Solvency and Labour Effort in a Monetary Theory of Production

Emiliano Brancaccio

DASES Università del Sannio
Via delle Puglie 82
82100, Benevento
Italia
emiliano.brancaccio@unisannio.it

ABSTRACT. *The scheme of a "monetary theory of reproduction" (MTR) developed here constitutes a novel combination of two of the major critiques of the neoclassical theory, namely the "surplus" approach and the "monetary circuit" approach. The scheme is characterised by an extensive interpretation of the economic system's conditions of reproduction in both physical and monetary terms, with a connection being established between the conditions of viability and solvency characteristic respectively of the surplus and monetary circuit approaches. Moreover, the monetary scheme of reproduction makes it possible to resolve certain dichotomies that have hitherto characterised the critical literature: between the real part and the monetary part of the system, between the long and the short period, and hence between production prices and market prices, and finally between the macroeconomic adjustment of demand to supply and supply to demand. The last section addresses the relationships between monetary circuit and technical change, with particular reference to changes in labour efforts. Specifically, it will be examined the case in which more intensive utilisation of labour has no effect on the system's macroeconomic conditions of solvency.*

KEYWORDS: *Surplus Approach, Monetary Circuit Approach, Reproduction, Solvency, Effort.*

DOI:10.3166/EJESS.21.195-211

"Our fundamental thesis is that it is impossible
to raise questions – and therefore to answer them –
except from the viewpoint of reproduction."
Louis Althusser, 1971.

1. "Reproduction" as an alternative to the paradigm of utility and scarcity

Neoclassical theory examines the functioning of capitalism in terms of the following exogenous data: the scarcity of the resources available, the utility of the economic agents considered and the existing technology of production. Key roles are played in this type of analysis by the allocation of rights to the ownership of resources and the decisions freely taken by each individual as regards utilisation of the same. Given the resources at their disposal, agents decide whether to consume them or to exchange them on the market on the basis of their preferences, the goal being to maximise their personal utility. The logic of individual actions is expressed in terms of a relationship between aims and scarce means with alternative uses, which is represented at the formal level through the criterion of constrained optimisation. Application of this criterion gives the levels of supply and demand for the resources that individuals decide to exchange on the market. The prices at which this exchange takes place must be such as to bring demand into perfect equilibrium with the given supply of resources. Prices will therefore constitute indicators of the scarcity of resources in relation to demand for the same and will rise or fall in proportion to the comparative scarcity of each resource. It is assumed in the basic versions of the theory that the full utilisation of resources is attained in this way, i.e. that the equilibrium prices are such as to ensure that demand wholly absorbs the existing endowment of resources. Once the prices are known, the distribution of the resources and of any products created by means of the same will also be determined. The neoclassical conceptual framework therefore describes the mechanics of capitalism in terms of a "linear" process that starts from the exogenous determination of the scarce endowments of resources and the utility of the agents concerned and ends with the endogenous determination of the quantities produced and exchanged as well as prices and distribution. It should be noted that this process characterises all the possible variants of the neoclassical analysis. From the original models of pure exchange to those with production and those that allow for the accumulation of capital, be they long or short-period, temporary or intertemporal, the logical foundations remain in any case the twin pillars of scarcity and utility.[1] And it should be noted that this also holds for modern "imperfectionist" versions of the neoclassical theory. Even if market imperfections, asymmetries of information,

1 See Robbins (1935), Samuelson (1947, 1970) and Petri (2004) for the general characteristics of the neoclassical-marginalist approach. For the distinctions between the short and long-period versions of neoclassical analysis, see Garegnani (1976) and Petri (2004). See also Aspramourgos (1986) for reasons why the term "marginalist" would be preferable to "neoclassical".

strategic interactions and social institutions are admitted, the equilibrium solutions may become more complicated but the cornerstones always remain the same[2]. Nearly one and a half centuries after the neoclassical-marginalist counter-revolution, scarcity and utility are therefore still conceived respectively as the origin and the destination of scientific discourse in the economic field. What lies outside these two boundaries can be of no interest to the orthodox economist. In other words, utility and scarcity act as binding and "imperialistic" categories. It is only arguments based on them that can be described as scientific.

Opposed to the neoclassical-marginalist system is the paradigm originating in the writings of the classical economists and Marx, which constitute the source of inspiration for the major critiques of the dominant economic theory developed during the 20th century. The neoclassical pillars of utility and scarcity lose all scientific importance in this alternative interpretation of capitalism, their place being taken by the alternative concept of "reproduction" of the system. The concept of reproduction is recognized in the field of research into social systems as possessing explanatory powers and considerable possibilities of expansion and applied development[3]. It is in this perspective that we here present a new framework based on an extensive interpretation of the concept of capitalist reproduction in both physical and monetary terms. This framework constitutes a synthesis of two of the major critiques of the neoclassical theory, namely the "surplus" approach and the "monetary circuit" approach[4]. We shall call this new scheme "monetary theory of reproduction" (MTR)[5].

