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Abstract

We critically review the previous attempts to introduce money and finance into Sraffa's price system, whose main difference is, we argue, their conception of the interest rate, either as an opportunity cost or as an effective cost of production. We examine the implications on three different grounds: (i) the formal consistency of the system; (ii) the possibilities to explicitly treat the financial industry as any other productive sector; and (iii) the validity of the so-called "monetary theory of distribution" (MTD). We then suggest a possible route, inspired by Schumpeter's ideas on economic development, to introduce the banking sector through its role of granting credit to innovation. Unlike previous contributions, this reformulation allows us both to justify the basic nature of the financial sector and simultaneously preserve the validity of MTD.

Keywords: Banking industry; Innovation; Monetary theory of distribution; Sraffa; Surplus approach.

JEL Codes: E11; E43; E52.

1. Introduction[1]

In Sraffa's (1960) masterpiece there is no explicit role for monetary and financial conditions. The only reference to the issue is the extensively quoted phrase in which the Italian scholar suggests the possibility of closing the price system by taking the money interest rates as exogenously given (Sraffa, 1960, p. 33).

[1] A preliminary version of this article was presented at the International Economic Policy Research Seminar held at Goethe University Frankfurt (Frankfurt am Main, February 12, 2019) and at the Centro Sraffa Seminar organized in collaboration with Dipartimento di Economia, Università Roma Tre (Rome, February 20, 2019). We would like to thank the participants of both events for their comments and suggestions. We would also like to thank an anonymous referee for his constructive observations. All the remaining errors are ours.

Since then, several attempts have been pursued to construct from this hint a "monetary theory of distribution" (hereafter, MTD), which, by endowing monetary conditions with a relevant role in the determination of the normal profit rate, aims to offer an alternative to the other distributive closures of the classical system[2]. This challenge is reinforced by the prevailing institutional conditions: capitalist economies have nowadays reached levels of productivity and political organization of the labour force that allow workers to participate in the distribution of the social surplus and, at the same time, the banking system has emerged as a key player in the financing of productive investment, structured around the regulating role of Central Banks.

Yet, the current stance of MTD is not fully satisfactory. The reason is that there is no proper treatment of the financial sector, which is either absent or its role as a basic sector is justified only thanks to the introduction of *ad-hoc* assumptions. Along this second route, the normal price-equation of the banking industry is simply unrealistically described: the financial industry is considered as any other productive sector that demands "corn" and "iron"; however, it cannot be overlooked that the technique for providing loan services is a special one, in particular, because means of payments can be produced *ex-nihilo* (in other words, physical costs of production are not the main components of normal costs). Thus, not only should one explain why the financial sector provides some services that are essential to produce the net output of the economy, but also identify the objective limits to the expansion of the banking industry and the constraints that prevent the profit rate afforded by this sector from being infinitely large.

This article aims to discuss the problems faced by the abovementioned proposals to introduce money and finance into Sraffa's price-equations and to suggest a possible alternative route to *explicitly* address the role of the banking industry, based on the role of financial institutions in providing credit to *technical innovations*.

To this aim, the paper is structured as follows. After this brief introduction, section 2 presents a general framework from which the different attempts to introduce money and finance into Sraffa's price equations can be interpreted as particular closures. Section 3 critically reviews the first and most popular attempts to develop MTD, those endorsed by Massimo Pivetti and Carlo Panico. This will give us the opportunity to distinguish between two notions of the interest rate, which are not properly disentangled in the literature[3]: the notion of opportunity cost and the notion of effective cost of production.

Section 4 analyzes some subsequent, less well-known, contributions to integrate financial and productive conditions, which enrich the previous theoretical frameworks, but still suffer from several shortcomings. As an attempt to capture the essential role of the financial sector, section 5 explores an alternative route to formalize the interaction between production and finance, inspired by Schumpeter's ideas on credit and innovation. Section 6 concludes the article.

[2] We essentially refer to the early classical view of an exogenously given real wage determined by labour subsistence and the Cambridge theory of distribution based on the allegedly positive connection between the rate of capital accumulation and normal profitability.

[3] See, however, Shaikh (2016).

2. Basic Framework

In order to discuss and compare the different contributions that aimed to introduce financial conditions within the surplus approach, we will show how they can be derived from a common general framework.[4]

Assume an economy with n industrial sectors that finance a certain proportion of real investment through own resources (i.e. retained earnings) and another portion via external funds, specifically, through loans provided by commercial banks.

The normal price of each commodity must therefore cover wages, expenses for the means of production, interest payments and, finally, profits accruing to the owners of capital. Denoting owned capital per unit of output by $\boldsymbol{k^O}$, credits raised by $\boldsymbol{k^B}$, the matrix of unitary capital requirements by $\boldsymbol{A}$[5], the unit direct labour requirements by $\boldsymbol{l}$ and assuming wages are paid *post factum*, this reads,

$$\boldsymbol{p} = \boldsymbol{l}w + \boldsymbol{k^O}(1+r) + \boldsymbol{k^B}(1+i) \qquad [1]$$

where $\boldsymbol{p}$ is the column vector of normal prices, $\boldsymbol{k^O} + \boldsymbol{k^B} = \boldsymbol{Ap}$, w is the money wage rate, r is the riskless rate of return on capital and i is the loan interest rate.

Let us define α_j as the share of borrowed capital over total capital advanced in sector j, or what is usually known as the leverage ratio:

$$\alpha_j \equiv (\boldsymbol{k^B})_j/(\boldsymbol{Ap})_j \qquad [2]$$

Using [2] and assuming all sectors exhibit the same level of α, we can re-express normal prices as:

$$\boldsymbol{p} = \boldsymbol{l}w + \boldsymbol{Ap} + \boldsymbol{Ap}[r(1-\alpha) + i\alpha] \qquad [3][6]$$

If $\boldsymbol{x}$ stands for the vector of normal sectorial gross outputs, we can also define the gross profit rate π on total capital - both own and borrowed - as:

$$\pi = [\boldsymbol{p}(\boldsymbol{I} - \boldsymbol{A}) - \boldsymbol{l}w]\boldsymbol{x}/\boldsymbol{Apx} \qquad [4]$$

The examination of the different explanations of π will be a crucial task along our inquiry, since the latter regulates the division of the social output between wages and the other categories of income.

Comparison between [3] and [4] yields:

$$\pi = r(1-\alpha) + i\alpha \qquad [5]$$

[4] Equations [1] to [5] closely follow Franke's (1988) formal framework.

