Inflation, Employment and Liquidity Preference in a Stock-Flow Consistent Model*

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Abstract:
This paper develops a stock-flow consistent model that integrates the role of liquidity preference into the economic behaviour and decision-making process of all private sectors of the economy, namely households, firms and commercial banks. Considerable attention is placed to the analysis of the channels through which the liquidity preference of these sectors can potentially affect the performance of a monetary production economy. It is argued that these channels are associated with *i)* the desired consumption and investment expenditures; *ii)* the asset allocation of households and banks; *iii)* the credit rationing and loan repayment procedure; *iv)* the lending and deposit interest rates; and *v)* the wage and profit claims of workers and firms respectively. In the simulations conducted we focus particular attention on how an uncertainty shock is likely to affect via the aforementioned channels the dynamics of employment and inflation. Furthermore, we explore the role that fiscal and monetary policy can arguably play if high employment and low inflation are to be attained in an environment of high perceived uncertainty and of diminished state of confidence.

JEL-Classification: E12, E21, E22, E24, E31, E52, E62

Keywords: stock-flow consistent modelling, inflation, employment, liquidity preference, fiscal and monetary policy

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1. Introduction

Liquidity preference constitutes a fundamental concept in Post Keynesian macroeconomic analysis of monetary production economies. The notion of liquidity preference brings to the forefront the non-neutral role of monetary and financial factors, the impact of uncertainty on economic behaviour as well as the relevance of money contracts and of cash payment commitments in the exploration of macroeconomic performance. It also reveals the fallacy that underlies Say's law pinpointing thereby the potential inability of money-using economies to attain full employment if essential policy interventions are not to be implemented.

In the recent literature of stock-flow consistent (SFC) modelling some aspects of the role of liquidity preference have been introduced into the behavioral equations framing the relevant models. In particular, most of the SFC models are inspired by Tobin's (1958, 1969) approach and formalize the asset choice of the household sector by assuming that the allocation of wealth is determined by assets' relative rates of return and by the transactions demand for money (see e.g. Lavoie and Godley, 2001-2; Godley and Lavoie, 2007; Dos Santos and Zezza, 2004; Zezza and Dos Santos, 2004, 2006). In Le Heron and Mouakil (2008) and Le Heron (2008, 2009) the above methodology is applied to the asset allocation of banks; furthermore, these authors formalize the credit rationing as a function of various risks associated with the liquidity preference of banks. Besides, Godley (1999), Lavoie and Godley (2006) and Godley and Lavoie (2007) associate banks' liquidity preference with their target liquidity ratio (which the authors define as the bills to deposits ratio) and allow the discrepancy between the actual and the target ratio to affect the interest rate on deposits.

The aforementioned models lack, however, to put forward an integrated approach to the role of liquidity preference in the economic performance of monetary economies. This is either because they confine the application of liquidity preference only to a specific sector of the economy[1] or due to the fact that the connection between liquidity preference and uncertainty is not explicitly formalized and explored. Furthermore, most

[1] The only SFC models that examine simultaneously the role of liquidity preference in two sectors of the economy (households and commercial banks) can be found in Godley (1999) and Godley and Lavoie (2007).

of these models apply liquidity preference issues only to the asset side of the balance sheet structures and not also to the liability one as, it has, for instance, been suggested by Minsky (1975, ch. 4).

The objective of this paper is to deploy a SFC model that explicitly integrates the role of liquidity preference into the economic behaviour of all private sectors of the economy (households, firms and banks) and pays considerable attention to its impact on both employment and inflation. By doing this, the paper attempts to fill the aforementioned gap in SFC modelling as well as to suggest that liquidity preference can potentially be linked not only to the dynamics of employment, as it has traditionally been argued, but also with the dynamics of inflation. Two additional aims are, *first*, to explore how each economic sector's preference for liquidity is interconnected with the liquidity preference of other sectors and, *second*, to assess how monetary and fiscal policies are likely to contribute to the attainment of high employment and low inflation in an environment of high perceived uncertainty.

The paper is organized in six sections including the present introduction. In section 2 the theory of liquidity preference is briefly discussed and the general analytical framework adopted in our model is addressed. Section 3 sets out the structure of the model; special emphasis is placed on the behavioural equations that capture the role of liquidity preference. Section 4 presents our experiments in which we investigate the effect of a shift in uncertainty and liquidity preference on inflation and employment; in this section the interplay among households', firms' and banks' liquidity preference is also discussed. In section 5 the role of fiscal and monetary policies is explored with the aid of some further simulations. Section 6 gives our conclusions.

2. Liquidity preference theory: a conceptual framework for the analysis of economic sectors' behaviour

Liquidity preference theory has a prominent role in Keynes's investigation of the behaviour of monetary production economies. At the heart of this theory is the assertion that in a world of fundamental uncertainty economic units desire to hold money (or,

generally, to have a liquid position) in order to protect themselves against unspecified and unspecifiable future events (Cardim de Carvalho, 2009).

In chapters 13 and 15 of *The General Theory* Keynes uses the liquidity preference theory in order to explain the determination of the long-term interest rate. In his analytical framework, where households are assumed to allocate their wealth between money and bonds, the interest rate is "the reward for parting with liquidity" (Keynes, 1936, p. 167) and is thereby the "'price' that equilibrates the desire to hold wealth in the form of cash with the available amount of cash" (*ibid.*). Nonetheless, using liquidity preference theory for the explanation of money demand and interest rate determination is just one of its potential interpretations (see e.g. Cardim de Carvalho, 1999).[2] Later expositions by Post Keynesian scholars have indicated that liquidity preference should also be viewed as a concept that underpins asset choice, liability structure determination, firms' investment decisions and banks' credit rationing procedures.

Robinson (1951), Davidson (1978) and Chick (1983) were among the first Post Keynesian scholars who suggested that the liquidity preference theory can be interpreted as a theory of asset choice that refers both to households' and firms' decision-making process. This is an interpretation that draws on Keynes's conceptual framework. In chapter 17 of *The General Theory* Keynes defines four attributes that characterize individual assets: the expected money return, q, the carrying cost, c, the liquidity premium, l, and the expected change in the money price of the asset, a. The own-rate of return of a specific asset is equal to the sum $q-c+l+a$. The asset alloacation is thereby based on the principle of the "maximization of net advantage" (Chick, 1983, p. 299) which implies that economic units allocate their available resources by comparing the rates of return on various assets. To put it differently, economic units decide about the proportion of each asset that they desire to hold by balancing the overall expected return of an asset, $q-c+a$, with the liquidity premium, l, that it provides.

In this context, of particular significance are the factors that determine this liquidity premium. The liquidity premium is an implicit yield that reflects how much economic units are willing to pay for the potential convenience or security provided by the power

[2] Cardim de Carvalho (1999) also pinpoints that such an interpretation is a narrow and debatable one.

of disposal over an asset (Keynes, 1936, p. 226; see also Dequech, 2005, p. 535). It follows that the liquidity premium of an asset depends on two factors: *first*, its power of disposal and, *second*, the willingness of economic units to pay for such a power. Let us first focus on the first factor. Davidson (1978, p. 62) explains that "[t]he power of disposal involves, in a monetary economy, the expectation of being able to exchange the asset for the medium of exchange cheaply and readily in a continuous spot market at a money price which is never very different from the well-publicised spot prices of the last few transactions". Following this definition as well as Robinson's (1951, p. 94) conceptual framework, it can be argued that the power of disposal is negatively linked to four kinds of risk: the illiquidity risk, the income risk, the capital risk and the risk of default. Illiquidity risk refers to the capacity to realize the value of an asset in cash whatever the value may be at the moment;[3] income risk captures the uncertainty for the future cash flows provided to the asset holder; capital risk reflects the fluctuations in capital asset prices;[4] risk of default refers to the likelihood borrowers being unable to honour (partially or totally) their cash payment commitments associated with their liabilities.

Turning to the second factor that determines liquidity premium, it is argued that the degree at which economic units are willing to pay for the power of disposal over an asset is associated with the motives that prompt them to be liquid in a monetary production economy. In chapter 15 of *The General Theory* Keynes postulates three such motives: the *transaction* motive which is linked to their need to make regular expenditures and to meet contractual obligations; the *precautionary* motive that refers to their desire to meet unforeseen contingencies; and the *speculative* motive which is related to the objective of profit earning from knowing better than the market what the future will bring forth.[5] The first motive reveals that the more are the regular expenditures and the contractual obligations the higher is the willingness of economic units to pay for a higher power of disposal. The precautionary motive implies that the preference for a higher power of disposal shifts up when the perceived uncertainty and/or uncertainty aversion are on the

[3] As Robinson (1951, p. 94) points out, this is "liquidity in the narrow sense".
[4] See Davidson (2002, p. 91) for a more detailed description of the capital and income risk.
[5] After the publication of *The General Theory* Keynes introduced a forth motive, the finance one, which captures the need to hold money for funding discretionary spending (see Keynes 1937a,b; Davidson, 1978, ch. 7).

increase; this implies that uncertainty affects positively the liquidity premium of liquid assets (Dequech, 2005). Besides, the speculative motive illustrates that the liquidity premium of a liquid asset is higher the higher is the expected depreciation of other assets (*ibid.*). It becomes thereby clear that economic units' preference for liquidity has, in conjunction with the risks tied to each asset, a fundamental role in determining their decision upon the asset allocation of resources.

However, liquidity preference theory may not be strictly interpreted as a theory of asset choice. In his exposition for liquidity preference theory Minsky (1975, ch. 4) goes the argumentation one step further.[6] He suggests that the liquidity preference theory should be viewed as a theory of portfolio choice. As he explains (*ibid*, p. 68), a portfolio decision captures not only the choice of which assets are to be held, but also the choice of how the position in these assets is to be financed (i.e. what liabilities are to be held). In light of this framework, Minsky applies Keynes's typology about the own rates of return on individual assets to the entire portfolio of economic units. More specifically, he (*ibid*, p. 85) asserts that the balance sheet of an economic unit is characterized by three attributes: *first*, its cash flows q, which are generated by the possession of portfolio's assets, *second* its cash outflows, c, associated with the unit's outstanding liabilities and, *third*, its liquidity premium, l, which is linked to the proportion of liquid assets in the balance sheet structure. The liquidity of a portfolio is reflected on l-c. This implies that the liquidity of a portfolio is not only affected by the liquidity premia of the liquid assets being held but also by the cash payment commitments due to outstanding liabilities.

The above interpretation is of particular importance for the analysis of firms' investment decision.[7] Firms should trade-off between the returns expected to be generated from their investment in capital goods and the deterioration of their liquid position. Investment on capital goods is associated with increased illiquidity basically for two reasons. First, capital stock is characterized by a very low degree of liquidity since there are no organized markets for the purchase of secondhand capital goods (Davidson, 2002,

[6] See also Cardim de Carvalho (1999) for a discussion of the Minskyan interpretation of liquidity preference.

[7] As we shall show in the next section, Minsky's interpretation has also significant implications for households' decision regarding their desired indebtedness.

p. 71). Second, when desired investment moves up, there is a potential increase in the need for external finance which in turn may lead to increased indebtedness and, thus, to higher cash payment commitments; consequently, as Kalecki (1937, 1971)[8] has also emphasized with his 'principle of increasing risk', increasing investment may entail increasing illiquidity risk (see, in particular, Kalecki, 1937, p. 442). It follows that firms' preference for liquidity becomes one of the factors that determines their desired amount of investment expenditures.

In recent Post Keynesian literature considerable attention has also been given to the liquidity preference of banks (see e.g. Dymski, 1988; Heise, 1992; Dow, 1996, 2006; Chick and Dow, 2002; Cardim de Carvalho, 1999; Rochon, 1999; Bibow, 1998, 2006; Monvoisin and Pastoret, 2003; Lavoie and Godley, 2006; Paula and Alvez, 2006; Le Heron and Mouakil, 2008; Le Heron, 2008, 2009).[9] It is argued that, except for households and firms, it is also banks that need to balance between profits and liquidity in their decision-making process. Within the context of the banking sector a liquid position consists in guarding against the risk of insufficient liquidity as well as that of insolvency.[10] The risk of insufficient liquidity is related to the potential inability of banks to honour their liability commitments (e.g. to satisfy depositors' demand for liquidity) while the risk of insolvency corresponds to the likelihood banks' assets being of insufficient value compared with their liabilities (basically because of loan defaults). An increase in the perceived risks of banks is likely to trigger three main effects. First, banks may become more cautious in their lending behaviour by increasing their minimum creditworthiness criteria; this is because they desire to decrease the possibility of default and safeguard thereby a liquid position. Second, and in accordance with the previous point, it is more likely banks to reallocate their resources towards investment (e.g commercial paper, bonds etc.), since securities market are characterized by higher liquidity, as well as towards safe assets (e.g. Treasury bills), which are associated with a low risk of default. Third, banks may apply higher interest rate premia as a compensation for undertaking higher risks. Banks' preference for liquidity determines to

[8] See also Sawyer (2001, pp. 495-498).
[9] Monvoisin and Pastoret (2003, pp. 28-31) point out that the liquidity preference of banks has its origin in Keynes's *Treatise on Money* and *General Theory*.
[10] See, in particular, Le Heron (1986, 2002), as quoted in Monvoisin and Pastoret (2003, p. 25).

what extent they are, in face of higher risks, willing to forego a more liquid position in favour of higher expected profitability.