The monetary theory of reproduction presents the following general characteristics. Firstly, the methodological individualism and subjectivism of the neoclassical theory is replaced with a holistic and objective conception of social reality. On this view, not only does the economic system exist prior to and independently of individuals but the latter are in turn influenced by the system in relation to the roles and functions they perform within it. In this perspective, the model is constructed on the basis of objective data susceptible of direct observation

2. For proof of this, consider the solutions of these new models, where both exogenous preferences and endowments remain clearly present. These new versions of the neoclassical analysis also include what are known as the New-Keynesian models, for which Greenwald & Stiglitz (1987) is generally regarded as constituting the epistemological and theoretical manifesto. See Eatwell and Milgate (1983) for the use of the term "imperfectionist".

3. A relevant example of these possibilities is the concept of reproduction made in Althusser (1971).

4. Among the numerous writings in the sphere of the "surplus" and "monetary circuit" approaches, a particular relevance is given here respectively to the works of Garegnani (1981, 1990) and Graziani (1989, 2003).

5. This synthesis constitutes a development of certain arguments already put forward in Brancaccio (2005). Among the previous proposals for a combination of the two approaches, see Lunghini and Bianchi (2004), Halevi and Taouil (1998), Febrero (2006). See also the collected articles in Deleplace and Nell (1996), Rochon and Rossi (2003) and Arena and Salvadori (2004) as well as the editors' introductions.

and drawn predominantly from macroeconomic and intersectorial financial data. Hypotheses about the behaviour of economic agents are instead reduced to the bare minimum and in any case based on the idea that the actions of individuals depend on the groups to which they belong and the roles assigned to each of them in society. Secondly, given the objective of identifying the conditions of reproduction of the economic system, the model is characterised by a vision of the mode of production differing radically from the neoclassical theory. Capitalism is in fact seen no longer as a "linear" process that starts from scarce endowments and preferences of agents and arrives at the prices and the quantities produced and exchanged, but as a "circular" process. The goods produced constitute both outputs and inputs of the system at the same time in the monetary theory of reproduction, and prices are determined on the basis of the condition that the economy is capable of reproducing itself constantly. For example, it can be assumed that the rate of profit and the quantities produced are exogenous data, and the prices and wages compatible with the conditions of reproduction – with the need to cover the production costs and profit – can therefore be determined endogenously. The theory is therefore the very opposite of neoclassical utility and scarcity. As the production inputs are themselves continuously produced in this theoretical framework, it would make no sense to regard prices as indicators of the comparative scarcity of exogenously given resources. Moreover, the preferences of individuals are not necessary for the purposes of the analysis. As will be seen more clearly below, the theory shows that some groups of individuals – especially workers – respond passively to the system's mechanism of reproduction, a situation in which it is obviously impossible to see the actions of individuals as free choices aimed at maximising individual utility.

The following sections will present a formal description of the monetary theory of reproduction focusing on the logical implications of the combination of the surplus and circuit approaches and the resulting extensive interpretation in both physical and monetary terms of the system's conditions of reproduction. In more precise terms, it will be shown that a link is established in this framework between the conditions of viability and solvency, which are characteristic respectively of the surplus and circuit approaches. It will also be shown that the monetary theory of reproduction makes it possible to resolve certain dichotomies that have characterised the critical literature so far, namely those between the real part and the monetary part of the system, between the long and the short period, and hence between production prices and market prices, and finally between the macroeconomic adjustment of demand to supply and supply to demand. The last section addresses a specific aspect of the theory regarding the effects of a technical change based on the increased effort and indicates the conditions under which an intensification of labour has no effect on the system's macroeconomic conditions of solvency.

2. The formal scheme of the monetary theory of reproduction

The MTR scheme represents a capitalist system closed to foreign trade. The actors taken into consideration are workers, firms and their owners regarded as a whole, and banks with the possible addition of the central bank and the government. It is supposed that two goods are produced – for example, corn and iron – by means of both these resources and labour. It is also assumed that there is only one given technology and that the duration of the means of production is limited to a single period. None of the assumptions specified here proves crucial in obtaining the key results of the analysis. The variables taken into consideration are listed below:

Table 1. *Variables of the MTR scheme*

a_{jk}	Technical coefficients of production: quantity of good k required to produce one unit of good j
l_j	Coefficients of labour: quantity of labour required to produce one unit of good j
K_j	Quantity of good j employed as input at the beginning of each period
X_j	Quantity of good j produced at the end of each period
p_j	Monetary price of good j calculated on the basis of the "normal" rate of profit and current monetary wage
q_j	Quantity of good j consumed by workers
Y	Monetary value of production
C	Monetary expenditure on consumption
I	Monetary expenditure on investment
Z	Autonomous monetary expenditure generating no productive capacity (e.g. public spending)
K	Monetary value of capital, *i.e.* of goods used as input
w	Monetary wage per unit of labour
r	"normal" rate of profit
g	Rate of accumulation
λ	Proportion in terms of which goods are consumed by workers
γ	Deviation of the rate of profit from its "normal" level r (if $\gamma = 1$, the market rate of profit is equal to the normal rate r)
δ	Deviation of monetary prices from prices corresponding to "normal" distribution (if $\delta = 1$, there is no deviation)
u	Deviation of degree of utilisation of productive capacity from "normal" degree of utilisation (if $u = 1$, there is no deviation)
s_k	Propensity to save of capitalist owners of firms

The subscripts *j* and *k* are generic. The subscript *c* will be attributed to corn and the subscript *i* to iron in this two-sector system. It is also assumed, unless otherwise specified, that all the variables of the model refer to the same time *t*. The system is made up of the following equations:

$$p_c = wl_c + (1+r)(a_{cc}p_c + a_{ci}p_i) \quad [1]$$

$$p_i = wl_i + (1+r)(a_{ic}p_c + a_{ii}p_i) \quad [2]$$

$$Y = \delta u(p_c X_c + p_i X_i) \quad [3]$$

$$Y = u(wl_c X_c + wl_i X_i) + (1+\gamma r)\delta_{t-1}(p_c K_c + p_i K_i) \quad [4]$$

$$Y = C + I + \delta Z \quad [5]$$

$$I = (1+g)\delta(p_c K_c + p_i K_i) \quad [6]$$

$$C = u(wl_c X_c + wl_i X_i) + (1-s_k)(1+\gamma r)\delta_{t-1}(p_c K_c + p_i K_i) \quad [7]$$

$$u(wl_c X_c + wl_i X_i) = \delta(p_c q_c + p_i q_i) \quad [8]$$

$$K_c = (a_{cc}X_c + a_{ic}X_i) \quad [9]$$

$$K_i = (a_{ci}X_c + a_{ii}X_i) \quad [10]$$

$$\lambda = q_i / q_c \quad [11]$$

The scheme offers a disaggregated analysis of production sectors, which is typical of the surplus approach. However, it is important to clarify that it is always possible to describe the same scheme in macromonetary terms, which is the usual exposition of the monetary circuit approach. From a theoretical point of wiew, there is no difference between these two perfectly equivalent accounting methods. The system is immediately distinguished by the intention to resolve the dichotomies between the real part and the monetary part of the analysis, between the long and the short period, and hence also between production prices and market prices. Equations [1] and [2] describe the system of prices. It should be noted that these are monetary prices determined as a function of the "normal" rate of profit *r* and the monetary wage *w*. It is of course possible at any moment to transform these monetary prices into the customary relative prices, usually expressed in the terms of one or more goods. Their presentation in nominal terms makes it possible, however, to highlight the movements of the economy around what is usually described in the surplus approach as the "normal" or "long-period" position of the system. Equations [9] and

[10] give us the quantities of iron and corn used as production inputs at the beginning of every period. For given levels of K_c and K_i available as input, the corresponding levels of X_c and X_i will constitute the output that can be obtained in conditions of the "normal" utilisation of productive capacity. Equations [3] and [4] define the term Y respectively as the monetary value of the total production obtained and as the corresponding monetary income distributed among the workers and the capitalist owners of the firms. As we shall see, the latter will then be responsible repaying any loans previously negotiated with banks. Equation [6] defines expenditure on means of production and [7] indicates expenditure on consumption. It should be noted that use will initially be made here of the classical saving hypothesis in the version whereby the workers spend all of their wages on consumption while the owners of firms save part of the profits obtained. The term Z indicates autonomous expenditure that generates no productive capacity, as typically exemplified by public spending. Equation [5] is the condition of macroeconomic equilibrium between monetary expenditure and the value of production. In attaining this equilibrium, as we shall see, a crucial role is played by the deviation δ from the monetary prices determined as a function of "normal" distribution and the deviation u from the degree of "normal" utilisation of productive capacity. Together with [11], equation [8] makes it possible to determine the absolute levels of corn and iron that the workers will be able to purchase and consume.