[5] For simplicity, capital is assumed to be only of the circulating type. The introduction of fixed capital would not affect the formal results to be discussed in this paper. Our equations are compatible with a treatment of fixed capital through a capital stock matrix, as in Cogliano et al. (2018), (Chapter 13).

[6] It could be argued that debt coefficients may differ among firms belonging to a particular sector of the economy, with the implication that the validity of law of one price for homogeneous commodities would be challenged (see Mongiovi and Rühl, 1993). However, if a normal level of α can be specified as part of the dominant technique in each productive sector, then those capitals that, by having recourse to a larger proportion of internal funds, face lower interest payments, simply yield quasi-rents.

It follows from [5] that the gross profit rate can be expressed as a weighted average of the riskless profit rate and the interest rate, with the proportions between own and borrowed capital as weight factors. This is none other than the division of the social output net of wages within the capitalist class.

Finally, using [5], condition [3] can be written in its usual form as:

$$\boldsymbol{p} = \boldsymbol{l}w + \boldsymbol{A}\boldsymbol{p}(1 + \pi) \qquad [6]$$

Since the nominal wage can be seen as the outcome of a bargain between capitalists and workers, it can be assumed to be determined before prices and distribution are known. This gives us the following additional equation:

$$w = \overline{w} \qquad [7][7]$$

The system [5]-[6]-[7] has $n + 2$ equations in $n + 5$ unknowns: $\boldsymbol{p}, w, \pi, r, i, \alpha$. It therefore has three degrees of freedom left.

This set of equations presents *two novelties* with respect to the representations one usually finds in the literature. On the one hand, the *financial structure of investment*, captured in the value of α, is explicitly included among the unknowns. And on the other, the *riskless* rate of return on capital, r, is *distinguished from* the money interest rate, i. This has two consequences that are worth mentioning: (i) to close the system, one needs determining the normal - as opposed to the actually observed - leverage ratio. Or at least, one should be able to answer whether there are forces that persistently influence α over sufficient time; (ii) since the loan interest rate, i, is treated as the normal price paid by industrial sectors for financial services, then: (ii.1) this variable must in principle be *distinguished from the deposit rate*, let us call it τ, the latter being approximately equivalent to the rate of return on a riskless bond, and therefore, the true opportunity cost of investment in industrial activities. Moreover, (ii.2) to determine i it is necessary to dig into the functioning of the credit system, and therefore, to *specify the price equation* of the banking sector.

Clearly, however, conditions (i) and (ii) are not independent from each other, since it is only when $\alpha > 0$ (i.e. when industrial sectors are normally indebted), and therefore, when the financial sector behaves as a basic sector in terms of Sraffa, that the determination of the loan interest rate becomes a necessary task to determine normal prices and distribution.

[7] Note that, although fixing the nominal wage rate and taking labour commanded as the *numeraire* are two different things, for the profit rate to be exogenously determined, both conditions must hold simultaneously. To see this, consider the possibility that a commodity - or bundle of commodities - is taken as the *numeraire*. In this case, the fixing of the money wage would immediately imply the determination of the real wage measured in terms of the *numeraire*, and therefore, the profit rate would become the endogenous distributive variable. On this point, see the exchange between Serrano (1993) and Smith (1996).

3. The First Attempts to Introduce Finance into the Classical System

The analytical framework of section 2 can be used to characterize the different approaches to money and finance –and incidentally, the different approaches to the nature of the interest rate, either as an *opportunity cost* or as an *effective cost of production* - that since the 1980s have been developed within the Sraffian approach.

3.1. Pivetti

Let us first inspect Pivetti's framework, which, perhaps due to its elegancy and simplicity, is currently considered as *the benchmark* to introduce monetary conditions within the surplus approach (see Pivetti, 1985 [1990]), 1991). Pivetti eliminates the three degrees of freedom of system [5]-[6]-[7] in the following way.

First, he relies on the notion of the interest rate as an *opportunity cost*. In other words, he assumes that firms can always invest their own capital *either* in the productive sphere of the economy or in "gilt-edged securities" (Pivetti, 1991, p. 23). The latter are assumed to yield a riskless rate of return, τ, arbitrarily set by the Central Bank through her action in the financial markets. This means that the following arbitrage condition must hold:

$$r = \tau \qquad [8]^{8,9}$$

Finally, i and α are determined in the following way. Since the structure of interest rates is not explicitly formalized, the rate of return on assets and the loan interest rate are assumed to be equal, and therefore,

$$i = \tau \qquad [9]$$

Conveniently enough, condition [9] "kills two birds with one stone", since it is sufficient to avoid dealing with both features (i) and (ii) discussed in section 2 above. First, because, given [8] and [9], it follows from [5] that $\pi = i$ *regardless* of the value of α. This means that the financial structure of investment is *irrelevant* to determine normal

[8] In general, the normal profit rate is divided into two components: the interest rate and the normal profit of enterprise, which is assumed to compensate for "risks and troubles". For simplicity, this second term has been assumed to be equal to zero.

[9] Central Banks directly control a *short-term nominal* interest rate, while the relevant interest rate in the normal-price equations (that is, the magnitude that is arbitraged with the profit rate over capital invested) is a *long-term real* interest rate, as Pivetti himself recognizes (Pivetti, [1990] 1985, pp. 447-48). Nevertheless, it can initially be asserted that *persistent* movements of the short-term interest rate imply, for a given state of expectations, movements in the same direction of the long-term interest rate. Of course, the state of *liquidity preference* of the private sector in specific situations may lead to a collapse of such correlation, given rise to perverse movements of the interest rate along the yield curve (see Kahn, [1954]1972). Regarding the control of the interest rate under inflationary conditions, Steindl (1990) suggests that the nominal interest rate must adjust to accommodate a certain pre-determined level of the real interest rate defined outside the monetary sphere, a contention Pivetti replies by expressing that it is always possible to reach a certain targeted real interest rate by manipulating the money interest rate in the necessary magnitude (Pivetti, op. cit, p. 460).

prices and distribution.[10] And second, because, due to [9], there is no explicit distinction between the loan and deposit rates. But this means that the financial sector, whose net income normally emerges from the spread between these two rates, *does not* earn positive profits in a long period position. In other words, if due to the first result the credit sector is conceived as a *non-basic* sector, the second one shows that this sector cannot be even considered as a *capitalist*, profit-seeking, industry.

