LABOR, MONEY, LABOR-SAVING INNOVATION AND THE FALLING RATE OF PROFIT*

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The immediate purpose of capitalist production is not "the possession of other goods", but the appropriation of value, of money, of abstract wealth.

-Theories II, p. 503

Money is labour time in the form of a general object, or the objectification of general labour time, labour time as a general commodity.

-Grundrisse, p. 168

This article presents a procedure to calculate the rate of profit assuming one-time labor-saving innovation. The debate on the effect of technical change on the profit rate has been centered on the so-called Okishio Theorem, a proposition actually advanced in 1905 by Tugan-Baranowsky, and subsequently reproduced by Moszkowska and Shibata[1]. According to the Okishio Theorem, labor-saving innovation raises the profit rate, a result that contradicts the law of the tendential fall in the rate of profit, proposed by Marx in Capital III.

In the 70s, Sraffian writers used this proposition widely as a part of their debate against Marx's theoretical work. However, diverse authors have shown recently the fragility of this approach[2]. This article also shows that the Okishian calculation of the profit rate is a partial and erroneous formalization of Marx's point of view.

If a labor-saving innovation is introduced, the profit rate cannot be calculated in the same way as when technology is constant. Additionally, the occurrence of technical change requires the introduction of money, conceived not only as a numéraire or symbol-money, but also as a *reserve of value*, as a thing able to conserve a given amount of social labor-time in an objective form, i.e. as *reserve-money*. The Okishian vision does not take these two things into account. It proposes no modification in the calculation of the profit rate when there is technical change, and reduces money to symbol-money. This explains its failure to formalize Marx's proposition correctly.

As will be shown, a key concept for analyzing the effect of labor-saving innovation on the profit rate is the monetary expression of labor (MEL), the quantitative relation between the form (specifically, the symbol-money form) and the substance (labor-time) of value[3]. Considering the dynamic of this relation permits one to contrast the Okishio Theorem to Marx's proposition and to formalize the latter.

The Okishian approach can be presented in the following way: let us focus on an economy in two different periods. In both periods, the same numéraire -kind of symbol-money, e.g. paper money- serves to measure commodity prices. In the second period a labor-saving innovation occurs, reducing the labor-time needed to produce the commodities. According to the Okishio Theorem, this change raises the rate of profit measured in numéraire prices. However, this is only one consequence of the labor-saving innovation because it also increases the MEL, a result ignored by the Okishio Theorem. A rising MEL implies that symbol-money represents less labor-time, an effect that in this article will be called *inflation of symbol-money*. In other words, as the labor-saving innovation reduces the labor-time represented by one unit of symbol-money, it becomes inflated in relation to the innovation's preceding period. Inasmuch as this endogenous inflationary effect compensates the rise in the Okishian rate of profit, the labor-saving innovation provokes a reduction in the profit rate measured in labor-time. Thus, the Okishian rate of profit can be

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1 Okishio [1961], Tugan-Baranowsky [1905], Bortkiewicz [1907], Moszkowska [1929], Shibata [1934]. Croce [1899] could also be considered as a precursor of this interpretation. Uncritical histories of the Okishio Theorem can be found in Groll and Orzech [1989] and Howard and King [1989].

2 Ernst [1982], Kliman [1988], [1996], Carchedi (1991), Freeman [1995], [1996].

3 This relation has been studied in static terms, among other authors, by Aglietta [1979] and Foley [1982]. See also Saad-Filho [1993a], Rodríguez [1994] and Ramos [1996].

interpreted as a *nominal* rate of profit, measured in terms of symbol-money.

In order to show this, the first and second sections present a simple numerical example assuming one-time technical change, prices = values, and a monetary system similar to that depicted by Marx in Capital I, Ch. 3. In a very simplified way, the third section focuses on the monetary consequences of the labor-saving innovation. The induced inflation provokes a crisis in the monetary system expressed by a devaluation of the symbol-money in terms of the *reserve-money*, which manifests the falling rate of profit externally. In the fourth section some factors that counteract and enhance the falling rate of profit -which could be formalized within this simple framework- are considered.

1. THE STATIC-NOMINAL RATE OF PROFIT

Throughout the following presentation, it will be assumed that prices = values; the inclusion of divergences between values and production prices complicates the exercise but adds nothing to the results. This framework also shows that the Okishian calculation fails to represent the dynamic of the rate of profit for reasons which are not linked with the so-called "transformation problem".

In this section, a two-department economy —means of production and means of consumption— is considered in a condition of stationary reproduction, i.e. having no technical change. This economy is depicted by the following matrices and vectors:

$$X_t = \begin{bmatrix} 960 \\ 960 \end{bmatrix} \quad A_t = \begin{bmatrix} 0.25 & 0.25 \\ 0 & 0 \end{bmatrix} \quad B_t = \begin{bmatrix} 0 \\ 0.1 \end{bmatrix}$$

$$L_t = [2.5 \;\; 2.5]$$

$$M_t = A_t + B_t L_t = \begin{bmatrix} 0.25 & 0.25 \\ 0.25 & 0.25 \end{bmatrix}$$

$$Y_t = (I - A_t)X_t = \begin{bmatrix} 480 \\ 960 \end{bmatrix}$$

$\mathbf{X}_t$ is the physical output vector, measured in units; $\mathbf{A}_t$ is the matrix of unit means of production coefficients; $\mathbf{L}_t$ is the vector or unit living labor coefficients and $\mathbf{B}_t$ is the vector of real wage, means of consumption per working day. The irreducible matrix $\mathbf{M}_t$ is formed by the unit coefficients of means of production (first row) and means of consumption (second row). Under static conditions, total physical net product is $\mathbf{Y}_t$.

It is known that the *static* rate of profit (π_t) of this economy is given by $\pi_t = (1/\varepsilon_t) -1$,, where ε_t is the maximum eigenvalue of matrix $\mathbf{M}_t$. In the example, $\varepsilon_t = ½$ (< 1; the economy is "productive"), and thus $\pi_t = 100\%$. Relative prices (= values) are obtained by the following system of homogeneous equations:

$$P_t\,[M_t - \varepsilon_t I] = 0 \qquad [1]$$

where $\mathbf{P}_t$ is the vector of relative prices. This system may be normalized by $P_2 = 1$, thus defining the physical exchange proportion between the two commodities:

$$P_t = [1 \;\; 1] \qquad [2]$$

It is important to say that the above procedure for obtaining the rate of profit through ε_t, as well as the calculation of relative prices by means of equation [1], is not a general method for calculating these magnitudes. It is valid only under two special conditions: either when there is no technical change, or when there is technical change but, over time, prices = values. The latter is the condition considered in this article[4].

