Financial integration and stabilization in a Monetary Union without or with bank rationing

Vincent Duwicquet and Jacques Mazier, November 2010

CEPN, Centre d'Economie de l'Université Paris Nord, CNRS

vincent.duwicquet@gmail.com, mazier@univ-paris13.fr

Abstract

In a monetary union, like the euro zone, adjustments facing asymmetric evolutions are more difficult due to fixed intra-European exchange rates, as it is illustrated by the actual crisis of Southern European economies. Well integrated capital markets, with portfolio diversification and intra-zone credit, would constitute a powerful adjustment mechanism, examined in detail by the "international risk sharing" approach. Its results are used by advocates of a liberal economic policy in the EU to promote deeper financial integration without having to develop a federal budget. However, the theoretical basis and the econometric methodology used can be both criticised.

A different approach is adopted in this paper, based on a "stock-flow consistent" model of a monetary union with two countries along the lines of Godley and Lavoie (2007). Alternative versions of the model are considered, with or without foreign financial assets, intra-zone credit and intra-zone capital income transfers, with or without credit rationing. Several results can be underlined. Holding foreign assets has a stabilising role, but the capital income stabilising coefficient seems smaller than the one obtained by the "risk sharing" approach. By contrast, intra-zone credit seems to have no specific stabilization effects. There is no increase of the stabilization coefficient to expect from the development of intra-zone credit. This is true without credit rationing, but also in case of global credit rationing from the banks of the two countries. The only case of stabilization appears in the case of credit rationing in the small country, partially compensated by credit from the rest of the Union. The role played by rising interest rates is also discussed. Results are used to enlighten the actual European crisis.

1. Introduction

In a monetary union like the euro zone adjustments facing asymmetric evolutions are more difficult due to fixed intra-European exchange rates. Since 1999 divergences in the evolution of different European economies have been more important than generally expected. The slowdown observed after 2001 has been unequal across the countries. The slow growth of the large continental countries, especially Germany, has contrasted with the better performances of smaller and more peripheral countries like Finland or Ireland and Spain which were led by a housing bubble. Divergences regarding inflation have also been significant. The financial crisis of 2007-2008 didn't hurt all the countries in the same way. Southern European economies have been clearly more touched and the Greek crisis in 2010 has been a threat for the whole Euro area. By contrast, Germany, although deeply hurt by the world recession, managed to recover strongly. Such an environment has brought to the fore traditional questions related to monetary union, that is, the nature of adjustment mechanisms and the difficulties due to asymmetric evolutions.

Adjustments mechanisms are defined in a broad sense as mechanisms which permit a country after a shock to return to the initial situation or, possibly, to full employment. They are of different nature.

Relative wage and price flexibility had been proposed from the start by single currency instigators and are still proposed in order to take place, at least partially, of exchange rate adjustments. Actually these mechanisms allow only a very slow and partial return to equilibrium with an important cost in terms of growth and employment and with large differences between countries, due to strong structural specificities (Mazier and Saglio, 2008). It is illusory to hope that more flexibility in the products and labour markets, obtained through "structural reforms", will improve these adjustment mechanisms.

Labour mobility is another potential adjustment mechanism, but it remains limited in the EU. Even in the case of the USA, inter-regional migrations follow a rather long-term dynamics which is not reversible in the short term and cannot be regarded as adjustment factors on a large scale (Mazier et al., 2002, 2007).

Fiscal policy can play a more active role in a federal state like the USA, but has no equivalent in the European case. According to rather old evaluations, the stabilization coefficient of the US federal budget would range between 15% and 28% (Pisani-Ferry et al., 1992; Goodhart et Smith, 1993). This question, theoretical in the European case due to the lack of a federal

budget, has been re-examined since the second part of the 1990s in an enlarged approach, the "international risk sharing" one.

Well integrated capital markets, with portfolio diversification and intra-zone credit, would constitute a powerful adjustment mechanism, examined in detail by the "international risk sharing" approach (Asdrubali et al., 1996; Asdrubali et Kim, 2004). The stabilization through capital income would be important in the US case (around 30%) and would reflect a deep financial integration with portfolio diversification at the level of the whole American area. The stabilization by federal transfers would be around 15%, close to previous studies' results. The stabilization by intra-zone credit would also be important (around 20%) but the interpretation of the econometric estimation raises many problems. More generally, the theoretical basis of the whole model and the econometric methodology used can be both criticised, mainly because it is too focused on the consumption-production adjustment and ignore other components, especially investment and firms' revenue. However, these results are used by advocates of a liberal economic policy in the EU to promote deeper financial integration without having to develop a federal budget.

That is why a different approach is adopted in this paper based on a "stock-flow consistent" model of a monetary union with two countries along the lines of Godley and Lavoie (2005-06, 2007[a], 2007[b]) and Lavoie (2003). The model describes assets and liabilities of all the agents (firms, households, and government) and analyzes financial integration in a consistent manner. The banking system of the monetary union comprises commercial banks in each country and a single central bank. We distinguish four kinds of assets: monetary assets held by households; bonds issued by each state and held by households of both countries; Treasury bills also issued by each state and held by commercial banks; equities issued by firms of both countries and held by households and firms of both countries. Firms can finance their real and financial investments by non-distributed profit, banking credit, or new equities issued. This stock-flow consistent approach of the monetary union allows a comprehensive analysis of real and financial adjustments through capital income (interests, dividends, and capital gains) and external finance (credit, equities, Treasury bills and bonds). Using two countries of unequal size, it describes relations between one country and the rest of the union.

