Release and Tying up of Productive Capital and the 'Transformation Problem'

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1 - Introduction

Marx's solution to the "transformation of the values of commodities into prices of production" has been criticized by the neo-Ricardians because "even if inputs prices are transformed, Marx's 'solution' is internally inconsistent" (Steedman, 1977, p. 29). Steedman argues that Marx's procedure is inconsistent because he "assumes that S/(C+V) is the rate of profit but then derives the result that prices diverge from values, which means precisely, in general, that S/(C+V) is not the rate of profit" (Steedman, 1977, P. 31). Steedman goes on and states that "adherents to Marx's 'solution' never attempt a direct reply to the above criticism. The reason is simple; the criticism is sound and cannot be answered" (Steedman, 1977, p. 31).

Since these Steedman's statements there has been several attempts to answer to the neo-Ricardian challenge (see, for example, Shaikh, 1977, 1984; Freeman, 1984; Lipietz, 1982; Kliman and McGlone, 1988; and Naples, 1989, 1993). These works have made some important contributions to the debate. For instance, Shaikh (1977) has shown that the transformation procedure is not about the transformation of values to prices but about direct prices (i.e. prices proportional to value) to prices of production. Besides, it has also be shown that Marx's procedure is an interactive process occurring in historical times, and not in simultaneous time which is characteristic of the neo-Ricardians' model. The static limitation of the neo-Ricardian approach has been demonstrated by several authors (Naples 1989; Freeman 1984; Kliman, 1993). Yet it is still unexplained what causes the differences between the so-called 'value' and 'money' rates of profit. The aim of this paper is exactly to address to this issue and to demonstrate, from the standpoint of Marx's circuit industrial capital, that this difference is but a consequence of the phenomena of release and tying up of productive capital which is brought about by changes in unit prices of the means of production and the workers' means of subsistence. By doing so we will be able to answer to the neo-Ricardians' criticisms and, therefore, to show that Marx's solution is perfectly consistent with the labor theory of value.

In other words, the aim of this paper is to show that if the phenomena of the release and additional tying up of productive capital, which are related with fluctuations in the unit value (or prices) of the means of production and labor power, are taken into account, then Marx's solution is correct and logically consistent. Moreover, we will also argue that Marx was well aware of this phenomena and of its implications in transforming values into prices of production.

This paper is organized as follows. In the first section we present Marx's concepts of release and tying up of productive and its implication for the circuit of industrial capital. Besides, we also show some evidence that Marx was well aware of the implications of these phenomena as far as the amount and the rate of profit are concerned. In the second section we will examine Marx's transformation procedure - which will be examined through the numerical example presented by Steedman (1977) in Chapter 3 of his book - in order to demonstrate that it gives rise

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to the phenomena of release and tying up of productive capital. We will also show that when these phenomena are taken into consideration there is no logical inconsistency in Marx's theory value and surplus value, as the neo-Ricardians claim[2]. The main conclusions of our analysis will be presented in the last section of this paper. All numeric examples will be presented in the Appendix.

2 - The circuit of industrial capital and the phenomena of release and tying up of productive capital

In this section we will briefly review Marx's concept of release and tying up of productive capital and its implications for the circuit of industrial capital. Moreover, we will also present some evidence to indicate that Marx was well aware of the implications of this phenomena for transformation of values into prices of production.

It should be pointed out that we will focus our attention on the emergence of these phenomena when it results from the changes in the price of the elements of the labor process (i.e. means of production, MP, and labor-power, LP). Therefore, other factors which may also bring about the release and tying up of capital - such as variation in the turnover time, increase in the productivity of labor, etc. - will not be analyzed.

