Forum for Macroeconomics and Macroeconomic Policies

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FMM WORKING PAPER

No. 17 · March, 2018 · Hans-Böckler-Stiftung

FURTHER INSIGHTS ON ENDOGENOUS MONEY AND THE LIQUIDITY PREFERENCE THEORY OF INTEREST

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ABSTRACT

We present a simple stock-ow consistent (SFC) model to discuss some recent claims made by Angel Asensio in the Journal of Post Keynesian Economics regarding the relationship between endogenous money theory and the liquidity preference theory of the rate of interest. We incorporate Asensio's assumptions as far as possible and use simulation experiments to investigate his arguments regarding the presence of a crowding-out effect, the relationship between interest rates and credit demand, and the ability of the central bank to steer interest rates through varying the stock of money. We show that in a fully-specified SFC model, some of Asensio's conclusions are not generally valid (most importantly, the presence of a crowding-out effect is ambiguous), and that in any case, his use of a non-SFC framework leads him to ignore important mechanisms which can contribute to a better understanding of the behaviour of interest rates. More generally, this paper hence once more demonstrates the utility of the SFC approach in research on monetary economics.

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Further insights on endogenous money and the liquidity preference theory of interest*

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March 13, 2018

Abstract

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Keywords: Horizontalism, structuralism, endogenous money, interest rates, stock-flow consistency
JEL-Classification: E5, E12, E40, E43

*Marc Lavoie gratefully acknowledges financial support from the Institute for New Economic Thinking (INET). Severin Reissl gratefully acknowledges funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 721846 (*ExSIDE* ITN).

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In a recent paper, Angel Asensio (2017) attempts to clarify the controversies between "horizontalists" and "structuralists" which have occurred in the field of monetary economics. In so doing, he makes his own proposal about how the money and credit markets should be formalised so as to integrate both the endogenous money view and Keynes's liquidity preference theory of the rate of interest. Surprisingly, there is no reference in his article to the work which has been done over the last 20 years within the stock-flow consistent (SFC) approach (see Godley and Lavoie, 2007; Caverzasi and Godin, 2015; Nikiforos and Zezza, 2017). One would have thought that this kind of work would have been highly relevant to Asensio's effort to integrate analyses of deposits, loans and bonds, their rates of return, as well as possibly aggregate output. One purpose of the present article is to show the usefulness of the SFC approach when discussing these complex monetary and financial issues, while also taking into account what is happening in the real economy. In particular, we show that the use of a fully-specified SFC framework makes it necessary to qualify Asensio's results even if one reproduces his assumptions as closely as possible.

We proceed as follows. In the first section of the paper, we recall what we believe to be the main points brought up by Asensio (2017). In the second section we present the structure of an SFC model which can be used to analyse these points. In the third section, we discuss the behavioural assumptions of the model, which are kept as close as can be to the various assumptions put forth by Asensio. The fourth section presents a number of experiments made to illustrate the usefulness of the model relative to the claims made in Asensio's paper. We conclude by making some additional comments.

The main claims made by Asensio

Angel Asensio makes three main points. The first two points will only be briefly dealt with in the current section, while the last one, with its associated claims, will be discussed in greater detail in this and the following sections.

His first point is that both the credit supply curve and the money supply curve should be drawn neither as a horizontal curve, as the "horizontalists" would put it, nor as an upward-sloping curve, as several “structuralists” would have it. Instead, as long as money is endogenous while banks provide credit on demand to creditworthy borrowers, these two curves should be negatively sloped, whereby the credit supply curve coincides with a negatively sloped credit demand curve. Perhaps the difference in perception arises from how one perceives supply curves: either as the price that will be set at different quantities supplied, or as the quantities that will be supplied for different prices as in the standard interpretation and the one that Asensio seems to endorse. We will not discuss this any further as it appears rather idiosyncratic. Readers interested in this issue may wish to consult Sawyer (2017), who expresses his uneasiness in using the notions of a supply of money as well as that of a supply of credit. The same uneasiness about what the demand for and the supply of money deposits stand for is also briefly expressed in Lavoie (2017, 356).

The second point, made in a number of places in Asensio (2017), is that post-Keynesians engaged in the horizontalist-structuralist debate have in general suffered from a confusion between flows and stocks. For instance, Asensio (2017, 329) writes that “indeed, ‘horizontalist’ and ‘structuralist’ models used to derive the money supply from the deposits resulting from the current flows of credit (less repayments) while the total money supply at a point in time should be derived from the total stock of loans outstanding (past and present) and from the central bank market interventions”. Asensio devotes a whole appendix to show that Palley (2013), who is closest to his analysis, is subject to this critique. Asensio distinguishes what he calls the “credit supply”, which is a flow, and the “total credit supply”, which is a stock; the same distinction is made with the money supply (a flow) and the total money supply (a stock): “The total demand for money at a point in time (stock) therefore is a broader notion compared with the demand for deposits resulting from the demand for credit at that time (flow)” (Asensio, 2017, 335). Besides Palley, Fontana and Setterfield (2009) as well as Howells (2009) are accused of this confusion, as is Lavoie (2014, 251). Other authors may have been sloppy at times in this regard, but given that Palley was a student of James Tobin while Lavoie was the co-author of Wynne Godley, the accusation that Palley and Lavoie are the culprits of such a slip-up appears to be rather surprising since Tobin and Godley are considered to be the founders of the SFC approach, one purpose of which is precisely to avoid confusion between stocks and flows. Asensio's claim is particularly curious in light of the fact that issues related to endogenous money theory have already been assessed in stock-flow consistent frameworks (Godley, 1999; Lavoie and Godley, 2001-02; Lavoie, 2017) in which stock-flow errors would become immediately obvious.

As his third main point, Asensio rejects a standard assumption in post-Keynesian economics, that is, the assumption that the lending rate is equal to some base rate (say, the target overnight rate set by the central bank - the target federal funds rate in the US, the main refinancing rate in the Eurozone) plus some exogenous markup. While there is ample evidence that the conventional prime lending rate is exactly set in this way in the United States, this indeed may not be the case of lending rates applied to non-prime borrowers. Asensio argues that full accommodation of the demand for loans by creditworthy borrowers does not imply an exogenous interest rate. For Asensio (2017, 336), and this is related to his first point, "insofar as the loan supply and creditworthy demand are equal by definition, the rate of interest on loans cannot be determined by any intersection of the supply and demand for loans". He argues that the rate of interest on bank loans ought to be competitive with the interest rates charged on financial markets, which Asensio calls the "market interest rate" or the "money market interest rate": "The rate of interest on loans and the money market interest rate can hardly differ from one another" (ibid.).[1] In more practical terms this market interest rate is the rate of interest on corporate paper when speaking of the short term, or the interest rate on corporate bonds when dealing with the long term.

In his effort to integrate the theory of endogenous money and Keynes's liquidity preference theory, Asensio argues that the interest rate charged to borrowers, that is, the interest rate paid by a borrower when getting funds from a bank or from the financial markets,

[1]The expression "money market interest rate" is a bit confusing as other authors close to Asensio's position give it a different meaning. For instance, Palley (2013) uses the terms "money market rate" and "central bank policy rate" interchangeably, meaning that these terms for him correspond to the federal funds rate and its target. Asensio's market rate or money market rate corresponds to the bond rate in the terminology of Palley (2013).

is equal to the central bank refinancing rate plus an endogenous markup which depends on the conditions in the market for money or liquidity (ibid., 337 & 340). In a nutshell, Asensio's central point is that "the markup reflected in the spread between the central bank refinancing interest rate and the market interest rate is endogenously determined by the total demand and supply of money, given the central bank refinancing rate" (ibid., 330).

