Working Paper

SFC FR Model
A Stock Flow Consistent model for the French economy

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April 2022

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Presentation

08/04/2022

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Abstract

An econometric SFC model of the French economy is presented. The structure of the model is analogous to that of already existing national-level SFC models with demand-led dynamics, a Kaleckian accumulation behavior and an indebtedness norm. A supply constraint results in a simple production function that determines potential output and allows for computation of an output gap. The general price level depends on a mark-up pricing rule, function of unit labor costs, with an effect from demand pressures. Value added is split among the different agents depending on simple structural parameters. Its distribution between wages, profits and other redistribution operations is based on a wage-price-unemployment relation. Financing methods via bank credit, bond and equity issuing, as well as financial investment behavior are described for each agent. The dynamic simulations on the past over the period 1996-2019 provide acceptable results.

In a second part the effects of unconventional monetary policy are evaluated. The distribution of helicopter money in favor of the government to finance additional public investment or social transfers leads to a recovery without public debt but, as a counterpart, with a worsening of central bank wealth and own funds. This would not be a problem according to supporters of this policy. A central bank could still work with negative own funds. This could be the case if the procedure is punctual and limited, but more problematic in the context of a sustained policy. In the case of Eurozone countries such policy would contradict European treaties. The partial cancellation of the public debt held by the central bank is another proposal. It has no effect on the real economy. Public debt falls but central bank wealth falls as much. This situation gives no room of maneuver to support new public investment. Last, the solutions proposed to restore the central bank's own funds are not convincing. Helicopter money could be used to credit the account of the government at the central bank and purchase new issued central bank equities. But this solution would not increase the central bank own funds as its wealth would be reduced by an equivalent amount.

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Introduction

The founding works of Godley and Lavoie (Godley, 1999; Lavoie and Godley, 2001; Godley and Lavoie, 2007) were well-adapted to study financialized economies as well as the international imbalances of the 1990s and 2000s. In the 2010s better calibrated or econometrically-based SFC models became more frequent. The Levy model of the US (Godley et al., 2005) was a forerunner. The Cambridge Alphametrics Model (CAM), for the world economy with 10 regions, also appears as a pioneer (for a recent presentation, see Cripps, 2014). The econometric SFC model of the Italian economy (Zezza and Zezza, 2020) seems the most complete version. In France the accumulation accounts (*comptes de patrimoine*) from INSEE and the financial accounts by Bank of France provide a detailed statistical framework, well-adapted for an econometric SFC model. It is in this perspective that a first version of an econometric SFC model of the French economy has been presented (Mazier and Reyes, 2022). This paper is based on the same model with a more developed treatment of the rates of interest and of the central bank. It is organized as follows. A second part presents the overall structure of the model, a third one describes the main equations. A fourth section displays the simulations in the past and the basic shocks on fiscal and monetary policies. A fifth section is devoted to unconventional monetary policies, helicopter money and a partial cancellation of debt held by the central bank. The last part concludes.[1]

The overall structure of the model

The structure of the model is analogous to that of already existing national-level SFC models. The economy is divided into five domestic agents; firms, households (including non-profit institutions serving households), banks, the central bank, the government, all of which interact with the rest of the world. The monetary and financial operations from the European central bank are included with the rest of the world (which is in a way quite symbolic) in the statistical conventions adopted.

The model is aggregate with a single product. Production (in volume, at constant prices) is determined by domestic demand (investment and change in inventories by firms, consumption and investment from households, the government and banks) and foreign demand (exports net of imports). A supply constraint is introduced and results, at this stage of the model, in a simple production function that determines potential output and allows for computation of an output gap. The general price level depends on a mark-up pricing rule, and is a function of unit labor costs with an effect from demand pressures. Value added is calculated from GDP in value after deduction of the VAT and import duties and taxes. This value added is split among the different agents depending on simple structural parameters. Its distribution between wages, profits, social contributions, taxes and other redistribution operations is described in order to arrive at the balance of the agents' accounts, taking into account their expenditures: disposable income, savings and financing capacity/need. Exports and imports are analyzed at the level of all goods and services according to demand (foreign and domestic, respectively) and relative prices.

[1] The complete working paper and the technical documentation are available on the website of the *Chaire Energie et Prospérité*.

Table 1 Symbolic balance sheet structure of economic agents

		Non-Fin. Corporations		Financial institutions				Government		Households + NPISH		Rest of the world	
				Banks		Banque de France							
		Asset	Liab.	Asset	Liab.	Asset	Liab.	Asset	Liab.	Asset	Liab.	Asset	Liab.
ANF_1	Produced non-financial assets	$p_{K_1}^F K_1^F$		$p_{K_1}^B K_1^B$				$p_{K_1}^G K_1^G$		$p_{K_1}^H K_1^H$			
ANF_{12}	Inventories (12) + valuables (13)	$p_{K_{12}}^F K_{12}^F$						$p_{K_{12}}^F K_{12}^F$		$p_{K_{12}}^F K_{12}^F$ $p_{K_{13}}^F K_{13}^F$			
ANF_2	Non-produced non-financial assets	$p_{K_2}^F K_2^F$		$p_{K_2}^B K_2^B$				$p_{K_2}^G K_2^G$		$p_{K_2}^H K_2^H$			
F_1	Monetary gold and SDRs					$p_G^{CB} G^{CB}$							$p_G^{CB} G^{CB}$
F_2	Bills and coins	H^F		H^B			H			H^H		H^R	
	Refinancing between financial institutions				RF	RF^{CB}							RF^R
	Bank reserves			RES			RES						
	Govt. account at CB						$D_L^{CB_G}$	$D_A^{CB_G}$					
	Target 2					$TRGT2$							$TRGT2$
	Deposits	D_A^F		D_A^B	D_L^B	D_A^{CB}	D_L^{CB}	D_A^G	D_L^G	D_A^H		D_A^R	D_L^R
F_3	Public securities	$p_{B_A}^{F_G} B_A^{F_G}$		$p_{B_A}^{B_G} B_A^{B_G}$		$p_{B_A}^{CB_G} B_A^{CB_G}$			$p_{B_L}^G B_L^G$			$p_{B_A}^{R_G} B_A^{R_G}$	
	Foreign securities	$p_{B_A}^{F_R} B_A^{F_R}$		$p_{B_A}^{B_R} B_A^{B_R}$		$p_{B_A}^{CB_R} B_A^{CB_R}$		$p_{B_A}^{G_R} B_A^{G_R}$		$p_{B_A}^{H_R} B_A^{H_R}$			$p_{B_L}^R B_L^R$
	Other securities		$p_{B_L}^F B_L^F$	$p_{B_A}^B B_A^B$	$p_{B_L}^B B_L^B$	$p_{B_A}^{CB} B_A^{CB}$		$p_{B_A}^G B_A^G$		$p_{B_A}^H B_A^H$		$p_{B_A}^R B_A^R$	
F_4	Loans	L_A^F	L_L^F	L_A^B		L_A^{CB}			L_L^G		L_L^H	L_A^R	L_L^R
F_5	[Domestic] Equity and inv. fund shares	$p_{E_A}^{F_{FR}} E_A^{F_{FR}}$	$p_{E_L}^F E_L^F$	$p_{E_A}^{B_{FR}} E_A^{B_{FR}}$	$p_{E_L}^B E_L^B$	$p_{E_A}^{CB_{FR}} E_A^{CB}$	$p_{E_L}^{CB} E_L^{CB}$	$p_{E_A}^{G_{FR}} E_A^{G_{FR}}$		$p_{E_A}^{H_{FR}} E_A^{H_{FR}}$		$p_{E_A}^R E_A^R$	
	[Foreign] Equity and inv. fund shares issued by RoW	$p_{E_A}^{F_R} E_A^{F_R}$		$p_{E_A}^{B_R} E_A^{B_R}$		$p_{E_A}^{CB_R} E_A^{CB_R}$		$p_{E_A}^{G_R} E_A^{G_R}$		$p_{E_A}^{H_R} E_A^{H_R}$			$p_{E_L}^R E_L^R$
F_6	Insurance. pension funds and s.g.s.	A_A^F			A_L^B			A_A^G		A_A^H		A_A^R	
F_7	Fin. derivatives and employee stock options	X_A^F			X_L^B			X_A^G		X_A^H			X_A^R
F_8	Other accounts receivable/payable	Z^F		Z^B		Z^{CB}		Z^G		Z^H		Z^R	
F	**Financial wealth**		$\mathbf{FW^F}$		$\mathbf{FW^B}$		$\mathbf{FW^{CB}}$		$\mathbf{FW^G}$		$\mathbf{FW^H}$		$\mathbf{FW^R}$
B90	**Net worth**		$\mathbf{WLTH^F}$		$\mathbf{WLTH^B}$		$\mathbf{WLTH^{CB}}$		$\mathbf{WLTH^G}$		$\mathbf{WLTH^H}$		$\mathbf{WLTH^R}$

Closes the column (sector) in flow   Closes the row (instrument) in flow

Table 2 Symbolic uses-resources table + flow of funds

		Firms		Financial inst excl BdF		Banque de France		Government		Households + NPISH		Rest of the world		Total (uses -res.)
Code	**Item**	**paid**	**received**	**paid**	**received**	**paid**	**received**	**paid**	**received**	**paid**	**received**	**paid**	**received**	
P6	Exports											$p_X X$		$p_X X$
P7	Imports												$p_{IM} IM$	$p_{IM} IM$
B11	*Trade balance*												$-TB$	TB
P1	Production		$p_Q Q^F$		$p_Q Q^B$				$p_Q Q^G$		$p_Q Q^H$			$p_Q Q$
P2	Intermediate consumption	$p_{IC} IC^F$		$p_{IC} IC^B$				$p_{IC} IC^G$		$p_{IC} IC^H$				$p_{IC} IC^H$
B1	*Value added*		VA^F		VA^B				VA^G		VA^H			VA
D11	Wages and salaries	W_p^F		W_p^B				W_p^G		W_p^H	W_r^H	W_p^R	W_r^R	0
D12	Labor contributions	LC_p^F		LC_p^B				LC_p^G		LC_p^H	LC_r^H	LC_p^R	LC_r^R	0
D29	Taxes on payroll and miscellaneous taxes on production	T_L^F		T_L^B				T_L^G	T_L	T_L^H			T_L^R	0
D319	Subsidies on production								$-Sub$				$-Sub^R$	$-Sub'$
D39	Other subsidies on production		$-Sub_r^F$		$-Sub_r^B$				$-Sub_r^G$		$-Sub_r^H$		$-Sub_r^R$	$-Sub^*$
D39b	Operating subsidies								$-Sub_r^{G'}$					$-Sub_r^G$
B2	*Gross operating surplus*	Π^F	Π^F	Π^B	Π^B			$[\Pi^G]$	$[\Pi^G]$	$[\Pi^H]$	$[\Pi^H]$			Π
D21	Net taxes on production								T_P				T_P^R	T_P^T
D41	Interest	Int_p^F	Int_r^F	Int_p^B	Int_r^B	Int_p^{CB}	Int_r^{CB}	Int_p^G	Int_r^G	Int_p^H	Int_r^H	Int_p^R	Int_r^R	0
D42	Distributed income of corporations	Div_p^F	Div_r^F	Div_p^B	Div_r^B	Div_p^{CB}	Div_r^{CB}		Div_r^G		Div_r^H	Div_p^R	Div_r^R	0
D43	Reinvested earnings on direct foreign investment	$RFDI_p^F$	$RFDI_r^F$	$RFDI_p^B$	$RFDI_r^B$							$RFDI_p^R$	$RFDI_r^R$	0
D44	Property income attributed to insurance policy holders		INS_r^F	INS_p^B					INS_r^G		INS_r^H		INS_r^R	0
D45	Rents	$RENT_p^F$							$RENT_r^G$	$RENT_p^H$	$RENT_r^H$			0
D5	Taxes on income and wealth	T^F		T^B					T	T^H		T^R		0
D61	Social contributions		SC_r^F		SC_r^B				SC_r^G	SC_p^H		SC_p^R	SC_r^R	0
D62	Social benefits	SB_p^F		SB_p^B				SB_p^G			SB_r^H	SB_p^R	SB_r^R	0
D7	Transfers	Tr_p^F		Tr_p^B	Tr_r^B			Tr_p^G			Tr_r^H		Tr_r^R	0
B6	*Gross disposable income*		Y_d^F		Y_d^B				Y_d^G		Y_d^H			Y_d
P3	Consumption							$p_C^H C^H$		$p_C^G C^G$				$p_C C$
B8	*Gross saving*		S^F		S^B				S^G		S^H			S
D9	Capital transfers		$Tr_{K_r}^F$		$Tr_{K_r}^B$			$Tr_{K_p}^G$		$Tr_{K_p}^H$		$Tr_{K_p}^R$	$Tr_{K_r}^R$	0
P51	Gross Fixed Capital Formation	$p_{I_1}^F I_1^F$		$p_{I_1}^B I_1^B$				$p_{I_1}^G I_1^G$		$p_{I_1}^H I_1^H$				$p_{I_1} I_1$
P52	Changes in inventories	$p_{I_{12}}^F I_{12}^F$						$p_{I_{12}}^G I_{12}^G$		$p_{I_{12}}^H I_{12}^H$				$p_{I12} I_{12}$
P53	Acquisition less disposals of valuables									$p_{I_{13}}^H I_{13}^H$				$p_{I_{13}}^H I_{13}^H$
NP	Acquisitions less disposals of non-fin non-produced assets	NP_p^F		NP_p^B				NP_p^G		NP_p^H				0
B9NF	*Financing capacity*	FCN^F		FCN^B		*0*		FCN^G		FCN^H		FCN^R		*0*
Adj	***Adjustment B9F - B9NF***	Adj^F		Adj^B		Adj^{CB}		Adj^G		Adj^H		Adj^R		**0**
		Firms		**Financial inst excl BdF**		**Banque de France**		**Government**		**Households + NPISH**		**Rest of the world**		
Flow	*Instrument*	*Asset*	*Liability*	*Asset*	*Liability*	*Asset*	*Liability*	*Asset*	*Liability*	*Asset*	*Liability*	*Asset*	*Liability*	
F1	Monetary gold and SDRs					$p_G^{CB} \Delta^* G^{CB}$							$p_G^{CB} \Delta^* G^{CB}$	0
F21	Bills and coins	$\Delta^* H^F$		$\Delta^* H^B$			$\Delta^* H^{CB}$			$\Delta^* H^H$		$\Delta^* H^R$		0
F295	Refinancing between FI				$\Delta^* RF$	$\Delta^* RF^{CB}$							$\Delta^* RF^R$	0
res	Bank reserves			$\Delta^* RES$			$\Delta^* RES$							0

gcb	Govt acc at the CB						$\Delta^* D_A^{CB_G}$	$\Delta^* D_A^{CB_G}$						0
tgt2	Target2					$\Delta^* TRGT2$							$\Delta^* TRGT2$	0
F2	Deposits	$\Delta^* D_A^F$		$\Delta^* D_A^B$	$\Delta^* D_L^B$	$\Delta^* D_A^{CB}$	$\Delta^* D_L^{CB}$	$\Delta^* D_A^G$	$\Delta^* D_L^G$	$\Delta^* D_A^H$		$\Delta^* D_A^R$	$\Delta^* D_L^R$	0
F3e	Public securities	$p_{B_A}^{F_G}\Delta^* B_A^{F_G}$		$p_{B_A}^{B_G}\Delta^* B_A^{B_G}$		$p_{B_A}^{CB_G}\Delta^* B_A^{CB_G}$			$p_{B_L}^{G}\Delta^* B_L^{G}$			$p_{B_A}^{R_G}\Delta^* B_A^{R_G}$		0
F3d	Foreign securities	$p_{B_A}^{F_R}\Delta^* B_A^{F_R}$		$p_{B_A}^{B_R}\Delta^* B_A^{B_R}$		$p_{B_A}^{CB_R}\Delta^* B_A^{CB_R}$				$p_{B_A}^{H_R}\Delta^* B_A^{H_R}$			$p_{B_L}^{R}\Delta^* B_L^{R}$	0
F3g	Other securities		$p_{B_L}^{F}\Delta^* B_L^{F}$	$p_{B_A}^{B}\Delta^* B_A^{B}$	$p_{B_L}^{B}\Delta^* B_L^{B}$	$p_{B_A}^{CB}\Delta^* B_A^{CB}$		$p_{B_A}^{G}\Delta^* B_A^{G}$		$p_{B_A}^{H}\Delta^* B_A^{H}$		$p_{B_A}^{R}\Delta^* B_A^{R}$		0
F4	Loans	$\Delta^* L_A^F$	$\Delta^* L_L^F$	$\Delta^* L_A^B$		$\Delta^* L_A^{CB}$			$\Delta^* L_L^G$		$\Delta^* L_L^H$	$\Delta^* L_A^R$	$\Delta^* L_L^R$	0
F5e	Domestic equity and investment fund shares	$p_{E_A}^{F}\Delta^* E_A^{F}$	$p_{E_L}^{F}\Delta^* E_L^{F}$	$p_{E_A}^{B}\Delta^* E_A^{B}$	$p_{E_L}^{B}\Delta^* E_L^{B}$	$p_{E_A}^{CB}\Delta^* E_A^{CB}$	$p_{E_L}^{CB}\Delta^* E_L^{CB}$	$p_{E_A}^{G}\Delta^* E_A^{G}$		$p_{E_A}^{H}\Delta^* E_A^{H}$		$p_{E_A}^{R}\Delta^* E_A^{R}$		0
F5d	Foreign equity and investment fund shares	$p_{E_A}^{F_R}\Delta^* E_A^{F_R}$		$p_{E_A}^{B_R}\Delta^* E_A^{B_R}$		$p_{E_A}^{CB_R}\Delta^* E_A^{CB_R}$		$p_{E_A}^{G_R}\Delta^* E_A^{G_R}$		$p_{E_A}^{H_R}\Delta^* E_A^{H_R}$			$p_{E_L}^{R}\Delta^* E_L^{R}$	0
F6	Insurance, pension funds and s.g.s.	$\Delta^* A_A^F$			$\Delta^* A_L^B$			$\Delta^* A_A^G$		$\Delta^* A_A^H$		$\Delta^* A_A^R$		0
F7	Fin. derivatives and employee stock options	$\Delta^* X_A^F$			$\Delta^* X_L^B$	$\Delta^* X_A^{CB}$		$\Delta^* X_A^G$		$\Delta^* X_A^H$			$\Delta^* X_L^R$	0
F8	Other accounts receivable/payable	$\Delta^* Z_A^F$		$\Delta^* Z_A^B$		$\Delta^* Z_A^{CB}$		$\Delta^* Z_A^G$		$\Delta^* Z_A^H$		$\Delta^* Z_A^R$		0
	Net acquisition of financial assets		$\boldsymbol{NAFA^F}$		$\boldsymbol{NAFA^B}$		$\boldsymbol{NAFA^{CB}}$		$\boldsymbol{NAFA^G}$		$\boldsymbol{NAFA^H}$		$\boldsymbol{NAFA^R}$	***0***

* NPISH = Non-profit institutions serving households
Cells in blue represent the closing items of the corresponding line
Financing capacity (FCN) + Adjustment (Adj) = Net acquisition of financial assets (NAFA)

The value of gross investment is identical to the value of the flow of non-financial assets. However, the same identity does not hold in volume. In other words; $p_{I_1} I_1 = p_{K_1} I_{1*}$ where p_{I_1} and I_1 are the price and volume of gross investment from the national accounts (uses-resources table), and p_{K_1} and I_{1*} are the equivalent items from the accumulation accounts. However, note that $p_{I_1} \neq p_{K_1}$ and that $I_1 \neq I_{1*}$. When dealing with this volume mismatch, we have to correct by including the identity linking both in value. The only item for which price and volume data in both sources is identical is *inventories*, so that $p_{K_{12}}^F I_{12*}^F = p_{I_{12}}^F$, $I_{12*}^F = I_{12}^F$ and $p_{K_{12}}^F = p_{I_{12}}^F$. The equations for the volume of gross investment are behavioral, and those of the flow of produced non-financial assets are the identities that guarantee accounting consistency. Table 3 and 7 illustrate the identities discussed.

Table 3 *National income and accumulation accounts in value*

	Sector	*Stock*	*Stock-1*	*Flow*	*Other changes in assets*	
					Revaluation	*Other changes in volume*
Produced non-financial assets	*Firms*	$p_{K_1}^F K_1^F =$	$p_{K_{1-1}}^F K_{1-1}^F (1-\delta_{K_1}^F) +$	$p_{K_1}^F I_{1*}^F (= p_{I_1}^F I_1^F) +$	$K_{1-1}^F \Delta p_{K_1}^F +$	$OCV_{K_1}^F$
		$p_{K_{12}}^F K_{12}^F =$	$p_{K_{12-1}}^F K_{12-1}^F +$	$p_{K_{12}}^F I_{12*}^F (= p_{I_{12}}^F I_{12}^F) +$	$K_{12-1}^F \Delta p_{K_{12}}^F +$	$OCV_{K_{12}}^F$
	Banks	$p_{K_1}^B K_1^B =$	$p_{K_{1-1}}^B K_{1-1}^B (1-\delta_{K_1}^B) +$	$p_{K_1}^B I_{1*}^B (= p_{I_1}^B I_1^B) +$	$K_{1-1}^B \Delta p_{K_1}^B +$	$OCV_{K_1}^B$
	Govt.	$p_{K_1}^G K_1^G =$	$p_{K_{1-1}}^G K_{1-1}^G (1-\delta_{K_1}^G) +$	$p_{K_1}^G I_{1*}^G (= p_{I_1}^G I_1^G) +$	$K_{1-1}^G \Delta p_{K_1}^G +$	$OCV_{K_1}^G$
	HH	$p_{K_1}^H K_1^H =$	$p_{K_{1-1}}^H K_{1-1}^H (1-\delta_{K_1}^H) +$	$p_{K_1}^H I_{1*}^H (= p_{I_1}^H I_1^H) +$	$K_{1-1}^H \Delta p_{K_1}^H +$	$OCV_{K_1}^H$
	All	$p_{K_1} K_1 =$	$p_{K_{1-1}} K_{1-1} (1-\delta_{k_1}) +$	$p_{K_1} I_{1*} (= p_{I_1} I_1)$	$K_{1-1} \Delta p_{K_1} +$	OCV_{K_1}
Cons.	*HH*			$+p_C^H C^H$		
	Govt.			$+p_C^G C^G$		
Trade	*RoW*			$+p_X X$		
				$-p_{IM} IM$		
GDP	*All*			$= p_Y Y$		

Financing methods via bank credit, bond and equity issuing, as well as financial investment behavior are then described for each agent. An adjustment item is the statistical discrepancy between the real sector accounts from INSEE and the financial accounts by Bank of France. Changes in assets and liabilities, as well as investments and changes in inventories, combined with the revaluation accounts for capital gains or losses, allow for the transition of the accumulation accounts from one year to the next in an SFC manner. The treatment of Other Changes in Volume (OCV) and of revaluations is important and rather technical. Without delving into the details, it suffices to say that for each item of the balance sheet an OCV or asset price must be computed in order to ensure stock-flow consistency (see appendix). Tables 1 and 2 provide the balance sheet structure of the domestic and foreign sectors and the uses-resources table. They give the definition of the main variables of the model. Tables 3 and 4 provide the numerical data for 2019 (in % of GDP), table 5 the revaluation tables, tables 6 and 7 the accumulation accounts in value and volume (see appendix for tables 3 to 7).

