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Circuit with Multi-period Credit

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ABSTRACT We develop a circuit model in which firms finance part of their investment using bank credit issued and reimbursed over several periods. The model has three main properties: profits originate in the overlap of investments financed by bank credit that remain to be repaid; Say’s Law is not verified, even when households do not save within a period; and the rate of investment must increase and then level off over time to avoid an overproduction crisis.

1. Introduction

In an article published in this journal more than a decade ago, Jean-François Renaud (2000) offered two Kaleckian solutions to the problem of the monetary realization of profits within a Post-Keynesian framework, relying on the existence of a capital-goods sector and on the ability of firms ‘to spend in the present—that is at the time of initial financing—the anticipated profits included in their supply price’ (Renaud, 2000, p. 293). The actual expenditure of anticipated profits is included either in the salaries advanced by the capital goods sector or in the financing of investments through bank credit. These solutions, however, were subjected to criticisms, expounded particularly by Rochon (2009).

In this article, we build upon Rochon (2009) and Cottin-Euzioli (2013) to show that a third Kaleckian solution is possible if investments are financed by bank credit issued over several production periods. In this solution, we can observe positive profits at the end of each production period, even after the reimbursement of the initial finance or bank credits. Our solution entails dropping the hypothesis that the length of the production process is equal to the term of all bank credits, an assumption on which most of the literature relies.¹

¹This hypothesis that the entire bank loan is repaid at the end of the period leads to a double contradiction. As Seppecher (2011, p. 85; our translation) explains, there is ‘an internal contradiction: the end of the circuit leads to the total disappearance of money, the monetary economy of production would then be fulfilled in losing its monetary nature, which is said, however, to be essential to it; an external contradiction: in the real world, credits are repaid every day, but the economy never stops to be monetary. If
Our work fits well within the parameters of the theory of the monetary circuit, which we present briefly in the second section. It requires the construction of a circuit with credits issued over several production periods, which we model in the third section. We then are able to develop, in Section 4, a new Kaleckian equation linking profits to investments.

Questions about the realization of profits and the validity of Say’s Law are closely related. As Renaud (2000, p. 289) reminds us, Say’s Law can be written in the form of two equalities: ‘On the one hand, production $Y_0$ creates a revenue $[E]$, or purchasing power, equal to its value. On the other hand, $[E]$ allows expenditure $D$ to be made, which is equal to it and which allows $Y_0$ to be ratified.’\(^2\) The issue of profit realization directly raises questions regarding the equivalence between $Y$ and $E$, and therefore about the validity of Say’s Law. In Section 5, using Kalecki’s profit equations as a starting point, we show that it is possible to refute Say’s Law, based on the difference between $Y$ and $E$. This refutation, however, does not imply that the economy is in a chronic under-consumption state. It only means that firms do not automatically generate sufficient revenues to be able to sell their production for profit. In Section 6, we study the conditions under which production generates sufficient revenues to be consumed in an economy growing along a steady path. We then obtain our main result, which is that in a growing economy it is increasingly difficult for production and therefore firms to generate revenues sufficient to buy all of the output. This result, we shall see, has further interesting ramifications.

2. The Monetary Circuit Theory

The mechanism of money creation and destruction constitutes the core of the monetary circuit. This theory relies on the well known—but rarely theorized—fact that money is created when banks issue credits and is destroyed when these credits are reimbursed and debts are cancelled. This approach is linked to the concept of endogenous money, according to which money is created \textit{ex nihilo} in response to the requirements of the production process. The monetary circuit theory is grounded in Keynes’s finance motive and has been elaborated by Graziani (2003), Parguez (2003), Poulon (1982) and Rochon (1999), among others.

The monetary circuit theory rests on four main postulates. First, money—or bank credit—constitutes an essential precondition for the production process to take place. It is therefore squarely within what Schumpeter (1954, p. 278) has called ‘monetary analysis’, in which money is introduced ‘on the very ground floor of our analytic structure’. This stands in contradiction to neoclassical or ‘real analysis’, where money is not necessary to explain production, that is, where ‘money enters the picture only in the modest role of a technical device’ (Schumpeter, 1954, p. 278).