Asensio claims that three broad consequences follow from this analysis. Firstly, an increase in liquidity preference, that is, a desire to hold more money and fewer other financial assets, will lead to an increase in market rates and hence in lending rates. Secondly, an increase in the supply of money associated with open-market operations ought to lead to a decrease in the market rate of interest and hence in the rate of interest on loans. "Central banks have the power to increase the total quantity of money much beyond the credit money by buying public and private debts in the markets" (ibid., 239). However, in a long aside, Asensio points out that market interest rates may not move after all and that such open market operations may fail to achieve the decrease in market rates, if economic agents hold firm to their belief in the existence of a conventional market interest rate, as Keynes (1936, 203-204) would have it (Asensio, 2017, 340). The interest rate would only decrease temporarily, as agents would sell financial assets in an attempt to become more liquid and thereby drive the rate back up.

Finally, following up on his analysis, Asensio computes the equilibrium market rate of interest of his model, and shows that within his model a higher level of economic activity must be associated with a higher rate of interest (ibid., 343), thus recovering the standard crowding-out effect which Asensio associates with Keynes and which can be found in the standard IS/LM model. The main reason for this, from Asensio's standpoint, is that the increase in economic activity leads to an increase in the transaction demand for money, which will not be fulfilled at a given rate of interest because this additional demand for money will go beyond the flow of money being endogenously created by the additional flow of credit.

In what follows, in part as a response to the critique that post-Keynesians are confusing stocks and flows, we wish to formalize Asensio's theoretical apparatus within a stock-flow consistent model. In particular, to illustrate the usefulness and clarity of this approach, we build a fairly simple SFC model with five sectors - households, firms, banks, the government and the central bank - with five interest rates: the rate on bank deposits, the rate on bank loans, the rate on commercial paper, the rate on short-term securities issued by the government (treasury bills), and the rate paid on bank reserves at the central bank, which is assumed to be the policy rate set by the central bank. We use terms associated with short-term securities, because, for simplification, our model will not deal with changes in asset prices, which makes more sense in the case of short-term financial assets.

Model structure

The structure of the model is relatively simple and is summarised in Tables 1 (the balance sheet matrix) and 2 (the transactions flow matrix) below.

Table 1: Balance Sheet Matrix

	Households	**Firms**	**Banks**	**Government**	**Central Bank**	Σ
Bank Deposits	$+M$		$-M$			0
Reserves			$+H$		$-H$	0
Commercial Paper	$+CP$	$-CP$				0
Bank Loans		$-L$	$+L$			0
Treasury Bills	$+GB_h$			$-GB$	$+GB_{cb}$	0
Inventories		$+INV$				$+INV$
Σ	V_h	V_f	V_b	V_g	0	$+INV$

Households hold bank deposits M, commercial paper CP and treasury bills GB as their assets. They receive wage income WB, distributed profits F from both firms and banks, as well as interest payments on all their assets whilst their only expenditures are on consumption C. Firms hold a stock of inventories INV which is financed by a combination of bank loans L and commercial paper (sold to households). They receive revenue from consumption expenditure and government spending G, they adjust their inventory stocks, and pay taxes T, wages, interest and distribute profits. Banks' assets are their loans to firms and their reserves H held at the central bank, while their only liabilities are households' deposits. They receive interest on loans and reserves, pay interest on deposits and distribute their profits to households. The government collects revenue in the form of tax payments as well as central bank profits F_{cb}. Its expenditures consist of government spending and interest payments on bills. Deficits are financed using treasury bills. The central bank holds a fraction of treasury bills while its liabilities consist of a stock of reserves of equivalent size.

Table 2: Transactions Flow Matrix

	Households	**Firms**		**Banks**	**Government**	**Central Bank**	Σ
		Current	Capital				
Consumption	$-C$	$+C$					0
Inventory Investment		$+\Delta INV$	$-\Delta INV$				0
Government Spending		$+G$			$-G$		0
Taxes		$-T$			$+T$		0
Wages	$+WB$	$-WB$					0
Distr. Firm Profit	$+F_f$	$-F_f$					0
Distr. Bank Profit	$+F_b$			$-F_b$			0
Distr. CB Profit					$+F_{cb}$	$-F_{cb}$	0
Interest on Com. Paper	$+r_{cp,-1}\ CP_{-1}$	$-r_{cp,-1}\ CP_{-1}$					0
Interest on Loans		$-r_{l,-1}\ L_{-1}$		$+r_{l,-1}\ L_{-1}$			0
Interest on Bills	$+r_{gb,-1}\ GB_{h,-1}$				$-r_{gb,-1}\ GB_{-1}$	$+r_{gb,-1}\ GB_{cb,-1}$	0
Interest on Deposits	$+r_{m,-1}\ M_{-1}$			$-r_{m,-1}\ M_{-1}$			0
Interest on Reserves				$+r_h\ H_{-1}$		$-r_h\ H_{-1}$	0
(Saving)	(sav_h)	(0)		(0)	(sav_g)	(0)	0
Δ Deposits	$-\Delta M$			$+\Delta M$			0
Δ Com. Paper	$-\Delta CP$		$+\Delta CP$				0
Δ Loans			$+\Delta L$	$-\Delta L$			0
Δ Bills	$-\Delta GB_h$				$+\Delta GB$	$-\Delta GB_{cb}$	0
Δ Reserves				$-\Delta H$		$+\Delta H$	0
Σ	0	0	0	0	0	0	0

The role of the buffer stock variable, which is important in ensuring the stock-flow consistency of the model, is played by M for households, by L for firms, by GB for the government (with the central bank acting as a lender of last resort purchasing any residual amount of GB not demanded by households) and by H for the central bank while the banks' balance sheet identity is implied by those of the other sectors.

Behavioural equations

In this section we discuss the key behavioural assumptions of the model (many of which are standard in the SFC literature; see Godley and Lavoie (2007)). A full list of model equations along with the parameter and initial values used is provided in the appendix.

Firms

Firms are assumed to formulate a real inventory target based on the expected real value of sales, given by $inv^t = \gamma_{inv}\ s^e$, where γ_{inv} is an inverse function of the average interest rate on commercial paper and bank loans (which are used to finance inventory stocks):

$$\gamma_{inv} = \gamma_1 - \gamma_2\ r^{av}. \tag{1}$$

In every period, they produce output equal to expected sales plus a fraction of the deviation of inventories from target:

$$y = s^e + \psi\ (inv^t - inv_{-1}). \tag{2}$$

Firms apply a simple mark-up pricing formula over a constant (exogenous) unit cost, meaning that output price and the distribution of income are exogenous and constant. We assume that at any given time, firms wish to finance changes in the stock of inventories by a combination of bank loans and commercial paper; in particular we assume that a fraction χ_{cp} of any change in inventories is financed through commercial paper, where this fraction is given by

$$\chi_{cp} = \begin{cases} \chi_1 + \chi_2\ (r_{l,-1} - r_{cp,-1}), & \text{if} \quad \Delta INV \geq 0 \\ \chi_1 - \chi_2\ (r_{l,-1} - r_{cp,-1}), & \text{if} \quad \Delta INV < 0. \end{cases} \tag{3}$$

This piecewise-linear function implies that whenever the interest rate on loans is higher than that on commercial paper, a larger fraction of increases in inventories are financed using commercial paper. Conversely, when the change in inventories is negative, firms pay off a larger fraction of those liabilities on which a higher rate of interest must be paid.[2] The change in the quantity of commercial paper is consequently given by

$$\Delta cp = \chi_{cp}\ \Delta INV, \tag{4}$$

with the residual amount of credit demand determining the change in loans. Thus, loan demand is assumed to be fully accommodated by banks, in line with what is assumed by Asensio (2017), as we do not consider issues of creditworthiness here. Hence, in line with the arguments of Asensio (2017), firms have multiple sources of credit, and bank loans compete with commercial paper. As an aside, it should be pointed out that commercial paper cannot fully replace bank loans at the macroeconomic level since only the latter imply a creation of means of payment. An increase in inventories financed by bank loans leads to an increase in the money supply (in the first instance held by firms, consequently distributed in the form of wage payments); by contrast, an increase in inventories financed by commercial paper leads only to a redistribution of existing means of payment from households to firms as households exchange deposits for commercial paper. Moreover, note that the structure of our model implies that there is certainly no confusion between stocks and flows. There is a well-defined *stock* of money, M, as well as a stock of reserves, H, both of which are distinct from the *changes* in the respective stocks, ΔM and ΔH, and the same is true for the *stock* of total credit, $L + CP$, and its change, $\Delta L + \Delta CP$, as well as the *stock* of bank credit, L, and its change, ΔL, as is clarified by the balance sheet and transactions flow matrices (Tables 1 and 2).