Different versions of the model are considered:

- a model of financial autarky without foreign financial assets and without intra-zone credit;
- a complete model with foreign assets and intra-zone credit where the degree of financial integration can be more or less developed;

- a model with intra-zone credit, but without foreign assets and intra-zone capital income transfers.

Furthermore banks can supply credit without rationing or with rationing. This rationing may be global by banks from both countries. Alternatively it may be specific to resident or non resident banks. Rationing may also concern Treasury bills which banks may buy without restriction or up to a certain limit, forcing the government to adapt its fiscal policy. Last, if interest rates are generally supposed constant and led by the key interest rate of the Central Bank, they can also become variable when banks are reluctant to finance an increasing deficit. Based on these different versions of the model, a whole set of simulations is used to study adjustments facing asymmetric shocks. By comparison, it is possible to estimate stabilization effects due to foreign capital income and portfolio diversification and to intra-zone credit. Several results[1] can be underlined.

-Foreign asset holdings have a stabilising role, but the capital income stabilising coefficient seems smaller than the one obtained by the "risk sharing" approach.

-By contrast, foreign loans (intra-zone credit) have no specific stabilization effects. This is due to the credit mechanism in a monetary union and to the key role played by refinancing by the central bank. Inside a monetary union, domestic credit and foreign credit from another member of the union are of the same type. There is no increase of the stabilization coefficient to expect from development of intra-euro zone credit. This is true without credit rationing or with global credit rationing by domestic and non resident banks.

-However, when non resident banks, contrary to domestic ones, do not ration credit or buy Treasury bills without restriction, intra-zone credit have a stabilization effect.

-But, when interest rates increase due to banks' reluctance to finance more issue of Treasury bills, intra-zone credit from the rest of the union has no more stabilizing effect due to its increasing cost. This can be regarded as an illustration of the last Greek and Irish crisis and as an argument in favour of a direct finance by the Central Bank.

The paper is organized as follow. A second section presents the main characteristics of the two-country stock-flow model in its basic specification. A third section presents simulations in response to asymmetric supply or demand shocks with the different versions of the model. Stabilization effects of foreign capital income and intra-zone credit, with or without credit rationing, are analysed. A last section concludes.

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[1] Preliminary results have been already presented in the case where there is no credit rationing (Duwicquet and Mazier, 2010-11).

2. A stock-flow consistent model of two countries in a Monetary Union

A SFC model with two countries in monetary union allows a consistent description of assets and liabilities and of all the associated real and financial flows. The monetary union is composed of two countries (N and S) with an asymmetry of size. The country S is five times larger than the country N. This configuration facilitates analyzing the adjustment mechanisms of the country N facing the rest of the monetary union. Consequently, it is possible to estimate the stabilization coefficients associated with capital incomes and intra-zone finance.

This model is inspired by Godley & Lavoie (2005-06, 2007[a], 2007[b]) and Lavoie (2003). But it differs in some points. We introduce asymmetry in size between the two countries. The monetary and financial sector is more developed. Firms accumulate both real and financial capital. They can finance their investments by non-distributed profit, banking credit, or equities. We introduce two commercial banks capable of supplying credit and also, possibly, rationing credit. Households hold banking deposits, bonds, and equities. We keep a similar representation of the central bank and the two governments which issue bonds and treasury bills. Lastly, the model has been calibrated to represent the structure of the European Monetary Union.

Table 1 describes the balance sheet in terms of assets (written with a positive sign) and liabilities (written with a negative sign) of each sector: households, firms, government, commercial banks and a single central bank. The transaction matrix, national accounts in flows, is provided in the Annex. Beyond fixed capital (K), seven kinds of monetary or financial assets are distinguished[2]: bank deposits (BD) held by households, bonds issued by governments ($p_b.B$) and held by households of both countries, loans (L) supplied by each commercial bank to firms of the two countries, the equities issued by firms ($p_e.E$) and held by households and firms of both countries, treasury bills issued by each State (BT) and held by commercial banks of both countries, high powered money (H) held by households (H_h) as well as commercial banks (reserve requirements) and advances supplied by the ECB to commercial banks (RF).

Households

[2] When there are two symbols (N and S), the subscript denotes the country where the asset is held, the superscript the country where the asset is issued. For example, BT_N^S is the bills held by country N and issued by the country S.

