Prices and Distribution in a Sraffian Credit Economy

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Sraffa's suggestion regarding the monetary determination of the rate of profits raises two fundamental questions addressed by this paper: (i) can the money rates of interest be envisaged as variables set by the financial system independently of the real sector of the economy? (ii) How can they determine the general rate of profits and so allow for the determination of natural prices and income distribution? To elaborate on the intuition that the competitive process must link the rate of profits earned in the financial sector (and ruled by the intermediaries' margin) to that earned in the production sector, a long-period credit economy is constructed. Unlike previous attempts, the system of equations describing such an economy leaves Sraffa's (1960) original price equations unaffected. If certain fairly unrestrictive conditions are met, the solution of this system is shown to exist and to be economically meaningful, hence supporting Sraffa's hint that the rates of interest are free to determine the rate of profits outside of the system of production.

1. Introduction

This paper elaborates on Sraffa's (1960, p. 33) cryptic claim that: 'The rate of profits, as a ratio, has a significance which is independent of any prices, and can well be "given" before the prices are fixed. It is accordingly susceptible of being determined from outside of the system of production, in particular by the level of the money rates of interest'. The plural 'rates' is worth stressing right at the start because it is of crucial importance for the interpretation proposed here.

In particular, the two main issues I will address can be summarized in the following questions. (i) Can the money rates of interest indeed be envisaged as variables which the financial (banking) system is free to set, institutionally, historically or by political power-play, independently of the real sector of the economy? (ii) How do these rates determine the rate of profits and in this way allow for the determination of the prices of production and of the real wage (which may include part of the surplus product)?

As discussed in Section 2, the view of the rates of interest as 'free

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parameters', i.e., numbers that, in money terms, are explained (and can be varied) outside of the production sector, does not seem to me highly controversial in non-orthodox theory, and this justifies my working hypothesis that the rates of interest are set by the financial system.

The centrepiece of the answer to the question of how to go from the rates of interest to the rate of profits will then be sought in the way the competitive process between the financial and the non-financial sector is envisaged. The intuition stressed here is that, if the rates of interest determine the rate of profits earned in the financial sector, and if this is linked by the competitive process to that earned in the production sectors, then the rates of interest can indeed regulate the rate of profits.

Since the profitability of the financial sector depends on the difference between the rate received by final lenders and that paid by final borrowers, i.e. the intermediaries’ margin, the modelling of the economy requires the consideration of more than one rate of interest. The structure of bank loans and deposit rates, explicitly analysed in the credit economy constructed below, will be taken as related to the yields in the money and capital market, but the process at work in that relation will not be at issue. In other words, I will consider only one of the existing intermediaries’ margins, i.e. the relationship between the rate on bank loans, chosen as the representative rate, and the rate on bank deposits. The understanding of the relationships which other rates will bear to the representative one requires an analysis of how banks and other intermediaries compete (set their charges) that goes beyond the aims of this preliminary investigation.

Once this aspect of money interest is introduced, a set of relations can be specified in the resulting credit economy. These relations involve a system of prices of production, the single, general money rate of interest, the money wage rate (given in terms of an abstract monetary standard and whose real value is determined only after the prices of production are known), the intermediaries’ margin, the rate of profits earned by banks and that earned in the production sector. The competitive process is modelled in a way that allows us to establish a simple relation between the latter two variables and so to determine prices and the real wage.

The relationships that will be specified between the rate of bank loans and that on bank deposits are shown in Section 4 to be constrained within some bounds; but this is not necessarily the only interest differential so constrained (the profits of all financial intermediaries would, in principle, have to be taken into account in the same way as bank profits will be). These constraints notwithstanding, the analysis provides a straightforward answer to the first question posed above. The main result is in fact that the set of interrelated prices, with the money rate of interest taken as given, may be shown to possess a solution vector for a relatively wide range of values for both the rate of interest and the intermediaries’ margin.

This demonstrates that the rate of interest is not tightly constrained by the system’s internal consistency, and it hence appears to be a variable that the financial sector may indeed have some leeway in controlling independently of the rest of the economy. It also demonstrates that financial intermediaries, by
imposing their rate of profits outside of the system of production, may play a major role in determining natural prices and the real wage.