After these considerations, [6] becomes:

$$\boldsymbol{p} = \boldsymbol{l}w + \boldsymbol{Ap}(1+\tau) \qquad [6A]$$

Note finally that in Pivetti there is a monetary theory of distribution *tout court*, in the sense that monetary conditions regulate the division of the social product between labour and capital. In other words, the deposit rate, τ, determines the riskless profit rate, r, through the arbitrage among investors, which due to [9], is equal to the gross profit rate, π. This finally determines money prices and hence the real wage, $\boldsymbol{\omega}$, which is determined by the following condition:

$$\bar{w} = \boldsymbol{\omega p^T} \qquad [10]$$

We can represent the connection among distributive variables through the following simple scheme:

$$\tau \Rightarrow r \Rightarrow \pi \Rightarrow \boldsymbol{\omega} \qquad [A]$$

However, since due to [9] there is no room for an explicit treatment of the financial sector, the latter can only influence normal income distribution *indirectly*. For this, one must additionally postulate some mechanism that connects financial conditions to the *data* of the price system. For instance, one could explain wage gaps across sectors due to the effect on social norms of persistent higher incomes obtained by top managers in the financial sector; or connect the level of the riskless money interest rate to the lobbying of financial institutions (see Pivetti, 2013).

3.2. Panico

In Panico (1985, 1988) α is treated as a purely technically given parameter like the coefficients of the input-output matrix $\boldsymbol{A}$, and therefore, this variable is *not included* among the unknowns of the price system[11]. This leaves system [5]-6]-[7] with only two degrees of freedom, i and π (or $\boldsymbol{\omega}$).[12]

[10] It is therefore understandable that some scholars (see Schefold, 2000) have argued that a sort of Modigliani-Miller theorem holds, in the sense that a firm's leverage ratio has no effect whatsoever on its weighted average cost of capital (see Villamil, 2008).

[11] Actually, in Panico's own formulation, α does not appear among the variables of the system; what we find instead is a given vector of debt coefficients per unit of output, $\boldsymbol{q}$. Both variables, however, are easily related in the following way: $\boldsymbol{q} = \alpha \boldsymbol{Ap}$

[12] One should add at this stage that there is a –minor- mistake in Panico's price equations, since he counts the effect of the interest rate on normal prices *twice*: instead of weighting the riskless profit rate, *r*, by the

To determine i, Panico *explicitly* considers - for the first time - the role of the interest rate as an *effective* cost of production, as something different from the notion of opportunity cost, by explicitly formalizing the price equation of the banking sector. This equation is introduced in the following way. Panico argues that banks set the loan interest rate, i, to cover their wage bill, the costs of capital goods and of funding - which consists of the interests that financial institutions pay for deposits , together with a normal rate of return on investment:

$$Ci = l_B wC + \boldsymbol{a_B^T p} C(1 + r) + D\tau \qquad [11]$$

where C is the amount of loans to firms (equal to $\boldsymbol{qx}$), D is the stock of deposits[13], l_B is the unitary labour requirement of banks and $\boldsymbol{a_B}$ is the material input vector of the credit sector. All this implies that, differently from Pivetti, here i is persistently higher than τ.

The "augmented" system [5]-[6]-[7]-[11] will be closed the moment r and τ are determined.

Panico proceeds as follows. He assumes the existence of at least two financial assets: bank deposits, whose gross return is τ, and short-term bonds, which are issued by the Central Bank or the Treasury, and yield i_b. Each asset has an "illiquidity premium", σ_i. In the case of deposits, given their high degree of liquidity, the illiquidity premium is assumed to be insignificant, and hence, their gross and net returns are considered virtually equal. Panico defines σ_i's as parameters that depend on the public's perception about the normal level of the interest rate and the degree of liquidity of the system, and that can be influenced by monetary policy (Panico, 1985, p. 55). Under normal conditions, the arbitrage pursued by investors leads to the equalization of *net* returns on financial assets:

$$\tau = i_b - \sigma_b \qquad [12]$$

On the other hand, the profit rate obtained in productive investments must be at least as high as the return on financial investments. Hence, one obtains condition [13], which is analogous to condition [8] in Pivetti's model:

$$\tau + \sigma_k = r \qquad [13]$$

Equations [12] and [13] would be enough to eliminate the remaining two degrees of freedom, τ and r, had i_b received the *usual* treatment as a policy-controlled variable. Panico, however, does not follow this route; instead, he endogenously determines

proportion of own capital on total investment, it is weighted by one; or put it differently, α is at the same time equal to and lower than one. Specifically, his price system can be written in the following way:

$$\boldsymbol{p} = \boldsymbol{l}w + \boldsymbol{Ap}(1 + r + i\alpha)$$

[13] The level of deposits in Panico's formulation is obtained by assuming, just like credit, that the deposit-to-output ratio, $\boldsymbol{\delta}$, is a technically given parameter. Therefore, given the vector of activity levels, $\boldsymbol{x}$, $D = \boldsymbol{\delta x}$. Since we omit from the system the deposits raised by firms, a further condition would be required in order to determine D. This point will be discussed later, when we analyze Ciccarone's approach to money and finance.

i_b through the following arbitrage condition, which states that the loan interest rate must be equal to the rate of return on bonds:

$$i = i_b \qquad [14]$$

Given the money wage and the illiquidity premia, money prices, the structure of interest rates (*i.e.* the deposit rate, the return on bonds and the loan interest rate), the profit rate and the real wage are all *simultaneously* determined.

MTD (i.e. the determination of the *gross* profit rate by monetary conditions) manifests itself in a rather cumbersome way. For our purposes, it is enough to notice that Panico believes that the Central Bank can *somehow manipulate the illiquidity premia*, and therefore, the whole structure of interest rates. When these are raised, the effect is an increase of industrial prices and a reduction in the real wage, through two complementary channels: *directly*, for a given riskless profit rate, production costs rise, since the burden of firms' debt increases. This channel highlights the role of the interest rate as an effective cost; *indirectly*, because due to the arbitrage among investors, the riskless profit rate will follow the pace of the now higher deposit rate. In this case, the interest rate plays the role of an opportunity cost[14]. Due to both direct and indirect effects, the gross profit rate rises and hence the real wage decreases:

$$\sigma_b \Rightarrow\ i_b \Rightarrow \begin{cases} i \\ \tau \Rightarrow r \end{cases} \Rightarrow \pi \Rightarrow \boldsymbol{\omega} \qquad [B]$$

Of course, a first problem with Panico's approach is that it is not clear how the monetary authority is able to control both the *direction* and *magnitude* of illiquidity premia. After all, it can hardly be denied that these variables have a significant subjective component, which does not seem to obey any general rule. This could easily be solved, as Panico does in a more recent formulation of his system, by considering the rate of return on assets as the policy tool employed by the Central Bank.[15]

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[14] To see the causal mechanisms more closely, assume, for instance a restrictive monetary policy. This measure increases illiquidity premia, and therefore, raises the return on bank deposits above the return on riskless securities (we see from [12] that $\tau > i_b - \sigma_b$). This gap vanishes only when i_b rises[14]. Since the financial sector arbitrates the interest rate charged on credits with the gross return on bonds –condition [14]-, i is accordingly raised. Thus, an extraordinary profit in the banking industry drives competition among banks for new deposits, thereby inducing a rise of the deposit rate τ (Panico, 1985, pp. 57-8). Therefore, the whole structure of interest rates moves upwards, as well as the profit rate – equation [13]-.

