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# On the Marxian Law of the Falling Rate of Profit and *Marx-Biased* Technical Change\*

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## Abstract

Karl Marx was one of the first analysts of capitalism's trends and problems. Here I offer a formal exposition of his thesis that the rate of profit tends to fall as a consequence of capital accumulation and analyze the most well-known counter-arguments. I then use the framework developed in the text to suggest a particular standpoint from which to look at development policy.

## 1 Introduction

One of the tenets of classical political economy is the fall of the average rate of profit as production expands and economies grow.

Karl Marx criticizes the explanation of the falling rate of profit given by "the economists" - especially by Ricardo - but accepts it as a tendency of capitalist economies.<sup>1</sup>

This part of Marxian economic theory plays an important role in Marx's ideas on the future of capitalism and on the possible space for socialism.

This paper contains an exposition of Marx's Law of the Falling Rate of Profit,<sup>2</sup> an examination of the criticism proposed by some authors and

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\*I thank Duncan Foley for his comments on this draft.

<sup>1</sup>He treats it in Part III of Volume III of *Capital*, entitled "The Law of the Tendency of the Rate of Profit to Fall".

<sup>2</sup>In the exposition I follow Foley (1986).

some ideas for an application of the categories emerged in the analysis. In illustrating the theory I recall its relevance for a number of contemporary economic issues.

## 2 Marx's law of the falling rate of profit

Marx's theory of the falling rate of profit came into existence in opposition to Ricardo's (1817) theory according to which the rate of profit falls as a consequence of diminishing returns to capital and labor. Ricardo saw the problem as a physical-technological one: as production expands, land becomes scarce and prevents the exact scaling up of production, thereby preventing the realization of a constant rate of profit. Ricardo believed that technological innovations could possibly eliminate scarcity and, therefore, prevent the rate of profit from falling.

Marx saw Ricardo's explanation as originating from misunderstanding a fundamental character of capitalist production: innovation. According to Marx, Ricardo failed to see the *technologically progressive* character of the capitalist mode of production. Innovation, in Marx's view, is intrinsic to capitalism in the sense that the same historical forces that lead to innovation lead to the expansion (and, eventually, collapse) of capitalism. If technology is not a limit to production, the fall of the rate of profit must be explained on different grounds and reconciled with the presence of innovations.

The rate of profit is the ratio of gross profits to the total capital bound up in production:

$$r = \frac{\Pi}{K}, \quad (1)$$

where  $\Pi$  represents gross profit and  $K$  represents total capital.

Assuming that the entire capital is circulating capital - which amounts to assuming that the rate of turnover of capital is one - and assuming that there are no overhead costs on surplus value so that profits and surplus value coincide<sup>3</sup>, I can express the rate of profit as

$$r = \frac{s}{c + v}, \quad (2)$$

where  $s$  is surplus value,  $c$  is the value of the means of production (constant capital) and  $v$  is the value of labor inputs.

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<sup>3</sup>Profit is the difference between surplus value - the amount of value produced and not paid to the workers - and all overhead costs, such as interest payments, executive stipends, other organizational costs etc.

Historically, a different ratio, the rate of surplus value  $\frac{s}{v}$ <sup>4</sup>, has been rising and Marx seems to be aware of it, even though he relied more on intuition than on statistical data. It is no surprise, then, that his starting point in the analysis of the issue of the falling rate of profit is constant capital, which represents the difference between the rising rate of surplus value and the profit rate, whose downward tendency he want to demonstrate.

When a capitalist discovers a new technology that allows a reduction of the costs of production, she can gain super-profits as long as the old technology prevails in the market. Indeed, the cost of a commodity is given by the amount of labor directly and indirectly needed in the firm to produce it, whereas its value and its price are determined by the quantity of *social abstract labor* embodied in it through the prevailing technology. Therefore, in order to gain *super-profits*, the capitalist needs to find new technologies that allow her to reduce the cost of producing its own commodity. This explains why Marx focuses on those innovations that modern growth theory calls "labor-saving". He seems to think that, in general, innovation is characterized by a bias towards the productivity of labor, such that the productivity of labor increases and the productivity of capital decreases - a pattern of innovation known as "Marx-biased".<sup>5</sup>

These innovations do not change the amount of value expanded through labor in a given working day. They increase the number of commodities that are produced during the working day and in which that given value is embodied in equal parts. In other words, an increase in labor productivity is an increase in the *use values* representing a given value and therefore it is associated with a reduction of the unit value of the commodities produced.

