modern concept), and this is identified in practice with the technical composition by a question of the internal logic of the theory of capital itself. Depending on the type of technical progress, the organic composition of capital and even the technical composition of capital will not increase.



## Chapter 3

### Types of technical progress

There is technical progress when the productivity of labour is increasing, or, in other words, when the new technology being introduced *reduces* the amount of direct and indirect labour incorporated in the goods and services produced, but the criterion to classify technical progress as capital-using, neutral, or capital-saving is the behaviour of the output-capital ratio, which we also may call the *productivity of capital*. Defined in these terms, technical progress can be measured in two ways. In terms of value, technical progress is given by the reduction of the labour value incorporated in a good. This, however, is a measurement that does not allow for aggregation. On the macroeconomic level, we can measure technical progress in terms of price by the rate of the growth of production per worker  $\dot{Y}/L$ . These two measurements are consistent under certain conditions. An increase in production per worker implies a reduction in the amount of labour incorporated in each good. In the scenario of a balanced competitive economy, this increase in the productivity of labour also implies a reduction in production prices. In this book, we will measure technical progress in terms of prices in keeping with the macroeconomic workability that option presents.

#### 1

Technical progress is an increase of the productivity of labour. There are three kinds of technical progress, depending on the corresponding variation in the productivity of capital, which is measured by the output-capital ratio,  $Y/K$ .<sup>xi</sup> As labour productivity increases, the productivity of capital can either fall, remain constant, or rise. In the first case, the output-capital ratio will be called *capital-using* or mechanization. In the second case, the output-capital ratio will be constant, and technical progress will be considered *neutral*. Finally, in the third case, the output-capital ratio will grow and technical progress will be *capital-saving*.<sup>xii</sup>

Technical progress has a decisive impact on the tendency of the profit rate. Capital-using technical progress will have a negative impact on the profit rate, and the opposite will happen with capital-saving technical progress. This fact becomes clearer and can be expressed more precisely if we assume that the rate of surplus value is constant.<sup>xiii</sup> The adoption of this assumption is not essential and can be immediately abandoned, but it allows for a more precise theoretical analysis, as we thus are adopting the usual alternative of maintaining the other variables constant. We will also use the simplifying assumption of an economy that has no state and not open to other countries. This means that the income is equal to the sum of profits and wages:

$$Y = (R + W).$$

But the assumption of a constant rate of surplus value results in the following:

$$\Delta Y/Y = \Delta R/R = \Delta W/W \quad \text{xiv}$$

By definition, when technical progress is capital-using, the output-capital ratio tends to decrease:

$$(Y/K) \downarrow$$

This, along with a constant rate of surplus value, gives us

$$\Delta Y/Y = \Delta W/W < \Delta K/K$$

As a result, the organic composition of capital increases and the profit rate decreases, as Marx's basic model predicts:

$$(K/W) \uparrow \text{ and } [R/(K + W)] \downarrow$$

Capital-using technical progress can be called mechanization because it theoretically consists of the substitution of labour for capital, without any new technical progress except this substitution, and, therefore, the fall of the price of production of the capital goods in use. In order to have the productivity of capital falling while the productivity of labour grows, we need that the rate of increase of capital be bigger than the rate of growth, which must be bigger than the increase of the labour employed in production:

$$\Delta K/K > \Delta Y/Y > \Delta L/L$$

For this to happen it is only necessary that the average price of the capital goods do not change. This comes from the addition of machines of an equal price and, therefore, of equal productivity. In carrying out this substitution, constant capital,  $K$ , increases more than employment,  $L$ , and, so, more than to total wages,  $W$ , thus provoking an increase in the composition of capital. To justify this substitution, the part of constant capital that is transferred to the product in the form of depreciation must be less than the total wages freed from direct production. But the amount of capital increases more than proportionately in relation to the product, causing a decrease of  $Y/K$ . Given a constant rate of surplus value, profits also increase less than proportionately, and we have the fall in the profit rate.

At a first glance, capital-using technical progress may be in illogical if we imagine that the companies would be substituting more efficient machines by less efficient ones. Obviously, this is not the case here. Capital-using technical progress takes place when *new* tasks or *new* sectors of the production process are mechanized (labour being substituted by machines) and the average productivity of capital falls, because, at a first moment, the companies tend to substitute capital by labour in the sectors that are obviously more advantageous, and then move on to substitute it in the sectors or tasks that are relatively less advantageous – where the machines are not so strongly more efficient than labour. The necessary consequence of such process is lowering the output-capital ratio of the whole economy,  $Y/K$ . This fall will only stop when there are no more tasks that can be advantageously mechanized, that is, sectors where new machines to perform new tasks, although less efficient than the machines that replaced other tasks, prove able to increase of the productivity of labour and a decrease in costs. Or more generally, technical progress ceases to be capital-using when it becomes relatively less important in relation to the alternative type of technical progress, capital-saving, in which machines don't substitute labour but substitute less efficient machines. From this moment on technical progress will probably tend to advance toward a phase in which the productivity of capital stabilizes because capital-using technology is compensated by capital-saving technology.

In Marx analysis, he generally took for granted capital-using technical progress, and therefore mechanization. For this reason, he predicted a reduction of the output-capital ratio, or an increase of the organic composition of capital, and thus an inevitable fall in the profit rate. Of course, there were exceptions and counter-tendencies, but his central reasoning was based on this assumption. Although this kind of technical progress is theoretically possible, and for long periods has proved to characterize capitalist development, as the output-capital ratio has not shown itself to be declining, it does not have been in also long phases of the history of capitalism.<sup>xv</sup>

In the nineteenth century, when Marx made his analysis, the technological innovations were probably mainly of capital-using nature. This kind of technical progress implies a reduction in the average productivity of capital, but it was perfectly justifiable if the new machines that were being introduced were not less efficient and more expensive substituting old machines (what makes no sense to the business entrepreneur), but rather were advantageously substituting direct labour. Whenever new technology implies the introduction of new machines that are more efficient than direct labour but less efficient than the average of the existing machines in an already mechanized economy, *technical progress will be capital-using*, as the average productivity of capital will fall even though the productivity of labour increases. The proviso that less efficient (lower output-capital ratio) and therefore relatively more expensive new machines are used for new activities that are not yet mechanized is important, because the corporation will obviously not substitute more efficient machine for less efficient ones. The simple addition of the same kind of machines being used can also happen. If these machines already in operation have a lower output-capital ratio than the average for the economic system, the addition of similar machines would cause a reduction of the average output-capital ratio of the system, implying capital-using technical progress.

However, as industrialization advances and technical progress is no longer concentrated in substituting direct labour (working with tools) for machines, but rather in substituting more efficient or cheaper machines for less efficient ones, *technical progress of the economy as a whole will no longer be capital-using, but capital-saving*. This process is also accelerated as the capital goods stop being produced by hand to be produced industrially, according to the criteria of efficiency or of the smaller cost, and, therefore, with the introduction of more and more systematic technological innovations.

In the transition from capital-using to capital-saving technical progress, the output-capital ratio will remain constant for a long period, because changes in the output-capital ratio usually change slowly, and *technical progress will be neutral*.