Now then, in capitalist society, exchanges are carried out by means of *money*, and not by barter relations, as equation [2] suggests. In Capital I, Marx distinguishes three functions of money: money as measure of value, money as means of circulation and "money-as-money". Money considered "as money" functions as an instrument of hoarding, means of payment and world money[5]. These functions are actually performed under some set of socially valid rules and institutions, i.e. a under a *monetary system*.

In this article, it is considered a monetary system in which the form of value is constituted by two closely related

4 When there is technical change and, for instance, prices = production prices, the nominal profit rate cannot be obtained through ε_t; nor can be relative prices calculated by means of system []

5 Capital I, p. 227-244. See also de Brunhoff [1976].

aspects or kinds of money, *symbol-money* and *reserve-money*. Commodities are compulsorily exchanged by means of symbol-money —the *pound*, £— paper money without intrinsic value issued by a national monetary authority which has "objective social validity... [acquired by] its forced currency"[6]. Side by side with symbol-money, there is also a commodity-money —*gold*— which has a parity with the £ sanctioned by the monetary authority. Hence, in this framework, reserve-money is a commodity with intrinsic value and, then, it contains, represents and can conserve a given amount of social labor-time[7]. The monetary authority can only issue paper money; so, it has no influence, for example, on the rate of interest.

The monetary system is thus organized by means of paper money endowed with forced currency and guaranteed by gold, the reserve-money. Additionally, it is assumed that, under certain circumstances, symbol-money can perform *any* monetary function[8]. In particular, the possibility of a continuous use of symbol-money instead of gold is given by the stability of the parity £/gold. Contrarily, a rise in this relation would provoke the lost of monetary functions by symbol-money and, consequently, an increase in the use of gold as money.

So, the first relation defining the monetary system is the *parity pound/gold* (G_t). This relation is defined as the amount of pound notes freely exchangeable with one ounce of gold in a given period. The dimension of this ratio is:

$$G_t = £/o.g. \qquad [3]$$

where o.g. means "ounces of gold". In period t, the specific parity pound/gold sanctioned by the monetary authority is £1 = 1 ounce of gold.

As already was noted, in this monetary system, because reserve-money is a commodity (*gold*), it *contains* and *represents* a certain amount of labor-time. However, it will be supposed that gold is not produced in this economy. The labor-time contained in, and represented by, one ounce of gold defines a second relation of the monetary structure: the *parity labor-time/gold* (γ_t), which has the dimension:

$$\gamma_t = w.d./o.g \qquad [4]$$

where w.d. means "working days". This is a relation between the substance of value —labor-time— and one specific aspect of the form of value —reserve-money. Frequently, Marx calls it "value of money", which is an ambiguous designation for two reasons: Firstly, because it is a relation between *labor-time* and reserve-money, not between "*value*" and "*money*". Secondly, because it can be confused with another relation, that between *labor-time* and *symbol-money*, which will be examined below. It is, thus, convenient to establish a special designation for γ_t, the relation between *labor-time* and *reserve-money*. Concerning γ_t, it will be supposed, firstly, that, in period t, the labor-time contained in one ounce of gold is equal to that contained in each of produced commodities and, secondly, that this relation is constant over time, i.e. $\gamma_t = \gamma_{t+1}$. The latter is an important assumption of Marx in Capital III, made in order to analyze the dynamic of profit rate: "Firstly, the *value of money*. This we can take as constant throughout."[9]

The explicit consideration of *symbol-money* permits one to establish a third relation in the monetary system: the *monetary expression of labor* (MEL_t), a ratio between the *pound* (£) and the substance of value (labor-time):

$$MEL_t = £/w.d. \qquad [5]$$

Since there is forced currency of paper money, labor-time is necessarily expressed through *pounds*. This defines the MEL_t as the amount of symbol-money which represents one unit of labor-time in a given period. (In section 3, it will be shown that the equation $MEL_t = G_t/\gamma_t$ is valid only under static conditions.)

Because, in period t, the labor-time contained in one ounce of gold is the same that that contained in each of the produced commodities and G_t = £1/1 ounce of gold, the vector of symbol-money prices —i.e. the exchange ratios of commodities [2] expressed in paper money— is $\mathbf{P_t}^{£}$ = [£1 £1]. Then, using the above-presented data, it is possible to construct the following scheme of reproduction:

6 Capital I, p. 226.

7 It is assumed that reserve-money is a commodity in order to simplify and to set a framework similar to that presented by Marx in Capital. However, reserve-money is essentially a functional, not natural, determination of money. Therefore, a non-commodity can act as reserve money. For instance, the US dollar is the reserve-money corresponding to the paper money issued in some Latin American countries. In this case, what is decisive for the peripheral monetary system is that reserve-money *represents* (not *contains*) a given amount of labor-time in a "stable" form. Contrasting with this opinion, see Mandel [1984], who maintains that reserve-money must be gold.

8 Except that of "world money", because the £ has a national determination.

9 Capital III, p. 142. I am grateful to Alan Freeman who drew my attention to this important passage. Certainly, relation γ can change over time. Marx considers the effect of its variations, for instance in *Contribution*, p. 182-3. However, the analysis of this variation is beyond the scope of this article.

Table 1

	C	V	C+V	SV=PR	VA=PP
I	240	240	480	480	960
	(800)	*(800)*	*(1.600)*	*(1.600)*	*(3.200)*
II	240	240	480	480	960
	(800)	*(800)*	*(1.600)*	*(1.600)*	*(3.200)*
Σ	480	480	960	960	1920
	(1.600)	*(1.600)*	*(3.200)*	*(3.200)*	*(6.400)*

In Table 1, numbers in the first line of each department are measured in £, while numbers in parentheses are measured in working days. The calculation of the latter will be explained below. Since prices = values, in each department the surplus value (SV) produced is equal to the appropriated profit (PR) and objectified value (VA) is equal to production price (PP). The static rate of profit is π_t = 100% and the rate of surplus value σ_t = 200%.

For reproduction to be accomplished, a mass of symbol-money (μ_t) must exist. Assuming that only current output is exchanged, this mass is defined by the following equation[10]:

$$\mu_t = P^{£}{}_t X_t / V_t \qquad [6]$$

where scalar V_t is the velocity of circulation of symbol-money. It will supposed that V_t = 1, so the mass μ_t introduced by the monetary authority is μ_t = £1920.