Households exhibit traditional consumption behaviour with a wealth effect, taking into account of capital gains on equities and bonds held. We specify a constant ratio of wealth to disposable income in the long run. Households' portfolio choice follows the approach developed by Godley (1999) and Tobin (1969), with an arbitrage between cash (H_h), bank deposits (BD), bonds ($p_b.B$) and equities ($p_e.E_h$), depending on the relative rates of return of each asset: r_b for the interest rate on bonds of each country; i_d for the interest rate on bank deposits which is the same in the two countries; r_e for the rate of return on equities in each country. The cash demand follows a simple transaction demand of money. The demand for bank deposits is not written and determined as a residual, using the accounting equation of the households' balance sheet.

Table 1: Balance sheet

	Households N	Firms N	State N	Banks N	ECB	Households S	Firms S	State S	Banks S	Total
Capital		$+K^N$					$+K^S$			$+K^N+K^S$
Deposits	$+BD^N$			$-BD^N$		$+BD^S$			$-BD^S$	0
Currency	$+H_h^N$			$+H^N$	$-H$	$+H_h^S$			$+H^S$	0
Credits		$-L^N$		$+L_N^N$					$+L_S^N$	0
				$+L_N^S$			$-L^S$		$+L_S^S$	
Refinancing				$-RF^N$	$+RF^N+RF^S$				$-RF^S$	0
Bonds	$+p_b^N.B_N^N$		$-p_b^N.B^N$			$+p_b^N.B_S^N$				0
	$+p_b^S.B_N^S$					$+p_b^S.B_S^S$		$-p_b^S.B^S$		
Bills			$-BT^N$	$+BT_N^N$					$+BT_S^N$	0
				$+BT_N^S$				$-BT^S$	$+BT_S^S$	
Equities	$+p_e^N.E_{hN}^N$	$+p_e^N.E_{eN}^N$				$+p_e^N.E_{hS}^N$	$+p_e^N.E_{eS}^N$			0
		$-p_e^N.E^N$								
	$+p_e^S.E_{hN}^S$	$+p_e^S.E_{eN}^S$				$+p_e^S.E_{hS}^S$	$+p_e^S.E_{eS}^S$			
							$-p_e^S.E^S$			
Wealth	$-VH^N$	$-V^N$	$-D^N$	$-VB^N$		$-VH^S$	$-V^S$	$-D^S$	$-VB^S$	$-K^N-K^S$
Total	0	0	0	0	0	0	0	0	0	0

Households' equations for country N

Consumption

$$C^N = a0^N + a1 . YHS_h^N + a2 . VH_{-1}^N$$

(VH^N = *households' wealth*, YHS_h^N = *disposable income with capital gains*)

Disposable income

$$YD_h^N = W^N + i_d . BD_{-1}^N + B_{N-1}^N + B_{N-1}^S + DIV_{hN}^N + DIV_{hN}^S - T^N$$

$$YHS_h^N = YD_h^N + CG_h^N$$

(*YD= disposable income, W = wages,* $i_d \,.\, BD_{-1}$ *= interests on bank deposits,* B_{N-1}^N *and* B_{N-1}^S *= interest on domestic and foreign bonds,* DIV_{hN}^N *and* DIV_{hN}^S *= received dividends on domestic and foreign equities, T = taxes,* CG_h *= households' capital gains*)

Taxes paid by households

$$T^N = \theta.(W^N + i_d \,.\, BD_{-1}^N + B_{N-1}^N + B_{N-1}^S + DIV_{hN}^N + DIV_{hN}^S)$$

Households' bonds demand

$$\frac{p_b^N.B_N^N}{VH^N} = v_0 + v_1 \,.\, r_b^N - v_2 \,.\, r_b^S - v_3 \,.\, i_d - v_4 \,.\, r_e^N - v_5 \,.\, r_e^S$$

$$\frac{p_b^S.B_N^S}{VH^N} = v_0 + v_1 \,.\, r_b^S - v_2 \,.\, r_b^N - v_3 \,.\, i_d - v_4 \,.\, r_e^N - v_5 \,.\, r_e^S$$

(*$p_b^N.B_N^N$ = government N bonds held by country N households,* $p_b^S.B_N^S$ *= government S bonds held by country N households,* r_b *= interest rate on bonds,* i_d *= interest rate on bank deposits,* r_e *= rate of return on equities*)

Households' equities demand

$$\frac{p_e^N.E_{hN}^N}{VH^N} = v_0 - v_1 \,.\, r_b^N - v_2 \,.\, r_b^S - v_3 \,.\, i_d + v_4 \,.\, r_e^N - v_5 \,.\, r_e^S$$

$$\frac{p_e^S.E_{hN}^S}{VH^N} = v_0 - v_1 \,.\, r_b^N - v_2 \,.\, r_b^S - v_3 \,.\, i_d - v_4 \,.\, r_e^N + v_5 \,.\, r_e^S$$

(*$p_e^N.E_{hN}^N$ = equities issued by country N firms and held by country N households,* $p_e^S.E_{hN}^S$ *= equities issued by country S's firms and held by country N households*)

Cash demand

$$H_h^N = \lambda_0 \,.\, C^N$$

Households' transaction equilibrium

$$\Delta BD^N = YD_h^N - C^N - p_b^N \,.\, \Delta B_N^N - p_b^S \,.\, \Delta B_N^S - p_e^N \,.\, \Delta E_{hN}^N - p_e^S \,.\, \Delta E_{hN}^S - \Delta H_h^N$$

