A Minskyan-Fisherian SFC model for analyzing the linkages of private financial behavior and public debt

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ABSTRACT

This paper builds a stock-flow consistent (SFC) model to analyze how private financial behavior impacts fiscal variables, by exploring the linkages between the financial and productive sides of the economy with prices given by a Phillips curve. We study three different fiscal expenditure regimes: 1. Automatic stabilizer: government expenditures follow an exogenous long run trend; 2. Countercyclical fiscal expenditure; 3. Fiscal austerity: government reduces expenditures when it faces an increase in its debt to capital ratio. The model has three major implications, ratifying Keynesian intuitions. First, an increase in public debt is an unintended consequence of contractionary financial conditions. Second, in most cases countercyclical fiscal expenditures improve both the economic activity and the trajectory of public debt to GDP. Third, austerity policies postpone and magnify the after-shock adjustment, and may not be compatible with fiscal soundness.

KEYWORDS: Fiscal Policy; Stock-Flow Consistent Model; Countercyclical Fiscal Policy; Austerity; Debt-Deflation; Deleveraging.

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1 Introduction

A well-known stylized fact of major financial crises is the rapid increase of public debt and a sharp reduction in private debt (Reinhart and Rogoff 2010). Is the increase in public debt the result of a lenient government fiscal behavior? How financial crisis and fiscal deterioration are connected? Is the increase in the debt/GDP ratio somehow avoidable by a specific fiscal regime (e.g., austerity)? What are the best alternatives in terms of the economic activity recovery and public debt sustainability itself?

To address these questions, we develop a stock-flow consistent (SFC) model building on the linkages between the financial and productive sides of the economy. We explicitly model firms' debt, which influence banks' supply of credit – and consequently the effective demand – making our economy compatible with Minsky's theory. With prices given by a traditional Phillips curve, we assess the role of inflation in exacerbating cycles downswing by increasing the real value of liabilities, consistent with Fisher (1933) theory.

Within this framework, the paper has two main goals: 1) to examine the relationship between private financial behavior and public debt. Even though several authors are concerned with the mutual interactions between private demand and fiscal deficit, such as Lerner, Steindl, and Godley, there is still room to improve the comprehension of how public debt is dynamically affected when it affects (and is affected by) private demand. We therefore try to clarify the interactions between private financial behavior, private demand, and the public debt; 2) to analyze to what extent the dependence of public debt on private financial behavior is conditional to the fiscal spending regime. We address these points through simulation, evaluating austerity and countercyclical policies after a shift in financing decisions of private agents following two criteria: the time elapsed for economic activity to recover and the public debt/GDP ratio.

The analysis carried out in this paper has similarities with Skott (2001), Schlicht (2006), Nakatani and Skott (2007), Palley (2010) and Botta (2013). It is more closely related to Godley and Lavoie (2007) and Ryoo and Skott (2013). Godley and Lavoie build a full-employment model with government consumption as the policy instrument and assume away capital accumulation, thus lacking the financial behavior of firms, crucial for our purposes. Ryoo and Skott deploy a richer financial structure, with capital accumulation, assuming full employment and given prices. The analysis is long run, and the absence of price change and underemployment make their framework incompatible with the study we undertake.

The contribution of our model is to provide a framework to analyze jointly short-term effects of changes in private financial behavior, combined endogenous inflation rate and different possibilities of fiscal policy (countercyclical policy, austerity and 'automatic stabilizers'). Our model builds on a point made by Minsky (1975) theory: the decision of investment comprises both non-financial assets and financial liabilities. The use of third-party capital enables firms to invest beyond retained profits, therefore allowing a more rapid capital accumulation. However, this may also create an additional source of instability. Lender's risk, or bank's risk assessment, plays a crucial role in limiting investment according to Minskyan theory. We model this feature explicitly in a way that enables actual investment to be lower than firms' desired investment.

Complementarily, the combination of credit contraction and deflation[1] can lead to a harmful descending spiral, for it may increase debt ratios even if debtors are trying to liquidate liabilities. This point, first stressed by Fisher (1933), is important to our goals because the way different fiscal regimes interacts with inflation may change both the oscillation amplitude and the time elapsed for the system to stabilize after a shift in private financial behavior.

To our best knowledge, combining these elements of Minskyan and Fisherian frameworks in a SFC model to analyze the impacts on fiscal variables has not been done yet, clearly limiting the assessment of short run dynamics or the impact of austerity policies. Particularly, working with given prices, as most previous papers do, also rule out potential negative feedback between debt, falling demand, and deflation, through the increase in real value of liabilities and burden of debt.

The model has three major implications, ratifying Keynesian intuitions. First, an increase in public debt may be an unintended consequence of contractionary private financial behavior. Second, in most cases countercyclical fiscal expenditures improve both the economic activity and the trajectory of public debt to GDP. Third, austerity policies postpone and magnify the required adjustment, and may not be compatible with fiscal soundness.

The paper is structured as follows. In section 2 we present our SFC model. We perform simulations changing central financing parameters in section 3. In section 4, we present our final remarks in light of Minskyan and Fisherian theories.

2 A SFC model with financial assets, credit rationing, and fiscal policy

We assume a closed economy, producing a single good, with four sets of agents (households, firms, banks and government) and five assets (deposits, equities, government bills, physical capital and

[1] The word deflation comprises two equally valid meanings: 1. a fall in general level of prices; 2. a fall in inflation rate. When we refer to deflation or deflationary effect, we do not necessary mean a fall in price level, therefore making our use of the word closer to the second definition.

loans). The accounting framework of the model is described in Table 1, which shows institutional sectors' balance sheets, and Table 2, providing the transactions and flow of funds matrix.

Table 1. Institutional sectors' balance sheets

	Households	**Firms**	**Banks**	**Government**	$\sum$
1. Deposits	$+M$		$-M$		0
2. Loans		$-L$	$+L$		0
3. Fixed Capital		$+p.K$			$+p.K$
4. Equity	$+p_eE$	$-p_eE$			0
5. Govt. Bills	$+B$			$-B$	0
6. Net Worth	$+V$	$+V_f$	0	$-B$	$+p.K$

Table 2. Transactions and flow of funds

	Households	**Firms**		**Banks**	**Govt.**	$\sum$
		Current	**Capital**			
1 Consumption	$-p.C$	$+p.C$				0
2 Investment		$+p.I$	$-p.I$			0
3 Public Spending		$+p.G$			$-p.G$	0
4 Wages	$+p.W$	$-p.W$				0
5 Taxes	$-p.T$				$+p.T$	0
6 Profits	$+p.FD$	$-p.F$	$+p.FU$			0
7 Interest on bills	$+nB_{-1}$				$-nB_{-1}$	0
8 Interest on loans		$-nL_{-1}$		$+nL_{-1}$		0
9 Interest on deposits	$+nM_{-1}$			$-nM_{-1}$		0
10 Subtotal	$+SAVh$	0	$+FU-I$	0	$+SAVg$	0
11 Δ Deposits	$-\Delta M$			$+\Delta M$		0
12 Δ Loans			$+\Delta L$	$-\Delta L$		0
13 Δ Equity	$-p_e.\Delta E$		$+p_e.\Delta E$			0
14 Δ Bills	$-\Delta B$				$+\Delta B$	0
15 $\sum$	0	0	0	0	0	0

Stock variables, shown in Table 1 and Table 2, are expressed in nominal values. This is equivalent to say that price is one, except in the case of the stock prices (p_e), which varies over time. Flow variables presented in capital letters are the real ones. The nominal values can be obtained by multiplying real variables by p, the general level of prices. Superscripts d and s stand for demand and supply, respectively.