\(^2\)Renaud uses the letter $R$ for revenue. We will instead use the letter $E$ to represent revenue, and use $R$ to represent the repayment of past bank credits.
Second, money is endogenous; its quantity depends primarily on firms’ demand for bank credits to finance the production of both consumption goods and investment goods. Hence, there is a hierarchy between monetary flows: ‘firms cannot produce without having access to monetary advances from banks. Households cannot spend money as long as firms have not produced and generated revenues’ (Lavoie, 1987, p. 68; our translation). This hierarchy is important. It explains the necessity of bank credit to initiate production, but also highlights the idea that the production process takes time.

Third, firms want to realize monetary profits. Indeed, the purpose of production is for firms to turn a sum obtained by bank credit into a monetary profit, that is, to somehow transform $M$ into $M'$.

Finally, the monetary circuit is usually studied within periods containing two main components: the ‘flow’ and the ‘reflux’ phases of production. A monetary circuit or a period of production begins with money flowing into the production sphere, as wages are paid and workers spend their wages, following an initial demand for bank credit. This observation makes it clear that money is not just a stock; it is also a flow that responds to the needs of the system. Provided firms are creditworthy, banks are willing to extend credit to them so they can use these funds to remunerate their workers and purchase non-labor inputs. As firms sell their output, they recoup part of the money they initially spent or injected at the beginning of the period of production. The reflux, at the end of the production period, is the moment during which credits issued at the beginning of the period are reimbursed. Money is then destroyed as the debts are extinguished.

3. Circuit Model with Multi-Period Credit

In this section we consider a typical circuit model, as described in the previous section, adding two critical assumptions. First, firms ask for bank credits to cover both their production costs and a part of their investment expenditures, that is, the purchase of capital goods, as in Parguez (1980). Second, bank credits used for financing investments are issued over several periods, as in Rochon (2005, 2009) and Cottin-Euziol (2013). This assumption reflects the fact that it takes time for an investment to become profitable. Firms, therefore, will reimburse the full amount of a long-term credit over several periods of production.

To simplify matters, we assume that there is no government spending or taxation. Hence, we only consider the behavior of a monetary economy driven by the production process and firms’ pursuit of profits. This in no way minimizes the important role of the State in generating private-sector profits or contributing to the growth of the economy. However, we believe that to explain the existence of profits at the macroeconomic level within the theory of the monetary circuit, we must do so without relying on the existence of the State or of an external sector.

To be clear, whereas part of investment expenditures is financed by bank credits issued over several periods, the bank credits financing production costs are repaid at the end of the production period. This means that, at the beginning of a period $t$, firms will ask for short-term bank credits to cover their production costs ($W^f_t$) and long-term bank credits to cover a part of their investments expenditures ($I^b_t$). We assume that all manufacturing costs are labor costs.
At the end of the period, credits covering production costs will be fully repaid at a short-term interest rate ($i^t$), and credits covering investments will only be partly repaid at a long-term interest rate ($i^l$). With $R_t$, the repayment of long-term credits within the period, the flow of payments may be depicted as in Figure 1.

Repayments of long-term credit will depend on the duration of the loans, or the ‘credit term’. If the credit term is $n$ periods, for instance, then long-term credit will be repaid over $n$ periods, and then repayments made in a particular period $t$ will depend on how much investment was financed by bank credits during the $n$ previous periods.

$$R_t = f(I_{t}^{bc}, I_{t-1}^{bc}, ..., I_{t-n}^{bc})$$

(1)

We suppose, to simplify the analysis, that banks do not invest, but they do pay wages, following Robinson (1956). Let’s call $W_{t}^b$ the amount of wages paid by banks to their employees in period $t$. We suppose that banks do not charge interest on credits financing their production expenditures. These credits are fully repaid at the end of the period.