2. The Rate of Interest as a Free Parameter

An interpretation of Sraffa's (1960) statement as a suggestion to place the determination of the money rates of interest in the hands of the banking (financial) sector is not particularly controversial; the idea has appeared in the literature, running across theories and models. More debated, but certainly present in the non-orthodox literature, has been the possibility for that sector to set interest rates independently of the real sphere of the economy. To support this claim it suffices to provide here four well-known examples.

Marx suggested that, although profit is the "ultimate determinant of the maximum limit of interest" (Marx, 1894, p. 360), the average rate of interest 'cannot be determined by any law' (Marx, 1894, p. 362), as interest cannot be found in the process of production, and it is thus impossible to calculate the cost of production of the commodity whose price is the rate of interest. Hence 'there is no such thing as a natural rate of interest in the sense in which economists speak of a natural rate of profit and a natural rate of wage' (Marx, 1894, p. 362).

The average rate of interest¹ was seen instead as a monetary phenomenon whose value is influenced by socio-economic, institutional and conventional factors. This influence can be direct, in which case the most important circumstances can be identified in: (i) the fact that capital can be borrowed without a view to productive employment; (ii) 'the development of the credit system and the attendant ever-growing control of industrialists and merchants over the money savings of all classes of society that is effected through the banker'; (iii) discount rate policy; (iv) the presence of custom, juridical tradition, etc.; (v) the constraint imposed by the rest of the world (Marx, 1894, pp. 361–367). But the influence of the same factors can also be indirect, operating via the conditions of competition faced by borrowers and lenders of interest-bearing capital.

Among the neoclassical authors, Wicksell (1936, chapter 9, section B) provided the clearest picture of the working of a credit economy. His description of the banking system was based on four fundamental assumptions: (a) banks do not possess their own capital; (b) they do not hold reserve assets; (c) their operating costs are zero; (d) the rate of interest on loans (r) is equal to that on deposits (t). He recognized that in practice \( r > t \), but in the context of that part of the book (although not in other parts), he believed it possible to assume that the necessary cash holding is reduced to a minimum amount and that the 'risk and trouble' entailed in banking activity is negligible; this suffices for assumption (d) to hold. He also believed these assumptions to be irrelevant for the general validity of his conclusions.

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¹ For the determination of this rate: 'we must 1) calculate the average rate of interest during its variations in the major industrial cycles; and 2) find the rate of interest for investments which require long-term loans of capital' (Marx, 1894, p. 362).
To understand the consequences of these hypotheses, consider the balance sheet identity of the banking system:

\[ D + E = B + A + V \]

where \( D \) represents deposits, \( E \) non-deposit liabilities (capital and reserves), \( B \) bills, bonds and shares, \( A \) advances (loans), and \( V \) cash reserve items. If \( E = B = V = 0 \), the identity becomes:

\[ D = A \]

Coupling this identity with assumption (d), the result is obtained\(^2\) that banks make neither profits nor losses. Assumption (d) also solves the problem that individuals could have the option of lending money directly to firms instead of depositing it with banks. Firms would borrow that money if agents asked for a rate of interest \( i \), where \( t < i < r \). If \( t = r \) then both individuals and firms are strictly indifferent between the two options, and we may then reasonably suppose that minor frictions drive the flows through the banking system.

This set-up enabled Wicksell to attribute to banks the power of determining the money rate of interest, justified the relative stickiness of this rate in relation to the natural rate, and allowed him to identify the causes of cumulative inflationary or deflationary processes in the slow reaction of banks to variations in the natural rate. As a consequence of these processes, the natural rate acts as a centre of gravitation for the money rate of interest: the way the latter is set by the financial sector is tightly constrained by the necessities of the real sector.

Keynes’s (1936) theory reduces the freedom left to the banking system in the fixing of the money rate of interest, which is seen as the result of a well-known tripartite influence: the level of economic activity; the state of confidence; (c) the behaviour of the banking system (including the monetary authorities) in determining the volume of exchanges of liquidity for securities (Keynes, 1973, p. 221). But (at least) the third influence is not very clear, since the rationale driving banks to buy just so many securities by selling just so much liquidity is not really explained.\(^3\)

The interpretation of the General Theory in terms of causal links suggests that these shortcomings can be overcome by including the rate of interest among the data of the theory. Pasinetti (1974, p. 47) suggests, for example, that what the theory requires: ‘is not that [the rate of interest] be determined by liquidity preference, but that it is determined exogenously with respect to the income generating process. Whether, in particular, liquidity preference or anything else

\(^2\) The view I will develop below of the financial system as a profit-making industry implies instead that \( r > t \).