Government expenditure is G, financed through taxes (T) and bills (B). The following equations define the government's constraints and decisions:

$$\Delta B \equiv nB_{-1} + p.G - p.T \tag{1}$$

$$T = \theta\left[(1-\pi)Y + FD + n\frac{(M_{-1}+B_{-1})}{p}\right] \tag{2}$$

$$G = G_{-1}[1+\gamma_0+\gamma_1(g_t-\gamma_0)] \tag{3}$$

Where n is the nominal interest rate, exogenously defined by the government, θ is the tax rate on households income, p is the level of prices, π is the profit share, Y is the real output, FD is dividends distributed by firms, M is households deposits, K is the real capital stock, g_t is equal to the real growth in tax revenues $(\Delta T/T_{-1})$ and γ_0, γ_1 are parameters in government spending decisions.

Equation (1) is the identity defining the government budget constraint. It simply says that public debt in period t depends on previous period stock of public debt plus interest, and on the primary deficit $(p.G - p.T)$. Equation (2) defines the real tax revenue. For simplicity, we assume that the only source of tax revenue are households' wages and financial income, and that the tax rate θ is exogenously defined. Tax revenues are clearly procyclical, as it depends positively on real output.

Equation (3) departs from traditional SFC literature, as most of the models treat government expenditure either as a constant share of capital stock (or output), such as Dos Santos and Zezza (2008), or as the responsible for closing the demand gap in full employment models (see Godley and Lavoie, 2007, and Ryoo and Skott, 2013 [2]). Indeed, these models endogenize the public sector primary balance, therefore ruling out the possibility of study non-Keynesian fiscal regimes.

In our model Government expenditure grows according to a long-term trend, given by γ_0, and a cyclical component, given by $\gamma_1(g_t-\gamma_0)$. In the case the long-term trend γ_0 is given by the steady state accumulation rate $(\gamma_0 = g_t^* = g_k^*)$, then $G = G_{-1}(1+g_k^*)$. In the steady state, this function is equivalent to Dos Santos and Zezza (2008) specification $(G = \gamma K_{-1})$, assuming the government adapts itself to changes in long run economic growth. Moreover, if this behavioral assumption holds, the 'purely' cyclical component of government expenditure function, given by $\gamma_1(g_t-\gamma_0)$, is not able to change, by itself, the steady state stock-flow and stock-stock relations.

The idea underlying the cyclical component is that government knows that tax revenues are a good thermometer for current economic activity. Needless to say, the absolute value of γ_1 measures the speed of adjustment of current government expenditure to deviations of current tax revenues growth relatively to its long-term trend.

[2] Ryoo and Skott (2013) also study the case where tax rate on corporate earnings is adjusted to achieve the full employment growth.

Three fiscal regimes can be drawn according to γ_1 value. If $\gamma_1 < 0$, government expenditure will respond inversely to deviations of current tax revenues from the long-term trend, meaning that an increase (decrease) in government expenditure takes place if economic activity is slowing down (accelerating). This can be interpreted as a countercyclical fiscal regime.

In an austere fiscal regime, $\gamma_1 > 0$: reflecting a defensive behavior of government towards public deficit and debt, when tax revenues fall, the government reduce its expenditure growth rate to avoid an increase in primary deficit. Nonetheless, the very definition of fiscal austerity does not imply government expenditure to be pro-cyclical in all circumstances. Austerity is about cutting spending while public deficit/debt are raising, in order to guarantee fiscal 'sustainability'. The concept says nothing in the opposite direction, when economic conditions create a comfortable fiscal situation. In this spirit, an additional condition is added to our model if $\gamma_1 > 0$:

$$\gamma_1 = \gamma_2, \text{ if } \Delta b_{-1}/b_{-2} > 0 \text{ or } (g_{t,-1} - \gamma_0) < 0 \mid g_t \leq \gamma_0$$

$$\gamma_1 = 0, \text{ otherwise;} \tag{4}$$

$$\text{with } \gamma_2 > 0$$

Equation (4) simply states that the speed of adjustment of government real expenditure growth will be set 'austere' if the public debt to capital relation, represented by $b = B/pK_{-1}$, increases and/or real tax revenues growth is below the long run trend, since $g_t \leq \gamma_0$. $\gamma_1 = 0$ in case these conditions are not met.

Finally, if $\gamma_1 = 0$, then government expenditure is uncorrelated to activity. In this case, public primary deficit depends solely on tax revenues, a procyclical variable. This concept is closely related to what the literature commonly refer as automatic stabilizers.

Households receive wages $(W = (1-\pi)Y)$ and dividends (FD) from firms, interests on government bills and on bank deposits, and decide how much to consume. Their portfolio asset composed of deposits (M), stocks (E) and government bills (B).

$$C = (1-\theta)\left\{\alpha_1(1-\pi)Y + \alpha_2\left[FD + n\frac{(M_{-1}+B_{-1})}{p}\right]\right\} + \alpha_3\frac{V_{-1}}{p} \tag{5}$$

$$SAVh = (1-\theta)[(1-\pi)p.Y + p.FD + n(M_{-1}+B_{-1})] - p.C \tag{6}$$

$$V \equiv V_{-1} + SAVh + \Delta p_e E_{-1} \tag{7}$$

Real consumption level is determined by means of a standard consumption function, represented in equation (5), where α_1 is the propensity to consume out of after-tax wages, α_2 is the propensity to consume out of after-tax financial income and α_3 is the propensity to consume out of wealth[3]. We assume, for simplicity, that $\alpha_1 = \alpha_2 = \alpha$. Equation (6) defines households' nominal savings, simply the nominal disposable income less nominal consumption. Recalling that stock prices fluctuate, the household budget constraint requires the inclusion of capital gains, which affects the end of period wealth given in (7). Plugging (5) and (6) into (7) we obtain:

$$\begin{aligned} V \equiv (1-\alpha_3)V_{-1} + (1-\theta)(1-\alpha)[(1-\pi)p.Y + p.FD + n(M_{-1} + B_{-1})] \\ + \Delta p_e E_{-1} \end{aligned} \tag{8}$$

In each period, households decide how to allocate wealth. As Dos Santos and Zezza (2008), the share δ (9) of wealth they allocate in stocks depends positively on a expectacional parameter δ_0 and negatively on the current interest rate set by the central bank. The amount of stocks E is decided by the firms, so that $E^d = E^s$. Thus, stock prices clear the market (10).

$$\delta = \delta_0 - n \tag{9}$$

$$p_e = \frac{\delta V}{E} \tag{10}$$

Conversely, the households demand a share $(1-\delta)$ of interest-bearing securities, which can be either public bills or bank deposits. As Ryoo and Skott (2013), we consider that bonds and deposits are perfect substitutes, as they have the same remuneration. An extra hypothesis is attached: all the bills supplied by the government are demanded by households (11), while deposits are obtained as a residual, closing the households budget constraint (12). This hypothesis avoids the indetermination in portfolio allocation (as both assets have the same risk and the same yield), and also offers a palatable 'closure' for the model, which will be pointed latter.