The production expenditures of firms and banks represent the revenues of households. Let’s call $W_{t}$ the total amount of wages received by households in period $t$. We have:

$$W_{t} = W_{t}^f + W_{t}^b$$

(2)

These revenues are consumed and saved. Households’ savings can be either hoarded in their bank accounts, or used to purchase securities sold by firms. In this latter case, savings will flow back to firms, as do consumption expenditures. Then, ‘it would appear that from the point of view of firms, consumption and financial saving (saving used to purchase securities on financial markets) play a similar role’ (Rochon, 1999, p. 12).This point of view is consistent with Keynes’s (1937, pp. 667–668) observation that ‘consumption is just as effective in liquidating the short-term finance as savings is’. Therefore, in our analysis, we are going to consider that savings only refer to the part of savings hoarded on bank accounts.

Within a period, households will save part of their incomes and use part of their savings. Let’s call $S_{t}$ the stock of households’ savings at the end of period $t$. With $\Delta S_t$ the net flow of households’ savings during this period, we have:

$$S_{t} = S_{t-1} + \Delta S_t$$

(3)

Periods are linked to previous ones in two ways. First, part of the multi-period credits issued during previous periods will be reimbursed within the current period. Secondly, profits realized by firms ($\pi^f$) and banks ($\pi^b$) at the
end of a period will be spent during the next period. We suppose that profits made during a period will be entirely spent during the next one. They are paid out to the owners of firms and banks and used to self-finance part of investment spending. Let’s call $I_{sf}^t$ the investments self-financed by firms through their past profits during period $t$. The profits paid out by firms to their owners will then depend on the difference between realized profits and investments self-financed ($\pi_{t-1}^F - I_{sf}^t$). As we have supposed that banks do not invest, banks’ profits are entirely paid out to their owners.

Then, for a given period $t$, the monetary flows are depicted in Figure 2. Firms request bank credits to cover their production costs and part of their investment spending. Then, they produce, pay wages and pay out a part of their past profits to their owners. Banks grant credits, pay wages and pay out their past profits to their owners. Households consume while firms buy capital goods. Some of these investments are financed from previous profits and another part is financed by bank credits. Credits due are eventually repaid to banks.

Such an economy is the focus of our investigation. We will first determine what drives profit across periods. Then we will investigate whether this economy can experience an overproduction crisis. The existence of credits issued over several periods links a period with the previous ones. This will lead us to consider the dynamic of a circuit with multi-period credit, the subject of Section 6.

4. Profit in a Circuit with Multi-period Credit

Using the analysis depicted in Figure 2, we can calculate the value for profits within a given period $t$. We first calculate firms’ profits, banks’ profits and then overall profits in this economy. We obtain then a third Kaleckian solution to the puzzle of the realization of profits in a monetary economy.

Firms’ receipts depend on households’ consumption and on investment spending. Consumption spending depends on wages and profits paid out. Investment spending depends on investment that is self-financed or financed on bank credit. Firms’ costs depend on wages and repayment of past credits. Recall that investment spending does not count as a cost for firms: only the repayment of debt incurred to

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3 We consider firms’ costs in the broad sense of the word, including the expenditure that represents the repayment of past credits.
finance investments is regarded as a cost. So we have, for firms’ profits:

\[
\pi^F_t = (W^F_t + W^B_t + (\pi^F_{t-1} - I^F_t) + \pi^B_{t-1}) - \Delta S_t + (I^{bc}_t + I^F_t) - ((1 + i^e)W^F_t + (1 + i^l)R_t) \\
= W^B_t + \pi^F_{t-1} + \pi^B_{t-1} - \Delta S_t + I^{bc}_t - i^e W^F_t - (1 + i^l)R_t
\]

(4)

Firms’ profits depend on wages paid by banks, spending from past profits, investments financed by bank credit, repayment of past investments financed by bank credits, the net flow of savings and interest costs. We can also aggregate both bank and private-sector profits in order to determine the overall level of profit income generated by the economy.