( $Y/K$ ) →

A constant rate of surplus value gives us

$$\Delta Y/Y = \Delta W/W = \Delta K/K$$

and therefore, the organic composition of capital and the profit rate are constant:

$$(K/W) \downarrow \quad \text{and} \quad R/(K+W) \downarrow$$

The assumption of neutral technical progress is conservative and prudent at the same time, as it presupposes a variation that does not affect the other variables. Since this kind of technical progress is the only one consistent with a steady state equilibrium, it is used in the models of economic growth, especially in Harrod's model (Harrod, 1939 and 1966; Hahn and Matthews, 1970). Actually, neutral technical progress is an *average* of capital-using technical progress and capital-saving technical progress. It is historically dominant when the processes of mechanization, which make average capital more expensive, begin to be compensated by the growing introduction of capital-saving techniques.

Finally, we can assume a capital-saving technical progress in which the drop in the price of capital is great enough to determine a rise in the output-capital ratio:

$$(Y/K) \uparrow$$

This case, along with a constant rate of surplus value, gives us

$$\Delta Y/Y = \Delta W/W > \Delta K/K$$

As a result, the organic composition of capital will decrease and the profit rate will rise:

$$(K/W) \downarrow \quad \text{and} \quad R/(K+W) \downarrow$$

Capital-saving technical progress is economically possible, but a profit rate that increases indefinitely is not; economic competition will not allow it.<sup>xvi</sup> However, in order for the profit rate and the organic composition of capital to become constant and the wage rate to increase more than productivity – what will mean the reduction of economic inequality – we only need to abandon the hypothesis of the constancy of the rate of surplus value and imagine a process of reduction of inequality, with wages growing more rapidly than profits. But historically the condition where the output-capital ratio is falling, the rate of plus value is falling, but the capital-wages and the rate of profit is constant only happened after World War II, in the Golden Years of Capitalism, but this will be the exception. In relation to this possibility, it is important to emphasize the dependency of the organic composition of capital in relation to the wage rate and to the kind of technical progress. If the rate of surplus value is constant, there is an inverse relation between the organic composition of capital and the profit rate. When the functional economic inequality (expressed by the surplus value rate) and the productivity of capital (expressed by the output-capital ratio) are falling, the organic composition of capital may be constant or increasing.

$$(Y/K) \downarrow, (R/W) \downarrow, (K/W) \rightarrow \text{ and } (R/K) \rightarrow$$

On the other hand, there is the variable wage rate. When it is growing at the same rate as the increase of productivity, thus maintaining constant the rate of surplus value, the organic composition of capital could be constant (and the profit rate constant), even if the capital-labour ratio grows, given a neutral technical progress. However, accepting Marx's assumption of a capital-using technical progress, the increase of the wage rate leads to the reduction of the rate of surplus value, and even if the organic composition of capital is maintained constant due to the increase in the wage rate, the profit rate would necessarily fall.

## 2

Admitting that the wage rate,  $W/L$ , grows at the same rate as the rate of labour productivity,  $Y/L$ , which seems to be a probable assumption for capitalism from the second half of the nineteenth century on, we can relate this assumption to the kind of technical progress and verify what will be the consequence in relation to the capital-labour ratio or the technical composition of capital,  $K/L$ , the organic composition of capital and the profit rate. We thus verify that the capital-labour ratio itself is not necessarily growing.<sup>xvii</sup>

First, examining just the relation between the kind of technical progress and the technical composition of capital, we must take into consideration labour productivity,  $Y/L$ , the productivity of capital,  $Y/K$ , and the technical composition of capital,  $K/L$ . These variables give us:

$$\frac{Y}{L} = \frac{Y}{K} \frac{K}{L}$$

or in terms of the growth rates:

$$\frac{\dot{Y}}{L} = \frac{\dot{Y}}{K} + \frac{\dot{K}}{L}$$

Therefore,

$$\text{if } \frac{Y}{L} \rightarrow, \text{ that is, } \frac{\dot{Y}}{K} = 0, \text{ then } \frac{\dot{Y}}{L} = \frac{\dot{K}}{L}$$

$$\text{if } \frac{Y}{L} \downarrow, \text{ that is, } \frac{\dot{Y}}{K} < 0, \text{ then } \frac{\dot{Y}}{L} < \frac{\dot{K}}{L}$$

Therefore, if technical progress is neutral, i.e., the productivity of capital,  $Y/K$ , is constant, or if technical progress is increasing i.e., the productivity of capital,  $Y/K$ , is decreasing, the growth rate of the technical composition of capital would be equal to or greater than the growth rate of the productivity of labour. In this case, if the product grows faster than the amount of labour, that is, if  $Y/L$  is growing, it is obvious that the capital-labour ratio,  $K/L$ , would also grow.

However, if technical progress were capital-using, increasing the productivity of capital,  $Y/K$ , the technical composition of capital could still increase, be constant or decline, depending of the growth rate of  $Y/K$  and  $Y/L$ . From the above equation, we would have:

$$\text{If } \frac{\dot{Y}}{K} = \frac{\dot{Y}}{L}, \text{ then } \frac{\dot{K}}{L} = 0, \text{ that is, } (K/L) \rightarrow$$

$$\text{if } \frac{\dot{Y}}{K} < \frac{\dot{Y}}{L}, \text{ then } \frac{\dot{K}}{L} > 0, \text{ that is, } (K/L) \uparrow$$

$$\text{if } \frac{\dot{Y}}{K} > \frac{\dot{Y}}{L}, \text{ then } \frac{\dot{K}}{L} < 0, \text{ that is, } (K/L) \downarrow$$

Therefore, if  $Y/K$  grows more slowly than  $Y/L$ ,  $K$  would grow faster than  $L$  and  $K/L$  would grow. Meanwhile, if  $Y/K$  were to grow at a faster rate than  $Y/L$ ,  $K$  would grow more slowly than  $L$ , and  $K/L$  would decrease. This last assumption is the limit case, so that we do not exaggerate the growing tendency of the technical composition of capital.

Let' us see now the relationship of the wage rate with the rate of surplus value, the organic composition of capital and the profit rate. When there is neutral technical progress, in which  $Y/K$  is constant and  $Y/L$  growing, the growth of the wage rate, which is the same as the productivity rate, is perfectly consistent with the growth of the capital-labour ratio,  $K/L$ , leaving the rate of surplus value and the profit rate constant. The technical composition of capital could be constant, growing or declining, depending on the growth rate of the productivity of labour and of capital. When there is capital-saving technical progress, in which  $Y/K$  and  $Y/L$  are both growing, a growing wage rate will be consistent with a constant rate of surplus value and organic composition of capital, as well as with a declining capital-labour ratio. In the case of capital-using technical progress in which  $Y/K$  is decreasing and  $Y/L$  growing, the capital-labour ratio would tend to grow, as in the case of neutral technical progress. Given a wage rate growing at the same rate as the productivity rate, the rate of surplus value would remain constant and the profit rate decline.