Households

Whilst the supply of commercial paper is determined within the firm sector, we must also formulate a demand side for the money market. Regarding the asset allocation of households, we assume that they formulate a demand for treasury bills based on a standard

[2] This is similar to one of Palley's (2013, 417; 2017, 101) assumptions, according to whom, all else equal, an increase in the bond rate will induce an increase in loan demand.

Tobinesque portfolio equation:

$$GB_h = (\lambda_{20} - \lambda_{21}\ r_{cp} + \lambda_{22}\ r_{gb} - \lambda_{23}\ r_m)\ V_{h,-1} - \lambda_{24}\ YD^e. \tag{5}$$

Similarly, we posit a portfolio equation for commercial paper, but as the supply of commercial paper is already determined by the financing needs of firms, we instead solve this equation for the *interest rate* on commercial paper, or more specifically the spread ε between the interest rate on commercial paper r_{cp} and the central bank target rate r_h. Doing so yields the following equation:

$$\varepsilon = \frac{CP + (\lambda_{13}\ r_m + \lambda_{12}\ r_{gb} - \lambda_{10} - \lambda_{11}\ r_h)\ V_{h,-1} + \lambda_{14}\ YD^e}{\lambda_{11}\ V_{h,-1}}. \tag{6}$$

The rate of interest on commercial paper is thus given by $r_{cp} = r_h + \varepsilon$, where the mark-up or spread ε is an endogenous variable which adjusts to clear the market for commercial paper. We believe that this is exactly what Asensio (2017) has in mind when he says that the market interest rate is equal to the central bank refinancing rate plus an endogenous markup.[3] Households' asset allocation is completed by the assumption that their deposit holdings act as a residual (as one portfolio item necessarily must in this approach). The remaining household behaviours are standard. We assume a Haig-Simons consumption function

$$C = \alpha_1\ YD^e + \alpha_2\ V_{h,-1}, \tag{7}$$

which conveniently allows us to solve for the implied steady-state level of household wealth as a function of steady-state consumption (which itself will turn out to be a function of exogenous government spending):

$$V_h = \frac{(1 - \alpha_1)\ C}{\alpha_2}. \tag{8}$$

[3]It seems to us, in line with Sawyer (2017), that it is more fruitful to speak of demand and supply on a security market than to discuss the supply of and the demand for money deposits or the equilibrium of the money market.

Banks and the central bank

In keeping with the arguments advanced by Asensio (2017) as well as Palley (2013, 207), banks are assumed to react to developments in financial markets by adjusting the loan rate r_l to keep it in line with the rate on commercial paper:

$$(9) \qquad \Delta r_l = \psi \; (r_{cp,-1} - r_{l,-1}).$$

At the same time, banks maintain a constant spread between the loan rate and the deposit rate r_m, so as to make profits:

$$(10) \qquad r_m = r_l - \omega.$$

The banking sector is as simple as it can be. In particular banks do not hold any treasury bills and hence are not attempting to satisfy some liquidity ratio, such as the ratio of safe assets (treasury bills) to loans. In Asensio's paper, the presence of banks is only implicit and their behaviour is not described, with the exception of the adjustment of the loan rate to what he calls the "money market interest rate".

As for the central bank, we assume that it is the residual purchaser on the market for treasury bills. This implies that the central bank has in mind a rate of interest on these bills and buys any residual amount of treasury bills left over by the household sector when the latter makes its portfolio decisions based on this treasury bill rate. In the calibration presented here, we assume that the treasury bill rate targeted by the central bank is equal to its policy rate, that is, the rate of interest paid on reserves, meaning that $r_{gb} = r_h$ so that the central bank pays exactly as much interest on reserves as it receives from bills. This means that central bank profit, F_{cb} will be 0 throughout and could in principle be eliminated from the tables and the equations. This is done merely for simplicity; we could just as well have supposed that the treasury bill rate targeted by the central bank is equal to its policy rate plus some exogenous markup so as to generate profits.

Government

The government undertakes an exogenous amount of government expenditure each period and collects taxes on nominal sales according to

$$T = \frac{\tau}{(1+\tau)}\, S. \tag{11}$$

Together with interest payments on treasury bills at the rate r_{gb} and transfers from the central bank this gives rise to an equation for the government balance:

$$sav_g = T - G - r_{gb}\, GB_{-1} + F_{cb}, \tag{12}$$

In the steady-state, we have $sav_g = 0$, and we can use the above equation along with the one determining tax payments to write

$$Y = \frac{(G + r_{gb}\, GB)(1+\tau)}{\tau}, \tag{13}$$

and

$$C = Y - G = \frac{(G + r_{gb}\, GB)(1+\tau)}{\tau} - G \quad (= YD). \tag{14}$$

These steady-state relationships will be useful in interpreting simulation outputs.

Simulation experiments[4]

We calibrate the model to a steady-state (which, given that this is not a growth model, is in fact a stationary state in which all model variables are constant) using the initialisation and parameter values detailed in the appendix. In order to discuss the arguments advanced by Asensio (2017), we carry out four main experiments, namely a permanent change in exogenous government spending, a permanent change in the desired inventory-

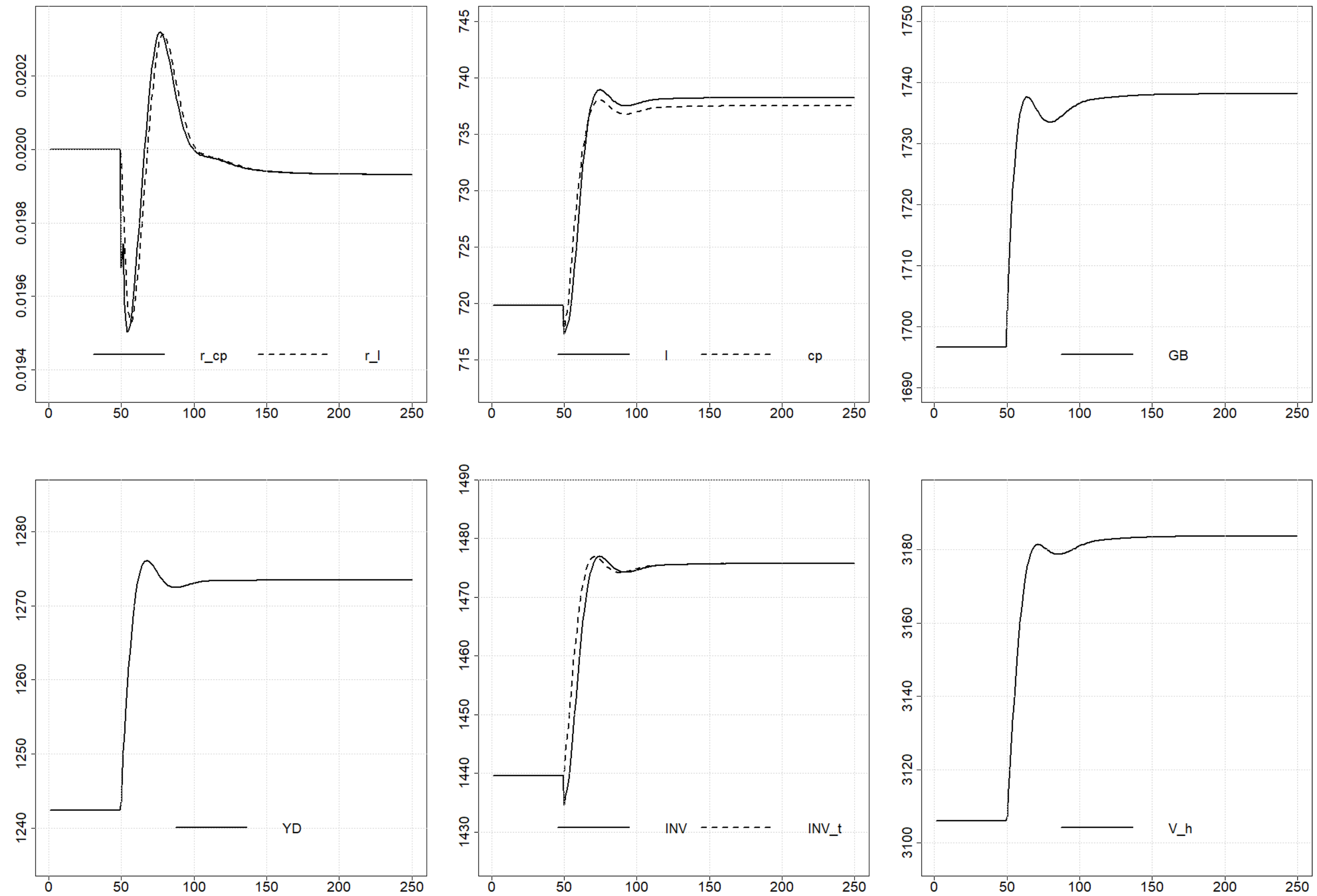
[4] All simulations were carried out using the PKSFC package for R provided by Antoine Godin, see `github.com/S120/PKSFC`.