Banks’ receipts depend on interests received on credit granted to firms. By deducting their production costs, we obtain the profit realized by banks:

\[
\pi^B_t = (i^e W^F_t + i^l R_t) - W^B_t
\]

(5)

So we obtain, for the overall profit of this economy:

\[
\pi_t = \pi^F_t + \pi^B_t
\]

\[
= (W^B_t + \pi^F_{t-1} + \pi^B_{t-1} - \Delta S_t + I^{bc}_t - i^e W^F_t - (1 + i^l)R_t) + (i^e W^F_t + i^l R_t - W^B_t)
\]

\[
= \pi^F_{t-1} + \pi^B_{t-1} - \Delta S_t + I^{bc}_t - R_t
\]

\[
= \pi_{t-1} - \Delta S_t + I^{bc}_t - R_t
\]

(6)

We can obtain positive profit by relying on investment financed by multi-period credits. Profits can theoretically be positive period after period, provided past profits and the monetary value of investments financed by bank credit exceed the repayment of past credits and the net flow of savings. The link between profits and these four parameters reflects the logic of the circuit described above. The production process generates both revenues and costs; profits arise if revenues are greater than costs. Wages and interest payments are both revenues and costs; since they counterbalance one another, they do not enter into this profit equation. But all of the variables that do enter into our profit equation generate either costs or revenues within the period. Spending on past profits generates revenues without generating costs, so it enters positively in our profit equation. In the same way, investments financed by bank credits generate revenues and only the part reimbursed within the period will be regarded as a cost. As for repayments of past bank credits, they are a cost for firms and do not generate any revenues.
within the period, the corresponding money being destroyed. Finally, savings decrease firms’ receipts.

One immediate conclusion we can draw is that it is not surprising to see in this equation investments and expenditures made out of past profits. Indeed, since Kalecki, we know that investments and capitalists’ consumption generate profits. However, a new variable that is rarely taken into account appears in this equation as well: the reimbursement of past bank credits. Like hoarding, these repayments clearly constitute a leakage out of the economic circuit because the corresponding money is destroyed. Although this idea is fundamental, economists rarely include it in their study of an economy’s imbalances.4

We can now show that profits ultimately originate from investments financed by bank credits. Past profits depend on past investments financed by bank credits. We can therefore replace past profits by their value in the profit equation. Profits made within a period then correspond to the difference between the sum of investments financed by bank credits and the sum of repayments and the overall amount of savings.

\[
\pi_t = I_t^{bc} - R_t - \Delta S_t + \pi_{t-1}
\]

\[
\pi_t = I_t^{bc} - R_t - \Delta S_t + (I_{t-1}^{bc} - R_{t-1} - \Delta S_{t-1} + \pi_{t-2})
\]

\[
\pi_t = \sum_{i=t-1}^{t} I_i^{bc} - \sum_{i=t-1}^{t} R_i - \sum_{i=t-1}^{t} \Delta S_i + \pi_{t-2}
\]

\[
\vdots
\]

\[
\pi_t = \sum_{i=1}^{t} I_i^{bc} - \sum_{i=1}^{t} R_i - \sum_{i=1}^{t} \Delta S_i
\]

\[
\pi_t = \sum_{i=1}^{t} I_i^{bc} - \sum_{i=1}^{t} R_i - S_t
\]

(7)

4To our knowledge, the only previous attempt to develop a profit equation similar to the one obtained here was undertaken by Henri Denis (1997, 1999), who, working within a monetary economy (but not a circuitist) framework, showed that ‘current profits made by firms are equal to the sum of paid profits and net investments not financed by households’ savings’ (Denis, 1999, p. 151; our translation). By calling net investments the difference between current investments and repayment of past investments, we obtain a result very similar to Denis’s, although we should note that Denis does not deal explicitly with repayment. Upon obtaining this result, Denis proposes a static study of the possibility of overproduction in a monetary economy. We will instead examine the dynamics of a monetary economy, taking into account the accumulation of repayments across periods.
The difference between the sum of investments financed by bank credits and the sum of repayments represents the amount of investment credit that still has not been repaid. It follows that investments financed by bank credits that have yet to be reimbursed are a source of profit.