There are other relations between the profit rate, the rate of surplus value, the organic composition of capital, the technical composition of capital, the wage rate and the kinds of technical progress that could be established. Those that have been mentioned, however, are sufficient for the next analysis that we will carry on the long-term tendency of the profit rate in capitalist development. They also allow verifying that any simple relation among these rates is deceiving. For now, it is just necessary is to conclude that any inference about the falling tendency of the profit rate based just on the growing tendency of the organic composition of capital is rushed. Therefore, there is no reason to unequivocally affirm that the tendency of the technical composition of capital or the capital-labour ratio will always be increasing. All the efforts of modern technologists are directed at saving not only labour, but also capital (in the sense of means of production). After all, capital is nothing more than accumulated labour. When there is fast technological progress, during which depreciation should be accelerated, the accumulation of labour does not last long. In these terms, there is a constant effort to develop cheaper industrial machines and systems, as well as less accumulated labour. While capital is also saved, all the accumulation of capital in progress cannot lead to an increase in the capital-labour ratio. The stability of the capital-labour ratio is perfectly

consistent with capital-saving technical progress, in which  $Y/L$  and  $Y/K$  are growing. If technical progress is neutral, increasing  $Y/L$  but keeping  $Y/K$  constant,  $K/L$  should increase. Capitalism is doubtlessly the mode of production defined by the accumulation of capital. But this does not mean that the process of capitalist development is made up of limitless accumulation. Although technical progress can be capital-saving, capitalist development is a process not only of accumulation but also of destruction of capital. The depreciation of productive equipment is fast and tends to accelerate as technical progress accelerates.

To sum up, if not even the technical composition of capital tends to grow as productivity increases, the growth of the organic composition of capital is even less essential. The tendency of the technical composition of capital depends on the kind of technical progress; the tendency of the organic composition of capital depends both on the kind of technical progress (via the  $K/L$  ratio) and the wage rate.

### 3

We should now re-examine the ratios among technical progress, wages and the profit rate. If we assume a neutral technical progress, in which the output-capital ratio remains constant, the wage rate could increase at the same rate as the increase in productivity without the profit rate falling.

Let  $Y/L$  be the growth of productivity and  $W/L$  the growth of the wage rate. If

$$\frac{\dot{Y}}{L} = \frac{\dot{W}}{L}$$

and the output-capital ratio  $Y/K$  is constant since the technical progress is neutral, then we would have

$$\Delta Y/Y = \Delta W/W = \Delta R/R = \Delta K/K$$

As a result, the rate of surplus value, the organic composition of capital and the profit rate will be constant:

$$(R/W) \rightarrow ; (K/W) \rightarrow ; (R/(K+W)) \rightarrow$$

In the long-term economic development models, it is usually assumed neutral technical progress and the wage rate growing at the same rate of the growth of productivity – a condition that is consistent with the maintenance of the profit rate. But we have two other possibilities: if technical progress is capital-using, and the wage rate grows at the same step as the increase in productivity, the profit rate will fall; if technical progress is capital-saving, the wage rate could grow at a faster pace than the increase in productivity, and the profit rate could nevertheless remain constant.

This possibility of the profit rate remaining stable while the wage rate grows at a faster pace than productivity is an important economic possibility in the history of capitalist development. The increase of the wage rate is a fundamental demand of the workers, and the maintenance of the profit rate is a condition for the survival of the capitalists. If capital-saving technical progress turns reality both objectives can theoretically be achieved. A capitalist utopia could be built based on such technical progress. But that does not have been the *usual* form of capitalist development, as it is not the situation where technological progress is capital-using, wages are constant, and the profit rate is falling, or it is capital-using, the profit rate is constant, and wages are falling. Instead, we will see that neutral technical progress and wages increasing with productivity is the more usual historical condition.

### 4

These three kinds of technical progress can be illustrated by a very simplified example that is summarized in Table I. For example: an economy in which the labour force,  $L$ , is 40 man-hours in a determined period. This labour force is fixed. There is also a constant rate of surplus value, equivalent to 100%. At first the labour force of 40 directly produces the consumer goods. On the other hand, there is a labour force that is already incorporated in the machines, therefore transformed into dead labour, equivalent to 40 man-hours. The constant capital of this economy is therefore 40. The direct labour produces, in the period, 40 units of a certain consumer goods. Therefore, each unit of labour force produces a unit of the product. The labour incorporated in the machines, that transfer their value to the product in terms of

depreciation, produces 80 units of the consumer goods. The productivity of the machines is, therefore, two times more than the one that produces without using machines. To simplify, the machines are totally automatic. Given a constant rate of surplus value, the other variables and ratios are resultant.

**Table 1 – Examples of technical progress**

Since the machines are more productive than direct labour, as direct labour is transferred to the production of machines, productivity is doubled, and the businessmen transfer labour from direct production to the production of machines. Let us suppose, in three cases, that this transfer is of 10 man-hours, that are incorporated into the construction of machines. This transfer corresponds to the accumulation of capital,  $K$ , in the model transformed in a numeric example in Table 1. Thus, the capital-labour ratio increases to 1.2 in the three examples.

The additional productivity of capital is different in the three cases of technical progress. In the first case, of capital-using progress, the additional capital has the same productivity as the capital existing before. There is only mechanization, that is, the simple addition of new machines to the old ones. Thus, the output-capital ratio falls. In the case of neutral technical progress, in which the output-capital ratio is maintained constant, the organic composition of capital and the profit rate are also maintained constant. Finally, in the case of capital-saving technical progress, the output-capital ratio increases, decreasing the organic composition of capital and raising the profit rate. In the three cases, as there is technical progress and as the rate of surplus value is constant, there is an increase in the wage rate. It is clear, however, that wages increase more when there is capital-saving technical progress than when there is capital-using progress. Strictly speaking, the wage rate in the three cases grows in the same proportion as productivity, since the distribution of the income is maintained constant.

## 5

In the late 1970s, when the first version of this book was already written, Nobuo Okishio (1977) and Joan Robinson (1978) published two articles in which the problem of the falling tendency of the rate of profit is analysed and a graphic treatment is presented that allows for the establishment of a relation between technical progress and the profit rate, given the wage rate. This treatment had already been adopted in other works, but Joan Robinson developed her presentation in a more complete way. I will begin the analysis with her proposal.

**Figure 2: Profit-wage curve**

## ENTER FIGURE 2

In Figure 2 we will imagine that the product per worker,  $y$ , and the wage rate,  $w$ , are measured by the vertical axis, and the profit rate by the horizontal axis. By accepting a series of simplifying assumptions (a closed economy without a government, a stationary state, organic composition of capital equal in all sectors, and, thus, prices corresponding to value on the macroeconomic level), we can trace the profit-wage curve,  $r_1 - y_1$ , based on the contribution of Piero Sraffa (1960). This curve shows all the possible combinations of the wage rate with the profit rate, given the technical composition of capital of the capital-labour ratio,  $K/L$ , that Joan Robinson intends also to be the organic composition of capital. Joan Robinson uses  $K$  for capital in terms of dead labour and  $C$  for capital in terms of price, in which this price is given by the discount of the flow of profit to a determined rate of profit. In the case above, as the organic composition of capital is the same for all sectors, the profit-wage curve is a straight line and the value of capital will be the same at all points in the curve. This is because if the value of capital is equal to profit divided by the profit rate, we can define capital per worker,  $K/L$ , by:

$$K/L = y_1 / r_1$$

in which  $y_1$  and  $r_1$  are, respectively, the profit per worker and the rate of profit (maximum) when the wage rate is zero.