\(^3\) Keynes himself seems to believe it to be the result of various elements, like the authorities’ reading of the business cycle, or the influence of the balance of payments. In any case, his rejection of a natural rate of interest and its replacement by the rate of interest as a conventional phenomenon denies the existence of a rate of profits that could be a centre of gravitation for the money rate of interest. In Keynes’s (1973, p. 123) words: ‘instead of the marginal efficiency of capital determining the rate of interest, it is truer (though not a full statement of the case) to say that it is the rate of interest which determines the marginal efficiency of capital’. This is of course a view rooted in a specific interpretation of the investment decision.
determines it, is entirely immaterial'. This view is supported by Keynes's (1973, p. 212) own statement that his theory of interest was an afterthought with respect to the idea that variations in the level of income bring about equality between saving and investment.

The post-Keynesian view of the endogeneity of the money supply aims to provide a straightforward explanation for this exogeneity of the rate of interest. The central bank is assumed to set the short-term rate of interest, the short-run money supply is represented by an horizontal curve, and the money stock is demand-determined (Kaldor, 1970; 1986). This idea has been expanded to show that the money supply may be credit-driven as well as demand-determined (Moore, 1988). Loan demand creates deposits. Increases in the demand for bank credit are met by banks, and this in turn determines increases in deposits (the supply of money is credit-driven). Asset holders' decisions about the kind of deposits to hold determine the composition of the various liquidity aggregates (the 'money supply' component is demand-determined). Finally, long-term rates of interest are determined by expectations about future short-term rates, and hence about future central bank decisions.

Hence, Sraffa is not alone in assuming that the money rate of interest can be envisaged as a 'free parameter' set by the banking system, or indeed by socio-historical factors, or by whatever else. The difficulty is rather that of explaining how it can generate the rate of profits outside of the production sector.

Sraffa's statement quoted in the introduction has been traditionally justified on the basis of the two-step view that: (1) the monetary authorities can determine the money rates of interest (Dobb, 1973, p. 271; Garegnani, 1978, p. 63; Vianello, 1985); (2) there exists a definite relationship between the rates of interest and of profits.

As for step (1), recent contributions have tried to clarify the level of persistency required for the monetary authorities' actions to influence the entire structure of rates (Panico, 1985, pp. 53–54), have justified the hypothesis of a predetermined rate of interest by focusing on the necessity for the authorities to manage the government debt and the spread between the rates of interest of one country and those ruling in the rest of the world (Pivetti, 1985, 1987, 1991, Chapter 2), or have expanded the focus of attention from the monetary authorities to the banking system as the institution that sets the rate of interest (Schefold, 1985a, 1985b).

As for step (2), the various explanations offered so far can be divided into two main approaches, summarised by Kurz & Salvadori (1995, pp. 481–483) along the following lines.

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4 A similar statement can be found in Robinson & Wilkinson (1985, p. 88): 'Keynes's theory of Demand and Supply of liquidity is quite unconvincing. It is also unnecessary. Each banking system has the power to regulate its level of interest rates but each one has to take account of the level of the others'.

5 This explanation is not however free of problems, as Kahn (1954) had noticed long before it was re-introduced in the post-Keynesian literature.

6 Unfortunately, these observations explain neither how the rate of interest is determined in the rest of the world nor the value it would take in a closed economy in the absence of government debt.
(2a) The rate of profits is equal to the sum of two independent magnitudes: the rate of interest and the rate of profits of enterprise (the latter being identified with the remuneration for 'risk and trouble' or with the profit guaranteed by the existence of some 'degree of monopoly'); lasting changes in the former determine consequent changes in the general rate of profits by construction (Pivetti, 1985, 1991, Chapter 3; Schefold, 1985a, 1985b). If interest payments are conceived as costs and if industrial firms equate prices to normal unit costs, the increase (decrease) in financial costs will induce prices to rise (fall) and, given the money wage, the real wage to fall (rise).\(^7\) If workers resist the increase in prices relative to the wage, a conflict occurs, the result of which cannot be foreseen (Vianello, 1985).\(^8\) In fact, a spiral of cost and price inflation can induce the authorities to reverse their monetary policy, but the same spiral, together with the change in relative prices, can also have effects on the level and composition of output or on the dominant technique of production.