According to Marx, industrial capital assumes, in the course of its circuit, three distinct forms: money-capital (M), productive capital (P)[3], and commodity-capital (C'). As a matter of fact, these three forms assumed by capital-value exist not only in succession but they also coexist side by side. The circuit of industrial capital can be described as follows:

$$M - C\{MP, L\}...P...C' - M'$$

This circuit begins with the capital-value in its money form (M). With a given amount of money the capitalist goes to two different markets: the commodities market (where he purchase the means of production necessary to produced his commodities) and the labor market (where he buys labor-power). In this way the transforms his capital-value from money into productive form. In its productive form the value-capital appears as two distinct processes: the labor process (which consists in the production of new use-values by means of the use-values bought previously in the markets) and the valorization process (which preserves the value of the means of production and, through living labor employed in production, creates new value). Thus the new commodities produced (C') have a total value which equals the value of the means of production transferred to the final product plus living labor employed (V + S) during the process of production - C' = C + (V + S). Part of the new value created only reproduce the value of labor power advanced (V) and the other part is the surplus-value (S) appropriated by the capitalist. In possession of the new commodities produced (C'), the capitalist return to the sphere of circulation in order to sell them and thus to transform his capital-value from the commodity into money form again. With the successful completion of the circuit, the capitalist must start this circuit again.

2Although we are going to use Steedman's numerical example, it should be clear that the results obtained are quite general and, moreover, that they are also important for the discussion of other phenomena like ground-rent and the tendency of the profit rate to fall.

3Productive capital, P, insofar as its material aspect is concerned, assumes the forms of means of production (MP) and concrete living labor (L). Whereas considered from its aspect of value (i.e. as a valorization process), productive capital assumes the forms of constant capital (C) and variable capital - living abstract labor or (V + S).

Let us now examine what would happen if at the beginning of the new turnover period the price of the means of production had fallen by (say) half. Assuming that the circuit, before the fall in the price of the MP, was as follows[4]:

$$M(\$100) - C\left\langle {}^{MP(\$80)}_{LP(\$20)} \right. \ldots P \ldots C'(\$120) - M'(\$120)$$

Due to the reduction of the price of the MP the capitalist, assuming that the scale of production remains the same, will buy the same amount of the MP by \$40 (instead of the \$80 advanced earlier on) and the same amount of labor power by \$20 (assuming that the price of labor power is unchanged). Therefore, the circuit of this industrial capital during its second turnover period can be represented as follows:

$$M(\$60) - C\left\langle {}^{MP(\$40)}_{LP(\$20)} \right. \ldots P \ldots C'(\$80) - M'(\$80)$$

The reduction in the price of the MP, everything else remaining constant, results in the release of an amount of \$40 of constant capital. Moreover, since this capital-value has not been returned to the production process in the second turnover period it cannot be transferred by labor to the final product. As a consequence, the commodity capital, although it remains unchanged in terms of use-values, has its total value declined from \$120 to \$80; that is, the reduction of the total value of the commodity capital equals the amount of constant capital which were released from production and which is kept in capitalist's 'pocket'.

It should be pointed out at this point that Marx defines release and tying up of capital as follows:

> "By tie-up of capital we mean that certain portions of the total value of the product must be reconverted into elements of constant and variable if production is to proceed on the same scale. By release of capital we mean that a portion of the total value of the product which had to be reconverted into constant and variable capital up to a certain time, becomes disposable and superfluous, should production continue on the previous scale." (Marx, 1977b, p.111).

4This example is taken from Marx (1978, p. 344). Marx is here analyzing "the influence which changes in the value of constant and variable capital exert on the rate of profit" (p. 328). He then presents the following example, "Let us now consider the manufacturer. Let us assume that he has laid out \$100 in cotton twist and made a profit of \$20. The product therefore amounts to \$120. It is assumed that \$80 out of the outlay of \$100 has been paid for cotton. If the price of cotton falls by half, he will now spend only \$40 on the cotton and \$20 on the rest, that is \$60 in all (instead of \$100) and the profit will be \$20 as previously, the total product will amount to \$80 (if he does not increase the scale of production). \$40 thus remain in his pocket. He can either spend it or invest it as additional capital". From this example Marx thus concludes that "what this phenomenon amounts to is this: release of a portion of the capital previously tied up in constant capital, or the conversion of a portion of the capital into revenue" (p.344-345). Moreover, Marx also notes that "this phenomenon of the conversion of capital into revenue should be noted, because it creates the illusion that the amount of profits grows (or in the opposite case decrease) independently of the amount of surplus-value. We have seen that, under certain circumstances, a part of rent can be explained by this phenomenon" (p. 345-6) [Marx is referring to his analysis in Chapter XVI, section 3c of the Theories of Surplus-Value, Part 2].