(*BD = bank deposits*)

Households' balance sheet

$$VH^N = BD^N + p_b^N \,.\, B_N^N + p_b^S \,.\, B_N^S + p_e^N \,.\, E_{hN}^N + p_e^S \,.\, E_{hN}^S + H_h^N$$

(*VH = households' net wealth*)

Households' capital gains on equities and bonds held

$$CG_h^N = \Delta p_b^N . B_{N-1}^N + \Delta p_b^S . B_{N-1}^S + \Delta p_e^N . E_{hN-1}^N + \Delta p_e^S . E_{hN-1}^S$$

Which gives on the whole:

$$\Delta VH^N = YD_h^N - C^N + CG_h^N = \textit{households' saving} + \textit{capital gains} = YHS_h^N - C^N$$

Firms

Firms have both real and financial accumulation following a Post-Keynesian theoretical framework (see Clévenot et al., 2010[a] ; 2010[b] for more developments). Their desired fixed investment (I^d) depends positively on the profit rate ($r_f = \frac{UP}{K_{-1}}$) and negatively on the debt structure ($\frac{L}{K_{-1}}$) and the cost of credit (r_l), with a possible positive demand effect. Their financial accumulation, i.e. firms' demand for equities ($p_e . E_e$), is mainly related to the rate of return on equities held (r_e) with an arbitrage between domestic and foreign assets and a positive effect of the rate of profit reflecting the global environment. Firms can finance their investments through undistributed profit (UP), bank credit, or by issuing equities. New equities issued by firms ($p_e . \Delta E$) are determined as a percentage of the total real and financial investment, with positive effects of both credit cost and the debt ratio whose respective increases lead firms to issue more equities. The rate of return on equities r_e is determined by dividends and capital gains.

Lastly, income distribution is analyzed in a simple way with a constant share of wages. Undistributed profit is determined by a constant rate of saving by firms (s_f). Distributed dividends between shareholders (households and firms of both countries) are related to the held equities structure.

Firms' equations for country N

Fixed investment

$$\frac{I^{dN}}{K_{-1}^N} = k_0{}^N + k_1 . r_{f-1}^N + k_2 . \frac{\Delta Y^N}{Y_{-1}^N} - k_3 . \frac{L^N}{K_{-1}^N} - k_4 . r_l$$

(I^d = *desired investment,* K = *fixed capital stock;* Y = *GDP;* r_f = *rate of profit* $= \frac{UP}{K_{-1}}$, UP = *undistributed profit,* L = *loans,* r_l = *interest rate on loans*)

Financial accumulation (firms' equities demand)

$$\frac{p_e^N . E_{eN}^N}{(K^N + p_e^N . E_{eN}^N + p_e^S . E_{eN}^S)} = f_0 + f_1 . r_e^N - f_2 . r_e^S + f_3 . r_f^N$$

$$\frac{p_e^S . E_{eN}^S}{(K^N + p_e^N . E_{eN}^N + p_e^S . E_{eN}^S)} = f_0 + f_1 . r_e^S - f_2 . r_e^N + f_3 . r_f^N$$

($p_e^N . E_{eN}^N$ = *equities issued by country N firms and held by country N firms,* $p_e^S . E_{eN}^S$ = *equities issued by country S firms and held by country N firms,* $K^N + p_e^N . E_{eN}^N + p_e^S . E_{eN}^S$ = *total real and financial assets held by country N firms,* p_e = *equities' price,* E = *number of equities*)

New equities issued

$$\frac{p_e^N . \Delta E^N}{(I^N + p_e^N . \Delta E_{eN}^N + p_e^S . \Delta E_{eN}^S)} = g_1 . r_l + g_2 . \left(\frac{L^N}{L^N + p_e^N . E^N + V^N} \right)_{-1} + g_3$$

($p_e . \Delta E$ = *new issued equities,* $I^N + p_e^N . \Delta E_{eN}^N + p_e^S . \Delta E_{eN}^S$ = *real and financial investment,* $\frac{L}{L + p_e . E + V}$ = *debt ratio in percentage of firms' total liability,* $p_e . E + V$ = *firms' own funds equal to issued equities + firms' net wealth*)

Rate of return on equities

$$r_e^N = \frac{\left(E_{-1}^N . \Delta p_e^N + DIV^N \right)}{\left(p_e^N . E^N \right)_{-1}} = \frac{\Delta p_e^N}{p_{e-1}^N} + \frac{DIV^N}{p_e^N . E^N{}_{-1}}$$

($E_{-1} . \Delta p_e$ = *capital gains,* DIV = *distributed dividends*)

Firms' flows of funds

$$I^{rN} + p_e^N . \Delta E_{eN}^N + p_e^S . \Delta E_{eN}^S = \Delta L^{sN} + UP^N + p_e^N . \Delta E^N$$

(I^r = *restricted investment,* ΔL^s = *credit supply*)

$$I = Min \left(I^d, I^r \right)$$

(I = *effective investment,* I^d = *desired fixed investment,* I^r = *restricted investment*)