For wage rates that are other than zero,  $w_A$  for example, and a profit rate less than the maximum,  $K/L$  would be:

$$K/L = (y_1 - w_A) / r_A \cdot \text{tg}\alpha$$

Thus, at any point of the profit-wage curve the value of capital per worker will be the same, as long as it is given by the angle of the line of  $y_1 - r_1$ , that is, by the tangent of the angle  $\alpha$ .

In Figure 2, the output-capital ratio, or the productivity of capital, is represented by  $r_1$ , as this is the maximum rate of  $Y/K = S/K$  when  $w = 0$ . In these terms, the further  $r$  is from the axis of origin, the greater the output-capital ratio. Technical progress measured in terms of the productivity of capital will occur mainly through dislocations of this point.

### Figure 3: Three types of technical progress

## ENTER FIGURE 3

In the Figure 3, the three kinds of technical progress can be seen, through the dislocations of the line of  $r_1 - y_1$ . In the three cases,  $y_1$  should move up ( $y_2$ ) as all technical progress should imply an increase in the productivity of labour. Technical progress will be neutral when the line moves to  $r_1 - y_2$ . Given the maintenance of  $r_1$ , the output-capital ratio remains constant. Now let us imagine that the movement is completely to the right in relation to the original line  $r_1 - y_1$ . In this case, in which the line moves to  $r_2 - y_2$ , there is capital-saving technical progress. The productivity of labour and of capital increases. Lastly, there is the case of capital-using technical progress,  $r_3 - y_2$ . The productivity of labour also grows in this case, but the productivity of capital falls, given that capital becomes more expensive.

## 6

These three kinds of technical progress, whose criterion for classification is the productivity of capital, should be clearly distinguished from another three that use the capital-labour ratio as their criterion: capital-intensive technical progress that raises the capital-labour ratio; constant technical progress that maintains the capital-labour ratio at the same level; and labour-intensive technical progress, that reduces the capital-labour ratio. Through these three kinds of technical progress we can graphically prove what we showed in Section 2 of this chapter about the K/L ratio. In the same way in which the organic composition of capital is not necessarily growing, the technical composition of capital itself is also not necessarily growing, to the contrary of what Marx maintained and what appearances indicate. As we will see in this section, if technical progress were, aside from capital-saving, also labour intensive, the capital-labour ratio or technical composition of capital will tend to decrease.

In Figure 2 we have already seen that the capital-labour ratio can be defined by  $y/r$ . It corresponds, therefore, to the inclination of the wage-profit curve, that is, to the tangent of the angle.

### Figure 4: Another three types of technical progress

ENTER FIGURE 4

Once the capital-labour ratio is defined graphically in these terms, the steeper the curve is, the more capital-intensive the technology is.

In Figure 4,  $r_1 - y_1$  is the reference curve, corresponding to the  $r_1 - y_1$  curve in the previous figure. It represents original technology. A movement of the curve to  $r_{II} - y_{II}$  represents constant technical progress. A movement to  $r_{IV} - y_{II}$  represents capital-intensive technical progress as it increases the inclination of the curve. A movement to  $r_{III} - y_{II}$  represents labour-intensive technical progress. As the entire curves end in  $y$ , this means that the increase in the productivity of labour is the same in all three cases.

The kinds of technical progress shown in Figure 4 are related with those of Figure 3, but they should be clearly distinguished. The economists who have dealt with the problem have generally not made this distinction, thus making analysis more difficult. In the examples of Figure 4, there are three cases of capital-saving technical progress, as in all three the output-capital ratio increases. But this does not mean



that the kinds of technical progress per intensity of capital or of labour are sub-divisions of capital-saving technical progress. As a matter of fact, both labour-intensive and constant technical progress are always capital-saving, as when  $y$  moves upwards to increase the productivity of labour,  $r$  moves to the right in order that the new curve will be less steep (labour-intensive technical progress), or to conserve the same slope (constant technical progress). Capital-intensive technical progress,  $r_{IV}-y_{II}$ , is consistent with capital-saving technical progress,  $r_2-y_2$ , as well as with neutral technical progress,  $r_1-y_2$ , or with capital-using technical progress,  $r_3-y_2$ . Looking at the problem from another viewpoint, neutral and capital-using technical progress are always capital-intensive, as the new technological curve is always steeper than the original one. Capital-saving technical progress is consistent with capital-intensive technical progress,  $r_{IV}-y_{II}$ , as well as with constant,  $r_{II}-y_{II}$ , or labour-intensive,  $r_{III}-y_{II}$ , technical progress.

When Marx spoke about technical progress, he was always thinking about capital-intensive technical progress. In fact, as technical progress tends to substitute capital for labour and it is generally capital-intensive. Constant technical progress is only a logical possibility, and labour-intensive, although it is more and more viable as the capital-saving techniques advance, is still an exception. However, to be consistent with the decline of the profit rate, given a constant wage rate, it is not enough that the technical progress be capital-intensive, but it must also be capital-using. The only curve that is consistent with the falling tendency of the rate of profit, therefore, is that which corresponds to capital-using and capital-intensive,  $r_3-y_2$ , technical progress. This kind of technical progress can be simply called capital-using, as all capital-using technical innovations are capital-intensive. But in this case the profit rate will only fall if the wage rate is at a level lower than  $w_B$ . Otherwise this same adoption of capital-using technology will involve an increase of the profit rate.

## Chapter 4

### Technical progress and the Okishio's theorem

Even in the strictly Marxist case of capital-using technical progress, in which the wage rate is below the point at which the new technological curve intersects the original curve, there is still a fundamental question. Why would a company adopt a technology in this range if it implies a fall in the profit rate? This was the basic question raised by Nobuo Okishio in a classic article published in 1961 in which he formulated what today is called the "Okishio theorem". The idea is simple. According to Okishio, when capitalists make decisions about investments, they orient themselves not around questions of productivity, but rather around questions of costs. It does not matter for them to know that the production of a certain good will increase per worker, but rather that the cost of this good will decrease if a technical innovation is introduced. In Marx's thinking, the capitalist adopts new technology and raises the organic composition of capital because his productivity increases, substituting labour by capital. In Okishio's thinking, what matters is costs. Lower costs do not necessarily correspond to the most productive technology, as the cost of the additional capital being used must also be considered.

Once this assumption was accepted, Okishio rigorously concluded that capitalists would not introduce a new technology if it did not diminish costs and therefore increase, rather than decrease, the profit rate. The profit rate would only fall if there were an increase in the wage rate at the same time. In Okishio's words:

Capitalists choose a new production technique, above all, according to cost criterion. Even if there were techniques that increase productivity of labour greatly, they could not be introduced by capitalists, unless they reduce the cost of production.... 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. (Okishio, 1961: 91-92)

When the problem is accepted in terms of the Okishio theorem, any logical base for Marx's proposal that as technical progress propitiates the substitution of labour by capital, it reduces the profit rate, disappears. For example, this is Joan Robinson's position when she states that "a rise in the capital to output ratio does not cause the rate of profit to fall, for a capital-using technique would not be adopted unless it raised profit per man employed at least as much as the cost of investment per man" (1978: 13). Besides reducing the Marxist case to only one special kind of technical progress, we now add the proposition that not even this case would be feasible, as the companies would not adopt a technology that would lower their profits, or in other words, that would not lower their costs. Likewise, if we maintain the assumption of a constant wage rate, it is not plausible to think about an increase in productivity that implies a lowering of the profit rate, as the rate of surplus value would be growing.