If the price of the MP had become dearer then the capitalist would have either to tie up additional constant capital in order to keep the scale of production constant, or to reduce the scale of production.

Now, we are going to examine the consequences for the industrial capital if the value of the labor-power, as a result of the decrease in the value of the workers' means of consumption, falls from $20 to $10. More specifically, let us assume that, in our first example of the circuit of industrial capital, the capitalist, by advancing $20 as variable capital, could employ 50 workers, but in the second turnover period he has to advance only $10 in order to employ the same 50 workers. If we assume further that the working day and the intensity of labor remain unchanged, then the same number of workers (50) will still incorporated a new value of $40. However, $10 of the new value created will reproduce the variable capital advanced, and consequently the surplus-value will be equal to $30. In other words, the rate of surplus-value will increase from 100% to 300%. The circuit of the industrial capital at its second turnover period will be as follows[5]:

$$M(\$90) - C\left\langle \begin{matrix} MP(\$80) \\ LP(\$10) \end{matrix} \right. ...P...C'(120) - M'(\$120)$$

Therefore, as we have seen above, for Marx the release or tying up of variable capital does not result in any change in the total value of the commodity capital - as it is the case with the constant capital - but it does bring about modifications in the rate of surplus-value and in the total capital advanced.

We will further examine the effects of the release and additional tying up of constant and variable capital for Marx's procedure for the transformation of value into prices of production in the next section.

Let us now turn to some textual evidence that Marx was in fact aware of the importance of these phenomena for the transformation procedure.

In Capital vol. 3 Chapter VI: The Effect of Price Fluctuations - Marx also analyzes the phenomena of release and tying up of productive capital. At the beginning of section II, he states that

> "the phenomena analyzed in this chapter require for their full development the credit system and competition on the world market, the latter being the basis and the vital element of capitalist production. These more definite forms of capitalist production can only be comprehensively presented, however, after the general nature of capital is understood. Furthermore, they do not come within the scope of this work and belong to its eventual continuation. Nevertheless the phenomena listed in the above title [i.e. appreciation, depreciation, release and tie-up of capital] may be discussed in a general way at this stage. They are interrelated, first with one another and, secondly, also with the rate and amount of profit. **They are to be briefly discussed here if only because they**

5"If wages fall in consequence of a depreciation in the value of labor-power ..., a portion of the capital hitherto invested wages is released. Variable capital is set free. In the case of new investments of capital, this has simply the effect of its operating with a higher rate of surplus-value... But in the case of already invested capital, not only does the rate of surplus-value rise but a portion of the capital already invested in wages is also released. Until this time it was tie up and formed a regular portion which had to be deduced from the proceeds for the product and advanced for wages, acting as variable capital if the business were to continue on its former scale. Now this portion is set free and may be used as a new investment, be it to extend the same business or to operate in some other sphere of production" (Marx, 1977b, p.114-5).

> **create the impression that not only the rate, but also the amount of profit - which is actually identical with the amount of surplus-value - could increase or decrease independently of the movements of the quantity or rate of surplus-value**" (Marx, 1977b, p. 110, emphasis added).

Furthermore, Marx calls our attention for the following, which does have a direct relation on the transformation of values into prices:

"we proceed in this entire analysis from the assumption that the rise or fall in prices expresses actual fluctuations in the value. But since we are concerned with the effects such price variations have on the rate of profit, it matters little what is at the bottom of them. The present statement apply equally if prices rise or fall under the influence of the credit system, competition, etc., and not on account of fluctuations in value" (Marx, 1977b, p. 113).

Finally, we should stress that when Marx is directly concerned with the "Conversion of profit into average profit" - that is, with the "transformation of values into prices of production" - he clearly indicated that

> "**Inasmuch as capital was tied up or released by such fluctuations of value, it was not only the rate of profit, but the profit itself, which was likely to be affected in this indirect manner**. However, this has then always applied only to such capital as was already invested, and not to new investments. Besides, the increase or reduction of profit always depended on the extent to which the same capital could, in consequence of such fluctuation of value, set in motion more or less labor; in other words, it depended on the extent to which the same capital could, with the rate of surplus-value remaining the same, obtain a larger or smaller amount of surplus-value. **Far from contradicting the general rule, or form being an exception to it, this seeming exception was really but a special case in the application of the general rule**." (1977b, p. 143-44, emphasis added).