The above brief discussion reveals, therefore, that the concept of liquidity preference is particularly relevant for the analysis of economic units' behaviour in all private sectors of a monetary economy. Moreover, although different aspects of the notion of liquidity preference are underscored in each sector's analysis, what should be drawn into attention is the prominent role of uncertainty in all these interpretations. An increase in the perceived uncertainty tends to lead economic units to adopt a more liquid posture which permits them to be less constrained by various types of commitment. This may trigger devastating effects on the overall economic activity (Bibow, 1998); it is the liquidity preference theory that brings to the surface the channels through which such an impact may exist.

In the subsequent section we deploy a SFC model wherein we attempt to incorporate this generalized conceptualization for the role of liquidity preference and to stress out the implications of such an incorporation. Particular attention is focused on the impact that uncertainty and the state of confidence are likely to have on the economic behaviour of households, firms and banks and thereby on the performance of a monetary production economy.

3. The structure of the model and the behavioral equations

Our postulated economy consists of five sectors: households, firms, banks, central bank and government. We distinguish between worker households who receive only wage income and rentier households that are recipients of capital income.[11] The model relies on *table 1* that depicts the transactions matrix and on *table 2* that gives the balance sheet matrix. In *table 1*, where the monetary flows between the sectors of the economy are portrayed, the sources of funds of each sector are illustrated by plus signs while the uses of funds are represented by negative signs. Stock-flow consistency requires that the sum of each row and column is equal to zero. In *table 2* the elements with plus signs

[11] See van Treeck (2009) for a similar distinction. A more realistic assumption would be to allow rentier households to receive both wage and capital income. However, such an assumption would further complicate our model without having something to offer to the main arguments developed in the paper.

represent assets and the symbols with negative signs indicate liabilities. The sum of every row is also zero except in the case of accumulated capital. The last row depicts the net wealth of each sector. Since in our model the role of inflation is explicitly considered, each nominal variable presented in the tables (and in the behavioral equations described below) has its real counterpart which is denoted by putting an *R* in front of the variable name.

Before we proceed it is worthy to point out that a key exogenous variable in our model is the index for the degree of perceived uncertainty, denoted by *unc*. This variable takes values from 0 (no perceived uncertainty) to 1 (full perceived uncertainty) and attempts to quantify the degree of uncertainty that characterizes the behaviour and decisions of economic units. When the state of confidence of economic units decreases as a result of an exogenous event (institutional change, information for a potential crisis, political instability etc.), the value of our index becomes higher, and *vice versa*. For the sake of the arguments developed below all economic sectors are assumed to perceive the same degree of uncertainty. In what follows we present the accounting identities and the behavioral equations that correspond to each sector of our postulated economy.

3.1 Government sector

$$RG = RG_{-1} \cdot (1 + g_{rg}) \tag{1}$$

$$G = p \cdot RG \tag{2}$$

$$T = IT + T_P + T_R + T_{BP} \tag{3}$$

$$IT = \frac{\tau}{1+\tau} Y \tag{4}$$

$$T_P = \tau_P TP_{-1} \tag{5}$$

$$T_R = \tau_R Y_{R-1} \tag{6}$$

$$T_{BP} = \tau_{BP} BP_{-1} \tag{7}$$

$$BD = BD_{-1} + G + r_{B_{-1}} B_{-1} - T - CBP \tag{8}$$

$$B = BD \tag{9}$$

$$r_B = r_{CB} \tag{10}$$

Table 1: Transactions Matrix

		Households		Firms		Commercial Banks		Central Bank		
	Government	Workers	Rentiers	Current	Capital	Current	Capital	Current	Capital	Total
Consumption		$-C_W$	$-C_R$	+C						0
Government expenditures	-G			+G						0
Net investment				+I	-I					0
Indirect taxes	+IT			-IT						0
Wages		+W		-W						0
After-tax profits			+DPT	-TPT	+UPT					0
Taxes on profits	$+T_P$			$-T_P$						0
Interest on consumer loans		$-r_{CL-1}rep_{CL}CL_{-1}$				$+r_{CL-1}rep_{CL}CL_{-1}$				0
Interest on industrial loans				$-r_{IL-1}rep_{IL}IL_{-1}$		$+r_{IL-1}rep_{IL}IL_{-1}$				0
Interest on deposits			$+r_{M-1}M_{-1}$			$-r_{M-1}M_{-1}$				0
Taxes on rentiers' income	$+T_R$		$-T_R$							0
Interest on CB advances						$-r_{CB-1}A_{-1}$		$+r_{CB-1}A_{-1}$		0
Commercial banks' profits			+BPT			-BPT				0
Taxes on commercial banks' profits	$+T_{BP}$					$-T_{BP}$				0
Central Bank's profits	+CBP							-CBP		0
Interest on treasury bills	$-r_{B-1}B_{-1}$		$+r_{B-1}B_{h-1}$			$+r_{B-1}B_{b-1}$		$+r_{B-1}B_{cb-1}$		0
Δconsumer loans		+ΔCL					-ΔCL			0
Δindustrial loans					+ΔIL		-ΔIL			0
Δdeposits			-ΔM				+ΔM			0
Δequities			$-\Delta ep_e$		$+\Delta ep_e$					0
ΔCB advances							+ΔA		-ΔA	0
Δtreasury bills	+ΔB		$-\Delta B_h$				$-\Delta B_b$		$-\Delta B_{cb}$	0
ΔHPM (High-Powered Money)			$-\Delta HPM_h$				$-\Delta HPM_b$		+ΔHPM	0
Total	0	0	0	0	0	0	0	0	0	0

Table 2: Balance Sheet Matrix

	Government	Households		Firms	Commercial Banks	Central Bank	Total
		Workers	Rentiers				
Deposits			+M		-M		0
Equility			$+ep_e$	$-ep_e$			0
Consumer loans		-CL			+CL		0
Industrial loans				-IL	+IL		0
Capital				+K			+K
CB Advances					-A	+A	0
Treasury bills	-B		$+B_H$		$+B_B$	$+B_{cb}$	0
High-Powered Money (HPM)			$+HPM_H$		$+HPM_B$	-HPM	0
Net Wealth	-B	-CL	$+V_R$	$+V_F$	0	0	+K

Equation (1) reveals that the real government expenditures, *RG*, are growing at an exogenously given rate, g_{rg}.[14] The nominal government expenditures, *G*, are given by (2); *p* is the price level. The government collects indirect taxes through an indirect tax rate as well as direct taxes from rentier households, firms and commercial banks. Equation (3) gives the government's total revenues from taxes, *T*, where IT stands for the indirect taxes, T_P for taxes from the profits of firms, T_R for taxes from rentier households and T_{BP} for taxes from commercial banks. Expressions (4)-(7) reflect the sources of tax revenue;[15] τ, τ_P, τ_R and τ_{BP} are respectively the indirect tax rate, the tax rate on firms' profits, on rentier households' income and on commercial banks' profits; furthermore, Y is the nominal income of the economy, TP the total pre-tax profits of firms, Y_R the nominal income of rentier households and BP the banks' pre-tax profits. By assuming that the government receives the central banks' profits, *CBP*, it follows that the government's budget deficit, *BD*, is given by equation (8) where B stands for the treasury bills and r_B for the interest rate on the treasury bills. Since the supply of bills by the government is determined by its budget constraint, expression (9) invariably holds. Note that the treasury bills are assumed to be bought by rentier households, commercial banks and the central bank, the latter acting as a residual purchaser. In addition, the interest rate on treasury bills is assumed to be equal to the central bank's discount interest rate, r_{CB} (equation 10).

3.2 Worker households

Worker households receive only wage income. It is assumed that their desired consumption is, at least in some periods, higher than this that can be financed from their income; hence, they take on consumer debt. It follows that their balance sheet consists of only one liability, their outstanding debt, which is equal to their unpaid consumer loans, *CL* (see *table 2*). What should be called into attention is that the more worker households wish to consume in excess of their disposable income the more they go into debt and the less liquid their position is likely to become. This implies that they decide

[14] See e.g. Godley and Lavoie (2007, p. 397) for a similar assumption.
[15] For equation (4) we have that $IT = \tau(Y - IT) \Rightarrow IT = [\tau/(1+\tau)]Y$. See e.g. Godley and Lavoie (2007, p. 331).

upon their desired spending by taking into account their preference for liquidity. It is hypothesized that worker households' liquidity preference is revealed on the limit that they assign regarding their burden of debt. Higher (lower) preference for liquidity entails a lower (higher) target burden of debt and thereby less (more) indebtedness and less (more) consumption expenditures. It is also noteworthy that the preference for liquidity of workers may exert some impact on their wage demands since an increase in the wage rate is likely to be favourable for their liquidity position. Equations (11)-(26) reflect more precisely the operations linked to worker households' decisions.

$$Y_W = W - r_{CL_{-1}} \cdot rep_{CL} CL_{-1} \tag{11}$$

$$W = w \cdot L_{-1} \tag{12}$$

$$RY_W = Y_W / p \tag{13}$$

$$RC_W = RY_W + \Delta CL / p \tag{14}$$

$$C_W = RC_W \cdot p \tag{15}$$

$$bur_W = \frac{(1 + r_{CL_{-1}}) rep_{CL} CL_{-1}}{W} \tag{16}$$

$$bur_W^T = \gamma_0 - \gamma_1 \cdot unc \tag{17}$$

$$C_{WD} = \xi \cdot (Y_W - rep_{CL} CL_{-1}) \tag{18}$$

$$\xi = 1 + \xi_1 (bur_{W_{-1}}^T - bur_{W_{-1}}) - \xi_2 \cdot r_{CL} \tag{19}$$

$$NCL_D = C_{WD} - (Y_W - rep_{CL} CL_{-1}) \tag{20}$$

$$CL_D = (1 - rep_{CL}) CL_{-1} + NCL_D \tag{21}$$

$$s_W = \frac{W}{Y} \tag{22}$$

$$s_{WB} = \frac{\left((1 + r_{CL_{-1}}) \cdot rep_{CL} CL_{-1}\right) / Y}{bur_W^T} \tag{23}$$

$$s_W^T = w_0 + w_1 \cdot re + w_2 \cdot s_{WB} \tag{24}$$

$$g_p^e = g_{p_{-1}} + \theta_{g_p} \cdot (g_{p_{-1}} - g_{p_{-1}}^e) \tag{25}$$

$$g_W = \theta_W \left(s_{W_{-1}}^T - s_{W_{-1}}\right) + \phi_1 g_p^e + \phi_2 g_\lambda \tag{26}$$

$$w = w_{-1}(1 + g_W) \tag{27}$$

Equation (11) gives the income of worker households, Y_W; W stands for the wage bill and r_{CL} for the lending interest rate on consumer loans. Worker households should repay each period a fraction, rep_{CL}, of their accumulated debt as well as the corresponding interest.[16] The wage bill is given by (12) where w stands for the wage rate and L for the level of employment. Workers are assumed to be paid for the labour they supplied in the previous period. Expressions (13)-(15) give the real income of workers households, RY_W, as well as their real and nominal consumption (RC_W and C_W respectively). Note that, as it will be clear below in the presentation of the banking sector, the term ΔCL in equation (14) represents the change in consumer loans after the application of the credit rationing procedure.

In equation (16) the burden of workers' debt, bur_W, is defined. This is equal to their cash payment commitments on their outstanding debt (interest plus principal repayments) as a fraction of their wage bill. It is presumed that the higher is bur_W the greater is the illiquidity risk if worker households go further into debt. The preference for liquidity of worker households is reflected on their target burden of debt, bur_W^T. As we have pinpointed above, higher target reveals lower preference for liquidity. Equation (17) indicates that bur_W^T is negatively associated with the degree of uncertainty ($\gamma_i > 0, i = 0,1$). Equation (18) gives the desired level of nominal consumption, C_{WD}. This can be higher or lower than their disposable income net of loan repayment, depending on whether $\xi > 0$ is lower or higher than one. The latter is defined in equation (19) ($\xi_i > 0, i = 1,2$). The lower is $bur_{W_{-1}}$ relative to $bur_{W_{-1}}^T$ the more likely it is for ξ_0 to be higher than one and thereby for workers' desired consumption to be higher than $Y_W - rep_{CL} CL_{-1}$. The rationale is that in this case worker households perceive the risk of illiquidity as not important enough so as to take it into account and give up borrowing. The opposite holds when $bur_{W_{-1}} > bur_{W_{-1}}^T$. It should also pointed out that,

[16] See van treeck (2009) and Godley and Lavoie (2007, p. 394) for a similar assumption.

according to (19), the desired consumption of workers depends also on the cost of borrowing as it is captured by r_{CL}.

