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## **Stock-flow consistent model with repayment of bank loans used to finance past investments**

Cottin-Euziol Edouard<sup>1</sup>, Piluso Nicolas<sup>2</sup>

### **Abstract:**

Stock-flow consistent modelling (SFC) is currently one of the most active fields of research in post-Keynesian macroeconomics (Caverzasi and Godin 2014). SFC models make it possible to study the dynamics of a monetary economy of production within a consistent accounting framework (Godley and Lavoie 2007, Dos Santos and Zezza 2008). However, with some rare exceptions (Le Héron 2008), SFC models do not take into account the repayment of bank loans that finance business investments. It is assumed that these investments are financed by perpetual loans or by constant turnover. In this article, we reject this assumption and build a model based on recent work (Rochon 2009, Cottin-Euziol and Rochon 2013), in which firms repay part of their past debt in each period. We then study the dynamics of this model. The results obtained indicate that the dynamics of a SFC model is significantly affected by taking these repayments into account.

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## 1. Introduction

Stock-flow consistent models (SFC) provide a coherent accounting framework for studying the dynamics of a monetary production economy (Godley and Lavoie 2007, Dos Santos 2003). The central role played by money in these models explains why they are particularly used in the post-Keynesian literature (Caverzasi and Godin 2014). The money that circulates in these models serves as a medium for all economic transactions and has as a counterpart the issuing of loans by banks (Lavoie 2004, Zezza 2012). In many SFC models, long-term bank loans mainly finance corporate investments. Indeed, firms generally do not have sufficient resources to fully finance their investments and therefore resort to bank financing (Dos Santos and Zezza 2008, Le Heron, 2008a). In the simplest models, which do not take the State into account, the financing of investments through banks can even represent the main source of money creation (Lavoie and Godley 2001).

However, with rare exceptions (Le Héron 2008b), the repayment of bank loans used to finance investments does not appear in SFC models. It is as if the financing of investments took place through the issuing of perpetual bank loans. Firms thus continue to pay interest on the borrowed sums throughout the period covered by the model without ever explicitly showing their willingness to repay the corresponding loans. Their level of indebtedness certainly affects their investment decisions (Taylor 2004), but the volumes repaid do not appear in the model. One possible explanation for this failure to take repayments into account is that the net financing requirements tend to increase at the macroeconomic level during periods of growth. Repayments by some firms of their past bank loans are therefore offset by the contraction of larger new loans by other firms. However, this analysis does not explain the terms of repayment of the loans contracted, ignores the need for firms to respect their financial commitments, and poses problems in the event of an economic downturn, when the repayment of past bank loans exceeds the issuing of new bank loans.

**Nevertheless**, within the framework of the monetary circuit theory (Rochon 2009, Cottin-Euziol and Rochon 2013) and Domar's growth model (Cottin-Euziol 2015), various authors have shown that taking into account the repayment of bank loans that financed past investments could have a lasting effect on the dynamics of an economy. These repayments represent a cost for firms, but the repayment of the bank loan principal does not generate any income, since it leads to the disappearance of the corresponding credit line. The repayment of a bank loan principal is therefore a non-revenue-generating cost (**BARRERE**). The increase in repayment volumes by enterprises then tends to raise the production costs of enterprises without increasing the level of income in the economy. This can create a mismatch between the value at which firms wish to sell their production and the level of aggregate demand, thus affecting the dynamics of economies.

In this paper, we discuss the impact of the repayment of bank loans for financing past investments on the dynamics of a three-sector SFC model (firms, households and banks). For this purpose, we present in section 2 the different ways of integrating bank loan repayments into the stock and transaction matrices of SFC models. In section 3, based on the above approach, we construct a SFC model integrating the repayment of past bank loans, which is close to the model developed by Dafermos and Nikolaidi (2019). In section 4, we perform simulations based on this model to better understand the impact of the repayment of past bank loans on the dynamics of a SFC model. In sections 5 and 6, we refine our analysis by performing simulations for different repayment rates and by exogenously modifying the investment rate. The conclusion is presented in section 7.

## 2. Repayment of bank loans in a SFC model

We consider an SFC model with three sectors: firms, households and banks. Households consume part of their income and save the rest. Firms produce, sell their output and invest. They make profits that they share between distributed profits, which are paid directly to households, and non-distributed profits, which allow firms to self-finance part of their investments. Non-distributed profits are generally insufficient to enable firms to finance all their investments. They then finance the non-self-financed investments by means of bank loans (Crotty 1992). The model therefore describes the functioning of a pure debt economy without financial markets. The bank loans granted are then repaid in the following periods, which is the main originality of the model considered here. The banks are assumed to be perfectly accommodating and make a profit through the interest rate they charge on the loans granted. Their profits are fully redistributed to households.

We then study different ways in which firms repay their past bank loans and compare the results with the standard situation where these loans are assumed to be perpetual. Specifically, we consider four cases, which correspond to the four possibilities for firms to repay their loans. In the first case, they repay their past bank loans by simply taking out new loans. In other words, they simply *roll over their debt*. In the second case, they repay their debt out of their non-distributed profits. In other words, these repayments do not affect the amount of distributed profits. In the third case, on the contrary, these repayments are made only out of the distributed profits. In this case, the amount of non-distributed profits of the firm is unaffected by the repayments. Finally, in the fourth case, we consider that the repayment of past bank loans is made on the realized profits, before they are divided between distributed and non-distributed profits. The repayments then affect the amount of distributed and non-distributed profits, but do not affect their distribution. These four configurations and their implications on the transaction and stock matrices of an SFC model are shown below and compared to the reference model in which bank loans are assumed to be perpetual (case 1).

The different variables in the model are as follows:

- TP: total profits of firms
- C: consumption
- I: investment
- W: wages
- $i_{lt}$ : interest rate on long-term loans for financing investments
- $L_{lt}$ : long-term corporate debt
- RP: retained corporate profits
- DP: distributed corporate profits
- D: household bank deposits
- BP: bank profits
- $i_D$ : interest rate on household deposits

In case 1, we use  $\Delta L^1$  to denote the new loans contracted by firms within a given period to finance their investments and  $L^1$  for the long-term bank debt of firms.

### Case 1: the bank loans issued are perpetual

We first present the transaction and stock matrices and the accounting identities of the reference case (Tables 1a and 1b), in which the loans granted by banks to firms are assumed to be perpetual. The firms therefore do not seek to repay the loans at any time. They pay interest on the sums borrowed throughout the period covered by the model.

The accounting identities associated with this model are set out below:

- Firm current account:  $TP = C + I - W - i_{lt}L_{lt}$
- Firm capital account:  $\Delta L^1 = I - RP$
- Household account:  $\Delta D = W + DP + BP + i_D D - C$
- Bank current account:  $BP = i_{lt}L_{lt} - i_D D$
- Bank capital account:  $\Delta D = \Delta L_{lt}$
- Corporate debt:  $L^1 = L_{t-1} + \Delta L^1 = L_{t-1} + I - RP$

In the following, we compare this model with the other cases mentioned above. This allows us to study the impact of different forms of repayment of past bank loans on the dynamics of an SFC model.