Firms' balance sheet

$$K^N + p_e^N . E_{eN}^N + p_e^S . E_{eN}^S = L^N + p_e^N . E^N + V^N$$

Wages

$$W^N = \rho \, . \, Y^N$$

($W = wages$)

Distributed dividends

$$DIV^N = \left(1 - s_f\right).\left(Y_{-1}^N - W_{-1}^N - r_l.L_{-2}^N\right)$$

$$UP^N = s_f.\left(Y_{-1}^N - W_{-1}^N - r_l.L_{-2}^N\right)$$

Distribution of dividends

$$DIV_{eN}^N = DIV^N.\left(\frac{E_{eN}^N}{E^N}\right)_{-1}$$

$$DIV_{hN}^N = DIV^N.\left(\frac{E_{hN}^N}{E^N}\right)_{-1}$$

$$DIV_{eS}^N = DIV^N.\left(\frac{E_{eS}^N}{E^N}\right)_{-1}$$

$$DIV_{hS}^N = DIV^N.\left(\frac{E_{hS}^N}{E^N}\right)_{-1}$$

(DIV_{eN}^N , DIV_{hN}^N, DIV_{eS}^N, DIV_{hS}^N = *dividends of country N's firms distributed to country N and S firms and households in relation with the number of equities held* E_{eN}^N , E_{hN}^N, E_{eS}^N *and* E_{hS}^N).

Banks

Two regimes can be considered:

-one where firms can get from banks all the credits demanded without restriction; credit demand is determined by the balance of the firms' flow of funds. Investment is equal to the desired investment (model 1).

-the other with credit rationing; the credit supply of banks depends on the financial fragility of firms represented by two parameters: the rate of profit (r_f) describing the ability of firms to face debt commitments and the debt ratio as a proxy of firms' financial soundness. Credit rationing occurs when credit demand is larger than credit supply. The restricted investment (I^r) is then determined by the different flows of financing: profit, equities and credit rationing from banks (L^s) (model 2).

To complete, the share between domestic and foreign banks' loans is simply related to the degree of openness of the economy. Reserve requirements in high powered money represent a fixed share of bank deposits and do not provide interest payments. A highly simplified treatment of interest rates is retained. The interest rate on loans (r_l) is presumed equal to the key interest rate of the central bank (i_b) plus a constant mark-up. To realize profits, banks apply a spread between the key rate and the rate on deposits (i_d). The central bank provides advances (RF) to commercial banks to allow the latter to provide the cash that households are asking for. These advances are made at a rate of interest (i_b) which is the key instrument of the monetary policy. They are determined as banks' balance. The central bank pays taxes, equal to its profit, which are shared between the two national governments in relation with each country's size.

Country N banks' equations

Credit

$$\Delta L^{sN} = \alpha_{n1} . r_f - \alpha_{n2} . \left(\frac{L^N}{K^N} \right)_{-1} + \alpha_{n3}$$

$$\Delta L^{dN} = I^{dN} - UP^N - p_e^N . \Delta E^N + p_e^N . \Delta E_{eN}^N + p_e^S . \Delta E_{eN}^S$$

$$\Delta L^N = min \left(\Delta L^{dN}, \Delta L^{sN} \right)$$

(ΔL^s = *credit supply,* ΔL^d = *credit demand*)

$$\Delta L^N = \Delta L_N^N + \Delta L_S^N$$

$$L_S^N = \left(\frac{X^N}{Y^N} \right) . L^N$$

(L_S^N = *credit supplied by country S banks to country N firms;* L_N^N = *credit supplied by country N banks to country N firms,* $\frac{X}{Y}$ = *rate of openness*)

Reserves requirements

$$H^N = \varepsilon . BD^N$$

(H = reserve *requirements in high powered money,* BD = *bank deposits*)

Taxes paid by commercial banks

$$TB^N = \theta_b . (r_l . L_{N-1}^N + r_l . L_{N-1}^S + r . BT_{N-1}^N + r . BT_{N-1}^S - i_d . BD_{-1}^N - i_b . RF_{-1}^N)$$

Banks' profit

$$PB^N = (1-\theta_b)\,.\,(r_l.L^N_{N-1} + r_l.L^S_{N-1} + r.BT^N_{N-1} + r.BT^S_{N-1} - i_d.BD^N_{-1} - i_b.RF^N_{-1})$$

Banks'net wealth

$$\Delta VB^N = PB^N$$

Refinancing

$$\Delta RF^N = \Delta H^N + \Delta L^N_N + \Delta L^S_N + \Delta BT^N_N + \Delta BT^S_N - \Delta BD^N - PB^N$$

(*RF = refinancing by the central bank, BT = Treasury bills purchased by commercial banks, BD = bank deposits, PB = banks' profit*)

Central bank tax

$$T€B = i_b.\left(RF^N_{-1} + RF^S_{-1}\right)$$

$$T€B^N = T€B.\left(\frac{Y^N}{Y^N+Y^S}\right)$$

($T€B^N$ = *tax paid by the central bank to country N government*)