to-sales ratio, a decrease in households' demand for commercial paper (associated with an equal increase in the demand for bank deposits), and an exogenous purchase of treasury bills by the central bank aimed at increasing the stock of money in the economy. According to Asensio's arguments, the first three experiments should be expected to lead to an increase in the endogenous interest rates (r_l, r_{cp}, and r_m) whereas the third should lead to a decrease. Finally, we carry out a fifth experiment investigating the relationship between the central bank's target rate and the endogenous interest rates. This is not directly related to the claims made by Asensio (2017) but gives rise to a result which may be of interest in the context of this debate.

The purpose of the first experiment (an increase in government expenditure) is twofold. Firstly, as shown in equation 13, G is a primary determinant of the steady-state level of income and hence sales, meaning that an increase in G should also, indirectly, lead to an increase in credit demand (due to higher desired inventory stocks). Secondly this experiment can be used to examine Asensio's claim that under his assumptions, there exists a crowding-out effect unless the central bank intervenes by lowering its target rate to prevent such an outcome. Figure 1 summarises the effect of a permanent increase in exogenous government expenditure. As expected, this increases both income and household wealth and leads to higher target and actual inventory stocks and consequently to an increased demand for loans and issuance of commercial paper.

Curiously, however, the figure reveals that in the new steady-state, the interest rates on commercial paper and bank loans are *lower* (if only by very little) than in the previous one, which is the exact opposite of what would be expected based on Asensio's arguments. Put very simply this result is due to the fact that the increase in government expenditure, and consequently income and sales increases not only the issuance of commercial paper, but also the demand for these assets, since with a higher level of wealth (a direct consequence of higher government expenditure), households are willing to hold a greater quantity of all assets. The dynamic adjustment shows that at different points in time, different effects dominate, making the commercial paper rate at first lower and then higher than its initial value, before it eventually settles to a new lower steady-state value.

Figure 1: Effect of an increase in exogenous government expenditure



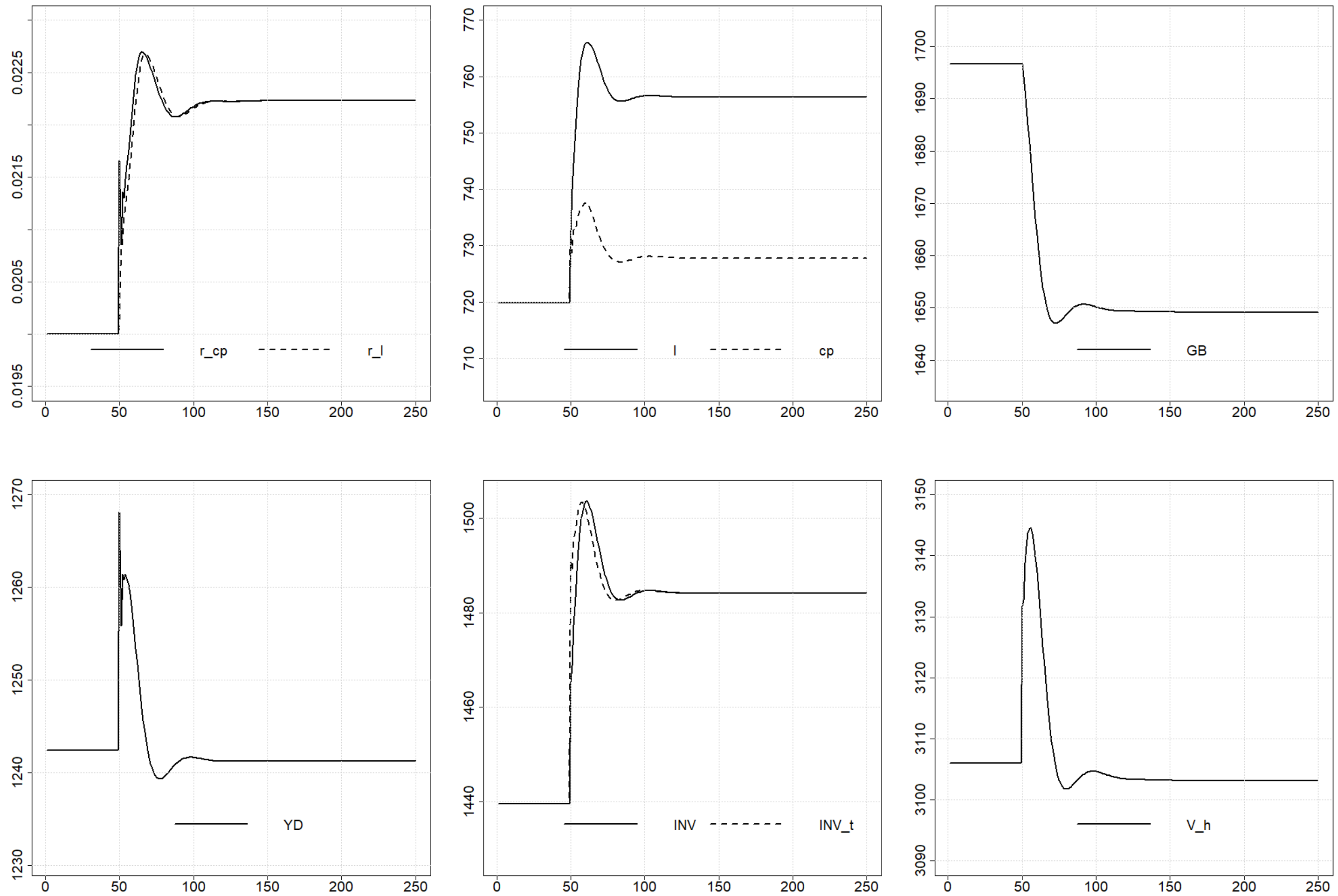
Similar simulation results - a temporary fall in interest rates followed by a return to the initial rate near the steady-state - were obtained by Lavoie (2017, 370-371), based on the model of Godley (1999) where banks have a target liquidity ratio and hence where the loan and deposit interest rates are endogenous, leading to the conclusion that one could obtain "a downward-sloping LM curve".[5] Palley (2017, 105) also arrives at this ambiguous result, based on his analytical model, arguing that "the LM curve in an endogenous money [sic] is not horizontal as often claimed and that the LM curve can be positively or negatively sloped depending on the relative income elasticities of loan and money demand". The bottom line of this first experiment is that in our model, the assumptions derived from Asensio (2017) do not necessarily imply the presence of a crowding-out effect. In the example shown here, we in fact obtain the opposite result, that is, steady-state endogenous interest rates which are slightly lower than their previous levels. The first section of the appendix presents some simple analytical results showing that the presence or absence of a crowding-out effect is ambiguous and dependent on parameter values.