### Case 2: firms repay their past debts by taking out new loans

In this configuration, firms repay part of the bank loans contracted during the period and these repayments appear as a negative in the firm's capital account and as a positive in the bank capital account (Tables 2a and 2b). These repayments are made possible by the contraction of new loans by firms. Therefore, the financial resources of these firms are not diminished. On the contrary, the repayments increase the amount of new loans contracted by firms compared to the reference case. Finally, insofar as firms take out more loans and use the loans taken out to repay their previous loans, the corporate debt at the end of the period and the stock matrix are not modified compared to the reference case.

This case can be formulated by taking  $\Delta L^2$  to measure the volume of loans contracted by firms within a period in this configuration and  $L^2$  their total indebtedness at the end of the period. The amount of loans taken out by the firm depends on the difference between their financing needs and their non-distributed profits plus the repayment of past bank loans:

$$\Delta L^2 = I - RP + R$$

The firm's indebtedness at the end of a period corresponds to its indebtedness at the end of the previous period minus the volumes repaid, to which is added the change in new loans contracted during the period. The indebtedness at the end of the period then corresponds to the corporate debt in case 1.

$$L^2 = L_{t-1} + \Delta L^2 - R = L_{t-1} + I - RP = L^1$$

There is therefore no difference between the results obtained with this model and the reference model. A consistent stock-flow model in which the repayment of past bank credits is not taken into account can therefore be seen either as a model in which the issued loans are perpetual, or as a model where these loans are repaid only through the issuing of new loans.

### Case 3: Credits are repaid from retained earnings

We now consider the case where firms are repaying past bank loans out of their non-distributed profits. In this case, firms continue to distribute just as much profit to their owners, preferring to repay past bank loans out of their retained earnings.

This changes the transaction matrix. Profits now have three uses: they are distributed, retained or used to repay past bank loans. Compared to the reference case, the firm capital account is decreased by the amount of repayments on the line relating to firm profits, and the bank capital account is symmetrically increased by the same amount (Tables 3a and 3b).

The stock matrix remains unchanged, as defined previously. In fact, if firms devote part of their non-distributed profits to the repayment of their past bank loans, this mechanically reduces the share of profits they will be able to devote to self-financing their investments. Therefore, assuming that the amounts invested remain the same, the decrease in retained earnings available for self-financing investments will lead firms to take out additional bank loans for an amount equivalent to the volumes repaid.

In this case,  $\Delta L^3$  is used to measure the volume of loans contracted by firms within a period and  $L^2$  their total corporate debt at the end of the period. The amount of credit taken out by firms depends on the difference between their financing needs and their retained earnings minus the repayment of past bank loans:

$$\Delta L^3 = I - (RP - R) = I - RP + R$$

The corporate debt at the end of a period is not modified since the amounts repaid are offset by the issuing of new loans for the same amount:

$$L^3 = L_{t-1} + \Delta L^3 - R = L_{t-1} + I - RP = L^1$$

We are therefore dealing with a case similar to the two previous ones. It is equivalent to considering that firms finance their investments by taking out perpetual loans, making their repayments out of new bank loans or out of their non-distributed profits.

#### Case 4: Credits are repaid from distributed profits

In this case, we make a hypothesis opposite to the situation discussed in the previous case. We assume that firms repay past bank loans from their distributed profits and not from their non-distributed profits. From this point of view, firms do not wish to see their financing capacities decrease as a result of taking into account the repayment of past bank loans. They therefore make these repayments by reducing their distributed profits accordingly.

At the level of the transaction matrix, the part of firm profits distributed to households therefore decreases by the same amount as the volumes repaid, while the part paid into bank capital increases symmetrically (tables 4a and 4b). Insofar as the amount of undistributed profits is not impacted here by repayments, the new loans taken out by enterprises will be identical to those in the reference case. They will correspond to the difference between the amounts invested and the retained profits.

Consequently, if the new loans contracted are not modified, but part of the old loans are repaid, taking the repayments into account will lead to a decrease in the volume of money and the corporate debt compared to the reference case. We can formulate this case at the level of the transaction and stock matrices, by taking  $\Delta L^4$  as the volume of loans contracted by firms:

$$\Delta L^4 = I - RP = \Delta L^1$$

It is then possible to determine the level of corporate debt at the end of the period:

$$L^4 = L_{t-1} + \Delta L^4 - R = L_{t-1} + \Delta L^1 - R = L^1 - R$$

The corporate debt is reduced by the amount of the repayments. Firms are therefore less indebted than in the previous cases. The dynamics of the model are thus modified. Indeed, since firms now devote part of their profits to the repayment of past bank loans, they distribute less of their profits to households, which will affect the level of aggregate demand. This decrease in the level of aggregate demand will in turn most certainly have a negative effect on the overall dynamics of the model.

In this case, we therefore find a relatively intuitive result, i.e. by reducing their overall indebtedness through the repayment of bank loans contracted in the past, firms will also negatively impact the level of aggregate demand. This result differs greatly from that obtained in the previous cases.

#### Case 5: Loans are repaid out of profits made

In the latter case, bank loans taken out by firms are repaid before the profits are divided between distributed and non-distributed profits. Consequently, taking the repayment of past bank loans into account will affect both the amount of distributed and non-distributed profits. This case appears as intermediate between the two previous cases.

We assume that firms devote a part  $s_f$  of their profits to self-financing their investments and distribute the other part  $(1 - s_f)$ . After taking into account the repayment of past bank loans, the proportion of non-distributed profits of the firm will therefore decrease by an amount  $s_f R$  while the distributed profits will decrease by an amount  $(1 - s_f)R$ . For a given level of investment, the decrease in retained earnings will encourage firms to make greater use of bank loans to finance their investments. The decrease in distributed profits will in turn tend to reduce household incomes (Tables 5a and 5b).

For a given investment rate, we can determine the impact of the repayment of past bank loans on the volume of new loans taken out and on the overall corporate debt, and then compare the results with the reference case. New loans taken out depend on the difference between investment and retained earnings:

$$\Delta L^5 = I - (RP - s_f R) = \Delta L^1 + s_f R$$

The corporate debt at the end of the period will therefore depend on the share of profits that firms devote to self-financing their investments:

$$L^5 = L_{t-1} + \Delta L^5 - R = L_{t-1} + \Delta L^1 + s_f R - R = L^1 - (1 - s_f)R$$

Also in this case, including the repayment of past bank loans is likely to have a lasting impact on the dynamics of the model. Indeed, the decrease in distributed profits will lead to a decrease in income and therefore in household consumption, which in turn will impact the investment decisions of firms.

Integrating the repayment of bank loans that financed past investments into the transaction and stock matrices of SFC models may allow a better understanding of the impact of these repayments on the dynamics of the models. We study this impact in more detail in the following section, by integrating these results into a model similar to that developed by Dafermos and Nikolaidi (2019).