Central bank money

$$H = H^N_h + H^S_h + H^N + H^S$$

Central bank equilibrium

$$\Delta H = \Delta RF^N + \Delta RF^S$$

(*this equation is derived from others*)

Interest rates

$$r_l = i_b + ml_b$$

$$i_d = i_b - m2_b$$

$$r = r_l = r^N_b = r^S_b$$

$$p^N_b = \frac{1}{r^N_b}$$

(i_b= *key interest rate of the central bank, exogenous,* r_l = *interest rate on loans,* i_d = *interest rate on deposits,* r = *interest rate on Treasury bills,* r_b = *interest rate on bonds,* p_b = *bonds price*)

In another version resident and non resident banks have specific behaviours. Credit rationing may come from banks of the small country facing economic constraints while banks of the rest of the union provide credit without restriction (model 3). Alternatively, credit rationing

may come from banks of the rest of the union while banks of the small country do not ration. This case illustrates the diffusion effect of a major bank crisis (model 3bis). The corresponding equations will be given later on. The case of variable rate of interest will be introduced at the end.

Government

Public finance is described in a simple way with exogenous expenditures and income taxes paid by households, commercial banks and central bank. Treasury bills are purchased by commercial banks without restriction, with the distribution between foreign and domestic bills related to the degree of openness. Interest rates on Treasury bills (r) and on bonds (r_b) are supposed to be equal to interest rates on loans (r_l).

Country N government equations

Budget balance

$$\Delta BT^N = G^N + r_n.BT_{-1}^N + B_{-1}^N - T^N - TB^N - T€B^N - p_b^N.\Delta B^N$$

(BT = *Treasury bills,* G = *public expenditures exogenous,* T = *income taxes,* TB = *tax paid by commercial banks,* $T€B$ = *tax paid by the central bank,* r = *interest rate on Treasury bills,* B = *interest on bonds,* $p_b.\Delta B$ = *new bonds issued by government*)

Treasury bills

$$\Delta BT^N = \Delta BT_N^N + \Delta BT_S^N$$

$$BT_S^N = \left(\frac{X^N}{Y^N}\right).BT^N$$

(BT_S^N = *country N Treasury bills held by foreign commercial banks of country S,* BT_N^N = *country N Treasury bills held by domestic banks*)

Bonds held by households

$$\Delta B^N = \Delta B_N^N + \Delta B_S^N$$

(B_S^N = *country N bonds held by country S households*)

Public debt

$$D^N = -BT^N - p_b^N.B^N$$

On the whole we have:

$$VH^N + V^N + VH^S + V^S + D^N + D^S + VB^N + VB^S = K^N + K^S$$

(*Total net wealth at the level of the whole monetary Union is equal to the total fixed capital; this equation is derived from others*)

In another version banks of the small country are reluctant to purchase Treasury bills without restriction. According to the structure of their balance sheet, they ration the Treasury bills and constraint the government to adjust its fiscal policy if non resident banks do not afford additional financing (model 4). In a last case variable interest rates are introduced. Banks may tighten the financial conditions and raise the interest rate on Treasury bills, with or without additional financing coming the rest of the union (model 5). The corresponding equations will also be given later on.

Foreign trade and current account

Foreign trade inside the monetary union depends only on the volume effect, since prices and exchange rates are fixed. The current balance (CUR) is composed of the trade balance, the balance of capital incomes received and paid to the rest of the monetary union, and the exchanges inside the banking system. Commercial banks pay interest to the central bank for their refinancing. But the central bank pays taxes to each government. In case of a deficit incurred by country N, the current balance is financed through three channels: the holding of more assets of country N (bonds, treasury bills, equities) by country S than the opposite (holding of assets of country S by country N); the channel of credit by banks of country S to firms of country N; the refinancing by the central bank which plays a key role as lender of last resort.

Current account equations

Foreign trade

$$log\left(IM^N\right) = \mu_0 + \mu_{In} \,.\, log\left(Y^N\right)$$

$$X^N = IM^S$$

IM = imports, X = exports

Current balance

$$CUR^N = \left(X^N - IM^N\right) + \left(B^S_{N-1} + r.BT^S_{N-1} + r_l.L^S_{N-1} + DIV^S_{hN} + DIV^S_{eN} + T€B^N\right)$$
$$- \left(B^N_{S-1} + r.BT^N_{S-1} + rl.L^N_{S-1} + DIV^N_{hS} + DIV^N_{eS} + i_b.RF^N_{-1}\right)$$

Goods and services equilibrium

$$Y^N = C^N + I^N + G^N + X^N - IM^N$$

On the whole, the model has 107 equations for 107 endogenous variables. G^N, G^S (public expenditures) and i_b (key interest rate fixed by the central bank) are exogenous.