These quotations are sufficient, in our opinion, to show Marx awareness of the so-called problems in the transformation of values into prices. As we have seen, according to him the equalization of industry rates of profit (assuming that everything else remains constant) brings about the phenomena of release and tying up of productive capital. And if one does not take into consideration the occurrence of these phenomena, he gets the **illusion** that profits may be different from the total surplus-value and that the so-called 'money' profit rate differs from the so-called 'value' profit rate.

3 - Marx's Transformation Procedure

3.1 - Steedman's numerical example

Steedman presents the following table of physical inputs and outputs which, in Marx's terms, represents the labor process and, thus, the technical composition of capital.

Table 1: Inputs and Outputs

	Iron (tons)	Labor (hr)	Final Product (tons)
1) Iron Industry	28.000	56.000	56.000
2) Gold Industry	16.000	16.000	48.000
3) Corn Industry	12.000	8.000	8.000
Total	56.000	80.000	-

In order to simplify our presentation we are going to assume that the length of the working-day is equal to 8 hours, and the intensity of labor is constant. Thus, 8 hours of labor correspond one worker, and by making this transformation of hours of labor into number of workers we obtain the following picture of the labor-process (which is equivalent to the former one):

Table 1A: Inputs and Outputs

	Iron (tons)	Number of Workers	Final Product (tons)
1) Iron Industry	28.000	7.000	56.000
2) Gold Industry	16.000	2.000	48.000
3) Corn Industry	12.000	1.000	8.000
Total	56.000	10.000	-

Steedman assumes that the real wages are equal to 5 units of corn for 80 hours of labor, it thus follows that the real wage of 10 workers is equal to 5 units of corn. Hence, the real wage per worker is equal to .5 units of corn.

From Table 1 (or Table 1A) Steedman calculate the value embodied in the commodities during the process of production as follows:

$28\ l_i + 56 = 56\ l_i$ $\quad 16\ l_i + 16 = 48\ l_g$ $\quad 12\ l_i + 8 = 8\ l_c$

or, $l_i = 2$ $\quad 16\ (2) + 16 = 48\ l_g$ $\quad 12\ (2) + 8 = 8\ l_c$

or, $l_g = 1$ $\quad$ or, $l_c = 4$.

Since the value of the labor power is equal to .5lc , and lc=4, it follows that the value of one unit of labor power is equal to 2, that is, V = 2. The surplus value produced by each worker is then equal to S = 8-2 = 6. He then may set out the value representation of the labor process, or the valorization process, as follows:

Table 2:

	C	V	S	M'
1) Iron Industry	56.000	14.000	42.000	112.000
2) Gold Industry	32.000	4.000	12.000	48.000
3) Corn Industry	24.000	2.000	6.000	32.000
Total	112.000	20.000	60.000	192.000

For reasons that will become clear later on, we are going to change silver industry for gold industry, so that the three industries in Steedman's example will be: 1) iron; 2) silver; 3) corn industries. The money-commodity will be gold and we are going to assume that 1 hour of labor is embodied in 1 unit of gold ($1). However, it is further assumed that there is no gold production in this economic system but it has 192 units of gold (money-commodity) which circulates in the economy. At the first period of production (period 1), the value of gold and silver are equal[6].

It is important to stress that the length of the working-day as well as the intensity of labor are going to remain unchanged. Furthermore, the labor process will be also unchanged, and hence not only the scale of production but also the technical composition of capital will remain constant throughout Marx's transformation procedure.

3.2 - Marx's solution

As we have already pointed out, we are going to work out Marx's solution through Steedman's numerical example. In order to carry out the transformation of values into prices of production we are going to rearrange Steedman's tables so that we can use only one table each time[7]. Tables 1A and 2 are jointly presented in Table 1 (see the Appendix).

We are going to assume further that the period of production is equal to one working-day for all and each industry (capital). This assumption will also facilitate our exposition.