Equation (20) shows the amount of demanded new consumer loans, NCL_D. This is positive (negative) when the desired nominal consumption is higher (lower) than worker households' disposable income net of loan repayment. Note that a negative amount of desired new consumer loans implies that workers wish to reimburse a greater proportion than rep_{CL} of their accumulated debt.[17] Equation (21) gives the desired amount of accumulated consumer loans, CL_D. In other words, it reflects the accumulated debt that worker households wish to hold according to their decision for the desired level of consumption expenditures.

Equations (22)-(27) describe wage determination. Equation (22) gives the before debt cash payment commitments income share of worker households, s_W. Expression (23) reveals the income share, s_{WB}, that is necessary to be attained in order for the actual burden debt of workers to be equal to their target one. This income share is given by the income share of cash payment commitments to the target burden of debt ratio.[18] In equation (24) the target share, s_W^T, is defined ($w_i > 0, i = 0,1,2$). This is hypothesized to be a positive function of an exogenous parameter and of the rate of employment which is used as a proxy for the bargaining power of workers. Furthermore, s_W^T is formalized to be positively affected by s_{WB}. In particular, we postulate that workers attempt to achieve their target burden of debt not only by reducing their spending and thereby their accumulated debt (as it was described above) but also by targeting a higher income share in the wage bargaining procedure. This is a complementary (or alternative) way to safeguard their desired liquidity position. It follows that their target share heightens (becomes lower) as a response to a higher (lower) income share of their debt cash

[17] For simplification reasons we assume that workers pay no interest on the fraction of their accumulated debt that is repaid in excess of $rep_{CL}CL_{-1}$.

[18] We have that $bur_W = \left[(1+r_{CL_{-1}})rep_{CL}CL_{-1}\right]\Big/W = \left[(1+r_{CL_{-1}})rep_{CL}CL_{-1}\right]\Big/Y\Big/s_W$.

Hence: $bur_W = bur_W^T \Rightarrow s_{WB} = \left[\left((1+r_{CL_{-1}})rep_{CL}CL_{-1}\right)/Y\right]\Big/bur_W^T$.

payment commitments and/or a lower (higher) target burden of debt.[19] The expected inflation, g_p^e, is given by formula (25); it is assumed that the expected inflation is equal to the lagged one plus an error correction mechanism ($\theta_{g_p} > 0$).[20] Equation (26) defines wage growth. This depends on the divergence between the lagged target and the lagged actual income share of workers as well as on the expected price inflation and on the growth rate of labour productivity, g_λ; $\theta_W > 0$ is an adjustment parameter; $\phi_i > 0$ (i=1,2) reflects the extent to which workers can pass on to wage growth the expected price inflation and the labor productivity growth.[21] Finally, equation (27) gives the nominal wage.

3.3 Rentier households

The balance sheet of rentier households is consisted of the following assets: high-powered money, HPM_H, money deposits, M, treasury bills, B_H, and equities, $e \cdot p_e$ (see *table 2*); note that e denotes the number of equities issued by firms and p_e denotes their price. Rentier households are assumed to consume a part of their disposable income and wealth; the latter is allocated to the aforementioned assets according to their preference for liquidity and to the relative rates of return on these assets. Equations (28)-(56) capture the economic behaviour of rentier households.

$$Y_R = DPT + r_{M_{-1}} M_{-1} + r_{B_{-1}} B_{\mathrm{H}_{-1}} + BPT \tag{28}$$

$$YT_R = Y_R - T_R \tag{29}$$

$$RYT_R = YT_R / p - g_p (V_{R_{-1}} / p) \tag{30}$$

$$RYT_R^e = RYT_{R_{-1}} + \theta_{RYT_R} (RYT_{R_{-1}} - RYT_{R_{-1}}^e) \tag{31}$$

$$p^e = p_{-1}(1 + g_p^e) \tag{32}$$

$$YT_R^e = p^e \cdot RYT_R^e + g_p^e \cdot \left(V_{R_{-1}} / p^e\right) \tag{33}$$

[19] Our formalization builds on Taheri's (1995) proposition that the interest rate is likely to affect positively the wage rate due to the outstanding debt of workers. Taheri (1995) provides some empirical evidence in favour of this argument.
[20] See e.g. Dos Santos and Zezza (2004). A similar formula is utilized below for the expected real disposable income of rentier households, the capital gains and the rate of return on equities.
[21] See Godley and Lavoie (2007) and Dallery and van Treeck (2009) for similar wage growth formulas.

$$V_R = V_{R_{-1}} + YT_R - C_R + CG \tag{34}$$

$$V_R^e = V_{R_{-1}} + YT_R^e - C_R + CG^e \tag{35}$$

$$CG = e_{-1} \cdot \Delta p_e \tag{36}$$

$$CG^e = CG_{-1} + \theta_{CG}(CG_{-1} - CG_{-1}^e) \tag{37}$$

$$RV_R = V_R / p \tag{38}$$

$$RC_R = a_1 RYT_R^e + a_2 RV_{R_{-1}} \tag{39}$$

$$C_R = RC_R \cdot p \tag{40}$$

$$HPM_{HN} = \left(\lambda_{10} + \lambda_{11} \cdot (-g_p^e / (1+g_p^e) + \lambda_{12} r^e r_M + \lambda_{13} r^e r_B + \lambda_{14} r^e rr_e^e + \lambda_{15}(YT_R^e / V_R^e)\right) V_R^e \tag{41}$$

$$M = \left(\lambda_{20} + \lambda_{21} \cdot (-g_p^e / (1+g_p^e) + \lambda_{22} r^e r_M + \lambda_{23} r^e r_B + \lambda_{24} r^e rr_e + \lambda_{25}(YT_R^e / V_R^e)\right) V_R^e \tag{42}$$

$$B_{HN} = \left(\lambda_{30} + \lambda_{31} \cdot (-g_p^e / (1+g_p^e) + \lambda_{32} r^e r_M + \lambda_{33} r^e r_B + \lambda_{34} r^e rr_e + \lambda_{35}(YT_R^e / V_R^e)\right) V_R^e \tag{43a}$$

$$E = \left(\lambda_{40} + \lambda_{41} \cdot (-g_p^e / (1+g_p^e) + \lambda_{42} r^e r_M + \lambda_{43} r^e r_B + \lambda_{44} r^e rr_e + \lambda_{45}(YT_R^e / V_R^e)\right) V_R^e \tag{44}$$

$$\lambda_{10} = h_{10} + h_{11} unc \tag{45}$$

$$\lambda_{20} = h_{20} + h_{21} unc \tag{46}$$

$$\lambda_{30} = h_{30} + h_{31} unc \tag{43b}$$

$$\lambda_{40} = h_{40} + h_{41} unc \tag{47}$$

$$rr_e = \frac{DPT + CG}{e_{-1} p_{e_{-1}}} \tag{48}$$

$$rr_e^e = rr_{e_{-1}} + \theta_{rr_e}(rr_{e_{-1}} - rr_{e_{-1}}^e) \tag{49}$$

$$r^e r_M = \frac{1 + r_M}{1 + g_p^e} - 1 \tag{50}$$

$$r^e r_B = \frac{1 + r_B}{1 + g_p^e} - 1 \tag{51}$$

$$r^e rr_e^e = \frac{1 + rr_e^e}{1 + g_p^e} - 1 \tag{52}$$

$$B_{HN} = V_R - E - M - HPM_H \tag{43}$$

$$B_H = z_1 \cdot B_{HN} \tag{53}$$

$$z_1 = 1 \text{ iff } B_{HN} \geq 0 \text{; otherwise } \quad z_1 = 0 \tag{54}$$

$$HPM_H = z_1 \cdot HPM_{HN} + z_2 \cdot (V_R - M - E) \tag{55}$$

$$z_2 = 1 \text{ iff } B_{HN} < 0 \text{; otherwise } z_2 = 0 \tag{56}$$

The before tax disposable income of rentier households is given by equation (28); *DPT* denotes the distributed after-tax profits of firms, r_M is the interest rate on deposits and *BPT* stands for the after-tax bank profits which are assumed to be distributed to rentier households. Expressions (29) and (30) give respectively the nominal and the real after-tax income of rentier households (denoted by YT_R and RYT_R); V_R stands for the nominal wealth. In equation (30) the losses in real wealth due to price inflation, g_p, are explicitly embodied.[22] The expected real after-tax income of rentier households, RYT_R^e, is defined in expression (31) ($\theta_{RYT_R} > 0$). Expression (32) defines the expected price level, p^e.[23] The expected after-tax nominal income, YT_R^e, is revealed in equation (33) while the actual and the expected nominal wealth of rentier households are defined in equations (34) and (35). The capital gains, *CG*, are given by equation (36) and the expected capital gains, CG^e ($\theta_{CG} > 0$) by equation (37); expression (38) shows the real wealth of rentier households, RV_R.

Equation (39) describes the real consumption function, RC_R. As in Godley and Lavoie (2007, pp. 140-141), capital gains in the current period are assumed not to have an impact on current consumption; they affect, however, the consumption in the subsequent period via the wealth term, $RV_{R_{-1}}$. The propensity to consume out of expected real disposable income is assumed to be higher than the propensity to consume out of the lagged accumulated wealth (i.e. $a_1 > a_2$). Equation (40) gives the nominal consumption, C_R.

Equations (41)-(47) reflect the asset choice of rentier households. It is assumed that the rentier households desire to hold each asset at a specific proportion λ_{i0} ($i = 1, 2, 3, 4$) of their expected wealth and that this proportion is modified according to the relative rates

[22] See Godley and Lavoie (2007, pp. 293-294, 322-325).
[23] Worker and rentier households are assumed to have the same expectations for inflation.

of return and to the transaction demand for money which is reflected on $\lambda_{i5}(YT_R^e / V_R^e)$. The proportion λ_{i0} is assumed to rely on the component of liquidity premium that is linked to each asset's power of disposal and to rentier households' precautionary motive. This fact is captured by equations (45), (46), (43b) and (47). The parameters $h_{i0}\,(i = 1, 2, 3, 4)$ reflect the proportion of each asset that is desired to be held irrespectively of the degree of uncertainty; these parameters depend on the degree of organization in the corresponding market which determines the type and the magnitude of the associated risks (see Davidson, 1978, 2002). High-powered money has the highest power of disposal since it is free of all the risks described in section 2. Deposits and treasury bills are generally short-dated assets and therefore their illiquidity risk is small; furthermore, their holding does not encompass income and capital risk (their interest rates are predetermined). However, holding deposits and treasury bills may entail some risk of default; the degree of such a risk depends on to what extent the rentier households believe that there is a potential for bankruptcy of commercial banks and of government respectively. With regard to equities, these can be easily liquidated but probably at a high cost due to income and capital risk. They are also characterized by a considerable risk of default.

Based on these risks, the liquidity premium of each asset is differently affected by a change in the degree of the perceived uncertainty. A higher perceived uncertainty leads rentier households to wish a more liquid position; simultaneously, it dives up the risks associated with the acquisition of equities and it may also give rise to the risk of default associated with deposits and treasury bills. Both of these results make higher the desired proportion of high-powered money in their portfolio and decrease the proportion of equities as well as that of deposits and treasury bills, although to a less extent. Hence, we have that $h_{11} > 0$, $h_{21}, h_{31}, h_{41} < 0$, as well as that $|h_{41}| > |h_{21}|, |h_{31}|$. [24]

Equations (41), (42), (43a) and (44) give the overall asset choice which relies on the Tobinsque approach (see e.g. Lavoie and Godley, 2001-2; Dos Santos and Zezza, 2004;

[24] The parameters h_{ij} fulfil the symmetry and vertical constraints.

and Godley and Lavoie, 2007).[25] Note that HPM_{HN} and B_{HN} represent the notional demand for high-powered money and treasury bills respectively; E stands for the demand for equities. As it is suggested by Lavoie and Godley (2007, p. 327-328), the expected inflation is introduced into the asset choice equations; note that $(-g_p^e/(1+g_p^e)$ is the expected real rate of return on high-powered money. In expression (48) the nominal rate of return on equities, rr_e, is defined. Equation (49) gives the expected return on equities, rr_e^e ($\theta_{rr_e} > 0$). In equations (50)-(52) the expected real rates of return on deposits, $r^e r_M$, treasury bills, $r^e r_B$, and equities, $r^e rr_e^e$ are reported.

In our formalization, treasury bills are assumed to function as a buffer. Equations (53)-(55) and (43) safeguard that the treasury bills actually held are either positive or equal to zero. When actual treasury bills are equal to zero the role of residual is attributed to high-powered money.[26]

3.4 Firms

The only asset at the disposal of firms is assumed to be the accumulated capital stock, *K*; their liabilities are the equities, $e \cdot p_e$, and the accumulated industrial loans, *IL* (see *table 2*). For reasons alluded to in the previous section, firms decide about their investment expenditures by taking, among others, into consideration how such a decision is likely to affect their liquidity position. In the formalization suggested below, firms' liquidity preference is captured by their target burden of debt (as in worker households) as well as by their 'animal spirits'. It should also be emphasized that, as it will be explained in more detail below, firms' preference for liquidity can be associated with price determination since inflation is viewed as a protection against illiquidity. The economic behaviour of firms is represented by equations (57)-(89).

$$RY = RC_W + RC_R + RI + RG \tag{57}$$

[25] The parameters λ_{ij} are all positive and fulfil the symmetry, vertical and horizontal adding-up constraints.