The MEL corresponding to the living labor can be defined as the ratio between the *value-product* (£-prices multiplied by physical net product) and total living labor $\mathbf{L}_t\mathbf{X}_t$. Under the static conditions prevailing in period t, this quotient is equal to the MEL corresponding to the whole labor-time objectified in the economy. Therefore, MEL_t can be calculated as:

$$MEL_t = P^{£}{}_t\, Y_t/L_tX_t = £1440/4800\textit{w.d.} = £0.3/\textit{w.d} \quad [7]$$

(In section 2, a more general calculation of the MEL will be presented.) Thus, in period t, one working day is expressed through £0.3, or, in other words, £1 expresses 1/0.3 = 3.33 working days.

Always taking into account that, in period t, static conditions prevail and prices = values, it is easy to calculate the vector of labor-times contained in commodities, either by $\mathbf{P}^{£}{}_t = \mathbf{P}^{£}{}_t(1/\text{MEL}_t)$ = [3.33 w.d. 3.33 w.d.], or by $\mathbf{P}^{£}{}_t = \mathbf{L}_t[\mathbf{I}\text{-}\mathbf{A}_t]^{-1}$. By means of vector $\mathbf{P}^{£}{}_t$, labor-time magnitudes in Table 1 (numbers in parentheses) are worked out. For instance, labor time contained in constant capital is $(\mathbf{P}^{£}{}_t\mathbf{A}_t)_j(\mathbf{X}_t)_j$; so, for Department I the calculation is 3.33*0.25*960 = 800 w.d.

Since the labor-time contained in one ounce of gold (relation [4]) is assumed to be equal to that contained in each of the produced commodities, the *parity labor-time/gold* is γ_t = 3.33 working days per ounce of gold.

2. THE DYNAMICS OF THE LABOR RATE OF PROFIT

The Okishio Theorem states that the rate of profit varies *inversely* to changes in the use of any input per unit of output. Thus, an *input-saving* innovation, reducing the intensity of either means of production or living labor, would increase the profit rate.

This approach is specially controversial for Marx's theory regarding the effect of reductions of living labor on the profit rate. If a labor-saving innovation provokes an increase in the profit rate, this would mean that profit is not a form of exploited labor, i.e. profit would arise from a source other than appropriated human labor.

Inasmuch as the main issue posed by the Okishio approach is the effect on the profit rate of a “saving” of living labor, the following exercise will consider a pure labor-saving innovation, one which leaves constant the amount of means of production per unit of output and reduces that of living labor[11]. According to the Okishio Theorem, this must imply an increase in the rate of profit; according to Marx, a reduction.

In period t+1, a uniformly labor-saving innovation is introduced in both sectors[12]. Physical output and the use of means of production are doubled, but only 90% of the living labor used in period t is employed, i.e. $\mathbf{L}_{t+1}\mathbf{X}_{t+1}$ = 4.320,

10 Capital I, p. 216.

11 The three-department example presented by Tugan-Baranowsky [1905], (pp. 180-1) assumes an uniform innovation which reduces the intensity of both means of production and living labor. Okishio's three-department example [1961], (pp. 92-5) presents an innovation in Department II which increases the intensity of means of production and reduces that of living labor.

12 The competitive process that induces some capitalist to develop this surplus-profit-generating process, and to others to forcibly adopt the new labor-saving techniques, will not be considered here.

instead of $\mathbf{L}_t\mathbf{X}_t$ = 4.800 working days. The real wage per unit of living labor is constant. In t+1, the economy is described by the following vectors and matrices.

$$X_{t+1} = \begin{bmatrix} 1920 \\ 1920 \end{bmatrix} \quad A_{t+1} = \begin{bmatrix} 0.25 & 0.25 \\ 0 & 0 \end{bmatrix} \quad B_{t+1} = \begin{bmatrix} 0 \\ 0.1 \end{bmatrix}$$

$$L_{t+1} = [1.125 \ 1.125]$$

$$M_{t+1} = A_{t+1} + B_{t+1}L_{t+1} = \begin{bmatrix} 0.2500 & 0.2500 \\ 0.1125 & 0.1125 \end{bmatrix}$$

After labor-saving innovation, the eigenvalue $\mathbf{M}_{t+1}$ is $\varepsilon_{t+1} = 0.3625 < \varepsilon_t = 0.5$. Therefore $\pi_{t+1} > \pi_t$, namely 176% > 100%. This is the result obtained by Tugan-Baranowsky in 1905 and reproduced by Okishio in 1961. Contrary to Marx's statements, a labor-saving innovation would rise, not reduce, π. This is simply an application of a Perron-Frobenius theorem: "The eigenvalue ε is a continuous, increasing function of the elements of **M**."[13] Since the ratios of the second row of $\mathbf{M}_{t+1}$ are lesser than those of $\mathbf{M}_t$, $\varepsilon_{t+1} < \varepsilon_t$ and, thus, $\pi_{t+1} > \pi_t$.

Initially, the Okishian calculation of π seems to suggest that the reduction in living labor has an influence opposite to that maintained by Marx. Actually, for this formalization, labor-time has no real influence on the profit rate. This is clear when one imagines a continuous reduction in living labor, which reduces unit real wages (matrix **BL**) to the limit zero, a dynamic that implies a continuous increase in π. Hence, an economy without human labor would yield a $\pi > 0$, a paradox already formulated by Dimitriev in 1904[14]. This paradox results from the fact that the calculation of π through ε is only a partial, static and money-neglecting formalization of Marx's theory. Before this can be considered in detail, it is necessary to develop the numerical example for period t+1.

Through equation [1], and again normalizing $P_2 = 1$, the vector of physical exchange between both commodities is obtained:

$$P_{t+1} = [1 \ 1] \qquad [8]$$

This vector is equal to [2] because innovation has been uniform for both departments. On the other hand, since there has been no change in the monetary system, prices expressed in symbol-money are equal to those of period t, i.e. $\mathbf{P}^{£}_{t+1}$= [£1 £1].

Table 2 presents the scheme of reproduction of t+1. Numbers in parentheses are labor-time magnitudes, the calculation of which will be explained below.

Table 2

	C	V	C+V	SV=PR	VA=PP
I	480	216	696	1.224	1.920
	(1.600)	*(720)*	*(2.320)*	*(1.440)*	*(3.760)*
II	480	216	696	1.224	1.920
	(1.600)	*(720)*	*(2.320)*	*(1.440)*	*(3.760)*
Σ	960	432	1.392	2.448	3.840
	(3.200)	*(1.440)*	*(4.640)*	*(2.880)*	*(7.520)*

π_{t+1} = £2.448/£1.392 = 176% and the rate of surplus-value σ_{t+1} = £2.448/£432 = 567%. Now then, since physical output has risen, reproduction in monetary terms faces a restriction, i.e. "the quantity of [symbol-]money... must increase."[15] In period t, the mass of symbol-money was μ_t = £1.920, which is not enough to allow the circulation in t+1. According to equation [6], this restriction could be overcome either by an increase in V_{t+1} or by an increase in μ_{t+1}. It will be supposed here that V_{t+1} remains constant and that the monetary authority raises μ_{t+1} to £3.840.