Consider next the effect of a direct increase in credit demand, implemented via an increase in γ_1 and hence the target inventory-to-sales ratio for any given average interest rate, summarised in Figure 2. It can be seen that this experiment leads to an immediate and permanent increase in the endogenous interest rates, but produces only a transitory positive effect on output and income since these only increase whilst inventories adjust to their new target level. Curiously, however, we also observe that the new steady-state levels of disposable income and household wealth are slightly *lower* than previously. The reason for this is that steady-state Y, YD and V_h are all *increasing* with the quantity of treasury bills (see also the further discussion provided in the first section of the appendix), due to the interest income accruing to bill holders, and that, as shown in Figure 2, an increase in target inventories leads to a decrease in the steady-state quantity of treasury bills due to the *transitory* boom caused by increased inventory accumulation.[6]

[5] This simulation result was presented at a conference in Berlin in 2001, but the paper was only published in 2017!

[6] This point was also made by (Lavoie, 2017, 371), when arguing "that the increase in inventories leads to a decrease in the share of wealth arising out of government debt, and since the steady-state income depends on the level of government expenditures, inclusive of interest payments on debt, the fall in government debt generates a fall in steady-state income".

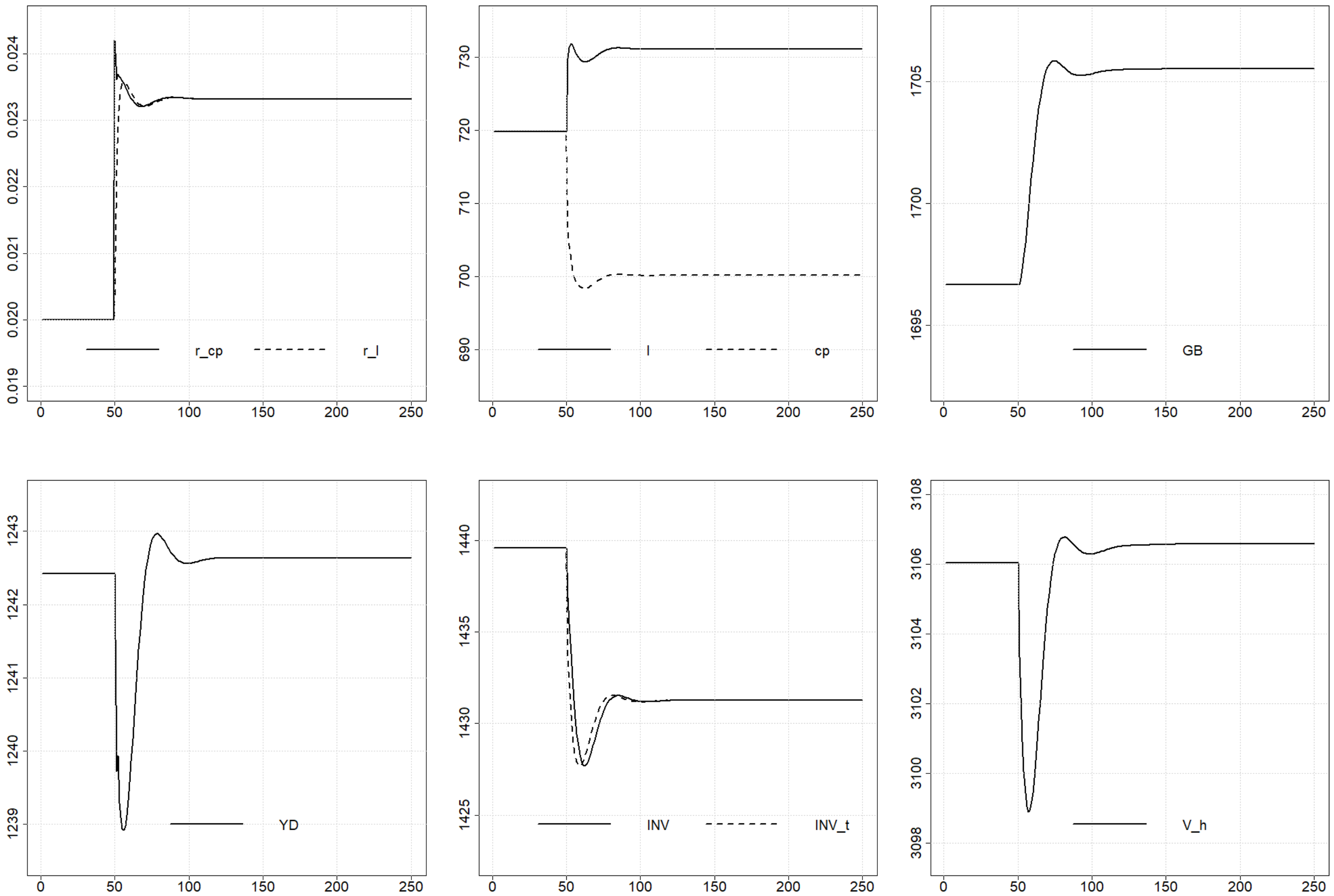
Figure 2: Effect of an increase in the target inventory-to-sales ratio



The result of this second experiment is hence perfectly consistent with the result of the first, namely that the movements of the endogenous interest rates will in essence depend on the relative movements of demand for non-bank credit by firms and the supply of such credit by households. In the new steady-state, we have, due to the increased target inventory-to-sales ratio, a permanently higher demand for credit whilst the supply of non-bank credit, due to the reduction in household wealth, is smaller than in the initial steady-state. The first section of the appendix provides some further interpretation of this result. The crucial point to take away from the first two experiments is hence that the response of the endogenous interest rates to exogenous "shocks" depends strongly on whether and how these affect the steady-state values of both stocks and flows in the model, leading to conclusions which are much less clear-cut than those derived from Asensio's framework which ignores such considerations.

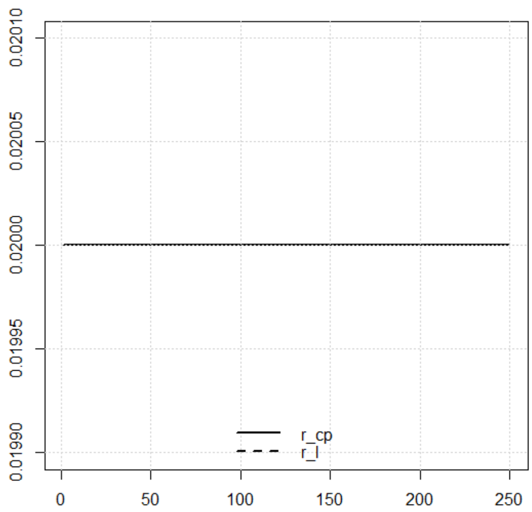
Another way to understand this result can be obtained if, instead of increasing the demand for non-bank credit by increasing the target sales-to-inventory ratio, we effectively reduce the supply by reducing the λ_{10} parameter in the households' portfolio choice equation, whilst implicitly increasing the demand for bank deposits for any given structure of interest rates. The result of this experiment is shown in Figure 3. The decreased demand for commercial paper on the part of households leads to an immediate increase in r_{cp}, raising r^{av} and hence reducing the target sales-to-inventory ratio, which also leads to a transitory decrease in output and household wealth. Firms react to the decreased supply of non-bank credit partly by increasing their borrowing from banks and partly by reducing their overall borrowing in line with the lower target inventory stock. For the same reasons outlined above, that is, the steady-state level of GB, the new steady-state levels of household wealth and disposable income are marginally higher than the previous ones, but the increase in household wealth is so small that the new steady-state supply of commercial paper remains below its previous level, meaning that the change in the endogenous interest rates is very robustly positive for reasonable parameter values.