With respect to non-financial assets, a distinction is made between produced capital (productive capital and housing), outstanding stocks and non-produced capital (land), the sharp rise in price of which is one of the characteristics of financialized capitalism and has had a significant macroeconomic impact.

Among the financial assets, a split is made traditionally between monetary gold and SDRs, cash and deposits, securities, loans, equities, insurance and pension funds, finance derivatives and other accounts receivable. For a better understanding of the monetary policy, deposits are analyzed in more detail with a subdivision between bills and coins, refinancing between financial institutions, bank reserves, the government account at the central bank, TARGET2 and other deposits. Two items deserve particular attention. On the one hand, the government's account at the central bank is isolated in order to study the effects of helicopter money. On the other hand, TARGET2 corresponds to the balance of the real and financial exchanges between France and the rest of the Eurozone. They are, respectively on the asset side of Bank of France and on the liability side for the ECB, thus appearing in the column rest of the world in the convention that has been adopted, and are considered exogenous because their determinants lie largely outside of the model. Securities are split between public securities (bonds issued by the government), other domestic securities issued by firms and financial institutions and foreign securities issued by the rest of the world and held by domestic agents. Equities are also split between domestic equities issued by firms and financial institutions and foreign equities issued by the rest of the world and held by domestic agents.

The main closures are the following:

- Firms balance their accounts by issuing the necessary shares.
- Households balance their account by getting into debt with banks.
- Bank reserves balance the banks' accounts.
- The equilibrium between assets and liabilities of the central bank corresponds to the missing equation of the model deducted from the writing of the other balances.
- Public debt, in the form of bank debt and bonds, balances the government's account.

- Deposits on the liability side, as representative of foreign deposits held by domestic agents, adjust the rest of the world's account.
- Banks absorb all public bonds available and extend credit without restriction.
- Banks balance the market of private domestic bonds and the market of domestic equities, the price of which depends on the price of foreign equity, which has a dominant effect.
- Foreign bonds and equity issued by the rest of the world equal their domestic demand.

The main equations

Next to computable equations written from the previous tables, the main equations can be presented by successive blocs: the firms, the households, the financial institutions, the interest rates and the prices of the financial assets, the rest of the world and, last but not least, the prices, wages and employment equations. For each equation some simple econometric results using OLS are given with figures to illustrate the evolution of the different variables.

Firms

Firms' non-financial accumulation rate

Firms have an accumulation rate of productive capital $\left(\frac{\Delta^* K_1^F}{K_{1-1}^F}\right)$ that depends on four variables, following a Kaleckian logic; the lagged profit rate related to total capital $\left(\frac{\Pi^F{}_{-1}}{p_{K_{1-1}}^F K_{1-2}^F + p_{K_{2-1}}^F K_{2-2}^F}\right)$ including the stock of land ($p_{K_2}^F K_2^F$); the real interest rate[2] ($r_L^F - \pi_Y$) and financial profitability ($r_{E_A}^F - \pi_Y$, where π_Y is the inflation rate), both with a negative sign; the debt structure here represented as the debt-to-own funds ratio $\left(\frac{L_L^F}{p_{E_L}^F E_L^F + WLTH^F}\right)$, also with a negative effect. Financial profitability of equities held is the sum of revaluation and dividends received divided by the stock of equity of the previous period $r_{E_A}^F = \left(\frac{E_{A-1}^F \Delta p_{E_A}^F + Div_r^F}{p_{E_{A-1}}^F E_{A-1}^F}\right)$. It is mainly driven by the growth rate of the price of equities. A version with the output gap (GAP) was tested but is not used in this version of the model. Inventories stock (K_{12}^F) follows a simple accelerator model.

Version without output gap

$$\left(\frac{\Delta^* K_1^F}{K_{1-1}^F}\right) = 0.02 + 0.1\left(\frac{\Pi^F{}_{-1}}{p_{K_{1-1}}^F K_{1-2}^F + p_{K_{2-1}}^F K_{2-2}^F}\right) - 0.1(r_L^F - \pi_Y) - 0.02(r_{E_A}^F - \pi_Y) - 0.03\left(\frac{L_L^F}{p_{E_L}^F E_L^F + WLTH^F}\right) + 0.01 d_{1990} + 0.01 d_{1991}$$

1983-2019 (6.9) (2) (-1.9) (-3.5)
(-4.5) (3) (2.2)

R2 = 0.59 ; DW = 1.2

[2] r_L^F is the apparent (or implicit) interest rate, calculated as the ratio of interests paid by firms and the stock of indebtedness from the previous period.

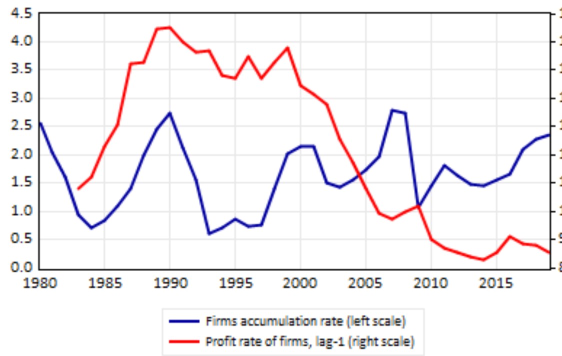
Version with output gap

$$\left(\frac{\Delta^{*}K_{1}^{F}}{K_{1-1}^{F}}\right) = 0.03 - 0.06(r_{L}^{F} - \pi_{Y}) - 0.02\left(\frac{L_{L}^{F}}{p_{E_L}^{F}E_{L}^{F} + WLTH^{F}}\right) + 0.3GAP + 0.006d_{1990}$$

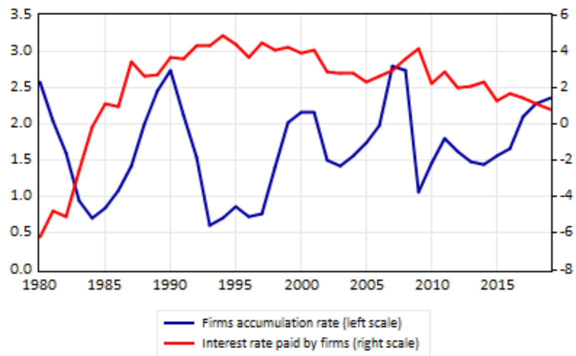
1981-2019 (15.4) (-2.4) (-5.6) (8.3) (1.9)

R2 = 0.77 ; DW = 0.8

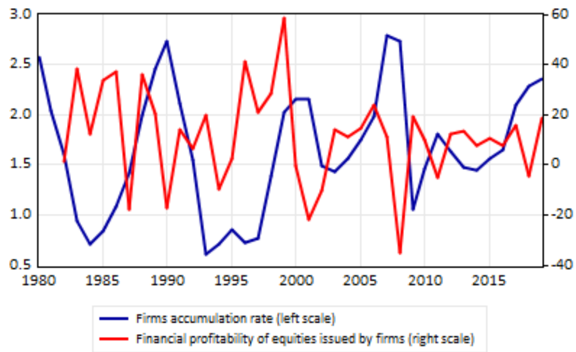
Figure 1 Firms' non-financial accumulation rate



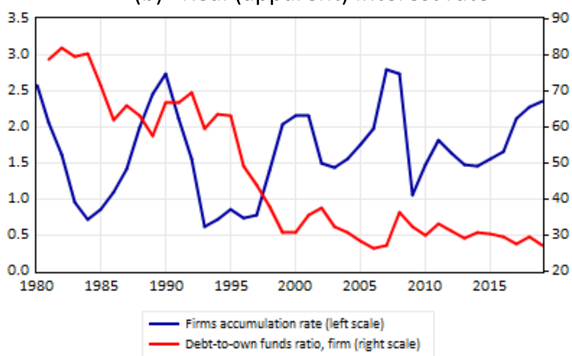
(a) Profit rate



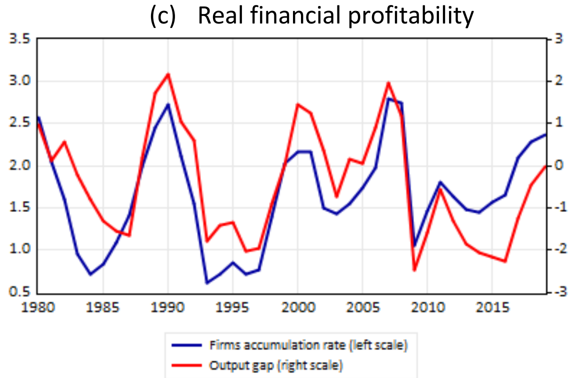
(b) Real (apparent) interest rate



(c) Real financial profitability



(d) Debt-to-own funds ratio



(e) Output gap

Firms' inventories

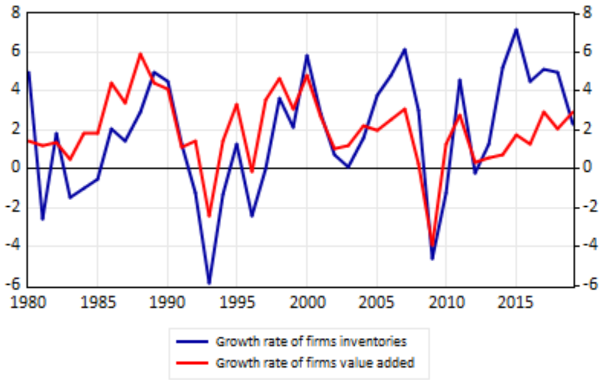
Firms' inventories follow a traditional accelerator effect.

$$\Delta\ln(K_{12}^{F}) = -0.01 + 0.8\Delta\ln(K_{12-1}^{F}) + 1.2\Delta\ln(va^{F}) - 0.6\Delta\ln(va_{-1}^{F}) + 0.04d_{2011} + 0.05d_{2014}$$

1983-2019 (-2.9) (7.3) (9) (-3.2) (2.8) (3.4)

R2 = 0.82 ; DW = 2.1

Figure 2 Growth rate of firms' inventories and g.r. of firms' value added



Price of firms' land

The price of firms' land ($p^F_{K_2}$) is influenced by the price of households' land ($p^H_{K_2}$) which itself is driven by the dynamics of the real estate, as it will be shown below.

$$\ln(p^F_{K_2}) = 0.86\ln(p^F_{K_{2-1}}) + 0.8\ln(p^H_{K_2}) - 0.7\ln(p^H_{K_{2-1}}) + 0.02d_{1989} - 0.02d_{1992} - 0.01d_{1993}$$

1982-2019 (34) (96) (-26) (3.3) (-3.7) (-2.6)

R2 = 0.99 ; DW = 1.77

Firms' financial rate of accumulation

In financialized capitalism, firms tend to favor financial accumulation $\left(\frac{\Delta^* E^F_A}{E^F_{A-1}}\right)$ at the expense of productive accumulation. This translates into a financial accumulation rate that is an increasing function of the profit rate $\left(\frac{\Pi^F}{p^F_{K_1}K^F_{1-1}+p^F_{K_{12}}K^F_{12-1}+p^F_{K_2}K^F_{2-1}}\right)$ and of financial profitability of equities held $(r^F_{E_{A-1}} - \pi_{Y-1})$, where (unlike the previous case) indebtedness as a ratio of own-funds $\left(\frac{L^F_L}{p^F_{E_L}E^F_L+WLTH^F}\right)$ plays a supporting role. A split between domestic (E^{FFR}_A) and foreign equity (E^{FR}_A) is also done.

$$\left(\frac{\Delta^* E^F_A}{E^F_{A-1}}\right) = 0.35\left(\frac{\Pi^F}{p^F_{K_1}K^F_{1-1} + p^F_{K_{12}}K^F_{12-1} + p^F_{K_2}K^F_{2-1}}\right) + 0.02(r^F_{E_{A-1}} - \pi_{Y-1}) + 0.01\left(\frac{p^F_{L_L}L^F_L}{p^F_{E_L}E^F_L + WLTH^F}\right) - 0.04d_{1994} - 0.02d_{2012-2018}$$

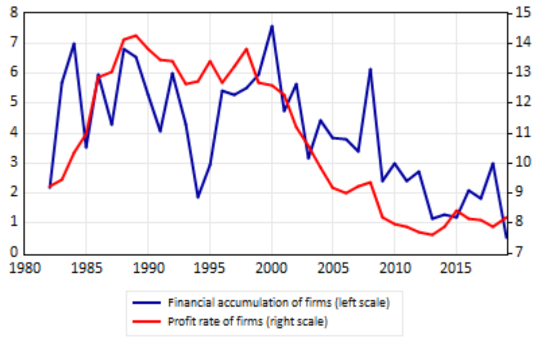
1983-2019 (5.2) (1.4) (0.9)

(-3.1) (-3.7)

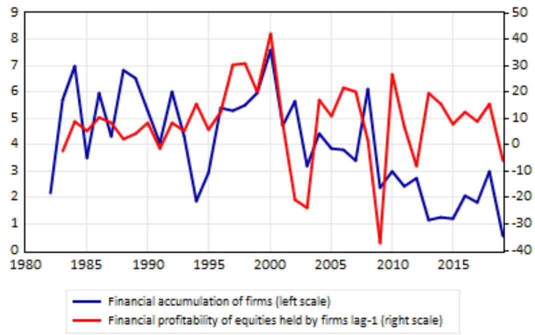
R2 = 0.66 ; DW = 2.2

$$p^{FR}_{E_A}E^{FR}_A = p^F_{E_A}E^F_A - p^{FFR}_{E_A}E^{FFR}_A$$

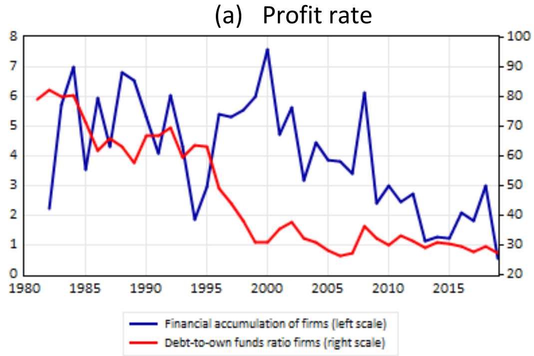
Figure 3 Firms' financial accumulation rate



(a) Profit rate



(b) Real financial profitability



(c) Debt-to-own funds ratio

Firms' indebtedness

Firms have an indebtedness behavior. In the medium-term[3] their debt structure, as a ratio of total non-financial capital $\left(\frac{p^F_{BL_L} BL^F_L}{p^F_{K_1} K^F_1 + p^F_{K_{12}} K^F_{12} + p^F_{K_2} K^F_2}\right)$, depends positively on the profit rate and negatively on the real interest rate[4] $(i_{10years} - \pi_Y)$. More than a debt behavior, it is an indebtedness norm, which reflects a given institutional relation between firms and banks. A split between bank debt (L^F_L) and bonds $(p^F_{B_L} B^F_L)$ is also made. Equities issued $(p^F_E \Delta^* E^F_L)$ close the firms' account.

$$\left(\frac{p^F_{BL_L} BL^F_L}{p^F_{K_1} K^F_1 + p^F_{K_{12}} K^F_{12} + p^F_{K_2} K^F_2}\right) = 7.7\left(\frac{\Pi^F}{p^F_{K_1} K^F_{1-1} + p^F_{K_{12}} K^F_{12-1} + p^F_{K_2} K^F_{2-1}}\right) - 3.2(i_{10years} - \pi_Y) - 0.15 d_{1987} - 0.1 d_{1995-2003}$$

1982-2019 (25.2) (-4.2) (-1.9) (-3.3)

R2 = 0.33 ; DW = 0.6

$$\Delta\left(\frac{p^F_{BL_L} BL^F_L}{p^F_{K_1} K^F_1 + p^F_{K_{12}} K^F_{12} + p^F_{K_2} K^F_2}\right) = 0.3\Delta\left(\frac{p^F_{BL_{L-1}} BL^F_{L-1}}{p^F_{K_{1-1}} K^F_{1-1} + p^F_{K_{12-1}} K^F_{12-1} + p^F_{K_{2-1}} K^F_{2-1}}\right) + 1.8\Delta\left(\frac{\Pi^F}{p^F_{K_1} K^F_{1-1} + p^F_{K_{12}} K^F_{12-1} + p^F_{K_2} K^F_{2-1}}\right) - 0.07 vc_{-1} - 0.08 d_{1996} + 0.07 d_{2014}$$

[3] vc (bottom equation) stands for vector of cointegration, and is the medium-term relationship normalized to 0.
[4] $i_{10years}$ is the interest rate on 10-year government bonds.

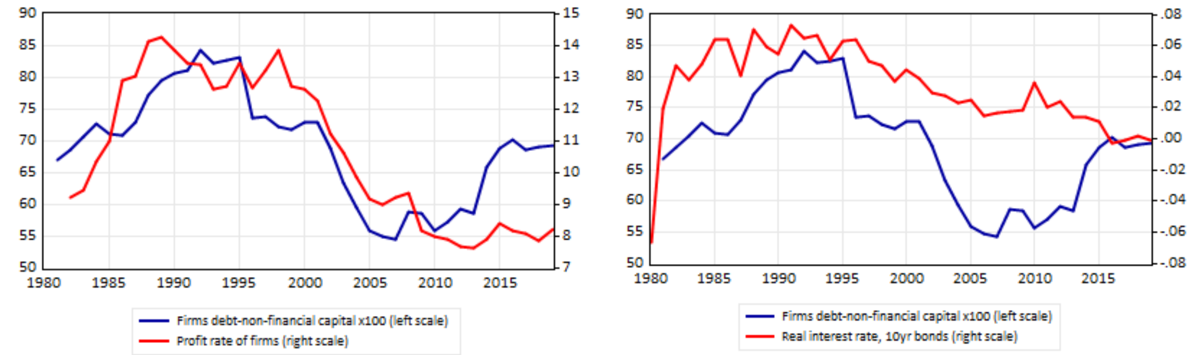
1983-2019 (2.7) (3.3)

(-1.5) (-3.7) (3.9)

R2 = 0.65 : DW = 2.1

$$\Delta^* L_L^F = p_{BL_L}^F \Delta^* BL_L^F - p_{B_L}^F \Delta^* B_L^F$$

Figure 4 Firms' total indebtedness



(a) Profit rate, level (b) Real interest rate

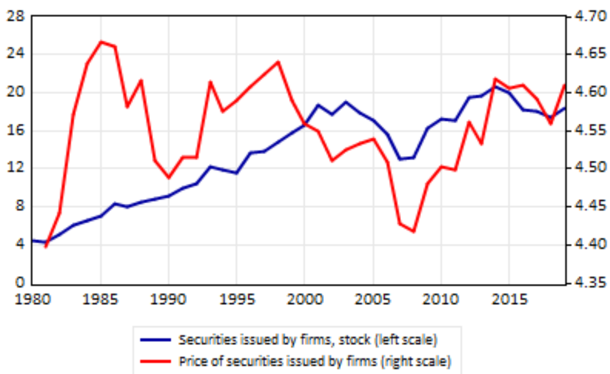
Securities issued by firms % of total indebtedness

$$\left(\frac{p_{B_L}^F B_L^F}{p_{BL_L}^F BL_L^F}\right) = 0.9\left(\frac{p_{B_{L-1}}^F B_{L-1}^F}{p_{BL_{L-1}}^F BL_{L-1}^F}\right) + 0.002\ln\left(p_{B_L}^F\right) - 0.03 d_{2007} + 0.03 d_{2009}$$

1981-2019 (30) (2.4) (-3) (2.8)

R2 = 0.96 ; DW = 2.1

Figure 5 Securities issued % of total indebtedness, NFCs



Firms' bank debt

$$\Delta^* L_L^F = p_{BL_L}^F \Delta^* BL_L^F - p_{B_L}^F \Delta^* B_L^F$$

Firms' financial assets

The change in firms' deposits as % of GDP $\left[\Delta\left(\frac{D_A^F}{p_Y Y}\right)\right]$ and the flow of inter-firm credits[5] as a share of firm's value added $\left(\frac{\Delta^* L_A^F}{VA^F}\right)$, i.e. credits granted by the firms to themselves, are the subject of a simplified model in which the real 10-year interest rate (with a negative sign) and the firms' indebtedness (as a liability) intervene respectively.

