The Repayment of Bank Credits Having Financed Investments in the Domar Model

Edouard Cottin-Euziol*

Abstract

In this article, we show that the repayment of bank credits having financed investments can represent an outflow outside the economic circuit in the Keynesian multiplier theory, just like savings. We then consider the impact of these repayments on the dynamics of the Domar model (Domar, 1947), which aims to extend the Keynesian multiplier to the long-term. We obtain that the rate of capital accumulation has to gradually rise throughout a growth phase, in order to avoid an overproduction crisis. This result paves the way to a theory of cycles based on the repayment of past bank credits having financed investments.

Keywords: Growth model, Endogenous Money, Business cycle

JEL Classification: E12; E32

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1. Introduction

During the inter-war period, the quantity theory of money was greatly questioned. Keynes, especially, explained that money should not only be regarded as a medium of exchange. It is also asked for precaution and speculation motives, showing a preference of economic agents for liquidity. Besides, firms need an advance of money to finance their investments. In this case, focus is not just put on a "desire to hold money, but rather [on] a desire to spend it" (Wray, 2006, p.5). This is the finance motive (Keynes, 1936, 1937a), which will be later on extended to current expenditures of firms, such as the payment of wages, reminding of the Treatise on Money's models (Keynes, 1930). This motive establishes that money is not only the condition of commercial exchange, but also the condition of the realisation of production.

Relying on Kahn's works (Kahn, 1931), Keynes developed his multiplier theory within this context. Firms ask bank credits in order to finance their investments, triggering a series of reactions which leads to an increase of the revenues and of the production both superior to the amount of the initial investment. This series of reactions takes place because the firms' spending constitutes the households' income and the households' consumption, in return, increases the firms' revenues and spending. Money is therefore an essential element for the realisation of production.

In this theory, investments are financed *ex ante* by bank credits and generate an equivalent amount of savings. It is then tempting to think that investments are all financed *ex post* by savings. Households would buy securities issued by firms and firms would use the money collected to repay their whole bank debt. However, this would mean that households hold their whole savings as securities, not as money, and that firms are never in debt with banks, except in the short term. This point appears to be very annoying to anyone aiming at understanding the functioning of a monetary economy, which was precisely the goal of Keynes. To quote Seppecher, raising the same issue within the Monetary Circuit Theory[1], this would lead to a double contradiction:

- "An internal [one]: closure of the circuit leads to the complete disappearance of money, the monetary economy of production would fulfil by losing its monetary characteristic, which is however said to be essential;
- An external [one]: in the real world, credits are repaid every day, but the economy never cease to be monetary" (Seppecher, 2011, p. 79)[2].

To a better understanding of the functioning of a monetary economy, we should then also consider that households can hold monetary savings and firms can finance their investments by bank credits issued on the mid and long term. This sounds sensible both for theoretical (Robinson, 1956) and realistic reasons (Seccareccia, 1996). Firms will then have to repay the bank credits having financed their investments during the next cycles of production. They will therefore have to devote a part of their receipts to these repayments.

Recent studies have shown that, in such an economy where investments are financed by bank credits issued on several cycles of production, the repayment of these credits should be regarded as an outflow outside the economic circuit (Rochon, 2009; Cottin-Euziol, 2013; Cottin-Euziol *et* Rochon, 2013). Indeed, as the repayment of a bank credit is equivalent to a destruction of money, interests excluded, the corresponding spending does not flow back to

[1] For further information about this theory, we refer for example to the works of Graziani (1990, 2003) and Rochon (1999).
[2] Our translation.

the economic circuit. Revenues that firms will distribute throughout a production process will then be inferior to the ones they have collected.

Raising this point, our goal will then be to consider the impact of these repayments, firstly on the value of the Keynesian multiplier when investments are financed by bank credits issued on several periods; secondly on the dynamics of the Domar model (1947), which relies mostly on it. To do so, we will first come back, in section 2, on the reasons explaining why repayment of past bank credits should be regarded as an outflow outside the economic circuit in this context. Section 3 will be devoted to the study of the impact of these repayments on the value of the Keynesian multiplier. In section 4, we will integrate this new multiplier into the Domar model. The dynamics of the new model obtained will be studied in section 5. We will finally show in section 6 how these results could explain the apparition of endogenous business cycles, and will conclude in section 7.

2. Repayment of Bank Credits in the Economic Circuit

In the introduction, we have given some indications explaining why the repayment of past bank credits having financed investments could be regarded as an outflow outside the economic circuit. In this section, we want to show that this result turns out to be true as soon as we consider an economy relying on endogenous money, a theory which well falls within the Keynesian multiplier theory.