13 Pasinetti [1977], p. 272.

14 "[I]t is theoretically possible to imagine a case in which all products are produced exclusively by work of machines, so that no unit of *living labor*... participates in production, and nevertheless an industrial profit may occur... this is a profit which will not differ essentially in any way from the profit obtained by present-day capitalists using hired workers... We have therefore seen, proceeding from Ricardo's analysis, that the origin of industrial profit does not stand in any 'special' relationship to the human labor used in production." Dimitriev, [1904], pp. 63-4.

15 Capital I, p. 215. "We do not need to rack out our brains to grasp that if our quarter of wheat costs £2, 100 quarters will cost £200, 200 quarters £400, and so on, and therefore that the quantity of money which changes places with the wheat, when it is sold, must increase as the quantity of the wheat increases." Capital I, pp. 214-5. In other words: "For Marx, inflation was not initially a monetary phenomenon, but derived from real forces." Naples [1996], p. 103.

How are the labor-time magnitudes of t+1 calculated? According to Table 2, at the start of t+1, capitalists advanced £1.392. This symbol-money is simply the representation of a certain amount of labor-time. As Marx says: “Money is labour time in the form of a general object.”[16] Now then, at the beginning of t+1, how many working days does £1.392 represent? Since, at this moment, the labor-saving innovation has not been introduced, the relation between symbol-money and labor-time is equal to that prevailing in period t, so that, £1 = 3.33 working days. So, as the MEL at the start of t+1 is necessarily equal to the MEL at the end of t, £1.392 represents £1.392*3.33 = 4.640 working days.

This is the labor-time corresponding to the cost-price, but how much surplus-labor is exploited in t+1? In this period, total living labor is $\mathbf{L}_{t+1}\mathbf{X}_{t+1}$ = 4.320 working days. Surplus-labor is the difference between total living labor and *necessary labor*, the labor represented by £432, advanced as variable capital. Since necessary labor is £432*3.33 = 1.440 working days, surplus-labor is 4.320-1.440 = 2.880 working days. The total labor-time objectified in t+1 is equal to the labor-time represented by the cost price + surplus-labor, 4.640 + 2.880 = 7.520 working days.

This allows us to calculate the rate of profit in labor-time terms, π^*_{t+1}, which is equal to:

$$\pi^*_{t+1} = 2.880\,w.d./\ 4.640\ w.d. = 62\% \qquad [9]$$

So, π^*_{t+1} = 62% is less than the nominal rate of π_{t+1} = 176%. Since static conditions prevailed in period t, $\pi_t = \pi^*_t$ = 100% and therefore the profit rate in labor-time terms has fallen between t and t+1. The rate of exploitation is 2.880 w.d./1.440 w.d. = 200%, less than the nominal rate of surplus-value σ_{t+1} = 576% and equal to that of period t, σ_t. This last result depends decisively on the fact that variable capital represents an amount of labor-time given by MEL_t. The amount of π^* and σ^* would be greater if variable capital in labor-time terms were calculated by means of MEL_{t+1}, instead of MEL_t. The first calculation implies that the *value of labor-power* is constant and is equivalent to Marx’s assumption in Capital III, Ch. 13, regarding the constancy of the rate of surplus-value.[17] The second calculation (using MEL_{t+1}) means that only *nominal wage* is constant, a situation which implies a reduction in the value of labor-power and thus an increase in σ^*. However, as it will be shown in section 4, the resulting rise in the rate of surplus-value does not completely offset the falling π^*.

The MEL_{t+1} corresponding to total production is calculated by the following formula:

$$MEL_t = P^{£}_{t+1}X_{t+1}/(\ P^{£}_{t}A_{t+1}X_{t+1}(1/MEL_t) + L_{t+1}X_{t+1}) = £0.5106/w.d. \qquad [10]$$

Equation [10] relates total output, measured in £, and total labor-time objectified in period t+1, given by the sum of the past labor-time, transferred from constant capital, and the living labor-time added. The price of the means of production used in period t+1 is determined at the end of period t, so that, when period t+1 starts, capitalists have already paid this price. Therefore, past labor-time corresponding to period t+1 is given by $\mathbf{P}^{£}_{\mathbf{t}}\mathbf{A}_{t+1}\mathbf{X}_{\mathbf{t+1}}(1/MEL_t)$[18].

As was noted in section 1, after labor-saving innovation has been introduced, the MEL_{t+1} corresponding to total production (equation [10]) differs from that of *living labor*. The latter ($MEL^{L}_{\mathbf{t+1}}$) is given by:

$$MEL_{t+1} = [P^{£}_{t+1}X_{t+1} - P^{£}_{t}\ A_{t+1}X_{t+1}]/L_{t+1}X_{t+1} = £0.67\ /w.d. \qquad [11]$$

This formula relates *value-product*, measured in £, with living labor. Value-product is the difference between total output and constant capital, determined by the price of the means of production prevailing at the start of t+1[19].

By means of equation [10], it is possible to calculate the vector of living labor contained in commodities in t+1: $\mathbf{P}^{£}_{t+1} = \mathbf{P}^{£}_{t+1}(1/MEL_{t+1})$ = [1.9583 w.d. 1.9583 w.d.]. A logical consequence of the labor-saving innovation is that $\mathbf{P}^{£}_{t+1} < \mathbf{P}^{£}_{t}$ = [3.33 w.d. 3.33 w.d.]. In contrast to the stationary situation considered in section 1, it is now no longer possible to calculate $\mathbf{P}^{£}_{t+1} = \mathbf{L}_{t+1}[\mathbf{I}\text{-}\mathbf{A}_{t+1}]^{-1}$. This calculation would imply the absurd situation that, given a labor-saving innovation, the labor contained in commodities at the end of t+1 would be equal to the labor contained at the beginning of this period. It is important to stress that money advanced at the beginning of t+1 is an *irreversible cost*, representing an amount of labor-time which is the real cost-price of commodities. Moreover, it is this *real* cost —the labor-time already spent— which must be compared with the surplus-labor exploited during t+1.

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16 Grundrisse, p. 168.

17 Capital III, p. 317. In Capital I, Marx also discusses this: “It will therefore be useful, if we want to conceive the relation in its pure form, to presuppose for the moment that the possessor of labour-power, on the occasion of each sale, immediately receives the price stipulated in the contract.” Capital I, p. 279.