Calibration

The model can be calibrated using balance sheets and national accounts in flows from Eurostat for the European countries. Two sets of calibration have been used, the first one with an important share of equities (400% of GDP as in France in 2006) which reflects a high degree of financialization. Dividends are larger than interest. The second calibration retains a smaller share of equities (172% of GDP) and a greater role played by credit. The capital-income ratio is also smaller ($\frac{K}{Y} = 2$ instead of 4), and equities are more held by firms than by households. Lastly, the share of foreign dividends in the total dividends received is kept constant instead of being determined by the structure of equities held. This assumption is more in line with the relative weakness of the capital income received from abroad. Our second calibration can be regarded as more realistic. But, as will be shown, the results of the two calibrations are rather close.

The elasticities in the equations are close to usual estimations. The basic scenarios follow a rate of growth of GDP of 2% and a gross rate of accumulation of 7%. Table in annex gives the values of the main parameters for calibration.

3. Adjustments inside the monetary union and stabilization effects

Methodology

After the presentation of the model's main characteristics, adjustment mechanisms facing supply or demand shocks can be analyzed. It allows a measure of stabilization coefficients, especially for capital incomes coming from the rest of the union and intra-zone finance. In order to identify the stabilization effects specific to each factor, three successive versions of the model will be used:

-The basic version corresponding with financial autarky (version 1) is without foreign assets and without intra-zone credit; there is no capital income from abroad; the current account is then financed only through refinancing by the central bank to the commercial banks;

-The second version (version 2) is the most complete case of financial integration with foreign assets and intra-zone credit. Two calibrations are distinguished. In version 2-a residents hold

25% of foreign equities in their portfolio which is close to the observed value; in version 2-b the share of foreign equities is supposed to be higher (80% of the total) which corresponds to a rather unrealistic value, but gives an upper evaluation of the stabilization effects through capital income;

-The third version (version 3) includes intra-zone credit and Treasury bills, but excludes foreign equities and bonds. Capital incomes from abroad are consequently missing. This version allows an estimation of the stabilization effect of intra-zone credit solely, by comparison with the basic version 1 of financial autarky.

These three versions will be combined with the five forms of the model which have been presented in the previous section, the model 1without global credit rationing, the model 2 with global credit rationing, the model 3 with credit rationing by domestic banks or by non resident banks (model 3bis), the model 4 with Treasury bills rationing by domestic banks, the model 5 with variable rate of interest on Treasury bills.

Table 2 sums up the whole set of configurations which will be considered. To simplify, a single shock will be examined in each case, a loss of competitiveness in country N facing the rest of the union[3].

Table 2: Adjustments in a monetary union: the different configurations

Versions / Models	Financial autarky	Normal financial integration	High financial integration	Intra-zone credit alone	High Intra-zone credit
Model 1 : Without global credit rationing	Model 1.1	Model 1.2 a	Model 1.2 b	Model 1.3	
Model 2 : With global credit rationing	Model 2.1	Model 2.2 a	Model 2.2 b	Model 2.3	
Model 3 : With credit rationing by domestic banks	Model 3.1			Model 3.3 a	Model 3.3 b
Model 3bis : With credit rationing by non resident banks	Model 3bis 1			Model 3bis 3a	Model 3bis 3b
Model 4 : Treasury bills rationing	Model 4.1			Model 4.3	
Model 5 : Variable interest rate	Model 5.1			Model 5.3	

Adjustments with no credit rationing (Model 1)

Adjustments mechanisms are analysed through a shock of a loss of competitiveness of country N facing the rest of the union. In the first version of the model there is no credit rationing and firms can get from banks all the demanded credit. Similarly Treasury bills are

[3] Results are given with a simplified version of the model where rates of growth of equity prices are exogenous. Consequently, the equations concerning the issue of new equities are taken out.

purchased by commercial banks without restriction. The loss of competitiveness of country N is described by an increase of the import propensity of 1% ($d\mu_{1n} = 0.01$). The GDP of country N decreases to the benefit of the rest of the union (country S). That country's trade deficit and current account deficit increase, inducing a larger foreign debt and payment of interest and dividends to country S. Due to their income's reduction, country N households consume less and demand fewer assets. Country N firms adjust in the same way and pay less dividends, which decreases the equities rate of return of country N and makes equities of country S more attractive. Thanks to the holding of country S assets, capital income of country N households and firms improves with rising dividends distributed by S firms whose profit are increasing. This contributes to sustain the demand and reduces the country N decrease, which leads to a stabilizing effect.

The loss of competitiveness and the foreign debt deteriorate the trade and current balances of country N. After an initial decline the current balance improves slightly more than the trade balance, thanks to the distribution of dividends of country S to country N. But this effect does not last and is quickly compensated by the rise of capital incomes paid to country S in the wake of growing foreign debt.

These adjustment mechanisms through capital incomes and through external finance from country S can be analyzed with the different structures of the model. Figure 1 compares the respective declines of GDP in country N after the loss of competitiveness in each of the four structures of the model.