The mechanisms of monetary creation and destruction are not a matter of debate among economists anymore. Indeed, *« According to pretty much all economists, money is created when a bank grant credit to one of its clients and is destroyed when this loan is reimbursed to the bank. » (Rossi, 2003, p. 340)*[3]. However, for a majority of economists, this does not mean that the amount of credits issued by banks is the main determinant of the volume of money. Most of them regard money as exogenous, its volume being determined by the amount of high-powered money delivered by the Central Bank. In this case, repayment cannot be considered as an outflow. Here is why.

When money is presumed to be exogenous, the monetary mass is determined by the quantity of central money offered by the Central Bank. The Central Bank makes available to commercial banks a certain amount of central money, which allows them, *through* the credit multiplier, to grant the economic agents a given volume of credits. The interest rates, endogenous, enable the balance between both supply and demand for money. Therefore, the supply of money restrains the demand for credits; the value of money comes from its scarcity. In this theory, a credit repayment does not affect the banks' reserves in central money because those reserves are determined upstream by the Central Bank. The repayment of a bank credit lowers the entire mass of credits granted by the banks in relation to the reserves of their central money. Doing so, it allows the banks to issue new credits for the exact same amount as the one of the repayments. Therefore, in such an economy, the repayment of credits does not influence the volume of money in circulation.

However, a growing minority of economists consider money as endogenous. Taking its roots in the *Treatise on Money* (Keynes, 1930) and Keynes 'articles posterior to the General Theory (Keynes, 1937a, b), this notion has been developed among others by Robinson (1956), Kaldor (1970) and Moore (1988). It states that the quantity of money is mainly determined by the demands of bank credits of solvent agents, the Central Bank merely setting the value of

[3]According to Maurice Allais, it is so "*since the publication in 1911 of Irving Fisher's Purchasing Power of Money'* "(Allais 1999, p. 83, our translation).

money by fixing its key rate. Money is detached from any reference to a standard and banks can grant credit theoretically without any limitation, obtaining afterwards the reserves required by the law. This does not mean that the access to bank credits cannot be constrained, but that their scarcity cannot be explained by boundaries in the money emission, as it was the case for example under a gold standard system[4]. Interest rates are, as for them, exogenous and no longer *natural*.

Within this framework, the repayment of a bank credit is not necessarily followed by the emission of a new credit, as it was the case for an exogenous money. On one hand, banks do not need to wait the repayment of past credits to issue new ones. On the other, every demand of credit made by an agent regarded as solvable by banks has already been satisfied at the current rate of interest. The repayment of a bank credit having financed investments then results then in a net monetary destruction. As it is a spending generating no revenues, as explained in the introduction, it can then be considered as an outflow outside the economic circuit. Therefore, as soon as we take an interest in an economy in which money is endogenous, as the Post Keynesians do (Piégay *et* Rochon, 2003; Lavoie, 2006), the repayment of past bank credits having financed investments should have an impact on the functioning of economies.

The Keynesian multiplier theory falls well within the notion of endogenous money, as the volume of money circulating is related to the amount of bank credits issued to finance investments. Therefore, this reinforces the idea that repayment of bank credits having financed investments should be taken into account in the Keynesian multiplier.

By considering such an economy, there are then two possible approaches to take these repayments (R) into account. The first one consists in suggesting that firms incurred more credits in order to reimburse the previous ones. In that case, if firms want to make investments for a sum I, they will incur to banks credits for a sum ($I + R$), in order to make their investments and pay back their previous credits. If this phenomenon can exist in the real world, it cannot yet be considered as recurrent. The long-term objective for a firm is to make a return on its investment and not basking in a Ponzi Game in which every investment is reimbursed thanks to the issuance of a new credit. In the same way, a bank will not bask itself in this kind of relationships with its clients. The fact that a firm regularly resorts to bank credit for cash balances matters is very different from the idea according to which it would ask for new credits to reimburse old ones. We therefore rule out this possibility of our study.

The second possibility consists in suggesting that firms devote part of their receipts to the repayment of past credits. In that case, firms do not distribute their entire receipts to households anymore, as it is the case in the Keynesian multiplier theory. A part of it will be devoted to the repayment of previously incurred credits from banks, resulting in a destruction of money. As it appears to us much more realistic, we will consider this second case in our study. The next section will then be devoted to the study of the impact of these repayments, made by firms on their receipts, on the value of the Keynesian multiplier.

[4] For further discussion about this point, we refer to the debate between Horizontalists, assessing a curve of money offer which is horizontal (Moore, 1989), and Structuralists, assessing that it is to certain extent positive (Wolfson, 1996, Dow, 1996, Palley, 1991). Nevetheless, for Lavoie (1996), these two positions do not question the endogenous nature of money and "*are matters of emphasis rather than substantial difference in opinion*" (ibid, p.275). We will adopt here, for the sake of simplicity, a pure horizontalist view. Our work is however able to fit both views mentioned.