[15] In his second formulation of MTD (Panico et al., 2012), Panico adopts a formalization previously developed by Kurz and Salvadori (Kurz and Salvadori, 1995, pp. 482-483). By doing so, he solves some inconsistencies of his first formulation by eliminating several specificities of the banking industry, but at the cost of obtaining a price system that becomes analogous to Pivetti's one. Analytically, this alternative system has the following equations:

$$\boldsymbol{p} = \boldsymbol{l}w + \boldsymbol{A}\boldsymbol{p}(1+r) + \boldsymbol{q}i$$
$$i = l_B w + \boldsymbol{a}_{\boldsymbol{B}}^{\boldsymbol{T}}\boldsymbol{p}(1+r)$$
$$w = \overline{w}$$
$$i_b = \overline{i_b}$$
$$r = \mu(\tau)$$
$$\tau = i_b$$

However, the major shortcoming of this system is that *there seems to be no reason to treat the financial structure of investment as a technical parameter*.[16] But had one decided to include α among the unknowns, Panico does not provide a plausible explanation for the leverage ratio that enter the dominant productive technique.[17] In other words, under this specification, the system becomes indeterminate.

4. Some Further Contributions to Integrate Financial and Productive Conditions

The analysis of Pivetti's and Panico's approaches allows us to reach two conclusions: first, if we accept that the structure of interest rates is exclusively determined by monetary and financial conditions, the notion of opportunity cost is *sufficient* for MTD, that is, for a determination of the normal (gross) profit rate, π, based on monetary and financial conditions (Pivetti). However, by itself this notion does not allow formalizing the influence of the financial system on relative prices and income distribution.

Necessary for this task, and this is our second conclusion, is to *explicitly* incorporate the more specific notion of the interest rate as an effective cost of production (Panico); in other words, not to simply subsume it, as Pivetti does, into the more general notion of opportunity cost.

But then, it seems natural to wonder whether the more "restrictive", so to speak, notion of effective cost is, *by itself*, also a sufficient condition for MTD. The study of two subsequent contributions to this literature, which have not received the attention they deserve, will allow us to shed some light on this issue. It will also give us additional elements both to discuss the determination of α (Franke) and to formalize the cost structure of the banking industry more rigorously (Ciccarone). As we shall see, unless one adopts more restrictive assumptions, the answer to the above question will be *negative*. With the ultimate implication that the notion of opportunity cost will be *necessary* too to provide a justification of MTD.

4.1. Franke

The most innovative part of Franke's contribution (Franke, 1988) is his analysis of the financial structure of investment. In terms of system [5]-[6]-[7], he eliminates the first of

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By combining the first and second equations, Panico obtains,

$$\boldsymbol{p} = \boldsymbol{l}^* w + \boldsymbol{A}^* \boldsymbol{p}(1 + r)$$

with $\boldsymbol{l}^* = \boldsymbol{l} + \boldsymbol{q} l_B$; $\boldsymbol{A}^* = \boldsymbol{A} + \boldsymbol{q}\boldsymbol{a}_{\boldsymbol{B}}^{\boldsymbol{T}}$. The key condition for this symmetry is the fifth equation, which is a general formulation of condition [8].

[16] Panico's treatment of $\boldsymbol{q}$ as a given parameter is even more problematic. As is clear from [9], this vector depends on prices, and therefore, is endogenously determined independently of whether α is technically given or not.

[17] Instead of the portion of capital financed through bank loans, one could interpret $\boldsymbol{q}$ as a kind of pure circulation cost, but this would not turn this coefficient less arbitrary. For an attempt to introduce money in Sraffa's system by means of circulation costs, see for instance, Hodgson (1981).

the three degrees of freedom by providing an explanation for the normal level of α. For this, he has recourse to the notions of borrower's and lender's risks, inspired by Kalecki and Minsky. Franke formalizes them in the following terms:

$$\alpha = \alpha(r, i) \qquad [15]$$

Franke suggests two alternative explanations for the behavior of α, as characterized by [15][18]: from the perspective of the borrower, he states that "since the borrower sees the cash flows due to debts as certain and the prospective yields as uncertain, increasing the ratio of investment that is debt-financed decreases the margin of security", and therefore, a rise of the interest rate that raises their level of indebtedness "would conflict with his need for security" (Franke, 1988, p. 263). This means, Franke concludes, that the desired leverage ratio decreases with the interest rate (i.e. $\alpha'_i < 0$). On the same footing, since an improvement in the expected cash flow raises, *ceteris paribus*, the expected yield of investment, then a rise in the net profit rate increases the desired leverage ratio (i.e. $\alpha_r > 0$).

On the other hand, behind the idea of lender's risk, we find Franke arguing that, for a given rate of return on capital, as the interest rate increases, the burden of firms' debt rises, and therefore, they are less likely to repay their liabilities. The implication is that banks become more reluctant to provide them with additional resources, and therefore, the leverage ratio decreases (this means that $\alpha_i < 0$). Similarly, when the net profit rate rises relative to the interest rate, banks are more willing to relax credit constraints ($\alpha_r > 0$).

The second degree of freedom is eliminated by exogenously fixing the money interest rate-condition [9]. As we have seen, this forces us to neglect the role of the financial sector as a capitalist, profit-seeking industry. Accordingly, Franke envisages them as intermediaries between firms and financial capitalists, which incur in no cost for their services (Franke, 1988, p. 265).[19]

The system has one degree of freedom left, which will be eliminated by providing a theory of distribution. One could rely on the notion of the interest rate as an opportunity cost, and therefore, employ [8] to determine r. But notice that, being essentially Pivetti's solution, this would simply eliminate the role of α in the system, whose formalization is, on the other hand, Franke's main scope. Indeed, as previously remarked, if [8] is introduced, the condition $\pi = r = i$ holds independently of the value of α.