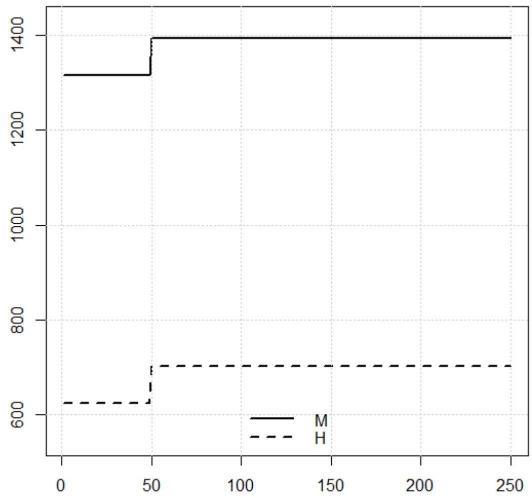
Figure 3: Effect of a decrease in the demand for commercial paper



For the fourth experiment, we simply impose that at a certain point in the simulation, the central bank purchases a given amount of treasury bills from households and continues to hold these until the end of the simulation, with the aim of increasing the stock of money in the system.[7] This is done in order to evaluate Asensio's claim that the central bank can control the stock of money and thereby influence the rate of interest. What happens in practical terms is that the central bank pays for the acquired treasury bills by transferring funds into the clearing and settlement system. As a result households acquire bank deposits while the banks acquire reserves at the central bank. As three assets are involved (treasury bills, bank deposits and reserves), six of the components of the balance sheet matrix of Table 1 must change. The results of this experiment are shown in Figure 4.

Figure 4: Effect of an exogenous increase in central bank treasury bill holdings





It can be seen that while the central bank is successful in increasing both the monetary base (reserves) and the stock of money through its intervention, this has no effect on the endogenous interest rates (or indeed any other model variable). The reason for this is simple, namely that making households exchange a part of their holdings of treasury bills

[7] In the model, unless the central bank accepts to have a treasury bill rate which falls relative to the policy rate, this can only be achieved by a fall in the λ_{20} coefficient, meaning that households accept to sell treasury bills with no change in their price (which is assumed to be constant and equal to 1).

for bank deposits does not by itself affect their portfolio preference for commercial paper (which is the primary driver of the endogenous interest rates). That is, unless we assume that, in response to the exogenous change in their portfolio holdings, households adjust their holdings of commercial paper, a change in the stock of money will not in and of itself have any further impact in the model. Asensio's claim that the central bank can, through asset purchases, to a certain degree influence the total stock of money in an economy does not run counter to horizontalist arguments. Indeed this view is an important component of post-Keynesian explanations of post-crisis monetary policy.

As explained by Lavoie (2010), quantitative easing measures following the global financial crisis have injected a large amount of reserves into banking systems, imposing a floor system whereby the central bank's target rate is equal to the interest rate paid on reserves, at the lower end of its interest rate corridor. In our model, we are effectively assuming the existence of a floor system since we do not assume that the central bank targets any particular level of reserves and posit that its target rate is equal to the interest rate on reserves. In such a situation, a change in the quantity of reserves will not have any impact on the interbank rate, unless it is so large as to effectively eliminate the floor system.[8] Instead, any effect on interest rates from asset purchases by the central bank would arise from their impact on asset prices and the yield curve.

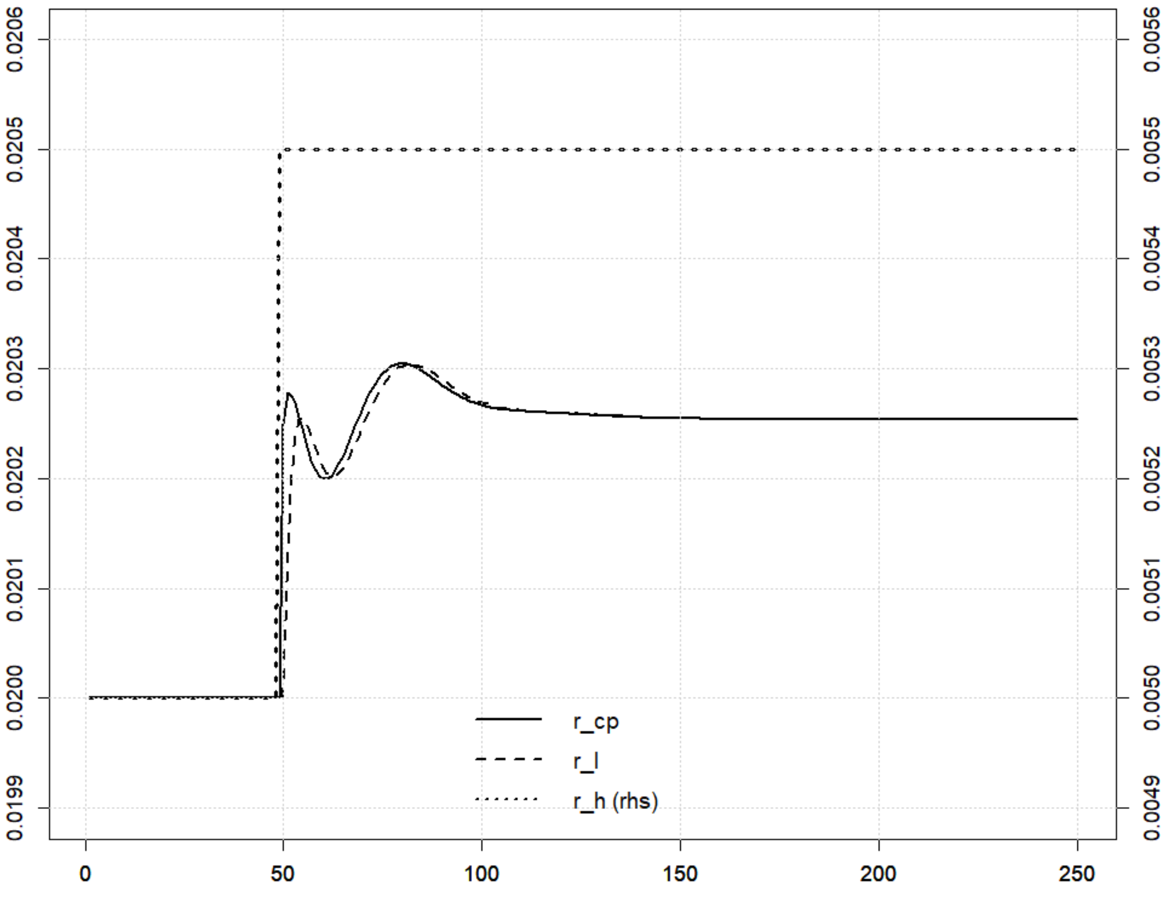
Such mechanisms are not depicted in our simple model but they are also not direct consequences of a shift of some "money supply" curve, however one might want to define such a construct. Indeed, as explained by Lavoie (2016), while it is perfectly permissible to assume that central bank asset purchases have an impact on interest rates, this is not due to their effect on the "money supply" since the latter does not, in fact, necessarily increase in response to such interventions.

The expression for ε given in equation 6 raises one further point which can be dealt with in a simple experiment. In particular, this expression (especially when rewritten as in equation 17 in the first section of the appendix) leads us to suspect that the interest rate on commercial paper, and hence all other endogenous interest rates, will not respond one-

[8]In a corridor system, there is also no straightforward relationship between the interbank rate and the stock of reserves due to the decoupling principle, as explained by Borio and Disyatat (2010).

for-one to an increase in the central bank rate. This is confirmed by an examination of Figure 5, which shows that r_{cp} in response to a small, 5 basis point increase of the central bank rate, increases by only just over 3 basis points, owing to the portfolio reallocation households undertake in favour of treasury bills, the interest rate of which is tied directly to the central bank's target rate. While not directly relevant to the arguments of Asensio (2017), this is an interesting implication of reproducing his assumptions in a fully-specified SFC model.