3. Repayment of Bank Credits in the Keynesian Multiplier

In the General Theory (Keynes, 1936) and the Domar model (Domar, 1947), the evolution of the overall demand is based on the Keynesian multiplier theory. Investment and revenue are linked by "*a definite ratio, to be called the Multiplier"* (*ibid*, p.76). Kahn was the first one to highlight this notion (Kahn, 1931) and summed it up in this famous extract:

> *"The increased employment that is required in connection actually with the increased investment will be described as the "primary" employment. It includes the "direct" employment, and also, of course, the "indirect" employment that is set up in the production and transport of the raw materials required for making the new investment. To meet the increased expenditure of wages and profits that is associated with the primary employment, the production of consumption-goods is increased. Here again wages and profits are increased, and the effect will be passed on, though with diminished intensity. And so on ad infinitum. The total employment that is set up in this way in the production of consumption-goods will be termed the "secondary" employment. The ratio of secondary to primary employment is a measure of these "beneficial repercussions" that are so often referred to.* (*ibid*, p.1)*"*

In the multiplier theory, incomes and revenues flows gradually weaken because households keep part of their incomes as savings, which represent an outflow outside the economic circuit. If we pursue this thinking to its end, to the moment where the sums spent and perceived become infinitesimal, we get the value of the multiplier. The propensity to consume (*c*) or to save (*s*) is presumed to be constant.

$$Y = I + cI + c^2 I + \ldots + c^k I = \frac{I}{1-c} = \frac{I}{s} \qquad (1)$$

Keynes then concluded that "given what we shall call the community's propensity to consume, the equilibrium level of employment (...) will depend on the amount of current investment" (Keynes, 1936, p.24). In the Domar model we will study later on, this phenomenon reproduces itself period after period: investments of the first period generate the overall demand of the first period, those of the second period the overall demand of the second period, and so on.

In the introduction, we asserted that it was sensible to consider that Households hold their savings as bank deposits and firms finance their investments by credits issued on several periods. Firms will then repay their bank debt during the following periods. We also explained previously why these repayments can constitute an outflow outside the economic circuit. We are now going to analyse the impact of these repayments on the value of the Keynesian multiplier. For simplifying purposes, we will suppose that Firms remain in debt with banks at the end of the period for all the investments financed by bank credit and repay their debt during the following periods. Households, as for them, hold all their savings as money, on bank accounts, their savings balancing then banks' balance sheets. The reality is probably between this extreme and the one assessing that all investments are financed *ex-post* by savings.

The repayment of a bank credit comprises two parts: the interest, which forms the banks' revenues, and the capital, which brings to the elimination of the corresponding credit line. The payment of the interests goes back into the economy, as well as the other revenues allocated by firms. Considering the framework that is ours, and supposing a constant propensity to consume, it does not change anything to the multiplier principle. On the contrary, the capital repayment constitutes an outflow outside the economic circuit, as seen previously. For this reason, it will have an impact on the multiplier value, as savings do. From

now on, when we will talk about credits' repayment, we will therefore allude to capital repayment only, interest excluded.

Before, in every production-revenue-consumption cycle, part of the allocated sums (s) was leaving the circuit in the form of savings. Now, within each and every of these cycles, a part (*s*+*b*) will leave the circuit, with (*b*) the share devoted by firms to the repayment of previous allocated bank credits, as shown in figure 1.

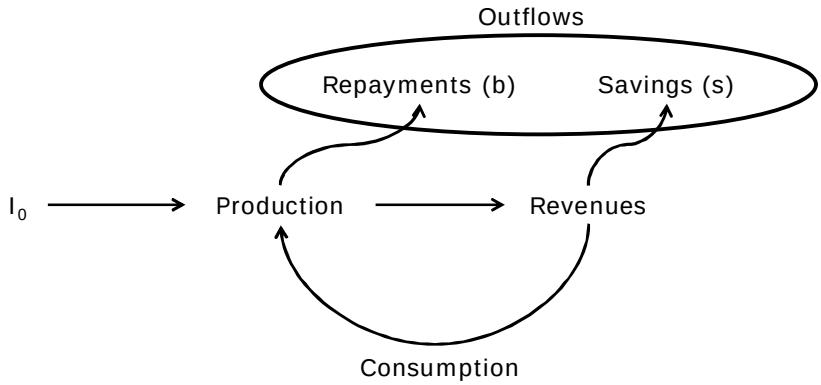

Figure 1: Outflows in the Keynesian multiplier, when taking into account the repayment of bank credits having financed past investments

The relation (1) then becomes[5]:

$$Y = (1-s-b)I + (1-s-b)^2 I + ... + (1-s-b)^k I = \frac{1}{s+b} I \qquad (2)$$

The multiplier value does not only rely on the propensity to consume, but also on the share of revenues devoted by firms to the repayment of previously allocated bank credits. To paraphrase Keynes, we can now say that, for a given value of the propensity of the community to consume *and a given volume of repayment of bank credits*, it is the sum of the current investment that determines the volume of employment. Taking into account the repayments of credits decreases the multiplier value.