3. A "snapshot" of the monetary circuit of reproduction

We have altogether 27 variables in 11 equations. Let us set 16 of the variables as exogenous. The remaining 11 variables will then be obtained endogenously. There are many different ways of closing of system in the observance of the theoretical assumptions. One of the various permissible solutions is presented below. In the case considered, the following 16 variables are taken as exogenous:

$$a_{jk}, l_j, K_j, Z, s_k, g, \delta_{t-1}, \lambda, w, r, \delta \text{ or } u$$

leaving the following endogenous variables:

$$p_j, X_j, q_j, Y, C, I, \gamma, \delta \text{ or } u$$

The mathematical solution of the system is as follows. Given w, r and the technical coefficients a,l, Equations [1] and [2] determine the prices p. Again given the coefficients a and the initial quantities of corn and iron K_j, equations [9] and [10] determine the quantities X_j that can be produced in conditions of normal utilisation of productive capacity. The substitution of Equations [4], [6] and [7] in [5] then gives:

$$1+\gamma r=\frac{1}{s_k}\left(\frac{\delta}{\delta_{t-1}}\right)\left[\frac{Z}{K}+1+g\right] \qquad [5']$$

where $K = p_cK_c + p_iK_i$. Equations [4] and [5'] constitute a sub-system with three unknowns, namely γ, δ, and u, whose combinations of equilibrium will be infinite in principle. For the sake of simplicity, we shall assume for the moment that there is no autonomous expenditure generating no additional capacity. We shall also adopt for now the "extreme" classical saving hypothesis whereby capitalists save all of their income. Therefore, $Z = 0$ and $s_k = 1$. If it is further assumed that the deviation from normal prices remains constant from one period to another, then $\delta_{t-1} = \delta_t = \delta$ and the macroeconomic equilibrium thus becomes:

$$\gamma r = g \qquad [5"]$$

from which we obtain the only deviation γ from the normal rate of profit that becomes necessary in order to ensure equilibrium. Therefore γr represents the market rate of profit, which rotates around the normal rate r. By substituting [3] in [4], we therefore obtain the combination of δ and u compatible with macroeconomic equilibrium. The precise values of this combination will depend on the way in which the firms decide to adapt the value of production to monetary expenditure. If they act on δ, the adjustment will take place through a deviation of prices with respect to the levels p compatible with the normal rate of profit. If they instead act on u, it will take place through a deviation of the degree of utilisation of productive capacity with respect to its normal value. Equilibrium will presumably be obtained through a combination of the two procedures. In order to facilitate the mathematical solution, however, we shall assume here that δ or u is set as exogenous and that the remaining endogenous variable is therefore obtained from [4]. Finally, while it will be possible to obtain Y from [3], C from [7] and I from [6], [8] and [11] will enable us to determine the physical quantities q_j of iron and corn consumed by the workers. The real wage therefore constitutes a residual determined subsequent to the analysis.

The mathematical solution of the system differs from those that usually characterise analyses based both on the surplus and on the monetary circuit approaches. In actual fact, it generates a sort of "snapshot" of the circuit of reproduction making visible what the usual systems normally leave in darkness, such as the connections between absolute levels and proportions, between long and short-period positions, and between physical and monetary variables. Suffice it to consider the assumption that production inputs are given. This derives precisely from the intention to obtain a "snapshot" of the process and in no way involves a return to the neoclassical paradigm of scarcity. In other words, the logic of

reproduction is fully respected, and with it also the respective modality of formation of prices and distribution[6].

4. The "sequence" of the monetary circuit of reproduction

We shall now try to go a little deeper than the "snapshot" of the process and provide a step-by-step description of the "sequence" of the monetary circuit of reproduction inherent in the framework outlined above. Let us start by assuming a monetary wage w and a given rate of normal profit r as exogenously given. We shall also assume to begin with that the firms keep the degree of utilisation of productive capacity at its normal level, for which $u = 1$. As a result, with the production techniques a_{jk} known and the initial quantities of available inputs K_j given, the quantities X_j to be produced are also known. It is also assumed initially that prices are at the level corresponding to normal distribution, for which $\delta = 1$. The sequence begins with requests for loans made by firms to banks. The loans requested are of two types. Applications will be made for a sum corresponding to:

$$wl_c X_c + wl_i X_i$$

needed by firms in order to pay the workers and produce the quantities X_j. Applications will also be made for a sum corresponding to:

$$(1 + g)(p_c K_c + p_i K_i)$$

needed in order to purchase new means of production. It should be pointed out that the overall amount of these loans does not derive from an autonomous decision on the part of firms but through negotiation with banks. This means that banks are crucially involved in determining the system's overall scale of production and also, as we shall see, its composition and distribution.