(2b) The banking sector, which is assumed to earn the general rate of profits on the capital it advances, is envisaged as providing, through short-term loans, banking services to firms. These banking services are as important for production as other services, like commercial activity, transportations, etc (Panico, 1988). The banking services are then conceived as basic inputs of industrial production, that is, banks are a basic sector. An increase (decrease) in the rate of interest on bank loans raises (reduces) banks' profits and the financial costs of industrial firms (the difference between interest payments and interest revenues). Under competitive conditions, the rate of profits will also rise (fall), as producers realize that the rate of return they were receiving before the variation in the rate of interest is now too low (high);\(^9\) prices will move in the same direction and the real wage, given the money wage, in the opposite direction.

This view has been encapsulated in the following system of equations (Panico, 1988):

\[
p = (Hp + wN)(1 + \pi) + ra - td
\]

\[
rA = (hp + wN)(1 + \pi) + \pi B + tD
\]

\[w = w^*
\]

\(^7\) By taking into account Sraffa’s notion of own rates of interest, and by assuming that investment is channelled towards the assets yielding the highest own rates, it is also possible to envisage a tendency (determined by the working of competition) towards the uniformity of such rates. In this context, the rate of interest controlled by the authorities may determine the whole structure of rates and the rate of profits (Panico, 1988).

\(^8\) It should be noted that as soon as joint-stock companies are considered, as in Vianello (1985), the general idea that changes in one rate of interest, say on bonds, determine variations in the same direction in the rates of return on equities could be controversial, unless it is supported by a detailed description of the competitive process in financial markets. The decrease in interest rates, and hence in costs, might well induce companies to increase dividends and so the rate of return on equities. In practice, with portfolio effects taken into account, yields on equities might move either way in relation to yields on bonds. See Friedman (1985).

\(^9\) This should imply the possibility of intersectoral capital flows from (into) production into (from) finance.
where $p$ is the price vector; $H$ is the material input matrix of the industrial sector (the $j$th row of $H$ represents the material inputs per unit of output of commodity $j$); $w$ is the money wage, taken as given; $N$ is the labour input vector of the industrial sector (the $j$th element of $N$ represents the direct labour used to produce one unit of commodity $j$); $\pi$ is the rate of profits; $r$ is the rate of interest on loans; $a$ is the (given) credit input vector of the industrial sector per unit of gross output, i.e. the ratio of loans to gross receipts in each industry; $i$ is the rate of interest on deposits; $d$ is the (given) deposit vector of the industrial sector, i.e. the ratio of deposits to gross receipts in each industry; $A$ is the (given) total amount of bank loans; $h$ is the material input vector of the banking sector; $N_f$ is the labour employed in the credit sector; $B$ is the portion of money reserves advanced by the same sector; $D$ is the (given) total amount of deposits.

In spite of their ingenuity in introducing explicitly the rates of interest in Sraffian models, these constructions suffer from various shortcomings, as pointed out by Mongiovi & Rühl (1993). In my opinion, a further problem with Panico's formulation is that the modification of Sraffa's (1960) price equations may raise the doubt that the system presented in *Production of Commodities* is not compatible, as it stands, with the description of a credit economy, in spite of Sraffa's own suggestion that prices and income distribution can be determined by taking the money rates of interest (the financial sector) as given. This observation provides a strong motivation to model the financial sector in a way not affecting Sraffa's price equations, as I try to do in the following sections.

3. The Basic Assumptions and the Financial Sector

If the exogeneity of the money rates of interest is due to the existence of a financial sector, a monetary economy with financial intermediaries must of course be explicitly considered. Moreover, to introduce financial assets into the system, it is necessary to have counterpart financial liabilities, and a consistent treatment of the rate of interest necessarily implies the explicit consideration of interest payments and receipts together with wages and profits.

Here, it will be useful to consider a simple economy where, besides entrepreneurs and workers occupied in firms, an organized system of financial intermediaries ('banks') contributes to production by advancing to entrepreneurs, at the beginning of the period, part of the finance necessary to buy capital goods, whose rate of depreciation is assumed to be equal to one, and to employ $N$ workers. (In the aggregate, the number of workers to employ and the capital goods to buy are derived from the given production technique and the given

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10 In particular, I share their view that in the system of equations (1)–(3) the debt coefficients, there taken as technical coefficients, will probably differ among the firms belonging to a particular sector; and, in the absence of a story explaining what regulates the rents reaped by low-debt producers, it is difficult to understand how the law of one price can be established in a sector where firms may have different interest costs per unit of output.