According to Marx, out of the many ways to cut this value - the different patterns of innovations - capitalists' prevailing one is to purchase more productive constant capital, leading to an increase of it relatively to variable capital, an increase of the *organic composition of capital*  $\frac{c}{v}$ . According to Marx, such an increase is so typical in the history of capitalism that it can be regarded as a "law of capitalist development". As the organic composition of capital increases, though, the same rate of surplus value is expressed in a lower rate of profit. In fact, rewriting the rate of profit as

$$r = \frac{s}{v} \left( 1 - \frac{v}{c + v} \frac{c}{v} \right), \quad (3)$$

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<sup>4</sup>This ratio is often referred to as *rate of exploitation*.

<sup>5</sup>The two most well know patterns of technical change are *Harrod-neutral* and *Hicks-neutral* technical change. Innovation is Harrod-neutral when it leaves the capital-output ratio unchanged and it is Hicks-neutral when it leaves unchanged the capital-labor ratio. If neutrality doesn't hold, innovation is "biased" in either sense.

we can analyze the impact of  $\frac{c}{v}$  on  $r$  when  $\frac{s}{v}$  stays constant, by considering the following cases:

1. if  $c$  increases and  $v$  stays constant, the ratio  $\frac{v}{c+v}$  decreases while  $\frac{c}{v}$  increases, but the former decreases proportionally more than the latter increases, thus the net effect is a decrease of  $r$ ;
2. if  $c$  stays constant and  $v$  decreases,  $r$  decreases;
3. if both  $c$  and  $v$  increase in such a way that  $\frac{c}{v}$  remains constant,  $r$  decreases.

Marx does not maintain that the amount of surplus value or its rate do not grow as production expands. He believes that the increase of constant capital is such that the rate of profit falls even if the rate of surplus value is rising. In modern economic terminology this is a severe form of diminishing returns to capital.

In order to analyze this proposition more thoroughly we have to go back to the original logic of innovation. As we have noted, when an innovation is introduced, the capitalist initially benefits from lower costs but, when the new technique becomes standard, final prices decrease and super-profits disappear. According to Marx, when the innovative technique becomes standard not only no capitalist gains a higher rate of profit than the others, but the average rate is lower than the original one.

To understand Marx's argument we must focus on two crucial variables whose movements are hidden by the cost-price sequence, namely the *real wage* and the *value of labor power*.<sup>6</sup>

From a different perspective, the rate of profit can be seen as

$$r = (1 - \omega)\rho, \tag{4}$$

where  $\omega$  is the money-wage share of output and  $\rho$  the output-capital ratio.

This relation allows us to see the distributional conflict between profits and salaries in a clearer way than the preceding expressions of the rate of profit, bringing the connection between the rate of profit and wages to light.

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<sup>6</sup>Labor power can be evaluated either through the commodities that are needed for its functioning and reproduction or through the commodities that are exchanged for it - whose value is the money wage. This recalls the common practice of evaluating factors of production either at the cost of producing them or at the cost of purchasing them. The value of labor power is given either by  $\sum_i v_i b_i$ , where  $v_i$  and  $b_i$  are respectively the value and the subsistence level of each commodity  $i$ , or by  $w \frac{1}{m}$ , where  $m$  is the ratio of total labor expended in the economy to the value added and  $1/m$  is the value of a money unit. The two calculations coincide when commodities are paid for at their values.