Stock of deposits held by firms

$$\Delta\left(\frac{D_A^F}{p_Y Y}\right) = 0.009 + 0.4\Delta\left(\frac{D_{A-1}^F}{p_{Y-1} Y_{-1}}\right) - 0.14(i_{10yrs} - \pi_Y) - 0.02 d_{1998} - 0.02 d_{2002}$$

1990-2019 (3.6) (2.2) (-2.4) (-2.9) (-2.9)

R2 = 0.64 ; DW = 2.3

Loans granted by non-financial firms

$$\left(\frac{\Delta^* L_A^F}{VA^F}\right) = 0.5\left(\frac{\Delta^* L_{A-1}^F}{VA^F{}_{-1}}\right) + 0.5\left(\frac{\Delta^* L_L^F}{VA^F}\right) - 0.3\left(\frac{\Delta^* L_{L-1}^F}{VA^F{}_{-1}}\right) + 0.05 d_{1992}$$

1981-2019 (3.6) (9.1) (-3) (2.3)

R2 = 0.57 ; DW = 2.3

Households

Households' consumption and investment

Household consumption (C^H) depends (somehow unsurprisingly) on disposable income $\left(\frac{Y_d^H}{p_C{}^H}\right)$ and a wealth effect $\left(\frac{WLTH^H}{p_C{}^H}\right)$, where $p_C{}^H$ stands for the consumer price index. Apart from disposable income, household investment (I_1^H) is a function of the real interest rate $(i_{10years} - \pi_I^H)$ with a negative effect and of the growth rate of the land price ($p_{K_2}^H$), which contributes to enhance the housing boom[6]. The price of land is itself a function of household investment and debt as a ratio of disposable income $\left(\frac{L_L^H}{Y_d^H}\right)$.

$$\ln(C^H) = 0.5 + 0.86\ln\left(\frac{Y_d^H}{p_C{}^H}\right) + 0.04\ln\left(\frac{WLTH^H}{p_C{}^H}\right) - 0.07 d_{1978-1984} + 0.04 d_{1984}$$

1978-2019 (2.8) (15.9) (1.8) (-8.8) (3.3)

R2 = 0.99 ; DW = 0.8

$$\Delta\ln(C^H) = 0.6\,\Delta\ln\left(\frac{Y_d^H}{p_C{}^H}\right) + 0.09\Delta\ln\left(\frac{WLTH^H}{p_C{}^H}\right) - 0.14 vc_{-1} + 0.02 d_{1987} + 0.01 d_{2013}$$

1979-2019 (8) (3.8) (-6.5) (3) (2)

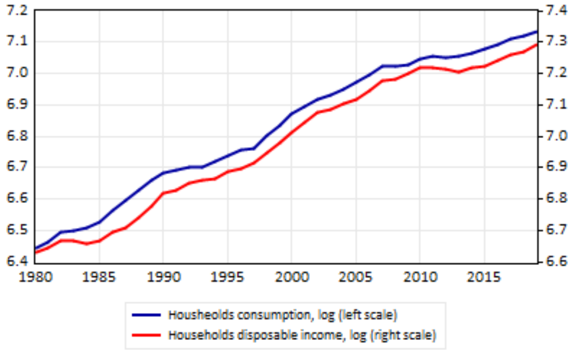
R2 = 0.78 ; DW = 1.9

---

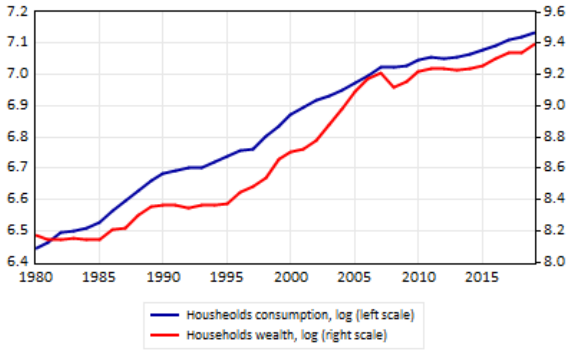
[5] Given the presence of the other changes in volume (*OCV*) in the flow-stock equations, the flow of an instrument like inter-firm lending is not $\Delta L_A^F = L_A^F - L_{A-1}^F$ but rather $\Delta^* L_A^F = L_A^F - L_{A-1}^F - OCV_{L_A}^F$.

[6] Note that the price index used as a deflator for disposable income and as the inflation rate in the real interest rate, is the price index of households' investment (p_I^H).

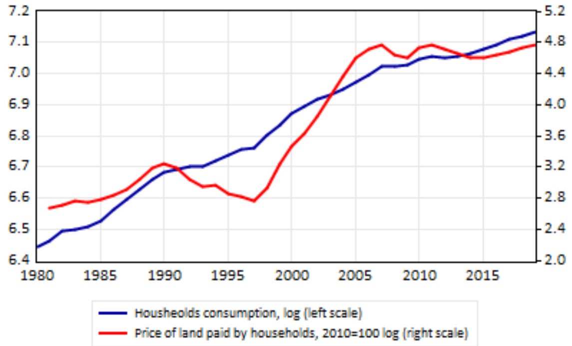
Figure 6 Households' consumption



(a) Disposable income, level

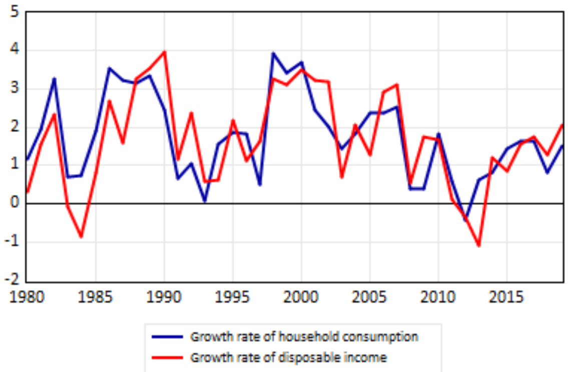


(b) Wealth, level

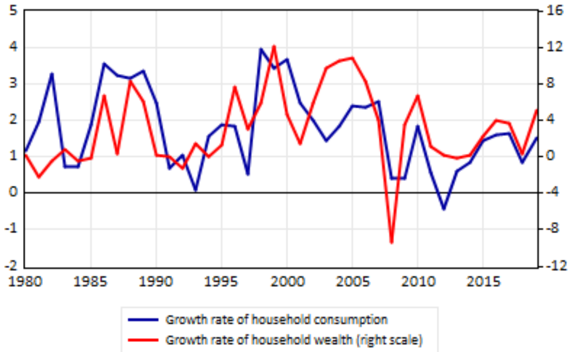


(c) Land price, level

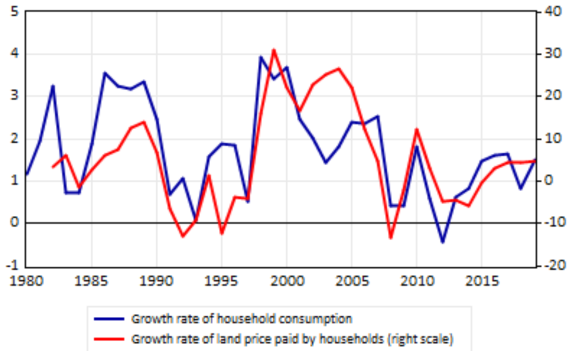
Figure 7 Households' consumption, differenced



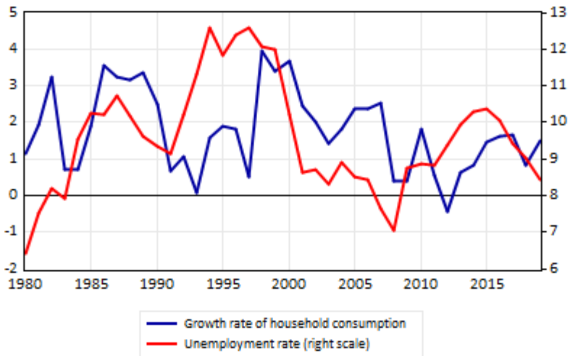
(a) Disposable income, growth rate



(b) Wealth, growth rate



(c) Land price, growth rate



(d) Unemployment rate, growth rate

Housing investment

$$\ln(I_1^H) = 1.1 + 0.5\ln\left(\frac{Y_d^H}{p_I^H}\right) - 0.9\left(i_{10years} - \pi_I^H\right) + 0.2\left(\frac{\Delta p_{K_2}^H}{p_{K_2-1}^H}\right) - 0.09d_{1992-2000} + 0.14d_{2007} + 0.13d_{2008}$$

1982-2019 (2.1) (7.4) (-2) (3.3) (-4.5) (3.4) (2.8)

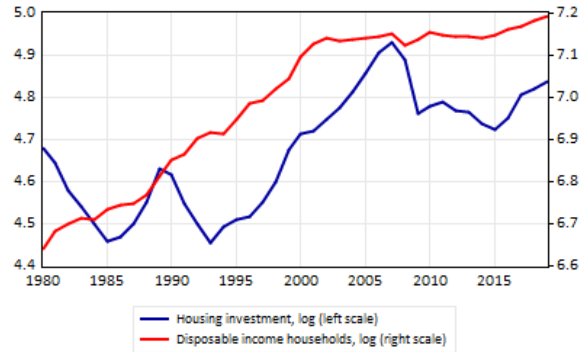
R2 = 0.93 ; DW = 1.2

$$\Delta\ln(I_1^H) = 0.4\Delta\ln(I_{1-1}^H) + 0.4\Delta\ln\left(\frac{Y_d^H}{p_I^H}\right) - 0.6\Delta\left(i_{10years} - \pi_I^H\right) - 0.4vc_{-1} - 0.05d_{2008} + 0.08d_{2009}$$

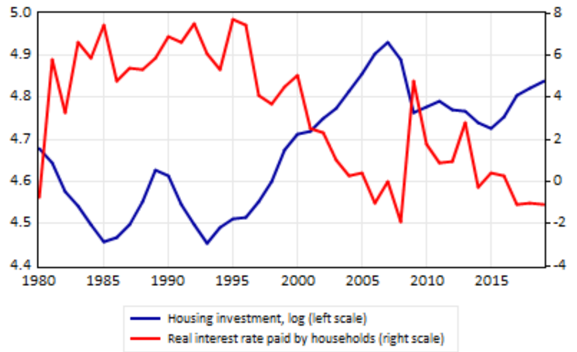
1983-2019 (3.8) (1.7) (-1.8) (-3.2) (-1.8) (-2.2)

R2 = 0.65 ; DW = 1.54

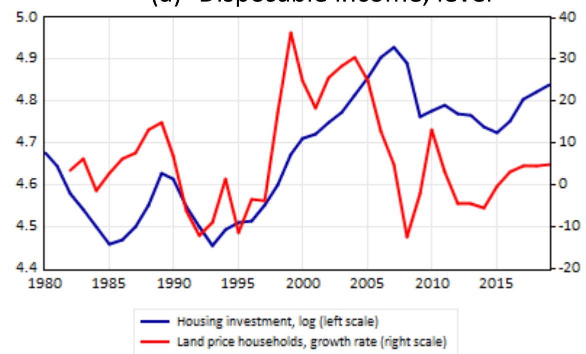
Figure 8 Housing investment



(a) Disposable income, level

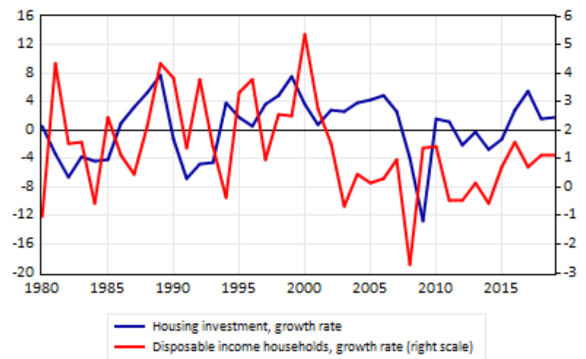


(b) Real interest rate, level

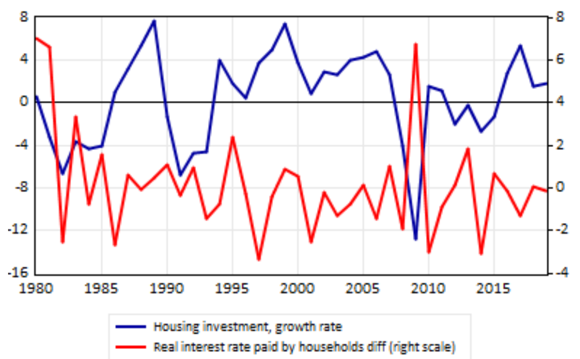


(c) Land profitability, level

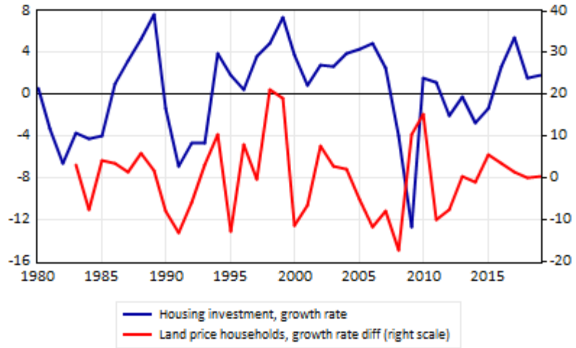
Figure 9 Housing investment, differenced



(a) Disposable income, 1st difference



(b) Real interest rate, 1st difference



(c) Land profitability, 1st difference

Price of non-produced non-financial assets, including land

$$\ln\left(p_{K_2}^H\right) = -9.5 + 2.1\ln\left(I_{1-1}^H\right) + 1.5\ln\left(\frac{L_L^H}{Y_d^H}\right) - 0.4d_{1992-2000}$$

1981-2019 (-6.7) (7.1) (13.8) (-5.7)

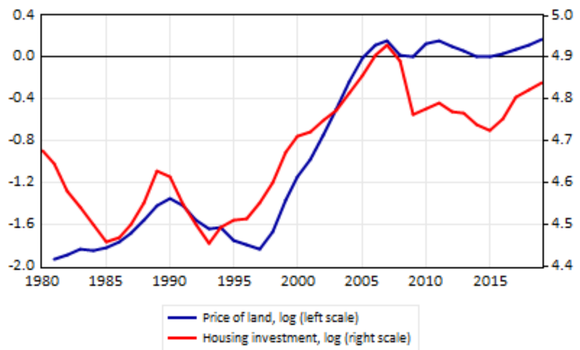
R2 = 0.97 ; DW = 0.6

$$\Delta\ln\left(p_{K_2}^H\right) = 0.61\Delta\ln\left(p_{K_2-1}^H\right) + 0.9\Delta\ln\left(I_1^H\right) - 0.15vc_{-1}$$

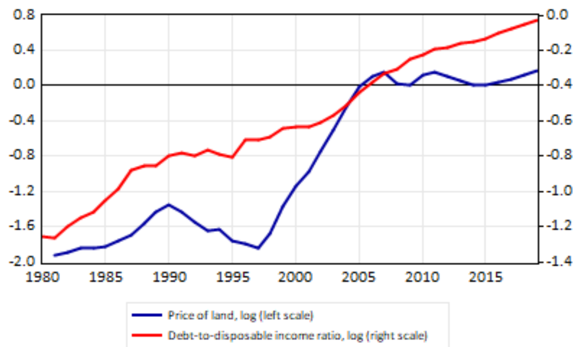
1983-2019 (5.9) (2.8) (-1.8)

R2 = 0.65 ; DW = 1.75

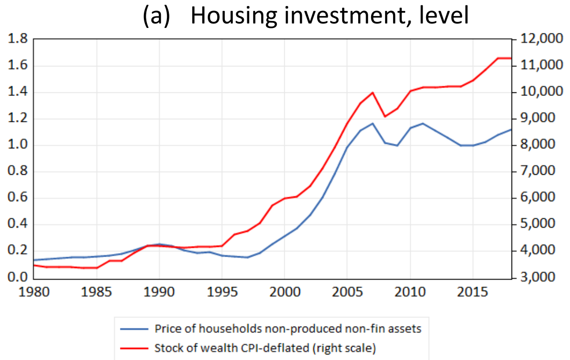
Figure 10 Price of non-produced non-financial assets, level



(a) Housing investment, level

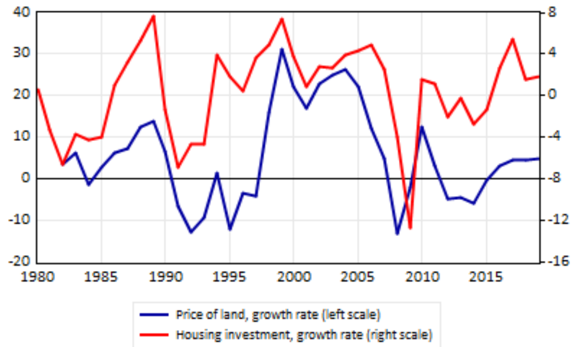


(b) Debt-to-disposable income ratio, level

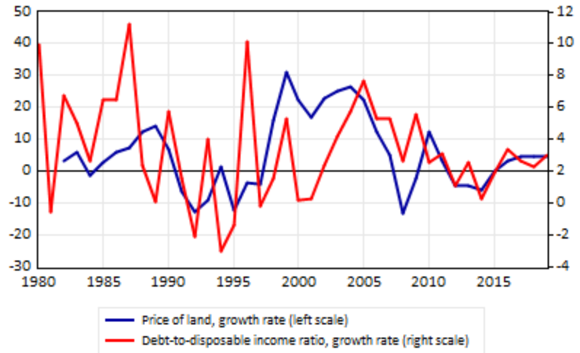


(c) Wealth CPI-deflated, level

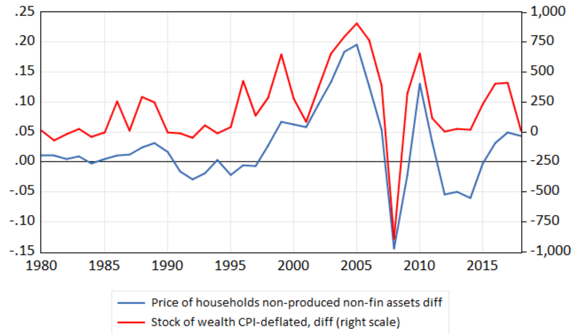
Figure 11 Price of non-produced non-financial assets, differenced



(a) Housing investment, 1st difference



(b) Debt-to-disposable income ratio, 1st difference



(c) Wealth CPI-deflated, 1st difference

Households' financial assets

Household deposits (D_A^H) are modeled in a simple way, as percentage of disposable income. Bank deposits depend on the 10-year real interest rate with a negative sign. Equity purchases ($p_{E_A}^H E_A^H$) are a function of the financial rate of return ($r_{E_A}^H - \pi_C^H$) and the 10-year real interest rate with a negative sign. There is a split between foreign ($p_{E_A}^{H_R} E_A^{H_R}$) and domestic ($p_{E_A}^{H_{FR}} E_A^{H_{FR}}$) equities held by households. Insurance purchases (A_A^H) are related to the weight of the eldest (60 or older) in total population $DepRatio_{old}$, supplemented in the short-term by a positive effect of the real 10-year interest rates and financial profitability. Loans (L_L^H) close households' account.

Deposits held by households, stock

$$\left(\frac{D_A^H}{Y_d^H}\right) = 0.9 - 1.04\left(i_{10yrs} - \pi_C^H\right) + 0.1 d_{2012-2019}$$

1980-2019 (57) (-3.2) (5.2)

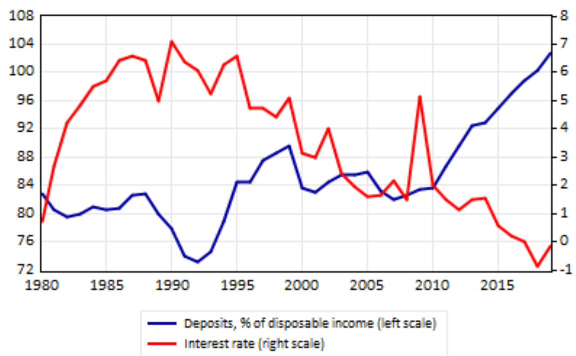
R2 = 0.74 ; DW = 0.7

$$\Delta\left(\frac{D_A^H}{Y_d^H}\right) = 0.5\Delta\left(\frac{D_{A-1}^H}{Y_{d-1}^H}\right) - 0.4\Delta\left(i_{10yrs-1} - \pi_{C-1}^H\right) - 0.2vc_{-1}$$

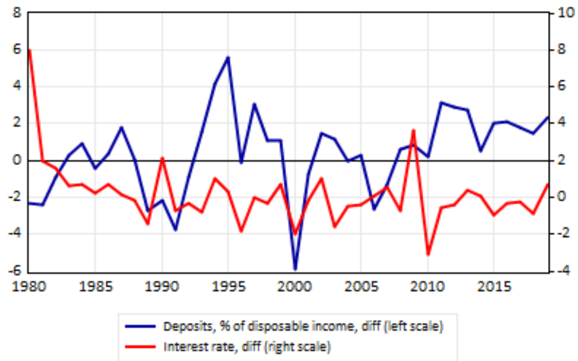
1980-2019 (3.5) (-2.4) (-2.2)

R2 = 0.32 ; DW = 1.8

Figure 12 Stock of deposits held by households



(a) Real interest rate



(b) Real interest rate, diff

Equities held by households, stock

$$\left(\frac{p^H_{E_A}E^H_A}{Y^H_d}\right) = 0.9 + 2.2\left(r^H_{E_A} - \pi^H_C\right) - 3.1\left(i_{10years} - \pi^H_C\right) - 0.17d_{1995}$$

1990-2019 (29) (6.7) (-4.7) (-2.1)

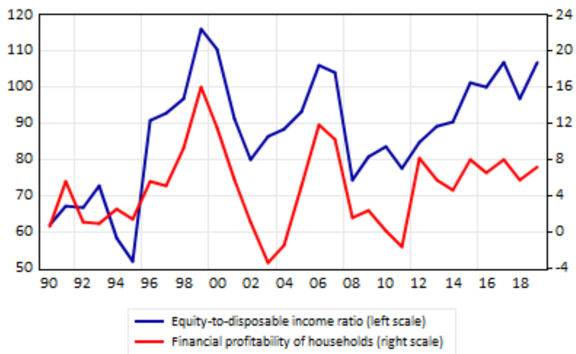
R2 = 0.79 ; DW = 1.3

$$\Delta\left(\frac{p^H_{E_A}E^H_A}{Y^H_d}\right) = 1.8\Delta\left(r^H_{E_A} - \pi^H_C\right) - 0.24vc_{-1} - 0.2d_{1994} + 0.3d_{1996}$$