18 This is the correct insight of the “sequential” or “temporal single system” approach developed by some authors: Ernst [1982], Carchedi [1984], Kliman and McGlone [1988], Giussani [1991], Maldonado-Filho [1995], Carchedi and de Haan [1996], Freeman [1996], McGlone and Kliman [1996]; an important precursor of this approach is Perez [1980].

19 On “value-product”, see Capital I, pp. 321 and 669.

What is the effect of the labor-saving innovation on MEL_{t+1}? According to equation [10], in t+1, £1 represents 1/0.5106 = 1.9583 working days while, in period t, £1 represented 3.33 working days. Therefore, as a result of the labor-saving innovation, symbol-money represents less labor-time; specifically, it represents only 1.9583/3.33 = 0.5875 of that represented in period t. Now, more monetary symbols (1/0.5875 = 1.702) are needed to represent one working day. This is a measure of the endogenous inflationary effect of the labor-saving innovation on symbol-money.

Therefore, the labor-saving innovation has two effects: It increases the nominal rate of profit but also raises the MEL, thereby reducing the capacity of symbol-money to represent labor-time. The Okishio Theorem takes only the first effect into account, neglecting the increase in the monetary expression of labor. However, this twofold result is implicitly stated by Marx:

> In itself, an increase in the quantity of use-values constitutes an increase in material wealth. Two coats will clothe two men, one coat will only clothe one man, etc. Nevertheless, an increase in the amount of material wealth may correspond to a simultaneous fall in the magnitude of its value[20].

Effectively, π describes the "material rate of profit"[21] such that it rises with an increase in "material wealth", ceteris paribus. However, this is only one result of the innovation, which also produces a "simultaneous fall in the magnitude of value". This "fall" is not formalized by π —which, therefore, is a one-sided representation of the dynamics of capitalist wealth— but by the increase in the MEL. In capitalist society, the increase in material wealth is not an aim in itself: "The immediate purpose of capitalist production is not the 'possession of other goods' but the appropriation of value, of money, of abstract wealth."[22]

The reduction in the amount of the *substance of value* —the living labor used— implies that, now, a given amount of symbol-money —one of the aspects of the form of value— represents less value, less labor-time. Value is the unity of substance and form; it is an amount of labor-time that must be expressed through money. Therefore, the "simultaneous fall in the magnitude of value" is expressed by a modification in the MEL, the quantitative relation between both poles of value.

The "simultaneous fall in value" provokes the reduction in the rate of profit in labor-time terms, which has been arithmetically calculated in [9]. The following is an algebraic derivation of this rate:

$$\pi^*_{t+1} = [P^{£}_{t+1}M_{t+1}X_{t+1}(1+\pi_{t+1})(1/MEL_{t+1}) - P^{£}_{t}\, M_{t+1}X_{t+1}(1/MEL_{t+1})]/\, P^{£}_{t}M_{t+1}X_{t+1}1/MEL_{t+1}) \quad [12]$$

Multiplying both numerator and denominator by MEL_t, and canceling the expression of cost-price, one obtains[23]:

$$1+\pi^*_{t+1}\ (1+\pi^*_{t+1})\ MEL_t\ /\ MEL_{t+1} \quad [13]$$

It is clear that $\pi^*_{t+1} = \pi_{t+1}$ when $MEL_{t+1}/MEL_t = 1$, i.e. when there is no labor-saving innovation.[24] An alternative formula for π^*_{t+1} is:

$$\pi^*_{t+1} = [1+\sigma_{t+1}-\alpha_{t+1}]/[\alpha_{t+1}(1+K_{t+1}) \quad [14]$$

where σ_{t+1} is the *nominal* rate of surplus-value (£2.448/£432 = 567%), K_{t+1} is the nominal composition of capital (£960/£432 = 2.22)[25], and α_{t+1} is the ratio between the MEL corresponding to living labor (equation [11]) and the MEL_t, so $\alpha_{t+1} = MEL^L_{t+1}/MEL_t = 0.67/0.3 = 2.22$.

Labor-saving innovation reduces the capacity of symbol-money to represent labor-time -an inflationary effect- and raises the nominal rate of profit (π). In equation [13], the inflationary effect is represented by the ratio $MEL_t/MEL_{t+1} = 0.5875 < 1$. In equation [14], symbol-money inflation is represented by the ratio $\alpha_{t+1} > 1$. Equations [13] and [14] have an important, Marxist, property: a continuous labor-saving innovation will cause a continuous rise in the MEL. If the amount of living labor tends toward zero, MEL tends toward infinity, and π^* tends toward zero. This

20 Capital I, pp. 136-7.

21 See Ernst [1982], p. 90.

22 Theories II, p. 503.

23 On this equation, see Carchedi [1991], Ch. 5 and McGlone and Kliman [1996].

24 In connection with the "transformation problem", this has been assumed by Roberts [1981], Wolff, Roberts and Callari [1982], Ramos [1991], Rodríguez [1994], Ramos and Rodríguez [1996].

25 On the distinction between value and organic composition of capital, see Capital I, p. 762, Capital III, p. 900-1, Theories III, pp. 386-7 and Saad-Filho [1993b].

overcomes the paradox of an economy without living labor and $\pi > 0$[26].

The two effects caused by the labor-saving innovation (increasing π *and* increasing MEL) can be formalized by the following inequalities:

$$MEL_{t+1}/MEL_t > (1+\pi_{t+1})/(1+\pi_\tau) > 1 \qquad [15]$$

Recalling that, in period t, $\pi_t = \pi*_t$, and using equation [13], it is clear that

$$\pi^*_{t+1} < \pi^*_t \qquad [16]$$

The law of the tendential fall in the rate of profit can be stated saying that a labor-saving innovation provokes an increase in the MEL greater than that corresponding to the nominal rate of profit.

3. THE RESERVE-MONEY RATE OF PROFIT AND THE MONETARY CRISIS

We have seen that there are two rates of profit, one expressed in symbol-money, π_{t+1} = 176%, and the real profit rate, expressed in labor-time, $\pi*_{t+1}$ = 62%. Equation [13] shows that the relation between these rates is given by the ratio of the monetary expressions of labor, MEL_t/MEL_{t+1}. The difference between π_{t+1} and $\pi*_{t+1}$ arises from the increase in the MEL caused by the labor-saving innovation, which diminishes the capacity of symbol-money to represent labor-time.

Although $\pi*_{t+1}$ is the real rate of profit, it must be expressed, in some way, through the external measure of value, namely *money*.[27] The monetary expression of $\pi*_{t+1}$ could be carried out either by means of symbol-money or reserve-money.