### **3. A simple SFC model with repayment of past bank loans**

In this section, we build an SFC model that explicitly includes the repayment of bank loans used to finance past investments and compare its dynamics to an SFC model in which bank loans are perpetual. For this, we consider an SFC model similar to the one developed by Dafermos and Nikolaidi (2019). We choose this model because of its simplicity, which allows us to clearly isolate the impact of past bank loan repayments on the dynamics of the model. Among the cases studied previously, we consider the one that seems the most realistic, namely the one in which firms repay their bank debt on their profits before sharing them between distributed and non-distributed profits.

This model comprises three sectors: firms, households and banks.

Household wages ( $W$ ) are assumed to represent a fixed proportion ( $s_w$ ) of the revenues of firms ( $Y$ ). Household financial income ( $Y_c$ ) is made up of the profits distributed by firms ( $DP$ ) and the banking sector ( $BP$ ) as well as the interest they receive on deposits from previous periods ( $i_D D_{-1}$ ). Household consumption within a period depends on wages and salaries and financial income received in the previous period as well as the amount of their bank deposits. Specifically, households consume within each period a fixed proportion of their wages ( $c_1$ ), financial income ( $c_2$ ) and deposits ( $c_3$ ) from the previous period. The change in household deposits within a given period ( $\Delta D$ ) corresponds to the difference between the income received by households during the period and their consumption.

### Households:

$$\text{Wages: } W = s_w Y \quad (1)$$

$$\text{Household income: } Y_c = DP + BP + i_D D_{-1} \quad (2)$$

$$\text{Consumption: } C = c_1 W_{-1} + c_2 Y_{c-1} + c_3 D_{-1} \quad (3)$$

$$\text{Deposits: } \Delta D = W + Y_c - C \quad (4)$$

The output of firms ( $Y$ ) depends on the level of consumption ( $C$ ) and investment ( $I$ ). Their productive capacity ( $Y^*$ ) is nevertheless limited by the amount of capital they possess ( $K$ ) and the capital productivity ( $v$ ), which is assumed to be fixed. The corporate profits ( $P^e$ ) correspond to the difference between, on the one hand, their revenues ( $Y$ ) and, on the other hand, the wages paid ( $W$ ), the interest paid on their debt ( $i_L L_{-1}$ ) and the amount of their debt repaid within each period ( $R$ ). If these repayments are zero, we find an SFC model in which the bank credits financing the investments are not repaid. Firms then retain part ( $s_f$ ) of their profits ( $RP^e$ ) to self-finance future production expenditures and distribute the remaining profits ( $DP^e$ ) to households. Business investment ( $I$ ) is assumed to represent a fixed share ( $g_k$ ) of the capital held by enterprises ( $K$ ). The change in corporate debt ( $\Delta L$ ) is the difference between their financing needs - non-self-financed investments ( $I - s_f RP^e$ ) - and past loans repaid within the period ( $\omega L_{lt}$ ).

### Firms:

$$\text{Output: } Y = C + I \quad (5)$$

$$\text{Productive capacity: } Y^* = vK \quad (6)$$

$$\text{Corporate profits: } P^e = Y - W - i_L L_{-1} - R \quad (7)$$

$$\text{Non-distributed profits: } RP^e = s_f P^e \quad (8)$$

$$\text{Distributed profits: } DP^e = P^e - RP^e \quad (9)$$

$$\text{Investments: } I = g_k K_{-1} \quad (10)$$

$$\text{Capital: } K = K_{-1} + I \quad (11)$$

$$\text{Bank loans: } \Delta L = I - RP^e - \omega L \quad (12)$$

Banks play a purely passive role in this model. They are perfectly accommodating and grant the requested loans ( $L$ ) to firms at a fixed rate ( $i_L$ ). The banks' profit ( $P^b$ ) is the difference between the interest received on the loans granted and the interest paid on deposits. We therefore assume that their



cost of production is zero. Finally, the stock-flow consistent nature of the model implies that the amount of household deposits with banks corresponds to the volume of loans granted by banks to households ( $L$ ).

**Banks:**

$$\text{Bank profits: } P^b = i_L L_{-1} - i_D D \quad (13)$$

$$\text{Deposits (redundant identity): } D = L \quad (14)$$

It is now necessary to specify the repayment conditions of past bank loans. Here we consider two modes of repayment. In the first case, we assume that the principal of each loan is repaid in equal parts over the  $n$  years following its issue. We also assume, for sake of simplicity, that the bank loans all have the same issue term. In this case, the volumes repaid within a period depend on the bank loans granted in the previous  $n$  periods:

$$R_t = \frac{1}{n} \Delta L_{t-1} + \frac{1}{n} \Delta L_{t-2} + \dots + \frac{1}{n} \Delta L_{t-n} \quad (15)$$

In addition to repayment of the bank loan principal, firms also pay interest to the banks on all loans taken out and not yet repaid.

The second assumption relating to the repayment of past bank loans is that these repayments represent within each period a given share ( $\rho$ ) of the corporate debt, based on the hypothesis proposed by Rochon (2009). In this case, the repayment of the principal of bank loans contracted by firms within a given period  $t$  is:

$$R_t = \rho L_t \quad (16)$$

In addition to these expenses, interest is paid on amounts borrowed and not yet repaid.

To study the impact of bank loan repayments on the dynamics of an SFC model, we carry out simulations based on the model described above and consider the two repayment modes mentioned.

**4. Effects of past bank loan repayments on the dynamics of an SFC model**

To study the impact of past bank loan repayments on the dynamics of an SFC model, we first perform a simulation of the previous model by assuming that bank loans are perpetual. Once the model is stabilized, we consider that all newly issued loans will have to be repaid, according to the two modalities mentioned above.

We set plausible values for the parameters and the initial values of the variables. The parameter values, close to those obtained by Dafermos and Nikolaidi (2019), are as follows:

$$\left\{ \begin{array}{l} s_w = 0.7 \\ c_1 = 0.9 \\ c_2 = 0.75 \\ c_3 = 0.1 \\ g_k = 0.05 \\ i_D = 0.01 \\ i_L = 0.03 \\ s_f = 0.5 \\ v = 1/3 \end{array} \right.$$

The initial values of the variables are set to be in agreement with the parameter values. The values for the variables are given below:

$$\left\{ \begin{array}{l} Y_0 = 100 \\ W_0 = 70 \\ TP_0 = 30 \\ DP_0 = 15 \\ RP_0 = 15 \\ BP_0 = 0 \\ Y_{c,0} = 30 \\ D_0 = 30 \\ C_0 = 70 \\ K_0 = 300 \\ I_0 = 0 \end{array} \right.$$

Three models are defined as follows:

- *Model 1*: the repayment of past bank loans does not appear.
- *Model 2*: firms repay a constant part of their debt within each period.
- *Model 3*: these repayments are made by constant amortization.

We run model 1 until period 100, at which point all the variables in the model grow at a constant rate. Beyond this period, we consider that new loans taken out by firms are repaid according to the conditions mentioned above (models 2 and 3). In model 2, we assume that firms repay 10% of their debt within each period, while in model 3 the loans are repaid by constant amortization over 10 years.

The results of the simulations are presented in Figures 1 to 6.