Assuming that competition compels the capitalists to sell their commodities at the price of production rather than at their values, we get the results presented in the Table 1 (which represents the first period of production and circulation of commodities). As a consequence of the equalization of industry rates of profit, industry 1 (iron industry) produced a commodity- capital equal to $112 but it is able to realize only $101.818. Therefore, this industry is forced by competition to give up a value equal to $10.182, whereas industry 2 (silver) has a commodity-capital of $48 but it realizes (that is, transform its commodity-capital into money-capital) $52.364 - what implies that industry 2 gets $4.364 more value than it has created. However, in the system as whole, these deviations cancel each other out.

It is important to pointed out that there is no disagreements between sale and purchase prices. At this period of production, sales prices are equal to purchase prices, as it should be[8]. But as reproduction proceeds, these new inputs prices are carried out to the next production period, that is the inputs are also transformed. Let us then assume that the capitalists have finished their

6 We are going to use the symbol $ to indicate the expression of value in terms of the money-commodity (gold), or simply in money terms.

7We are going to follow Marx in the form which the tables are presented. See, for example, Theories of Surplus-Value, part II, Chapter XIII.

8Steedman, because he assumes prices to be set in instantaneous time, mistakenly claim that "this is nonsensical since the sale and purchase are two aspects of the same transaction. Hence inputs must be transformed as well as outputs" (Steedman, 1977, p. 43-4).

production of the first period and sold (and purchased) the commodities in order to produce and consume again, at the same scale, in the next period.

Let us look at industry 2. It has realized a value of $52.36, in other words, it has transformed its commodity-capital into money capital which amounts to $52.364. Now, in order to continue its process of production, capital 2 has to buy 16 units of iron, which costs now $1.818 and hires 2 workers at the money wages of $4.727 (V = 2x.5x$4.727). Therefore, from the proceeds ($52.364) capitalist 2 has to reconvert $29.091 into constant capital and $4.727 into variable capital, which represents a total advanced capital for period 2 of $33.818. But let us recall that in period 1, his constant capital was equal to $32 and his variable capital was equal to $4. However, because the prices of production are different from values (i.e. direct prices), capitalist 2 can buy the same amount of means of production (16 units of iron) with less money-capital ($2.909), and, on the other hand, he has to increase his expenditure of variable capital by $.727. Therefore, capitalist 2 has kept $2.182 of his value-capital in money form and transformed $33.818 from money form into productive capital[9]. By hypothesis, all amount of profit realized as revenue. It thus follows that $2.909 of constant capital have been released from the productive sphere while an additional $.727 of variable capital have been tied-up, which makes the total amount of productive capital to be released equal to $2.182[10]. The release of capital means that part of the value capital is not transformed back into productive capital, it remains in money form. By repeating the same analysis for each industry we obtain the following calculations:

A) Amount of constant capital in period 2:

Industry 1: 28 units of iron x $1.818 = $50.909
Industry 2: 16 units of iron x $1.818 = $29.091
Industry 3: 12 units of iron x $1.82 = $21.818

B) Amount of variable capital in period 2:

Industry 1:7 workers x .5 units of corn (real wage) x $4.727 = $16.455
Industry 2:2 workers x .5 units of corn (real wage) x $4.727 = $4.727
Industry 3:1 workers x .5 units of corn (real wage) x $4.727 = $2.364

C) Amount of surplus-value in period 2 (S = value added - variable capital):

Industry 1: S = $56 - $16.545 = $39.455
Industry 2: S = $16 - $4.727 = $11.273
Industry 3: S = $8 - $2.364 = $5.633.

In Table 2 of the Appendix we present the complete results for the second period of reproduction. Let us now compare period 2 with period 1 as far as the total capital is concerned.

Due to the reduction of the price of iron from $2 to $1.82, the value of the total constant capital has decline from $112 to $101.818, and since the price of corn has risen from $4 to $4.727, the variable capital has been increased from $20 to $23.636. These changes have different effects on the rate of profit, which is equal to S/(C + V).

9As we shall see in the next section, the capital-value which has been released, because we are assuming simple reproduction, must be spent as revenue by the capitalists.

10It is important to stress that by release of capital Marx means "that portion of the total value of the product which had to be reconverted into constant or variable capital up to a certain time, becomes disposable and superfluous, should production continue on the previous scale" (Capital, 1978b, p. 111).