It is possible to calculate the total amount of credits reimbursed by firms at the end of the multiplier process for a given value of (*b*):

$$R = bI + b(1-s-b)I + b(1-s-b)^2 I + ... + b(1-s-b)^k I = \frac{b}{s+b} I \qquad (3)$$

In other words, if firms had to face repayments for a sum R and if initial investments were of I, firms would have to devote a share b of their revenues to those repayments.

In the same way, we can calculate the sums saved for a volume of initial investments (I):

$$S = sI + s(1-s-b)I + s(1-s-b)^2 I + ... + s(1-s-b)^k I = \frac{s}{s+b} I \qquad (4)$$

Contrarily to the teachings of the *General Theory*, savings are in this context no longer equal to the amount of investments made at the beginning of a period. It can be easily

[5] To be exact, firms give a part (1-b) of their receipts to households, who consume a part (1-s) of their revenues. So, within a cycle production-revenue-consumption, a part (1-s)(1-b) of the revenues remains in the monetary circuit. However, for simplifying purposes, we use here the approximate value (1-s-b).

explained. In the usual multiplier theory, savings constitute the final destination of the entire money poured into circulation at the beginning of a period. Therefore, it is logical that the sums saved are equal to those invested. However, in the theory presented here, the funds raised have, in the end, two destinations: the repayment of past credits and savings. Savings can only be inferior to investments.

Thus, we can note that the sums of savings and of repayments of credits strictly correspond to the sum of initial investments:

$$S + R = \frac{s}{s + b} I + \frac{b}{s + b} I = I \qquad (5)$$

We can rewrite this equation under the form:

$$S = I - R \qquad (6)$$

The right hand side of the equation represents the net change of investments within a period. Savings are therefore equal to the *net* change of investments. This result makes sense. In the multiplier model and the one of Domar, an investment financed by bank credit generates equivalent savings. Here, the repayment of a bank credit that has financed an investment symmetrically leads to a decrease of savings. Indeed, the decrease of revenues engendered by these repayments results in a decrease of future receipts and revenues, and eventually in a decrease of savings.

We have seen, in this section, that the repayment of bank credits financing investments affects the multiplier value. We will from now on study their impact on the dynamics of the Domar model, which aims to spread to the long-term the Keynesian multiplier. To do so, we will incorporate in that model the results obtained in this section.

4. Repayments of Bank Credits in the Domar Model

What is now commonly known as the Domar model is based on the article of Domar of 1947. The model makes the proposition to extend to the long term the multiplier theory developed by Keynes in the *General Theory*. To this end, it integrates also the effects of investment on the evolution of the capital stock, and so on the aggregate supply. This considered, Domar builds a growth model, giving the chance to study the dynamics of an economy on a longer basis, as indicated in the following quotation:

> *"Because investment in the Keynesian system is merely an instrument for generating income, the system does not take into account the extremely essential, elementary, and well-known fact that investment also increases productive capacity. This dual character of the investment process makes the approach to the equilibrium rate of growth from the investment (capital) point of view more promising: if investment both increases productive capacity and generates income, it provides us with both sides of the equation the solution of which may yield the required rate of growth*" (*ibid*, p.73).

Therefore, investments come to raise the capital stock (K) and the production capacity of the economy, as explained in Domar's previous quotation. Domar makes the link between the production capacity and investments by the parameter σ which he calls the "potential

social *average productivity of investment*", and that "*indicates the increase in productive capacity which accompanies rather than which is caused by each dollar invested*" (1947, p.40)[6].

The two effects of investments, both on supply (Y^s) and demand (Y^d), are at the core of the Domar model and can be described by the following equations:

$$\begin{cases} Y_{t-1}^{d} = \dfrac{I_{t-1}}{s}, Y_t^{d} = \dfrac{I_t}{s} \Rightarrow \Delta Y_t^{d} = \dfrac{\Delta I_t}{s} & (7) \\ Y_{t-1}^{s} = \sigma K_{t-1}, Y_t^{s} = \sigma K_t = \sigma\left(K_{t-1} + I_{t-1}\right) = Y_{t-1}^{s} + \sigma I_{t-1} \Rightarrow \Delta Y_t^{s} = \sigma I_{t-1} & (8) \end{cases}$$

In this model, investment is at the same time the main factor to the increase of demand and supply. However, as Domar wrote it, it will not have the same effect on the two:

> "[...] *the whole body of investment, so to speak, increases productive capacity, but only its very top -the increment -increases national income*". There is a "*lack of symmetry between the effects of investment on productive capacity and on national income*". (*ibid*, p.47)

