IS THERE A TENDENCY OF THE RATE OF PROFIT TO FALL?

Theory, Evidence and an Adequate Model

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Abstract: The Law of the Tendency of the Rate of Profit to Fall, put forward by Marx in *Capital* Vol.3, is a theoretical summary of the social reality of capitalist society. However, this law is still controversial and some scholars have criticized Marx for it, including Japanese scholar Okishio Nobuo in his Okishio Theorem, although these criticisms are theoretically untenable. In this article, after commenting on the relevant arguments, we show that the rate of profit inevitably falls and develop a model to illustrate this. We find Marx's claim that the falling rate of profit, followed by the higher organic composition of capital, is justified even under the circumstance that the rate of surplus value rises and new fixed capital reduces.

Key words: rate of profit; law of the tendency of the rate of profit to fall; Okishio Theorem; capital depreciation

1. Introduction

It was pointed out by Marx in *Capital* Vol. 3 that,

> Owing to the distinctive methods of production developing in the capital system the same number of laborers, i.e., the same quantity of labor-power set in motion by a variable capital of a given value, operate, work up and productively consume in the same time span an ever-increasing quantity of means of labor, machinery and fixed capital of all sorts, raw and auxiliary materials and consequently a constant capital of an ever-increasing value. This continual relative decrease of the variable capital vis-à-vis the constant, and consequently the total capital, is identical with the progressively higher organic composition of the social capital in

its average. It is likewise just another expression for the progressive development of the social productivity of labor, which is demonstrated precisely by the fact that the same number of laborers in the same time, i.e., with less labors, convert an ever-increasing quantity of raw and auxiliary materials into products, thanks to the growing application of machinery and fixed capital in general. To this growing quantity of value of the constant capital—although indicating the growth of the real mass of use-values of which the constant capital materially consists only approximately—corresponds a progressive cheapening of products. Every individual product, considered by itself, contains a smaller quantity of labor than it did on a lower level of production, where the capital invested in wages occupies a far greater place compared to the capital invested in means of production.

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 labor exploitation, is represented by a continually falling general rate of profit. The progressive tendency of the general rate of profit to fall is, therefore, just an expression peculiar to the capitalist mode of production of the progressive development of the social productivity of labor. This does not mean to say that the rate of profit may not fall temporarily for other reasons. But proceeding from the nature of the capitalist mode of production, it is thereby proved a logical necessity that in its development the general average rate of surplus-value must express itself in a falling general rate of profit. Since the mass of the employed living labor is continually on the decline as compared to the mass of materialized labor set in motion by it, i.e., to the productively consumed means of production, it follows that the portion of living labor, unpaid and congealed in surplus-value, must also be continually on the decrease compared to the amount of value represented by the invested total capital. Since the ratio of the mass of surplus-value to the value of the invested total capital forms the rate of profit, this rate must constantly fall. (Marx 2004b, 236–37)

This claim of Marx, referred to as the law of the falling rate of profit, is opposed by some scholars who have advanced alternative theories. To respond to this contrary literature, we developed a model in this article to show that the rate of profit inevitably falls. We briefly recount the arguments on the law of the falling rate of profit in section two, review the sparse heterodox and orthodox literature on the rate of profit in section three, analyze the calculations of the rate of profit in the literature in section four, propose and prove a theory that the rate of profit inevitably falls in

section five and then finally, in section six, develop a model to illustrate this point before offering a final conclusion.

2. Arguments on the Falling Rate of Profit

One of the objections came from the Okishio Theorem of the Japanese scholar Okishio Nobuo, in which he argued that the capitalists would introduce a new technique to reduce costs of production without considering whether it would improve labor productivity or not. Therefore, it was claimed that a new technique alone could not produce a fall in the rate of profit, unless there was a large enough rise in real wages.