Let us now go on to examine the macroeconomic equilibrium. The substitution of [3], [6] and [8] in [5] gives the following condition of equilibrium:

---

6. Taking the inputs *Kj* as exogenous entails no return whatsoever to the logic of neoclassical scarcity. The prices corresponding to normal distribution are in any case determined in such a way as to ensure the system's conditions of reproducibility and with no reference to equilibrium between the given endowments of resources and their associated demand. As regards market prices, while it is true that they could respond to a possible imbalance between income and monetary expenditure, here too there is no connection with the definition of scarcity in the neoclassical sense. The dynamics of market prices and ensuing distributive effects can rather be seen as reflecting asymmetries of power between capitalists and workers in access to money, which are inconceivable within the framework of the dominant theory.

$$\delta u(p_c X_c + p_i X_i) = u(wl_c X_c + wl_i X_i) + (1 - s_k)$$
$$(1 + \gamma r)\delta_{t-1}(p_c K_c + p_i K_i) + (1 + g)\delta(p_c K_c + p_i K_i) + \delta Z$$

It should be noted that now u and δ can be different from one, i.e. we can have both a deviation from the degree of normal utilisation and a deviation from the prices corresponding to normal distribution. It will in fact be precisely the movement of these variables with respect to the initial unitary values that determines the macroeconomic equilibrium. To be more precise, the equation clarifies that macroeconomic adjustment can take place in three ways: through an adaptation of the degree of utilisation of productive capacity, an adaptation of prices or a combination of these two mechanisms. The choice between these different possibilities is obviously an exclusive prerogative of the firms. However, at this level of abstraction and in observance of our objectivist approach, we shall not investigate on the internal mechanics of this choice and leave the scheme open to all of the possibile decisions.

Adjustment through a deviation u from the degree of normal utilisation of productive capacity acts on the units of labour employed. It will in fact become necessary to increase the number of units of labour if utilisation of the means of production is intensified and to decrease it in the opposite case. We thus have a change in total wages and associated consumption. A change in u instead leaves the value and physical volume of investments intact. Adjustment through a deviation δ with respect to the prices corresponding to the normal rate of profit works on the contrary to determine a change in the value both of investments and possibly of autonomous expenditure that generates no productive capacity, but has no effect on the value of wages and consumption. The idea in this connection is that there exists a deep asymmetry of power between the different social actors involved. While the firms – and any body responsible for autonomous expenditure – can promptly adjust their spending to variations in prices, monetary wages are instead exogenous and hence do not adjust automatically. Equilibrium is therefore obtained through a distributive effect between firms on the one hand and workers on the other. This effect will obviously alter the average propensity to save and therefore the associated division of expenditure between consumption, investment and any autonomous expenditure generating no productive capacity. Finally, it should also be borne in mind that equilibrium is probably obtained in reality through a combination of variations of u and δ with respect to their normal values.

It is interesting to note that the simultaneous presence of both mechanisms of equilibrium within the same analytical structure makes it possible to resolve a conceptual separation that has long existed in the critical literature between the processes of adjustment based on adaptation of the scale and composition of supply to demand and those based on the opposite adaptation of demand to supply[7]. In any

7. The adjustment of supply to demand is seen here as corresponding to a change in u and a resulting deviation from the degree of normal utilisation of production capacity. The

case, regardless of the mechanism of macroeconomic adjustment, once the output has been sold, the firms will obtain a certain amount of monetary income equal to:

$$Y = \delta u(p_c X_c + p_i X_i) = u(wl_c X_c + wl_i X_i) + (1+\gamma r)\delta_{t-1}(p_c K_c + p_i K_i)$$

It should be noted that total profit is calculated in this equation on the capital loaned in the previous period, and therefore on the basis of the deviation δ_{t-1} referred to that period. Now, given the income obtained from the sale of their production, the firms will have to make the following repayments to the banks, the first term regarding the payment of wages and the second expenditure on investments:

$$u(wl_c X_c + wl_i X_i) + (1+i)\delta_{t-1}(p_c K_c + p_i K_i)$$

As regards the schedule of repayments, it is assumed here that there is an interval between those for loans for the payment of wages and those for loans to purchase means of production. It is in fact assumed that the loans for wages obtained at the beginning of the period must be repaid at the end of it at a rate of interest that can be regarded initially as negligible, whereas the loans obtained for expenditure related to investments at the beginning of a period can be repaid later, at the end of the next period rather than the same one, and at a rate of interest i set exogenously through negotiation between firms and the banks. It should be noted in this connection that net of the interest paid, the second term of the last expression above corresponds precisely to investment over the preceding period:

$$\delta_{t-1}(p_c K_c + p_i K_i) = (1+g)\delta_{t-1}(p_c K_{c(t-1)} + p_i K_{i(t-1)}) = I_{t-1}$$

It is important to specify that the only crucial hypothesis in obtaining the key results of the scheme is that for at least one kind of loans there is a delay between disbursements and repayments. On the basis of this assumption, it becomes possible to repay in money not only capital but also interests to banks - a case which seemed inconsistent with the old versions of monetary circuit. Furthermore, the same assumption makes consistent the monetary circuit with the multiplier of autonomous expenditure[8]. All the other hypothesis serve only the purpose of making the

---

adjustment of demand to supply takes place instead through a distributive effect corresponding to a change in δ and a consequent deviation from normal prices. In the Keynesian sphere, it is interesting to note that the first type of adjustment can be derived from the *General Theory* and the second from the *Treatise on Money*. The case of the so-called Cambridge equation should be ascribed to the second type of adjustment. On the Cambridge equation and the relationships between growth and distribution, see Foley and Michl (1999) among others.