To re-establish the validity of Marx's hypothesis that the profit rate could go down when capital-using technical progress is introduced, we must allow the wage rate to increase at approximately the same rate as the increase in productivity, so that the rate of surplus value can be maintained constant. In this case, going to Figure 3, as long as the initial wage rate is above  $w_B$ , the capital-using technical progress  $(r_3-y_2)$  would be preferable in relation to the original technology  $(r_1-y_1)$ , and in this way, we could have the Marxist situation of a fall in the profit rate.<sup>xviii</sup> This fall would take place through the following process. First, the companies would introduce new capital-using techniques, increasing the productivity of labour and their profit rates. The increase in the productivity of labour, however, would be proportionately greater than the rise in the profit rate, given the slope of the curve. This means that, given the assumption of constant wages, there is an increase in the profit rate, although it is less than the increase in productivity. If, in this case, the wage rate grows at the same rate as productivity, the profit rate will fall, as predicted by Marx.

We can demonstrate this fact either by observing the graphs or by the following algebraic demonstration: if  $K/L$  is increasing and if we can divide both terms in this relation by  $R$ :

$$\frac{K}{L} = \frac{K/R}{L/R} = \frac{R/L}{R/K}$$

Thus, the growth of profit per worker,  $R/L$ , would soon be greater than the growth of the profit rate,  $R/K$ . On the other hand, as the wage rate is still considered to be constant, the participation of wages in the income will decrease and the rate of productivity will grow even quicker than the profit rate.

## Figure 5: Wage rate, technical progress and the profit rate

ENTER FIGURE 5

At this point the workers will put on pressure for wages equivalent to the increase in productivity and the rate of profit will fall, as the wage rate will then increase more than the profit rate had increased. However, it was necessary to introduce a second variable -- the ability of the workers to make their wages accompany the increase in production so that the profit rate falls due to a capital-using technical innovation.

Looking at Figure 5 can also see the phenomenon that I am analysing. In this graph, we can see what happens to the profit rate when the wage rate rises at the same rate as the increase in productivity with two given kinds of technical progress: capital-using and neutral. The Figure on the left shows capital-using technical progress. It is the Marxist case in which the profit rate finally falls. The Figure on the right shows neutral technical progress in which the profit rate remains constant. In Figure 5, productivity increases from  $y_1$  to  $y_2$ , in approximately one-third, due to the adoption of a new technique. As a result, the profit rate, which was  $r_4$  (the initial profit rate, given  $w_1$ ) first increases to  $r_5$  (the intermediate profit rate). Note that the increase in the profit rate is greater in the case of neutral technical progress than in capital-using progress. Next, the wage rate also goes up one third, to  $w_2$ . The result of this for capital-using technical progress is that the profit rate falls to  $r_6$  (the final profit rate), a level lower than the initial rate of  $r_4$ . In the case of neutral technical progress, the profit rate falls to exactly the same level that it was at initially, therefore making  $r_6$  equal to  $r_4$ .

If we were to add an additional figure in which technical progress were capital-saving, accepting a hypothesis that the wage rate grows at the same rate as the increase in productivity, it is easy to see that the final profit rate,  $r_6$ , would be greater than the initial profit rate of  $r_4$ .

### 1

The conclusions derived from the analysis of figures 1 to 5 are naturally consistent with the results of analysing the tendency of the profit rate that we carried out in the precedent chapters. In that analysis we also made the wage rate grow at the same rate as the increase in productivity, maintaining the rate of surplus value constant. Therefore, it is clear that we cannot predict the decline of a profit rate merely based on technical progress, even if it is capital-using. It is still necessary to consider what happens to the wage rate at the same time. If it is not growing, the profit rate will not fall, because a new technique that is less profitable will not be adopted. We could still try to imagine a case of Schumpeterian innovation, in which a firm adopts a new capital-using technique and has extraordinary profits while its monopoly advantage lasts. This would be while its prices continue to refer to the costs of the firms that still have not copied the technical innovation.<sup>xix</sup> But even in this case, the capital-using technical innovation would not imply a reduction in the profit rate as long as wages are not increased. The result of the innovation would at first be an extraordinary profit, to the right of point  $r_5$  on Figure 5. But after this it would return to  $r_5$ , and then, if the wage rate is raised in proportion to the increase in productivity, the profit rate would end up at the same level as  $r_6$ .

It was possible for Marx to predict that the introduction of technical progress would lead to a decrease in the profit rate because he defined technical progress by the increase in the organic composition of capital instead of the technical composition of capital. As opposed to Joan Robinson,

Marx clearly distinguished the two relations, but he imagined that they both would have proportionately the same tendency to grow as the wage rate remained constant. Yet, in the moment that the wage rate ceases to be constant, we can no longer establish that proportionality between the organic composition and the technical composition of capital.

However, Marx was mistaken when he predicted, without establishing the due restrictions, that, given a basically constant wage rate, the adoption of capital-using techniques would imply a reduction of the profit rate. It was made very clear in the previous analysis that a firm that only adopts a new technique in this case increases its profit rate at first. The reduction of the profit rate takes place later, when the following conditions are present:

- a. the technical progress is capital-using in such a way that the productivity of labour grows proportionately more than the profit rate; and
- b. the wage rate increases approximately in the same proportion as the increase in productivity so that the profit rate finally falls.

Marx would not have made this mistake, however, if he had given enough emphasis to the fact that technological innovations are not introduced concomitantly. If he had stressed this fact, we could find a situation in which technological innovation is adopted even if it provokes a fall in the profit rate. A fall in the profit rate, however, only takes place later (always provided that the technical progress is capital-using and the wage rate increases in proportion to productivity). At first there would be no fall in the profit rate because the innovation would benefit only the innovating firm, lowering its costs in relation to the others. Only later, after the other firms imitate the innovation and their prices go down, would the profit rate fall, given the capital-using nature of the technical progress adopted. In this case, the profit rate would fall even without an increase in the wage rate above the increase of productivity, making the general character of the Okishio theory invalid.

Joan Robinson's mistake is in confusing or identifying the composition of capital with the technical composition of capital. This allows her to needlessly define the organic composition of capital by the slope of the profit-wage curve or the technological curve, which define the technical composition of capital or the capital-labour ratio. This also permits her to identify technical progress with the organic composition of capital, seemingly in the same direction as Marx, but actually in a very different one as, living in the Twentieth Century, Joan Robinson cannot even pretend to adopt the assumption of a constant wage rate. Despite this confusion, which made her analysis much more difficult to follow, Joan Robinson ends up confirming, in the same line as Nobuo Okishio, that a technical innovation that reduces the profit rate would not be adopted. Thus, the need to introduce the raising of the wage rate in the problem so that the falling tendency of the rate of profit is kept valid.