Little wonder that Franke does not follow this route. He instead fixes the real wage in terms of a given consumption bundle, ω, from outside the price system (Franke, 1988, p. 264). Although Franke does not formalize this condition, under the assumption that the nominal wage rate is exogenously given by [7], this distributive closure can be simply written, using [10], in the following way:

$$\bar{w} = \bar{\boldsymbol{\omega}}\boldsymbol{p}^{\boldsymbol{T}} \qquad [16]$$

[18] Actually, Franke is not entirely clear on whether these two explanations can be complementary, and thus, their interaction determines a level of α that somehow balances the supply and demand for credit.

[19] However, Franke stresses that his system is compatible with the distinction between two different interest rates and the introduction of a capitalist banking industry (Franke, 1988, p. 270).

Under this closure, $\boldsymbol{p}$ and π are simultaneously determined by [6] and [16]. Then, once i is exogenously fixed (e.g. by the central bank), both α and r are residually determined by [15] and [5]:

$$\bar{\boldsymbol{\omega}} \Rightarrow \pi \Rightarrow i \Rightarrow \begin{cases} \alpha \\ r \end{cases} \qquad [C]$$

Notice therefore that the role of α is here substantially diminished with respect to Panico's contribution, since it only regulates the distribution of the surplus net of wages between industrial and financial capitalists, but it *does not affect neither relative prices nor the fundamental distribution of the social product, namely that between capital and labour*. The latter, in fact, is exclusively determined by purely technical conditions of the basic industrial sectors and the exogenous real wage:

Our examination of Franke's analysis allows us to answer the question we posed at the beginning of this section - whether the notion of the interest rate as an effective cost of production is enough for the validity of MTD - in the following way. Without the notion of opportunity cost - which is tantamount to allowing for the possibility of *arbitrage* between productive and financial investments - the necessary positive relationship between a given money interest rate and the riskless profit rate, *is lost*. Therefore, the division of the social output between workers and capitalists becomes indeterminate, unless a theory of the gross profit rate, π, *independent* of monetary and financial conditions, is offered. With the implication that, if any, the role of financial conditions, expressed by α and i, is *limited* to regulate the distribution of a given surplus *within* the capitalist class.

Before concluding this subsection, it seems useful to address some considerations about the way α is determined by Franke. First, if one attempts to justify the behavior of α from the borrower's perspective, one should consider that the idea that the "prospective yields" on investment - to use Franke's own words - are independent of debt payments is tied to the particular distributive closure adopted by the author, which *neglects* the role of the interest rate as an opportunity cost. Indeed, notice that, if *at least* some arbitrage between industrial and financial investments were allowed, then an increase in the interest rate charged by banks would have the effect of raising the normal profit rate r *pari passu*, and hence, prices would be raised accordingly. Therefore, it would be illegitimate to consider prospective yields as independent of the behavior of the interest rate. But if the movement of i affects both, debts and income, it is hard to see why the "margin of security" of firms is diminished when i rises.

The same consideration seems to apply if one justifies the normal level of α adopting the lender's viewpoint. Moreover, if one follows this justification, it is hard to see why this level of α, as *unilaterally* decided by an average bank, and which only provides, again in Franke's words, "the *upper-limit* of indebtedness he is willing to accept" (Franke, 1988, p. 263, italics added), can also be the level that tends to be realized, unless one adopts a supply-side view that *all* credit is automatically demanded by the industrial sector.

4.2. Ciccarone

Ciccarone (1998) determines the distribution of social output between real wages and gross profits by eliminating the three degrees of freedom of system [5]-[6]-[7] (i.e. i, r, α)

in the following way. In the first place, since the financial sector is considered as any other capitalist sector, its price, the loan interest rate, is explicitly distinguished from the deposit - riskless- interest rate (feature (ii.1) of section 2). This is not formalized in Ciccarone by introducing the price-equation of the banking sector as it would be natural to conclude (see feature (ii.2) of section 2). Rather, he assumes that the banking industry has the capacity, probably due its *monopoly power*, to exogenously fix the banking spread, β:

$$\tau = \beta i \qquad (0 \leq \beta \leq 1) \qquad [17]$$

This does not mean that the price-equation of the financial industry has no role in Ciccarone's framework. On the contrary, due to the introduction of further restrictive assumptions, it determines the system's net profit rate, r- the second degree of freedom - as we will see next.

Furthermore, this allows Ciccarone to present, relative to the previous contributions examined here, a more plausible formalization of the cost structure of the banking system, which highlights the role of financial regulations over liquidity and capital requirements, in determining the dominant technique of credit provision.

To this aim, he introduces the financial system's balance-sheet identity:

$$E \equiv C + R - D \qquad [18]$$

where E is equity capital, R is the level of bank reserves and, as before, C is the amount of loans to industrial sectors and D is the stock of deposits.

The level of bank reserves, R, can be expressed as a certain prudential proportion of D, say ρ, which reflects the effect of financial regulation and the previsions of banks regarding the normal amount of liquidity required to meet their clients' demand for cash:

$$R = \rho D \qquad [19]$$

Ciccarone further assumes that financial intermediaries advance their own funds to buy capital goods and hire labour[20]. Therefore, the total profits of banks (P_B) are equal to:

$$P_B = iC - \tau D - (l_B w + \boldsymbol{a}_B^T \boldsymbol{p})C \qquad [20]$$

Hence, for given levels of C and D, which Ciccarone assumes to be *independent* of productive conditions of industrial sectors (on this point see below), from [18], [19] and [20], it is possible to determine the profit rate of the financial industry as:

$$r_B = \frac{iC - \tau D - [C - (1-\rho)D]}{C - (1-\rho)D} \qquad [21]$$

Finally, due to the competition among capitals, r_B determines the normal level of profitability for the whole economy:

$$r_B = r \qquad [22]$$

[20] See also Park (2002).

The system is closed the moment α is determined. Ciccarone does not offer a definite solution to this issue. The reason is that, although he acknowledges that it cannot be conceived as a purely technical parameter (Ciccarone, 1998, p. 405), he simply states that any hypothesis for the leverage ratio could work "just as well" (Ciccarone, 1998, p. 409).[21] Given α, the normal demand for credit, C, is obtained, and from [18] and [19], the normal level of deposits, *D*, follows.