Figure 5: Effect of an increase in the interest rate on reserves



Conclusion

Overall, our experiments suggest that while Asensio (2017) raises a number of important points, particularly regarding competition between bank- and non-bank lending and the effects thereof on mark-up formation in the banking sector, some of his conclusions do not appear robust to an examination within a fully-specified (yet simple) SFC framework, even when one follows his assumptions are closely as possible. The use of a partial, non-SFC perspective leads him to ignore some important feedback effects, the inclusion of which may or may not leave his conclusions unaffected, and the consideration of which in any case allows for a better understanding of the dynamics of monetary economies. Thus, our paper shows once more that, on a broader note, when dealing with monetary economics, one has to go beyond a partial equilibrium analysis that ignores feedback effects on the accumulation of assets or liabilities or on the values taken by real variables. One has to do better than moving around supply or demand curves of money or of credit, as is done for instance by Chick and Dow (2002), without considering the implications of doing so outside of a static, partial equilibrium framework.

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Notation

sav_h	Household saving
sav_g	Government deficit/surplus
WB	Wage bill
$F_{f/b/cb}$	Firm profits/Bank profits/Central Bank profits
C/c	Consumption (nominal/real)
G/g	Government expenditure (nominal/real)
$INV^{(t)}/inv^{(t)}$	(Target) inventory stock (nominal/real)
T	Tax payments
CP	Commercial Paper
L	Bank loans
H	Reserves
M	Bank deposits
$GB_{(h/cb)}$	Treasury bills (held by households/central bank)
r_{cp}	Interest rate on commercial paper
r_{gb}	Interest rate on treasury bills
r_l	Interest rate on bank loans
r_m	Interest rate on bank deposits
r_h	Interest rate on reserves
V	Wealth
$YD^{(e)}$	(Expected) disposable income
$s^{(e)}$	(Expected) real sales
S/s	Nominal/real sales
Y/y	Nominal/real output
λ_{ij}	Portfolio choice parameters
α_i	Consumption propensities
ψ	Adaptation parameter
p	Price level
ε	Commercial paper mark-up
γ_{inv}	Target inventory to expected sales ratio
γ_1	Target inventory ratio intercept
γ_1	Target inventory ratio sensitivity to average interest rate
r^{av}	Average interest rate on commercial paper and bank loans
N_d	Labour demand
α	Labour productivity
w	Wage rate
UC	Unit cost
θ	Price mark-up over unit cost
χ_{cp}	Fraction of change in inventories financed by commercial paper
χ_1	χ_b intercept
χ_2	χ_b sensitivity to interest rate differentials
ω	Mark-down over loan rate on bank deposits
τ	Sales tax rate

Appendices

Further discussion of simulation results

The expressions for steady-state income and wealth derived in the main text can be used to shed more light on the effects at work in producing the result shown in figure 1, and in particular on what determines whether in the new steady-state, following an increase in exogenous government expenditure, the endogenous interest rates settle below or above their previous level. Recall that the mark-up over the central bank rate on commercial paper, which determines the level of the other endogenous interest rates in the model, is given by a rearranged portfolio equation:

$$\varepsilon = \frac{CP + (\lambda_{13}\ r_m + \lambda_{12}\ r_{gb} - \lambda_{10} - \lambda_{11}\ r_h)\ V_{h,-1} + \lambda_{14}\ YD^e}{\lambda_{11}\ V_{h,-1}}. \tag{15}$$

Rewriting this expression only in terms of the level of government spending G and parameters in order to examine its derivative would result in a very lengthy and complicated expression. Instead, we rewrite the expression as follows:

First, note that the right hand side of equation 15 contains r_m which is a function of ε; in the steady-state: $r_m = r_l - \omega = r_h + \varepsilon - \omega$. Next, recall that the steady-state output, disposable income, and consequently household wealth can be written as functions of the level of government expenditure:

$$\begin{aligned} Y &= \frac{(G + r_{gb}\ GB[G])(1+\tau)}{\tau}, \quad \frac{dY}{dG} > 0 \\ YD &= \frac{(G + r_{gb}\ GB[G])(1+\tau)}{\tau} - G, \quad \frac{dYD}{dG} > 0 \\ V_h &= \frac{(1-\alpha_1)\ YD}{\alpha_2} \quad \frac{dV_h}{dG} > 0, \end{aligned} \tag{16}$$

where $GB[G]$ is used to signify that the quantity of treasury bills is itself a function of G as well, which is shown in simulations to be *increasing*. Finally, simulations also show that the steady-state stock of commercial paper is an increasing function of government expenditure (the exact value of which will, just like that for the stock of treasury bills, depend on the adjustment path), i.e. $\frac{dCP}{dG} > 0$. Keeping this in mind and using the expression for r_m presented above we rewrite equation 15 as follows:

$$\varepsilon = \frac{CP - (\lambda_{10} + \lambda_{13}(\omega - r_h) - \lambda_{12} r_{gb} + \lambda_{11} r_h)V_h + \lambda_{14} YD}{V_h(\lambda_{11} - \lambda_{13})}, \tag{17}$$

where we have assumed that $V_h = V_{h,-1}$ and $YD = YD^e$ since we are comparing steady-states. This, in turn, enables us to rewrite the expression for ε as

$$\varepsilon = \frac{CP}{V_h(\lambda_{11} - \lambda_{13})} - \frac{(\lambda_{10} + \lambda_{13}(\omega - r_h) - \lambda_{12} r_{gb} + \lambda_{11} r_h)}{(\lambda_{11} - \lambda_{13})} + \frac{\lambda_{14} YD}{V_h(\lambda_{11} - \lambda_{13})}. \tag{18}$$

From our discussion of the Haig-Simons consumption function above, however, we know that in the steady-state, the ratio of disposable income to household wealth is determined simply by the consumption propensities, namely

$$\frac{YD}{V_h} = \frac{\alpha_2}{(1 - \alpha_1)}, \tag{19}$$

so that we finally arrive at the expression

$$\varepsilon = \frac{CP}{V_h(\lambda_{11} - \lambda_{13})} - \frac{(\lambda_{10} + \lambda_{13}(\omega - r_h) - \lambda_{12} r_{gb} + \lambda_{11} r_h)}{(\lambda_{11} - \lambda_{13})} + \frac{\lambda_{14} \alpha_2}{(1 - \alpha_1)(\lambda_{11} - \lambda_{13})}, \tag{20}$$

or, for simplicity,

$$\varepsilon = \frac{CP}{V_h(\lambda_{11} - \lambda_{13})} + z, \tag{21}$$

where z denotes the latter two fractions appearing in equation 20 which only involve parameters. This equation reinforces the intuition for the results of our experiments provided above, showing that the steady-state level of ε depends on the ratio of the stock of commercial paper to the level of household wealth, i.e. on the demand for non-bank credit relative to the main variable determining its supply through households' portfolio choice.[9] Knowing that both CP, and V_h are (positive) functions of G, we can then write

[9]Note that we could further rewrite equation 21 by using equation 16 to express V_h as a function of government expenditure and the stock of treasury bills. However, we believe this presentation to be more

an expression for the derivative of ε with respect to G as follows:

(22) $$\frac{d\varepsilon}{dG} = \frac{V_h \frac{dCP}{dG} - \frac{dV_h}{dG} CP}{(\lambda_{11} - \lambda_{13})(V_h)^2}.$$

While the denominator of this expression is clearly positive since logic requires that $\lambda_{11} > \lambda_{12} + \lambda_{13}$ (see Godley and Lavoie, 2007, 145), it does not appear possible to make a definitive judgement regarding the relative size of the two parts of the numerator (before and after the minus respectively). Indeed, while in the example simulation we showed above, $\frac{d\varepsilon}{dG}$ was negative, one can also easily construct a case in which the opposite result obtains (although in all cases, the effect on interest rates appears to be slight for reasonable parameter values). This demonstrates that within a fully-specified SFC-framework, even when incorporating Asensio's assumptions as far as possible, the relationship between government expenditure and interest rates, and hence the presence or absence of a crowding-out effect is ambiguous. In particular, it will depend on the exact values taken by the derivatives of V_h and CP with respect to G as well as the absolute values of these variables, which in turn depend on the specific values of a range of parameters.