In most of the proposed solutions to the puzzle of the realization of profits in a monetary economy (as, for instance, in the first solution put forward by Renaud), the amount of profits realized by firms depends on the amount of expected profits. In other words, the more profits firms hope to make, the greater profits they actually realize. In our solution, there is no link between the amount of expected profits and the amount of realized profits. Profits are purely passive. Thus, as in the second solution of Renaud (2000, pp. 299–300), ‘profit loses its status as an explanatory variable and becomes a purely endogenous variable that escapes the grasp of its legitimate owners.’

This then allows for a complete refutation of Say’s Law, based on the discrepancy between \( Y \) and \( E \). Realized profits can be different from expected profits. An insufficient level of investment spending, for instance, could prevent firms from realizing their expected profits. As profits are included in the prices of the goods firms sell (through a mark-up), low investment spending implies that the aggregate supply will fall short of an equivalent level of demand. We expand on this point in the next section.

5. A Refutation of Say’s Law

As mentioned in the introduction, for Say’s Law to be verified, production, \( Y \), has to generate sufficient revenue, \( E \); and then spending, \( D \), must be equal to all of that revenue. Refuting Say’s Law then must contest one or another of these equalities. The failure of spending to equal revenue essentially involves the non-reinvestment of savings. This possibility has been thoroughly discussed in the annals of economic thought (particularly by Keynes, 1930, 1936).

But the possibility that \( Y \) and \( E \) might not be equal has received much less scrutiny. Two of the earliest commentators on the matter were Sismondi (1819) and Malthus (1820). For Sismondi, this possibility meant that capitalism is often in a state of chronic shortage of demand. Malthus argued that the economy’s output could be fully absorbed by demand only if there existed a category of revenues external to the process of production, that is, only if there were a class of buyers who did not contribute to production.

Kalecki (1965), however, paved the way to a third solution. Kalecki showed that investments generate profits. Hence investment spending by firms can generate sufficient revenues to enable them to sell their output at a profit. This solution is more an advance over Sismondi’s, for it explains how an economy can experience both growth and depression, and it does so without relying upon categories of income and expenditure that are external to the production process, as in Malthus’s. If investments are lower than firms’ expected profits, then firms will not succeed in selling their entire production at the desired prices: the economy will experience a state of overproduction. If investments are higher than or equal to expected profits, the revenues generated will be sufficient to buy the entire production. In this sense, within Kalecki’s theory on profits are the seeds
to refute Say’s Law. However, Kalecki did not accomplish this refutation because, as Denis explains, he failed to draw a clear distinction between expected and realized profits: ‘to [refute Say’s Law], it would have been necessary to clearly differentiate between profits expected by capitalists, which are those they have to realize for production to be maintained at a certain level, profits they decide to pay to themselves, and realized profits, which they actually make. Unfortunately, this was never done by Kalecki’ (Denis, 1999, p. 133, our translation, original emphasis).

Let us now make that distinction between expected and realized profits, and assume that firms wish to sell their production with a given mark-up on their manufacturing costs:

$$\pi_t^{\text{expected}} = mW_t$$

Taking account of Kalecki’s profit equation, we find that realized profits depend on investments:

$$\pi_t^{\text{realized}} = I_t$$

The revenues generated will then be less than the value of output, and the economy will experience a state of overproduction if $I_t < mW_t$, and conversely if $I_t > mW_t$.