Investment, which diminishes the short-term overproduction *via* the increasing of demand it generates, can therefore worsen overproduction in the long-term by augmenting the production capacity of the economy: "*As far as unemployment is concerned, investment is at the same time a cure for the disease and the cause of even greater ills in the future*". (*ibid*, p 49-50)

Nevertheless, it exists an investment rate for which the demand growth is compatible with the supply growth. This rate gives us the *required* growth rate of the capital, and consequently the growth rate required for the economy to rise along the path to full employment. Domar makes his point in the following extract:

> *"If investment increases productive capacity and also creates income, what should be the magnitude of investment, or at what rate should it grow, in order to make the increase in income equal to that of productive capacity? Couldn't an equation be set up one side of which would represent the increase (or the rate of increase) of productive capacity, and the other-that of income, and the solution of which would yield the required rate of growth?" (ibid,* p.7)

By equalizing (7) and (8), we obtain the required growth rate. It depends on the marginal propensity to save and on the coefficient σ:

$$\left(\frac{\Delta I}{I}\right)_t = \sigma s \qquad (9)$$

If investments grow to an inferior rate to the one obtained, the supply growth will be higher than the one of demand. Factors of production will be underused. If they grow at a superior rate, the demand growth will be higher than the supply growth. The production capacity of the economy will be insufficient regarding the demand.

If we integrate our new multiplier value in the model, the evolution of the aggregate supply is not modified. However, for reasons previously mentioned, the evolution of the

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[6] In a model close to Domar's one, Harrod links them with the parameter C, which "*stands for the value of the capital goods required for the production of a unit increment of output*" (Harrod, 1939, p.16). Both obtain the same relation with $\sigma = 1/C$.

overall demand is going to be affected by the decrease of the multiplier effect coming from the taking into account of the repayment of credits. The new equations ruling the Domar model now become:

$$\begin{cases} \Delta Y_t^d = \dfrac{\Delta I_t}{s + b_t} & (10) \\ \Delta Y_t^s = \sigma I_{t-1} & (11) \end{cases}$$

A balanced growth consequently needs a growth rate of investments of:

$$\left(\frac{\Delta I}{I}\right)_t = \sigma\left(s + b_t\right) \qquad (12)$$

The multiplier effect being lower, a given change of investments will generate a lower growth of the overall demand. A higher growth rate of the investments will consequently be required to allow demand to grow at the same pace as supply.

The propensity of households to save and the coefficient σ are the two parameters of the model. The main variable of the model, investments, is totally endogenous. Indeed, required investments depend on the value of the two parameters and of the one of (b), which depends of the repayment of past investments. Once the values of the parameters s and σ and the initial conditions are known (K_0, R_0), it is then possible to determine the dynamics of such an economy. The initial conditions allow to indicate the volume of investments necessary to the equalization of supply and demand for the first period, which will determine the value of the repayments for the following period, and therefore the one of new investments needed to maintain a balanced growth, and so on, as shown in figure 2.

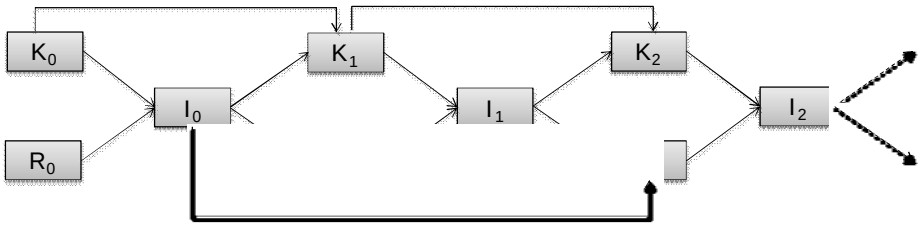

Figure 2: Relation between the successive values of the capital stock (K_0), investments (I_0), and the repayment of bank credits having financed investments (R_0)

We are trying to determine the sum of investments required to experience the same increase in both supply and demand from one period to another. To do this, we first express b_t in terms of $\left(I_t, R_t, s\right)$ in equation (3).

$$R_t = \frac{b_t}{s + b_t} I_t \Rightarrow b_t = \frac{s}{I_t / R_t - 1} \qquad (3')$$

We then solve equation (12), by replacing b_t by its expression found in (3').

$$\left(\frac{\Delta I}{I}\right)_t = \sigma\left(s + b_t\right) \Rightarrow \frac{I_t - I_{t-1}}{I_{t-1}} = \sigma\left(s + \frac{s}{I_t / R_t - 1}\right) \qquad (13)$$

This equation can be rewritten in the form of a second degree equation:

$$I_t^2 - I_t\left(I_{t-1} + R_t + \sigma s I_{t-1}\right) + I_{t-1} R_t = 0 \qquad (14)$$

This second degree equation offers two solutions, of which only one is positive:

$$I_t^{\text{required}} = \frac{(R_t + I_{t-1} + \sigma s I_{t-1}) + \sqrt{(R_t + I_{t-1} + \sigma s I_{t-1})^2 - 4 I_{t-1} R_t}}{2} \qquad (15)$$

Knowing the value of previous investments, therefore of present repayments, this equation gives us the amount of investments required to the equalization of both the global supply and demand.