11 This is in line with Marx's view that: (i) 'if there were no money at all, there would certainly be no general rate of interest' (1894, p. 495); (ii) 'if all capital were in the hands of industrial capitalists there would be no such thing as interest and rate of interest' (Marx, 1894, p. 377, but see also p. 361, p. 370, p. 378).
level and composition of output.) The money rate of interest on loans \((r)\) and the nominal wage rate \((w)\) are taken as free parameters.\(^{12}\) Besides the loans made by the financial sector (and the associated deposits) there are no other securities. The working of competition brings about a uniform rate of profits in the production sectors. Joint production is excluded.

As wages are determined, at the beginning of the period, in terms of an abstract standard, workers do not know the amount of consumption goods their money wages will actually buy.\(^{13}\) Wages are then assumed to be spent at the end of the period, when the produced commodities are available and their prices are known. To make things simple, I assume that during the period all wages are deposited into interest bearing deposit accounts (but workers could buy pension rights, insurance policies, or the like), earning a rate of return \(t.\)\(^{14}\) The amount they spend at the end of the period is thus, \textit{ex-post}, equal to \((1 - s)(1 + t)wN,\) where \(s\) represents the propensity to save out of wages.\(^{15}\)

The view of the financial (banking) sector as a profit-making industry implies that \(r > t;\) this, in its turn, requires us to solve the problem of individual lending in a different way from that chosen by Wicksell (1936). Such a solution is provided by Marx’s (1894) analysis of banking activity which he also envisaged, as already noted by Panico (1988), as profit-earning; the bank’s profit being ‘in general made by borrowing at a lower rate of interest than it receives in loaning’ (Marx, 1894, pp. 402–403).

With the evolution of a capitalist society, financial capitalists (bankers) take the place of individual money capitalists, concentrating in their hands: (a) the deposits of money capitalists; (b) the money savings of all other classes; (c) ‘money capital which every producer and merchant must have as a reserve fund, or receives in payment’ (Marx, 1894, p. 403). These developments prevent agents from freely lending their money out at the ruling rate of interest: ‘Small amounts, each in itself incapable of acting in the capacity of money capital merge together into large masses and thus form a money power’ (Marx, 1894, p. 403). The solution to the problem under examination is hence provided by an institutional feature of the financial activity, not really at odds with the

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\(^{12}\) Note that the free parameters are the two variables for which Keynes (1936) either did not provide an explanation \((w)\), or for which he provided a controversial explanation \((r)\).

\(^{13}\) The assumption of a given money wage rate within a long-period framework has already been made in the literature (e.g. Panico, 1988; Pivetti, 1991) and it has already raised the unanswered question of whether the exogeneity of the money wage rate is in fact compatible with the long-period method (Foley, 1989).

\(^{14}\) The substance of the results would not change if wages were gradually spent during the period.

\(^{15}\) The value of the average saving propensity is derived after the vector of prices is obtained. If the components of the output vector \(X\) are ordered in such a way as to have the consumption goods expressed by the first \(k\) elements of \(X\) (call this vector \(X^k\)), the constraint that the value of output generated by the consumption good sectors must equal the share of income spent for consumption goods (in its turn equal to the value of the net product times the propensity to consume \((1 - s)\)) can be written as \(X^k p^l = (1 - s)(X - XH)p\), where \(p^l\) is the vector composed by the first \(k\) elements of the price vector \(p\) similarly ordered. When prices of production are determined, this equation can be solved for \((1 - s)\); the consumption propensity is equal to the value of the produced consumption goods over the value of the net product (net income). This is of course an identity derived from a certain notion of ‘market-clearing’: at the resulting prices of production, \textit{effectual} demand will necessarily be equal to supply (Garegnani, 1990, p. 132).
traditional notion of competition, which is incorporated in the model developed here: individuals cannot lend small amounts directly because these sums cannot act as money capital; they hence have no alternative to giving them to bankers at a rate \( r < r \).