As it stands, however, this solution is not fully satisfying, because it overlooks two important elements—the financing of the investments and consumption of past profits—which we shall now discuss in the context of our model. Using equation (6), we obtain the following:

$$\begin{cases} 
\pi_t^{\text{expected}} = mW_t \\
\pi_t^{\text{realized}} = \pi_{t-1} - \Delta S_t + I_{t}^{bc} - R_t 
\end{cases}$$

From equation (10) it follows that revenues will increase at the same pace as the value of production provided we have the following:

$$\pi_{t-1} - \Delta S_t + I_{t}^{bc} - R_t = mW_t$$

or:

$$I_{t}^{bc} = R_t + \Delta S_t + mW_t - \pi_{t-1}$$

The difference between expected profits in period $t$ and profits realized in period $t-1$, i.e., $(mW_t - \pi_{t-1})$, represents the increase in profits firms expect to make between these two periods. Hence, to avoid overproduction the volume of investment financed by bank credit has to be sufficient to cover the repayment of past bank credits and the variation in savings, the two leakages of the system. In addition, they have to create the surplus amount of profits firms plan to make between two periods. The result is consistent with the analysis of Section 4. Investment financed by bank credit creates profits, whereas debt repayment and savings decrease profits.
So investment financed by bank credits has to be sufficient to counterbalance repayment of past bank credits and new savings, and then to create the amount of profits firms expect to make. We may note that even if all of the revenues of the period are consumed ($\Delta S_t = 0$), an overproduction crisis can occur if the volume of investment financed by bank credit is lower than the volume of repayment and the variation of profits firms expect to make. This reinforces the idea that the main argument here concerns not the equality between $E$ and $D$, but between $Y$ and $E$.

To avoid overproduction, current investments will have to cover repayments, which depend on past investments financed by bank credits. The equivalence between $Y$ and $E$ within a period depends then on decisions taken during the previous periods. We therefore need to consider a multi-period analysis of the model, which means its dynamics.

6. Dynamics of a Circuit with Multi-period Credit

We will now focus on developing the dynamics of our model. To be precise, we would like to know how investment must evolve across periods to avoid overproduction so as to allow realized profits to equal expected profits. First, we shall consider a monetary economy on a steady growth path. Then, using equation (12), we will determine the volume of investment financed by bank credit that is necessary to allow firms to realize their expected profits within each period.

Let us consider an economy with manufacturing costs growing at a given rate $g$ and with firms selling their output at a given mark-up, $m$. We also suppose that households save a constant net flow of their incomes within each period. We can then rewrite equation (12), taking into account these assumptions:

$$
(I_{bc}^{\text{required}}) = R_t + \Delta S_t + (\pi_t^{\text{expected}} - \pi_{t-1})
$$

$$
= R_t + sW_t + (mW_t - mW_{t-1})
$$

$$
= R_t + sW_t + \left( mW_t - \frac{m}{1+g}W_t \right)
$$

$$
= R_t + \left( \frac{s + sg + gm}{1+g} \right)W_t
$$

This equation gives us the amount of investment financed by bank credit required to allow $E$ to be sufficient to buy $Y$ within each period. This notion of required

\footnote{We can then easily show that saying that households save a constant part of their revenues is equivalent to saying that they save a constant part of their wages. We can also show that if households save a constant part of their incomes (or wages) within each period, then after several periods the ratio between the stock of households’ savings and their current income will be constant.}
investment has some similarities with the required growth rate of investments developed by Domar (1947); in both cases, it corresponds to the volume of investment necessary to allow demand to grow at the same pace as supply.

Dividing by the value of aggregate production, $Y_t$, we can then compute the required rate of investment financed by bank credit:

$$\left( \frac{I_{bc}}{Y_t} \right)_{\text{required}} = \frac{R_t}{Y_t} + \left( \frac{s + sg + gm}{1 + g} \right) \frac{W_t}{Y_t}$$  \hspace{1cm} (14)

It is necessary to pay attention to the definition of $Y$, which differs from the one commonly used. The value of production is generally defined as the sum of wages and profits (or, the sum of consumption and investment):

$$Y_t = W_t + \pi_t$$  \hspace{1cm} (15)

This equality shows that the receipts from the sale of output are entirely used to pay wages (or repay bank credit, which has enabled the initial financing of wages) or to pay profits. It is necessary to add a third element to our model: the repayment of past bank credits. Henceforth in our discussion, the receipts of firms will be used to pay wages and profits and to repay past bank credits. Assuming production with manufacturing costs $W_t$, prices will be set at:

$$Y_t = W_t + \pi_t^{\text{expected}} + R_t = W_t + mW_t + R_t$$  \hspace{1cm} (16)