Henceforth, what are left to clarify are the conditions to the repayments of credit, in order to be able to determine the evolution of investments required throughout the periods. For us, the hypothesis best to make a compromise between realism and a necessary simplification of reality consists in suggesting that every investment is equally reimbursed on the n periods that follow its issuance. In that case, the repayments of credits of one period will vary according to the investments made during the previous n periods[7].

$$R_t = \frac{1}{n} I_{t-1} + \frac{1}{n} I_{t-2} + \ldots + \frac{1}{n} I_{t-n} \qquad (16)$$

By inserting the equation (16) into the equation (15), we get a recurrent series of degree n. Investments from the period *t* rely on the value of the investments made from the period $(t-1)$ to the period $(t-n)$.

It is extremely complicated to determine analytic values for such a series. Hence our proposal to determine the evolution of investments required thanks to simulations. This will be the purpose of the next section.

5. Simulation and Dynamics

Equations (15) and (16) require simulations for the results to be implemented. We use for this a simple spreadsheet (Excel 2010). The Domar model being in discrete time, the values of variables within a period t can be determined from their values within period (t-1).

To do these simulations, we need to fix the values of the parameters as well as the initial conditions. For the parameters s and σ we choose what appears to us as reasonable values, a saving rate of 20% and a coefficient σ of 1/3 $(s = 0{,}2\,;\ \sigma = 1/3)$[8]. We suppose that the repayments of past bank credits at the beginning of the model are null ($R_0 = 0$) and consider the initial stock of capital equal to the unit ($K_0 = 1$). We then focus on the evolution of the rate of capital accumulation for different values of n, the duration of repayments of credits.

Once the evolution of required investments known, we can determine the evolution of the rate of capital accumulation required to maintain demand on a same level as supply:

$$\frac{K_{t+1}^{\text{required}} - K_t}{K_t} = \frac{K_t + I_t^{\text{required}} - K_t}{K_t} = \frac{I_t^{\text{required}}}{K_t} \qquad (17)$$

[7] We recall that, by repayment of bank credits, we only mean the repayment of the capital of these credits. Interests are excluded as they form banks revenues and therefore stay in the economic circuit.

[8] However, whatever the values chosen for these parameters, the main features of the dynamics of our model are not modified.

In figure 3, we present the results obtained over about twenty periods. Beyond, the values of variables stabilize. We offer three simulations for credits being issued for different periods, here 3, 5 and 10 periods.

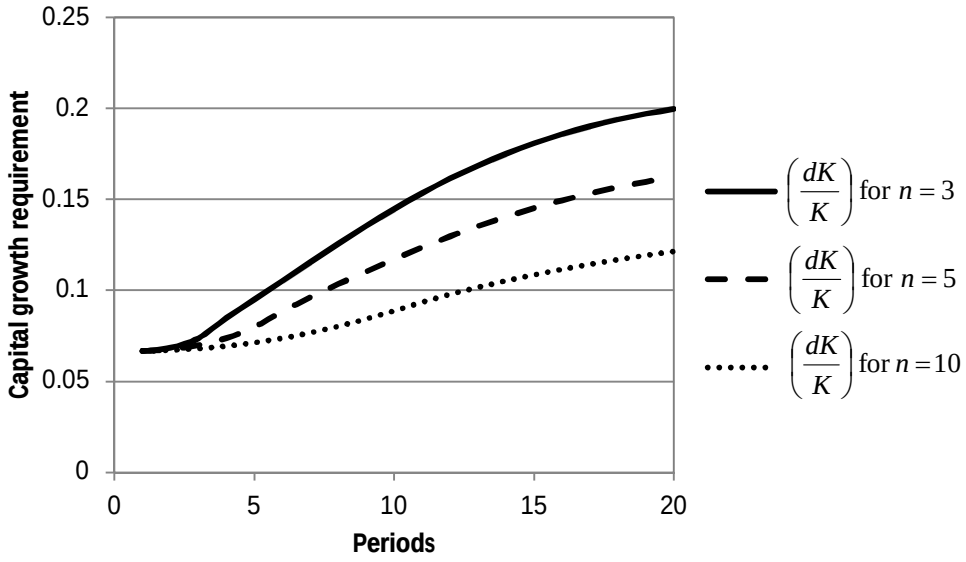

Figure 3: Evolution of the capital growth rate *required* to maintain full employment of production inputs

The main result obtained, identical to every simulation made whatever the duration of repayment and the value of parameters, is: the rate of capital accumulation has to gradually increase throughout the development of the economy, to increase supply and demand at the same pace. In other words, it has become more and more difficult in a growing economy to maintain a balanced growth. The main reason for this result is that we have taken into account the repayments of credits that have financed past investments. The more important the repayments are, the bigger is the share of firms' revenues leaving the economy in order to reimburse them, the lower is the multiplier effect, and so the increase of the overall demand, the more we will need big investments.