It is necessary, therefore, to always make the distinction between the technical composition,  $K/L$ , and the organic composition of capital,  $K/W$ , clear. The organic composition of capital depends directly on the technical composition of capital, and inversely on the wage rate. The wage rate, in turn, directly refers to the rate of surplus value. The technical composition of capital can be increasing while the organic composition of capital is constant or even decreasing, depending on the wage rate. In these terms, even though the kinds of technical progress are essential to analyse the declining tendency of the profit rate, they only make sense when we also take the wage rate into consideration. This is because the kinds of technical progress influence the organic composition of capital, but they are not the only things to determine it. The organic composition of capital also depends on the wage rate, as it defines itself by the ratio between capital and total wages.

But we should still remember that the wage rate and technical progress directly influence the rate of surplus value. If the wage rate is constant, as the productivity of labour increases, total profits tend to grow more than total wages (even allowing for a constant profit rate), and thus, the rate of surplus value always grows. For the rate of surplus value to be constant, we have already seen that the wage rate must grow at the same rate as the increase in productivity. Obviously, for this happening, it is necessary to assume that the workers have some bargaining power. The declining tendency of the profit rate, therefore, can only be admitted if, together with the strictly technological and economic elements, a political element was added: the bargaining power of the workers, or, in other words, class struggle.<sup>xx</sup>

Marx was mistaken when he imagined that the profit rate would tend to decline because of the introduction of technical progress, even in the case of capital-using technical progress. Or better, this proposition is only valid when we abandon the assumption of a constant wage rate, what was reasonable in the time of Marx because wages were at the subsistence level. Except for in the special case of the introduction of innovations that, at the same time, reduce both production costs and the output-capital

ratio (capital-using technical progress), corporations would not adopt a new technique if it were to not reduce their costs, given prices and wages. In these terms, Nobuo Okishio notes that whenever any technique introduced by capitalists in the basic industries implies lower costs, it necessarily increases the profit rate. This would not increase only if the growth of the wage rate were to cancel out the capitalist dream (Okishio 1961: 92).

This does not mean, however, that the kind of technical progress becomes irrelevant when we examine the profit rate, and that we should concentrate only on the movements of the wage rate determined by class struggle. In the same way that making the profit rate depend directly on the kind of technical progress is economicism, making it depend only on class struggle is to fall into the error of politicism, reducing economics to politics. The ability of the class struggle to raise the wage rate of the workers has been limited historically by the rate of the increase of productivity or by a little more than this index. Thus, the rate of surplus value in the last century has tended to remain constant, with a slight falling tendency in the second half of this century.<sup>xxi</sup>

## 2

The debate on the falling tendency of the rate of profit seemed to be practically closed in the face of three powerful arguments:

- a. because the empirical data did not substantiate it;
- b. because the cases of capital-using technical progress were becoming more and more rare; and
- c. mainly because the theory of Okishio had a devastating logical force.

The defence of the law in its original form fell to the fundamentalists like Cogoy or Mattick, supported in the "logical possibility" that transforms the problem into mere metaphysics: while the maximum that the rate of surplus value can grow to is to one when the wage rate falls to zero, the organic composition of capital can grow infinitely. Recently, however, Anwar Shaikh published an article in which, after repeating some fundamentalist arguments and analysing Dobb's positions assumed in *The Political Economy of Capitalism*, he presented an original argument against the theory of Okishio, thus sparking a far-ranging debate (1978). In his theorem, Okishio showed that the corporations only adopt a new technique if it presents a lower unit production cost. He calls this "cost criterion." Once this criterion is accepted, and given the prices of inputs and the wage rate, Okishio shows that the profit rate will grow or at least remain the same, but never fall. A company will not adopt a technique with a greater unit cost, and therefore it is not possible to talk about a falling tendency of the rate of profit. If a new technique adopted, with lower costs and therefore with a lower production price, is related to the production of wage goods or production goods (basic goods), the profit rate will grow. If it is related to luxury goods, the profit rate will remain constant. Okishio concludes:

The proposition that the new technique satisfying cost criterion introduced in basic industries necessarily increases the general rate of profit cannot be consistent with Marxian law of the rate of profit to fall. This proposition states that, however large the organic composition of production may become, the general rate of profit must increase without an exception, only if the newly introduced technique satisfies the cost criterion and the rate of real wage remains constant. (1961: 92).

This theory was already discussed in the previous chapter by the demonstration of the graphs. Shaikh first tries to disqualify this argument by confirming that Okishio disregarded the difference between fixed costs and variable costs. However, Takeshi Nakatani (1980) responded to this criticism, citing a 1963 article by Okishio that was published exclusively in Japanese, in which the theory was perfectly consistent with the introduction of fixed costs.

Shaikh's basic argument is something else, based on the existence of two criteria for the adoption of a new technique: the cost criterion, adopted by Okishio, according to which the method of production with the cheapest unit cost is the one that will always be adopted, and the "optimality criterion," mostly used by the neo-Ricardians of Cambridge, according to which the capitalist will adopt the technique that increases his transitional profit rate, that is, the profit rate that prevails while the wage rate and the price of merchandise do not change. Shaikh states:

According to the optimality criterion, no existing capitalist (nor any potential entrant) would choose the mechanized technique over the handcraft, because of its lower rate of profit... But the point is precisely that within the battle of competition, the choice is not 'voluntarily' in the above sense (at least, no more so than in any other type of war). Faced with the possibility of a cheaper method of production, the first capitalist to make the move will be able to lower his price to a point where the others make little or no more profits (or even suffer losses) - while still making a profit himself. (1978: 245-6)

This reasoning corresponds the argument of Schumpeterian innovation that we had already quickly gone over in the previous section, before we knew about the contribution of Shaikh. Actually, the discussion would be clearer (Shaikh and his critics are confusing in this respect), if we were to think about three alternative criteria:

- a) the cost criterion;
- b) the transitional profit rate criterion; and
- c) the final profit rate criterion, that Shaikh calls the "optimality criterion."

As Takeshi Nakatani (1980) showed, Nobuo Okishio substituted the transitional profit rate for the cost criterion when he introduced fixed costs into his theory in 1963. This is ultimately the criterion used by Shaikh, who changed its name to "competitive criterion", pointing out that a company will adopt a technique that makes lower costs and a greater transitional profit possible (as long as its innovation is not copied). To counter this argument, the third criterion is raised: the final profit criterion. The capitalists will only adopt a technique that, as a last resort, would increase its final profit rate. This is the criterion that Okishio ultimately adopted at the same time in which he thought that this criterion is completely consistent with the cost or transitional profit criterion. It is also the optimality criterion that Shaikh's critics usually use.

For example, Ian Steedman (1980) tried to discuss the criterion for choosing the techniques used by Shaikh, but he concentrated his analysis on the distinction between fixed and variable costs, that in the end is not fundamental for Shaikh's argument. What is essential in this argument is the additional profit margin that the company is able to obtain with the introduction of an innovation that allows it to have lower unit costs, even when fixed costs are taken into consideration, as long as its competitors do not copy it and lower their prices as well, leading to a lowering of the price of the product. John Roemer, who criticized Shaikh mainly because the latter based his argument on the distinction between the margin and the profit rate, made the same mistake and, therefore, on the introduction of fixed costs that had been overlooked by Okishio. Roemer even showed that he had not completely understood Shaikh's argument based on the criterion of obtaining a larger transitional profit, when he said: "But the criterion of innovation with which Shaikh burdens his capitalists is completely irrational and ad hoc: they ignore fixed capital! Any capitalist considering an innovation which involves fixed capital must amortize the costs of fixed capital..." (1979: 387). Shaikh and his capitalists, like those of Roemer, are tired of knowing that that fixed costs must be amortized.