Firstly, let us consider how $\pi*_{t+1}$ could be expressed by means of symbol-money. It is clear that, although the labor-saving innovation has reduced the *quantitative* capacity of symbol-money to represent labor-time, this does not affect its *qualitative* function. Labor-time magnitudes forming the real profit rate can be converted into symbol-money magnitudes by simply multiplying them by a constant MEL, for instance by MEL_t = £0.3/w.d. Thus, cost-price is 4.640 w.d.*0.3 = £1.392 and surplus-labor is 2.880 w.d.*0.3 = £864; the profit rate is £864/£1.392 = 62%. These are ideal symbol-money figures, since actually the MEL does not stay constant. However, the fall in the profit rate would not be felt by capitalists were money only a symbol. To have a real expression of this effect, it is necessary to take into account the other type of money, reserve-money, gold.

In period t, we have assumed that the *parity labor-time/gold*, γ_t (relation [4]) was 3.33 working days per ounce of gold. Gold is not produced in this economy, so the labor-saving innovation has not involved it. Hence, the amount of labor contained in gold remains constant during period t+1, γ_{t+1} = 3.33 working days per ounce of gold. So, dividing cost-price in labor-time terms and surplus-labor by this *constant* γ, it is obtaining the same rate of profit already obtained using a constant MEL.

The falling rate of profit appears clear to capitalists only insofar as they actually try to express and appropriate their profit in terms of physical gold. At the beginning of period t+1, capitalists advanced £1.392 which, at this time, were freely changeable by 1.392 ounces of gold because both forms of money represented the same amount of labor-time: 4.640 working days. The *parity pound/gold* sanctioned by the monetary authority (relation [3]), was G_t = £1/1 ounce of gold. At the end of t+1, capitalists pocket £2.448, which represent 2.880 working days of surplus-labor (See Table 2). This amount of surplus-labor, appropriated under the form of symbol-money, can no longer be converted into 2.880 ounces of gold, as it could in period t, but only into 864 ounces of gold, i.e. the quantity of reserve-money which represents this labor-time (2.880 w.d./3.33). Therefore, the parity pound/gold G_{t+1} has risen from G_t = £1/1 ounce of gold to G_{t+1} = £2.83/1 ounce of gold (£2.448/864 ounces of gold). In period t, $G_t = MEL_t*\gamma_t$, but now $G_{t+1} = MEL^s_{t+1}*\gamma_{t+1}$, where MEL^s_{t+1} is the monetary expression of *surplus-labor* (£2.448/2.880 w.d. = £0.85/w.d.; see Table 2). In the static situation depicted in period t, the MEL is common to the diverse components of commodities' value, an equality which ceases in period t+1.

The devaluation of £ against gold induces a monetary crisis, because symbol-money has not maintained its capacity to conserve value. Now, a contradiction between the two kinds of money —symbol-money, and that functioning as a reserve of value— arises. Since the labor-saving innovation has "destroyed the truth" in the £ as an instrument suited to conserve value, capitalists can start increasingly to express their assets either in terms of reserve-money or in another symbol-money. This implies that, rapidly, the £ loses its diverse monetary functions. What was money in

26 "Two workers working for 12 hours a day could not supply the same surplus-value as 24 workers each working 2 hours, even if they were able to live on the air..." Capital III, p. 356.

27 "Money as a measure of value is the necessary form of appearance of the measure of value which is immanent in commodities, namely labor-time." Capital I, p. 188.

period t, becomes non-money in period t+1. The monetary authority must avoid this situation and, primarily, "reestablish the truth" in £. Because, in this abstract exercise, the only power of the monetary authority is to issue symbol-money, it is forced to carry out a monetary reform. The "new pound" (£*) is therefore created; its sanctioned parity against the reserve-money is, again, £* = 1 ounce of gold, replacing "new pounds" for "old pounds" in the proportion £*1 = £2.83[28]. "Old pounds" are no longer legal means of circulation. Thus, at the end of t+1, capitalists must forcibly deflate (by 1/2.83) their £2.448 profit, which becomes £*864 (corresponding to 864 ounces of gold). Having advanced £1.392 (corresponding to 1.392 ounces of gold), their reserve-money rate of profit is 62%.

Discussion of the complexities behind the notion of reserve-money[29], as well as the dynamic of the profit rate when credit system, State debt, stock market, etc. are taken into account, clearly lies beyond the purpose of this article. Certainly, the rate of profit falls through a concrete process more complex than that suggested by the above-presented exercise, whose main purpose is, rather, to stress the meaning of Marx's assumption regarding the constancy of the "value of money" when the law of the tendential fall in the rate of profit is analyzed[30]. This assumption implies that the dynamics of the rate of profit in the presence of labor-saving innovations should be analyzed using a money having a constant or "stable" capacity to represent labor-time. The endogenous inflationary effect on symbol-money arising from the labor-saving innovation must therefore be eliminated in order to calculate the rate of profit, a methodological point that is missed in the Okishian tradition.

4. COUNTERACTING AND ENHANCING FACTORS

A systematic analysis of the counteracting and enhancing factors of the tendency to fall of the rate of profit is also beyond the scope of this article. To consider the cheapening of constant and variable capital, economy in means of production, technological depreciation, and other factors affecting the dynamic of profit rate, would require that a succession of periods be taken into account[31]. Notwithstanding this, the rise in the rate of exploitation (as a counteracting factor) and the presence of fixed capital (as an enhancing factor) can be considered in the simple framework presented above.

4.1 Increasing rate of exploitation

In equation [12], in order to calculate π^*_{t+1} the *total* capital advanced is expressed in labor-time terms by means of MEL_t. This means that both, constant and variable capital are *advanced* at the beginning of t+1. As was noted in section 2, this procedure implies that, in period t+1, the rate of exploitation is equal to that of period t+1 (200%), and that necessary labor remains 1/3 of the working day.

However, workers are paid in symbol-money, which, at the end of period t+1, represents less labor-time[32]. It is clear that if the MEL changes during period t+1, then the same symbol-money wage will represent a different amount of labor-time if workers receive their wages at the end of the period than if they received them at the start. This means that variable capital should be converted into labor-time units by means of MEL_{t+1}, not MEL_t. Using the data of Table 2, variable capital represents £432/0.5106 = 846 working days of necessary labor and, thus, the surplus-labor amounts to 4.320-846 = 3.474 working days. So, workers would appropriate only an equivalent of 1/5 of the working day. This rise in the rate of exploitation (to 411%) compensates for the fall in labor-time rate of profit. According to this calculation, the cost-price in labor-time terms is 3.200_c+846_v = 4.046 working days. Calling the resulting rate of profit π^{**}_{t+1}, one obtains π^{**}_{t+1} = 3.474/4.046 = 86%. Thus, despite the rise in the rate of exploitation, π^{**}_{t+1} is less than π_t = 100%[33].