When prices decrease the real wage tends to increase. Here we need to consider two possibilities:

1. If, as Marx seems to imply, the value of labor power is to remain constant, the real wage increases in the same proportion as the productivity of labor. The share of money wages  $\omega$  does not change but, if the productivity of capital  $\rho$  decreases - as Marx thought - the rate of profit falls;
2. if the real wage is to remain constant - according to the rule that workers always receive their subsistence goods - the money wage decreases in the same proportion in which prices have dropped. The wage share  $\omega$  decreases and may offset the decrease of  $\rho$ . This forms the substance of Okishio's criticism, examined more in detail in the following section.

In order to understand why a falling rate of profit characterizes capitalist production, it is important to relate the falling rate of profit to a fundamental fact of capitalism, i.e. the process of *accumulation*. Accumulation is the increase in the quantity of use value to be converted into capital, set in motion by the capitalists' drive to earn ever-increasing profits. Innovators accumulate in order to gain super-profits and other capitalists follow, competing away those profits. Accumulation proceeds causing dramatic repeated increases in constant capital and a fall of the rate of profit.

If capitalists could not earn higher profits through increases in the scale of production, they wouldn't innovate at all and accumulation wouldn't take place. Hence an other law of capitalist development: a falling rate of profit goes "hand in hand" - says Marx - with increasing profits.<sup>7</sup>

Marx sees the law of the falling rate of profit operating as a tendency. Indeed he acknowledges the existence of several counteracting forces that hamper the fall and, although he believes that the net result of the forces at play is a fall in the rate, he doesn't rule out the possibility that in specific times and places the rate of profit might temporarily rise.

The counteracting forces examined by Marx are the following:

1. **An increase of the rate of exploitation**  $\frac{s}{v}$  that can be produced by the extraction of absolute or relative surplus value. The extraction of absolute surplus value does not alter the organic composition of capital and, in order to produce an increase in the rate of exploitation, the extraction of relative surplus value must take place without altering that ratio (and this is possible in some cases).

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<sup>7</sup>In industrialized economies decreasing profit margins and increasing average firm size can be observed in many sectors. Banking and retail commerce are just two examples.

2. **Depression of wages below the value of labor power.** This force can manifest itself when an absolute or relative overpopulation of workers is formed as a consequence of the introduction of new labor-saving methods of production.
3. **Cheapening of the elements of the constant capital.** Marx believes that the constant capital - a measure of value - grows less than proportionately to its mass. Thus the organic composition of capital grows at a lower pace than the amount of capital per worker, taken as a measure of the accumulation process.
4. **Relative overpopulation.** As the organic composition of capital increases, fewer workers are needed to produce the same amount of surplus value. This encourages the creation of new lines of production - possibly of labor-intensive luxury goods - that can rely on salaries lower than the average.
5. **International trade.** It cheapens some elements of constant capital and the commodities exchanged for variable capital.
6. **Increase of *stock capital*.** As capitalist production and accumulation progress, a portion of capital is borrowed and is compensated just with interest, which is lower than industrial profit. This portion is not included in the calculation of the average rate of profit.

The law of the falling rate of profit enlightens an internal contradiction in the capitalist mode of production. It breeds over-production, speculation, crises, excess capital, excess population. At certain stages, therefore, capitalism conflicts with its own further development.

Surplus value must be produced and sold, but the production of surplus value relies on exploitation which, by reducing consumers' purchasing power, undermines its own realization. The market, therefore, must be continually expanded.

Accumulation depends on the mass of profits - not on their rate - and on the cheapness of the commodities that capitalists buy as capital and consumption. Accumulation gains strength as it proceeds. Countries that have already accumulated a lot can accumulate faster than others. Large capitals with lower rates of profits accumulate faster than smaller capitals with higher rates of profits. In order to obey the immanent necessity to accumulate, capital continually seeks concentration. This leads to over production of capital.

Summarizing, Marx sees the development of capitalistic productive forces - that is, synthetically, the growth of the organic composition of capital - as



a historical necessity. Capitalist are subject to this necessity which forces them to introduce technological innovations and, therefore, to unintentionally reduce the average rate of profit. The fall of the rate of profit leads to seek higher absolute profits through a spiral of concentration and more innovations.