[26] See Godley and Lavoie (2007, p. 330-331) for a similar formalization. It should be noted that in the computer program equation (41) substitutes equations(41a) and (41b).

$$g_{ry} = (RY - RY_{-1}) / RY_{-1} \tag{58}$$

$$Y = RY \cdot p \tag{59}$$

$$TP = Y - IT - W - r_{L_{-1}} \cdot rep_{IL} IL_{-1} \tag{60}$$

$$TPT = TP - T_P \tag{61}$$

$$UPT = s_f TPT_{-1} \tag{62}$$

$$DPT = TPT - UPT \tag{63}$$

$$u = RY / RK \tag{64}$$

$$cu = u \cdot v \tag{65}$$

$$bur_F = \frac{(1 + r_{IL_{-1}}) rep_{IL} IL_{-1}}{Y - IT - W} \tag{66}$$

$$bur_F^T = \delta_0 - \delta_1 \cdot unc \tag{67}$$

$$RI_D = \left(b_0 + b_1 cu_{-1} + b_2 \frac{UPT}{K_{-1}} + b_3 (bur_{F_{-1}}^T - bur_{F_{-1}}) - b_4 \cdot r_{IL} \right) RK_{-1} \tag{68}$$

$$b_0 = b_{00} - b_{01} \cdot unc \tag{69}$$

$$I_D = RI_D \cdot p \tag{70}$$

$$e = e_{-1} \cdot (1 + g_e) \tag{71}$$

$$p_e = E / e \tag{72}$$

$$NIL_D = I_D - UPT - p_e \cdot \Delta e + rep_{IL} IL_{-1} \tag{73}$$

$$IL_D = (1 - rep_{IL}) IL_{-1} + NIL_D \tag{74}$$

$$I = UPT + \Delta IL + \Delta e \cdot p_e \tag{75}$$

$$RI = I / p \tag{76}$$

$$RK = RK_{-1} + RI \tag{77}$$

$$K = RK \cdot p \tag{78}$$

$$\lambda = \lambda_{-1} \cdot (1 + g_\lambda) \tag{79}$$

$$L = RY / \lambda \tag{80}$$

$$g_L = (L - L_{-1}) / L_{-1} \tag{81}$$

$$re = L / LF \tag{82}$$

$$p = m(1 + \tau) \cdot \frac{w}{\lambda} \tag{83}$$

$$s_F = 1 - s_W - (IT / Y) \tag{84}$$

$$s_{FB} = \frac{\left((1 + r_{IL_{-1}}) \cdot rep_{IL} IL_{-1}\right) / Y}{bur_F^T} \tag{85}$$

$$s_F^T = f_0 + f_1 \cdot cu + f_2 \cdot s_{FB} \tag{86}$$

$$g_m = \theta_m (s_{F_{-1}}^T - s_{F_{-1}}) \tag{87}$$

$$m = m_{-1} \cdot (1 + g_m) \tag{88}$$

$$g_p = (p - p_{-1}) / p_{-1} \tag{89}$$

Since no inventories are incorporated in the analysis, total output produced, *RY*, equals the sum of real consumption (of both worker and rentier households), real investment, *RI*, and real government expenditures (equation 57). The growth rate of output, g_{ry}, is defined in expression (58); equation (59) gives the nominal income. The pre- and after-tax total profits of firms are revealed in equations (60) and (61); *TPT* stands for the after-tax profits. Note that r_{IL} is the interest rate on loans and rep_{IL} is the loan repayment ratio. The undistributed profits, *UPT*, are assumed to be a fraction, s_f, of lagged after-tax profits (equation 62). The distributed profits are settled as a residue (equation 63). The capital-output ratio is defined in equation (64) and the capacity utilization, *cu*, in expression (65); v is the potential output to capital ratio which is assumed to be technologically fixed. Equation (66) gives the firms' burden of debt, bur_F, which is the cash payment commitments on their outstanding debt (interest plus principal repayments) as a fraction of their total profits net of indirect taxes and labour cost. In equation (67) the target burden of debt is hypothesized to be a negative function of the degree of uncertainty ($\delta_i > 0, i = 0,1$).

The real desired investment of firms, RI_D, is given by expression (68); it should be noted that our investment function draws on the Kaleckian literature[27] and has as an innovative feature the explicit incorporation of the role of liquidity preference; this role is captured by introducing the actual and the target burden of firms' debt as arguments in this function. More precisely, the desired rate of accumulation is presumed to depend on

[27] See e.g. Lavoie and Godley (2001-2, pp. 285-288)

a term b_0 that captures 'animal spirits', the lagged rate of capacity utilization, the undistributed profits to lagged capital ratio, the discrepancy between firms' lagged target and actual burden of debt and the lending interest rate ($b_i > 0, i = 0,1,2,3,4$). In equation (69) the 'animal spirits' are shown to be negatively affected by uncertainty ($b_{0i} > 0, i = 0,1$). Equation (70) gives the nominal desired investment, I_D. For reasons of simplicity we assume that the number of equities issued by firms grows at a constant exogenous rate, g_e (equation 71).[28] Equation (72) captures the stock market equilibrium. The amount of demanded new industrial loans is revealed in equation (73). Note that NIL_D can be negative if firms' retained profits are more than sufficient to finance both the nominal desired investment and the repayment of principal. If this is the case NIL_D corresponds to the amount of the accumulated debt that the firms wish to repay in excess of $rep_{IL} IL_{-1}$.[29] Equation (74) gives the amount of industrial loans that the firms desire to hold according to equation (73). The actual nominal investment, *I*, is revealed on equation (75); as it will become clear below, ΔIL represents the change in the industrial loans after the consideration of credit rationing. The real investment is given by equation (76) while expression (77) indicates the real capital stock, *RK*; in this expression capital depreciation is assumed away. It follows that the nominal capital stock is given by identity (78). The labour productivity, λ, is presumed to grow at an exogenously given rate, g_λ (equation 79). The level of employment is defined in equation (80); equation (81) gives the growth rate of employment, g_L, while the employment rate is represented by equation (82); *LF* denotes labour force which is assumed to be exogenously given.

Equations (83)-(89) mirror the determination of price inflation. Firms are assumed to set the price of their product as a mark-up, *m*, over the average labour cost; since they desire to pass on to prices (and thereby on to workers' income share) the cost of indirect taxation, the price-setting equation takes the form given by identity (83).[30] The income

[28] A similar assumption has been adopted by Le Heron and Mouakil (2008, p. 417).

[29] In similar vein with worker households, we assume that workers pay no interest on the fraction of their accumulated debt that is repaid in excess of $rep_{IL} IL_{-1}$.

[30] In particular, we assume that firms wish their total sales to be equal before and after the imposition of indirect taxes. Thus, if $p^* = m \cdot (w/\lambda)$ is the desired price level in the case of no indirect taxation, we have that $p \cdot RY - (\tau/1+\tau) p \cdot RY = p^* \cdot RY \Rightarrow p = m(1+\tau)(w/\lambda)$. Note that we implicitly assume for

share of firms before debt cash payment commitments, s_F, is revealed in equation (84). Equation (85) defines the income share, s_{FB}, that is necessary to be attained in order for the actual firms' burden of debt to be equal to their target one.[31] Equation (86) gives the target income share, s_F^T, which is a function of the rate of capacity utilization[32] and of s_{FB} ($f_i > 0, i = 0,1,2$). The inclusion of the last term extents the argument that can be found in the recent Post Keynesian literature according to which firms are likely to pass on to prices their interest cost (see, among many contributors, Hein, 2006, 2007; Hein *et al*, 2008; Argitis, 2001; Argitis and Pitelis, 2001; Lima and Setterfield, 2008). The distinctive feature of our formalization is that it links such a behaviour with the liquidity preference of firms. Equation (87) reflects that the growth rate of mark-up, g_m, which depends on the divergence between the lagged target income share and the lagged actual one; $\theta_m > 0$ is an adjustment parameter Equation (88) gives the mark-up and equation (89) describes price inflation.

3.5 Commercial banks

Commercial banks in our model are assumed to hold consumer loans, industrial loans, treasury bills, B_B, and high-powered money, HPM_B. Their liabilities are the money deposits and the advances from the central bank, A. Banks make profits by borrowing workers and firms and by investing on treasury bills. Recall that all these profits are distributed to rentier households. Thus, banks can use only their liabilities in order to finance their asset position. Drawing on the endogenous money approach for central banking we assume that the central bank provides whatever advances demanded by commercial banks. However, it should be called into attention that since the rate on deposits is lower than the rate on advances (which is the central bank's discount rate) banks always use as a first source of funding their money deposits.

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simplification that firms use L and not L_{-1} when they calculate their unit labour cost. See Zezza and Dos Santos (2004) and Godley and Lavoie (2007, pp. 319-320) for similar price-setting equations.

[31] We have that $bur_F = \left[(1+r_{IL_{-1}})rep_{IL}IL_{-1}\right] \Big/ \left[Y - W - IT\right] = \left[(1+r_{IL_{-1}})rep_{IL}IL_{-1}\right] \Big/ Y \Big/ s_F$.

Hence: $bur_F = bur_F^T \Rightarrow s_{FB} = \left[\left((1+r_{IL_{-1}})rep_{CL}IL_{-1}\right)/Y\right] \Big/ bur_F^T$.

[32] For the positive effect of capacity utilization on the target income share of firms see e.g. Dutt (1992), Cassetti (2002) and Lima (2004).

In our postulated banking sector the profits of commercial banks come basically from lending consumers and firms. Thus, banks should evaluate the risks associated with lending expansion (illiquidity and default risk) and use credit rationing procedures in order to avoid them. At this point the liquidity preference of banks is of particular importance. In our model this preference is mirrored on their target loans to deposits ratio; this is Eichner's (1985, 1987) *degree of liquidity pressure*. When banks have a higher preference for liquidity they target a lower degree of liquidity pressure, and *vice versa*. This ratio, however, is not targeted only by using the credit rationing procedure. Banks may also increase (decrease) the rate on deposits when they perceive their degree of liquidity pressure to be higher (lower) than their targeted one (see Godley, 1999; Lavoie and Godley, 2006; Godley and Lavoie, 2007). This can affect the asset choice of rentier households since it favours reallocation towards money deposits improving thereby the liquidity position of banks. A further mechanism through which banks may attempt to attain their degree of liquidity pressure, when the latter is higher than the target one, is by demanding from their borrowers to reimburse a greater proportion of their loans each period. [33] Finally, we would like to stress out that in our formalization the liquidity preference of banks is allowed to affect the determination of lending interest rates; in particular, we follow Le Heron and Mouakil (2008) and we allow the latter to be affected by the perceived illiquidity and default risks. Equations (90)-(134) reflect more precisely the conceptualization of banking sector's operations.

$$BP = r_{CL_{-1}} CL_{-1} + r_{IL_{-1}} IL_{-1} + r_{B_{-1}} B_{B_{-1}} - r_{M_{-1}} M_{-1} - r_{CB_{-1}} A_{-1} \tag{90}$$

$$BPT = BP - T_{BP} \tag{91}$$

$$liq = \frac{CL + IL}{M} \tag{92}$$

$$liq^T = \kappa_0 - \kappa_1 \cdot unc \tag{93}$$

$$CR_{CLN} = \omega_1 \cdot unc + \omega_2 \cdot bur_{W_{-1}} + \omega_3 (liq_{-1} - liq^T) + \omega_4 \cdot r_{CB} \tag{94}$$

$$CR_{ILN} = \sigma_1 \cdot unc + \sigma_2 \cdot bur_{F_{-1}} + \sigma_3 (liq_{-1} - liq^T) + \sigma_4 \cdot r_{CB} \tag{95}$$

$$CR_{CL} = CR_{CLN} - z_3 \cdot (CR_{CLN} - 1) - z_4 \cdot CR_{CLN} \tag{96}$$

$$z_3 = 1 \text{ iff } CR_{CLN} > 1; \text{ otherwise } z_3 = 0 \tag{97}$$

[33] See Lavoie (2008, p. 352) for a similar point referring more precisely to the recent financial crisis.