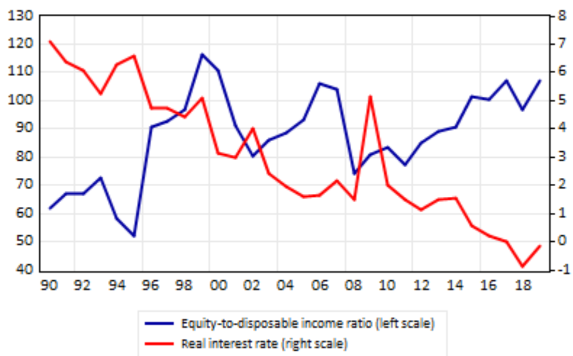
1990-2019 (6.7) (-1.6) (-2.7) (4.8)

R2 = 0.77 ; DW = 2.12

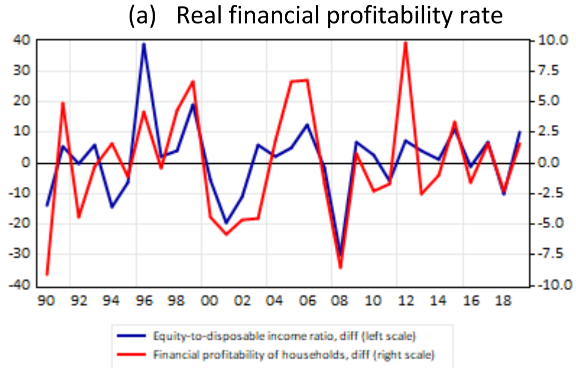
Figure 13 Stock of equities held by households



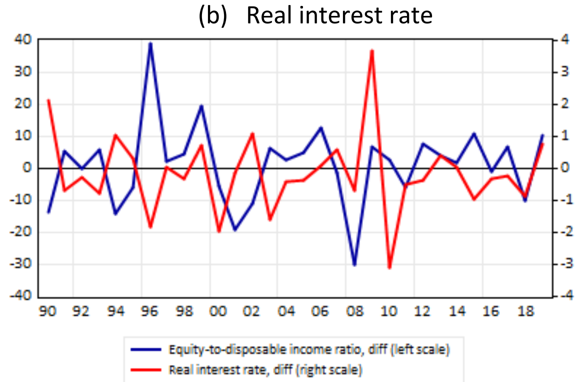
(a) Real financial profitability rate



(b) Real interest rate



(c) Real fin. profitability rate, 1st difference



(d) Real interest rate, 1st difference

Insurance, pension and standardized guarantee schemes held by households, stock

$$\left(\frac{A_A^H}{Y_d^H}\right) = -2.7 + 0.13(DepRatio_{old}) + 0.2d_{1983-1998} + 0.3d_{1999-2013}$$

1978-2019 (-22) (29) (5.5) (11)

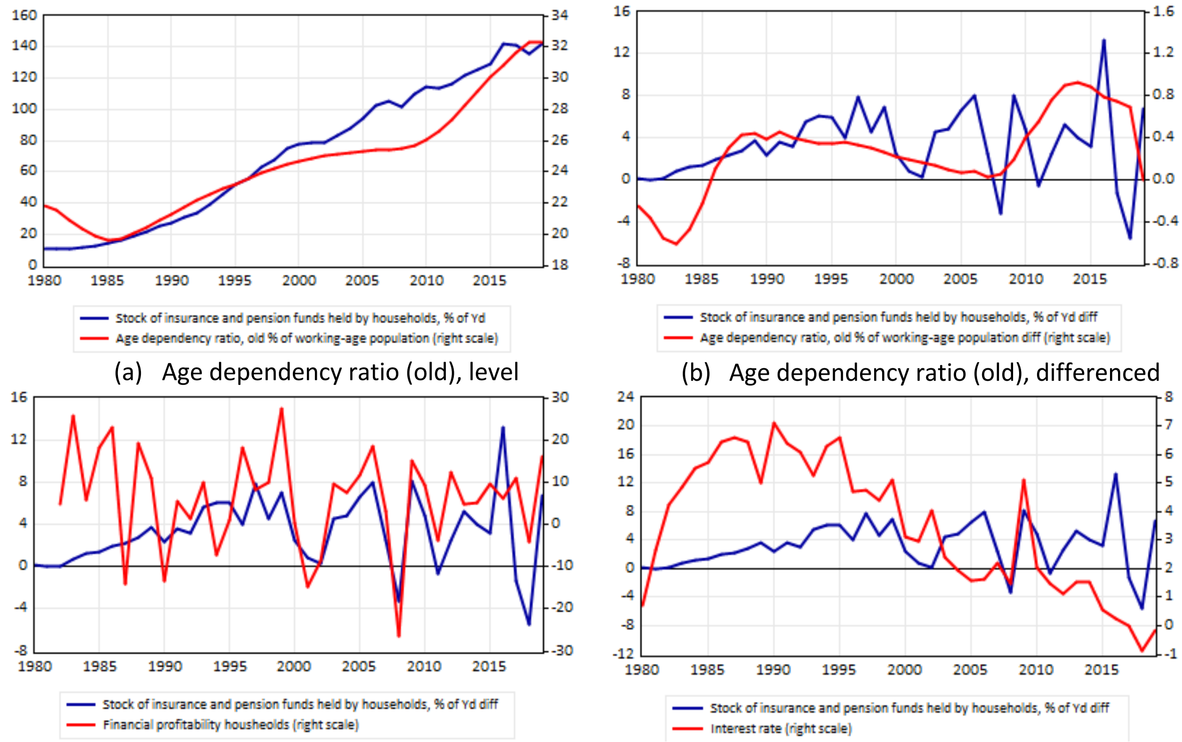
R2 = 0.97 ; DW = 0.82

$$\Delta\left(\frac{A_A^H}{Y_d^H}\right) = 0.27\Delta\left(\frac{A_{A-1}^H}{Y_{d-1}^H}\right) + 0.02\Delta(DepRatio_{old}) + 0.3\left(i_{10years} - \pi_C^H\right) + 0.1\left(r_{EA}^H - \pi_C^H\right) - 0.15vc_{-1} + 0.1d_{2016} - 0.06d_{2017}$$

1982-2019 (2.1) (1.8) (2.3) (4.3) (-2.6)
(4.3) (-2.2)

R2 = 0.6 ; DW = 2

Figure 14 Flow of insurance, pension and standardized guarantee schemes held by households



(a) Age dependency ratio (old), level

(b) Age dependency ratio (old), differenced

(c) Real financial profitability

(d) Real interest rate

Banks

Banks are accommodating in the current version of the model. They grant all credits requested ($\Delta^* L_A^B$), buy all public bonds available ($p_{B_A}^{B_G}\Delta^* B_A^{B_G}$) and balance the market of domestic private bonds ($p_{B_L}^B \Delta^* B_L^B$), as well as domestic equities ($p_E^{FR}\Delta^* E_L^B$). The rate of accumulation of foreign securities ($\frac{\Delta^* B_A^{B_R}}{B_{A-1}^{B_R}}$)depends on foreign-domestic long term interest rates differential ($i^{LT_{cr}} - i^{LT*}$). The demand for private domestic securities ($p_{B_A}^B \Delta^* B_A^B$) depends of the domestic rate of growth and of the domestic – foreign interest rate differential after exchange rate adjustment ($r_A^B - i_{10yr}^* + \frac{\Delta NEER}{NEER_{-1}}$). The bank financial accumulation rate $\left(\frac{\Delta^* E_A^B}{E_{A-1}^B}\right)$ depends on financial profitability lagged one period $(r^B_{E_{A-1}} - \pi_{Y-1})$. There is a split between foreign and domestic equities $\left(\frac{p^{B_R}_{E_A} E^{B_R}_A}{p^B_{E_A} E^B_A}\right)$ depending on exchange rate variation. Banks collect the net deposits (D^B_L), insurance policies (A^B_L) and financial derivatives (X^B_L). Last, banks' reserves (RES) close the banks' account.

Banks' accumulation rate

$$\left(\frac{I^B}{K^B_{1-1}}\right) = 0.02 + 0.9\left(\frac{I^B_{-1}}{K^B_{1-2}}\right) - 0.03d_{1994} - 0.03d_{2013}$$

1983-2019 (1.9) (13) (-2.7) (-2.8)

R2 = 0.85 ; DW = 1.8

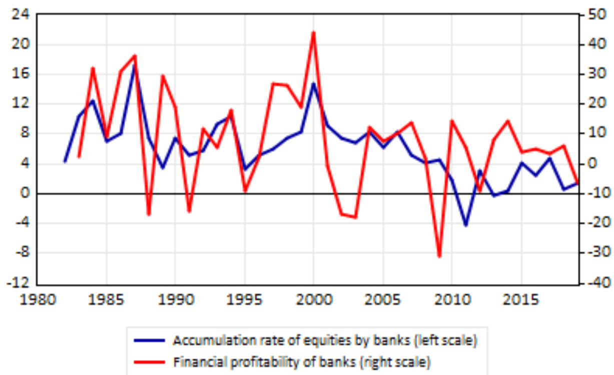
Financial accumulation of banks (equity)

$$\left(\frac{\Delta^* E^B_A}{E^B_{A-1}}\right) = 0.03 + 0.4\left(\frac{\Delta^* E^B_{A-1}}{E^B_{A-2}}\right) + 0.05(r^B_{E_{A-1}} - \pi_{Y-1}) - 0.09d_{1987} + 0.07d_{2000} - 0.08d_{2011}$$

1983-2019 (3.7) (3.6) (1.5) (-3.3) (2.2) (-3.1)

R2 = 0.66 ; DW = 1.7

Figure 15 Banks' financial accumulation



(a) Real financial profitability rate

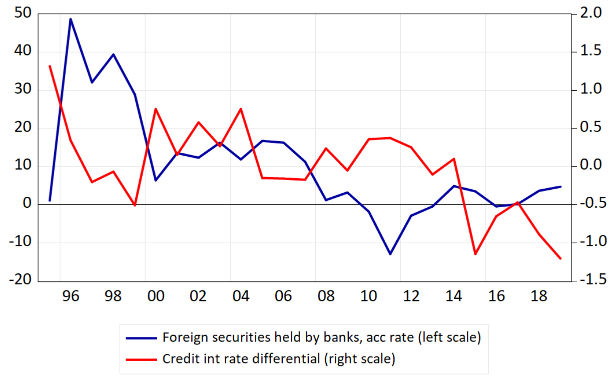
Foreign securities held by banks

$$\left(\frac{\Delta^* B^{B_R}_A}{B^{B_R}_{A-1}}\right) = 0.65\left(\frac{\Delta^* B^{B_R}_{A-1}}{B^{B_R}_{A-2}}\right) - 3.1(i^{LT_{cr}} - i^{LT*}) + 0.5d_{1996} + 0.2d_{1998}$$

1995-2019 (9.3) (-1.6) (8.5) (2.9)

R2 = 0.86 ; DW = 1.9

Figure 16 Foreign securities held by banks and credit interest rate



Other securities held by banks

$$\left(\frac{p_{B_A}^{B}\Delta^* B_A^B}{p_Y Y}\right) = 0.6\left(\frac{\Delta Y}{Y_{-1}}\right) + 0.6 r_A^B - 0.6\left(i_{-1}^* - \frac{\Delta NEER_{-1}}{NEER_{-2}}\right) + 0.05 d_{2011}$$

1995-2019	(1.8)	(2.1)	(-1.7)	(2.5)

$R2 = 0.4$; $DW = 1.5$

Banque de France

Interests and dividends paid and received are computed according to the corresponding assets. Profits are transferred to the government as tax. Bills and coins (H) are supplied by the central bank. Central bank deposits held by the government (D_L^{CBG}) are isolated as they are used to study the helicopter money. Foreign bonds held by the central bank ($p_{B_A}^{CBR} B_A^{CBR}$), public bonds ($p_{B_A}^{CBG}\Delta^* B_A^{CBG}$), other domestic bonds ($p_{B_A}^{CB}\Delta^* B_A^{CB}$) and refinancing ($RF^{CB}$) correspond to different forms of quantitative easing. Equities issued by the central bank ($p_{E_L}^{CB} E_L^{CB}$) are exogenous. Central bank equilibrium is the unwritten equation.

$$\Delta^* H = \Delta^* H^F + \Delta^* H^B + \Delta^* H^H + \Delta^* H^R$$

$$D_L^{CBG} = D_A^{GCB}$$

$$p_{B_A}^{CBR} B_A^{CBR} = \gamma_{B_A}^{CBR} p_Y Y$$

$$p_{B_A}^{CBG}\Delta^* B_A^{CBG} = \gamma_{B_A}^{CBG} p_Y Y$$

$$p_{B_A}^{CB}\Delta^* B_A^{CB} = \gamma_{B_A}^{B} p_Y Y$$

$$\Delta^* RF^{CB} = \varphi_{RF}^{CB} p_Y Y$$

$$p_G^{CB}\Delta^* G^{CB} + \Delta TRGT2 + \Delta^* RF^{CB} + \Delta^* D_A^{CB} + p_{B_A}^{CBG}\Delta^* B_A^{CBG} + p_{B_A}^{CBR}\Delta^* B_A^{CBR} + p_{B_A}^{CB}\Delta^* B_A^{CB} + \Delta^* L_A^{CB} + p_E^{CB}\Delta^* E_A^{CB} = \Delta^* H + \Delta^* RES + \Delta^* D_L^{CB} + \Delta^* D_L^{CBG} + p_{E_L}^{CB}\Delta^* E_L^{CB} + Adj^{CB}$$

Interest rates and financial assets prices

Interest rates are treated exogenously with the ECB key interest rate ($r_€$) and the 10-year interest rate on public bonds (i_{10yrs}) playing a leading role. Apparent (or implicit) interest rates are calculated for the various securities and are determined with simple margins with respect to the 10-year bonds interest rate or the ECB interest rate. Short term interest rate on deposits (r_D) and long term interest rate on credit (i^{LTcr}) are determined in the same manner. The price of public bonds ($p^G_{B_L}$) varies inversely with respect to the one paid by the government (r^G_L). It plays a leading role in the determination of other prices of bonds such as bonds issued by firms ($p^F_{B_L}$), public bonds held by firms ($p^{F_G}_{B_A}$), private bonds held by households ($p^H_{B_A}$) or private bonds held by banks ($p^B_{B_A}$). Last, for each security (domestic private bonds, foreign bonds, public bonds), one price ($p^B_{B_L}, p^{B_R}_{B_A}, p^{R_G}_{B_A}$) must be obtained implicitly to guarantee flow-stock consistency by writing that the sum of the revalorization effects equals to zero.

$$r_D = 1.4 + 0.5 r_€$$

$$i^{LTcr} = 0.93 i_{10yrs}$$

$$r^G_L = 0.9 + 0.85 i_{10yrs}$$

$$\ln\left(p^G_{B_L}\right) = -0.39 + 0.1 \ln\left(\frac{1}{r^G_L}\right)$$

$$\ln\left(p^F_{B_L}\right) = 0.8 \ln\left(p^F_{B_{L-1}}\right) + 0.9 \ln\left(p^G_{B_L}\right) - 0.7 \ln\left(p^G_{B_{L-1}}\right)$$

$$p^{F_G}_{B_A} = \psi^{F_G}_{pBA} p^G_{B_L}$$

$$p^H_{B_A} = \psi^H_{pBA} p^B_{B_L}$$

$$\Delta \ln\left(p^B_{B_A}\right) = 0.2 \Delta \ln\left(p^B_{B_{A-1}}\right) + 0.7 \Delta \ln\left(p^G_{B_L}\right)$$

$$\Delta p^B_{B_L} = -\left(\frac{B^F_{L-1}}{B^B_{L-1}}\right) \Delta p^F_{B_L} + \sum_i \left(\frac{B^i_{A-1}}{B^B_{L-1}}\right) \Delta p^i_{B_A} \quad \text{for } i = B, CB, G, H, R$$

$$\Delta p^{B_R}_{B_A} = \left(\frac{B^R_{B_{L-1}}}{B^{B_R}_{B_{A-1}}}\right) \Delta p^R_{B_L} - \sum_i \left(\frac{B^{i_R}_{B_{A-1}}}{B^{B_R}_{B_{A-1}}}\right) \Delta p^{i_R}_{B_A} \quad \text{for } i = F, CB, G, H$$

$$\Delta p^{R_G}_{B_A} = \left(\frac{B^G_{L-1}}{B^{R_G}_{A-1}}\right) \Delta p^G_{B_L} - \sum_i \left(\frac{B^{i_G}_{A-1}}{B^{R_G}_{A-1}}\right) \Delta p^{i_G}_{B_A} \quad \text{for } i = F, B, CB$$

Interest rates

Interest rate on deposits

$$r_D = 1.4 + 0.5 r_€ + 1.1 d_{2008}$$

1996-2019 (12.4) (8.8) (2.5)

R2 = 0.81 ; DW = 1.1

Interest rates on credit

$$i^{LTcr} = 0.93 i_{10yrs} + 0.9 d_{1999}$$

1996-2019 (57) (3.1)

R2 = 0.97 ; DW = 2.7

Apparent interest rate received by firms

$$r_A^F = 3.6 + 0.63 r_€ + 2.5 d_{2001}$$

1996-2019 (14.3) (4.8) (2.6)

R2 = 0.62 ; DW = 0.6

Apparent interest rate paid by firms

$$r_L^F = 1.6 + 0.7 i_{10yrs}$$

1996-2019 (7.5) (11.7)

R2 = 0.86 ; DW = 1.1

Apparent interest rate received by households

$$r_A^H = 1.6 + 0.5 r_€ + 1.1 d_{2008}$$

1996-2019 (15.5) (8.9) (2.8)

R2 = 0.82 ; DW = 1.5

Apparent interest rate paid by households

$$r_L^H = 0.9 i_{10yrs} + 1.2 d_{2009}$$

1996-2019 (31) (2.2)

R2 = 0.89 ; DW = 1

Apparent interest rate received by banks

$$r_A^B = 0.4 + 0.5 r_{A-1}^B + 0.4 i_{10yrs} + 1.1 d_{2007} - 1.5 d_{2009}$$

1982-2019 (1.8) (4.1) (3.6) (2.3) (-2.9)

R2 = 0.97 ; DW = 2.3

Apparent interest rate paid by banks

$$r_L^B = 0.9 + 0.9 i_{10yrs}$$

1996-2019 (2.9) (11.6)

R2 = 0.85 ; DW = 1.3

Apparent interest rate received by the government

$$r_A^G = 2.5 + 1.6 r_€ - 3.2 d_{2006} - 3.3 d_{2007}$$

1996-2019 (8.7) (10.3) (-2.8) (-2.9)

R2 = 0.84 ; DW = 2.1

Apparent interest rate paid by the government

$$r_L^G = 0.9 + 0.85 i_{10yrs} + 0.8 d_{1998}$$

1996-2019 (6.1) (21.3) (2.4)

R2 = 0.96 ; DW = 1.1

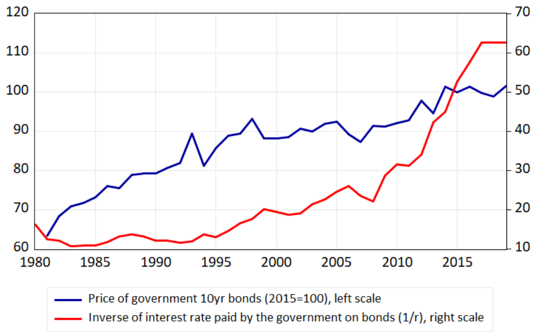
Figure 17 Observed and apparent Interest rates

Price of public bonds, issued by thegovernment

$$\ln(p_{B_L}^G) = -0.4 + 0.09 \log\left(\frac{1}{r_L^G}\right)$$

1996-2019 (-11) (9.2)

R2 = 0.79 ; DW = 1.9



Price of equities

Price of domestic equities

The price of domestic equities (p_E^{FR}) is mainly determined by the price of foreign equities (p_E^*), but also by the share of domestic equities in the total of equities held.

$$\ln(p_E^{FR}) = -9.6 + 0.8\ln(p_E^*) + 2.3\ln\left(\frac{p_E^{FR}E_A^{FR}}{p_{E_A}E_A} \times 100\right)$$

1981-2019 (-3.9) (24.6) (3.9)

R2 = 0.96 ; DW = 1.22

$$\Delta\ln(p_E^{FR}) = 0.9\Delta\ln(p_E^*) - 0.4\Delta\ln(p_{E-1}^*) - 0.5vc_{-1} + 0.3d_{1984} + 0.3d_{1988}$$

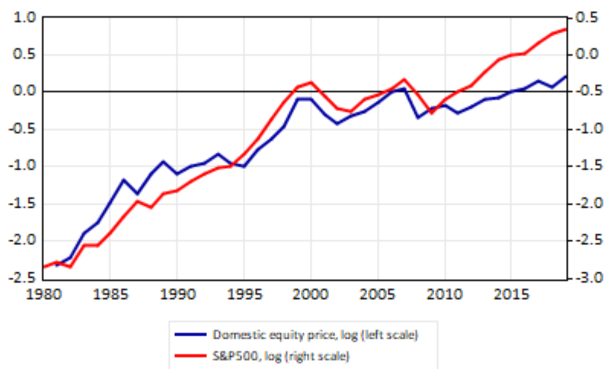
1982-2019 (6.8) (-2.7) (-4.3) (2.7) (2.9)

R2 = 0.62 ; DW = 1.9

$$\boldsymbol{p_E^{FR}E_A^{FR} = p_{E_A}^{F_{FR}}E_A^{F_{FR}} + p_{E_A}^{B_{FR}}E_A^{B_{FR}} + p_{E_A}^{CB_{FR}}E_A^{CB_{FR}} + p_{E_A}^{G_{FR}}E_A^{G_{FR}} + p_{E_A}^{H_{FR}}E_A^{H_{FR}}}$$

$$\boldsymbol{p_E E_A = p_{E_A}^F E_A^F + p_{E_A}^B E_A^B + p_{E_A}^{CB} E_A^{CB} + p_{E_A}^G E_A^G + p_{E_A}^H E_A^H}$$

Figure 18 Domestic equities price



Price of equity held by the government

$$\ln\left(p_{E_A}^G\right) = -0.32 + 0.3\ln\left(p_{E_A}^{FR}\right) + 0.3d_{2008-2019} - 0.2d_{1996} + 0.3d_{2006} + 0.4d_{2007}$$

1981-2019 (-11.8) (11.9) (9.9) (-3) (3.7) (5.2)

R2 = 0.96 ; DW = 1.2

$$\Delta\ln\left(p_{E_A}^G\right) = 0.4\Delta\ln\left(p_{E_A}^{FR}\right) - 0.5vc_{-1} - 0.2d_{1996} + 0.2d_{2006}$$

1982-2019 (6.4) (-2.9) (-2.8) (2.6)

R2 = 0.58 ; DW = 1.9

Financial profitability

Financial profitability of equity issued or held is the sum of revaluation and dividends paid or received divided by the stock of equity of the previous period. It is mainly driven by the rate of growth of equities' price. Financial profitability ratios can be calculated for the different assets.