The second argument was that the organic composition of capital increased with the rate of surplus value simultaneously in general. Behind the increase of organic composition of capital, it was the implicit process of accumulation of capital, in which there were some factors elevating the rate of profit, such as productivity growing faster than wages or the introduction of innovative technology, while some factors prevented the rate of profit from falling. The accumulation of capital and the improvement of technology did not imply that the capital for every individual laborer increased, and only some technological innovations were capital intensive. In addition, with the improved labor productivity and stable real wages, the value of variable capital declined which consequently caused an increased rate of exploitation, preventing the rate of profit from falling. It was believed that Marx ignored the accelerated turnover of capital as well as the growing proportion of investment in non-productive areas, whose increasingly obvious function was to hinder the falling rate of profit. So, it was argued that there was no sound reason to draw the conclusion that the increase of organic composition alone would make the rate of profit fall. The pressure of competition urged the rapid improvement of productivity. Although the amount of the means of production perhaps increased, its value remained the same or even decreased. By using a mathematical model based on the independence of the increments of fixed capital and variable capital to the increment of surplus value, it could be proved that the rate of profit fell under the circumstance that the increments of the fixed capital and the variable capital were greater than the corresponding increment of the surplus value. Thus, it was argued that the premise of an increasing organic composition of capital did not necessarily hold in Marx' law of the falling rate of profit (Zhu 2008). Higher technical composition of capital did not imply the same higher tendency of the organic composition, as the increase of productivity offset the increase of the amount via the declining price of the machines (Zhou 2010). If there was unused labor available in the system, the capitalists would invest in machines rather than labor (Harman 2007).

Other scholars argued that the diversity of industrial sectors played an important role in stimulating the accumulation of capital. Marx refers to this in an unnoticed corner of *Capital* Vol. 3 referring to the work of Jones, but did not list it among the factors which counteracted the fall of the rate of the profit. This was not accidental, because if the diversification of industrial sectors brought about by product innovation is considered, Marx's methodological foundation for the falling rate of profit might be shaken (Zhang, Meng, and Lu 2006, 411).

Scholars who supported the law considered the "great depression" of the 1920s and 1930s, caused by the decline of capital accumulation by the capitalists, as proof that the higher organic composition of capital caused the rate of profit to fall. Due to counter-tendencies, the fall of the rate of profit was nonlinear. Sometimes it changed in a latent form. Sometimes it was manifested strongly in certain periods, but weakly in other periods with a form of cyclical crisis. The capitalists could not overcome the limit of the existing labor hours; the rate of profit inevitably fell in the long term (Zhu 2008). Marx himself recognized that rises in productivity reduced the proportion of the working day the workers needed to cover the cost of their own living standards. The capitalists could then control a greater share of their workers' labor as profits without cutting real wages, but there was a limit to how far this counter-influence could operate. If four hours labor a day covered the costs of keeping workers alive, then it could be cut by an hour to three hours a day even though the workers' past labor could be transformed into an ever greater accumulation of means of production. When the bubble burst, it was discovered that an immense investment in real economy such as fiber optic telecommunication networks was not profitable, and many major companies made profits which were virtually speculative. With claimed profits around 50% higher than real profits, capitalists were driven to seek innovations in technologies that kept them ahead of their rivals. There was an empirical reply that the investment in material terms grew faster than the workforce and the net stock of capital per person employed in the USA grew at 2% to 3% a year from 1948 to 1973 (Harman 2007).

3. Literature Review

As Harman noticed, the capitalists pursued the extra surplus value in competition with other capitalists. Consequently, Okishio was incapable of refuting the law of the falling rate of profit. On the contrary, Okishio completely ignored the capitalists' pursuit of profit. In fact, the cost of luxuries was much higher than that of common merchandise, whereas capitalists would produce luxuries because high cost implies high price and consequently high profit.

Marx claimed that the high organic composition of capital would cause a fall of the rate of profit, but this does not mean the former is the only reason for the latter.

So enumerating other possible reasons for a falling rate of profit is not sufficient to disprove the law of the falling rate of profit. This is especially so in this case because price cannot be taken as one of the factors that changes profit, since it is a dependent, not an independent, variable.

When considering the rise of the organic composition of capital, not only fixed capital but also circulating constant capital should be taken into account. If competition increased the amount of production materials, but the value of output remained the same or even decreased, it would inevitably cause the rate of profit to fall. "In fact, it would rather be the reverse; it would be the competitive struggle which would begin because the fallen rate of profit and over-production of capital originate from the same condition" (Marx 2004b, 90).

The high surplus value rate was not equivalent to high profits or a higher rate of profit. A low rate of surplus value can yield a high profit rate and vice versa.