$$z_4 = 1 \text{ iff } CR_{CLN} < 0 \text{; otherwise } z_4 = 0 \tag{98}$$

$$CR_{IL} = CR_{ILN} - z_5 \cdot (CR_{ILN} - 1) - z_6 \cdot CR_{ILN} \tag{99}$$

$$z_5 = 1 \text{ iff } CR_{ILN} > 1 \text{; otherwise } z_5 = 0 \tag{100}$$

$$z_6 = 1 \text{ iff } CR_{ILN} < 0 \text{; otherwise } z_6 = 0 \tag{101}$$

$$CL_0 = (1 - rep_{CL})CL_{-1} + NCL_D(1 - z_7) \tag{102}$$

$$z_7 = CR_{CL} \text{ iff } NCL > 0 \text{; otherwise } z_7 = 0 \tag{103}$$

$$IL_0 = (1 - rep_{IL})IL_{-1} + NIL_D(1 - z_8) \tag{104}$$

$$z_8 = CR_{CL} \text{ iff } NCL > 0 \text{ ; otherwise } z_8 = 0 \tag{105}$$

$$FC = CL_0 + IL_0 \tag{106}$$

$$CL_N = (\mu_{10} + \mu_{11} r_{CL} + \mu_{12} r_{IL})FC \tag{107}$$

$$IL_N = (\mu_{20} + \mu_{21} r_{CL} + \mu_{22} r_{IL})FC \tag{108a}$$

$$\mu_{10} = CL_0 / FC \tag{109}$$

$$\mu_{20} = IL_0 / FC \tag{108b}$$

$$IL_N = F - CL_N \tag{108}$$

$$CL = z_9 \cdot CL_N + z_{10} \cdot CL_D \tag{110}$$

$$z_9 = z_{9p} \text{ iff } CL_N \le CL_D \text{; otherwise } z_9 = 0 \tag{111}$$

$$z_{9p} = 1 \text{ iff } NCL_D \ge 0 \text{; otherwise } z_{9p} = 0 \tag{112}$$

$$z_{10} = 1 \text{ iff } CL_N > CL_D \text{; otherwise } z_{10} = z_{10p} \tag{113}$$

$$z_{10p} = 1 \text{ iff } NCL_D < 0 \text{; otherwise } z_{10p} = 0 \tag{114}$$

$$IL = z_{11} \cdot IL_N + z_{12} \cdot IL_D \tag{115}$$

$$z_{11} = z_{11p} \text{ iff } IL_N \le IL_D \text{; otherwise } z_{11} = 0 \tag{116}$$

$$z_{11p} = 1 \text{ iff } NIL_D \ge 0 \text{; otherwise } z_{11p} = 0 \tag{117}$$

$$z_{12} = 1 \text{iff } IL_N > IL_D \text{; otherwise } z_{12} = z_{12p} \tag{118}$$

$$z_{12p} = 1 \text{ iff } NIL_D < 0 \text{; otherwise } z_{12p} = 0 \tag{119}$$

$$HPM_B = a_{hpm} M \tag{120}$$

$$B_{BN} = M - HPM_B - CL - IL \tag{121}$$

$$A_N = HPM + CL + IL - M \tag{122}$$

$$A = z_{13} \cdot A_N \tag{123}$$

$$z_{13} = 1 \text{ iff } A_N \geq 0 \text{; otherwise } z_{13} = 0 \tag{124}$$

$$B_B = z_{14} \cdot B_{BN} \tag{125}$$

$$z_{14} = 1 \text{ iff } B_{BN} \geq 0 \text{; otherwise } z_{14} = 0 \tag{126}$$

$$LR_{CL} = \omega_1 \cdot unc + \omega_2 \cdot bur_{W_{-1}} + \omega_3 (liq_{-1} - liq^T) \tag{127}$$

$$LR_{IL} = \sigma_1 \cdot unc + \sigma_2 \cdot bur_{F_{-1}} + \sigma_3 (liq_{-1} - liq^T) \tag{128}$$

$$r_{CL} = r_{CB} + spr_{CL} + m_{CL} \cdot LR_{CL} \tag{129}$$

$$r_{IL} = r_{CB} + spr_{IL} + m_{IL} \cdot LR_F \tag{130}$$

$$r_M = r_{CB} - spr_M + m_M \cdot (liq_{-1} - liq_{-1}^T) \tag{131}$$

$$spr_M = \rho \cdot r_{CB} \tag{132}$$

$$rep_{CL} = \psi_0 + \psi_1 \cdot (liq_{-1} - liq_{-1}^T) + \psi_2 \cdot unc \tag{133}$$

$$rep_{IL} = \varepsilon_0 + \varepsilon_1 \cdot (liq_{-1} - liq_{-1}^T) + \varepsilon_2 \cdot unc \tag{134}$$

Equations (90) and (91) give the pre- and after-tax profits of banks. The degree of the liquidity pressure of banks, *liq*, is defined in equation (92). Expression (93) reveals that the target degree of liquidity pressure of banks is a negative function of the degree of uncertainty ($\kappa_i > 0, i = 0,1$). Our formalization for credit rationing follows closely that of Le Heron and Mouakil (2008).[34] In particular, we define an index for the degree of credit rationing, *CR*, which takes values from 0 (no rationing) to 1 (full rationing). The degree of credit rationing depends on the illiquidity and default risk. Equations (94) and (95) give respectively the notional degree of credit rationing on consumer and industrial loans (denoted by CR_{CLN} and CR_{ILN}); note that $\omega_i > 0, i = 1,2,3,4$ and $\sigma_i > 0, i = 1,2,3,4$. The first term in these equations reveals that an increase in the perceived uncertainty gives rise to the illiquidity and default risk and thereby to credit rationing; the second term reflects the risk of default as it is captured by the burden of borrowers' debt; the third term represents the illiquidity risk as it is perceived by the banking sector; lastly, an increase in the discount rate of the central bank is assumed to give rise to the cost of liquidity since it triggers an increase in the banks' cost of borrowing (either via deposits

[34] See also Le Heron (2008, 2009).

or via central banks' advances); further, since we have assumed that $r_B = r_{CB}$, a higher discount rate motivates banks to hold more treasury bills instead of loans (which translates in stricter credit rationing), and *vice versa*. Equations (96)-(101) give the actual indices for the degree of credit rationing by insuring that $0 \leq CR_{CL}, CR_{IL} \leq 1$.

In our formalization banks decide for an 'initial' amount of supplied consumer and industrial loans based on the procedure of credit rationing. However, this amount can be modified when they take also into account the relative rates of return on these assets. Equations (102)-(105) give the 'initial' amount of consumer and industrial loans, denoted respectively by CL_0 and IL_0. These equations reflect that credit rationing can occur only when $NCL_D, NIL_D > 0$. Identity (106) shows the total amount of finance via credit, *FC*. Equations (107)-(109) indicate that this finance can be reallocated according to the relative lending interest rates.[35] These equations give the notional consumer and industrial loans, CL_N and IL_N.[36] The actual ones are given by equations (110)-(119). The mechanisms proposed in these equations insure that, after the relative rates of interest have also be taken into account, the loans supplied are not higher than the demanded ones as well as that it still holds that no credit rationing takes place if $NCL_D, NIL_D \leq 0$.

Equation (120) indicates that commercial banks are forced by the government to hold reserves in the form of high-powered money, HPM_B. These are assumed to be a proportion, a_{hpm}, of their money deposits. Equations (121)-(126) reflect that in our postulated banking system commercial banks hold each period either treasury bills or central banks advances. It is assumed that they do not hold both of them simultaneously.[37] In particular, if deposits net of the reserves are higher than granted loans, the treasury bills play the role of the buffer variable. If, on the other hand, granted loans are higher than deposits net of reserves, banks borrow from the central bank and

[35] The parameters μ_{ij} are all positive and fulfil the symmetry, vertical and horizontal adding-up constraints.
[36] In the computer program equations (108a) and (108b) are replaced by (108).
[37] See Lavoie and Godley (2006) for a different assumption and for a further discussion on this issue.

the role of the buffer variable is attributed to advances. Note that B_{BN} and A_N denote the notional amount of treasury bills and advances respectively.

In equations (127) and (128) the lender's risk from granting consumer and industrial loans is defined; LR_{CL} stands for the lender's risk from consumer lending and LR_{IL} for the lender's risk from industrial lending. The formulas are the same with that which have been used for the definition of the credit rationing (equations 94 and 97) with the only difference being the exclusion of the last term that refers to the impact of the central bank's discount interest rate.[38] Note also that we do not impose a specific restriction regarding the values that *LR* should take.

The interest rates on commercial loans, industrial loans and deposits are described in equations (129)-(131). The lending interest rates are set as a mark-up over the discount rate of the central bank. This mark-up consists of an autonomous spread (spr_{CL} and spr_{IL}), basically determined by the degree of oligopoly in the banking sector, and a variable risk premium that is linked to the lender's risk ($m_{CL}, m_{IL} > 0$). On the other hand, the deposit interest rate is set as a mark-down over r_{CB}. This mark-down depends on spr_M that captures market power and on the discrepancy between the lagged target and the lagged actual degree of liquidity pressure ($m_M > 0$). Equation (132) implies that spr_M is lower the lower is the central bank's discount interest rate ($0 < \rho < 1$); this is to insure that r_M will not turn to negative when the discount interest rate approaches zero. Finally, equations (133) and (134) reveal that the loan repayment ratios respond to the discrepancy between the lagged actual and the lagged target degree of liquidity pressure; they are also assumed to react positively to higher uncertainty ($\psi_i > 0, i = 0,1,2$; $\varepsilon_i > 0, i = 0,1,2$) .

[38] Le Heron and Mouakil (2008) and Le Heron (2008,a,b) use the central bank's discount rate as a determinant of the lender's risk; in particular, they associate it with the market risk. In their model market risk for banks is significant since the latter are presumed to lend firms not only via loans but also via commercial paper, bonds and equities. In our model such a possibility has been excluded and, hence, market risk is not so important for the determination of the lender's risk.

3.6 Central bank

$$CBP = r_{CB_{-1}} A_{-1} + r_{B_{-1}} B_{CB_{-1}} \tag{135}$$

$$HPM = HPM_H + HPM_B \tag{136}$$

$$B_{CB} = B - B_H - B_B \tag{137}$$

$$HPM = A + B_{CB} \tag{138-red}$$

The profits of the central bank are defined in equation (135). The total high-powered money, *HPM*, is equal to the high-powered money held by rentier households and by commercial banks (equation 136). Identity (137) implies that the central bank purchases the treasury bills, B_{CB}, that are not bought by households and banks. Finally, identity (138-red) shows that the high-power money is equal to the central bank advances plus the treasury bills held by the central bank. This identity is redundant is the sense that it is logically implied by all the other equations of the model. In the computer program this identity has to be 'dropped' out in order to avoid over-determinacy. However, it is necessary to verify that it is realized in our numerical simulations. Indeed, when our model is solved in the computer program, identity (138-red) invariably holds.

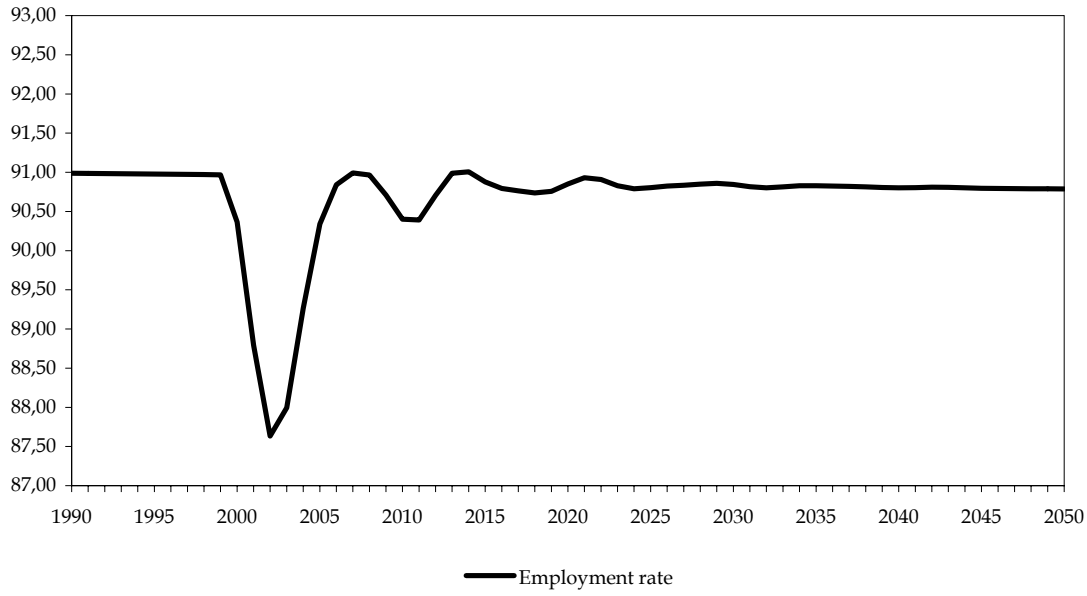
4. Experiments about an uncertainty-liquidity preference shock

The model sketched in the preceding section is very complicated; hence, its analytical solution would not be very informative. For this reason the model was solved numerically and a series of simulations were conducted.[39] Through a process of successive approximations a steady state was found with all stocks and flows growing by about 2.5% per period and prices rising by about 0.087%.; the rate of employment in this steady state is approximately equal to 91.0%. The model starts from this 'baseline' solution ('year 1900') and extents over 100 'odd' years. At year '2000' a shock of uncertainty is assumed to hit the economy. In particular, we shock our model by introducing an increase in the index for uncertainty from 0.2 to 0.4.

[39] Our simulations were carried out using E-views 6.0. software. I would like at this point to thank Edwin Le Heron and Tarik Mouakil who kindly provided me with the e-views program that has been used for their simulations in Le Heron and Mouakil (2008).

Figure 1 depicts the implications of such a shock for the evolution of the rate of employment. It turns out that the rise in uncertainty produces a brisk drop in the employment rate in the initial periods; however, after a few periods the employment rate starts increasing again and gradually stabilizes on a level a bit lower than the initial one.