Notice that the normal profit rate of the economy, r, is *exclusively* determined by monetary and financial conditions.[22] In other words, the banking sector behaves as the *only basic sector of the system* (think of the corn sector in Ricardo's model- see Sraffa 1951, in *Works I*, xxxi-. This property is not explicitly remarked by Ciccarone, although it is fundamental to understand why, despite the notion of the interest rate as an opportunity cost is absent from the system (i.e. condition [8] does not hold), the notion of the interest rate as an effective cost of production is in this case sufficient to explain the distribution of the social surplus between profits and real wages (that is, MTD holds). The respective causal chain from monetary conditions to income distribution can be expressed as:

$$\tau \Rightarrow i \Rightarrow r_B \Rightarrow r \Rightarrow \pi \Rightarrow \boldsymbol{\omega} \qquad [D]$$

Clearly, however, the assumptions under which this version of MTD holds are undoubtedly restrictive. One thing is to plausible treat the financial sector as a basic sector in terms of Sraffa, and another very different thing is to treat it as the *only* basic sector of the economy.[23] For this condition to hold, the variables that determine r_B in [21] should not be influenced by the conditions of production of industrial sectors. However, simple inspection of the factors that determine C reveals that this condition does not necessarily hold. In fact, C can be obtained by multiplying the value of capital, $\boldsymbol{Apx}$, by the leverage ratio:

$$C = \alpha \boldsymbol{Apx} \qquad [23]$$

It is clear from [23] that, in general, C will depend on normal prices and income distribution, and therefore, cannot be determined before the latter are known.

This section leaves us with the following three results. The first one is that we have confirmed that, unless one resorts to some *ad-hoc*, and therefore restrictive, assumption

[21] Ciccarone discusses two particular alternative cases: 1) all capital employed in industry is advanced by banks (i.e. $\boldsymbol{C} = (\boldsymbol{lw} + \boldsymbol{Ap})\boldsymbol{x}$), and 2) banks only lend to firms the sum necessary to cover wages ($\boldsymbol{C} = \boldsymbol{lwx}$).

[22] Actually, there is a mistake in Ciccarone's price system. Since he does not distinguish between gross and net profit rates, two possible cases can be considered. Either the profit rates that enter the capitalist arbitrage are the net ones, but in this case the price equations in Ciccarone are wrongly specified (unless α is zero, and then, the financial system has no role whatsoever as a basic sector of the economy). Or the price equations are correct (and the gross profit rate captures the distribution between own and borrowed capital), but then the arbitrage condition is wrongly specified in terms of gross profit rates, which cannot be argued to exhibit a tendency to be equalized.

[23] In Ricardo's model corn is treated as the only basic sector of the economy due to an alleged homogeneity between output and capital in this sector. Beyond the fact that, as is well-known, Ricardo's assumption is not generally valid, here one cannot even rely on this kind of argument because credit can be created *ex nihilo*. In other words, physical costs are only a minor component of normal costs of production in the financial sector. Therefore, the only way to evaluate whether the banking industry is the only basic sector of the economy is by showing that no element in [21] is influenced by technical conditions of industrial sectors.

(the hypothesis that the banking sector behaves as the only basic sector of the economy), the notion of opportunity cost is not only sufficient, but also *necessary* for MTD.

Since the notion of the interest rate as an effective cost is still necessary and sufficient to justify the role of finance as a basic sector; and since this needs both explaining the financial structure of investment, α, and specifying the determinants of the loan interest rate, i, we have in this regard reached two further results: first that, although Franke's formalization of α as an endogenously determined variable is a step forward with respect to those presentations that treat it as a technically given parameter, his resort to the notion of "credit risk" does not seem very promising, and different channels that may influence the level of this variable *should* be explored. A somewhat similar conclusion can be drawn from Ciccarone's formalization of the price equation of the banking sector. He correctly stresses the influence of institutional factors on the loan interest rate, but he *illegitimately* treats the total amount of credits and deposits as if they were independent of the conditions of production of the other sectors of the economy.

In the following section we will attempt to provide an alternative route to introduce the financial sector into Sraffa's price system that takes due consideration of these three results.

5. Innovation and Finance

Several contributions that adopt the classical approach have emphasized the nature of financial services as a non-basic, or luxury, commodity (see for instance, Barba and De Vivo, 2012). This standpoint is undoubtedly influenced by the recent trends during the financialization-stage of capitalism, with the development of financial products such as securitization or derivatives, which were largely responsible for the recent global financial crisis.

However, the previous viewpoint overlooks the central role of the banking sector in providing finance to capitalist production, and more specifically, in promoting innovation.[24] In other words, finance makes it possible to implement an existing method, or a

[24] Interestingly this view of the financial system as a basic sector is in our opinion closer to Sraffa's standpoint. For instance, Sraffa himself devoted his attention to the special role of banks in providing finance to industry. This interest can be traced back to his *Lectures on Continental Banking* in the spring term of 1929 and 1930, in which Sraffa emphasized the differences between the British and Continental banking systems and stressed the importance of the relations between banks and industry on the Continent[24], or in his late unfinished project to publish the works of Saint Simon from the end of the 1950s into the 1960s (see Bellet and Lutz, 2018). This special role of finance is also emphasized by Keynes, when he introduces the *finance motive* for demanding money, which plays a key role in justifying why investment precedes saving: "There has, therefore, to be *a technique* to bridge this gap between the time when the *decision* to invest is taken and the time when the correlative investment and saving actually occur. This service may be provided either by the new issue market *or by the banks*…" (Keynes, 1937, p. 246, italics added). And, the British scholar continues, "*Investment finance in this sense is, of course, only a special case of finance required by any productive process"* (Keynes, 1937, p. 247, emphasis added).

new one (i.e. an invention), which, despite being able to generate a bigger net social output, may not be implemented, since it is not cost-minimizing at the given prices and distribution.[25] In this regard, in what follows we will present a simple model that captures a *double role of the banking industry* in this process; we will therefore follow a line of research inspired by Schumpeter's ideas[26]. On the one hand, to create, through changes in income distribution, the conditions required for innovation to be profitable; on the other, to allow the effective implementation of technical innovation, through the provision of financial resources to entrepreneurs.

However, our approach to the financial system as a basic sector *should not be interpreted as the only possible way* to connect financial conditions with the productive sphere of the economy. Rather, we aim to capture one *possible channel* through which the financial industry may affect the *size and distribution* of the social surplus[27].

5.1 The financial structure of investment

In order to isolate the role of credit on the dynamics of innovation in its utmost transparency, it is useful to differentiate between two kinds of firms within a particular industry. On the one hand, already existing firms that employ the dominant technique, are assumed to finance investment by having recourse to retained earnings. In contrast, those entrepreneurs who intend to introduce an invention will be assumed to require credit provided by financial institutions. Thus, two kinds of techniques may co-exist in each sector, namely, the dominant one (i.e the one that determines the normal price for each commodity), and the innovative method, which will only be introduced if, at the given prices, yields extra-profits.[28]

In the light of this consideration, let us inspect once again the price system [5]-[6]-[7]. Recall that this system has three degrees of freedom left to determine the following unknowns: α, r, i. Now, the distinction between new and existing methods of production allows us to immediately determine the level of α. The latter is zero for producers using

[25] For a discussion on the role of innovation in classical economists and Marx, see Kurz (2010).