It can be seen that, whatever the mode of repayment considered, taking the repayment of past bank loans into account leads to a transitory decrease in the growth rate of the economy in the model (Figure 1). This decrease can be explained by the decrease in demand induced by the repayment of bank debts by firms. The repayment of the principal of past bank loans represents here a leakage out of the economic circuit, since it leads to the destruction of the corresponding credit line. The sums repaid thus represent amounts that could not be distributed to increase income and consumption. It can be seen that the impact of repayments on growth is stronger when these repayments are made by constant amortization. These repayments are in fact added to each other over the duration of their issue, which explains the phenomenon observed. Beyond the 10<sup>th</sup> period, the first loans begin to be repaid in full and the volumes repaid are then close to those obtained when firms are supposed to repay a constant proportion of their debt within each period. Finally, the growth rate of the economy returns to the level it had before the repayments were taken into account. This last result is mainly explained by assuming that investments represent a fixed share of existing capital. We will test this assumption in a future study.

The inclusion of repayments affects the net profit rates of corporate repayments (Figure 2). These profit rates decrease because firms now have to spend part of their profits on repaying bank loans that financed their past investments. This additional expenditure, which is not accompanied by additional revenue since the corresponding sums are destroyed, therefore mechanically reduces the net profits of the firms. The decrease in profits is slightly higher when the credits are repaid by constant amortization, corroborating the results obtained previously concerning the impact of this mode of

repayment on the growth rate. The decrease in corporate profits is, however, partially offset by the decrease in corporate debt (figure 3), which reduces the interest charges that firms pay to banks. The decrease in corporate debt is the consequence of the gradual repayment of loans taken out, whereas previously these loans were assumed to be perpetual. The reduction in corporate debt automatically leads to a reduction in the interest paid to banks, and therefore in their revenues and profits. The share of bank profits in the economy therefore decreases after taking into account the repayment of past bank loans (Figure 4). Repayments gradually rise in relation to the level of production (Figure 5) and the profits made by firms (Figure 6) until they reach a threshold. In each case, the effect is slightly stronger when the bank loans financing the investments are repaid by constant amortization. In our model, non-self-financed investments are the only requirement for financing long-term bank loans; once repayments reach their threshold value, they make up 9% of the value of production and more than 30% of the profits made.

So far, we have considered a fixed rate at which firms repay their debt (10% of the debt in model 2 and repayment by constant amortization over 10 years in model 3). In the next section, we vary this rate to better understand the impact of repayments on the dynamics of the model.

## **5. Modification of repayment rates and terms of repayment**

In this section, we look at the impact of a change in the repayment rate on the dynamics of the model. In Model 2, we set this rate at 10%, i.e. we assume that firms repay 10% of their bank debt within each period. Here, we modify this rate upwards to fix it in a first case with  $\rho=0.05$  and in a second case with  $\rho=0.2$ . We present the results obtained in Figures 7 to 12.

We can see that the higher the repayment rate, the more the growth rate of the economy is affected by the inclusion of repayments (Figure 7). Indeed, a higher repayment rate means that firms have to spend a larger share of their profits on repaying past bank loans. This means that they have to reduce distributed profits, which affects the level of aggregate demand. The profit rate of firms net of the repayment of past bank loans is also strongly affected by the rate of repayment of corporate debt. The higher the repayment rate, the lower the net profit rate (Figure 8). The counterpart is that the corporate debt rate decreases when repayment rates increase. The faster firms repay their debt, the less indebted they become (Figure 9).

For banks, profits decrease when firms repay their bank loans faster (Figure 10). The decrease in the bank debt of firms due to the increase in their repayment rate reduces the interest paid by firms to the banks. Therefore, the higher the loan repayments, the lower the corporate debt and the lower the bank profits. However, this lower debt still accounts for a larger share of the wealth created in the economy (Figure 11) and corporate profits (Figure 12). In other words, the greater the debt repayment efforts, the more debt decreases in nominal terms, but the greater the share of debt repayment in relation to wealth creation and corporate profits.

We conducted a similar study on Model 3, shortening and lengthening the duration terms of bank loans<sup>3</sup>. The results are identical to those obtained with the previous model. The shorter the repayment period of bank loans, the more negative the effect on the growth rate of the economy and the repayment rates increase relative to the profit of the firms and the volume of wealth produced. The profit rate of banks also decreases. And the converse applies with an increase in the duration of bank loans.

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<sup>3</sup> We can provide results and graphs on request.

So far, we have studied the impact of the repayment of past bank loans on the dynamics of the model for a constant investment rate. We now explore the behaviour of the main variables of the model when the investment rate is modified exogenously.

## **6. Exogenous modification of the investment rate**

A sudden decrease in the rate of investment in an economy should have a negative effect on growth rate, therefore increasing the burden of past debt. In this section, we quantify this impact using simulations. For this purpose, we compare the dynamics of model 1 with models 2 and 3 when the investment rate decreases. In previous sections, investments are assumed to represent the equivalent of 5% of the capital stock of the economy. After stabilization of the growth rate for all three models, we assume that the economy undergoes an exogenous shock on investments, which fall to only 4% or 3% of the existing capital stock. The results obtained for the growth rates of these models are presented in Figures 13 and 14.

We can see that this shock on the level of investment has a much greater impact on the growth rate of the economy when the model includes the repayment of past bank loans. For an investment rate increasing within each period from 5% to 4%, the growth rate per period decreases to about 1.2% in model 1, while it decreases to 0.3% in model 2 and then becomes negative, falling to -0.2% in model 3. The difference in growth rates between Model 1 and Models 2 and 3 increases if the investment rate falls even further. In Figure 14, we present the results obtained for investments decreasing from 5% to 3% of the existing capital stock. In this case, while a fall in the investment rate causes a contraction of activity slightly above 2% in model 1, it exceeds 4% in model 2 and reaches almost 6% in model 3.

These differences can be explained by the fact that the decrease in the growth rate of the economy following a decrease in investment will reinforce the burden of past debts and therefore their repayment. This effect is illustrated in Figure 15, which shows the evolution in percentage points of repayment volumes in relation to the profits made by firms after the investment rate decreases to 3%. We can see that, as a result of the decrease in investment rates, there is an increasing share of corporate profits that must be dedicated to the repayment of past bank loans. This phenomenon can be explained by a combination of two factors. On the one hand, corporate profit grows at a slower pace as a result of the decrease in investment. On the other hand, repayments continue to remain at significant levels since they are inherited from past periods when investments were higher. As firms have to dedicate more resources to these repayments, they have less profit to distribute and spend on future investments. The result is a much steeper fall in growth rates when the repayment of past bank loans is taken into account.

## **7. Conclusion**

In this study, we show that the repayment of past bank loans can play an important role in the dynamics of an SFC model. The growth rate of the economy, the rate of corporate debt, or the profit rates of firms and banks are durably affected by taking into account the repayment of bank loans that have financed past investments. These repayments change the dynamics of the economy because they represent a cost for firms that - apart from interest payments - does not generate income, since they result in the destruction of the corresponding credit line. This impact of repayments is accentuated when economic activity slows down or decreases. The burden of past debts is then reinforced, which can aggravate the depression, even if the overall debt of the economy decreases. This mechanism that we find in our model is reminiscent of the debt-deflation mechanism highlighted by Fisher (1933).