$$B = B^s = B^d \tag{11}$$

$$M = V - p_e E - B \tag{12}$$

Firms' markup on unit costs μ, assumed to be exogenously fixed, defines the profit share (13), while the real output is the sum of consumption, investment and government expenditures (14):

$$\pi = \frac{\mu}{1+\mu} \tag{13}$$

$$Y = C + I + G \tag{14}$$

The capacity utilization (15) is defined as the ratio of output to full capacity output (Y_{fe}), while the full capacity output (16) is defined as a constant share (σ), given by current state of technology[4], of

[3] In our model wealth is equal to net wealth, as households are assumed to have no liabilities

[4] This does not mean that full output capacity output is exogenous, as its growth rate depends on previous period growth of capital stock.

previous period capital stock. Needless to say, σ can be interpreted as the maximum output/capital ratio.

$$u = \frac{Y}{Y_{fe}} \tag{15}$$

$$Y_{fe} = \sigma K_{-1} \tag{16}$$

The firms decide how much to invest, based on a traditional neo-Kaleckian 'structuralist' investment function (e.g., Bhaduri and Marglin 1990).

$$I^d = \beta_0 K_{-1} + (\beta_1 + \beta_2 \pi) Y \tag{17}$$

Dividing both sides K_{-1} yields

$$\frac{I^d}{K_{-1}} = \beta_0 + (\beta_1 + \beta_2 \pi) u \sigma \tag{18}$$

Where β_0 is a parameter capturing entrepreneurs' state of expectations, β_1 is the sensitivity of desired investment to capacity utilization (or demand) and β_2 is the sensitivity to profit rate.

In our artificial economy, three sources of funding are available to finance firms' investment: retained earnings (FU), issuance of shares (E), and bank loans (L) – similarly to Minsky (1975). Retained earnings (19) are assumed to be an exogenously-defined s_f fraction from gross operating profits $(F = \pi Y)$. Distributed profits (FD) close firms' *current* budget constraint, in (20). Following Dos Santos and Zezza (2008), we assume the firms to keep a fixed E/K ratio ψ, yielding (21).

$$FU = s_f \pi Y \tag{19}$$

$$FD = (1 - s_f)\pi Y - n.\frac{L_{-1}}{p} \tag{20}$$

$$E = \psi K \tag{21}$$

Thus, to fulfill desired investment firms recur to bank loans. The demand for loans (L^d) is represented in (22). Firms' actual nominal investment is given by (23), which closes its *capital* budget constraint. Real capital stock is given by the law of motion (24), for a given level of capital depreciation δ_k, while the actual growth in capital stock $(g_k = \Delta K / K_{-1})$ is written in (25).

$$L^d = L^d_{-1} + p.I^d - p.FU - p_e \Delta E \tag{22}$$

$$p.I \equiv p.FU + \Delta L + p_e \Delta E \tag{23}$$

$$K = I + (1 - \delta_k) K_{-1} \tag{24}$$

$$g_k = \frac{I}{K_{-1}} - \delta_k \tag{25}$$

For simplicity, *banks* are assumed to make no profit, so the interest rate charged in loans is the same determined by the central bank. Nonetheless, contrary to most Post Keynesian SFC models (see for instance Lavoie and Godley (2001/2002), Lavoie (2008), Dos Santos and Zezza (2008) and van Treeck (2009)), banks are active in deciding loan supply ($L^s = L$) to firms, in the same spirit of Le Heron and Mouakil (2008) – though our banks' balance sheet is much simpler. Banks loans supply decision is represented in (26):

$$L = (1-\lambda)(\Delta L^d + L_{-1}) \tag{26}$$

where λ is the lender risk, treated as an exogenous variable. This function says that total loan supply varies according to banks' risk perception. It opens the possibility of credit rationing (Davidson 1972/1978, Stiglitz and Weiss 1981), meaning that the adjustment of loan supply-demand occurs through quantity, not prices.

Finally, we define inflation rate (ϖ) in a standard Phillips curve (27): current inflation is a weighted average of lagged inflation rate (ϖ_{-1}) and a 'normal' level of inflation (ϖ_0), plus the impact of output gap[5]. The change in price level is represented in (28). With a constant markup, distributional effects of inflation are ruled out[6], so it changes only the aggregate level of prices. Equation (29) simply defines the real interest rate.

$$\varpi = \eta\varpi_{-1} + (1-\eta)\varpi_0 + \xi(g_k - g_{k_{-1}}) \tag{27}$$

$$p = p_{-1}(1+\varpi) \tag{28}$$

$$r = \frac{1+n}{1+\varpi} - 1 \tag{29}$$

The hidden (or redundant) equation, implied by all other model's equations, is the *ex post* identity shown in (30). Making use of van Treeck (2009, p. 477) words, 'we refind the well-known result that the equality of 'money demand' and 'money supply' is not an equilibrium condition but follows the very logic of a monetary production economy in which money is endogenous'.

$$M \equiv L \tag{30}$$

The system of difference equations that arises from our simple model is too complex for obtaining an analytical solution. For this reason, we do some simulated experiments with fictitious parameter

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[5] Recall from equation (16) that potential output is $Y_{fe} = \sigma K_{-1}$. Then, as $Y_{fe,-1} = \sigma K_{-2}$, it is straightforward to show that $g_{fe} = \Delta Y_{fe}/Y_{-1} = g_{k,-1}$

[6] We are well aware of Phillips curve potential flaws. Nonetheless, modelling inflation as a conflicting claim would complicate the analysis, without corresponding benefits for our purposes, which only requires endogenous inflation to evaluate the impact of price level on real value of assets and liabilities.

values in order to analyze our model's implications. It is possible to verify that the intensive dynamics of stock-stock and stock-flow relations of the model is governed by the: 1. Capacity utilization; 2. Public debt to capital ratio; 3. Firms' leverage, $l = L/pK_{-1}$; 4. Households wealth to capital ratio, $v = V/pK_{-1}$; 5. The real growth in capital stock, g_k. The inflation rate level is also important in determining the convergence of such ratios to steady state, but does not influence (and rather is not influenced by) the steady state ratios endogenously, as one can infer from (27).

3 Experiments

In this section, we discuss some experiments aiming at the comprehension of how private financial behavior influences the fiscal variables (public deficit and debt), in different fiscal regimes. By financial behavior, we mean households', banks' and firms' decisions that affects investment financing. Given the *desired investment* $(I^d, 17)$, three parameters are crucial in determining *effective* investment $(I,\ 23)$: 1. the retention rate s_f, which determines firms' own funding; 2. the lender's (banks) risk perception λ, which influences supplied bank loans; 3. the share of wealth households allocate as stocks, δ (or, actually, the expectacional parameter δ_0), which affects the funding from the stock market. One may wonder why not to shock $\psi = E/K$ parameter. The reason is that, contrarily to δ_0, ψ does not change the composition of firms' liabilities acquisition in the long run. In equation (22), $p_e \Delta E$ corresponds to the funding firms raise in the stock market. Assuming a constant δ, and substituting (10) and (21) into $p_e \Delta E$, after straightforward calculation, we obtain:

$$p_e \Delta E = \delta V . \frac{g_k}{1 + g_k} \tag{31}$$

Thus, in our model, δ changes the long run liability structure. A change in ψ would only determine temporary effects, through variation on stock prices and households wealth.