Using the notation employed in the previous section, assume that financial intermediaries advance their own funds (equity) to buy the inputs (office space, machinery, etc) and the labour required to use them profitably; for simplicity, it is here assumed that all expenses are labour costs: banks employ \( N_f \) workers and pay a nominal wage bill equal to \( w N_f \). Their balance sheet identity is

\[
D + E = A + V
\]

(4)

\( V \) (on which no interest is assumed to be earned, but on which a rate of interest smaller than \( r \) could be earned without changing the substance of what follows) can be expressed as a certain imposed or prudential proportion of \( D \)

\[
V = \rho D \quad (0 \leq \rho < 1)
\]

(5)

and identity (4) can be re-written as

\[
E = A + V - D = A - (1 - \rho)D = w N_f
\]

(6)

The total profits of financial intermediaries \( (P_f) \) are then equal to

\[
P_f = r A - t D - w N_f = r A - t D - [A - (1 - \rho)D]
\]

(7)

and the rate of profit in the financial sector is\(^\text{16}\)

\[
\pi_f = \frac{P_f}{E} = \frac{r A - t D - [A - (1 - \rho)D]}{A - (1 - \rho)D}
\]

(8)

Had it been assumed, as in Wicksell (1936), that \( A = D \) and that banks hold neither equity nor reserves, the profitability of the financial sector would have tended to infinity, unless the difference between borrowing and lending rates had been set, again as in Wicksell (1936), equal to zero.

In this set-up, it should not be controversial to assume that the rate of profits in the financial sphere is in a certain (long-period) relation with that earned in the industrial sphere: if the former were lower (greater) than the latter, some of the financial (industrial) firms would move to the industrial (financial) sector, and the usual movements in quantities would bring the rates to equality, unless some institutional barrier prevented mobility between the two spheres. Without changing the essence of what follows, and in line with system (1)–(3) above, I will assume here that perfect mobility equalizes gross rates of profit across all sectors.

The model hence takes as data: (i) the level and composition of output; (ii) the technical conditions of production; (iii) the money wage rate; (iv) the money rate of interest on loans. (i) and (ii) determine the labour employed which, together with (iii), sets the money wage bill. Besides \( A \) and \( D \), which will be

\(^{16}\) This rate of profits is of course identical to that which can be obtained by solving equation (2) for \( \pi \) under the assumption that \( h = 0 \) and \( B = 0 \).
further discussed in the next section, the endogenous variables are the intermediaries' margin, the rate of profits, the monetary prices of the commodities and the real wage.

4. The Long-period Position of the Economy

Adopting the notation of the previous sections, the economy is described by the following system of equations

\[ p = (Hp + wN)(1 + \pi) \]  \hspace{1cm} (9)

\[ \pi_f = \frac{rA - tD - [A - (1 - \rho)D]}{A - (1 - \rho)D} \]  \hspace{1cm} (10)

\[ \pi = \pi_f \]  \hspace{1cm} (11)

\[ w = w^* \]  \hspace{1cm} (12)

\[ r = r^* \]  \hspace{1cm} (13)

\[ p_w = a_w p_a + b_w p_b + \ldots + k_w p_k \]  \hspace{1cm} (14)

\[ w_r = w/p_w \]  \hspace{1cm} (15)

where \( H \) is assumed to be irreducible, so that every commodity is basic in Sraffa's sense;\(^{17}\) \( A \) and \( D \) are two scalars; \( p_w \) is the money price of one unit of the composite wage commodity, dependent on the given bundle of wage goods \((a_w, b_w, \ldots, k_w)\) which defines that unit (Pivetti, 1991, p. 71) in terms of the first \( k \) commodities, assumed to be the consumption goods;\(^{18}\) \( w_r \) is the real wage.

As for the determination of \( A \) and \( D \), it should be noted that treating \( A \) as an endogenous variable would require the addition of one equation and one unknown to system (9)–(15). For example, if industrial firms, given their production decisions, were assumed to borrow from banks the sum necessary to buy all the inputs and to advance the wage bill, it would be possible to write the equation

\[ A = XHp + wN \]

where \( X \), of dimension \((1 \times n)\), represents the output vector of the industrial sector. Alternatively, and more simply, it could be assumed that industrial firms borrow only a sum equal to the wage bill, in which case the equation to add would be

\(^{17}\) It is possible to relax this assumption to state that the first \( k \) elements of \( X \), representing consumption goods, are never used as inputs and that all the other goods are basic in Sraffa's sense. Under both assumptions, together with that of single commodity production, 'perverse' results in the wage–profit relation are ruled out.

\(^{18}\) This specification, adopted here to highlight a link with the existing literature, is not really necessary, as the real wage rate can be determined, when the money wage and the prices of production are known, for any bundle of wage commodities.
\[ A = wN \]

Any other hypothesis would of course do just as well.