Profitability of equities issued

$$r_{E_L}^F = \left(\frac{E_{L-1}^F \Delta p_{E_L}^F + Div_p^F}{p_{E_{L-1}}^F E_{L-1}^F}\right)$$

Profitability of equities held

$$r_{E_A}^F = \left(\frac{E_{A-1}^F \Delta p_{E_A}^F + Div_r^F}{p_{E_{A-1}}^F E_{A-1}^F}\right)$$

Government

Government is described in a traditional manner with taxes related to economic activity and incomes, public expenditures exogenous or dependent on GDP, public value added (VA^G) related to public wages and public employment exogenous. Total public indebtedness ($p_{BL_L}^G BL_L^G$) closes the account of the government with a split between loans (L_L^G) and public bonds ($p_{B_L}^G B_L^G$).

$$VA^G = \alpha_{VA}^G (W_p^G + LC_p^G)$$

$$p_{BL_L}^G \Delta^* BL_L^G = \Delta^* D_A^{GCB} + \Delta^* D_A^G + p_{B_A}^G \Delta^* B_{B_A}^G + p_{B_A}^{GR} \Delta^* B_{B_A}^{GR} + p_{E_A}^G \Delta^* E_A^G + \Delta^* A_A^G + \Delta^* X_A^G + \Delta^* Z^G - \Delta^* D_L^G + p_{I_1}^G I_1^G + p_{I_{12}}^G I_{12}^G - S^G + Tr_{K_p}^G + NP^G - Adj^G$$

$$\Delta^* L_L^G = p_{BL_L}^G \Delta^* BL_L^G - p_{B_L}^G \Delta^* B_L^G$$

Rest of the world

Foreign trade

Exports (X) and imports (IM) depend respectively on foreign (Y^f) and domestic demand (Y) as measured by GDP in volume. Since the analyses are conducted for all goods services, it is more difficult to obtain satisfactory econometric results on price competitiveness. For imports the relative price effects could not be identified and only import prices (p_{IM}) could be isolated. Export and import prices are determined in standard fashion with a price maker/price taker arbitrage.

Exports, volume

$$\ln(X) = 1.7 + 0.6\ln(Y^f) - 0.5\ln\left(\frac{p_X}{p_{X*}}\right) + 0.1d_{1989} + 0.2d_{1990} + 0.2d_{1991-2009}$$

1978-2019 (18) (48) (-3.9) (2.5) (3.2) (15)

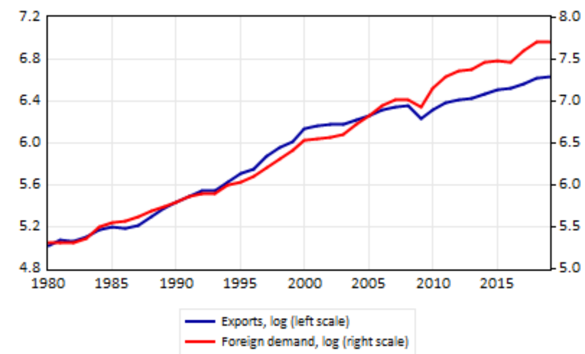
R2 = 0.99 ; DW = 0.9

$$\Delta\ln(X) = 0.3\Delta\ln(X_{-1}) + 0.4\Delta\ln(Y^f) - 0.2\Delta\ln\left(\frac{p_X}{p_{X*}}\right) - 0.14vc_{-1} - 0.07d_{2009}$$

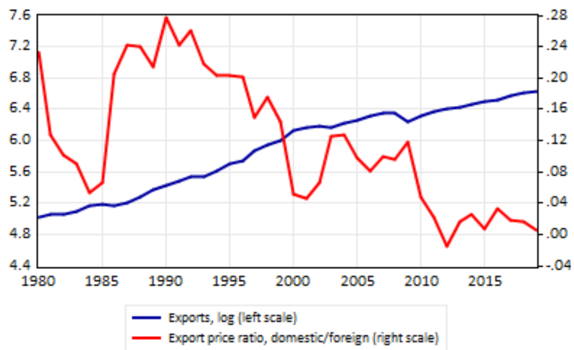
1978-2019 (4.6) (8.4) (-2.6) (-1.6) (-2.9)

R2 = 0.69 ; DW = 1.8

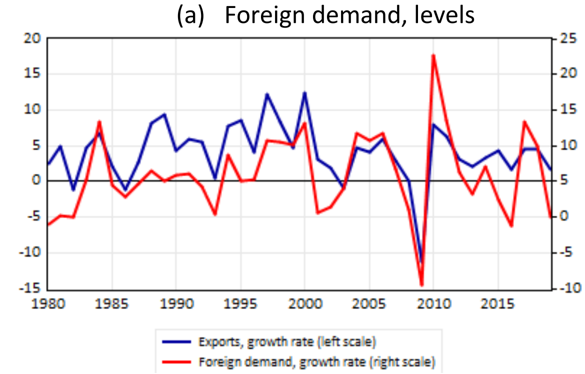
Figure 19 Volume of exports



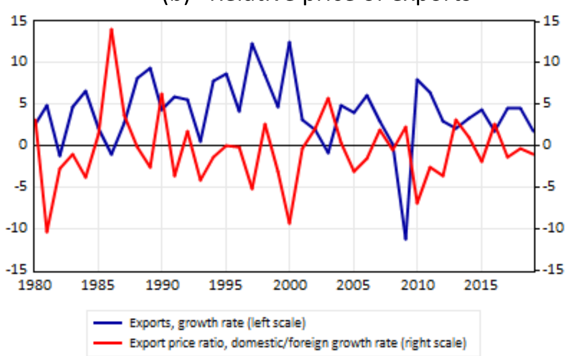
(a) Foreign demand, levels



(b) Relative price of exports



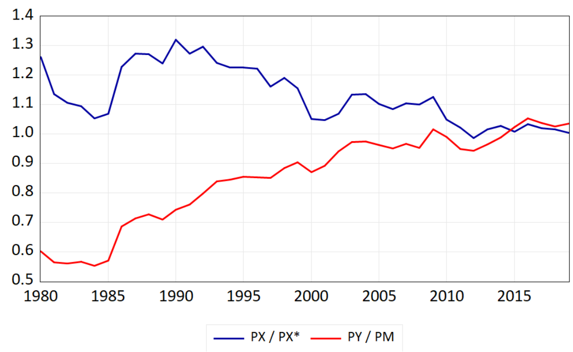
(c) Foreign demand, growth rate



(d) Relative price of exports, growth rate

(e)

Figure 20 Export and import price competitiveness



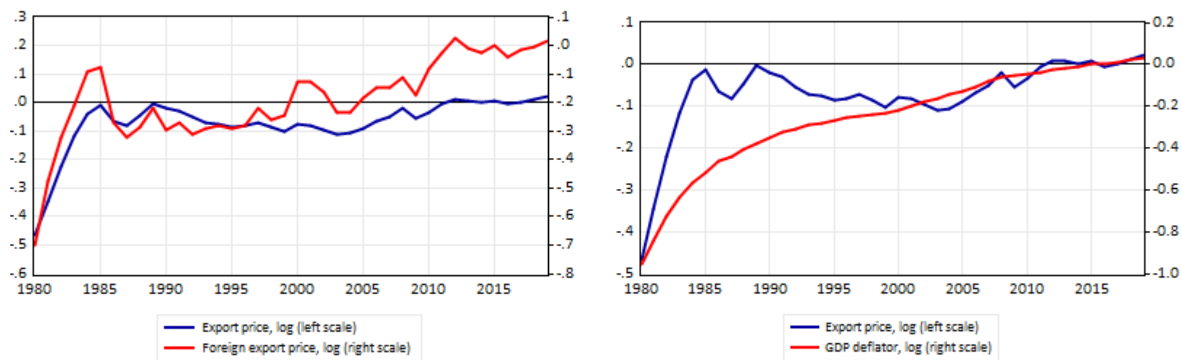
Price of exports

$$\ln(p_X) = 0.03 + 0.5\ln(p_{X*}) + 0.3\ln(p_Y) + 0.14d_{1978-1999} + 0.07d_{1990} - 0.08d_{1999}$$

1978-2019 (4.5) (10) (7.9) (10) (2.1) (-2.4)

R2 = 0.96 ; DW = 0.52

Figure 21 Price of exports



(a) Competitors' export price

(b) GDP price

Imports, volume

$$\ln(IM) = -8.5 + 1.8\ln(Y) - 0.2\ln(p_{IM}) + 0.01t - 0.05d_{1989-1994}$$

1980-2019 (-10.3) (14.5) (-3.5) (4.8) (-3.9)

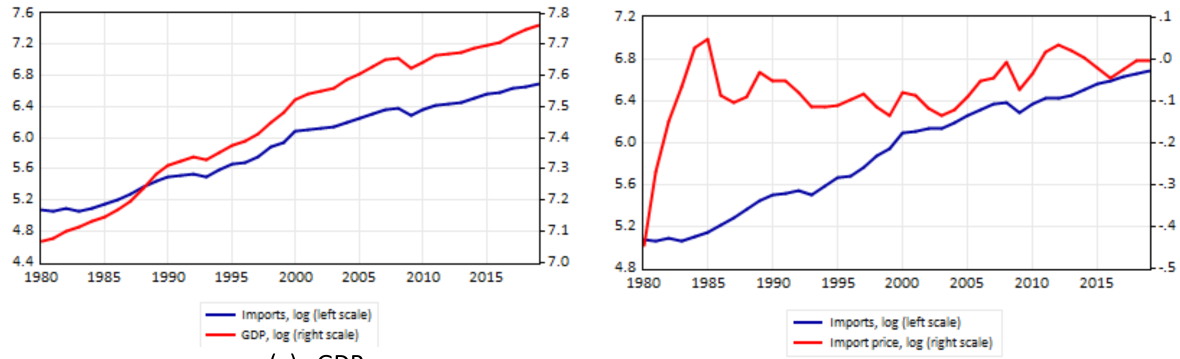
R2 = 0.99 ; DW = 1

$$\Delta\ln(IM) = 2.2\Delta\ln(Y) - 0.5vc_{-1}$$

1980-2019 (14.3) (-4.3)

R2 = 0.8 ; DW = 1.79

Figure 22 Volume of imports



(a) GDP

(b) Import price

Price of Imports

$$\ln(p_{IM}) = 0.6\ln(p_{MSH}) + 0.1d_{1981-1985} + 0.07d_{1985-1997}$$

1980-2019 (27) (8.1) (9)

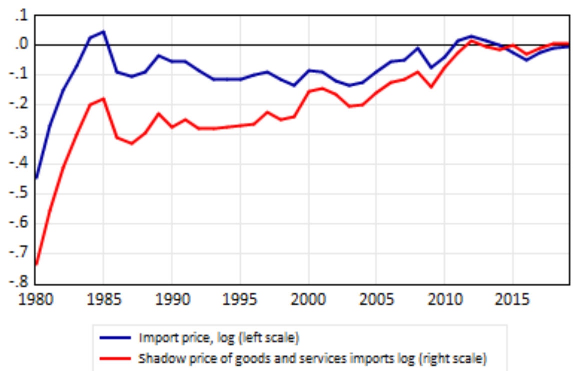
R2 = 0.93 ; DW = 1

$$\Delta\ln(p_{IM}) = 0.12\Delta\ln(p_{IM-1}) + 0.7\Delta\ln(p_{MSH}) - 0.45vc_{-1} - 0.05d_{1986}$$

1980-2019 (2.1) (12) (-5.1) (-2.5)

R2 = 0.92 ; DW = 1.4

Figure 23 Price of imports

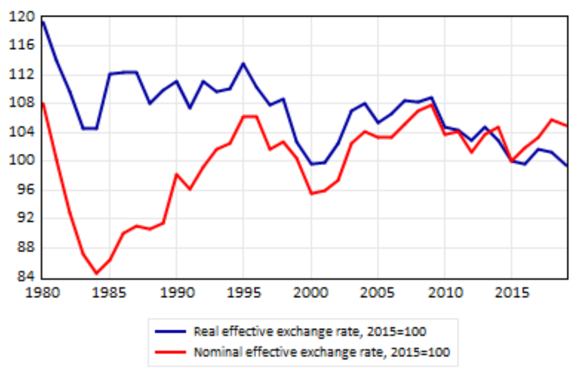


(a) Imports shadow price

Capital flows

Capital inflows, in the form of bank deposits (D_A^R) and of loans granted by the rest of the world (L_A^R), depend on economic activity and on the short term interest rate differential after correction of the exchange rate variation. Similarly, public bonds held ($\Delta^* B_A^{R_G}$) and other debt securities held by the rest of the world ($\Delta^* B_A^R$) are related to economic activity and to the long term interest rate differential. Share purchases, including inward foreign direct investment (E_A^R), depend on the economic activity and financial profitability for shares ($r_{E_A}^R$). Since the mid-2000s, purchases of government securities by the rest of the world have been part of quantitative easing policy. Capital outflows, in the form of credit to the rest of the world ($\Delta^* L_L^R$), depend on foreign economic activity. It has not been possible to find a significant effect of interest rate differential. Foreign securities issued by the rest of the world, medium term capital outflows ($p^R_{B_L}\Delta^* B^R_L$), are determined by the demand of foreign securities by domestic agents. Likewise foreign equities issued by the rest of the world, including outward foreign direct investments ($p^R_{E_L}\Delta^* E^R_L$), equal the sum of the demand of foreign equities by domestic agents. Lastly, the flow of deposit liabilities of the rest of the world held in France ($\Delta^* D^R_L$) balance the rest of the world account.

Figure 24 Effective exchange rates, 2015=100



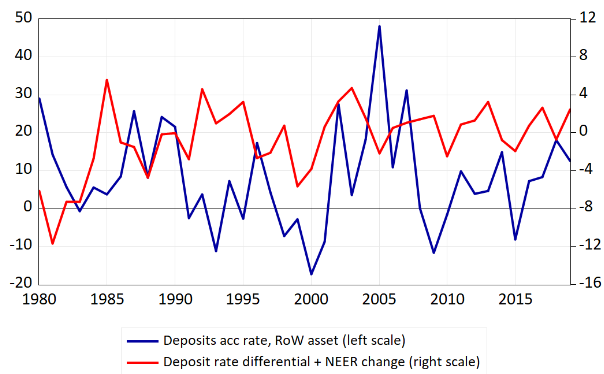
Deposits held by the rest of the world (deposits capital inflows)

$$\left(\frac{\Delta^* D^R_A}{D^R_{A-1}}\right) = 2.9\left(\frac{\Delta Y}{Y_{-1}}\right) + 2\left(i^D_{-1} - i^{D*}_{-1} + \frac{\Delta NEER_{-1}}{NEER_{-2}}\right) + 0.4 d_{2005}$$

1990-2019 (3) (2.4) (3.6)

R2 = 0.44 ; DW = 1.9

Figure 25 Deposits held by the RoW



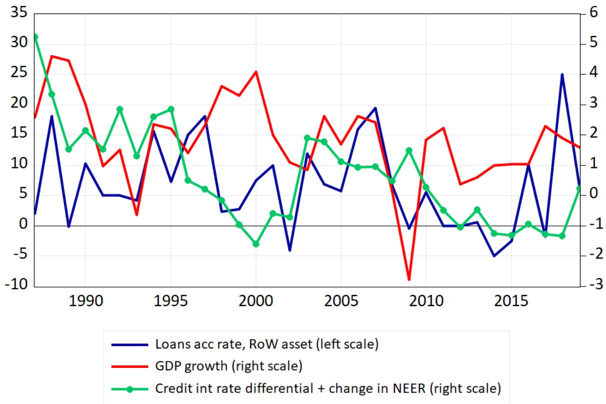
Credit held by the rest of the world (credit capital inflows)

$$\left(\frac{\Delta^* L^R_A}{L^R_{A-1}}\right) = 0.03 + 1.2\left(\frac{\Delta Y}{Y_{-1}}\right) + 1.3\left(i^{LTcr} - i^{LT*} + \frac{\Delta NEER}{NEER_{-1}}\right) + 0.2 d_{2018}$$

1987-2019 (1.7) (1.6) (1.9) (3.3)

R2 = 0.35 ; DW = 1.96

Figure 26 Credit capital inflows and its determinants



Public securities

$$\left(\frac{\Delta^* B_A^{R_G}}{B_{A-1}^{R_G}}\right) = 0.04 - 0.14\left(\frac{\Delta^* B_{A-1}^{R_G}}{B_{A-2}^{R_R}}\right) + 2.2\left(\frac{\Delta Y}{Y_{-1}}\right) + 3.9\left(i_{10yr} - i^{LT*} + \frac{\Delta NEER}{NEER_{-1}}\right) + 0.15 d_{2001} + 0.26 d_{2009}$$

1996-2019 (1.8) (-5) (2.4) (4.3) (3.4) (4)

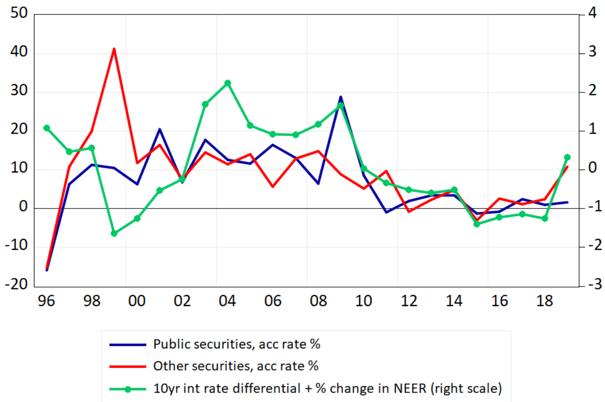
Other securities

$$\left(\frac{\Delta^* B_A^{R}}{B_{A-1}^{R}}\right) = 0.34\left(\frac{\Delta^* B_{A-1}^{R}}{B_{A-2}^{R}}\right) + 2.2\left(\frac{\Delta Y}{Y_{-1}}\right) + 3\left(i_{10yr} - i^{LT*} + \frac{\Delta NEER}{NEER_{-1}}\right) + 0.3 d_{1999}$$

1996-2019 (2.9) (2.8) (2.4) (4.4)

R2 = 0.6 ; DW = 2.3

Figure 27 French securities held by the RoW



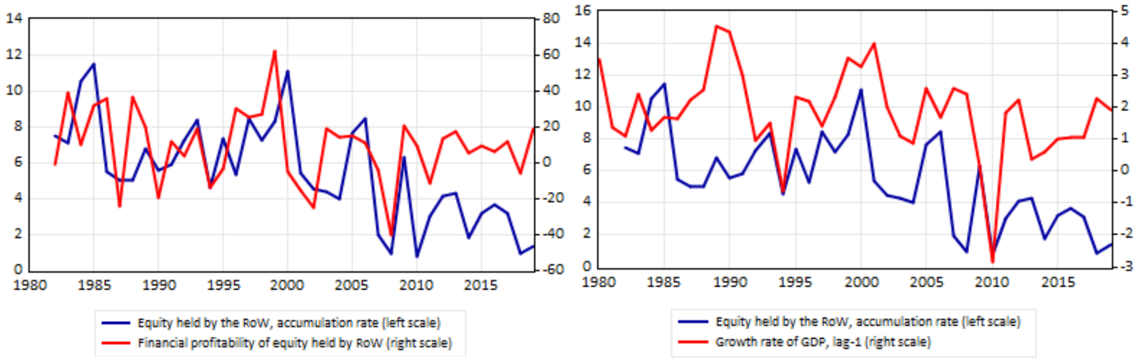
Equities held by the rest of the world (inward foreign direct investment)

$$\left(\frac{\Delta^* E_A^{R}}{E_{A-1}^{R}}\right) = 0.04 + 0.05\left(r_{E_A}^{R} - \pi_Y\right) + 0.6\left(\frac{\Delta Y_{-1}}{Y_{-2}}\right)$$

1982-2019 (5.5) (2.4) (1.9)

R2 = 0.2 ; DW = 1.33

Figure 28 Equities held by the rest of the world



Monetary gold and Special Drawing Rights, price

$$\ln(p_{G_A}^{CB}) = 0.98\ln(p_{gold}) + 0.2d_{1981-1985}$$

1981-2019 (33) (3.2)

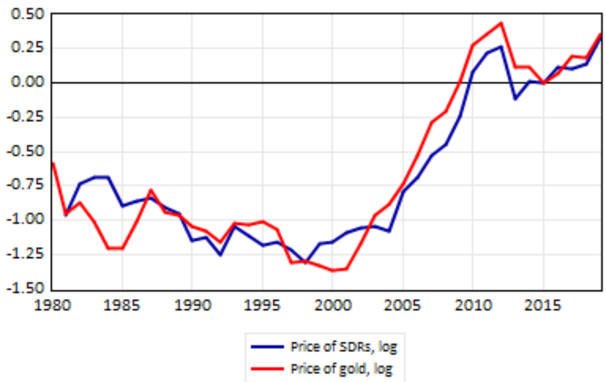
R2 = 0.92 ; DW = 0.58

$$\Delta\ln(p_{G_A}^{CB}) = 0.5\Delta\ln(p_{gold}) - 0.5vc_{-1} - 0.3d_{2013}$$

1982-2019 (5) (-4.9) (-3.3)

R2 = 0.68 ; DW = 1.74

Figure 29 Price of gold SDR



Deposits received by the RoW, closes the sector's account

$$\Delta^* D_L^R = \Delta^* H^R + \Delta^* D_A^R + \boldsymbol{p_{B_A}^{RG}}\Delta^* \boldsymbol{B_A^{RG}} + \boldsymbol{p_{B_A}^{R}}\Delta^* \boldsymbol{B_A^{R}} + \Delta^* L_A^R + \boldsymbol{p_{E_A}^{R}}\Delta^* \boldsymbol{E_A^{R}} + \Delta^* A_A^R + \Delta^* Z^R - Adj^R - FCN^R - \boldsymbol{p_G^{CB}}\Delta^* \boldsymbol{G^{CB}} - \Delta^* RF^R - \boldsymbol{p_{B_L}^{R}}\Delta^* \boldsymbol{B_L^{R}} - \Delta^* L_L^R - \boldsymbol{p_{E_L}^{R}}\Delta^* \boldsymbol{E_L^{R}} - \Delta^* X_L^R$$

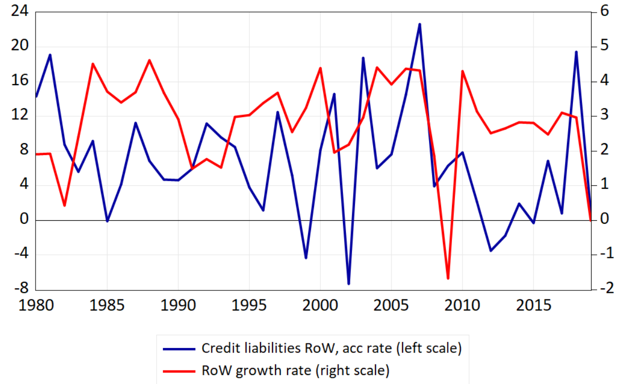
Loans received by the RoW

$$\left(\frac{\Delta^* L_L^R}{L_{L-1}^R}\right) = 1.9\left(\frac{\Delta Y^*}{Y_{-1}^*}\right) + 0.14d_{2007} + 0.14d_{2018}$$

1979-2019 (5.6) (2.2) (2.1)

R2 = 0.12 ; DW = 1.7

Figure 30 Loans received by the RoW



Prices

The general price level (p_Y) is determined by mark-up pricing from unit labor costs (ULC) with a short-term effect on demand pressure, measured (in the absence of a better indicator) by an output gap (GAP). A short-term effect of import price (p_{IM}) has also been added. Potential output (va^{M^p}) results from a simple production function used as a first approximation. The prices of the different elements of the demand are derived from the GDP price. The price of households' consumption is determined by an accounting identity.