8. See Brancaccio (2005) for further discussion.

mathematical exposition simpler[9]. Among these hypothesis there is also the uniformity between sectoral accumulation rates g, between sectoral deviations u from normal utilization, between sectoral deviations δ from normal prices and, as a consequence, also the uniformity between sectoral market rates of profit γr. This assumption can be certainly accepted in a first approximation, but it should be abandoned at a deeper level of analysis[10].

5. Physical viability, monetary solvency and political sustainability of the system

Once the loans and associated interest have been paid, the firms will have non-negative net profits only if the income deriving from sales is not less than the payments owed:

$$(1+\gamma r)\delta_{t-1}(p_c K_c + p_i K_i) \geq (1+i)\delta_{t-1}(p_c K_c + p_i K_i)$$

In other words, only if:

$$\gamma r \geq i \qquad [12]$$

This is the *condition of solvency*, compliance with which obviously constitutes an crucial factor for the reproducibility of the system. Taking into account the condition of macroeconomic equilibrium [5'], we can substitute the market rate of profit so that the condition of solvency becomes:

$$\frac{1}{s_k}\left(\frac{\delta}{\delta_{t-1}}\right)\left[\frac{Z}{K}+1+g\right] \geq 1+i \qquad [13]$$

If it is assumed that $Z = 0$, $s_k = 1$, $\delta = \delta_t = \delta_{t-1}$, [5"] holds and the condition of solvency can therefore be rewritten as follows:

$$g \geq i \qquad [13']$$

9. In strictly logical terms, there would be no difficulty whatsoever in admitting a positive rate of interest also on the repayment of wages. It could indeed even be assumed that the repayment of loans to cover wages takes place over the same interval as for investments, and therefore that banks charge the same interest on both types of loan. In all these cases, however, the resolution of the system would be unduly burdened without achieving any significant increase in the theory's explanatory power.

10. It is possible to demonstrate that the basic logical implications of the scheme (vitality, solvency and sustainability conditions, see below) do not depend on the uniformity of these variables.

Since the growth rate *g* depends not only on the firms' decisions as regards accumulation but also on the supply of credit on the part of banks, it can be asserted that solvency with respect to the loans obtained in the previous period will depend on the readiness to grant loans in the current period. In other words, the ability of banks to obtain repayment depends on their decisions as regards the volume of lending.

The condition of solvency thus delineated is of the monetary type and is more restrictive than the canonical *condition of viability* of the system, which refers instead to the physical characteristics of the economy considered. The condition of viability corresponds in fact to a situation in which the economy is capable of generating a physical surplus or at least of replenishing the goods destroyed in the production process. If this physical viability is to be ensured, the output of all the goods must be greater than or at least equal to the inputs of the same:

$$X_c \geq a_{cc} X_c + a_{ic} X_i$$
$$X_i \geq a_{ci} X_c + a_{ii} X_i$$

From which, by carrying out some simple substitutions, we obtain:

$$\begin{aligned} &(1 - a_{cc}) > 0 \\ &(1 - a_{cc})(1 - a_{ii}) - a_{ci} a_{ic} \geq 0 \end{aligned} \qquad [14]$$

This is the condition of viability of the economic system (Kurz and Salvadori, 1995). It can be shown that by positing $w = 0$ and assuming compliance with [14], we obtain the following from the price Equations [1] and [2]:

$$r \geq 0$$

In other words, compliance with the condition of viability indicates only that the system is capable of generating a non-negative physical surplus. It will therefore be understood that the condition of viability is far less restrictive than the condition of solvency. In actual fact, as follows from [12], the simple existence of a physical surplus is not sufficient for the purposes of solvency. It is also necessary for the market rate of profit to be sufficient for the payment of interest and repayment of monetary loans.

Attention should be drawn to the fact that the workers' wages are either reduced to mere subsistence or regarded as purely residual in the case both of physical viability and of monetary solvency. In the case of the condition of viability, the physical surplus is in fact calculated on the assumption that the monetary – and therefore real – wage is zero. This is an assumption that recalls the idea of a wage reduced to the minimum needed to ensure reproduction of the workforce, and is for this reason usually included directly among the technical coefficients of production.