### 3 Okishio's criticism

Scholars seem to agree that Marx failed to demonstrate the *necessity* of the fall of the rate of profit. Even a brief "philology" of the Marxian conception of necessity does not seem to secure any support to the necessity of falling rates of profits.

Because Marx was a Hegelian and because his historical materialism revolves around the notion of "historical necessity", one might think that by "necessity" Marx actually meant reality. Hegel in fact, in his Logic, conceived necessity as a character of reality since he believed that only experience could reveal the true determinations of an object or fact and, therefore, that experience was a cogent - necessitating - instrument of knowledge. One might think so, but there two elements at least that make this conclusion unlikely. First Marx explicitly refused the sequence in Hegelian logic and famously noted that it is "standing on its head". Second, his method of analysis in Capital would be contradicted by the possibility decucting capital accumulation from any theoretical priors.

Okishio (1961) went further and questioned the sheer possibility of a falling rate claiming that in Marx's theory the rate of profit must rise as a consequence of the introduction of labor-saving innovations. Okishio focuses on Marx's vision of real wages as the amount of necessities that allow a socially conditioned subsistence. He points out that, if one believes that real wages stay at the subsistence level, money wages must adjust as prices vary.

In Marx's treatment of the consequences of innovations, the unit value of commodities decreases as the quantity of abstract labor power embodied in them decreases. Therefore, for real wages to remain constant, money wages must decrease in the same proportion of the decrease in prices. If the real wage doesn't vary, the rate of profit realized after the introduction of the new technology rises.

Supposing that at the existing technology, the production of corn requires  $n$  units of labor and  $a$  units of corn, the value of corn is given by

$$p = n + pa \tag{5}$$

and, therefore,

$$p = \frac{n}{1-a}. \quad (6)$$

Given a money wage  $w$  the real wage is

$$b = w \frac{(1-a)}{n}. \quad (7)$$

The profit is  $p - (pa + wn)$  and the capital bound up in production is of course  $pa + wn$ . Thus the rate of profit is

$$r = \frac{1}{a + bn} - 1. \quad (8)$$

If a new technique is introduced and generally adopted, that allows to produce one unit of corn with  $n'$  units of corn and  $a'$  units of corn and it is viable, such that

$$pa' + wn' < pa + wn, \quad (9)$$

the price of corn becomes

$$p' = \frac{n'}{1-a'}. \quad (10)$$

For the real wage to remain constant, the money wage has to be

$$w' = p'b. \quad (11)$$

At these new price and money wage the rate of profit becomes

$$r' = \frac{1}{a' + bn'} - 1, \quad (12)$$

where

$$r > r' \quad (13)$$

as we assumed  $a' + bn' < a + bn$ . If, on the other hand, we keep the value of labor power constant and so we keep the money wage constant, the rate of profit under the new technique becomes

$$r' = \frac{1}{a' + (1-a')w} - 1 \quad (14)$$

and we have

$$r' < r, \quad (15)$$

if  $a' > a$ . For this last condition to apply it has to be

$$\frac{n - n'}{a' - a} < \frac{w}{p}. \quad (16)$$

The problem with Okishio's analysis is that it doesn't acknowledge the importance that Marx gave to the value of labor power. If the value of labor power is the constant element in the analysis of the innovation, the rate of profit falls.

## 4 *Marx-bias* in the extended penn world tables

Data from the *Extended Penn World Tables* seem to roughly confirm Marx's prediction of a growing productivity of labor and a falling productivity of capital for industrialized economies. The US, Japan, United Kingdom, Germany (only post-unification), France, Spain, and Italy all show positive trends of labor productivity and negative trends of capital productivity over the last forty years. In some of these economies, though, there are periods of rise in the productivity of capital. Some explain these rises with a long lag of the effect of innovations on the introduction of innovations themselves. Innovations require large investments, which succeed to increase output more than proportionally only after a long time. Therefore, in intermediate periods, the average productivity of capital turns out to be higher.