In any case, once \( A \) is fixed, \( D \) will be determined by balance sheet consistency. From (6), it is straightforward that

\[ D = \frac{A - wL_f}{1 - \rho} \]

This shows that any assumption that can be made about \( A \), and hence about \( D \), will not affect the internal consistency of the system, since it will always be necessary to add two equations and two unknowns to the description of the economy. Hence, in order to avoid making a specific hypothesis on the borrowing necessities of industrial firms, and in line with system (1)–(3) above, in this preliminary attempt, without affecting the essence of what follows, I will consider \( A \) and \( D \) as given variables.

The system (9)–(15) then has \( n + 6 \) equations but \( n + 7 \) unknowns \( (p, \pi, \pi_f, r, t, w, p_w, w_t) \); it can, however, be easily closed by adding an equation for \( t \), i.e. financial intermediaries fix not only the level of the (single, general) money rate of interest, but also their margin

\[ t = \alpha r \quad (0 \leq \alpha \leq 1) \quad (16) \]

Equations (10), (13) and (16) determine \( \pi_f \). \( p \) is then obtained through (9), (11) and (12), i.e. prices are determined so as: (i) to allow for the reconstruction of the means of production in each industry, and (ii) to generate a certain rate of profits in the industrial sector that is congruent with the money rates (plural) of interest (i.e. with the rate of profits of financial intermediaries), given the assumption that profitability is equalised through competition.

The solution of this system of equations must of course respect the conditions \( t < r < \pi \). Given this set-up, and indicating with \( \bar{\pi} \) the maximum rate of profits, the main results can be summarized in two propositions.

**Proposition 1:** In the economy described by the system of equations (9)–(16), provided that a plausible condition on \( \alpha \) is met, there exists a wide interval for the values the money rate of interest may take such that \( 0 < t < r < \pi = \pi_f < \bar{\pi} \) and the solution of the system has economic meaning.

**Proof:** The following conditions must be satisfied for the solution of the system to be economically meaningful.

(a) From Equations (10) and (16), to have \( \pi = \pi_f > 0 \) it must be the case that

\[ \frac{r(A - \alpha D)}{A - (1 - \rho)D} - 1 > 0 \Rightarrow r > \frac{A - (1 - \rho)D}{A - \alpha D} \quad (17) \]

(b) From Equation (17), \( r > 0 \) requires

\[ A - (1 - \rho)D > 0 \quad (18) \]

\[ A - \alpha D > 0 \quad (19) \]
Condition (18) is always satisfied since \( E = A - (1 - \rho)D > 0 \) by assumption.

c) From Equations (10) and (16), \( \pi = \pi_f < \bar{\pi} \) requires
\[
r < (1 + \bar{\pi}) \frac{A - (1 - \rho)D}{A - \alpha D} \tag{20}
\]

d) Finally, \( \pi = \pi_f > r \) requires
\[
r(A - \alpha D) > (1 + r) [A - (1 - \rho)D] \Rightarrow r > \frac{A - (1 - \rho)D}{(1 - \rho - \alpha)D} \tag{21}
\]

As Equation (21) is more binding than Equation (17), (20) and (21) define the set of values that \( r \) may take. For (21) to hold it must be
\[
1 - \rho - \alpha > 0 \Rightarrow \alpha < 1 - \rho \tag{22}
\]

If Equation (22) holds, (19) is certainly satisfied. Alternatively, if \( \pi = \pi_f > 0 \) and \( \pi = \pi_f > r \), then \( r > 0 \):
\[
\frac{A - (1 - \rho)D}{(1 - \rho - \alpha)D} > \frac{A - (1 - \rho)D}{A - \alpha D}
\Rightarrow A - \alpha D > (1 - \rho - \alpha)D \Rightarrow A > (1 - \rho)D \Rightarrow A(1 - \rho) D > 0
\]

which is true by assumption. That is, if \( \pi = \pi_f > 0 \) and \( \alpha < 1 - \rho \), then \( r > 0 \). Hence, if Equation (22) holds, there will exist an \( r \) (and hence a \( t \)) in the set defined by Equations (20) and (21) so that \( 0 < r < \pi = \pi_f < \bar{\pi} \).

e) But to meet simultaneously (20) and (21) it must also necessarily be the case that
\[
(1 + \bar{\pi}) \frac{A - (1 - \rho)D}{A - \alpha D} > \frac{A - (1 - \rho)D}{(1 - \rho - \alpha)D} \Rightarrow \alpha < \frac{(1 + \bar{\pi})(1 - \rho)D - A}{\bar{\pi}D} = 1 - \rho - \frac{E}{\bar{\pi}D} \tag{23}
\]

Equation (23) is more binding than (22) as
\[
1 - \rho > 1 - \rho - \frac{E}{\bar{\pi}D}
\]

This completes the proof.