Nakatani also begins his criticism of Shaikh by discussing the problem of fixed costs. He then goes on to discuss the criteria for innovation, and opts for the criterion of maximizing the final profit when he states: "Shaikh calls the cost criterion a 'competitive criterion' and the profit rate criterion an 'optimality criterion' and he concludes that the battle of competition forces capitalists to employ the former as the basis for technical choice. But this is not correct." (1980: 66). However, Nakatani is not content with trying to show that the optimality criterion would be the most correct. Actually, he is not able to show that the capitalist chooses the final profit criterion. He ends by admitting that, faced with strong competition, the capitalist is forced to use the technique with the highest transitional profit rate. Meanwhile, it should be noted that in the end, the profit rate falls not because this criterion was used for the choice, but because, with the lower prices derived from the new technique, the real wage rate and the cost of raw materials will be relatively higher to the price of the produced good (1980: 66).

Note that in this case, as already seen in the previous section, when Shaikh's argument is forestalled by talking about the Schumpeterian innovation, the technical progress would necessarily have to be capital-using, and the profit rate finally fall because the wage rate would grow in proportion to productivity. Shaikh's argument, however, continues to be valid. The technique with a lower cost, greater margin, higher transitional profit rate and lower final profit rate is that which is adopted. The increase in the wage rate comes endogenously from the actual lowering of the prices of the basic merchandise that were being produced by a cost-lowering technique (that is, it comes from the increase in the productivity of labour). If this new technique were capital-using, it would imply a lowering of the profit rate, after

having increased it during a transition period during which the other competitors had still not adopted the new technique.

Another critic of Shaikh is Philippe Van Parijs (1980), who attempted to write an obituary of the law of the falling tendency of the rate of profit. However, to criticize Shaikh, he first tried to attribute a much greater rationality and vision to the capitalist than could be reasonably imagined. The capitalist would predict that his final profit rate would be lower and would not adopt a technique with a greater margin and transitional profit rate. Per Parijs, the capitalist projected by Shaikh does not act rationally. He asks: "why should a capitalist adopt a capital-intensive technique which will give him (at best) a rate of profit which is lower than the general rate?" (1980: 11). However, it seems that Parijs immediately perceives that his question does not deserve an answer, as he assumes that the capitalist would be capable of making all the calculations and discovering that the additional profits that the adopted innovation will bring him with a greater final margin will disappear and become lower than the current one when his competitors copy him. This argument is almost as foolish as that which I heard from a neoclassic economist who, faced with the problem, resolved it immediately by saying that, when the capitalist notices that he has adopted a less profitable technique, he will go back to using the previous one. Parijs then goes on to a second argument against Shaikh that is even more neoclassic than the first one. He states that the balanced profit rate is only slightly higher than the interest rate. If the capitalist adopts a new technique that brings a lower profit rate, the gap between the balanced profit rate ( $r$ ) and the balanced interest rate ( $i$ ) would diminish or disappear. "At 'equilibrium', however, the gap between  $i^*$  [the equilibrium rate of interest] and  $r^*$  [the equilibrium rate of profit] is precisely what is needed to induce capitalists to take the risk of investing productively" (1980: 11). With this brilliant argument, he hopes to have saved the Okishio theorem.

I think that Okishio would gladly dispense with this kind of discussion in his favour. We cite it anyway not only because Parijs' article pretentiously claims to be an obituary of the law of the falling tendency of the rate of profit (something that Okishio probably never thought of), but also because his reasoning represents a paroxysm of an extremely abstract, a-historic kind of reasoning that ends up violating the economic process.

Despite these defences, such as that of Nakatani, however, we think that the Okishio theory loses its validity, and the law of the falling tendency of the rate of profit recuperates theoretical validity thanks to Shaikh's criticisms. If the Okishio theory is taken to its ultimate consequences, corporations would never select a technique that would end up bringing them a lower average profit rate. This would only happen if the wage rate were to increase.

In capitalism, the wage rate tends to increase. This is not only because the increase in the productivity of labour implicit in the reduction of the production price of the merchandise produced with the new, more capital intensive (and more capital-using) techniques would tend to provoke a real increase in the wage rate, but also because the trade unions tend to demand and safeguard this increase. In these terms, the law of the falling tendency of the rate of profit recuperates its theoretical code. Its main limitation, which we examined extensively in the previous chapter, is not the Okishio theorem, but rather the kinds of technical progress. If these were neutral or capital-saving, there would have absolutely no tendency to decline. It is only in the cases that are becoming historically more and more rare in the countries that are already industrialized, of capital-using technical progress (mechanization) with the wage rate increasing at the same rate as productivity, that the profit rate would tend to fall.

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<sup>i</sup> - The bibliography on the falling tendency of the profit rate in Marx is extensive. For a summary on the subject consult Guido Mantega (1976). In this work the author divides the economists who write on this theme into critics of Marx's position, among whom stand out the names of Sweezy, Joan Robinson, Steindl and Hodgson, and orthodox, among whom he cites Paul Mattick, David S. Yaffe and Mario Cogoy. Later we will examine the recent debate on this subject, based on the analyses of Nobuo Okishio and Anwar Shaikh.

<sup>ii</sup> - At the beginning of the Industrial Revolution the profit rate in the textile industry was around 20 to 30% in England and France. There were similar, although slightly lower, rates in the metal industry. In the sugar industry in France at the beginning of the Nineteenth Century, the profit rates were between 30 and 40%. An average for all industries would probably be between 20 and 35%. In the Twentieth Century, these rates are considerable lower. In the United States between 1922 and 1929, the average profit rate for industrial corporations was between 9 and 11%; between 1946 and 1951, the profit rate for the industrial corporations was 14%, falling to 12% between 1951 and 1955. In England, the profit rate between 1956 and 1961 was an average of 9.6%. In Belgium, between 1954 and 1960 it was 8% (Paul Bairoch, 1967). Joseph Gillman calculated that the profit rate for the United States, in terms of indexes, reached 69% in 1800, 50% in 1900, and then established itself around 30% between 1919 and 1952, with a tendency to rise to a level of almost 40% after World War II (Joseph Gillman, 1957: see the whole series in Table VI of the Appendix). It should be noted that in the data of Bairoch as well as that of Gillman, the profit rate was clearly falling in the Nineteenth Century, but in the Twentieth Century it has become stable.

<sup>iii</sup> - As I noted in the Introduction, I will use the notations in terms of real prices, and not in terms of value. Aside from this, there is a series of variable, such as employment, L, population, N, the wage rate, w, etc., for which Marx did not use notations. The absolute values always appear in capital letter and the rates in small letters.

<sup>iv</sup> - Constant capital, C, which is made up of fixed capital and raw materials utilized, is measured by Marx in terms of flows, so that it can be directly added to variable capital and to surplus value. To transform the flows in stocks, all we need is to know the depreciation rate, fixed capital and the turnover of the stock of intermediary goods or raw material used in production. Marx normally uses these concepts in terms of flows. There are certain moments, however, when he seems to prefer to use the same variables in terms of stocks. As the two treatments are interchangeable, it seemed better to me to maintain the main variables in terms of flows.