We perform four experiments, focusing on transitional dynamics, covering changes in the three parameters:

1. A credit crunch caused by a transitory increase in lender's risk, combined with a fiscal regime where only automatic stabilizers operate ($\gamma_1 = 0$ in equation (3)). In order to evaluate the importance of the inflation behavior for the outcomes, we analyze several combinations for parameters η and ξ in the Phillips curve (27);

2. A same-sized credit crunch, but with a cyclically-reactive fiscal expenditure. We evaluate two fiscal regimes: a countercyclical fiscal expenditures $(\gamma_1 < 0)$, and the austerity case, that is, a pro-cyclical fiscal expenditures regime $(\gamma_1 > 0)$;

3. An increase in firms' retentions rate s_f, considering an automatic stabilizer $(\gamma_1 = 0)$, a countercyclical fiscal regime $(\gamma_1 < 0)$ and an austere fiscal regime $(\gamma_1 > 0$, following (4) condition);

4. A decrease in the share of households portfolio allocated in stock (δ_0), leading to a change in firms' financing composition, with all the above-mentioned fiscal regimes.

All the trajectories are compared with the same baseline steady state (see appendix for parameter values). The results are evaluated according to two criteria: the time elapsed for economic activity to recover and the public debt to capital b trajectory. We also focus on the role of inflation, fiscal policy and their interaction in the transition to the steady state. Results are presented for the public debt to capital, the government nominal deficit to capital, the private balance to capital ratios, firms' leverage and, finally, the trajectory of output compared to the baseline steady state.

Of course, this is a theoretical exercise. It shows where the economy tends to assuming a constant state of expectations – although, in practice, it does not remain constant for long enough for that to happen (Keynes 1936). While analyzing the transition, one should not disregard that 'trajectories in which the balance sheets of large parts of even whole institutional sectors (as productive companies or households) become more fragile can lead to regime changing structural breaks due to endogenous reasons' (Macedo e Silva and Dos Santos 2011, p. 113). This means that, even though the model converge to a steady state, one should not ignore that very discrepant trajectories can lead to a structural disruption.

3.1 Effects of a transitory shock in lender's risk (λ): non-reactive fiscal expenditure

In this experiment, we temporarily shock lender's risk[7] (which generates a credit crunch) and present the result for different combinations of parameters η and ξ in equation (27): 1. if $\eta = 0, \xi = 0$, the inflation rate is constant over time; 2. if $\eta = 0.95, \xi = 1$, we have an intermediate case, where current inflation is sensitive to past inflation and to the output gap; 3. $\eta = 1, \xi = 1$ means that current inflation is the past inflation plus the effect of output gap, more sensitively than former case; 4. finally, if $\eta = 1, \xi = 2$, inflation is very sensitive to the output gap. The changes in inflation parameters make it easier to emphasize the role of inflation in the outcomes. Fiscal expenditures simply follows its long-term trend.

[7] We introduce in the model a simple exponential function for the lender risk shock to be transitory, given by $\lambda = \lambda_{-1}^{a} + \lambda_0$ For λ to be time-decreasing and converge to 0, $a > 1$. The shock takes place in period t=5, with an increase of 5 percentage points in λ_0, and a is set to be 1.02. If $t > 5$ then $\lambda_0 = 0$.

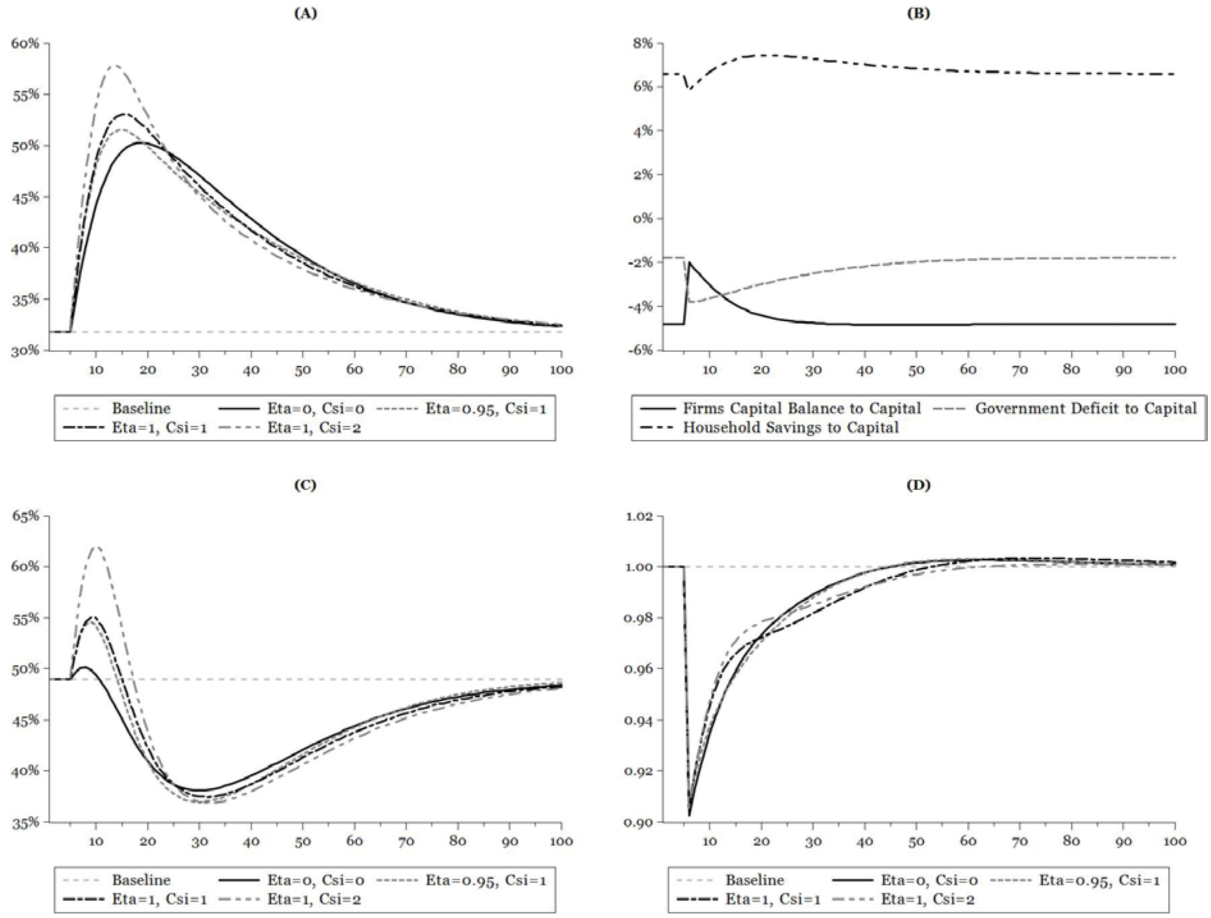

Figure 1. Effects of a temporary increase in lender's risk (λ) *in key variables, with different combinations of inflation parameters* η *and* ξ *and* $\gamma_2 = 0$*. (A) Public debt to capital ratio; (B) Government net lending, firms' Capital Balance to Capital* $(FU - I)/K$*, and households saving to capital (Note: these variables sums 0, according to row 10 in Table 2).* Inflation parameters in (B) are $\eta = 0, \xi = 1$*; (C) Firms' leverage, or loan to capital ratio; (D) Real output to baseline.*

The shock in λ mean, from equation (26), that firms' desired investment will not be completely financed by banks. Further, it requires firms to repay a share λ of past stock of loans.

Chart (A) in Figure 1 shows the dynamics of public debt to capital ratio after the credit crunch for different inflation parameters. The meaningful increase in public debt is a result of several phenomena.