GDP price

$$\ln(p_Y) = 0.4 + 0.9\ln(ULC) + 0.04d_{1998-2008} + 0.02d_{2010}$$

1990-2019 (46.6) (70.2) (11.1) (2.1)

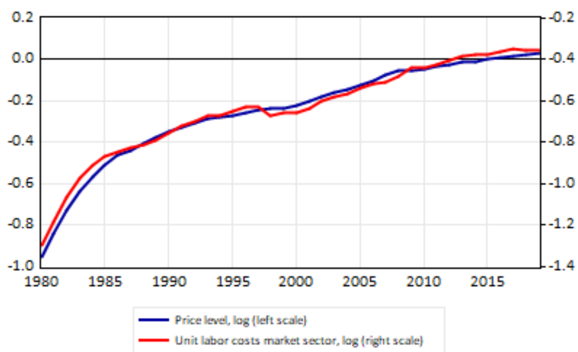
R2 = 0.99 ; DW = 1.4

$$\Delta\ln(p_Y) = 0.01 + 0.4\Delta\ln(ULC) + 0.3GAP + 0.03\Delta\ln(p_{IM-1}) - 0.4vc_{-1} + 0.01d_{1998} - 0.01d_{1999} - 0.02d_{2009} + 0.01d_{2010}$$

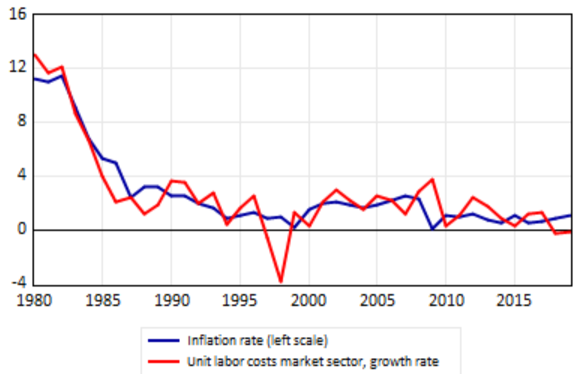
1980-2019 (9.4) (9.5) (4.9) (1.5) (-12.4) (3.2) (-3.1)
(-3.5) (2.8)

R2 = 0.99 ; DW = 1.64

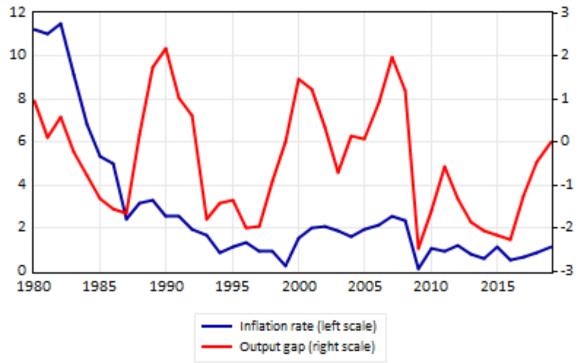
Figure 31 GDP price



(a) Unit labor costs



(b) Unit labor cost, g.r.



(c) Output gap

Price of firms' investment

$$\Delta \ln(p_I^F) = 0.96\Delta \ln(p_Y) + 0.03 d_{2000}$$

1978-2019 (27) (2.9)

R2 = 0.91 ; DW = 1.53

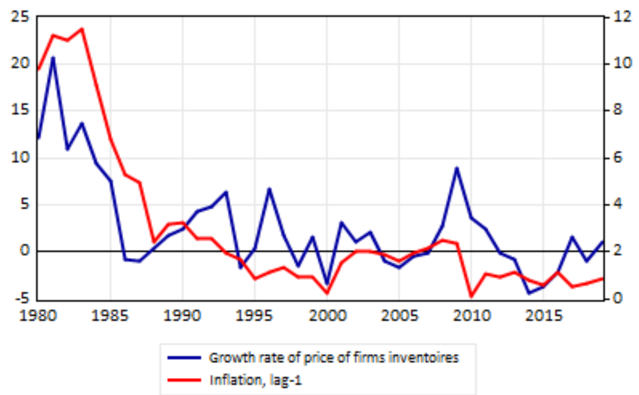
Price of firms' inventories

$$\Delta \ln\left(p_{K_{12}}^F\right) = 0.3\Delta \ln\left(p_{K_{12-1}}^F\right) + 0.6\Delta \ln(p_{Y-1}) - 0.06 d_{1986} + 0.06 d_{1996} + 0.07 d_{2009}$$

1982-2019 (2.9) (3.5) (-2.6) (2.6) (2.9)

R2 = 0.73 ; DW = 2.1

Figure 32 Growth rate of the price firms' inventories and inflation



Price of households' investment

$$\Delta \ln(p_I^H) = 0.98\Delta \ln(p_Y) + 0.02 d_{1980} - 0.03 d_{1996} + 0.03 d_{2006} + 0.04 d_{2008}$$

1978-2019 (24.6) (2.3) (-2.3) (2.5) (3.5)

R2 = 0.92 ; DW = 1.99

Price of produced non-financial assets

$$\Delta \ln\left(p_{K_1}^H\right) = 0.003 + 0.8\Delta \ln\left(p_{K_{1-1}}^H\right) + 0.76\Delta \ln(p_Y) - 0.72\Delta \ln(p_{Y-1}) + 0.02 d_{1987} - 0.02 d_{2008} - 0.02 d_{2012}$$

1983-2019 (1.9) (6.7) (3.5) (-4.4) (2.7) (-2.5) (-2.5)

R2 = 0.85 ; DW = 1.83

Price of banks' investment

$$\Delta \ln(p_I^B) = -0.01 + 1.1\Delta \ln(p_Y) - 0.03d_{1992} + 0.03d_{1997}$$

1978-2019 (-4.6) (18) (-2.4) (2)

R2 = 0.89 ; DW = 1.63

Price of banks' produced non-financial assets

$$\Delta \ln\left(p_{K_1}^B\right) = 0.4\Delta \ln\left(p_{K_{1-1}}^B\right) + 0.7\Delta \ln(p_Y) + 0.06d_{1985} + 0.04d_{1986} - 0.02d_{1985}$$

1983-2019 (5.1) (4.6) (5.2) (3.3) (-2.2)

R2 = 0.94 ; DW = 1.2

Price of current public expenditure

$$\Delta \ln(p_C^G) = 0.97\Delta \ln(p_C^H) + 0.02d_{1995} + 0.02d_{1999} + 0.03d_{2002} + 0.03d_{2009}$$

1978-2019 (41.7) (3.2) (3.7) (4.6) (3.9)

R2 = 0.96 ; DW = 1.7

Price of public investment

$$\Delta \ln(p_I^G) = 1.1\Delta \ln(p_Y) + 0.03d_{1980} - 0.03d_{2015}$$

1978-2019 (25) (2.2) (-2.3)

R2 = 0.92 ; DW = 1.61

Price of government non-financial assets

$$\Delta \ln\left(p_{K_1}^G\right) = 0.3\Delta \ln\left(p_{K_{1-1}}^G\right) + 0.6\Delta \ln(p_I^G) - 0.02d_{2008}$$

1980-2019 (1.7) (3.4) (-2.5)

R2 = 0.92 ; DW = 1.3

Households' consumption price

$$p_C^H = \left(\frac{\boldsymbol{p_Y Y - p_C^G C^G - p_{I_1}^F I_1^F - p_{I_1}^B I_1^B - p_{I_1}^G I_1^G - p_{I_1}^H I_1^H - p_{I_{12}}^F I_{12}^F - p_{I_{12}}^G I_{12}^G - p_{I_{13}}^H I_{13}^H - p_X X + p_{IM} IM}}{Y - C^G - I_1^F - I_1^B - I_1^G - I_1^H - I_{12}^F - I_{12}^G - I_{13}^H - X + IM}\right)$$

Wages

Wage per worker in the market sector (w^M) results from a wage-price-unemployment relation with an indexation slightly less than unity and a medium-term labor productivity $\left(\frac{va^M}{N^M}\right)$ effect. This wage per worker in the market sector serves as a reference for the evolution of that of the other sectors.

Wage per capita (market sector)

$$\ln(w^M) = 0.9\Delta \ln(p_C^H) - 0.1\ln(u) + 0.7\ln\left(\frac{va^M}{N^M}\right) + 0.1d_{2009-2019} - 0.04d_{2009}$$

1978-2019 (52.3) (-5.2) (73) (13.1) (-2.3)

R2 = 0.99 ; DW = 0.5

$$\Delta \ln(w^M) = 0.005 + 0.5\Delta \ln(w^M_{-1}) + 0.4\Delta \ln(p^H_C) + 0.43\Delta \ln\left(\frac{va^M}{N^M}\right) - 0.38\Delta \ln\left(\frac{va^M_{-1}}{N^M_{-1}}\right) - 0.2vc_{-1} - 0.02d_{1983} - 0.02d_{1992} - 0.02d_{2011}$$

1980-2019 (2) (3.8) (3.5) (4) (-3.5) (-2.3)
(-2.6) (-2.5) (-2.3)

R2 = 0.96 ; DW = 1.97

Wage per worker paid by firms

$$\Delta \ln(w^F_p) = 0.4\Delta \ln(w^F_{p-1}) + 1.01\Delta \ln(w^M) - 0.4\Delta \ln(w^M_{-1})$$

1980-2019 (2.6) (27) (-2.4)

R2 = 0.99 ; DW = 2.12

Wage per worker paid by banks

$$\ln(w^B_p) = -0.1 + 1.12 \ln(w^M) + 0.07d_{1994-2007}$$

1978-2019 (-3.5) (81) (5.8)

R2 = 0.99 ; DW = 0.5

$$\Delta \ln(w^B_p) = 1.06\Delta \ln(w^M) - 0.17vc_{-1} + 0.06d_{1993} - 0.05d_{2008}$$

1979-2019 (21) (-2.2) (3.3) (-3)

R2 = 0.83 ; DW = 1.4

Wage per worker paid by the government

$$\ln(w^G_p) = -0.2 + 1.02 \ln(w^M) + 0.08d_{1978-1984} + 0.06d_{1994-2007}$$

1978-2019 (-4.4) (74) (5.1) (8.3)

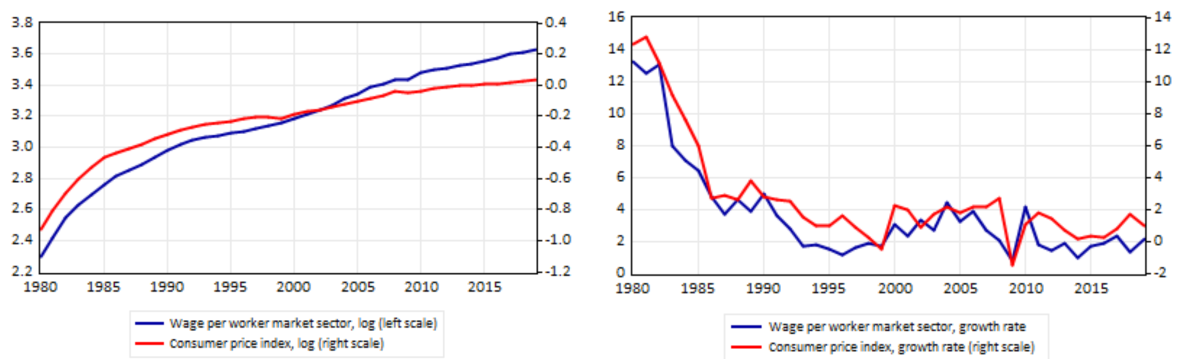
R2 = 0.99 ; DW = 0.9

$$\Delta \ln(w^G_p) = 0.45\Delta \ln(w^G_{p-1}) + 0.53\Delta \ln(w^M) - 0.17vc_{-1} - 0.03d_{1985} - 0.02d_{1987}$$

1980-2019 (5.3) (6.1) (-2.6) (-3.9) (-2.6)

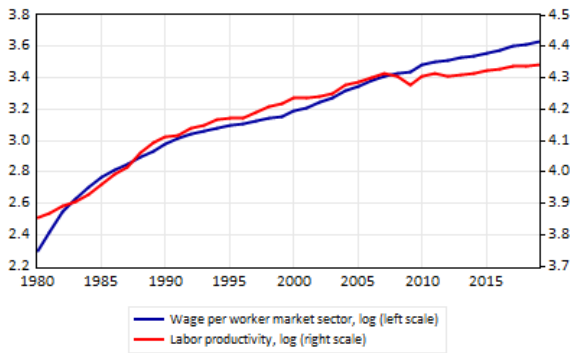
R2 = 0.93 ; DW= 1.8

Figure 33 Wage per worker

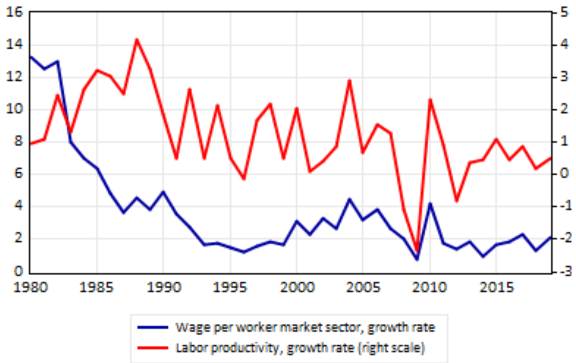


(a) Consumer price index (b) Inflation rate

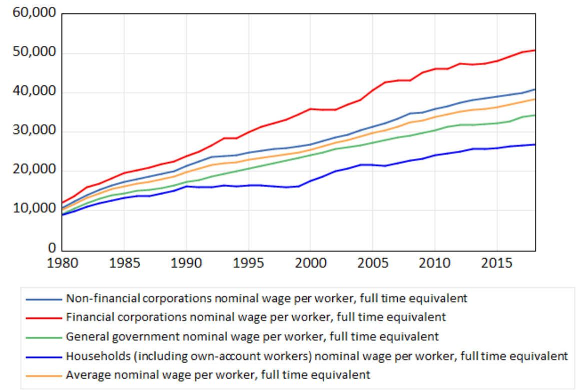
(c) Unemployment (Phillips curve)



(d) Labor productivity



(e) Labor productivity, 1st difference



(f) Wages paid by institutional sector per annum

Employment

Employment in the market sector (N^M) adjusts with respect to medium-term employment resulting from the production function. Public employment is exogenous. Active population (AP i.e. labor force) results from flexion of activity rates (AP/TAP) as a function of job creation (N).

Employment, market sector

$$\Delta\ln(N^M) = 0.5\Delta\ln(N^M_{-1}) + 0.5\Delta\ln(va^M) - 0.08vc*_{-1} - 0.01d_{1982-1992} - 0.01d_{2004}$$

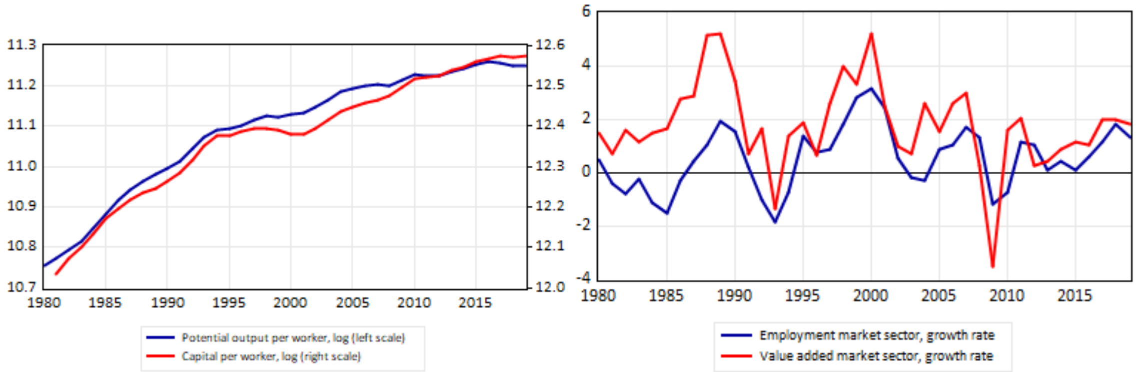
1982-2019 (6.5) (9.7) (-2.4) (-4.9) (-2.6)

R2 = 0.85 ; DW = 2.2

$$vc* = \ln(N^M) - \left(\frac{\ln(va^M) - 0.8 - 0.5\ln(K^M_1) - 0.014t + 0.01t_{1992}}{1 - 0.5}\right)$$

(See potential production equation below)

Figure 34 Employment (market sector)



Employment, non-market sector

$$N^G = N^{NM} \quad \text{exogenous}$$

Total employment

$$N = N^M + N^G$$

Salaried employment, in % of total employment

$$\ln\left(\frac{N^{S_M}}{N^M}\right) = 3.9 + 0.009t - 0.01t_{2000-2019}$$

1978-2019 (228) (23.4) (-14)

R2 = 0.95 ; DW = 0.09

Active population and working age population

$$\ln(AP) = 0.37\ln(N) + 0.56\ln(TAP) + 0.002t$$

1979-2019 (5.5) (9.7) (7.2)

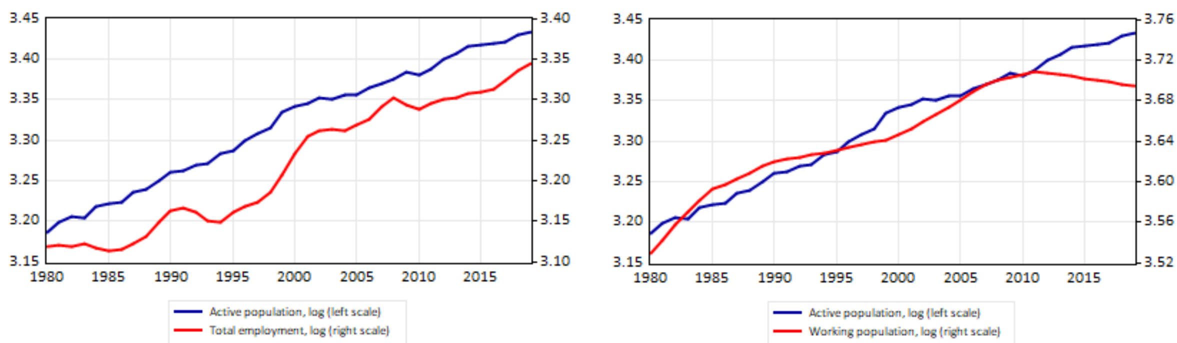
R2 = 0.98 ; DW = 0.32

$$\Delta\ln(AP) = 0.4\Delta\ln(N_{-1}) + 0.4\Delta\ln(TAP) - 0.2vc_{-1} + 0.01d_{1994} + 0.02d_{1999}$$

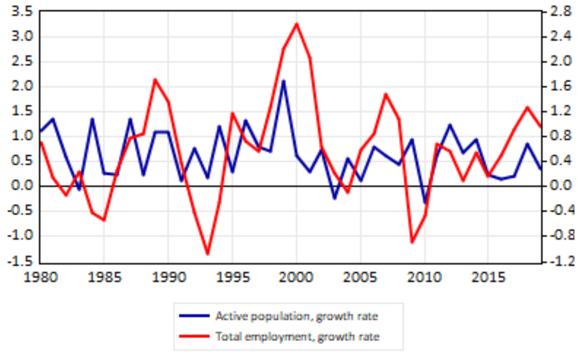
1981-2019 (4.2) (2.7) (-2.5) (3) (3.5)