Marx considers this type of effect in a letter to Engels of April 22, 1868:

If, with a falling value of money, the price of labour does not rise by the same proportion, then it *falls*; the rate of

28 In most Latin American countries, processes similar to this "reform" are carried out daily by means of the exchange rate of the local currency with the US dollar. However, this does not align prices with labor-time because, presumably, the US dollar becomes inflated over time in relation to labor-time.

29 Two obvious directions of research can be mentioned: Firstly, the analysis of the *change* in the capacity of reserve-money (not only of symbol-money, as it is considered in this article) to represent labor-time. Secondly, the analysis of the *nature* of reserve-money. In this respect, it is clear that, although gold has been legally suppressed as reserve-money since 1971, this does not mean that the function of value conservation has been (or may be) eliminated, but only that, nowadays, the nature of reserve-money is more complex than that considered by Marx.

30 Capital III, p. 142. See footnote 9.

31 See, for example, Freeman [1996] and Kliman [1996].

32 See Ernst [1982], p. 88.

33 It is important to note that, insofar as the existence of symbol-money is considered, this effect is independent of the time at which workers are paid.

surplus-value would then rise and so, all other things being equal, does the rate of profit. The increase in the latter... is due to a simple lowering of wages, and the decrease is due to the situation where the change in wages only slowly accommodates the change in the value of money.[34]

Marx's "falling value of money" is, in the framework of this article, a "rising MEL", provoking a fall in the labor-time represented by symbol-money. It is important to note that, in Marx's letter, changes in the MEL (corresponding to symbol-money) are not distinguished clearly from those of the parity labor-time/gold (corresponding to reserve-money). In any case, in an analysis of the falling rate of profit taking into account more periods than t and t+1, Marx's assumption of constant rate of surplus-value implies that, eventually, wages rise, annulling the increase in the MEL, and preserving the fraction of the working day for which workers receive an equivalent.

However, even assuming that this is a factor permanently counteracting the falling rate of profit, it is, at the same time, offset by the falling in the relative importance of living labor in total advanced capital. This is shown by an algebraic specification of π^{**}_{t+1}:

$$\pi^{**}_{\tau+1} = [1 + \sigma_{t+1} - \beta_{t+1}]/[\beta_{t+1} + \alpha_{t+1} K_{t+1}] \quad [17]$$

where β_{t+1} is the ratio between the MEL^{L}_{t+1} corresponding to living labor (equation [11]), and MEL_{t+1}, so $\beta_{t+1} = MEL^{L}_{\mathbf{t+1}}/MEL_{t+1} = 0.67/0.5106 = 1.3056$; other ratios defined in equation [14]. Equation [17] is analogous to equation [14], which also shows that a continuous increase in the MEL (reflected by ratios α_{t+1} and β_{t+1}) provokes a continuous reduction in π^{**}_{t+1}. In the limit, as living labor is reduced to zero, the MEL, as well as α_{t+1} and β_{t+1}, become infinite. Hence, "the compensation for the reduced number of workers provided by a rise in the level of exploitation of labour has certain limits that cannot be overstepped; this can certainly check the fall in the profit rate, but it cannot cancel it out."[35]

4.2 Fixed capital[36]

The presence of fixed capital enhances the tendency of the profit rate to fall. Assuming fixed capital, the nominal rate of profit can be defined as:

$$\pi_{t+1} = [P^{£}_{t+1}X_{t+1} - P_t^{£}M_{t+1}X_{t+1}]/[P_t^{£}M_{t+1}X_{t+1} - P_0^{£}F_{t+1}X_{t+1}] \quad [18]$$

where $\mathbf{F}_{t+1}$ is the matrix of fixed capital. Let us assume that fixed capital was bought in period 0 and that it does not depreciate. If labor-saving innovations occur during the next t+1 periods, the MEL continuously grows, so that:

$$MEL_{t+1} > MEL_t > \ldots > MEL_0 \quad [19]$$

If the MEL grows at a constant rate δ, then:

$$MEL_t = MEL_0\,(1 + \delta)^t \quad [20]$$

In order to obtain the corresponding labor-time rate of profit in period t+1 (π^*_{t+1}), each element of equation [18] has to be converted into a labor-time magnitude by its respective MEL, defined according to equation [20]. This gives:

$$\pi^{*}_{t+1} = [P^{£}_{t+1}X_{t+1} - (1 + \delta)P_t^{£}M_{t+1}X_{t+1}]/[(1 + \delta)P_t^{£}M_{t+1}X_{t+1} + (1 + \delta)^{t+1}P_0^{£}F_{t+1}X_{t+1}] \quad [21]$$

Evidently, fixed capital enhances the fall in the rate of profit. Both an increase in δ and longer time until the fixed capital fully depreciates will cause a greater fall in π^*_{t+1}. Equation [21], however, only illustrates this tendency in a qualitative manner, because it does not take into account the structure and the rate of depreciation of fixed capital. In particular, a rapid depreciation of fixed capital slows the fall in the rate of profit.

CONCLUSION

The Okishio Theorem is an erroneous formalization of Marx's law of the tendential fall in the rate of profit because it reduces capitalist wealth to its material aspect, neglecting the dynamic of value. The Okishian rate of profit can be interpreted as a static, nominal rate, measured in symbol-money, which differs from the dynamic, real rate of profit, measured in labor-time. The relation between the two rates is given by the change of the monetary expression of labor (MEL), the quantitative relation between the two poles of value, its substance (labor-time) and its form (money).

This article has illustrated the calculation of both, the nominal and the real rates of profit, analyzing the consequences of a one-time labor-saving innovation in a two-department economy without fixed capital. The

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34 Letters on Capital, p. 131.

35 Capital III, p. 356.

36 I thank Andrew Kliman, who helped me to express rigorously the intuition behind this sub-section.

resulting augmentation of the productivity of labor raises the nominal rate of profit, but it also increases the MEL. Since the latter effect counteracts the former, it is clear that the labor-saving innovation provokes a reduction in the labor-time rate of profit. The Okishio Theorem takes into account only the nominal rate of profit.

The falling real rate of profit appears externally only through monetary relations. To show this, a monetary system has been considered, in which two types of money have been rigorously distinguished: symbol-money and reserve-money —serving as reserve of value. As labor-saving innovation raises the MEL, symbol-money represents less labor-time, an endogenous inflationary effect that, eventually, provokes its devaluation against reserve-money. The falling real rate of profit is expressed through the resulting crisis in monetary system. In this simple framework, the rise in the rate of exploitation and the inclusion of a non-depreciating fixed capital have also been considered, as, respectively, counteracting and enhancing factors of the falling rate of profit.