First, the increase in lender's risk leads to a contraction in credit and a considerable reduction in actual investment to capital, melting down the real growth in capital stock (g_k). Through investment multiplier effects, the fall in investment triggers a contraction in economic activity (see Chard (D) in Figure 1), though to a lesser extent than investment. The lower output causes a fall in tax revenues (equation 2). With the fixed growth rate of fiscal expenditures (equation 3, with $\gamma_1 = 0$), it is not hard to see from (2) this means an increase in government primary deficit and nominal deficit to capital ratios. The higher government deficit to capital ensures the increase in firms' savings to capital, as represented in Chart (B) in Figure 1.

The above flow analysis is influenced by and helps in explaining stock variables dynamics. On the one hand, stock variables are an outcome from economic agents' spending decisions. On the other, it influences itself spending decisions (Ryoo and Skott 2013), as one clearly sees, for example, in the consumption equation(5), where consumption appears as a function both of wealth and interest income (dependent on financial stocks). Thus, the increase in public debt to capital stock ratio is a result of the increased public deficit and, at the same time, smooth the private sector stock adjustment, as it raise households consumption and firms' savings.

To shed light on the mechanism on the adjustment mechanism, let us examine the case with constant inflation $(\eta = 0, \xi = 0)$. The tightening in credit conditions causes a reduction in loans to capital ratio (or firms' leverage). The slowdown in capital accumulation causes a reduction in new equity emission, leading to capital gains and increased stock prices, combined with the rise in public debt to capital ratio above explained. Both movements clarify how the initial credit shock, which relatively (to baseline) reduces loans stock, meets the condition of an equivalent reduction in deposits, for equation (30) to hold.

Dynamically, the capital gains and the higher public debt generate an increased consumption to capital ratio, because of the 'autonomous' consumption (wealth and interest on bills), partially counterbalancing the fall in actual investment and catalyzing the convergence of wealth to capital back to the steady state ratio. This process takes place until capacity utilization reaches a critical level, as consumption and (mainly) government expenditure grows temporarily more than capital stock, resulting in higher demand for investment. The higher actual investment, increasingly closer to desired investment insofar as lender's risk fall, alleviates fiscal pressures and gradually allows the decrease of public debt to capital ratio.

The role of inflation is also clear in charts (A) and (C) (Figure 1). The higher the sensitivity of inflation to current economic activity, the more intense is the increase of loans and public debt to capital ratio, due to two simple reasons: 1. the lower inflation (or an appreciation of the currency) rises the real interest rate; 2. financial stock variables are nominally defined, but capital (and flow variables) are susceptive to the change in the price level. While the values of bills, deposits and loans are nominally unchanged, the reduction in the price level (or deceleration of price change ratio) decreases the nominal value of susceptible variables, such as capital stock and output. Therefore, inflation reaction to the credit crunch affects crucially the amplitude of the resulting cycle.

This raises the paradox pointed by Fisher (1933) and captured in this simple model. Debtors liquidate a share of its debt, but, in spite of having a sounder finance at the end of the period, they owe relatively more. In addition, the fall in nominal income makes it harder to meet financial commitments, or severely augments the burden of debt. The process aforementioned was wisely synthetized in Fisher's (*op. cit.*, p. 344) famous sentence: 'The more debtors pay, the more they owe'.

3.2 Effects of a transitory shock in lender's risk (λ): reactive fiscal expenditure

In section 3.1, we described the mechanism through which a temporary credit crunch leads to a higher public debt, as well as the role played by inflation in determining the intensity of the increase. We are not going to repeat the whole analysis in this section. The central motivation for the experiment we perform in current section is to assess if the choice of fiscal regime is capable of changing fiscal variables trajectory.

Lender's risk shock is equivalent, inflation parameters are set to be the intermediate $(\eta = 0.95, \xi = 1)$ and the fixed inflation $(\eta = 0, \xi = 0)$ cases presented above, whereas the parameter γ_1 in government expenditure function assumes positive (austere fiscal regime) or negative (countercyclical fiscal regime) values. These parameters values provide a good starting point for analyzing how fiscal regimes interacts with the after-shock consequences in stock-stock and stock-flow variables, including fiscal regimes' impact on inflation.

Chart (A) in Figure 2 shows how public debt to capital ratio behaves after the credit crunch. As in the first case, public debt to capital increases, no matter what fiscal regime is adopted. Austerity cannot do much to smooth public debt to capital ratio increase. In fact, the scenario in which inflation is more sensitive to current economic activity exhibit a higher peak. Otherwise, countercyclical fiscal expenditures do not make public debt to capital ratio to explode, delivering a slightly lower peak for such a relation.

The role of inflation in determining this trajectory of public debt to capital ratio was already discussed in previous section and it holds in this case. An issue to be addressed is how each fiscal regime interacts with inflation. Owing to the deflationary effects of austerity policies, the result is a greater increase in public debt to capital ratio in comparison with alternative scenarios. Such relationship between austerity and inflation is highlighted by the difference between sensitive-inflation (Austerity) and insensitive-inflation (Austerity – constant inflation) cases in Chart A, Figure 2. Analogously, countercyclical fiscal policy is more effective when the inflation rate is sensitive to economic activity, indicating that countercyclical fiscal policy offset (at least in part) the deflationary trend.