Similar patterns of productivity, as for industrialized economies, seem to characterize Taiwan, Korea, Indonesia and India.

However, for Sub-Saharan Africa the picture is substantially different. Mauritania, Mali, Niger, Chad, Sudan, Central-African Republic and Congo show falling productivities of labor and rising productivities of capital, consistently with de-industrialization.

## 5 *Marx-biased* technical change and development policy

Marx's picture of capital accumulation fits well the classic industrialization scenario but, at a first glance, it does not seem to explain the experience of developing countries. The de-industrialization appearing from the data is often explained with the widespread policies of export-led growth, trade liberalization and privatization.<sup>8</sup>

Marx's vision of capitalist accumulation does not apply to non-industrial economies when we see them as closed systems but it becomes relevant in the presence of international trade. Furthermore his vision of the origin of capitalism contributes to interpreting liberalization policies. According to Marx, the rise of capitalism relies - among the other things - on the "institutional" preconditions given by the *expropriation* of land and the *commodification* of

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<sup>8</sup>The flip side of these policies is the suppression of import-substituting industrialization policies, which are also often blamed for deindustrialization in sub-saharan Africa. Such explanation is particularly appealing if one agrees that, historically, protectionism has been the only road to high income (Chiang, 2002).

labor and the cited policies can be interpreted precisely as creating these conditions. Liberalization means market exchange without protection at the custom level but also without ties - nor protection of any other form - at the level of the internal market (national monopolies, regulations etc.) and, by creating markets, it helps the commodification of labor. Privatization generally refers to natural resources and public utilities and, as such, it serves the expropriation of land.

Liberalization and privatization policies seem to fit in the more general agenda for development that is often referred to as "Neoliberal".<sup>9</sup> According to this agenda developing countries should rely on foreign direct investment (FDI) and, therefore, they should inform their policies to the goal of attracting foreign investors. Accordingly the neoliberal agenda assigns a fundamental role to macroeconomic stabilization and to the creation and enforcement of property rights. From the point of view of transnational capital movements a competitive market for all commodities including labor adds to the stability of a country.

As I have indicated above, from the Marxian perspective capitalist accumulation requires the continuous extension of the market both for final commodities and for production inputs. Developing countries have long supplied industrialized ones with the latter and, therefore, their productivity pattern should not be expected to fit the classical industrialization scenario. Developing countries are unlikely to be the theatre of a significant (frontier) innovation process. Rather the technological changes that they undergo are catching-up ones. Hence, the experience of developing countries cannot be brought against the Marxian theory of accumulation and of the tendency of the rate of profit to fall. Rather such theory helps interpreting the international development agenda in the light of accumulation as experienced by industrialized economies.

As a closing note it should be recalled that some very successful developmental programs implemented in Sub-Saharan Africa over the last thirty years have been based on labor-intensive investments. In particular many programs implemented by the International Labor Organization have emphasized the possibility of responding to the large need of infrastructure construction with labor-oriented technology. The proponents of these programs have been advertising them to funding institutions - FDI suppliers - mainly as an alternative way to sustain the profitability of those construction

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<sup>9</sup>For a brief exposition of development orientations on the part of the industrialized world and development institutions (such as the IMF and the World Bank), see Esterly (2007). The World Bank has recently reviewed its activity and partially agreed that an excessively liberalization-friendly environment has been harmful to many developing countries (World Bank, 2005)

projects.

In a very Marxian fashion, institutions from the industrialized world<sup>10</sup> have been proposing low-labor-productivity projects as forms of profitable investment. In an even more Marxian fashion, the declaration of Philadelphia, that is integrating part of the ILO's constitution, reaffirms as a first principle that "labor is not a commodity".

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<sup>10</sup>The International Labor Organization, founded in 1919, is part of the United Nation "system" and it supposedly strives to promote fair economic relations especially in developing countries. An outstanding critic of the role of the ILO - although in a different historical context - was Karl Polanyi (1957).