On the basis of the model developed here, much further research can be envisaged. First of all, it would be necessary to endogenize the rate of investment. A slowdown in activity, caused by the repayment of past bank loans, should have a negative effect on this rate. The investment rate should also depend on the level of corporate debt, increasing when there is decreasing corporate debt. The repayment of past bank loans would then have an ambiguous effect on the investment rate, since these repayments would influence the level of overall demand as well as reduce the level of corporate debt. Empirical studies could be aimed at determining the share of past bank loan repayments in corporate profits. Such an approach would also allow us to have a more precise view of this process, which has been relatively little studied so far. Ultimately, this type of study could lead to the consideration of new monetary policy instruments to mitigate the impact of past bank loan repayments in times of economic crisis, for example by facilitating the extension of bank loan maturities.

Meanwhile, the first results obtained here suggest that SFC models should explicitly incorporate the repayment of bank loans used for financing past investments.

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Table 1a: Transaction-flow matrix of case 1

	Firms		Households	Banks		$\Sigma$
	Current	Capital		Current	Capital	
Consumption	+C		-C			0
Investment	+I	-I				0
Wages	-W		+W			0
Interest on loans	$-i_{lt} * L_{lt}$			$+i_{lt} * L_{lt}$		0
Interest on deposits			$+i_d * D^h$	$-i_d * D^h$		0
Firms' profits	-P <sup>e</sup>	+RP <sup>e</sup>	+DP <sup>e</sup>			0
Banks' profits			+P <sup>b</sup>	-P <sup>b</sup>		0
Change in loans		$+\Delta L_{lt}$			$-\Delta L_{lt}$	0
Change in deposits			$-\Delta D^h$		$+\Delta D$	0
$\Sigma$	0	0	0	0	0	0

Table 1b: Balance sheet of case 1

	Firms	Households	Banks	$\Sigma$
Capital	+K			+K
Loans	$-L_{lt}$		$+L_{lt}$	0
Deposits		$+D^h$	-D	0
Total (net worth)	+V <sup>e</sup>	$+D^h$	0	+K

Table 2a: Transaction-flow matrix of case 2

	Firms		Households	Banks		$\Sigma$
	Current	Capital		Current	Capital	
Consumption	+C		-C			0
Investment	+I	-I				0
Wages	-W		+W			0
Interest on loans	$-i_{lt} * L_{lt}$			$+i_{lt} * L_{lt}$		0
Interest on deposits			$+i_d * D^h$	$-i_d * D^h$		0
Firms' profits	-P <sup>e</sup>	+RP <sup>e</sup>	+DP <sup>e</sup>			0
Banks' profits			+P <sup>b</sup>	-P <sup>b</sup>		0
Change in loans		$+\Delta L_{lt} - R$			$-\Delta L_{lt} + R$	0
Change in deposits			$-\Delta D^h$		$+\Delta D$	0
$\Sigma$	0	0	0	0	0	0

Table 2b: Balance sheet of case 2

	Firms	Households	Banks	$\Sigma$
Capital	+K			+K
Loans	$-L_{lt}$		$+L_{lt}$	0
Deposits		$+D^h$	-D	0
Total (net worth)	+V <sup>c</sup>	$+D^h$	0	+K



Table 3a: Transaction-flow matrix of case 3

	Firms		Households	Banks		$\Sigma$
	Current	Capital		Current	Capital	
Consumption	+C		-C			0
Investment	+I	-I				0
Wages	-W		+W			0
Interest on loans	$-i_{lt} * L_{lt}$			$+i_{lt} * L_{lt}$		0
Interest on deposits			$+i_d * D^h$	$-i_d * D^h$		0
Firms' profits	-P <sup>e</sup>	+RP <sup>e</sup> - <b>R</b>	+DP <sup>e</sup>		<b>+R</b>	0
Banks' profits			+P <sup>b</sup>	-P <sup>b</sup>		0
Change in loans		$+\Delta L_{lt}$			$-\Delta L_{lt}$	0
Change in deposits			$-\Delta D^h$		$+\Delta D$	0
$\Sigma$	0	0	0	0	0	0

Table 3b: Balance sheet of case 3

	Firms	Households	Banks	$\Sigma$
Capital	+K			+K
Loans	$-L_{lt}$		$+L_{lt}$	0
Deposits		$+D^h$	-D	0
Total (net worth)	+V <sup>c</sup>	$+D^h$	0	+K

Table 4a: Transaction-flow matrix of case 4

	Firms		Households	Banks		$\Sigma$
	Current	Capital		Current	Capital	
Consumption	+C		-C			0
Investment	+I	-I				0
Wages	-W		+W			0
Interest on loans	$-i_{lt} * L_{lt}$			$+i_{lt} * L_{lt}$		0
Interest on deposits			$+i_d * D^h$	$-i_d * D^h$		0
Firms' profits	$-P^e$	$+RP^e$	$+DP^e - R$		$+R$	0
Banks' profits			$+P^b$	$-P^b$		0
Change in loans		$+\Delta L_{lt}$			$-\Delta L_{lt}$	0
Change in deposits			$-\Delta D^h$		$+\Delta D$	0
$\Sigma$	0	0	0	0	0	0

Table 4b: Balance sheet of case 4

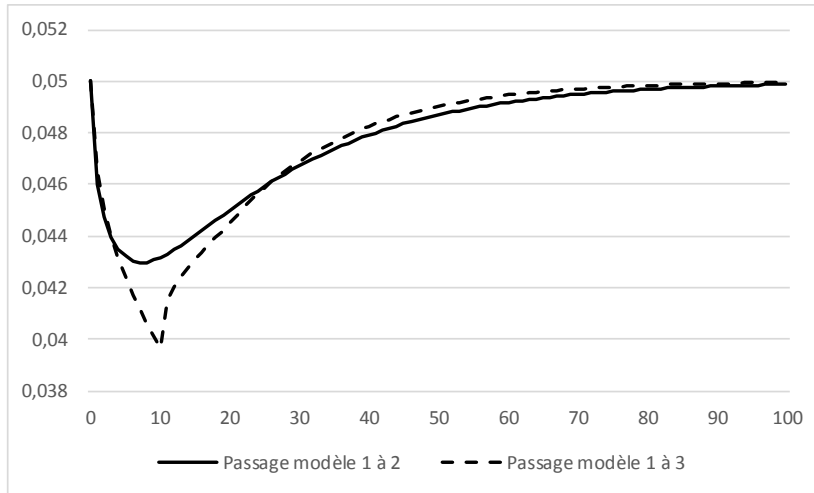
	Firms	Households	Banks	$\Sigma$
Capital	+K			+K
Loans	$-L^l + R$		$+L^l - R$	0
Deposits		$+D^h$	-D	0
Total (net worth)	$+V^e$	$+D^h$	0	+K