Figure 1: The effect of higher perceived uncertainty on the evolution of employment rate



Let us focus on the channels that explain such a development. *Figure* 2 portrays the fall that the uncertainty shock triggers to the target burden of debt of worker households and firms as well as to the target degree of liquidity pressure of banks (see equations 18, 67 and 93). *Figure 3* illustrates the reallocation of rentier households' wealth following a decrease in the state of confidence. This figure reveals that rentier households hold a greater proportion of their wealth in the form of high-powered money as an attempt to improve their liquid posture (see equations 45, 46, 43b and 47). Moreover, *figure 4* shows that the lending interest rates move up in the initial subsequent periods; this is explained by the rise in banks' target degree of liquidity pressure which heightens the lender's risk (see equations 129 and 130). The increase in banks' target degree of liquidity pressure also explains, in conjunction with the general impact of the diminished state of confidence, why the loan repayments ratios initially go up, as it is depicted in *figure 5* (see equations 133 and 134). Additionally, *figure 6* shows that there is a passing increase in the burden of debt of workers and firms arising from the rise in lending interest rates and in loan repayment ratios (see equations 16 and 66).

Figure 2: The effect of higher perceived uncertainty on the target burden of debt of worker households and firms and on the target degree of liquidity pressure of banks

Figure 3: The effect of higher perceived uncertainty on the proportion of rentier households' wealth being held in the form of various assets

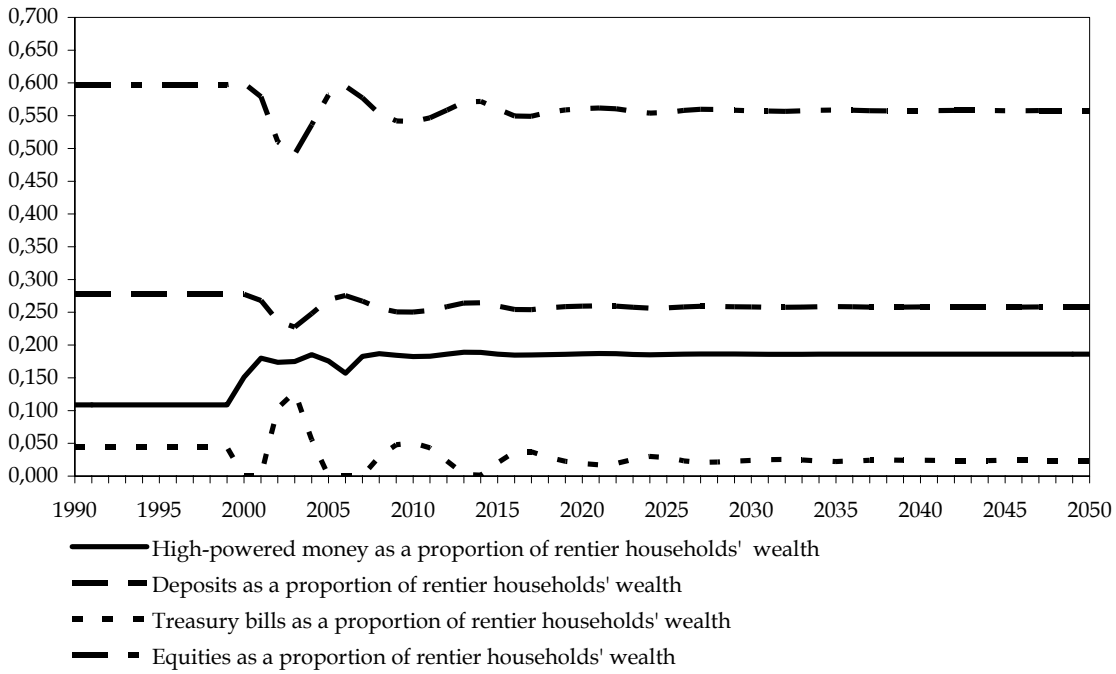


Figure 4: The effect of higher perceived uncertainty on the evolution of the lending interest rates

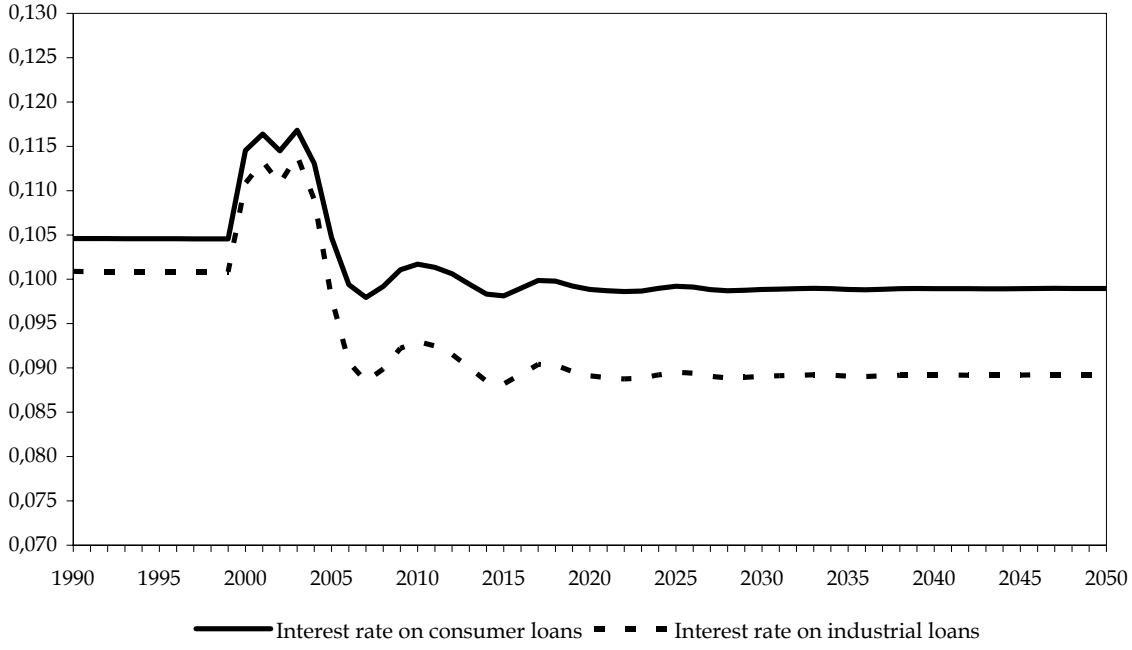


Figure 5: The effect of higher perceived uncertainty on the evolution of consumer and industrial loan repayment ratios

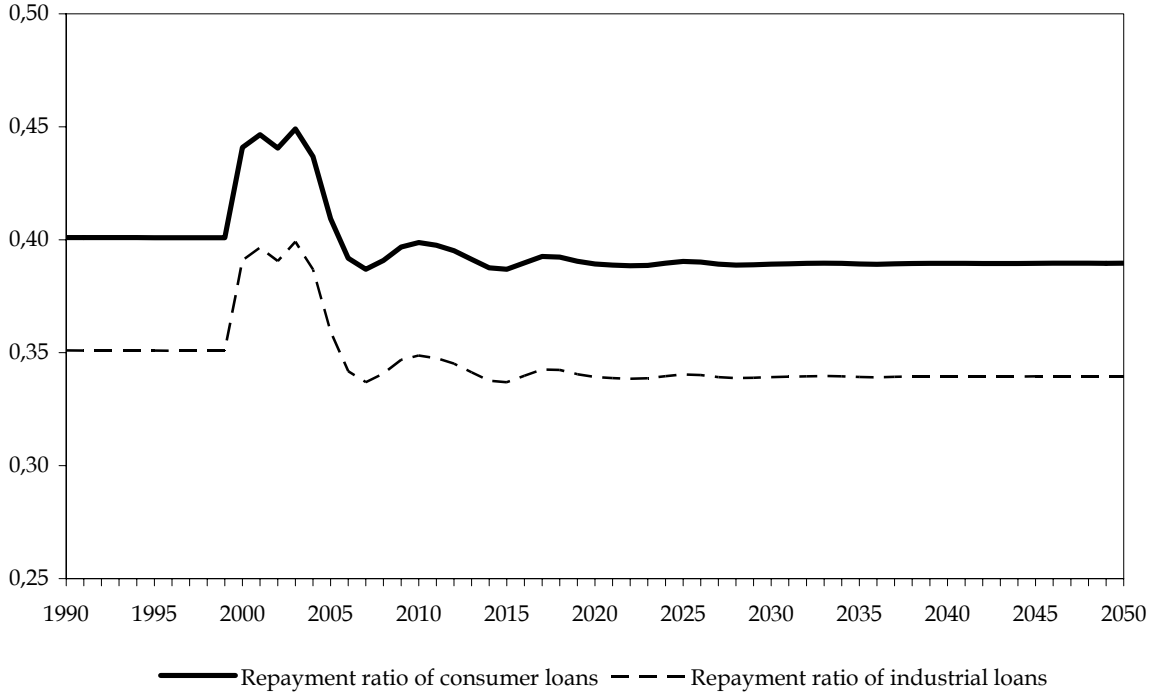
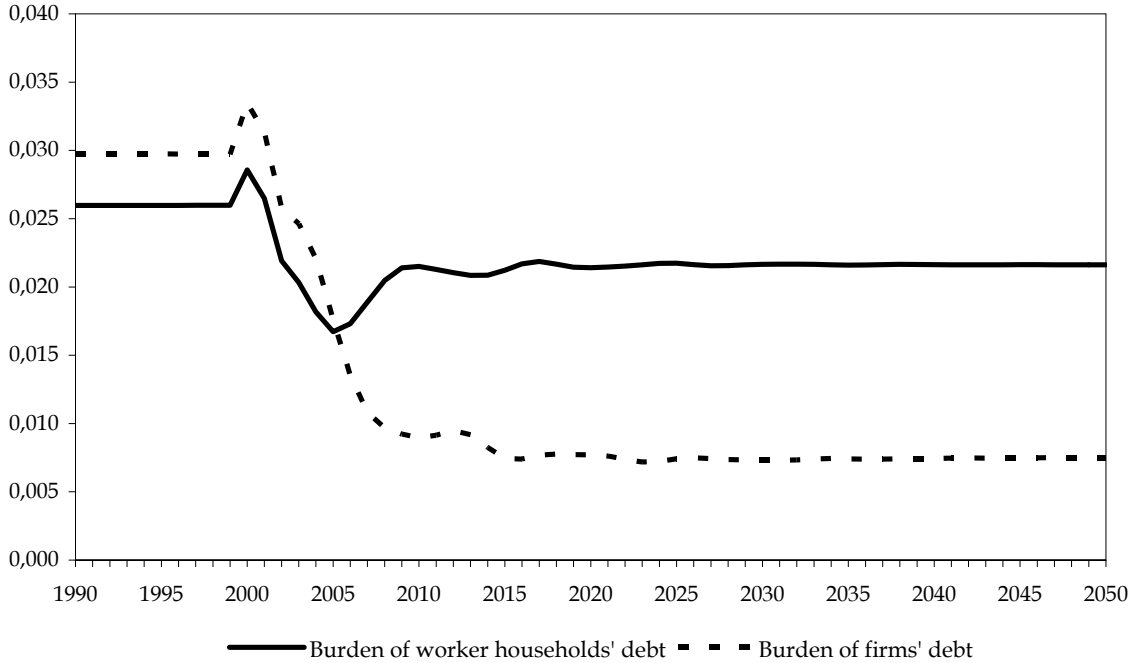


Figure 6: The effect of higher perceived uncertainty on the evolution of the burden of debt of worker households and firms



The sharp decline in the rate of employment in the first periods under examination is the result of the aforementioned developments which bring about a contraction in both consumption and investment expenditures. More precisely, the lower target burden of debt of workers and firms as well as the higher lending interest rates generate a decline in the desired consumption and investment expenditures (see equations 18, 19 and 68). Furthermore, the higher target degree of liquidity pressure of banks, in conjunction with the increase in the perceived risks of default and illiquidity and with the initial rise in the burden of debt of private sector, makes banks more reluctant to lend workers and firms. In other words, the degree of credit rationing moves up (*figure 7*) making it more difficult for workers and firms to finance their already diminished desired consumption and investment expenditures (see equations 94 and 95).