When Domar writes: "*investment is [...] the cause of even greater ills in the future*" (1947, p. 50), he is thinking about the increase of production capacities of the economy caused by investment. The more the present investments are important, the more the production capacities of the economy will be considerable tomorrow and the more a great demand will be needed to fully use the production factors. By taking into account the repayments of bank credits having financed investments, we add, besides this effect on supply, their depreciative effect on overall demand. To overcome these two effects, the accrual rate of investments has then to gradually rise before stabilising itself after several periods.

We notice that the shorter the duration of the issuance of credits is, the higher the growth rate required of the capital will be. This is how it can be explained: the shorter the duration of the issuance of credits is, the more the volumes to reimburse are important during the next periods and the more it is necessary for new investments to be made to counterbalance the decrease of the demand provoked by these repayments. These bigger investments will then increase future repayments, once again requiring bigger investments flows.

These results could give an explanation to the shifting from a prosperity phase to a depression one. Indeed, it will be easy to understand, considering the obtained figures, that an economy would not be able to follow the pace of the capital accumulation required, after

several periods. To take, for instance, the case when credits are reimbursed on a 3-year-period, the required rate of capital accumulation becomes exorbitant after a few periods. An economy under such conditions would not be able to keep up this pace for more than a few periods and would rapidly find itself with a rate of capital accumulation inferior to the one required. It would then see a faster increase of its capacity of production over its overall demand that would lead to a crisis of overproduction.

The main result obtained, the increase of the required growth rate of investments, can therefore explain how, after a few years time, a growing economy can face a crisis of overproduction. Now is to observe that, symmetrically, this result could give an explanation on how we pass from a phase of depression to a prosperous phase, offering a new explanation to the genesis of the economic cycles.

6. Repayment of Bank Credits and Economic Cycles

Two main results emerge from the previous parts. First, the more the volumes of repayment of credits are important, the more the volumes invested, and thus the rate of capital accumulation, will have to be significant to reach a same level of overall demand. Second, in a growing economy, the investment rate or the rate of capital accumulation required to obtain a balanced growth has to gradually rise before reaching a threshold value. This value, according to the conditions, can be very high and therefore almost unreachable, compared with what an economy can do.

If we gather these results with the idea, developed by Harrod (1939), that an excess demand with regard to supply will stimulate investments while an excess supply with regard to demand will abase them, making an unstable balance, we can obtain a succession of economic cycles.

Let's place ourselves at the very beginning of a growing phase. The rate of capital accumulation requires to obtain a balanced growth is low, as shown in the graphics above. A weak investment rate, or capital accumulation, is therefore sufficient to allow demand to rise at the same pace as supply. However, if the growing phase keeps going, the rate of capital accumulation required to obtain a balanced growth is going to rise, as shown in our results. The opportunities of investment also multiply themselves during the growing phase. The effective capital accumulation rate can therefore last for a certain time above the required rate without impairing the growing phase to stop. However, we have seen that, after some periods, the accumulation rate required of the capital could become too important regarding what an economy can do. There will therefore be a time when the effective capital accumulation rate will be below the required accumulation rate, namely a time when the growth rate of demand will become inferior to the one of supply. Firms will then have to face with excess capacities of production, which will mark the end of the prosperity phase.

These excess capacities are going to make the investment rate drop while the accrual rate required, which vary according to the repayment of the previous investments made during the growing phase, is going to maintain itself at a high level. The gap between required and effective capital accumulation rate will then increase, decreasing even more investments and heightening the extent of depression. However, after several periods, the decreasing of investments for the beginning of the depression phase will result in a decrease of the repayments, and so, of the required capital accumulation rate. This last rate will then be low and, even for a small volume of investments, the demand growth will be able to overtake the

one of supply[9]. This result will tend to stimulate investments, while the required capital accumulation rate, which depends on the repayment of investments made during the depression phase, will remain low for a few more periods. These conditions will put a start to a new growing phase that will end when the volumes of repayment, and so the rate of required capital accumulation, will reach again levels that are too high.

This reasoning is represented in the graphic below.