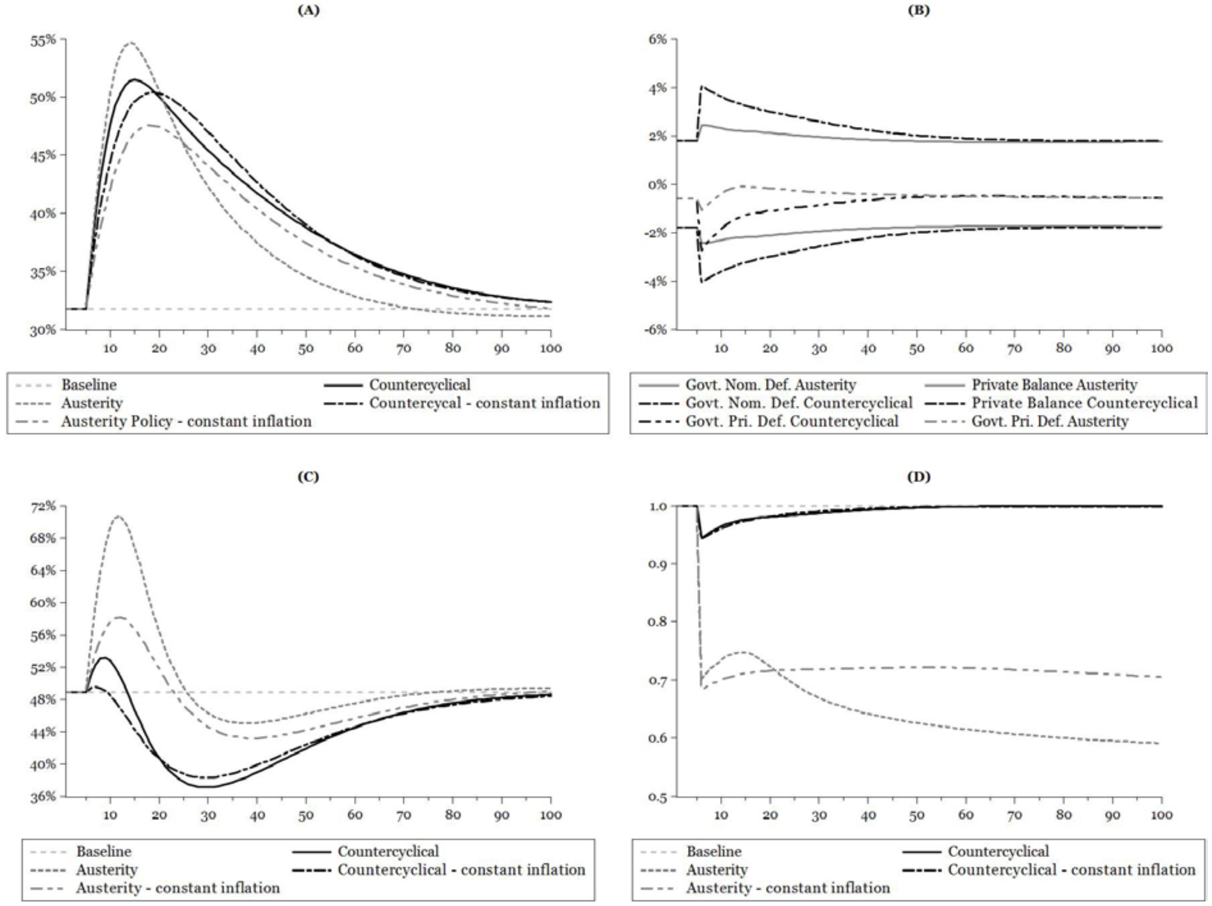

Figure 2. Effects of a temporary increase in lender's risk (λ) *in key variables, for countercyclical* $(\gamma_2 = -0.9)$ *and austere* $(\gamma_2 = 0.9)$ *fiscal regimes. (A) Public debt to capital ratio; (B) private balance (firms' capital balance plus household savings) to capital and government primary/nominal deficit to capital. (C) Firms' leverage, or loan to capital ratio; (D) Real output to baseline.*

If the inflation rate was insensitive to economic activity, then austerity would relatively reduce public debt to capital ratio increment and countercyclical fiscal expenditure would have less effect. As the hypothesis of insensitiveness of inflation to economic activity hardly holds in reality, the deflationary (inflationary) effect of austerity (countercyclical fiscal expenditures) regime are crucial to evaluate policies' results.

Moreover, when it comes to the flow of funds of the economy, represented in Chart B (Figure 2), the crucial difference between austerity and countercyclical policies becomes clearer. The required adjustment in private sector's balance sheet caused by the credit crunch, detailed in previous section, is stuck because of the defensive behavior of government towards its deficit in austerity case, which does not allow public expenditure to capital to increase. The cut in spending to keep primary deficit 'sustainable' causes the necessary adjustment, both in capacity utilization and firms' liabilities, to be made through consumption and a general fall in GDP.

As we showed above, the consumption to capital ratio will increase because of the wealth effect, as well as the higher interest payment to on government debt. The main adjustment occurs through GDP: the burden of debt increases in firms' capital account, due to both firms' reduced real (triggered by the lower demand) and nominal (triggered by the deflationary trend) profits caused by austerity policies. This leads to a lower actual investment, hence to a smaller capital accumulation (g_k). The capacity utilization adjusts because of the lower investment.

In contrast, the countercyclical increase in fiscal expenditures accelerates the convergence, due to government expenditure to capital $(g = G/K_{-1})$ increases in a faster pace. A higher g contributes to improve capacity utilization, allowing the investment demand to recover more rapidly. Simultaneously, the higher nominal deficit meets the higher demand for liquidity: equation (26) implies that loans should be repaid to banks if $\lambda > 0$, thus firms make use of retained profits to meet the financial commitments. The net flow of money coming from the government enables firms to meet the required loan repayments, as it helps in increasing firms' profits.

Largely, the abovementioned differences is reflected in firms' leverage dynamics, represented in Chart C, Figure 2. Even when austerity does not cause deflation, we observe a higher peak and a longer time for the leverage to decline, whilst countercyclical government expenditure is able to boost the deleveraging. Precisely, this occurs due to the austere government 'denial', imposed by its decision of spending, to be a counterpart for the firms' stronger need of money to settle debt.

If the fiscal regime is not capable of changing level of stock-stock and stock-flow relations, as reflected in the convergence for the same level of public debt, deficit and private debt, presented respectively in Charts A, B, and C, the same is not true for the output *level*. In all cases, the pre-credit-crunch growth is restored, as one can see in flat lines in Chart D, Figure 2. Countercyclical policy reduces the intensity of output fall, rapidly restoring the 'normal' growth: GDP to baseline falls around 9% without in 'automatic stabilizer' case (Chart D, Figure 1), and around 5% with countercyclical expenditure. However, a meaningful part of austerity adjustment involves the reduction in real GDP *level*, as to restore the capacity utilization and 'normal' growth.

3.3 Effects of a permanent increase in retention rate (s_f)

Both foregoing experiments represent transitory shocks in our artificial economy, not able to change steady state ratios. A permanent change in firms' retentions rate is comprised in this section, leading to a change in firms' investment financing, which reduces the necessity of resorting to bank loans.