**Proposition 2:** In the economy described by the system of equations (9)–(16), a higher \( r \) is associated with higher \( t, \pi \), and prices relative to the wage.

**Proof:** It is straightforward to verify that a higher \( r \) implies, from (16), a higher \( t \) and, from (10), (11) and (16), a higher \( \pi \). Then, with \( I \) representing the identity matrix, the price system (9) can be rewritten as
\[
[I - (1 + \pi)H]p = (1 + \pi)wN \tag{24}
\]

It follows that
\[
\frac{p}{w} = (1 + \pi) \left[ I - (1 + \pi)H \right]^{-1}N = (1 + \pi)z \tag{25}
\]

where \( z = [I - (1 + \pi)H]^{-1}N \). In Sraffa’s (1960) system, when \( \pi \) increases each
element of $z$, $z_j$, increases (if $H$ is irreducible or if consumption goods are not used as a means of production) or at least does not decrease (in the remaining cases) for all $j$: each and every $z_j$ is an increasing (at least non-decreasing) continuous function of $\pi$. Since $(1 + \pi)$ also increases when $\pi$ increases, in the present economy a higher $\pi$ implies higher $\frac{p}{w}$. This completes the proof.

If $r$ is in the set of values compatible with an economically meaningful solution, the only binding constraint is that $\alpha$ must be set lower than unity minus the reserve/deposit ratio (assumed to be greater than or equal to zero and less than one, but presumably closer to the former than to the latter value) minus a coefficient equal to $\frac{E}{\pi D}$ (where $E$ can be taken to be much smaller than $D$). If this condition is satisfied and, given the nominal wage, banks increase the rate of interest, then their rate of profits, and hence the general rate of profits, will increase. With a given nominal wage, the higher rate of profits requires higher prices; hence the real wage decreases. But interest payments on deposited wages increase. Workers will presumably bargain depending on how they perceive the overall effect on their income; if they abstract from interest earnings, a spiral of cost and price inflation may result.

It is worth stressing that, in this economy, both Marx’s (1894) idea that the category of interest is not present in the sphere of production, as well as Sraffa’s (1960) hint that the rates of interest may set the rate of profit outside of the system of production, have been respected.\textsuperscript{19} Moreover, changes in the money rates of interest influence relative prices and income distribution through the rate of profits.

5. Conclusions

This paper has tackled the question of whether the banking system can indeed fix the level of the money rates of interest independently of the rest of the economy. A simple long-period credit economy has been considered and it has been described through a system of equations which, contrary to previous attempts, leaves Sraffa’s (1960) original price equations intact. The solution of the system so set up, it turns out, is consistent with Sraffa’s hint that the money rates of interest are free to regulate the rate of profits, hence contributing to the determination of natural prices and the real wage. To obtain this result, the following variables must be taken as data: (i) the level and composition of output; (ii) the technical conditions of production; (iii) the money wage rate; (iv) the representative money rate of interest; (v) the intermediaries’ margin.

The general observation to be drawn from the analysis is that the banking system might actually have some freedom in controlling the money rates of interest outside of the system of production. This observation relies however on

\textsuperscript{19} It does not of course follow that the rates of interest Sraffa had in mind coincide with the basic rate and intermediary margin utilized in this exposition; but such a margin (between the rates at which intermediaries borrow and the rates at which they lend) is inherent in any system with more than one rate.
the assumed compatibility of the exogenous money wage rate with the long-period methodology here employed, a problem which has not been at issue.

As to how the independent determination of the money rates of interest might be brought about, the existing literature is rather unsatisfactory because the prevailing explanations tend to rely on such question-begging elements as 'the authorities', 'the budget deficits', the 'balance of payments', etc. I close by suggesting that the desired exogeneity may instead be explained by the special nature of the competitive process taking place within the financial sector. However, the search for an explanation able to reconcile competitive profit rate equalization across sectors with the exogenous interest rate setting in the financial sphere goes beyond the aims of the investigation proposed here.

References