R2 = 0.2 ; DW = 1.44

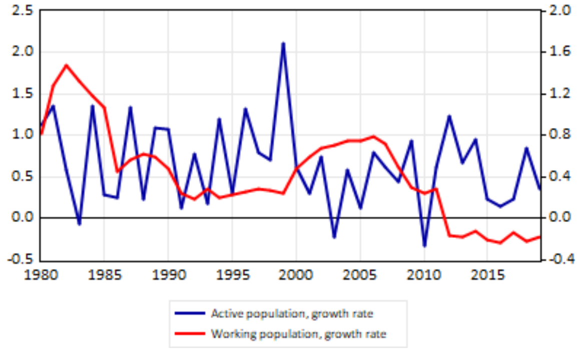
Figure 35 Active population, employment and working age population



(a) Total employment (b) Working population



(c) Total employment, growth rate



(d) Workig population, growth rate

Potential production (market sector)

$$\ln\left(\frac{va^{M^p}}{N^M}\right) = 0.95 + 0.5\ln\left(\frac{K_1^M}{N^M}\right) + 0.014t - 0.01t_{1992-2019} - 0.01d_{1996} + 0.02d_{1995-2010} - 0.02d_{2017-2019}$$

1981-2019 (2.7) (5.9) (6.4) (-6.9) (-1.9) (7.3) (-3.5)

R2 = 0.99 ; DW = 1.24

Output gap

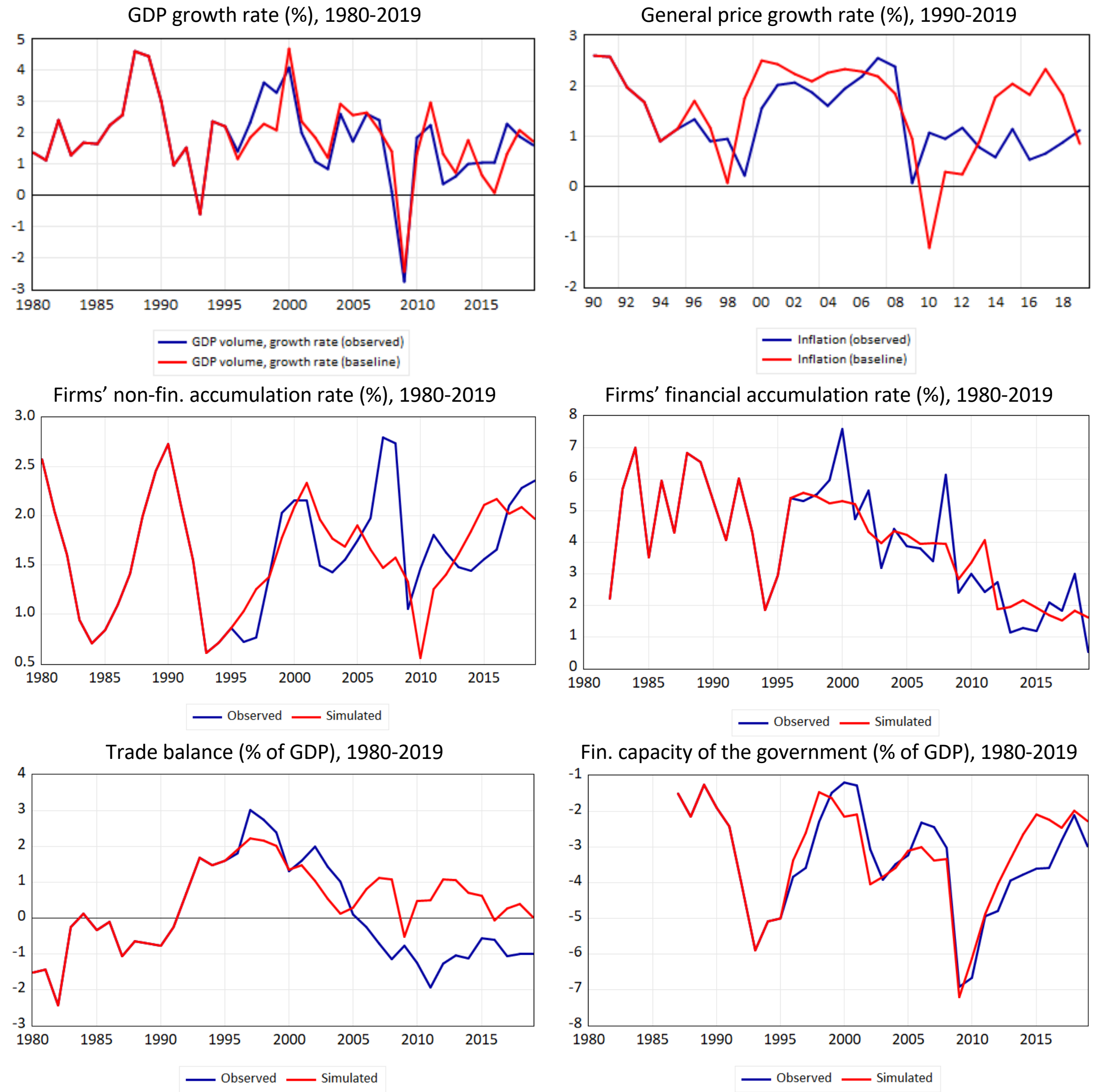
$$gap = \left(\frac{va^M - va^{p^M}}{va^{p^M}}\right)$$

Simulations and basic variants

Simulations on the past

The model is ran in dynamic simulation to reproduce the past starting in 1996, year after which the dataset is homogenous[7]. Results are overall acceptable. We observe however an overestimation of prices and wages after 2012. We verify that the sum of financing capacities from the different agents is equal to 0 and that the central bank equilibrium is verified (rounded to the nearest decimal).

Figure 36 Observed series vs simulations since 1996, selected variables (with price of public bonds exogenous)



[7] *Banque de France* provides the necessary data for the analysis of the financial accounts in two datasets. The first goes from 1978 to 2009 (discontinued) and the second from 1995 onwards. We kept the second dataset (which follows the SNA 2008 methodology) and adapted the methodology of the first one (SNA 1996) in order to fit before 1995.

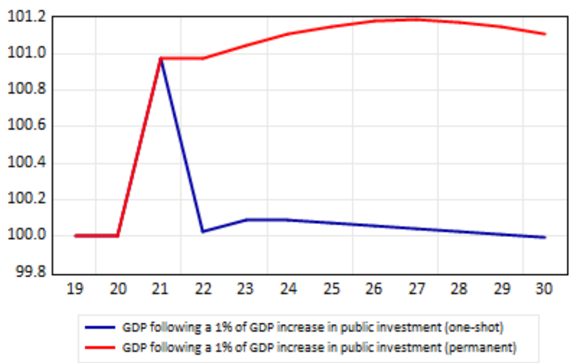
Fiscal and monetary policies: basic variants

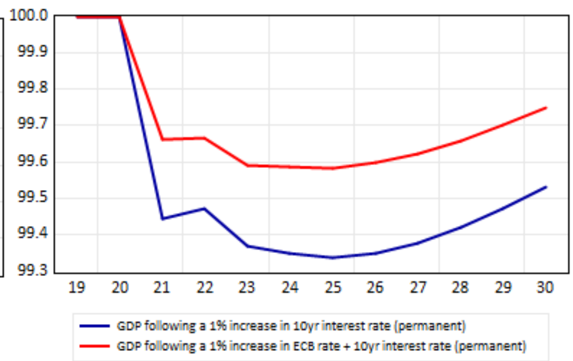
In order to study fiscal and monetary policies, two basic variants are performed: a 1% of GDP increase in public investment (either one-shot in a given year, or permanent each year), a 1% increase of the rate of interest (both the key interest rate of the ECB and the 10-year interest rate on public bonds). These shocks were performed with respect to a fictitious baseline built over the period 2019-2030 abstracting from the COVID crisis. This is to ensure that the baseline is not affected by extreme shocks. The analysis of the COVID crisis and the Ukrainian war will be studied in the future.

The increase in public investment has the usual stimulus effects, a one-off or lasting increase in the volume of GDP depending on the nature of the shock, a limited or longer lasting inflationist shift depending on the case, an imbalance in the trade balance and public finance, and an increase in public debt limited to less than 1% of GDP in the case of a one-off shock or reaching nearly 4% of GDP over a 10-year period[8].

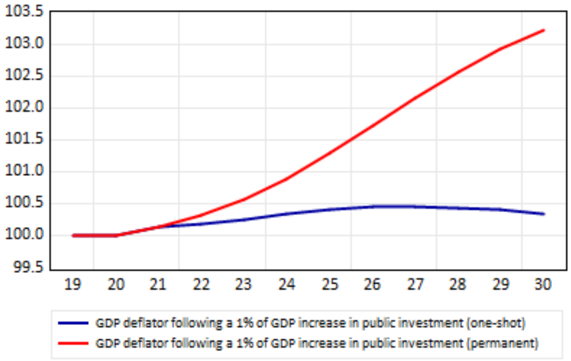
An increase of the 10 year interest rate of 1% has a negative effect on economic activity (-0.7% at medium term on GDP) mainly through a decrease of firms' investment and on prices (-1.2% at medium term on GDP deflator). The trade balance is slightly improved thanks to the declining activity and the moderate improvement of price competitiveness. On the opposite the government balance worsens (-2.5% of GDP in the medium term) due to the decrease of taxes and the rising cost of the debt. Consequently, the public debt ratio increases rather sharply (+18% of GDP) due to cumulative effects and to the decline of the nominal GDP. When the two rates of interest, both at medium term and at short term, are increased, the recessive effect is less marked thanks to the stimulating effects induced by the increasing received interests which depend on short term rates of interest.

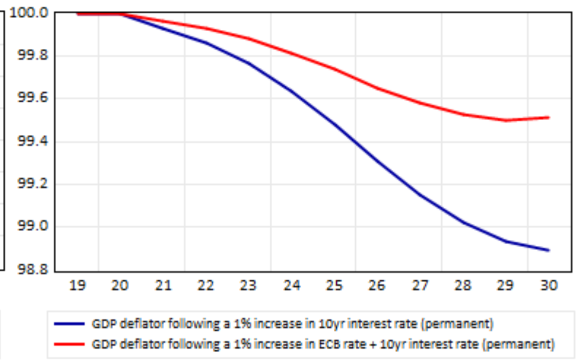
Figure 2: Impact of an increase of public investment and of an increase of the rate of interest

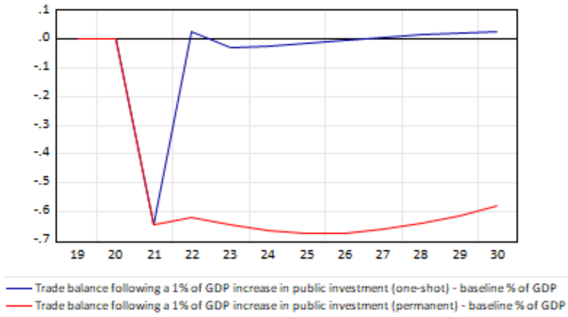


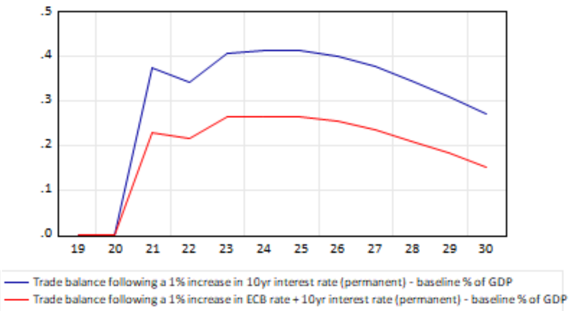


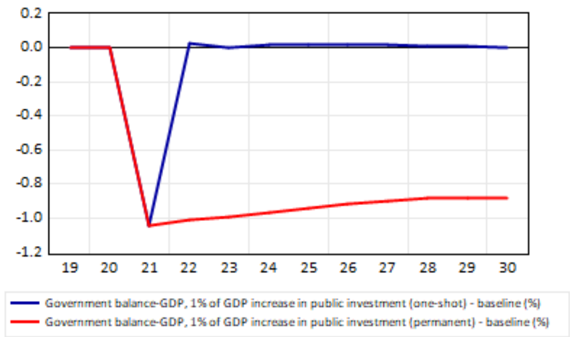
[8] GDP in volume and the price level are presented here as after-shock series multiplied by 100, divided by the baseline series. Trade and public balance as well as public debt are shares of GDP, so that the table shows the after-shock–baseline differences.

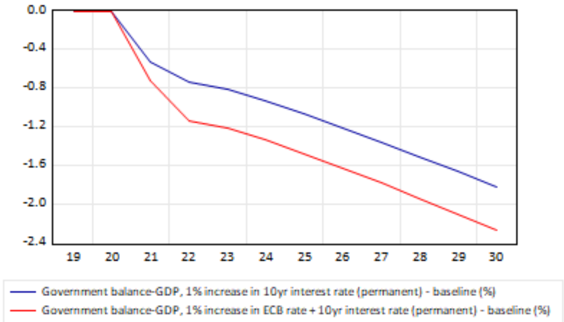

GDP deflator following a 1% of GDP increase in public investment (one-shot)
GDP deflator following a 1% of GDP increase in public investment (permanent)

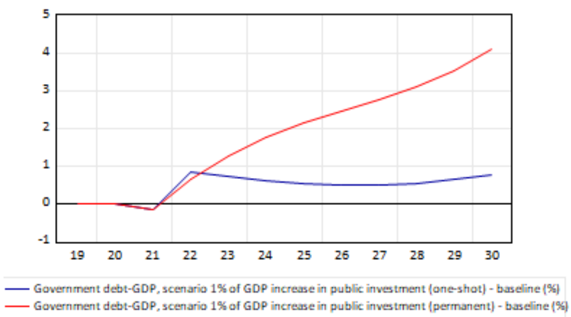

GDP deflator following a 1% increase in 10yr interest rate (permanent)
GDP deflator following a 1% increase in ECB rate + 10yr interest rate (permanent)

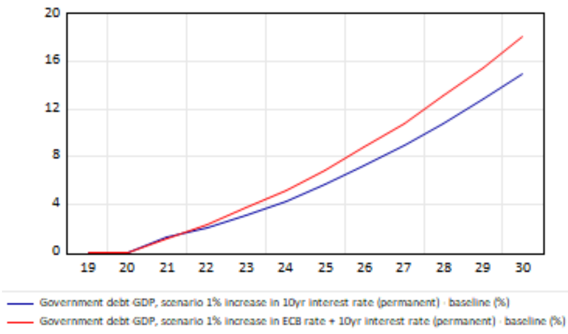

Trade balance following a 1% of GDP increase in public investment (one-shot) - baseline % of GDP
Trade balance following a 1% of GDP increase in public investment (permanent) - baseline % of GDP

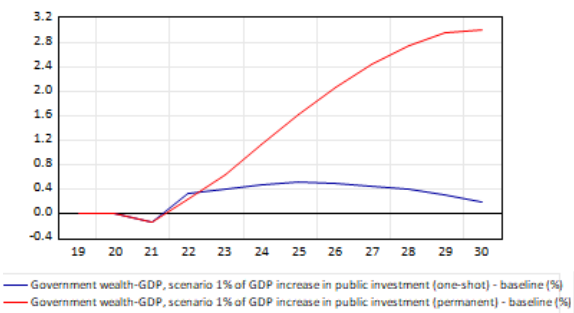

Trade balance following a 1% increase in 10yr interest rate (permanent) - baseline % of GDP
Trade balance following a 1% increase in ECB rate + 10yr interest rate (permanent) - baseline % of GDP

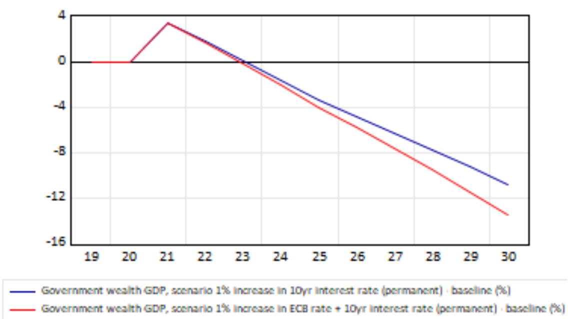

Government balance-GDP, 1% of GDP increase in public investment (one-shot) - baseline (%)
Government balance-GDP, 1% of GDP increase in public investment (permanent) - baseline (%)


Government balance-GDP, 1% increase in 10yr interest rate (permanent) - baseline (%)
Government balance-GDP, 1% increase in ECB rate + 10yr interest rate (permanent) - baseline (%)


Government debt-GDP, scenario 1% of GDP increase in public investment (one-shot) - baseline (%)
Government debt-GDP, scenario 1% of GDP increase in public investment (permanent) - baseline (%)


Government debt GDP, scenario 1% increase in 10yr interest rate (permanent) - baseline (%)
Government debt GDP, scenario 1% increase in ECB rate + 10yr interest rate (permanent) - baseline (%)


Government wealth-GDP, scenario 1% of GDP increase in public investment (one-shot) - baseline (%)
Government wealth-GDP, scenario 1% of GDP increase in public investment (permanent) - baseline (%)


Government wealth GDP, scenario 1% increase in 10yr interest rate (permanent) - baseline (%)
Government wealth GDP, scenario 1% increase in ECB rate + 10yr interest rate (permanent) - baseline (%)

Unconventional monetary policy and fiscal policy

Two forms of unconventional monetary policy can be studied in this model; helicopter money and the cancellation of a part of the public debt held by the central bank.

Helicopter money

Helicopter money can take several forms, either as a distribution of central bank money directly to households or businesses, or as a distribution to the government. If we want to avoid a distribution of banknotes, the first form assumes that all households and firms have an account with the central bank. This is theoretically possible, especially with the project of development of central bank digital currency. But it is not the case today. This is why we are only interested in the second form, i.e. via the State and its account with the central bank. Several steps have to be distinguished to account for helicopter money in the model.

The first is pure helicopter money distribution, i.e. the feeding of the State's account with the central bank for an amount equivalent to 1% of GDP and paid the first year[9]. This distribution alone does not have an impact other than increasing government wealth and diminishing that of the central bank. In a second step, in order to be able to use this helicopter money the government must transfer it to the accounts of commercial banks. The account with the central bank is debited, and the account with private banks is credited[10]. This transfer also has no impact on the real sector. In each case government wealth increases with respect to the baseline. It even increases slightly more thanks to the interest paid by banks to the government, and public debt decreases accordingly. Conversely, the central bank's wealth remains reduced by the same amount as before, while bank reserves (which can be interpreted as the central bank's indebtedness to private banks) increase.

In a third step the government uses helicopter money to finance additional public investment of the same amount (1% of GDP). Bank deposits are brought back to initial levels. We observe, unsurprisingly, a recovery effect with slight inflationary pressures of an identical size to the effects obtained in the case of public investment financed by public debt. However, the financing methods are different. In the current case, the government balance deteriorates by the same amount but public debt does not increase, given that expenditure is financed by the helicopter money transfer. The graphs in level below illustrate this point. The graphs in percentage of GDP may seem paradoxical. Given the GDP increase the public balance as percentage of GDP worsens and simultaneously public debt as % of GDP falls. This recovery via investment without public debt has a counterpart. The wealth of the central bank worsens as much and stays at that level under the effect of the recovery. Symmetrically, government wealth increases given that the stock of capital increases without additional debt. It is worth

[9] To account for this distribution of helicopter money in the model, it is necessary to feed the government's account with the central bank and add a negative gap-filling variable of the same amount on the accounting identity determining the variation of public indebtedness, in order to translate the fact that the government's account is increased thanks to helicopter money and not by indebtedness.

[10] Here again the logic of the model requires the introduction of a gap-filling variable on the government's liability deposits, which are simply modeled as a function of government deposits held. This variable is negative to reflect the fact that these deposits have no reason to increase in the event of a helicopter money transfer.

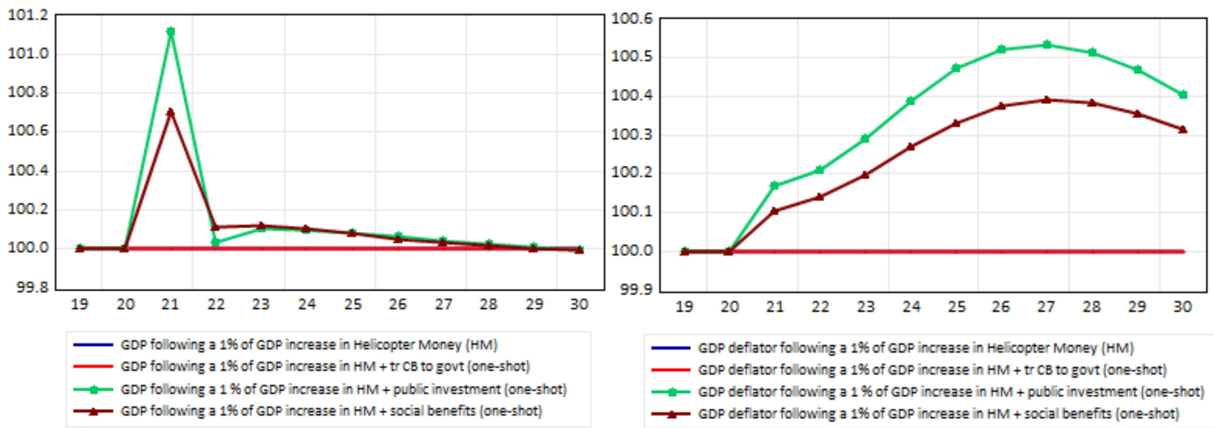
noting that bank reserves (i.e. central bank indebtedness to banks) initially increase and only slightly fall when the helicopter money is used to finance the public investment.