First, let us examine the influence of the additional variable capital which is tied-up. This phenomenon (the transformation of part of the surplus value into variable capital) has a two-fold effect on the rate of profit. On the one hand, by decreasing the rate of surplus-value it decreases the total amount of surplus-value, which means that the numerator of the profit rate decreases. On the other hand, by increasing the variable capital it increases one component of the denominator of this ratio. Then, if the increase in variable capital is equal to d (and hence the surplus-value is reduced by d) we would have that:

$$\bar{r}_1 = \frac{S}{(C+V)} = \frac{60}{112+20} = .4545$$

while in period 2 we would have that:

$$\bar{r}_2 = \frac{(S-d)}{[C+(V+d)]}$$

Now, let us examine the influence of the release of constant capital upon the rate of profit. The reduction of the constant capital does not have any effect on the rate of surplus-value, hence on the amount of surplus value either. However, a "fall or rise in the value of the elements of constant capital affects the rate of profit by altering the ratio of surplus-value to the total capital outlay" (Marx, 1978, pp. 347-8). Thus, if the reduction in constant capital is equal to d (as a consequence of the release of constant capital by an amount equal to $d), we have that the new rate of profit is:

$$\bar{r}_1 = \frac{S}{[(C-d)+V]}$$

Therefore, the release or additional tie-up of variable capital, under our assumptions, can only change the rate of surplus-value and therefore the rate of profit, but it cannot have any effect on the total value created. Nevertheless, a change in the amount of constant capital has an equal effect on the total amount of value which is transferred to commodity capital during the production process. In this example we have that the total amount of constant capital released from period 1 to period 2 is equal to $10.182 and the reduction in the total value of the commodity capital is also equal to $10.182 (C1'=$192 - C2'=$181.818).

We are now in condition to sum up the effects of the release or additional tie-up of constant and variable capital on the circuit of industrial capital. Changes in the amount of constant capital, with labor process remaining unchanged, has the following effects:

1. changes the total amount of value transferred to the commodity-capital by the same amount of the variation in C;
2. has no direct effects on the rate and the amount of surplus-value;
3. changes the rate of profit since $\bar{r}_1 = \frac{S}{[(C-d)+V]}$.

The changes in the variable capital, which is due to fluctuations in the prices of the elements which make up the real wage, have the following effects:

4. they do not affect the total amount of value incorporated, during the production process, into the commodity capital;
5. they change the rate of surplus value and, as a consequence, the total amount of surplus-value appropriated by capitalists;
6. they change the rate of profit because both the amount of surplus and of the variable capital change in opposite direction and by the same amount. That is, $\bar{r} = \frac{(S \pm d)}{[C+(V \pm d)]}$

Let us now return to the reproduction process. By repeating these calculations we get a new situation for each new period of reproduction. From period 17 onwards the situation becomes stable, that is, the phenomena of release and tying up of productive capital ceases to happen, and consequently the reproduction process, also in terms of value, remains unaltered over time (see Appendix for the presentation of the results for all seventeen reproduction periods).

It is clear that in period 17 - as a matter of fact this happens in all reproduction periods - the sum of prices of production is equal to the sum of values ($172.692) and the sum of profits is equal to the sum of surplus-value ($59.138). Therefore, the general rate of profit is equal to $\bar{r} = \frac{S}{C+V}$ and it is exactly what Marx claims it to be.

However, there is a difference in the general rate of profit between period 1 and period 17 which has to be explained. We have already discussed it briefly above but it seems to be worthwhile to deal with this difference again, since the phenomena of release and tie-up of capital "create the impression that not only the rate of profit, but also the amount of profit - which is actually identical with the amount of surplus-value - could increase or decrease independently of the movements of the quantity or the rate of surplus-value" (Capital, 1977b, p. 110).

How can we explain the change in the rate of profit from period 1 to period 17 if there has been no real change in the economy?