Figure 7: The effect of higher perceived uncertainty on the evolution of the degree of credit rationing on consumer and industrial loans

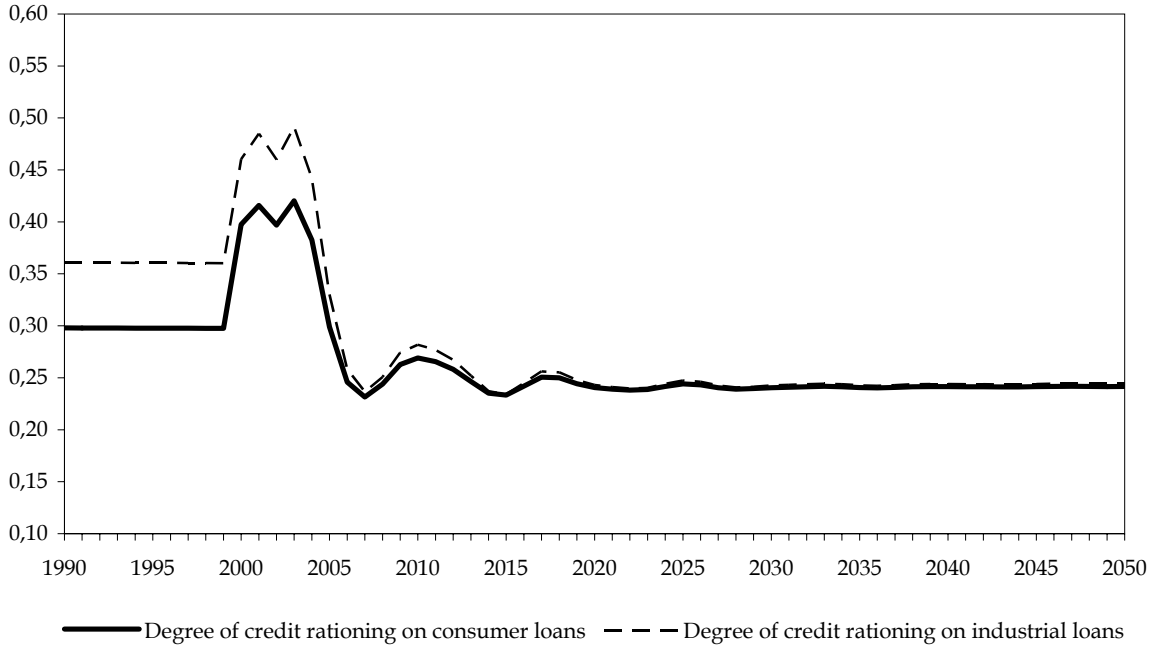
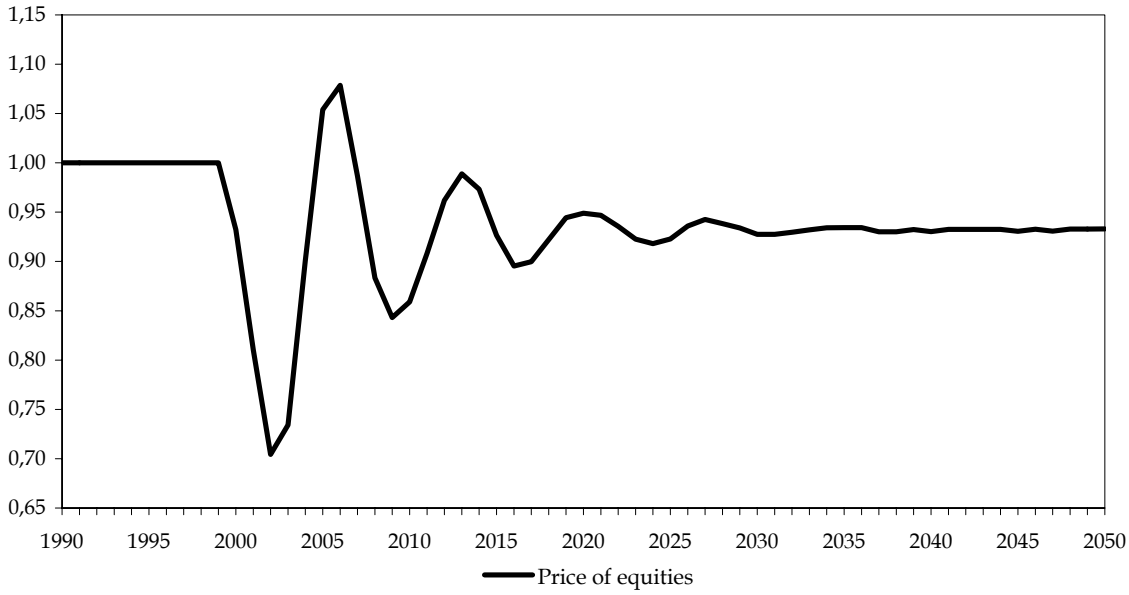
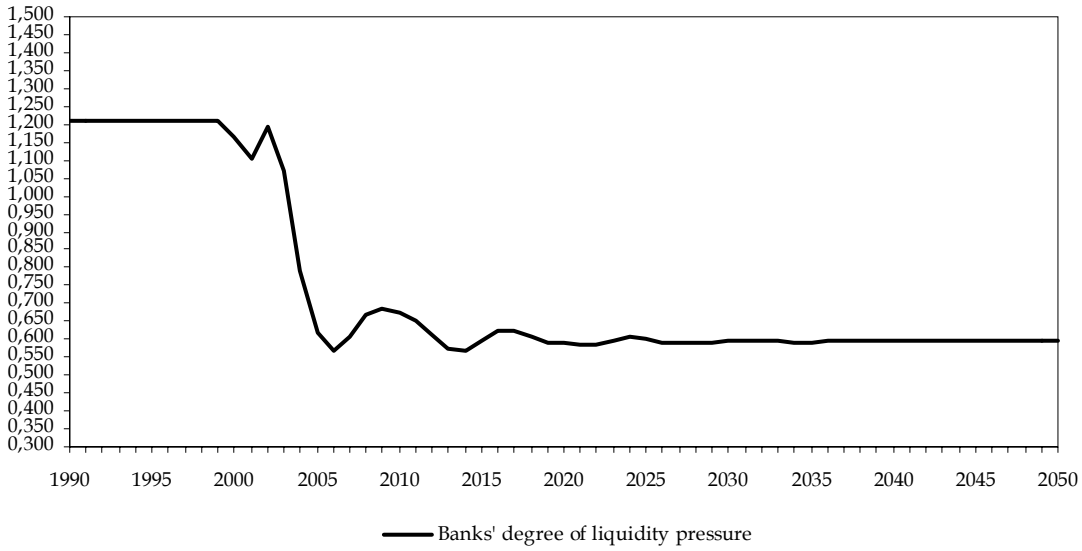


Figure 8: The effect of higher perceived uncertainty on the evolution of the price of equities



At this point it should be noted that a further reason that explains banks' decision to make stricter their criteria for creditworthiness is the decline in the bank deposit holdings arising from rentier households' preference for higher liquidity; this decline leads banks to balk debt rollover for private sector in order to be able to attain (or at least to approach) their target degree of liquidity pressure. The liquidity preference of rentier households is also at the heart of firms' lower ability to finance their investment projects via equity emission. The reason is that the price of equities moves down (see *figure 8*) – there is some overshooting for only two periods- reflecting the diminished demand for equities that occurs due to higher perceived uncertainty.

Figure 9: The effect of higher perceived uncertainty on the evolution of the banks' degree of liquidity pressure



The above developments provide, therefore, the main explanation for the brisk drop in the employment rate as a response to a decline in the state of confidence. However, as it was pinpointed above, the rate of employment gradually increases after the initial downward movement. What happens is that that the contraction of new borrowing brings down the burden of debt of workers and firms (see *figure 6*) with feedback expansionary effects on consumption and investment expenditures. Furthermore, as it is illustrated in *figure 9*, banks manage to push down their degree of liquidity pressure; this development further contributes to the increase in economic activity and employment

rate since it puts downward pressure on lending interest rates (*figure 4)*, loan repayment ratios (*figure 5*) and degree of credit rationing (*figure 7*).

We now move on to discuss the impact of higher perceived uncertainty on the evolution of price inflation; this is revealed in *figure 10*. It turns out that inflation goes up in the initial periods and then falls vigorously before it ends up a bit higher than its starting value. The explanation behind this development is that the increase in the target burden of debt of worker households and firms, combined with the rise in their debt cash payment commitments, induce them to target higher income shares in the very initial periods after the shock (*figure 11*). However, the drop in the rate of employment and in capacity utilization very soon counterbalances the above developments (which have already commenced to become less powerful) generating a fall in the target income share of workers and firms and thereby in the rate of inflation. In the subsequent periods there is an almost total recovery in the level of aggregate demand; simulateneously, the income share that is necessary for workers and firms to attain their higher target burden of debt stabilizes on a slightly higher level than in the baseline solution. This explains why the rate of inflation eventually reaches a level a bit higher than the initial one.

Figure 10: The effect of higher perceived uncertainty on the evolution of price inflation

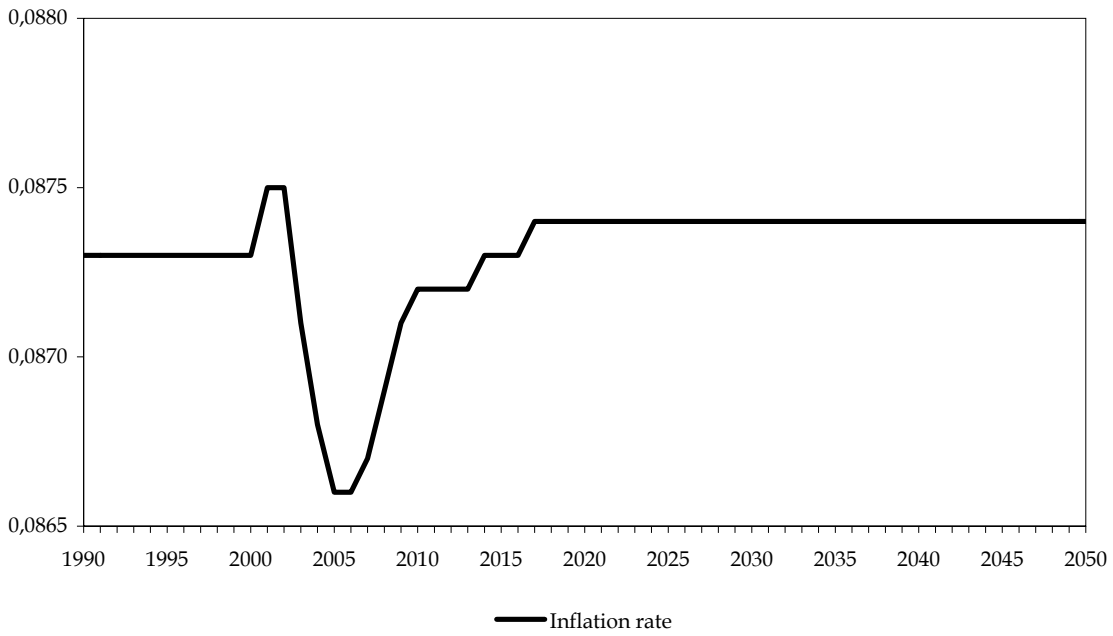
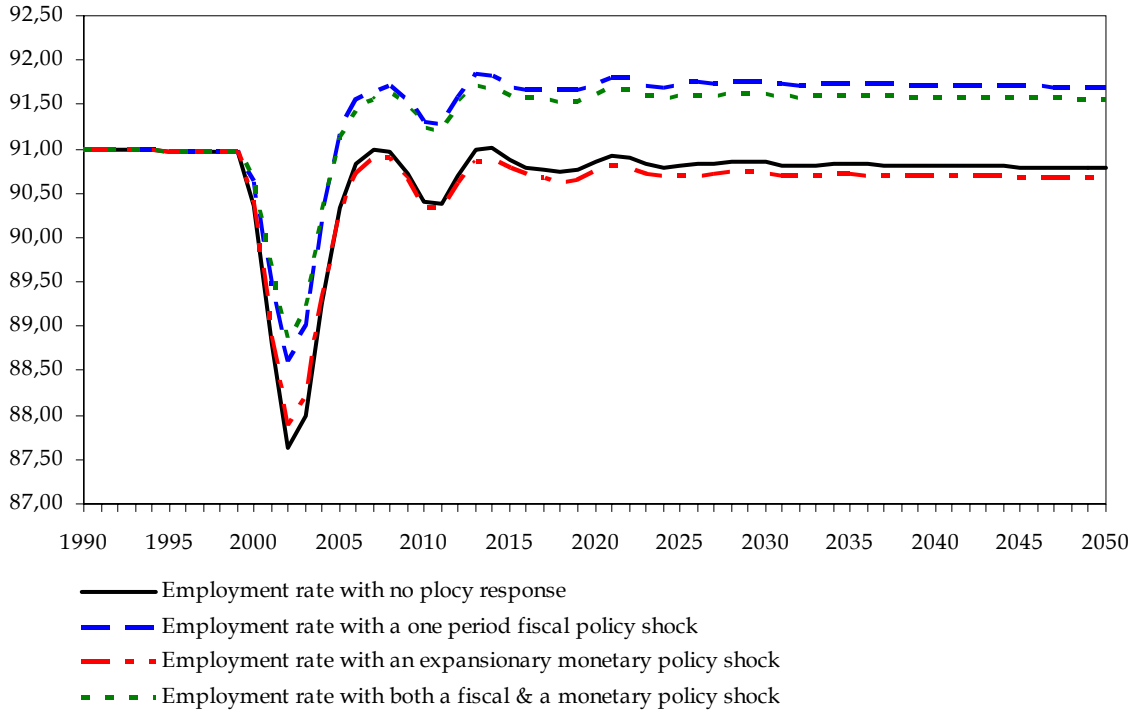


Figure 11: The effect of higher perceived uncertainty on the evolution of target income shares

5. The role of fiscal and monetary policy

In this section we turn to explore the potential capacity of fiscal and monetary policy to counterbalance the unfavourable effects that an uncertainty shock has been shown to trigger on the rate of employment and inflation. In particular, we consider four alternative scenarios. The first scenario is that of no policy response and corresponds to the situation that was described in the previous section. The second scenario is that fiscal authorities perceive the decrease in the state of confidence of the private sector and respond by increasing only for one period (year '2000') the real government expenditures from 2.5% to 3.5%. In the third scenario we presume that the central bank imposes a permanent decrease in the discount interest rate from 4% to 0.5%. Finally, the forth scenario is a combination of the second and the third one, namely both fiscal and monetary policy are assumed to be implemented.