Considering the relations between the organic composition of capital, the rate of surplus value and the profit rate, we notice that they satisfy the formula

$$P' = \frac{m'}{\frac{C}{V} + 1}, \tag{1}$$

where P' is the profit rate, m' is surplus value rate, C is fixed capital, V is variable capital and C / V (denoted by C_V) is the organic composition of capital. If we differentiate P' by C_V, we have

$$\frac{dP'}{dC_v} = \frac{\frac{dm'}{dC_v} - P'}{C_v + 1}. \tag{2}$$

Thus, as long as

$$\frac{dm'}{dC_v} < P', \tag{3}$$

even if

$$\frac{dm'}{dC_v} > 0, \tag{4}$$

from (2) and (3), we have

$$\frac{dP'}{dC_v} < 0. \tag{5}$$

Inequality (4) means that higher capital organic composition leads to a higher rate of surplus value.

Inequality (5) shows that the rate of profit falls with a rising organic composition of capital. Furthermore, the rise of the organic composition of capital associated with technical progress will accelerate the rate of depreciation and result in the elimination of the original fixed capital. It is possible that profit falls due to the compensation for the loss.

If total profits increase, it is acceptable that the rate of profit falls. For rational capitalists, it is much better to make use of capital with a lower rate of profit rather than leave it aside with no profit. When the new accumulated capital is applied in "labor intensive" areas, the profit rate is usually low because the newly accumulated capital is not sufficient to be used as effectively as the original capital and it cannot generate the same rate of profit. This new capital has no influence on the general rate of profit caused by the increase of the organic composition of capital, though it lowers the profit rate.

Through the development of capitalism, we can see that even if surplus labor is available, capitalists will still invest in machines rather than labor. When a substantial number of unemployed laborers exist in a capitalist society, the machines cannot be improved. Improvements in machinery and consistent investment of capitalists into new machinery cause many workers to lose their jobs, causing many surplus laborers to enter the marketplace.

From the perspective of diversification in the industrial sectors, Jones emphasized that in spite of the falling rate of profit the inducements and faculties to accumulate are augmented (Marx 2004b). At a low rate of profit, the speed of accumulation is ordinarily faster than that of the numbers of the people (entering the workforce), while at a high rate of profit the speed of accumulation is slower than the number of workers leaving the market, which leads to the diversification of the industrial sector which offsets the fall of the profit rate.

4. Calculating the Rate of Profit

In reality, some factors hamper calculating the general rate of profit, so we have to approximate it by calculating the average rate of profit as the approximate value of the general rate of profit. To this end, some scholars have tried to calculate the rate of profit and analyze its trend.

American scholars Basu and Melonakos found weak evidence of a long-term downward trend in the general profit rate for the US economy for the period 1948–2007 (Basu and Manolakos 2013). The profit rate data they utilized were gathered from scholars and the rate of profit calculated by dividing the total profit (net domestic product minus the wage) by the net stock of fixed capital valued at replacement cost. The profit rate defined by them was much higher than what was defined by Marx. According to Marx's definition, the denominator of the formula to calculate the profit rate should include wages, and materials, circulating capital, industrial capital as well as the role that commercial capital plays in the distribution of profit. Furthermore, fixed capital should be calculated at the same value that the capitalists invested rather than the replacement cost. On the contrary, the loss of the par value and the replacement cost should be deducted from the numerator. Hence, we believe that Basu and Melonakos' study is not strong enough to illustrate Marx' law of falling profit rates.

Chinese scholars Li and Zhu (2005) have calculated the profit rate of US private sector capital investments and drew the conclusion that since the mid-19th century, the profit rate of the USA experienced four periods of declining values. The average profit rate was 17.5% during 1869–1897, 13.0% during 1898–1940 and 12.7% during 1983–2000. When they calculated the profit rate, the numerator was the profit, which equaled the net domestic product less the cost of wages and tax (indirect tax and corporate income tax included) and the denominator is the net value of net non-residential fixed capital. In the denominator, they ignored variable capital, circulating fixed capital and commercial capital, and in the numerator, they chose not to deduct indirect tax and corporate income tax, because many indirect taxes are passed on to the workers and consequently it was inappropriate to subtract the wage bill and indirect tax together.