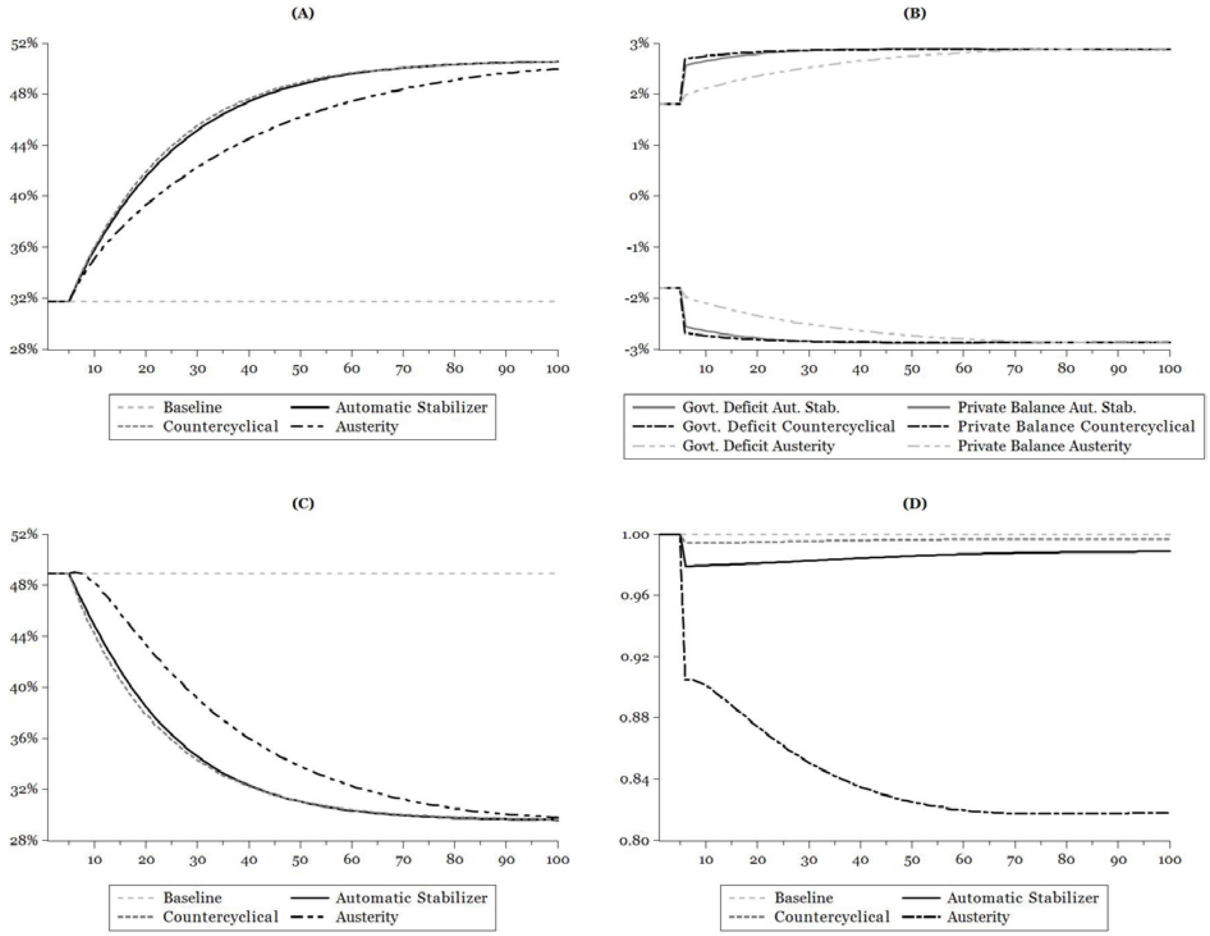

Figure 3. Effects of a permanent increase in retentions rate s_f from 0.3 to 0.35 of gross profits, considering three fiscal regimes: automatic stabilizer $(\gamma_1 = 0)$, countercyclical policy $(\gamma_1 = -0.9)$, and an austere policy $(\gamma_1 = 0.9)$. (A) public debt to capital ratio (B) private balance (firms' capital balance plus household savings) to capital and government nominal deficit to capital. (C) Firms' leverage, or loan to capital ratio; (D) Real output to baseline.

Contrary to previous experiments, the increase in retention rate brings a change in steady state ratios: public debt to capital raises raises (Chart A, Figure 3), whereas firms' leverage decreases (Chart C, Figure 3). The adjustment process is close in spirit, but not the same. The similar part is related to the fiscal impacts: falling demand leads to lower tax revenues, hence increasing both public deficit and debt to capital ratio. Differences come from the source of the decreased demand: a raise in retention rate results in lower dividend paid to households. This leads to a contraction in consumption, to a reduction in capacity utilization and then to a fall in investment. Recall that in the credit-crunch cases investment was the leading variable.

When it comes to the fiscal regime distinctions, austerity just postpone the required adjustment and worsen it qualitatively, as the transitional accommodation is partially settled by means of higher interest payments (see Chart B, Figure 3) and a sluggish firms' deleveraging (Chart C, Figure 3). Automatic stabilizer and countercyclical fiscal regimes show resembling results in terms of stock-stock and stock-flow adjustment. Notwithstanding, countercyclical policy is capable of keeping output level higher (see Chard D, Figure 3), inasmuch as it holds demand higher than other scenarios when private demand have a more prominent tendency to shrinkage, while austerity has the opposite effect.

3.4 Effects of a permanent decrease in households demand for shares (δ)

As the increase in retention rate, a permanent shift in households demand for equities (δ_0 in equation 9) changes system's stock-flow and stock-stock ratios in the long run, as one can see in Figure 4. A fall in demand for shares decreases equities price (equation 10), causing capital losses and a reduction in households wealth (see equation (7)). The negative wealth effect leads to a reduction in consumption, that reduces investment demand (equal to actual investment, as $\lambda = 0$). This is the underlying adjusment channel thorugh which a permanent decrease in households demand for share causes economic activity to slowdown.

The first remarkable difference concerns the intensity of the adjusment: even with a meaningful fall in δ_0, from 0.44 to 0.34, the output contraction is not as pronounced as in earlier cases[8] (see Chart D, Figure 4), nor the increase in public or private debt (Chart A and D, Figure 4, respectively). Coutercyclical fiscal policy remains delivering a higher long run level of real output (combined with a faster convergence), while austerity pushes it down.

Nominal profits fall in austeirity case explain a great part of the leveraging that one could observe in chart C (Figure 4). A non-trivial feature of the model complementarily explains how austerity circumvents a part of the fiscal deterioration, delivering a lower public debt to capital ratio as compared to expansionary cases. One can show that dividing (31) by pK_{-1} we get:

$$\frac{p_e \Delta E}{pK_{-1}} = \delta v \frac{g_k}{1 + g_k} \tag{32}$$

[8] Parameter α_3 in consumption function (5) is crucial to give the intensity of demand fall.