In the case of the condition of solvency, wages can instead prove greater than subsistence but are taken as an endogenous variable situated subsequent to the entire process. This is an aspect of the analysis connected to the residual determination of the quantities of goods consumed by workers, and one that confirms the logically subordinate position of the working class. Such logical subordination should not, however, be mistaken for inevitable political subjection. We have in fact shown elsewhere that by setting "permissible" minimum levels of wages and hence of the distribution of income, it is possible to identify the solution space within which the sustainability of the system is guaranteed, while a contradiction between exogenous and endogenous variables can arise outside it with the possibility of the latter having a retroactive effect on the former (Brancaccio, 2005). This logical contradiction reveals a conflict between the actors concerned that could even come to undermine the "normal" rate of profit, upon which the entire mechanism hinges. We thus arrive at the definition of the *condition of sustainability* of the system. This further condition proves to be even more restrictive than the previous ones at the formal level. It is in fact obvious that the constraint of a minimum wage reduces the permissible solution space of the system. At the level of material interpretation, however, the condition of sustainability extends the concept of reproduction beyond the boundaries of the two previous conditions. It cannot in fact be interpreted in simply monetary or physical terms, but must be understood in a primarily political sense.

6. Solvency and labour effort

The monetary theory of reproduction outlined above is laden with potential theoretical developments. One of the possible areas of investigation regards the transition from an analysis of average profits to one taking into consideration the distribution of profits and the associated conditions of solvency of the various parties involved. This would shed light on the link existing between the lending of banks, the structure of the relations of credit and debt formed between the actors in the system, the liquidity that profit-making firms tend to accumulate, and the situations of insolvency affecting those making a loss. This link will be examined elsewhere with a view to shedding light on the ability of the system outlined to investigate one of the typical Marxian "laws of tendency", namely the one regarding the centralisation of capital. We shall instead focus in this last section on a more specific but not therefore less important aspect of the analysis. We want to examine the relationship between the dynamics of monetary circuit and a particular form of technical change consisting of an increase in labour effort, the latter being understood as an intensification giving rise to a growth in the productivity of labour (and hence a decrease in the coefficients l_j). In particular, we shall see that under certain assumptions there is no connection between solvency of the system and labour effort. Let us return to the condition of solvency expressed by Equation [12]:

$$\gamma r \geq i$$

In what way could increased effort affect this condition? As we know, the labour coefficients are situated within the price Equations [1] and [2]. Let us now reverse the exogenous and endogenous variables. If wage is regarded as given and one of the prices is taken as numeraire, these equations make it possible to determine the normal rate of profit r residually. It is easy to demonstrate that in this case a reduction of one or both the coefficients l_j would give rise to an increase in r. But is this increase capable of fostering compliance with the condition of solvency? The answer is not necessarily affirmative. There is in fact a possibility that any increase in the normal rate of profit r will be wholly offset by a movement of the deviation γ in the opposite direction. In order to clarify this point, let us return to Equation [5'] of macroeconomic equilibrium:

$$1 + \gamma r = \frac{1}{s_k}\left(\frac{\delta}{\delta_{t-1}}\right)\left[\frac{Z}{K} + 1 + g\right]$$

This equation of equilibrium proves compatible in general with a variety of values assumed by γr. In particular, if the setting of exogenous variables proposed in Section 3 is accepted, we find that Equations [4] and [5'] constitute a system with three unknowns, namely γ, δ, and u, whose solutions are infinite. In this case, it is therefore possible to admit that the labour coefficients are reduced subsequent to an increase in effort, and therefore that r increases without this necessarily determining any compensating variation in the opposite direction of γ. It is then possible to maintain that greater labour effort is conducive to compliance with the condition of solvency of the system. The situation changes, however, if $Z = 0$ and $s_k = 1$ or if it is simply assumed that $\delta = \delta_{t-1}$. In this cases, [5'] univocally determines the level of γr guaranteeing macroeconomic equilibrium. If the normal rate of profit were to increase, the deviation from it would therefore necessarily tend to decrease due to the mechanism rebalancing income and aggregate expenditure. On these assumptions, greater labour effort therefore has no repercussions on the macroeconomic solvency of the system[11].

This result is interesting because it sheds light on a typical feature of the capitalistic mechanism, namely that an action proving conducive to the interests of

11. The same problem can also be examined from a different viewpoint by putting forward a further possible division of exogenous and endogenous variables. For example, by taking both real wages and the minimum profit needed to repay loans as exogenous, the combination of coefficients of labour could be obtained endogenously from Equations [1] and [2]. On this view, the system would determine its technology internally and hence also the degree of labour effort compatible with the constraints imposed by the exogenous factors. In this case, the techniques of production prove the variables most susceptible of shaping in accordance with the needs and convenience of capitalist reproduction. In this connection, see Lunghini (2008).

the individual firm could instead prove useless or even counter-productive from the viewpoint of firms as a whole. This can be explained at the analytical level in the following terms. Increased labour effort enables firms to reduce production costs. If it is assumed that this reduction leaves the real wage unchanged and serves to benefit profits alone, a macroeconomic effect of distribution favourable to firms and their owners will automatically take place. Given the classical hypothesis of saving, however, this effect also reduces the average propensity to aggregate spending and therefore reduces the value of production, income and profits until the equilibrium between income and aggregate expenditure is restored. A reduction in profits can only be avoided if macroeconomic equilibrium is determined in some other way[12].