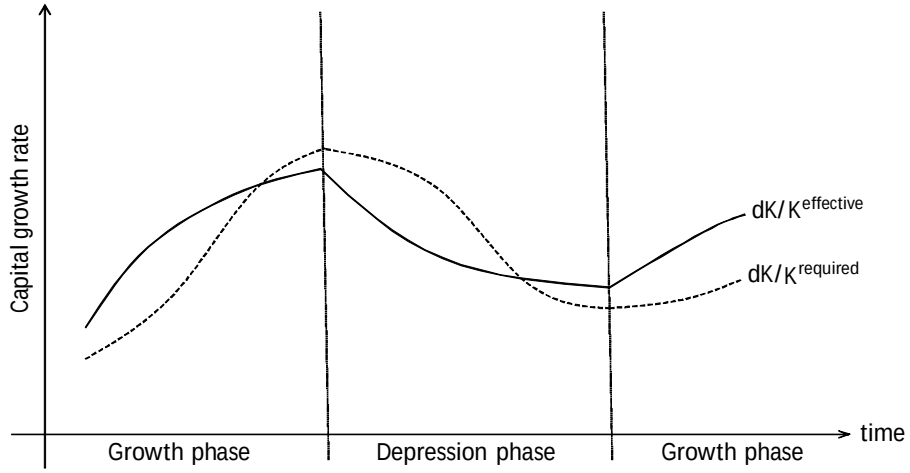

Figure 4: An explanation of economic cycles based on the difference between the required and effective rates of growth of capital

Here, we settled for a description of the chains that, on the basis of the obtained results, could explain a succession of economic cycles, without looking for a modelling from the Domar model. Such a modelling would ask to issue a certain number of arbitrary hypotheses, considering the links between growth rate and investment rate, excess capacities of production and decreasing of investments, which go beyond the framework of this article. Moreover, a situation in which the repayment of bank credits is over the issue of bank credits cannot be modelled within the Domar framework, as repayments cannot excess investment. The intuitive appeal of this result will then be the subject of a future article.

We can notice that these results seem in contradiction with some Post-Keynesian growth models, based notably on the Cambridge Equation. Indeed, these models show that the economy growth should be stable on the long-term. We think then that it could be interesting to integrate repayments of bank credits having financed investments in Post-Keynesian models later to Domar's one in order to compare the dynamics observed.

7. Conclusion

Investments play a fundamental role in Post Keynesian theories. Not only do they allow to accumulate capital, they also play a dynamic role in the evolution of overall demand or in the genesis of profits (Kalecki, 1943). However, few works have, to our knowledge, focused on the conditions of their reimbursement, when Households hold monetary savings and investments are financed by bank credits issued on several periods. Here we demonstrate that, by doing so, the conditions of growth of an economy are modified and economic cycles can arise.

[9] However, this is on condition that the depression phase has not totally destroyed the social and economic structures of the society.

At the very beginning of his famous *Expansion and Employment* article, Domar sums up Keynes's thought about the importance of savings in unemployment and the refutation of Say's law:

> *"Our comfortable belief in the efficacy of Say's Law has been badly shaken in the last fifteen years. Both events and discussions have shown that supply does not automatically create its own demand. A part of income generated by the productive process may not be returned to it; this part may be saved and hoarded."* (Domar, 1947, p.83)

To our opinion, a very similar sentence could be written about the repayment of past bank credits. A part of spending made by firms may not be returned to them because the repayment of past bank credits, interests excluded, represent a net destruction of money and a net outflow outside the monetary circuit. Say's law is not verified in the former case because households' spending is lower than revenues and in the latter because firms' spending is lower than their receipts. This idea meets some thought of Malthus (1820), Marx (1885) and Renaud (2000) about the inequality between the value of production and the revenues generated by production.

However if the explanation of crises by excess of savings leads to an abundant literature, it is the opposite situation as for the deficiency of revenues generated by the production process. What we are showing in this article is that, in addition to savings and other explanations of crisis and economic cycles (among others: Schumpeter, 1954; Fisher, 1933; Minsky, 1986; Graziani, 1990), these patterns could also find their origins in the outflow that constitutes the repayments of past bank credits. Crisis and economic cycles could therefore find their origin not only in the monetary nature of the economies, but also in the nature of money, which is a *temporary and indebtedness* one.

In addition to the implementation of stimulus policies, the solution to the problem of business cycles could then also lies in a modification of the mechanisms of money creation and destruction. This conclusion meets the point of view of Jean de Largentaye, the French translator of the *General Theory*, when he writes in his second preface of this book:

> "*The key to full employment is not to be found in monetary expansion, or in the Revenue Policy, nor in the other expedients deduced from the General Theory. As far as we are concerned, it is to be found in the abandonment of the empirical institution, unfair and inefficient, namely the credit money, and its replacement by rational money adjusted to its economic and social functions. May Keynes' work help to make this point understood*." (De Largentaye, 1968) [10]

May this article contribute to this debate.

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[10] Our translation.

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