Table 5a: Transaction-flow matrix of case 5

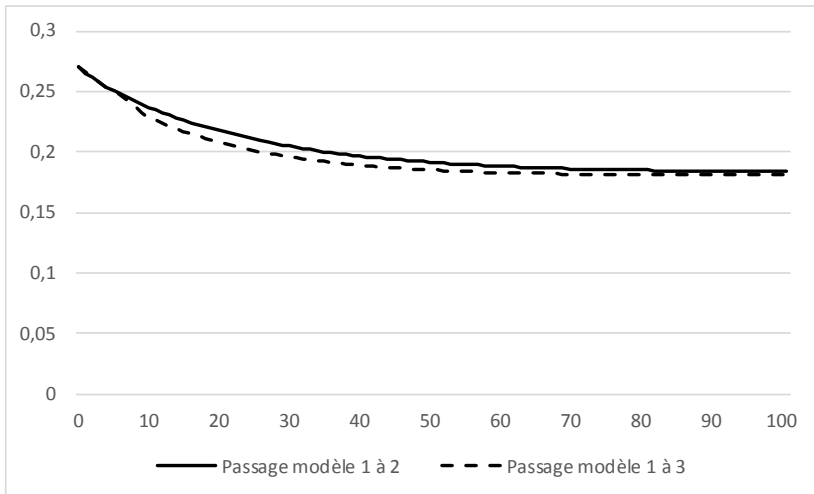
	Firms		Households	Banks		$\Sigma$
	Current	Capital		Current	Capital	
Consumption	+C		-C			0
Investment	+I	-I				0
Wages	-W		+W			0
Interest on loans	$-i_{lt} * L_{lt}$			$+i_{lt} * L_{lt}$		0
Interest on deposits			$+i_d * D^h$	$-i_d * D^h$		0
Firms' profits	$-P^c$	$+RP^c - s_f R$	$+DP^c - (1-s_f)R$		<b>+ R</b>	0
Banks' profits			$+P^b$	$-P^b$		0
Change in loans		$+\Delta L_{lt}$			$-\Delta L_{lt}$	0
Change in deposits			$-\Delta D^h$		$+\Delta D$	0
$\Sigma$	0	0	0	0	0	0

Table 5b: Balance sheet of case 5

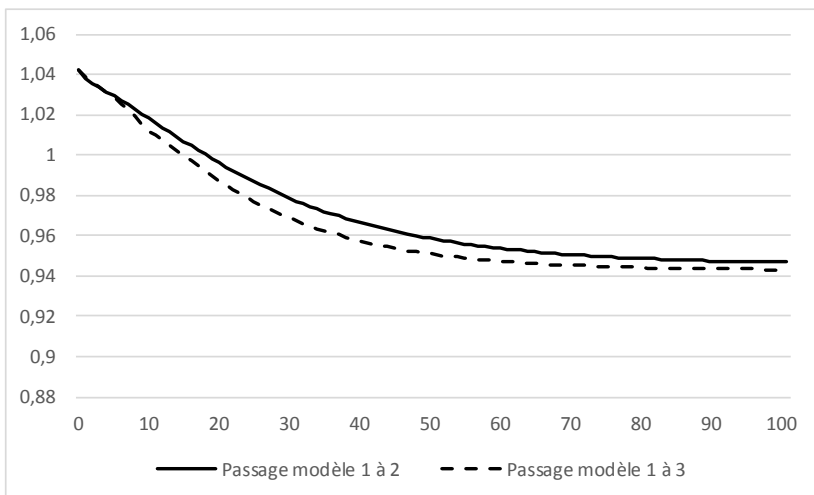
	Firms	Households	Banks	$\Sigma$
Capital	+K			+K
Loans	$-L^1 + (1-s_f)R$		$L^1 - (1-s_f)R$	0
Deposits		$+D^h$	-D	0
Total (net worth)	$+V^c$	$+D^h$	0	+K



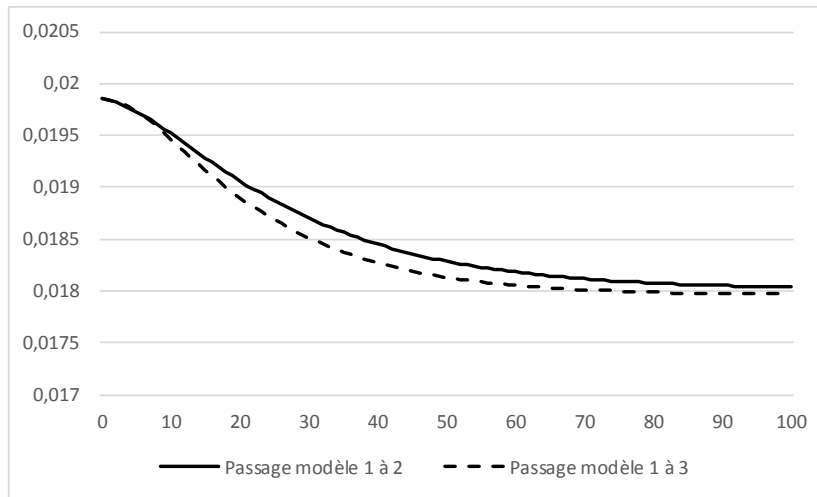
**Figure 1:** Growth rate of the economy ( $dY/Y$ ) in models 2 and 3



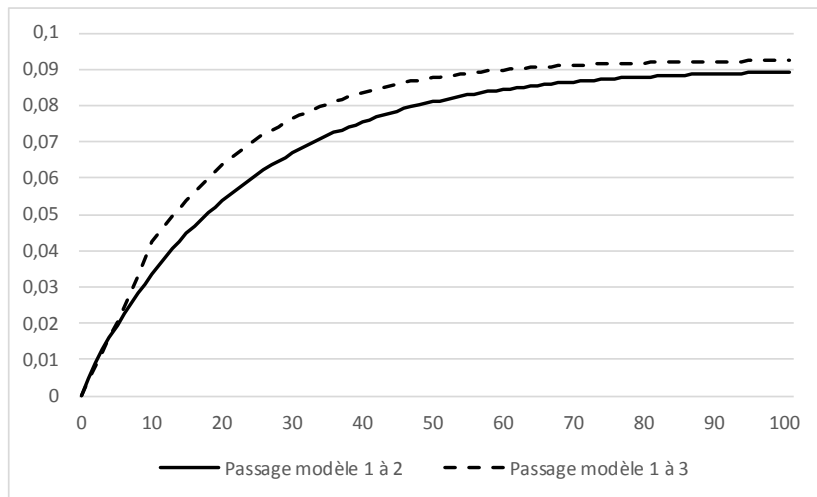
**Figure 2:** Profit rates net of corporate repayments in models 2 and 3