Chinese scholars Fusheng Xie and An Li analyzed the point of view of Weisskopf and Henry and Becker and then calculated the profit rate in the USA. They found the average profit rate of the USA was 8.35% during 1975–2008, and the median is 8.53%, which are both lower than the average profit rate and the median (10.61% and 10.53%) during 1952–1974 (Xie and Li 2011). When they calculated, they divided the profit rate into the product of three variables as share in the profit, rate of capacity utilization and capital ratio of output and capacity, i.e.,

$$r = \frac{\Pi}{K} = \left(\frac{\Pi}{Y}\right) \times \left(\frac{Y}{Y^*}\right) \times \left(\frac{Y^*}{K}\right). \tag{6}$$

Where, r is the profit rate, Π is the mass of surplus value, K is nominal capital, Y is nominal output, and Y^* is nominal potential output. Π / K is the profit rate,

Π / Y is the profit share, Y / Y^* is rate of capacity utilization, and Y^* / K is the ratio of output to capacity. They analyzed the data of pre-tax quarterly profit rate of non-financial corporate profit in the USA from 1975 to 2008. Profit here is before tax including capital consumption adjustment. The nominal capital inventory is the sum of residential and non-residential building, equipment and software, together with inventory. Obviously, this calculation does not align with Marx's original definition. Residential buildings are consumption goods of the capitalists and workers, so how can they be included in the nominal capital inventory? Marx pointed out that "they may belong, as dwelling houses, etc., to the consumption-fund, and in the case they are not part whatever of the social capital, although they constitute an element of the social wealth of which capital is only a part" (Marx 2004a, 235).

In addition, if the three ratios profit share ($^*\Pi / Y$), capacity utilization (Y / Y^*) and output-capital ratio (Y^* / K) cannot be obtained directly, the only option is to calculate Π / K directly, especially $(\sum\Pi) / (\sum K)$, the average profit rate of total capital in non-financial corporations.

The American scholar Economakis and others utilized the rate of return on net fixed capital as the index of Marx's rate of profit, in which net payments to labor were deducted from the surplus (i.e., profit) and the result divided by net fixed assets (i.e., fixed capital). They came to the conclusion that the rate of return of net fixed capital in non-financial corporations of the USA recovered during 1962–1982 after the crisis, but was still less than that in the mid-1940s and the mid-1960s.

Generally, these calculations diverge substantially from Marx's original definition. Firstly, almost all the scholars deviated from Marx in the calculation of the numerator in considering fixed capital without variable capital and circulating fixed cost. They also ignored that Marx claimed the capital of capitalists covered money, production and commodity capital, and they did not include these three in total capital. Commercial capital, which takes part in the distribution of profit and lowered the average profit rate, was also ignored.

Secondly, the profit term in the numerator deviates from Marx's definition. First, when the tax contains indirect tax and corporation tax, it is a deduction from profit. Secondly, the payment to the CEO and executives should also be taken into consideration in the profit term. On this, Marx pointed out:

> A portion of profit may, indeed be separated, and is separated in reality, as wages, or rather the reverse, that a portion of wages appears under capitalist production as internal part of profit. This portion, as Adam Smith correctly deduced, presents itself in pure form, independently and wholly separated from profit (as the sum of interest and profit of enterprise), on the one hand, and on the other, from that portion of profit which remains after interest is deducted, as profit of enterprise

> in the salary of management of those branches of business whose size, etc., permits of a sufficient division of labor to justify a special salary for a manager. (Marx 2004b, 430–31)

Third, commercial business income (not only profit before interest and tax) should be in profit term, because the expenditure of commercial departments is sustained by the surplus value transferred from industry. Fourth, when Chinese enterprises transfer some surplus value to the USA in international trade, the surplus value transferred should be deducted from the net domestic product of the USA and this will show up in our calculations.

If we use data from the national income accounts, we get prices rather than values. The currency value changes when inflation or deflation happens, which will influence the price. The way to eliminate the effects of inflation or deflation is to use the consumer price index or product price index to convert nominal to real values. However, the price index cannot reflect the real change of the currency's value, so their use may make a significant difference, but also brings in deviations.

In fact, no capitalists collect the kind of data that are required, because they do not imagine that the data would be calculated for the aims of theoretical research, and the national statistical office never asks companies to provide the relevant information. The data provided by the national office or the companies are based on the capitalist's own statements (Marx 2004b, 430–31). The companies often try to understate the profits to governments to avoid taxes and keep the information from the workers in order to justify low wages, while at the same time they often overstate their profits to shareholders as to boost their stock exchange rate and their borrowing capacity (Harman 2008). Therefore, based on such distorted data about profits, the empirical studies can only provide us with the trend of change in average profit rates roughly.