Equation (14) can therefore be rewritten as follows:

$$\left( \frac{I_{bc}}{Y_t} \right)_{\text{required}} = \frac{R_t}{W_t + mW_t + R_t} + \left( \frac{s + sg + gm}{1 + g} \right) \frac{W_t}{W_t + mW_t + R}$$

$$= \frac{R_t}{(1 + m)(1 + g)^{t-1}W_1 + R_t} + \left( \frac{s + sg + gm}{1 + m}(1 + g)^{t-2}W_1 + R_t \right)$$  \hspace{1cm} (17)

If we first do not take into account the volume of repayment (i.e., if we suppose that $R_t = 0$), we can then notice that the required rate of investment financed by bank credit should be equal to a constant $\left( \frac{s + sg + mg}{(1 + m)(1 + g)} \right)$ for each period. It will have to cover the net part of the revenue saved and then ‘create’ the increase in profits firms expect to realize. If we consider plausible values for the parameters, we conclude that it should reach a constant and low level to avoid overproduction. Our economy seems then to be at a low risk of overproduction. However, we have still not taken into account the repayment of past investments financed by bank credits. If we do so, a very different story emerges.

Let us suppose, for instance, that credit used to finance investment is reimbursed in equal parts over $n$ periods. The value of current repayments will then
depend on investments financed by bank credit during the \( n \) previous periods:

\[
R_n = \frac{1}{n} I_{bc}^{t-1} + \frac{1}{n} I_{bc}^{t-2} + \cdots + \frac{1}{n} I_{bc}^{t-n}
\]  

(18)

In the same way, the required investments financed by bank credits will depend on investments financed by bank credit during the \( n \) previous period. Mathematically, this means that we have to solve a \( k \)-order linear recurrent sequence, so that analytic values can be obtained only with considerable difficulty.

Simulation exercises, however, can indicate how the required rate of investments financed by bank credit might evolve across periods. To do this, we need to set values for the parameters \((n, g, s, m)\) and initial values for the manufacturing costs \((W_1)\) and repayments of past bank credits \((R_1)\). The model works then in this way: the repayments of past bank credits determine, with the parameters, the required volume of investments financed by bank credit in the period; the volume of investments financed by bank credit determine the volume of future repayments; and so on: the required rate of investments financed by bank credit and the volume of repayment are purely endogenous variables.

We present one example of our simulations with given values for the parameters and given initial values for the variables. Then we analyze the effects of changes in the parameters. We set for the first simulation the following values for the parameters:

- a growth rate of 3\%: \( g = 0.03 \);
- a mark-up of 20\%: \( m = 0.2 \);
- savings represent within each period 5\% of wages: \( S_t = 0.05 W_t \);
- bank credits are repaid in equal parts over 5 periods:

\[
R_t = \frac{1}{5} I_{t-1} + \frac{1}{5} I_{t-2} + \frac{1}{5} I_{t-3} + \frac{1}{5} I_{t-4} + \frac{1}{5} I_{t-5}
\]

Regarding initial values, we suppose that initial repayments are nil \((R_1 = 0)\) and initial manufacturing costs are equal to one \((W_1 = 1)\). The evolution of the required investment rate is depicted in Figure 3, from period 1 to period 100, after which it reaches a threshold value. We also show the curve of the repayment rate, i.e., the volume of repayment as a proportion of the value of aggregate output \((R_t/Y_t)\).

Three main results emerge from this simulation. First, the required investment rate must gradually increase throughout the development of the economy. In other words, it becomes increasingly difficult in this growing economy to maintain balanced growth. The main reason for this result is that we take into account the repayment of credits that have financed past investments. Investments undertaken to generate profits and counterbalance savings will lead to repayments in future periods. Then, future investments will have to be greater because they will also have to counterbalance these repayments. These bigger investments will then increase future repayments, once again requiring bigger investment flows.
Second, the repayment curve follows closely the investment curve and represents the largest component to the evolution of the required investment rate. So the dynamic of a monetary economy seems to rely strongly on the relation between the issue of new bank credits and the repayment of past bank credits. The remaining part is explained by savings and the increase in profits firms expect to make.