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<sup>v</sup> - Marx confirms: "This mode of production produces a progressive relative decrease of the variable capital as compared to the constant capital, and consequently a continuously rising organic composition of the total capital. The immediate result of this is that the rate of surplus-value, at the same, or even a rising degree of labour exploitation, is represented by a continuous fall of the general rate of profit." (1894: 212-213).

<sup>vi</sup> - In respect to this, see Okishio, 1961:89.

<sup>vii</sup> - In the same line of thinking, Paul Mattick confirms: "Marx's theory of accumulation is thus at the same time a theory of crisis, as it locates the origin of crisis in an insufficient valorisation of capital, which in turn, originates in the breakthrough of the falling tendency of the rate of profit." (1977: 56).

<sup>viii</sup> - We will discuss the economic cycle more extensively in Chapter XI.

<sup>ix</sup> - The growing nature of the capital-labour ratio can be historically verified, but it is not as clear and indisputable as we might think. In 1929 dollars, the capital per employed person in the USA, excluding the farm sector and households, in 1889, 1890 and 1891 was \$2,986. In 1912, 1913 and 1914, this figure had risen to \$4,053 (cf. E.H. Phelps Brown and Margaret H. Browne, 1968: Appendix 3). According to another source, with obviously different criteria, the capital-labour ratio, which had an index of 1 in 1900, rose to 2.36 in 1921 (Paul H. Douglas, 1964:145). However, it is interesting to note that in the period between 1920 and 1938 in the United States, the per capita capital fell from \$4,502 to \$3,901. In England the capital-labour ratio increased, although less emphatically. In 1913 pounds, it rose from 251 pounds in 1869 to 259 pounds in 1913, remaining stable until 1938 (E.H. Phelps Brown and Margaret H. Browne, 1968:Appendix 3). See Table III of the Appendix, in which these data appear in the form of an index. Note that, strictly speaking, the technical composition of capital should be measured in fiscal terms according to Marx. In the next chapter I will verify that if technical progress is capital-saving and labour intensive, the capital-labour ratio itself will not grow.

<sup>x</sup> - I will not consider the possibility that  $w$  could be equal 1. If  $w = 1$ , then,  $R = 0$ , and, because  $Y = W + S = wL + S$ , it would get the unusual result that  $Y = L$ .

<sup>xi</sup> Strictly speaking, it does not make sense to talk about the productivity of capital, as only labour produces value. But it is a practical concept when it simply signifies the output-capital ratio. Note, on the other hand, in order to simplify things, that we are, considering  $K$  as the total capital (both constant and variable) in stock terms. In a later numerical example we will separate constant capital from variable capital again in order to calculate the profit rate.

<sup>xii</sup> For types of technical progress, see the original concept of Roy Harrod (1939;1966).

<sup>xiii</sup> The use of a constant rate of surplus value in almost this whole book is not arbitrary. When we propose a division of capitalist development in phases, we are admitting a distribution of the income between profits and wages that is constant for all of the phases except the first one. The historical data reveal that the rate of surplus value either is stable or tends to diminish. But this reduction can be due to the fact that the growing salaries of the technobureaucrats are always added to the wages of the workers in official statistics. Aside from this, when a peasant becomes a wage earner, this increases the participation of the wage earners, but not of the workers. Once these observations are made, we confirm, for the United Kingdom, that the income coming from (surplus value) represented 36% of the total in 1860-69; 37% from 1926-29; 21% from 1954-60. For the United States, the figures are 22% from 1899-1908; 24% from 1919-28; 25% in 1929; and 19% from 1954-60. For Germany, the figures are 16% in 1895; 19% in 1913; 10% from 1925-29 and 18% from 1954-60 (RF) (Kuznets, 1966:169).

<sup>xiv</sup> The reader should note that we are using two kinds of notations to express the rate of variation of a variable. When the variable is defined by two others, such as the productivity of labour ( $Y/L$ ), the rate of variation is expressed by  $(\Delta Y/L)$ . If it is a simple variable, as the level of income ( $Y$ ), the variation is expressed by  $(\dot{Y}/Y)$ .

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<sup>xv</sup> In the United Kingdom and in the United States, from the 1870s to the 1920s, the output-capital ratio was relatively constant, meaning that technical progress was neutral. See Table VIII in the Appendices.

<sup>xvi</sup> We have already seen that in the United Kingdom the participation of the surplus value in the income, that was approximately 36% in nineteenth century, fell to 21% in the middle of the twentieth century (see footnote 3). The rate of surplus value showed, therefore, a declining tendency. On the other hand, the output-capital ratio, that was 0.31% in 1870, rose to 0.50 in 1938 (see footnote 5). Therefore, we can see that the fall in the rate of surplus value was compensated for by the rise of the productivity of capital, allowing the profit rate to probably remain relatively constant (we were unable to obtain data on the profit rate).

<sup>xvii</sup> See the tables in the appendices on the evolution of per capita income, the productivity of labour and the rate of surplus value. While the data are not absolutely conclusive, note that, until the middle of the twentieth century, the growth of the wage rate and the per capita income followed approximately the same regularity, determining the stability, with same falling tendency, of the rate of surplus value. Beginning in the 1950's, the wage rate began to grow more rapidly and the rate of surplus value to fall.

<sup>xviii</sup> It should be noted that, in graphic terms, the condition placed by Okishio on the choice of new techniques is satisfied by the external line that outlines the profit-wage curves. In Figure 3, for example, taking into consideration only the curves corresponding to original technology ( $y_1-r_1$ ) and to capital-using technology ( $r_3-y_2$ ), any point that outlines the external line (called the wage border by Garegnani and the northeast border by Samuelson), given by  $r_1$ , B (intersection) and  $y_2$ , heed the criterion of minimizing costs in the choice of new techniques. Thus, in the area below B, that is, a wage rate below  $w_B$ , a new technique that represents capital-using technical progress would never be adopted.

<sup>xix</sup> This argument is almost the same as that raised by Anwar Shaikh when he tries to disqualify the Okishio theorem. As I was unaware of it when I wrote this section in 1978, it will be discussed in the following section.

<sup>xx</sup> In fact, this is also Nobuo Okishio's conclusion when he states that "(1961:96)

<sup>xxi</sup> The tendency of the profit rate will also be influenced by the level of unproductive labour in the economy. An increase in the employment of unproductive labour tends to quell the effect of technical progress on the growth of the productivity of labour. That is, for a given level of productivity of productive labour, a relative increase in total unproductive labour necessarily signifies a direct deduction from profits (R), which then goes on to depress the rate of surplus value (R/W) to a macro level. In this way, an eventual reduction of the rate of surplus value (R/W), that is, an increase in W in relation to R, can be the result not only of an increase in the wage rate (W), but also a proportional increase of unproductive labour in the economy. A tendency in monopolist capitalism towards an increase in unproductive labour can thus be considered, together with class struggle and the kind of technical progress, as an additional factor supporting the argument of the falling tendency of the rate of profit.