REFERENCES

Aglietta M. [1979] A THEORY OF CAPITALIST REGULATION, THE US EXPERIENCE, New Left Books, London.

Bortkiewicz L. [1907] *Value and Price in the Marxian System*, International Economic Papers, Nº 2, 1952.

Brunhoff S. de [1976], MARX ON MONEY, Urizen Books, New York.

Carchedi G. [1984] *The Logic of Prices as Values*, ECONOMY & SOCIETY, 13:4.

Carchedi G. [1991] FRONTIERS OF POLITICAL ECONOMY, Verso, London

Carchedi G. and de Haan W. [1996] *The Transformation Procedure: A Non-equilibrium Approach*, in A. Freeman and G. Carchedi (Eds.).

Croce B. [1899] *Una Obiezione alla Legge Marxistica della Caduta del Saggio di Profitto*, in MATERIALISMO STORICO ED ECONOMIA MARXISTICA, Laterza, Bari, 1961.

Dimitriev V.K. [1904] ECONOMIC ESSAYS ON VALUE, COMPETITION AND UTILITY, (ed. D.M. Nuti), Cambridge University Press, Cambridge, 1974.

Ernst J. R. [1982] *Simultaneous Valuation Extirpated: A Contribution to the Critique of the Neo-Ricardian Concept of Value*, RRPE, 14:2

Foley D.K. [1982] *The Value of Money, the Value of Labor-Power, and the Marxian Transformation Problem*, RRPE, 14:2.

Freeman A. [1995] *Marx without Equilibrium*, C&C 56.

Freeman A. [1996] *Price, Value and Profit: A continuous, general, treatment*, in A. Freeman and G. Carchedi (Eds.).

Freeman A. and G. Carchedi (Eds.) [1996] MARX AND NON-EQUILIBRIUM ECONOMICS, Edward Elgar, Cheltenham.

Giussani P. [1991] *The Determination of Prices of Production*, International Journal of Political Economy, 21.

Groll S. and Z.B. Orzech [1989] *From Marx to the Okishio Theorem: A Genealogy*, HOPE, 21:2.

Howard M.C. and J.E. King [1989] A HISTORY OF MARXIAN ECONOMICS. VOLUME I (1883-1929), MacMillan, London.

Kliman A. [1988] *The Profit Rate under Continuous Technological Change*, RRPE, 20:2&3.

Kliman A. [1996] *A Value-Theoretic Critique of the Okishio Theorem*, in A. Freeman and G. Carchedi (Eds.).

Kliman A. and T. McGlone [1988] *The Transformation Non-Problem and the Non-Transformation Problem*, C&C, 35.

Maldonado-Filho E. [1994] *Release and Tying up of Productive Capital and the "Transformation Problem"*, URPE Conference at the ASSA, fall.

Mandel E. [1984] *Gold, Money and the Transformation Problem*, in E. Mandel and A. Freeman (Eds.) RICARDO, MARX, SRAFFA. THE LANGSTON MEMORIAL VOLUME, Verso, London.

Marx K. [1968] THEORIES OF SURPLUS VALUE II, Progress Publishers, Moscow.

Marx K. [1972] THEORIES OF SURPLUS VALUE III, Progress Publishers, Moscow.

Marx K. [1970] A CONTRIBUTION TO THE CRITIQUE OF POLITICAL ECONOMY, Progress Publishers, Moscow.

Marx K. [1973] GRUNDRISSE, Penguin Books, Harmondsworth.

Marx K. [1976] [1981] CAPITAL I, III, Penguin Books, Harmondsworth.

Marx K. and F. Engels [1983] LETTERS ON CAPITAL, New Park Publication, London.

McGlone T. and Kliman A. [1996] *One System or Two? The Transformation of Values into Prices of Production versus the Transformation Problem*, in A. Freeman and G. Carchedi (Eds.).

Moszkowska N. [1929] EL SISTEMA DE MARX. UN APORTE PARA SU CONSTRUCCIÓN, Cuadernos de Pasado y Presente Nº 77, México, 1979.

Naples M. I. [1996] *Time, Money, Equilibrium: Methodology and the Labour Theory of the Profit Rate*, in A. Freeman and G. Carchedi (Eds.).

Okishio N. [1961] *Technical Changes and the Rate of Profit*, Kobe University Economic Review, 7.

Pasinetti L. [1977] LECTURES IN THE THEORY OF PRODUCTION, Columbia, New York.

Perez M. [1980] *Valeur et Prix: Un Essai de Critique des Propositions Néo-Ricardiennes*, Critiques de L'Economie Politique, Nouvelle Série, 10.

Ramos A. [1991] *Competencia y Reproducción Capitalista: Una Interpretación de la Transformación de Valores en Precios de Producción*, CIENCIAS ECONÓMICAS, 11:1-2, Costa Rica; REALIDAD ECONÓMICA, 105-106, Buenos Aires, 1992.

Ramos A. [1996] *The Monetary Expression of Labour: An Interpretation of the Relation between Value-Substance and Value-Form*, paper presented in the third Miniconference of the IWGVT at the EEA, Boston, March 15-17.

Ramos A. and A. Rodríguez [1996] *The Transformation of Values into Prices of Production: A Different Reading of Marx's Text*, in A. Freeman and G. Carchedi (Eds.).

Roberts B. [1981] VALUE CATEGORIES AND MARXIAN METHOD. A DIFFERENT VIEW OF PRICE-VALUE TRANSFORMATION, Ph.D. Dissertation, Department of Economics, University of Massachusetts, Ahmerst.

Rodríguez A. [1994] LE TRAVAIL ET LA FORMATION DES PRIX, Université Catholique de Louvain, Faculté des Sciences Economiques, Sociales et Politiques, Nouvelle Série Nº239, CIACO, Louvain-la-Neuve.

Saad-Filho A. [1993a] *Labor, Money, and "Labour-Money": A Review of Marx's Critique of John Gray's Monetary Analysis*, HOPE, 25:1.

Saad-Filho A. [1993b] *A Note on Marx's Analysis of the Composition of Capital*, C&C 50.

Shibata K. [1934] *On the Law of Decline in the Rate of Profit*, Kyoto University Economic Review, 9:1.

Tugan-Baranowsky M. [1905] THEORETISCHE GRUNDLAGEN DES MARXISMUS, Duncker & Humblot, Leipzig; Spanish translation: LOS

FUNDAMENTOS TEÓRICOS DEL MARXISMO, Hijos de Reus Editores, Madrid, 1915.
Wolff R.D, B. Roberts and A. Callari [1982], *Marx's (not Ricardo's) 'Transformation Problem': A Radical Reconceptualization*, HOPE, 14:4.