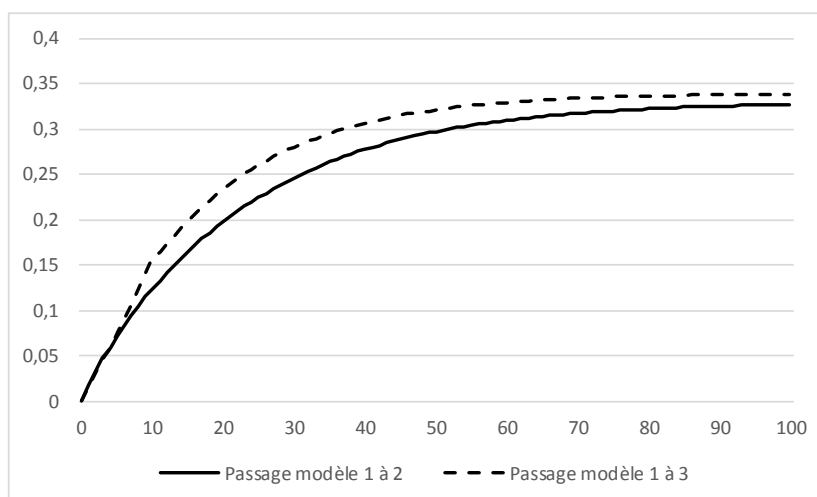
**Figure 3:** Corporate debt of firms in models 2 and 3



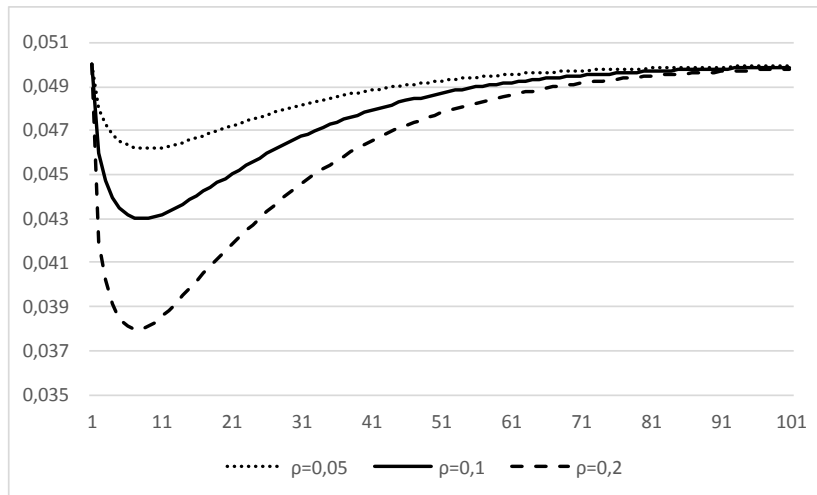
**Figure 4:** Share of bank's profits in models 2 and 3



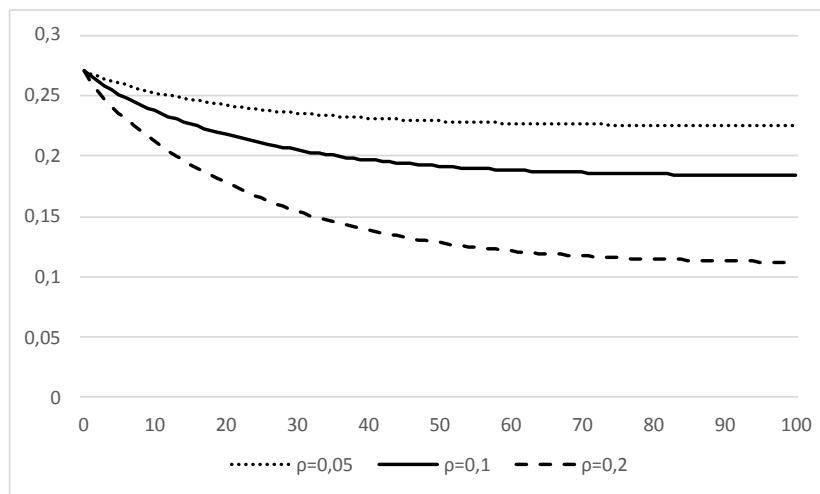
**Figure 5:** Repayments in relation to the level of production in models 2 and 3



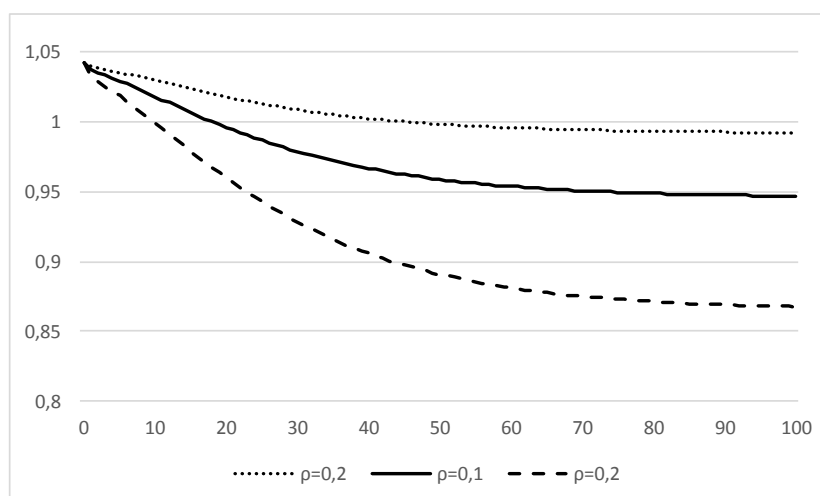
**Figure 6:** Repayments in relation to the level of firms' profits in models 2 and 3



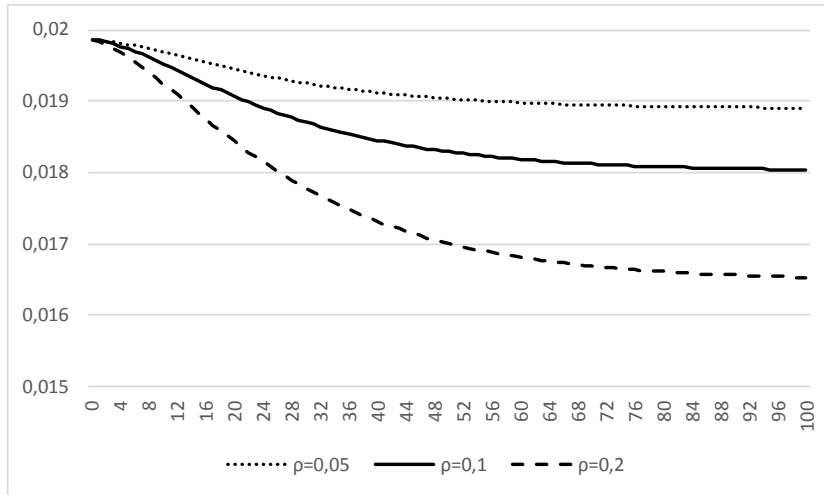
**Figure 7:** Growth rate of the economy for three different repayment rates in model 2