Because there has been a successive change in the individuals prices of production of the iron and corn during these reproduction periods, although both the scale and the technical composition of capital have been unchanged, two effects have occurred. On the one hand, there has been a release of constant capital which equal to $19.308 (=$92.692-$112) and, on the other hand, there has been an additional tying-up of variable capital equal to $.862 (=$20.862-$20) with the consequent reduction of the amount of surplus-value by $.862 (S=$59.138-$60). Therefore, the rate of profit in period 1 was:

$$\bar{r}_1 = \frac{\$60}{(\$112+\$20)} = 45.45\%$$

Nevertheless, due to the release and additional tie-up of capital, the rate of profit in reproduction period 17 is equal to:

$$\bar{r}_{17} = \frac{(\$60-\$.862)}{[(\$112-\$19.308)+(\$20+\$.862)} = 52.08\%$$

Therefore, the rate of profit has changed for two reasons: (i) because part of the constant capital has been released and; (ii) because part of the surplus-value has been transformed into variable capital.

3.3 - Analysis of the Reproduction Process as a Whole[11]

However, we still have two problems to consider. First, as we know, at the beginning of the reproduction process we had a total value of $192 (C'=$192) and now, at period 17, the total value produced is equal to $172.692, that is, $19.308 less value has been materialized in total output than in period 1. How is it possible for $19.308 disappear from sight? Secondly, what happens with the capital that has been released?

11I want to acknowledge my debt with A. Kliman who has pointed me out that unless the capital that has been released is converted into revenue, the conditions for simple reproduction will no be satisfied.

In fact, we have already solved the first problem. At period 1, $192 was materialized in the total commodity-capital (C1'), but due to changes in the individuals prices of production part of the capital-value was not reconverted from its money form into productive (constant) capital and therefore ends to act as capital-value for the capitalist class. As the reproduction process continued, and the process of release of constant capital also continued to happen, an increasing part of the capital-value (although in a decreasing ratio) ceased to function as capital. Consequently, this constant capital which has been released from production could not be incorporated into the next commodity capital produced. At reproduction period 17 we thus have the following situation: total constant capital, C = $92.692; total variable capital, V = $20.862; which makes the total productive capital to be equal to $113.554. The total amount of constant capital which were released from the reproduction process is equal to $19.308. As we have already explained, an increase in variable capital implies into a decrease in the amount of surplus value, but that part of the constant capital which is not reinvested (that is, reconverted into productive capital) cannot be transferred to the final product. Therefore, the decrease in the total amount of value produced in the economy (but it should be stressed that there has been no change whatsoever in the production of use-values) is because an equal amount of constant capital has been released. Indeed, if we add up the total value transferred and the total value materialized within the production process in reproduction period 17 with the total amount of constant capital which has been released from the production process (and, as we shall see below, which has been converted into revenue), which equals to $19.308, we get the same amount of value this economy produced at the first period of reproduction, namely $192 (= $172.692 + $19.308). In other words, $19.308 of the original constant capital has been released, and as a consequence it has ceased to be incorporated into the commodity capital produced from period 17 onwards.

From the foregoing we can see that it is important not only to pay attention to the transformation of variable capital into surplus-value (or vice versa) and its effect on the rate of surplus-value, and consequently on the rate of profit, but also that special attention must be placed on the release or tying up of constant capital. These latter phenomena not only affect the rate of profit but they also influence the total amount of value produced in the economy.

Let us now turn to the second question, namely: what happens with the capital-value which has been released?

So far we have only focused our attention on the circuit of capital, but to get an answer to our question we must consider both the circuits of capital and of revenue.

At the end of reproduction period 1, the capitalist class has produced a commodity capital of $192 (which is made up of 56 units of iron, 48 units of silver and 8 units of corn). This commodity capital must now be sold, and they are to be sold, according to our assumptions, at their individual prices of production. It is the capitalists of industries 1, 2, and 3 which buy the 56 units of iron (which amounts to $101.818). They also hire 10 workers, paying $23.636 for them to work at the second period of production. The workers use their wages in order to purchase 5 units of corn. After those sales, it is left unsold 3 units of corn and 48 units of silver, which must be purchase by the capitalist class for their individual consumption.

As we can see in the table of period 1 in the appendix, the total profit appropriated by capitalists is equal to $60, but the capitalist total consumption (KC) would be equal to

KC1 = 3 units of corn*IPPC + 48 units of silver*IPPS

KC1 = 3*$4.727 +48*$1.091 = $ 66,545

It is clear then that capitalists' revenue (i.e. profits) is insufficient to allow them to buy all their allotted consumption basket. In fact, with their total profits the capitalist class would be able to purchase 3 units of corn and only 42 units of silver. Thus, it would remain unsold 6 units of silver. However, in order to keep the economy under simple reproduction assumptions, the capitalist class must convert the total capital released (which, at this first circulation period equals to \$6.545) into revenue. By using the total capital released as revenue, the capitalists can buy all six unsold units of silver (6 units of silver*IPP_S = \$6.545).