However, besides such calculation and analysis by using the data which almost are not practical, we can feel the fall in the profit rate from the confidence of the contemporary capitalists and executives. For instance, there is a word of *the era of mini profit*, which means the world economy comes into an era with low rates, weak profits and limited returns (Harman 2007). The pressure of executives to achieve revenue targets in the Western countries is higher at present than several years ago. These perceptions from the business world are enough to show the fall in the rate of the profit.

5. A Law That the Profit Rate Is Inevitable to Fall

In this section, we will prove that the profit rate of total capital will inevitably approach zero and will even fall below zero, as long as capitalist production

develops continuously. The theorem illustrates the law of the general rate of profit to fall better than Marx's case that with the rising of the organic composition of capital the profit rate will decline; the theorem also argues that the law of the tendency of the profit rate to fall is a self-evident necessity of the capitalist mode of production.

In *Das Capital*, Marx criticized Doctor Price and pointed out that Price was simply dazzled by the enormous numbers that resulted from a geometrical progression. Price did not consider the conditions of reproduction and labor and regarded capital as a self-regulating automation and a self-growing number. He was struck by the thought that he had found the law of its growth in the formula $s_n = c(1 + i)^n$, in which s_n = the sum of capital + compound interest, c = advanced capital, i = rate of interest (expressed in aliquot parts of 100), and n stands for the number of year in which this process takes place (Marx 2004b, 445–46).

We notice that, if $c > 0$, $i > 0$, then as $n \to +\infty$, we have $s_n \to +\infty$, which encourages us to put forward the law that the profit rate will inevitably fall, which can be proved by using the method of reduction.

We first suppose the law is false. It follows that the profit rate is always greater than a very small positive number, so we can suppose the accumulation rate b is a fixed portion of it. According to Marx's view, production through expansion and accumulation adds surplus value and appears as a means of enrichment and the personal aim for the capitalist, which is contained in the general tendency of capitalist production. With the development of capitalism, production became necessary for every individual capitalist (Marx 2004a, 92). For a single capitalist, a very small amount of accumulation cannot be enough for production on an extended scale, but for the total capital of the society, a very small amount of accumulation is capable of production on an extended scale.

Denote the original gross capital of the whole society as C_0 (>0), after n years of accumulation, the social gross capital is

$$C_n = C_0 (1+b)^n. \tag{7}$$

Since $b > 0$, we have

$$\lim_{n \to +\infty} C_n = +\infty. \tag{8}$$

For example, even if the original social gross capital is 1 ton of gold, the profit rate will not fall till accumulation reaches 1%. It is obviously impossible that 3,000 years later, with total population at 600 billion, the average capital could attain more than 1,500 tons. Hence, the premise is false that the profit rate is always greater than a small positive number, so the profit rate must inevitably fall.

Obviously, we cannot stop time, i.e., n is growing, so we can only halt or delay the process of $C_n \to +\infty$ by lowering b or destroying parts of C_0. In the capitalist system, it does mean that "the fall of the rate of profit, depreciation of existing capital, and development of the productive forces of labor at the expense of already created productive forces" (Marx 2004a, 92). So the depreciation of current capital is the reason for the fall of the rate of profit.

We can see there are two ways for the profit rate to fall. One method is gradual decline till 0 as the limit; thus, there is an upper bound of increase of capital rather than approach to infinity. The other is of cyclical downturn and sometimes it is below 0 and sometimes above 0, which precisely embodies the capitalist business cycle. In the long run, the profit rate must be falling generally, or the impossible outcome $C_n \to +\infty$ will occur.

6. A Model of the Tendential Fall in the Rate of Profit

Let us consider the relation between the rise of organic composition of the capital and the fall in the profit rate, as theorized by Marx, in more depth.

To be consistent, we consider the commodity cotton. Suppose total capital is a constant, namely, K, and before the organic composition rises, the advanced total capital is $C_1 + C_2 + V$, where C_1, C_2 and V are respectively fixed capital, circulating constant capital and variable capital, so that $C_1 + C_2 + V = K$. In one production process, n units of cotton are produced, the number of laborers is L, and the attrition rate of fixed capital is α (<1). Suppose one worker creates 1 unit of labor value, so surplus value is $m = L - V$, the rate of surplus value is $m' = (L - V) / V$, and the organic composition of capital is

$$C_v = \frac{C_1 + C_2}{V} = \frac{K - V}{V} \tag{9}$$

and the profit rate

$$p' = \frac{L - V}{K}. \tag{10}$$

The cost price of every unit of cotton is $w = c_1 + c_2 + v$, where $c_1 = \alpha C_1 / n$, $c_2 = C_2 / n$, $v = V / n$, and every unit of labor value is $u = V / L$.