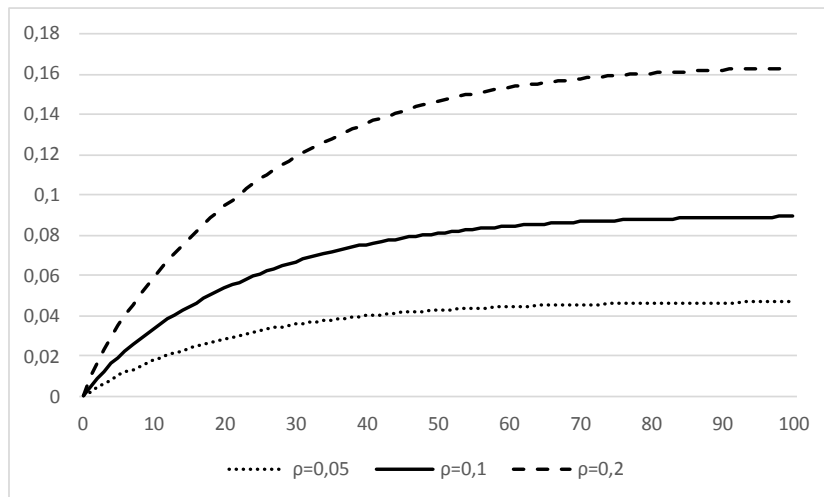
**Figure 8:** Firms' profit net of the repayment of past bank loans for three different repayment rates in model 2



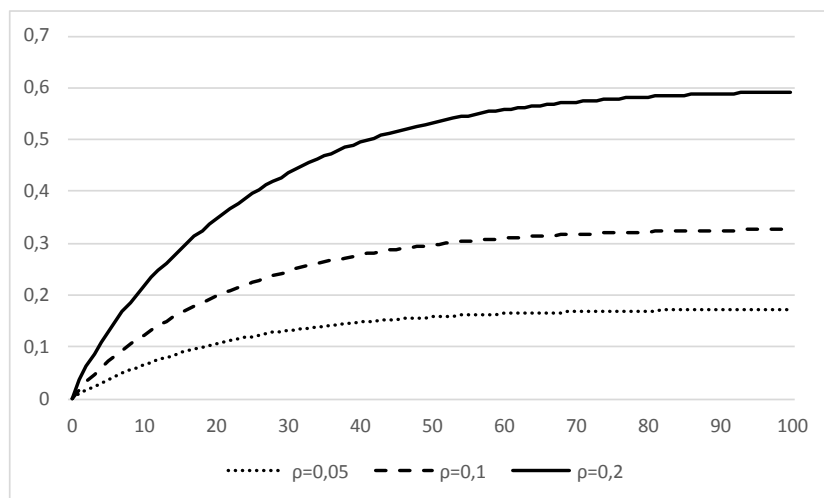
**Figure 9:** Corporate debt for three different repayment rates in model 2



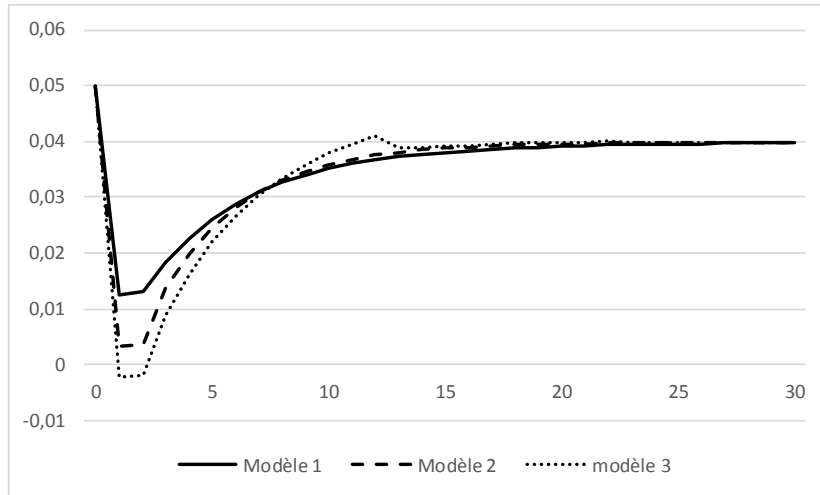
**Figure 10:** Share of bank's profits for three different repayment rates in model 2



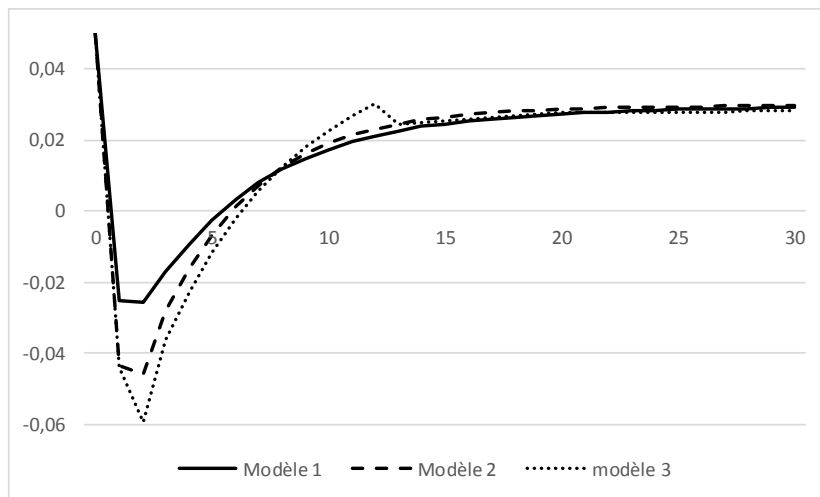
**Figure 11:** Repayment in relation to the level of production for three different repayment rates in model 2



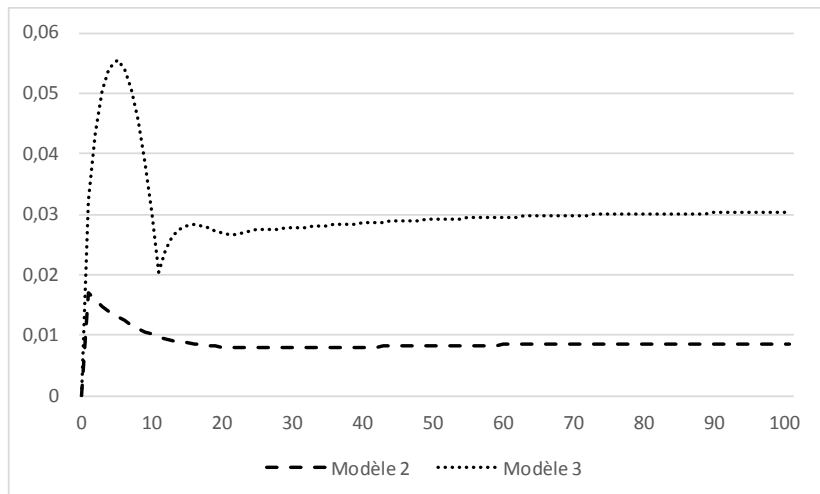
**Figure 12:** Repayment in relation to the level of firms' profit for three different repayment rates in model 2



**Figure 13:** Growth rate of the economy after a shock on the level of investment (which falls to 4% of the existing capital stock) in models 1, 2 and 3



**Figure 14:** Growth rate of the economy after a shock on the level of investment (which falls to 3% of the existing capital stock) in models 1, 2 and 3



**Figure 15:** Evolution in percentage points of repayment volumes in relation to the profits made by firms after the investment rate falls to 3%