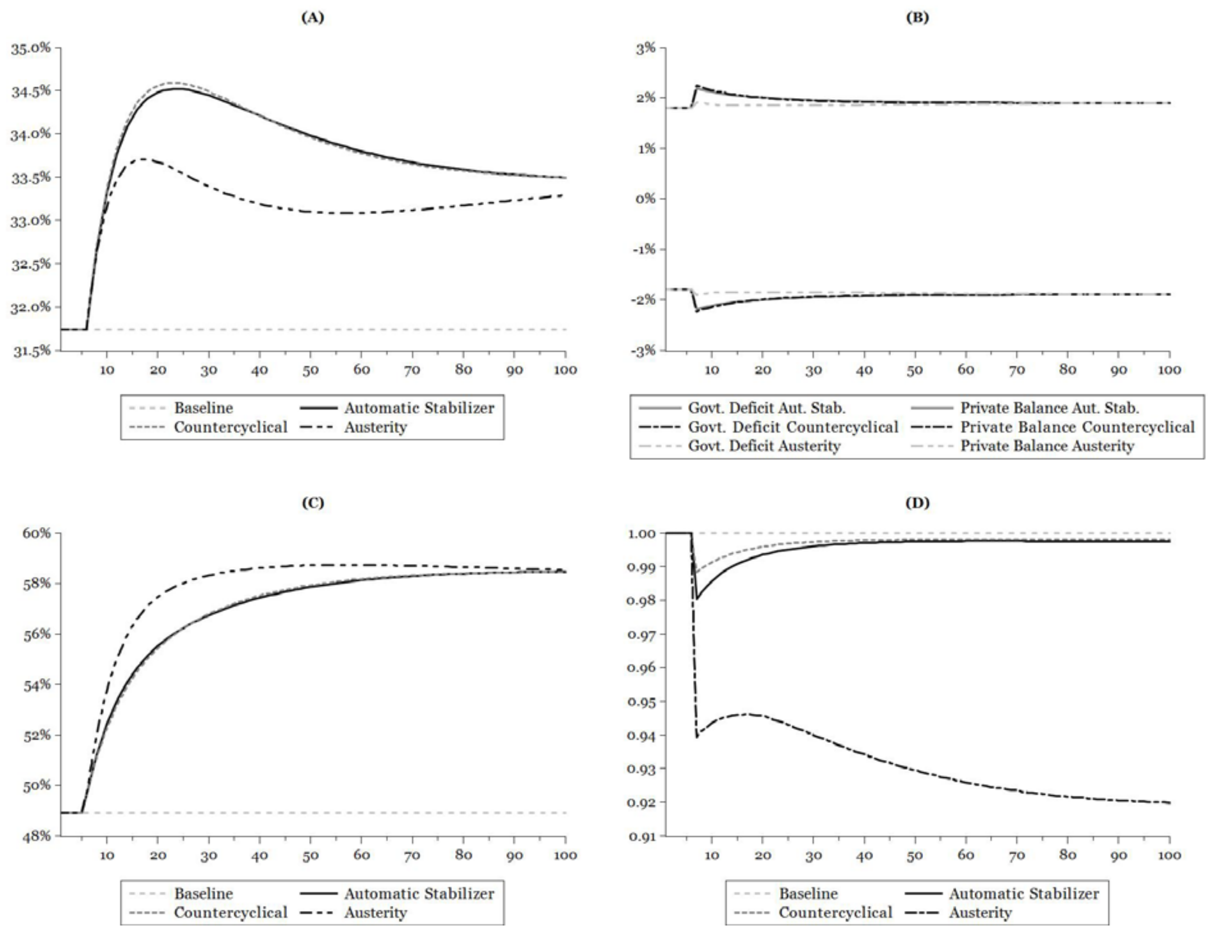

Figure 4. Effects of a permanent decrease in the share of households portfolio allocated in stocks (δ_0) *from 0.44 to 0.34, considering three fiscal regimes: automatic stabilizer* $(\gamma_1 = 0)$, *countercyclical policy* $(\gamma_1 = -0.9)$, *and an austere policy* $(\gamma_1 = 0.9)$. *(A) public debt to capital ratio (B) private balance (firms' capital balance plus household savings) to capital and government nominal deficit to capital. (C) Firms' leverage, or loan to capital ratio; (D) Real output to baseline.*

where $v = V/pK_{-1}$. The proportion of actual investment (I) financed in stock market is dependent both on real stock of wealth and on the real growth of capital stock. Austerity remains being deflationary, contributing to a relative increase in v as compared to expansionary fiscal regime. Nonethless, the reduction in g_k in austere fiscal regime more than compesates the relative increase in v. This way, the share of investiment financed through primary offering relatively reduces, forcing firms to more intensivelly recur to bank loans as to fullfil desired investment, leading to an accelerated leveraging (Chart C, Figure 4).

Higher leverage requires lower government debt to capital ratio for the system to close (see equation 30). The higher wealth to capital, combined with the lower public debt to capital, allows this to happen in this austerity scenario. A similar process happens in all above-described scenarios. Nonetheless, the impact of this effect is not remarkable as compared to the process analyzed earlier, making its net impact on general results negligible.

In addition, this adjustment occurs precisely because austerity drags capacity utilization rate down (due to lower g_k), holding capital stock growth beyond the steady state level for a long time (see equation 17 and Chard D, Figure 4). The short period (timid) success of austerity in reducing debt to capital ratio relatively to countercyclical policy is offset in the long run, as all fiscal regimes converges to the same steady state ratios, with the cost of a permanent decrease in GDP level.

4 Final remarks

As Keynes and Minsky taught us, monetary economies must be studied as a conjunction of *interconnected* agents: in macroeconomics one cannot ignore that the decisions of a group (or institutional sector) may affect decisively the balance sheet of the others, triggering a reaction that may be inconsistent with the initial desired change.

The central role of the interactions between public and private sectors was highlighted by both Minsky and Godley. Our model has explored some of these interactions.

The role of governments seems to be crucial. First, the model's results suggest that public debt and deficit to capital ratio are strongly connected to the private financial behavior. It confirms and explores the Keynesian intuitions according to which it is misleading to depict the behavior of public deficit and debt ratios to capital as the direct result of the fiscal stance.

All experiments creating contractionary shocks in parameters influencing firms' financing of investment – namely, an increase in lender's risk, an increase in firms' retention rate and a fall in household demand for stocks – lead to higher public debt and nominal deficit to capital ratios[9]. This relation is *causal* by a logical reason: contractionary private financial behavior precedes temporally fiscal deterioration.

Broadly, the channel of transmission is the fall in economic activity resulting from the contraction provoked by the shift in private financing decisions, which lowers considerably government tax revenues, generating bigger deficit and debt. Moreover, the way the decrease in economic activity interacts with the inflation rate showed to be of prime importance for the dimension of public debt to capital to increase. The higher the inflation rate sensitiveness to current economic activity, the greater the deflationary trend after a fall in economic activity and, as a consequence, and the bigger the increase in public debt to capital ratio. This is the Fisherian effect.

We deliberately studied only contractionary cases (which may trigger government austere behavior), or the downswing phase of the business cycle. Nonetheless, the model also implies as well that more

[9] The long run impact depends on the nature of the shock, whether transitory or permanent.

permissive (or debt-tolerant) private financing conditions leads to a fiscal improvement, in the sense that public deficit and debt to GDP ratios required to equilibrate agents' portfolio are lower.

Second, our simulations points out that the fiscal deterioration in the aftermath of contractionary private financial behavior is not conditional on the fiscal regime. In the austerity case we studied, government expenditure falls to counterbalance the trend of higher primary deficit to capital after the shock. This behavior pushes most of the adjustment to the new financial condition to the private sector, sparking a negative spiral that leads to a fall in long run output level[10]. The change in GDP level is a result of the temporary (and accumulated over time) lower government expenditure and capital stock growth in austere times, suggesting the existence of path dependence in our economy.

Meanwhile, the reason why countercyclical fiscal policy works is *objective*. In a regime where in the very beginning of the shock the government expenditures increase countercyclically, economic activity recovery runs in a faster pace (so as firms' profits), leading to outcomes that are no worse than those produced by austerity in terms of fiscal variables. This surprising result is related to the mutual interactions between fiscal policy, economic activity and inflation. Whilst countercyclical fiscal contributes to counterbalance the deflationary trend favorable for the recovery, in most cases austerity adds fuel to the deflationary trend.

We have shown that this is the more likely reason why austerity is not capable of delivering better results in terms of fiscal variables comparatively to countercyclical policy case. There is a material need – to be more precise, a monetary need – for more cash flows in a contractionary financial environment, for the private agents to honor financial commitments, which can be provided by the public deficit. In addition, stabilization depends on public debt itself, as it is not only a result of people's spending decisions and fiscal policy: it influences the spending decisions, meaning that the interactions between public debt and effective demand implies a particular trajectory for the public debt (Ryoo and Skott 2013).

In their full employment SFC model, Ryoo and Skott (2013, p.524) conclude analytically that 'fiscal deficits and a rise in public debt are necessary if the government wants to maintain full employment following a decline in demand', and that 'fluctuations in private sector confidence and financial behavior can and should be offset by variations in public debt' (*op. cit.*, p.525). We agree in spirit with Ryoo and Skott, but we go beyond: in closed economies, meaningful changes in private state of expectations or objective shifts in private financial behavior do not give the 'Big Government' a real option, in terms of avoiding a deterioration in fiscal variables, even if not pursuing full employment.

[10] Even if GDP is shifted downwards, which is not necessarily the case, in our model the stock-stock and stock-flow ratios converges to the same point in the long run.

Even if preliminary (and more complex, though not presented in this paper) versions of the model pointed to the same qualitative results, there are still some limitations. In our opinion, the main limitation is the closed economy framework. Similar processes in open economies may lead to different adjustment dynamics, depending on its size, openness, on the scale and pervasiveness of the crisis, on the currency-sovereignty, on the position of the currency in international hierarchy, on the cooperative or beggar-the-neighbor international policies, among other structural characteristics.

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6 Appendix

α	0.75	α_3	0.03	λ	0
ϖ_0	0.02	s	0.3	δ_0	0.44
γ_0	0.04	γ_1	0	μ	0.33
β_1	0.1	β_2	0.16	σ	0.77
δ_k	0.08	ξ	1	η	0.95
β_0	0.013	ψ	0.15	θ	0.32

Appendix 1. Parameter values for the baseline simulation (rounded values)