Helicopter money to finance public investment is presented by its proponents (Couppey-Soubeyran, 2020) as a useful tool in a period of strong public indebtedness. The previous simulations could be completed by examining, not only a one-off shock but also a permanent increase in public investment in the context of the energy transition. The conclusions to be drawn would not be fundamentally different. There is no miracle. The recovery without public debt has as a counterpart a worsening of central bank wealth. This would not be a problem according to supporters of this policy. A central bank could still work with negative own funds. This could be the case if the procedure is punctual and limited, but more problematic in the context of a sustained policy. Financial markets could push up interest rates. The solutions proposed to restore the central bank's own funds are discussed below. The size of bank reserves would facilitate capital outflows or slippages in the securities or real estate markets. In the French case, as in the case of countries in the Eurozone without a central bank properly speaking, such policy would contradict European treaties. It could only be undertaken after a series of time-consuming negotiations whose outcomes would be more than uncertain.

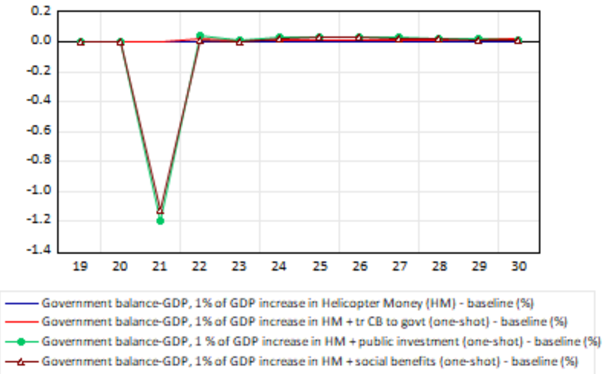
Another possible use of helicopter money is to finance increased social transfers to households for an amount equivalent to 1% of GDP according to the same modalities as in the third step seen previously (the first two steps are identical). The results are similar to the previous ones with an increase of public investment, a recovery without public debt, but a worsening of central bank wealth.

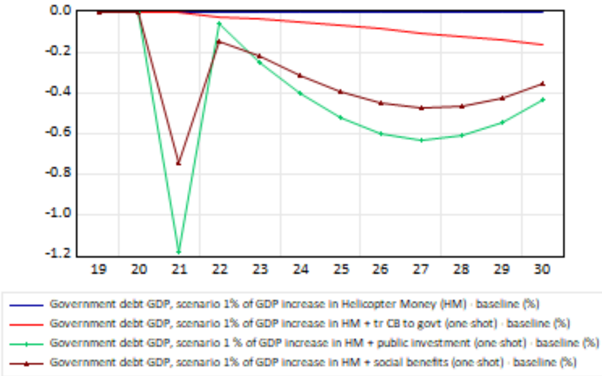
Figure 3 Impact of helicopter money distribution of 1% of GDP, with a one-off increase in public investment or with social transfers in 2021

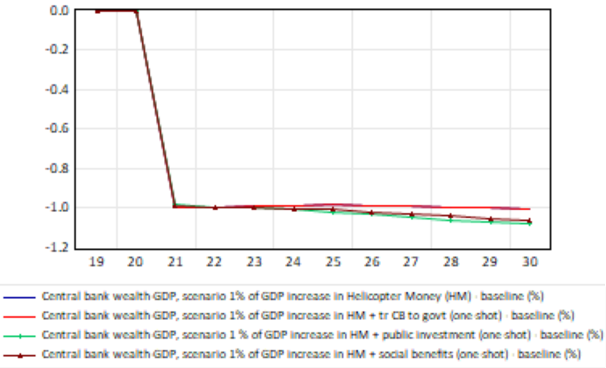
Relative deviation from baseline x 100 ($Y^{scenario} \cdot 100 / Y^{baseline}$)

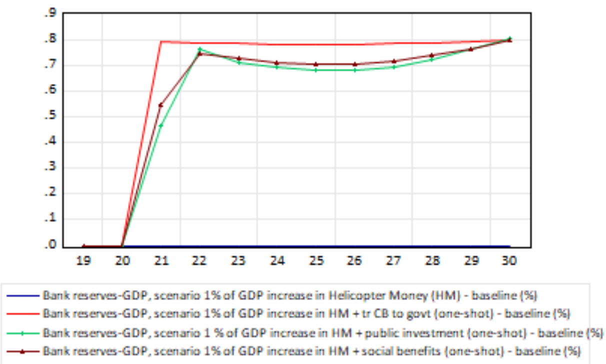


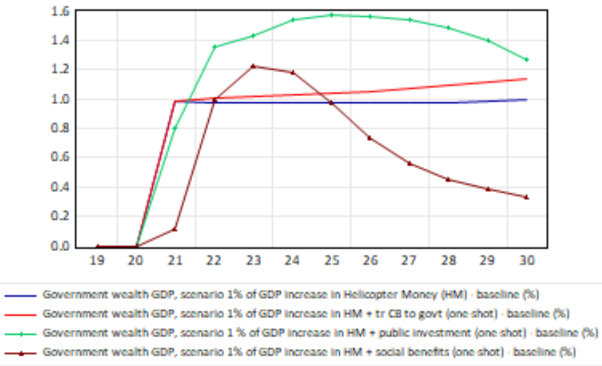
Absolute deviation from baseline, series as % of GDP ($Y^{scenario} - Y^{baseline}$)



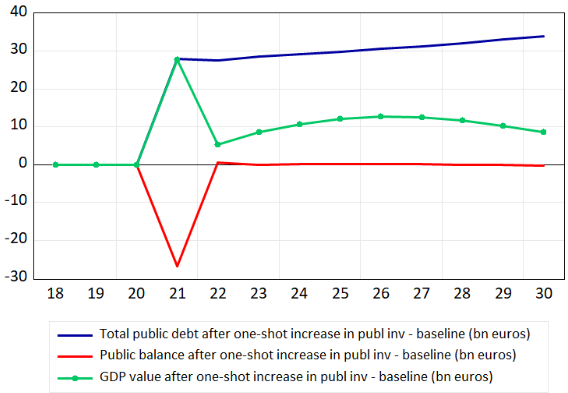


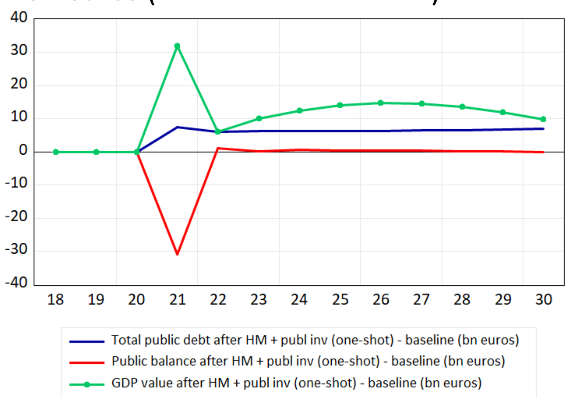






Absolute deviation from baseline, billion euros ($Y^{scenario} - Y^{baseline}$)





Cancellation of public debt held by the central bank

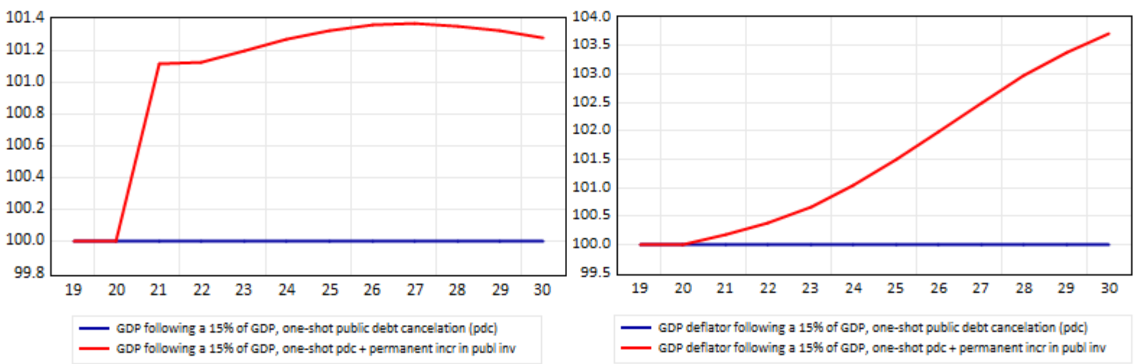
As a result of unconventional monetary policy, central banks hold a large amount of government securities, which constitute a significant part of public debt. One proposal put forward by some authors (Scialom and Bridonneau, 2020) is to cancel part of this debt in order to lighten budget constraints, thus providing room for maneuver to better finance the energy transition. This policy (cancellation of public debt equivalent to 15% of GDP) can be studied in the model in a simple way. A first gap-filling variable of -15% of GDP is introduced in the flow-stock equation generating the stock of public debt held by the central bank[11]. The same negative shock is introduced in the flow-stock equation generating the stock of total debt. Lastly, another gap-filling variable equation indicates that the cancellation concerns only public bonds. This partial cancellation of public debt held by the central bank has no effect on the real economy. Public debt falls but central bank wealth falls as much.

For the supporters of this policy, the reduction of public debt would loosen the constraints and would open the way to an increase in public investment (5% of GDP on a permanent basis) to finance the energy transition. As the simulations show, the combination of these two measures, partial cancellation of debt and increase in public investment, leads to a sustained recovery with rising inflationary pressures due to demand pressure and wage drift. Thanks to the initial cancellation, public debt remains under control despite the increase in the public deficit. The counterpart of these evolutions is a persistent and marked deterioration of the central bank's wealth (-14% of GDP).

These results raise, in addition, the same reservations as those formulated about helicopter money. Insofar as the amounts of cancellation are high (more than in the previous case), it is difficult to believe that this marked deterioration of the central bank's own funds can remain without consequences. The risk of rising interest rates cannot be ignored. The ways in which the central bank can replenish its capital are not convincing, and accepting such policy within the Eurozone seems rather unlikely.

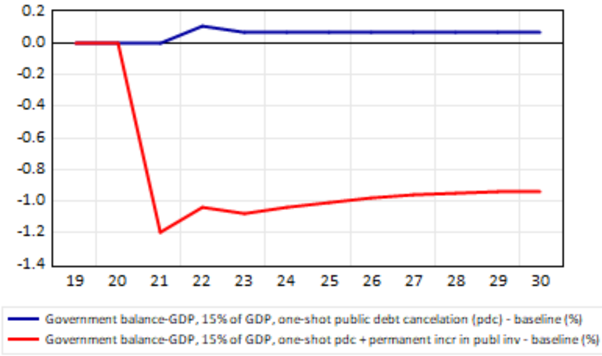
Figure 4 Impact of a partial cancellation of debt held by the central bank, starting in 2021

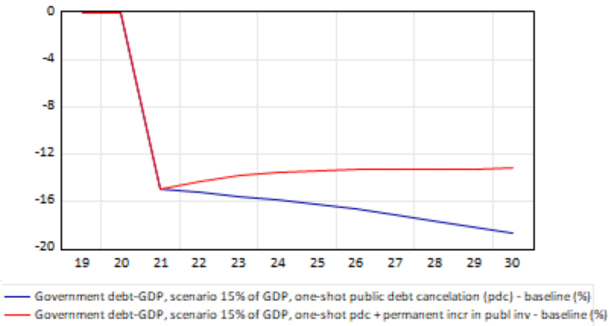
Relative deviation from baseline x 100 ($Y^{scenario} \cdot 100 / Y^{baseline}$)

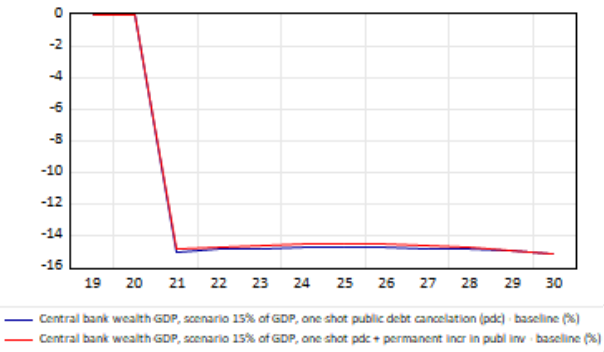


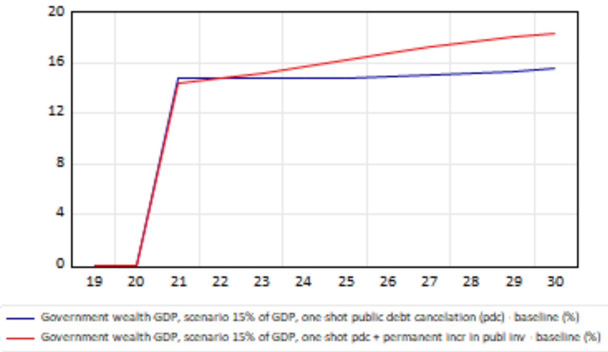
Absolute deviation from baseline, series as % of GDP ($Y^{scenario} - Y^{baseline}$)

[11] This is introduced in the term other changes in volume (OCV) that closes the flow-stock equation and integrates, among others, the effects of the cancellation.









Recapitalization of the own funds of the central bank

Non conventional monetary policy, whether in the form of helicopter money or of cancellation of public debt held by the central bank, leads to a worsening of the wealth of the central bank. This deterioration could be important in the cases of financing large investment programmes for the climatic transition or cancelling the public debt generated by the covid crisis. The supporters of these policies argue that this question of the wealth of the central bank is not essential. A central bank can support negative own funds without difficulty. This is not evident, especially in the case of an important amount. The credibility of the central bank could be questioned and an increase of the interest rates could happen. Another answer is given. As the central bank can create its own currency, its recapitalisation would be easy and without cost.

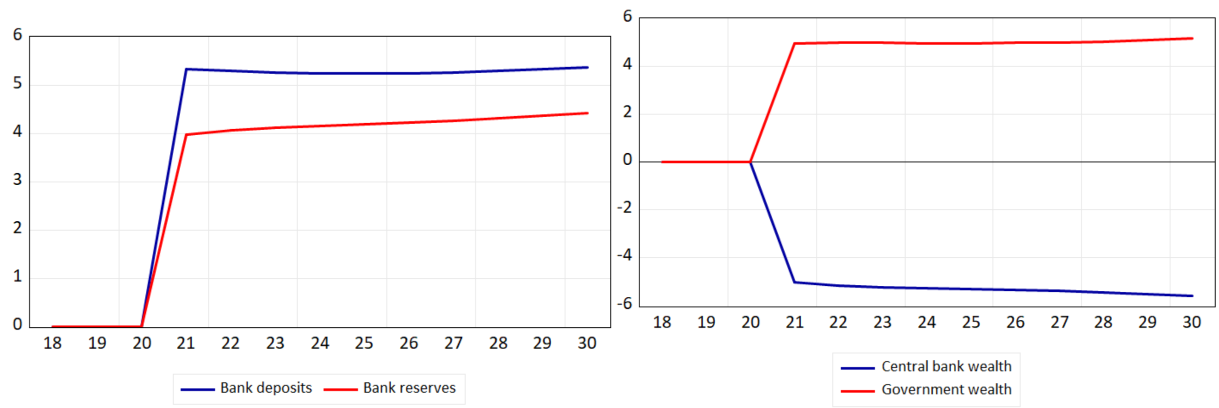
This point can be examined with the model. Recapitalisation of the central bank can be done in a simple way. The central bank issues new equities which are bought by the government thanks to a distribution of helicopter money to the government. This can be introduced in different steps in the model. First helicopter money is distributed to the government by feeding its account at the central bank for an amount equivalent to 5% of GDP[12]. This amount is taken as a simple illustration as it represents only a part of the cost of the covid crisis for the public finance or a part of the public debt which could be cancelled. In a second step the government transfers this amount of helicopter money to its account at commercial banks. Its account at the central bank is debited while its account at the commercial banks is credited

[12] As previously to account for this distribution of helicopter money in the model, it is necessary to add a negative gap-filling variable of the same amount on the accounting identity determining the variation of public indebtedness, in order to translate the fact that the government's account is increased thanks to helicopter money and not by indebtedness.

(of 5% of GDP)[13]. In a third step the central bank issues new equities (for an amount of 5% of GDP) which are bought by the government. Consequently the bank account of the government is debited while the bank deposits of the central bank are increased. In the non financial sphere (GDP and price) nothing changes. At the monetary and financial level the equities issued by the central bank are increased but the wealth of the central bank is reduced of the same amount (-5% of GDP). All in all, the own funds of the central bank (equities issued plus wealth) remain unchanged.

Figure 5 Impact of a recapitalization of the own funds of the central bank equivalent to 5% of GDP

Absolute deviation from baseline, series as % of GDP ($Y^{scenario} - Y^{baseline}$)



However two other evolutions must be noted. The government wealth is increased (of 5% of GDP) since the government holds the new equities issued by the central bank. For the public sector as a whole (government and central bank) this means that its wealth is constant. This gives a more positive estimate of the financial situation of the public sector. But simultaneously the bank reserves, which can be interpreted as a debt of the central bank towards the commercial banks, increase of the same amount (5 % of GDP). As it has been already noticed, these increasing bank reserves could facilitate capital outflows and slippages in the financial markets. On the whole, these results show that the recapitalization of the central bank raises problems. It cannot be done as simply as it is sometimes said (a "simple click").

Conclusion

Based on the accumulation accounts of INSEE and the financial accounts of Bank of France, an econometric SFC model of the French economy has been presented. It is an aggregate model with a single product distinguishing five domestic agents (firms, households, banks, central bank, government) and the rest of the world with a complete representation of economic and financial accounts in flows and stocks. The structure of the model is close to that of existing SFC models with demand-led dynamics, an accumulation behavior of a Kaleckian type and an

[13] Once again the logic of the model requires the introduction of a gap-filling variable on the government's liability deposits, which are simply modeled as a function of government deposits held. This variable is negative to reflect the fact that these deposits have no reason to increase in the event of a helicopter money transfer.

indebtedness norm. The dynamic simulations on the past over the period 1996-2019 provided acceptable results. The fiscal and monetary policies have been studied with basic variants (increase of public investments and increase of rates of interest) which have given the usual multiplier effects.

Furthermore, the effects of unconventional monetary policies have been evaluated. A distribution of helicopter money in favor of the government to finance additional public investments or social transfers has a stimulating impact without increasing the public debt. However, as a counterpart the wealth and own funds of the central bank deteriorate by an amount equivalent to the initial shock. If the intervention is not punctual and limited, this evolution could be problematic. It seems difficult to finance large public investment programs for the climate transition by this simple distribution of helicopter money. Similarly, partial cancellation of the public debt held by the central bank has been examined. It has, as a counterpart, a degradation of the wealth and own founds of the central bank which are too important to remain without consequences. It does not give new leeway to finance public expenditures. Last, the recapitalization of the own funds of the central bank has been discussed. It raises also problems and cannot be done as a “simple click”.

This version of the model could be improved on several points. First, the creation of central bank electronic money is currently under discussion. Some of its potential impact could be discussed with the model by introducing a new type of asset. Central bank electronic money could be distributed to households or to the government. Second, medium term interest rate could be endogenized by no longer assuming that the market of public bonds is balanced by the demand of the banks. This would allow an examination of the consequences of monetary financing. Third, an explicit treatment of the ECB currently integrated in the rest of the world remains to be done.

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Appendix

The treatment of Other Changes in Volume (OCV) and of revaluations is important, and rather technical. For each item of the balance sheet an OCV or asset price must be computed in order to ensure stock-flow consistency. Taking domestic equities as an example,

$$p_{E_L}^i E_L^i = p_{E_{L-1}}^i E_{L-1}^i + p_{E_L}^i (E_L^i - E_{L-1}^i) + E_{L-1}^i (p_{E_L}^i - p_{E_{L-1}}^i)$$

$$p_{E_A}^{j_{FR}} E_A^{j_{FR}} = p_{E_{A-1}}^{j_{FR}} E_{A-1}^{j_{FR}} + p_{E_A}^{j_{FR}} (E_A^{j_{FR}} - E_{A-1}^{j_{FR}}) + E_{A-1}^{j_{FR}} (p_{E_A}^{j_{FR}} - p_{E_{A-1}}^{j_{FR}})$$

with $i = F, B, CB$ and $j = F, B, CB, G, H, R$

In order to have assets = liabilities $\Sigma p_{E_L}^i E_L^i = \Sigma\, p_{E_A}^{j_{FR}} E_A^{j_{FR}}$ both in $t-1$ and in t, some constraints must be imposed on flows (OCV) and on revaluation effects (prices). The equilibrium of flows between equities issued and held gives

$$\begin{aligned} p_E^{FR} (\Delta^* E_L^B + \Delta^* E_L^F + \Delta^* E_L^{CB}) \\ = p_{E_A}^{F_{FR}} \Delta^* E_A^{F_{FR}} + p_{E_A}^{B_{FR}} \Delta^* E_A^{B_{FR}} + p_{E_A}^{CB_{FR}} \Delta^* E_A^{CB_{FR}} + p_{E_A}^{G_{FR}} \Delta^* E_A^{G_{FR}} + p_{E_A}^{H_{FR}} \Delta^* E_A^{H_{FR}} \\ + p_{E_A}^R \Delta^* E_A^R \end{aligned}$$

with the relations $\Delta E_L^B = E_L^B - E_{L-1}^B = \Delta^* E_L^B + OCV_{E_L}^B / p_{E_B}^L$ for each item. A consistency must exist between the OCV

$$\Sigma OCV_{E_L}^i = \Sigma OCV_{E_A}^{j_{FR}}$$

$$OCV_{E_L}^B = \Sigma OCV_{E_A}^{j_{FR}} - OCV_{E_L}^F - OCV_{E_L}^{CB}$$

Regarding the revaluation effects the constraint to be held is

$$\Sigma\, E_{L-1}^i \Delta\, p_{E_L}^i = \Sigma\, E_{A-1}^{j_{FR}} \Delta p_{E_A}^{j_{FR}}$$

Which gives a determination of $p_{E_A}^R$

$$\Delta p_{E_A}^R = \sum_i \left(\frac{E_{L-1}^i}{E_{A-1}^R} \right) \Delta p_{E_L}^i - \sum_j \left(\frac{E_{A-1}^{j_{FR}}}{E_{A-1}^R} \right) \Delta p_{E_A}^{j_{FR}} \quad \text{for } i = F, B, CB \quad \& \quad j = F, B, CB, G, H$$