Figure 12: The effect of higher perceived uncertainty on the evolution of the rate of employment: 4 different scenarios



In *figures 12* and *13* we portray respectively the evolution of the rate of employment and of the rate of inflation. Consider initially the second scenario. *Figure 12* reveals that fiscal policy makes less severe the immediate drop in the rate of employment; moreover, when the employment rate recovers it appears to overtake its baseline level. However, it should be stressed out that under this scenario inflation is higher than in the case of no policy response both in the very initial periods after the shock as well as in the periods that follow the recovery.

Under the third scenario the mitigation in the brisk decline of employment is very partially attained and, when the recovery is achieved, the rate of employment is slightly lower than what would have been in the case of no policy response. Consequently, monetary policy appears to be a much less potent tool than fiscal policy with regard to the stabilization of aggregate demand.[40] This low impact of monetary policy is

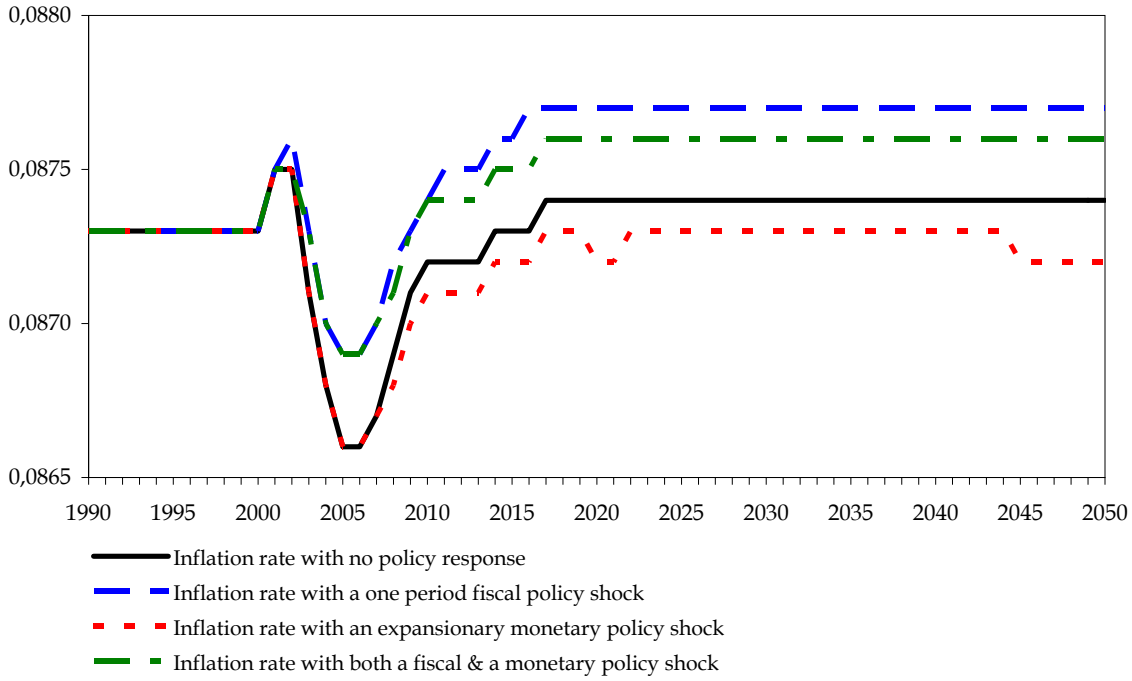
[40] This result seems to be in line with the arguments that have been developed by many Post Keynesian scholars according to which fiscal policy has a much more severe effect on aggregate demand than monetary policy (see e.g. Arestis and Sawyer, 2004).

potentially explained by the fact that in our artificial economy the decline in the discount interest rate has both favourable and unfavourable effects on aggregate demand. On the one hand, by triggering a decline in the lending interest rates, it gives a boost to the desired consumption of worker households as well as to the desired investment expenditures. Further, rentier households respond to the lower deposit and bill interest rate by modifying the composition of their wealth towards equities; this exerts upward pressures on the price of equities and thereby on rentiers' wealth and consumption expenditures. On the other hand, a lower discount rate is likely to bring about a negative effect on the consumption expenditures of rentier households since their income from deposits, bills and banks' distributed profits is pushed down; moreover, the decline in the deposit interest rate exerts upward pressure on banks' degree of liquidity pressure making them more prudent in their lending behaviour.

Turning to the impact that monetary policy may exert on inflation, our experiment leads us to an unconventional result: decreasing discount rate of interest not only does not result in higher inflation but, on the contrary, drives the latter down when the recovery starts occurring. This result is explained by the beneficial affect that the lower discount interest rate exerts on the lending interest rates and thereby on the burden of debt of worker households and firms.

Our forth scenario seems to be the one with the highest overall effectiveness. The combination of fiscal and monetary policy delivers high levels of employment safeguarding at the same time that inflation does not increase substantially as in the case of a pure fiscal policy shock. This result leads us to argue that both fiscal and monetary policies are essential to be implemented if authorities wish to mitigate the unfavourable effects triggered by a shock of uncertainty on the performance of a monetary production economy.

Figure 13: The effect of higher perceived uncertainty on the evolution of the inflation rate: 4 different scenarios



6. Conclusion

This paper developed a Post Keynesian SFC model which explicitly integrates the role of liquidity preference into the economic behaviour of households, firms and banks. In particular, liquidity preference was modelled to affect the desired consumption and investment expenditures, the asset allocation of households and banks, the credit rationing and loan repayment procedure, the lending and deposit interest rates as well as the wage and profit claims of workers and firms respectively. One of the central features that differentiates this model from other SFC ones is that it allowed us to identify and discuss the mechanisms through which perceived uncertainty is likely to affect the liquidity preference of all private sectors and thereby the performance of the macroeconomy.

In the simulations conducted we, more precisely, focused attention on the impact that a 'crisis of confidence' can arguably have on the evolution of employment and inflation. In our postulated economy a shock of uncertainty appears to bring about a substantial

drop in the rate of employment in the initial periods after the shock. This was shown to be explained via a number of channels that are linked to households', firms' and banks' desire to hold a more liquid posture characterized by less commitment to investment goods and/or to illiquid financial assets (equities, loans etc.). It is also noteworthy that eventually the rate of employment brings almost totally back to its initial value, a development that is basically associated with the gradual decrease in private sector's burden of debt and in bank's degree of liquidity pressure. With regard to the dynamics of inflation, some important fluctuations were observed as a response to diminished confidence. Initially, as the lending interest rate and the loan repayment ratio are driven up by higher perceived risks, the private sector's burden on debt turns out to get heavier pushing thereby up the target income shares and the rate of inflation. Very soon, however, the decrease in the rate of employment and in capacity utilization counterbalances the above development and generates a fall in the rate of inflation; the latter starts increasing again when aggregate demand begins to recover. Since higher perceived uncertainty has pushed permanently down the burden of debt targeted by workers and firms the inflation rate reaches ultimately a higher level than in the baseline solution.

We next turned to explore the effects of expansionary fiscal and monetary policies which were viewed as potential tools for counterbalancing the unfavourable impact of higher perceived uncertainty. By stabilizing aggregate demand, fiscal expansion was shown to partially offset the initial sharp drop in the rate of employment even though it turns out to generate higher inflation. On the other hand, a decrease in the central bank's discount interest rate does not appear to have a noteworthy effect on the rate of employment; however, it drives down the rate of inflation via its favourable impact on the private sector's burden of debt. Overall, a combination of higher government expenditures with a lower discount interest rate was indicated to constitute the appropriate policy mix if high employment and low inflation are to be attained. Based on these results, the paper advocates that expansionary macroeconomic policies can potentially play a crucial stabilizing role in an environment of high uncertainty and of diminished state of confidence, as the one we have recently witnessed with the emergence of the global financial crisis.

Appendix

Symbols for endogenous variables

A central bank's advances
A_N notional central bank's advances
B treasury bills
b_0 autonomous investment
B_B treasury bills held by banks
B_{BN} notional treasury bills held by banks
B_{CB} treasury bills held by the central bank
B_H treasury bills held by rentier households
B_{HN} notional treasury bills held by rentier households
BD budget deficit
BP pre-tax profits of banks
BPT after-tax profits of banks
bur_F firms' burden of debt
bur_F^T firms' target burden of debt
bur_W worker households' burden of debt
bur_W^T worker households' target burden of debt
CBP central banks' profits
CG capital gains
CG^e expected capital gains
CL consumer loans
CL_D consumer loans demanded
CL_0 'initial' consumer loans
CL_N notional consumer loans
C_R nominal consumption of rentier households
CR_{CL} credit rationing on consumer borrowing
CR_{CLN} notional credit rationing on consumer borrowing
CR_{IL} credit rationing on industrial borrowing
CR_{ILN} notional credit rationing on industrial borrowing
C_W nominal consumption of worker households
C_{WD} desired nominal consumption of worker households
cu capacity utilization
DPT distributed after-tax profits of firms
e number of equities
E_D demand for equities
FC amount of finance via credit
G nominal government expenditures
HPM high-powered money

HPM_B high-powered money of banks
HPM_H high-powered money of rentier households
HPM_{HN} notional high-powered money of rentier households
I nominal investment
I_D desired nominal investment
IL industrial loans
IL_D industrial loans demanded
IL_0 'initial' industrial loans
IL_N notional industrial loans
IT indirect taxes
g_p price inflation
g_p^e expected price inflation
g_{ry} growth rate of output
g_L growth rate of employment
g_m mark-up growth
g_W wage inflation
K nominal capital stock
L level of employment
λ labour productivity
λ_{10} 'initial' proportion of high-power money on rentier households' portfolio
λ_{20} 'initial' proportion of deposit money on rentier households' portfolio
λ_{30} 'initial' proportion of treasury bills on rentier households' portfolio
λ_{40} 'initial' proportion of equities on rentier households' portfolio
liq degree of liquidity pressure
liq^T target degree of liquidity pressure
LR_{CL} lender's risk from consumer lending
LR_{IL} lender's risk from industrial lending
M deposit money
m mark-up of firms
μ_{10} 'initial' share of consumer loans to the total amount of finance
μ_{20} 'initial' share of consumer loans to the total amount of finance
NCL_D amount of new demanded consumer loans
NIL_D amount of new demanded industrial loans
p price level
p^e expected price level
p_e price of equities
r_B interest rate on treasury bills
r_{CL} nominal interest rate on consumer loans
RC_R real consumption of rentier households
RC_W real consumption of worker households

re	rate of employment
rep_{CL}	repayment ratio of consumer loans
rep_{IL}	repayment ratio of industrial loans
r_{IL}	nominal interest rate on industrial loans
r_M	nominal interest rate on deposits
$r^e rr_B$	expected real rate on bills
$r^e rr_M$	expected real rate on deposits
$r^e rr_e^e$	expected real rate of return on equities
RG	real government expenditures
RI	real investment
RI_D	desired real investment
RK	real capital stock
RV_R	real wealth of rentier households
rr_e	rate of return on equities
rr_e^e	expected rate of return on equities
RY	real output
RY_W	real disposable income of worker households
RYT_R	real after-tax disposable income of rentier households
RYT_R^e	real expected after-tax disposable income of rentier households
s_F	firms' income share
s_{FB}	firms' income share corresponding to the attainment of their target burden of debt
s_F^T	target firms' income share
spr_M	spread of the deposit interest rate
s_W	workers' income share
s_{WB}	workers' income share corresponding to the attainment of their target burden of debt
s_W^T	target workers' income share
T	total taxes
TP	total pre- tax profits of firms
TPT	total after-tax profits of firms
T_{BP}	taxes on banks' profits
T_P	taxes on firms' profits
T_R	taxes on rentier households' income
u	output to capital ratio
UPT	undistributed after-tax profits of firms
V_R	nominal wealth of rentier households
V_R^e	expected nominal wealth of rentier households
w	wage rate
W	wage bill
ξ	variable reflecting the excess of desired nominal consumption over worker households' disposable income net of loan repayment

Y nominal income
Y_R pre-tax nominal disposable income of rentier households
YT_R after-tax nominal disposable income of rentier households
YT_R^e expected after-tax nominal disposable income of rentier households
Y_W worker households' disposable income
z_i, z_{ip} variables used for adjustment mechanisms

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