[26] "While granting credit is not essential in the normal circular flow, because in it no necessary gap exists between products and means of production, and because it can be assumed there that all purchases of production goods by producers are cash transactions or that in general whoever is a buyer previously sold goods of the same money value, it is certain that there is such a gap to bridge in the carrying out of new combinations" (Schumpeter, 1949, p. 107, emphasis added).

[27] Besides the financing of technological innovations, the financial sector may affect the size of the surplus through alternative channels. For instance, the financial system tends to accelerate the turnover of capital and therefore, increases the normal profit rate. In addition, financial conditions may influence effective demand and thus, the rhythm of output growth, which due to Kaldor-Verdoorn Law, can induce technical progress in industrial sectors. Furthermore, certain financial services may enter, directly or indirectly, the consumption bundle of workers (see for example, Di Bucchianico, 2019).

[28] Innovation can be thought as feature of the long period position and not just as a matter of out-of-equilibrium adjustment, because they are developed *continuously*. It could be argued that the respective quasi-rents should be eliminated in the long period, but in a growing economy, they are constantly reproduced (*Cf.* Schefold, 1993).

the dominant technique, and one for those aiming to introduce the new productive method. This eliminates the first degree of freedom.[29]

Moreover, we know that, for MTD to hold, the notion of opportunity cost must be present in the system. Therefore, we eliminate the second degree of freedom with condition [8] (that is, $r = \tau$). Notice then that, the moment $\alpha = 0$ for those producers using the dominant technique, it follows from [5] that $\pi = r$. As in Pivetti, therefore, the division of the social product between workers and capitalists can be determined without inspecting the role of the financial system. In other words, without specifying the price equation of the banking sector that determines the normal level of the loan interest rate.

However, this does not mean that the banking sector does not play any role in the system, as we proceed to show below.

5.2. Financial conditions, innovation and net output

Let us assume that in sector j a new method of production, s, is introduced. Since it is not by definition initially dominant, the innovative entrepreneur takes the selling price of commodity j as given. Therefore, given p_j, the respective price equation determines his profit rate, π_s:

$$p_j = l_j^s w + \boldsymbol{A_j^s p}(1 + \pi_s) \qquad [24]$$

For the innovative entrepreneur, the cost of funding is the loan interest rate, i, which, acts *exclusively* as an effective cost of production:

$$\rho_s = \pi_s - i \qquad [25][30]$$

It follows from [25] that ρ_s must be positive for an innovation to occur. And since ρ_s is a negative function of the loan interest rate, more restrictive credit conditions diminish the rate of innovation.

We can now discuss the *basic* role, in Sraffa's sense, of the banking industry. This, however, cannot be the outcome of loans (i.e. the output of the banking sector) being used, either directly or indirectly, in the dominant methods of production of all commodities. After all, this is precluded by assumption in the model. As we shall see, this role

[29] Of course, nothing prevents capitalists from investing their retained earnings in the new method. This would make $\alpha < 1$ for innovators. Likewise, α could be greater than zero for those entrepreneurs using the dominant technique (i.e. credit could be used to finance activities that already take part of the circular flow). While our assumption is rather strong, it aims to highlight the special role of credit in the process of innovation. This is why, as we explained in the text, we are not providing a theory of the normal level of α, but just a channel through which financial conditions could affect normal income distribution and technical change.

[30] Notice that [24] and [25] show that the notion of the interest rate as an effective cost of production is present in the system, but only for innovative entrepreneurs. While the notion of opportunity cost only applies to those capitalists that employ the dominant technique. Of course, the innovative entrepreneur could use the loan either to invest in the dominant technique, or in a financial asset. However, this would evidently not be convenient for her since either of these two alternative activities would yield the riskless rate of return τ, i.e. the deposit rate, which is by assumption smaller than the loan rate i and therefore, a negative net return ρ_s for the innovator.

rather emerges because of the possibility that, due to the innovation, the *size of the net product rises*.

To see this, consider the effect of a reduction in the loan rate from i_0 to i_1[31]. If this reduction is strong enough, it may induce technical change: entrepreneurs will find it profitable to innovate and adopt the new method s, because relative to the dominant method, γ, they can obtain extra-profits, namely $\rho_s > 0$. When method s is generalized, the prices of commodities that were subject to the innovation decrease, and, for a given net profit rate, the real wage increases.

Notice actually that, as anticipated in the introduction to this section, the financial system performs a *double* role: besides allowing the *diffusion* of the innovation, with the reduction in the loan interest rate banks also *induce* entrepreneurs to innovate. These two roles can be illustrated by means of Figure 1.

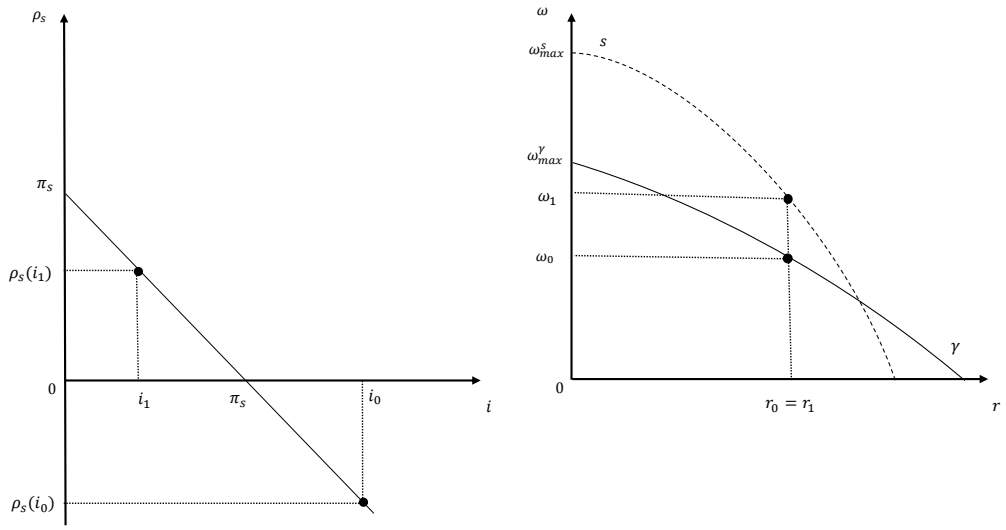

Figure 1- Financial conditions and induced technical change.