Now suppose that due to the application of machinery, a smaller quantity of labor power and greater productivity of labor are achieved, and a production process in the same time can produce $n^*(>n)$ units of cotton. Assume the materials such as the price of cotton yarn, the technical relation between materials and productions as well, remains the same, i.e., c_2 in one unit cotton is the same, so under

the new production conditions, $C_2^* = n^* c_2 = (n^* / n)C_2$, $C_1^* = C_1 + \Delta$, α stays the same, so

$$V^* = K - \left(C_1^* + C_2^*\right) = V - \Delta - \left(\frac{n^*}{n} - 1\right)C_2. \tag{11}$$

Obviously, if aggregate capital is the same, and if $V^* < V$, the organic of composition rises, while as long as $(n^* / n - 1)C_2 > -\Delta$, we have $V^* < V$, and, the increase of the new machinery price, i.e., $\Delta>0$, will raise the organic composition of the capital. When the price of new machinery is lower than before, i.e., $\Delta<0$, the organic composition of capital can rise as long as the consumption of the materials increases, until $(n^* / n - 1)C_2 > -\Delta$. To simplify, denote $X = (n^* / n - 1)C_2 + \Delta$, so X is the increment of the variable capital. Then obviously $X < V$.

Assume that cotton is workers' consumption goods, whose labor productivity rises, lowering the value of labor power, and that the new value of labor power is $u^* = u - \delta > 0$, $\delta \geq 0$, so new surplus value rate is

$$m^{*\prime} = \left(\frac{1 - u^*}{u^*}\right) = m' + \frac{\delta}{u^* u} \geq m'.$$

Under the new machinery, the new cost price of one unit cotton is $w^* = c_1^* + c_2^* + v^*$, where $c_1^* = \alpha(C_1 + \Delta) / n^*$, $c_2^* = c_2$, $v^* = V^* / n^*$. Obviously, for the new machinery, it is necessary that $w^* < w$.

It follows that $\alpha(C_1 + \Delta) / n^* + V^* / n^* < \alpha C_1 / n + V / n$

i.e.,

$$\alpha \frac{(C_1 + \Delta)}{n^*} - \alpha \frac{C_1}{n} < \frac{V}{n} - \frac{V^*}{n^*}. \tag{12}$$

The left-hand side of (12) is the new increased machinery value in one unit of cotton; the right-hand side is the decreased labor value in one unit of cotton. It confirms what Marx said, "therefore, the limit to his using a machine is fixed by the difference between the value of the machine and the value of the labor-power replaced by it" (Marx 2004b, 451).

With the new value of labor power, the amount of labor employed by the new variable capital

$$L^* = \frac{V^*}{u^*} = \frac{V - X}{u - \delta}. \tag{13}$$

Every worker produces the same amount of value a day yielding a new profit, i.e. surplus value $m^* = L^* - V^*$, and a new rate of profit

$$p^{*\prime} = \frac{L^* - V^*}{K}. \tag{14}$$

Obviously, in this model, as long as $m^* < m$, the rate of profit will fall. And if

$$\delta < \frac{(1-u)X}{L-X}, \tag{15}$$

we can satisfy $m^* < m$. Due to $L > V > X$ and $u < 1$, Hence, if $X > 0$, the right-hand side of (15) is greater than 0. It follows that when $\delta = 0$, the value of labor power will not fall and the rate of surplus value will stay the same, so as long as the organic composition of capital rises, i.e., $X > 0$, the profit rate will fall. If $\delta > 0$, the surplus value rate increases, but as long as (15) is satisfied, both the surplus value and the profit rate will fall when the organic composition of capital rises, as Marx said "the rate of surplus-value, at the same, or even a rising, degree of labor exploitation, is represented by a continually falling general rate of profit" (Marx 2004b, 236–37). And here, the price of new machinery is unnecessarily greater than the old one.

7. Conclusion

In this article, we develop a theorem and a model to show that as long as the capitalist mode of production continues, the profit rate inevitably will fall to zero, or equals to or below zero. Marx's law of the tendential fall in the rate of profit followed by the higher organic composition of capital is also tenable even under the circumstance that the rate of surplus rate rises and the value of new fixed capital reduces.

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