As can be seen in Table 18 of the Appendix, the foregoing analysis holds for all 17 periods of reproduction. We can thus state that the analysis of the 'transformation problem' which is carried over within the framework of simple reproduction implies to assume that all capital that is released must be converted into revenue.

3.4 - Comparing Steedman's and Marx's Results

Let we now compare the results which were obtained by Steedman using the neo-Ricardian model with those which we have obtained using Marx's procedure.

First of all, it is important to recall (see page 15 above) that we have changed the silver industry for the gold industry in the Steedman's example, this was done in order to have gold as the money-commodity, and consequently to keep constant the value of gold (i.e. that 1 hour of labor is embodied in 1 unit of gold, \$1) during the reproduction process. This hypothesis allowed us to keep separated the changes in prices which were due to the release and tying up of productive capital from those changes which would have resulted from variations in the value of the money-commodity. But now, in order to compare both results we must express all money values in terms of commodity 2 (silver in our example). By doing so we get the following results:

Variables	Steedman's results	Marx's results
Price of iron (p_i)	\$1.705	\$1.704
Price of corn (p_c)	\$4.296	\$4.297
Wage rate (w)	\$.268	\$.269
Profit rate (r)	52.08%	52.08%

Therefore, leaving aside rounding errors, Marx's procedure for transforming direct prices to prices of production gives us the same results as that obtained by neo-Ricardian approach, but very different analytical results emerged.

The time pattern of the rate of profit and the rate of surplus-value during the seventeen reproduction periods are shown in the pictures below.

4 - Final Remarks

The neo-Ricardian criticisms of Marx's theory of value and its conclusion that "no value magnitude plays any significant role in the determination of the rate of profit (or prices of production)" (Steedman, 1977, p. 65), has been shown to be unsound. For each period of reproduction, we have that the rate of profit is given by S/(C+V) and the sum of production prices is equal to the sum of values whereas the sum of profits is equal to the sum of surplus-value. Thus the so-called 'invariance postulates' hold good for each reproduction period. Consequently, the "inconsistency" in Marx's solution is only apparent, an illusion[12], which is

12Let us recall that, according to Marx (1977b, p. 110), the phenomena of release and tying up of capital "are to be briefly discussed here if only because they create the **impression** that not only

created by the neo-Ricardian's method of 'solving' it (which is based on the conception of instantaneous time, instead of Marx approach that treats price formation in terms of real time). As we shown above, the neo-Ricardian methodology obscure important phenomena: not only the release and tying up of productive capital, but also the conversion of part of the capital-value (i.e. capital which has been released from production sphere) into revenue.

When we take the

their values. By using Marx's procedure we were able to solve the so-called 'transformation problem' and to show the inadequacy of the neo-Ricardian methodology for dealing with this problem since it obscure some important changes and, as a consequence, it gives the illusion that there exist an inconsistency between values and prices of production. In our opinion, in the foregoing analysis Marx's method is shown to be much more powerful than the neo-Ricardian one.

Finally, it should be also pointed out that although the value composition of capital has changed, these changes do not reflect any change in the technical composition and, therefore, there has been no change in the organic composition of capital. Let us recall that, according to Marx (Capital, 1977a, p. 612), the "value-composition of capital, in so far as it is determined by its technical composition and mirrors the change of the latter" is called organic composition of capital.

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the rate, but also the amount of profit - which is actually identical with the amount of surplus-value - could increase or decrease independently of the movements of the quantity or rate of surplus-value".

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Appendix: Tables of the Reproduction Periods and of the capital and Revenue Consumptions

Notation:
C = constant capital;

V = variable capital;

S = surplus-value;

O = output (in physical terms);

LP = labor-power (in numbers of workers employed);

C' = commodity capital;

IV = individual value (value per unit of output);

r = rate of profit;

PP = total price of production;

IPP = individual price of production (i.e. price of production per unit of output);

P = total profits.