The case described shows that the dynamics of monetary circuit can also give a stimulus to "regressive" technical changes, based on the intensification of labour effort. An economic crisis, for example, could make the solvibility condition more binding. Then it could induce firms to increase the effort of workers in order to reduce costs, increase profits and facilitate refunds. This solution will favour some specific firms, in particular those able to intercept the weak flows of monetary expenditure. However, as we have shown, this procedure might have no effect on the macroeconomic equilibrium. In other words, at aggregate level the macroeconomic condition of solvibility could remain unsatisfied. In conclusion, this is a case in which the power of finance makes pressure on the social bodies and moulds them for its advantage. But there is no reason to expect that in this way it will be able to guarantee the general reproduction of the system.

7. References

Althusser L., "Ideology and Ideological State Apparatuses", *Lenin and Philosophy and Other Essays*, New York, Monthly Review Press, 1971.

Arena R., Salvadori N. (eds), *Money, Credit and the Role of the State. Essays in Honour of Augusto Graziani*, Ashgate, Hants-Burlington, 2004, p. 152-174.

Aspramourgos T., "On the origins of the term neoclassical", *Cambridge Journal of Economics*, Vol. 10, No. 3, 1986, p. 265-70.

Brancaccio E., "Un modello di teoria monetaria della produzione capitalistica", *Il Pensiero economico italiano*, Vol. 13, No.1, 2005, p. 91-122.

Deleplace G., Nell E.J. (eds.), *Money in motion*, London, Macmillan, 1996.

12. This can happen, for example, if we admit positive variations in time of the deviation of prices from the levels corresponding to normal distribution. If it is assumed that autonomous expenditure generating no productive capacity does no always adapt promptly to these variations, it is in fact possible to conclude that the latter determine an increase in aggregate expenditure and therefore also in the market rate of profit ensuring macroeconomic equilibrium.

Eatwell J., Milgate M., *Keynes's Economics and the Theory of Value and Distribution*, Londo, Duckworth, 1983.

Febrero E., "Monetary Theory of Production. A Classical-Circuitist Alternative Interpretation", *Xe Jordanadas de Economia Critica*, 2006, Barcelona.

Foley D., Michl T.R., *Growth and distribution*, Cambridge MA, Harvard University Press, 1999.

Garegnani P., "On a Change in the Notion of Equilibrium in Recent Work on Value and Distribution", *Essays in Modern Capital Theory*, Brown *et al.* (eds.), Amsterdam, North Holland, 1976.

Garegnani P., "Value and Distribution in the Classical Economists and Marx", *Oxford Economic Papers*, No. 36, 1984.

Garegnani P., "Classical versus Marginalist Analysis", *Essays on Piero Sraffa*, Bharadwaj K., Schefold B. (eds.), London, Routledge, 1990.

Graziani A., "The theory of monetary circuit", *Thames Papers in Political Economy*, 1989.

Graziani A., *The monetary theory of production*, Cambridge, Cambridge University Press, 2003.

Greenwald B., Stiglitz J.E., "Keynesian, New Keynesian and New Classical Economics", *Oxford Economic Papers*, No. 39, 1987.

Halevi J., Taouil R., "On a post-Keynesian stream from France and Italy. The circuit approach", *Working Papers in Economics*, University of Sidney, Department of Economics, 2002.

Kurz H., Salvadori N., *Theory of Production*, Cambridge, Cambridge University Press, 1995.

Lunghini G., "From Natural Order to Case: Money and Machineries", *European Journal of Economic and Social Systems*, Vol. 21, No. 2, 2008, p. 165-179.

Lunghini G., Bianchi C., "The monetary circuit and income distribution: bankers as landlords?", *Money, Credit and the Role of the State. Essays in Honour of Augusto Graziani*, R. Arena and N. Salvadori (eds), Hants-Burlington, Ashgate, 2004, p. 152-174.

Robbins L., *A History of Economic Thought: The LSE Lectures*, edited by Steven G. Medema and Warren J. Samuels, Princeton, NJ, Princeton University Press, 2000. [1935]

Rochon L.P., Rossi S. (eds.), *Modern theories of money*, Cheltenham and Northampton, Edward Elgar, 2003.

Samuelson P.A., *Foundations of Economic Analysis*, Cambridge MA, Harvard University Press, 1947.

Samuelson P.A., *Nobel lecture*, 1970.