Third, after several periods, the required rate of investments financed by bank credit reaches values that seem unattainable, suggesting that this economy can no longer achieve sustained growth.

Of course, more simulations could be carried out with different parameter values or different initial conditions. Such simulations produced the following results. An increase in the savings rate would raise the value of the required investment rate over the entire development path of the economy. An increase of the growth rate slightly increases the threshold value. A modification of the mark-up affects very slightly the dynamics of the required investment rate and its threshold value. The faster the reimbursement of long-term credit (over fewer periods), the greater the required investment rate: indeed, if firms are forced to reimburse long-term credit over a shorter period of time, they will have to reimburse a greater amount in each period, and more new investments will have to be undertaken to counterbalance these repayments. As for the initial conditions, they do not change the threshold values by the required investment rate and the repayment rate.\(^6\)

The main conclusion we can draw from all these simulations is that the results from the first simulation remain true, whatever the initial conditions or the parameter values: the required rate of investments financed by bank credit

\(^6\)The corresponding simulations and more details about these results are available from the authors on request.
has to increase throughout the growth phase, mainly because of the increased
repayment of loans, and after a number of periods it reaches very high levels.

These results could explain how we move from a period of growth to a recession,
even when there is no increase of savings within a period. When we consider
the threshold values, it is easy to see that after several periods an economy will not
be able to achieve the higher required investment rate. Under such conditions, an
economy would rapidly find that the increase in the value of aggregate output
exceeds the increase in the economy’s revenues.

7. Conclusion

The simple model presented in this article is a preliminary step to understanding
the functioning of a monetary economy in which bank credit is extended and
repaid over many periods. Despite its simplicity, the model has enabled us to
derive new results about the origins of profits and overproduction crisis in a mon-
etary economy.

First, using a multi-period model that incorporates Kaleckian and circuitist
elements, we have shown that investments financed by bank credits and not yet
reimbursed generate profits. This result has led us to partly modify Kalecki’s
profit equation.

Secondly, in our model, Say’s Law does not hold even when savings within a
period are nil. This result can be explained by the fact that there are from now on
two leakages in the economic circuit: savings and repayment of past bank credits.
The second of these has generally been ignored in the literature. Savings create a
discrepancy between revenues and consumption whereas the repayment of past
bank credits creates a discrepancy between revenues and the value of production.
It represents an expenditure for firms, without generating any revenues in the
economy, as the money repaid is destroyed. Our simulations show that it could
play an important role in causing overproduction.

Third, we have studied the dynamics of an economy ruled by the profit
equation that we discussed at the beginning of this article. We can summarize
these dynamics in the following way. The production process does not automati-
cally create the amount of money needed to generate and sustain profits. This
amount is created by investments financed by bank credits. But since past invest-
ments are always being repaid, new investments will also be necessary in the next
periods to counterbalance these repayments. Simulations exercises show that these
repayments will increase across periods, relative to the value of production. There-
fore, the rate of new investments financed by bank credits will have to increase as
well. For otherwise firms will not be able to sell their output at the price they
expected, and the economy will experience overproduction. We then show that
a monetary economy needs an increasing then constant rate of investments
financed by bank credit to avoid overproduction.

Finally, contrary to what some authors have argued, we have shown that
firms can theoretically generate profits without relying on government expendi-
tures. However, this does not mean that governments do not have an important
role to play. Our analysis shows that the realization of profits requires an increas-
ing rate of investments financed by bank credits. This rate reaches an unattainable
magnitude after several periods, and as a result the system becomes unsustainable. But growth can be restored through the injection of income through fiscal deficits; for, as Kalecki (1965) showed, public debt increases profits. In an economy that relies on credit money, deficit spending by the State could therefore be essential to achieving sustained growth.

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