A similar analysis can be undertaken to gain a better understanding of the effects of an increase in γ_1, our second experiment. Noting that, as explained in our discussion of th second experiment in the main text, steady-state Y, YD and V_h are decreasing functions of γ_1, while CP is, (as one might suspect) an increasing function of γ_1, we obtain a derivative of ε with respect to γ_1 which looks identical to that obtained for G:

(23) $$\frac{d\varepsilon}{d\gamma_1} = \frac{V_h \frac{dCP}{d\gamma_1} - \frac{dV_h}{d\gamma_1} CP}{(\lambda_{11} - \lambda_{13})(V_h)^2}.$$

Once again, the denominator is clearly positive, but this time, we can also be certain about the sign of the numerator since we know that $\frac{dCP}{d\gamma_1} > 0$ and $\frac{dV_h}{d\gamma_1} < 0$. Indeed, our simulation experiments confirm that $\frac{d\varepsilon}{d\gamma_1}$ is robustly positive. While the result of Asensio (2017) hence appears to be confirmed in this instance, we nevertheless submit

useful in terms of intuition.

that our analysis is to be preferred since our use of a fully stock-flow consistent framework, just as argued by Godley (1999), enables us to gain a much closer understanding of the mechanisms involved in producing this outcome.

Full list of model equations

Households

$$sav_h = WB + F_f + F_b + r_{cp,-1}\ CP_{-1} + r_{gb,-1}\ GB_{h,-1} + r_{m,-1}\ M_{-1} - C \tag{24}$$

$$V_h = M + CP + GB_h \tag{25}$$

$$\Delta M = sav_h - \Delta CP - \Delta GB_h \tag{26}$$

$$YD = WB + F_f + F_b + r_{cp,-1}\ CP_{-1} + r_{gb,-1}\ GB_{h,-1} + r_{m,-1}\ M_{-1} \tag{27}$$

$$YD^e = YD^e_{-1} + \psi\ (YD_{-1} - YD^e_{-1}) \tag{28}$$

$$C = \alpha_1\ YD^e + \alpha_2\ V_{h,-1} \tag{29}$$

$$c = \frac{C}{p} \tag{30}$$

$$\varepsilon = \frac{CP + (\lambda_{13}\ r_m + \lambda_{12}\ r_{gb} - \lambda_{10} - \lambda_{11}\ r_h)\ V_{h,-1} + \lambda_{14}\ YD^e}{\lambda_{11}\ V_{h,-1}} \tag{31}$$

$$r_{cp} = r_h + \varepsilon \tag{32}$$

$$GB_h = (\lambda_{20} - \lambda_{21}\ r_{cp} + \lambda_{22}\ r_{gb} - \lambda_{23}\ r_m)\ V_{h,-1} - \lambda_{24}\ YD^e \tag{33}$$

Firms

$$F_f = C + G + \Delta INV - T - WB - r_{l,-1}\ L_{-1} - r_{cp,-1}\ CP_{-1} \tag{34}$$

$$V_f = INV - L - CP \tag{35}$$

$$\Delta L = \Delta INV - \Delta CP \tag{36}$$

$$s = c + g \tag{37}$$

$$s^e = s^e_{-1} + \psi\ (s_{-1} - s^e_{-1}) \tag{38}$$

$$inv^t = \gamma_{inv}\ s^e \tag{39}$$

$$\gamma_{inv} = \gamma_1 - \gamma_2\ r^{av} \tag{40}$$

$$y = s^e + \psi\ (inv^t - inv_{-1}) \tag{41}$$

(42) $$r^{av} = r_{l,-1} \ \frac{L_{-1}}{L_{-1} + CP_{-1}} + r_{cp,-1} \ \frac{CP_{-1}}{L_{-1} + CP_{-1}}$$

(43) $$\Delta inv = y - s$$

(44) $$N_d = \frac{y}{\alpha}$$

(45) $$WB = N_d \ w$$

(46) $$UC = \frac{w}{\alpha}$$

(47) $$p = (1 + \theta) \ UC$$

(48) $$INV = inv \ UC$$

(49) $$INV^t = inv^t \ UC$$

(50) $$S = s \ p$$

(51) $$Y = s \ p + \Delta inv \ UC$$

(52) $$\Delta CP = \chi_{cp} \ \Delta INV$$

(53) $$\chi_{cp} = \begin{cases} \chi_1 + \chi_2 \ (r_{l,-1} - r_{cp,-1}), & \text{if} \quad \Delta INV \geq 0 \\ \chi_1 - \chi_2 \ (r_{l,-1} - r_{cp,-1}), & \text{if} \quad \Delta INV < 0 \end{cases}$$

Banks

(54) $$F_b = r_h \ H_{-1} + r_{l,-1} \ L_{-1} - r_{m,-1} \ M_{-1}$$

(55) $$V_b = H + L - M$$

(56) $$\Delta r_l = \psi \ (r_{cp,-1} - r_{l,-1})$$

(57) $$r_m = r_l - \omega$$

Government

(58) $$sav_g = T - G - r_{gb} \ GB_{-1} + F_{cb}$$

(59) $$V_g = -GB$$

(60) $$\Delta GB = -sav_g$$

(61) $$T = \frac{\tau}{(1 + \tau)} \ S$$

(62) $$G = g \ p$$

(63) $$r_{gb} = r_h$$

Central Bank

(64) $$F_{cb} = r_{gb}\ GB_{cb,-1} - r_h\ H_{-1}$$

(65) $$V_c b = GB_{cb} - H$$

(66) $$GB_{cb} = GB - GB_h$$

(67) $$H = GB_{cb}$$

Parameters, exogenous variables & initial values

Table 3: Parameters & Exogenous variables

Parameter	Value	Parameter	Value	Parameter	Value
χ_1	0.5	χ_2	1000	τ	0.25
γ_1	1.45	γ_2	2.5	θ	0.5
α	1	ψ	0.5	α_1	0.875
α_2	0.05	ω	0.01	λ_{10}	0.27727
λ_{11}	2.5	λ_{12}	1.25	λ_{13}	1.25
λ_{14}	0.2	λ_{20}	0.45	λ_{21}	1.25
λ_{22}	2.5	λ_{23}	1.25	λ_{24}	0.2
g	200	r_h	0.005	w	1

Table 4: Initial values

Variable	Initial value	Variable	Initial value	Variable	Initial value
inv	1419.5887	INV	1419.5887	s	1028.2776
s^e	1028.2776	YD	1242.4165	YD^e	1242.4165
V_h	3106.0411	r_m	0.01	r_l	0.02

Table 4: Initial values

Variable	**Initial value**	**Variable**	**Initial value**	**Variable**	**Initial value**
r_{cp}	0.02	M	1324.6626	CP	709.7943
GB	1696.6581	GB_h	1071.5842	GB_{cb}	625.0739
L	709.7943	H	625.0739		

Impressum

Publisher: Hans-Böckler-Stiftung, Hans-Böckler-Straße 39, 40476 Düsseldorf, Germany
Contact: fmm@boeckler.de, www.fmm-macro.net

FMM Working Paper is an online publication series available at:
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ISSN: 2512-8655