The second role is described by the left-hand side of the figure. It shows an "iso-profit" curve for the entrepreneurs which exhibits different combinations between ρ and i that allow the innovative method to obtain the profit rate, π_s (see [24]). Therefore, if ρ_s is initially negative due to the burden of the loan, by sufficiently decreasing the level of i banks can induce entrepreneurs to find it convenient to innovate. The right-hand side of the figure shows how, with the diffusion of the innovation, method s is gradually employed even by those entrepreneurs who have internal funds, and therefore becomes part of the dominant technique. Since the reference interest rate for capitalists employing the dominant technique, τ, has not changed, the real wage increases. Note moreover that in this case, the adoption of method s allows a rise in the size of net output ($\omega^s_{max} > \omega^\gamma_{max}$).

[31] The possible causes of this reduction will be explored in the following sub-section, when the determinants of the price equation of the banking system are explored.

5.3. The price equation of the banking sector

The closure of the system still requires the determination of the level of i and, therefore, the specification of the normal-price equation of the banking sector:

$$iC = E(1 + r) + \tau D + i_b R \quad [26]$$

where, recall, $C = (\boldsymbol{Ap})_j^s x_j^s$ is the amount of credit granted to industrial innovators, E is equity capital, D is the amount of deposits[32], R is the amount of cash reserves and i_b as the interest rate charged by the Central Bank to the financial industry for the supply of cash reserves. In other words, this rate is set by the monetary authority when she plays its role as lender of last resort. R and D keep the relationship already determined by [19].

Equation [26] requires some further adjustments. Equity capital as a share of total credit, e, can be assumed to be given at a particular level, either because a specific proportion between the industrial and financial sectors in the economy is assumed (see, for instance, Park, 2002), or because the Central Bank, through financial regulation, controls this ratio. This would be to prevent, for instance due to macroprudential motives, an excessive expansion of the amount of credit in the economy. The latter route is undoubtedly less arbitrary and will be the one followed next:

$$e = \frac{E}{C} = \bar{e} \quad [27]$$

Now, dividing [26] by C and using [19] and [27] one obtains:

$$i = \bar{e}(1 + r) + (\tau + \rho i_b)d \quad [28]$$

where d is the deposit-to-credit ratio.

Moreover, at least for the financial system as a whole, $d \equiv 1$[33], since, following the causality endorsed by the Post-Keynesian monetary view, "loans create deposits" (and deposits create reserves). Hence [28] is reduced to:

$$i = \bar{e}(1 + r) + (\tau + \rho i_b) \quad [29]$$[34]

and therefore, given the structure of interest rates (i_b and τ), and the financial regulation parameters (e and ρ), the notion of opportunity cost ($r = \tau$) is enough to determine the

[32] Only households are assumed to keep deposits with banks.

[33] "Loans make deposits, so that total deposits increase whenever banks make additional loans" (Moore, 1989, p. 19).

[34] One could also allow for specific determinants of the "risk-and-trouble" term of the banking industry, σ_B. Analytically,

$$r_B = \tau + \sigma_B$$

Thus, financial innovations that allow, for instance, reducing the costs of identifying clients' default risk, or moving these risks outside banks' balance sheets, such as securitization, may reduce σ_B, and, thereby, the level of i. Monopoly rents due to the entry barriers in the banking industry could also be included in the analysis.

Note also that, once σ_B is brought into the picture, the position of both horizontalists and structuralist monetary scholars can be captured by the model. The former by assuming that σ_B is given independently of the level of loans, and the latter by considering that σ_B, and therefore i, is a positive function of C.

normal level of i through [29]. Notice therefore that, differently from Ciccarone's approach to the issue, C and D play no role in the normal price equation of the financial industry, since banks are *price-makers* and *quantity-takers* in both the loan and deposit markets.

Condition [29] is also useful to very simply grasp the effects of financial conditions on the loan rate, and, as we have seen above, ultimately, on the rate of technical innovation. By decreasing either capital requirements or liquidity ratios, the Central Bank can induce, for a given structure of interest rates (given τ and i_b), a reduction in i[35], which, as we have seen in V.2, increases the level of extra-profits and therefore, induces firms to innovate.

$$e \Rightarrow i \Rightarrow \rho_s \Rightarrow \boldsymbol{A}, \boldsymbol{l} \Rightarrow \boldsymbol{\omega} \qquad [E]$$

6. Concluding remarks

Throughout this paper we have performed two main tasks. First, we have discussed the main difficulties faced by the literature to introduce money and finance into Sraffa's price system. We have shown that the essential feature of each framework consists in the specific conception of the interest rate, namely, as an opportunity cost or as an effective cost of production (or both simultaneously). The particular notion adopted has significant consequences on three different dimensions: (i) the formal consistency of the system; (ii) the possibilities to explicitly treat the financial industry as any other productive sector of the economy; and (iii) the validity of a "monetary theory of distribution" (MTD).

In this regard, while the notion of the interest rate as an opportunity cost is both *necessary and sufficient* for a consistent specification of the price system in which MTD holds (i.e. an explanation of the gross profit rate by recourse to monetary and financial conditions before the determination of relative prices and the real wage), the notion of the interest rate as an effective cost of production is both necessary and sufficient to explicitly treat the banking sector as a basic sector of the economy. If one aims to explain the persistent influence that monetary and financial conditions seems to have been exerting on income distribution during the last decades in a *fundamental* way, the implication is that both notions must simultaneously coexist in the system.

Second, we have suggested a possible route through which the financial system may influence the size and distribution of the social surplus, through its fundamental role of granting credit to innovation. This reformulation, by conceiving the interest rate as an opportunity cost only for entrepreneurs employing the dominant technique, and exclusively as an effective cost of production for entrepreneurs aiming to introduce new methods, has allowed us to both justify the basic nature of the financial sector and simultaneously preserve the validity of MTD.

[35] For instance, as Moore states:

> A rise (reduction) in reserve requirements raises (lowers) the cost of obtaining funds to place in loans via additional deposits in the manner of an indirect tax (Moore, 1989, p. 16).

We conclude with the following remark: rather than a definite answer to the role played by finance in the size and distribution of social output, our contribution should be interpreted as a step further in the discussion initiated more than 30 years ago on how to integrate monetary and financial conditions into the modern surplus approach to prices and distribution. We hope, therefore, to have encouraged future research on this field.

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