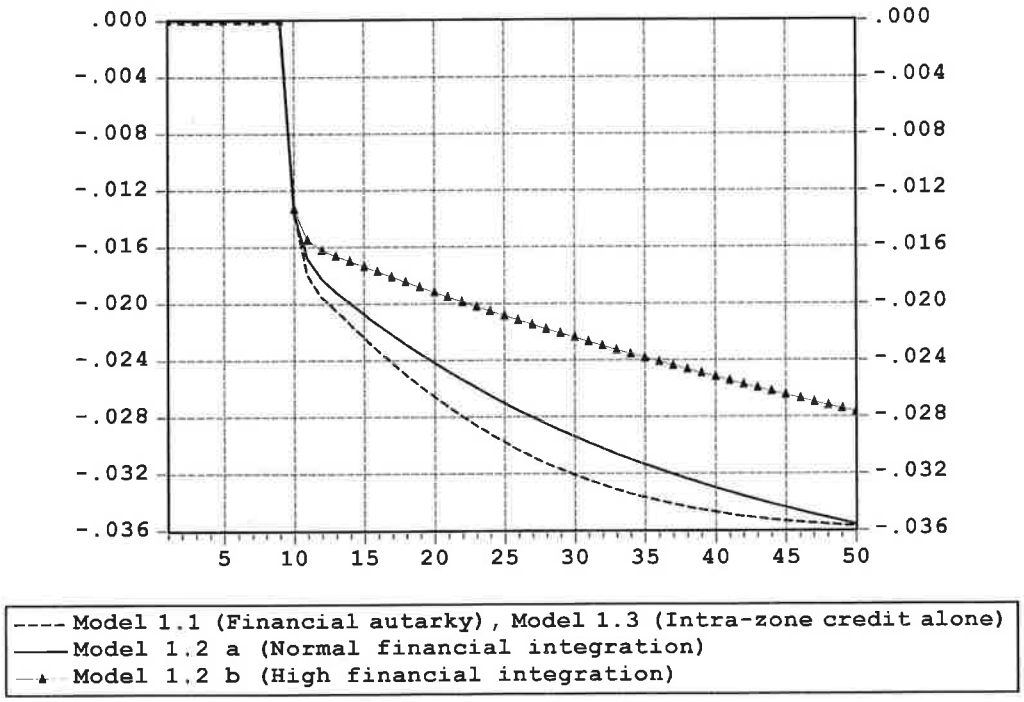
The first result is the identity between financial autarky (model 1.1 without foreign assets and without intra-zone finance) and the case where there is only foreign finance with intra-zone credit and Treasury bills (model 1.3). This means that the foreign finance through intra-zone credit or Treasury bills has no specific stabilization effect. As the central bank refinances already the commercial banks, the development of intra-zone credit or Treasury bills has no additional effect in the face of a shock. In a monetary union there is no difference of nature between domestic credit and foreign, but intra-zone, credit. The refinancing by the central bank plays in the same way.

The comparison between financial autarky (model 1.1) and the two cases of complete financial integration (model 1.2-a and 1.2-b) with foreign assets and capital income is interesting. The decline of the GDP is clearly less pronounced in model 1.2-b where the share of foreign assets in total assets is high (and even very high). This means that capital incomes indeed have a stabilization effect. However, in model 1.2-a, where the share of foreign assets

is more limited (and more realistic), the dampening of the shock is reduced, but significant in the short- to medium-term.

In the long run there is a reversal, characterized by a stabilization that becomes more important in the basic model without foreign assets. This is explained by the more sustained growth which can be obtained in country S when capital income is kept at home instead of being distributed to country N. This stronger growth of country S is sufficient in the long run to sustain the country N growth through more exports from country N to country S. But this is only a long-term effect.

Figure 1 : Effects on the GDP of a loss of competitiveness in country N



A stabilization coefficient can be calculated by measuring the gap between financial autarky and the other models. For the model 1.1, the relative decline of the GDP after the shock (at period 10) can be written at period 13: $\frac{\text{(Yn after the shock - Yn before the shock)}}{\text{Yn before the shock}} = -2.05\%$.

For the model 1.2-a, we get: $\frac{\text{(Yn after the shock - Yn before the shock)}}{\text{Yn before the shock}} = -1.91\%$.

The gap between the two models is obtained by the ratio of the relative decrease of the GDP:

$$\frac{Model\ 1.2\ a}{Model\ 1.1} = \frac{-1.91\%}{-2.05\%} = 93.4\%$$

which is equivalent to a stabilization coefficient of 6.6%. Table 3 gives different stabilization coefficients measured with the same method at three periods and for the three models examined.

Table 3: Stabilization coefficients after a loss of competitiveness (shock in t=10)

	t=13	*t=15*	*t=20*
Model 1.2 a Normal financial integration	6.6%	7.5%	9.0%
Model 1.2 b High financial integration	19.0%	22.5%	27.8%
Model 1.3 Intra-zone credit alone	0.0%	0.0%	0.0%

Source : Authors'estimation

The stabilization by capital incomes (according to the model 1.2-a) would be 6.6%, which is small. For the model 1.2-b the stabilization would be around 19% for the period 13. This is obviously higher, but corresponds to an unrealistic hypothesis as already indicated. The underlying idea is simple: the more country N agents hold country S assets, the more will capital incomes from country S to country N have an adjustment effect, as the country S benefits of a recovery thanks to its gain of competitiveness and distributes more dividends.

In complement, the diffusion effects of a negative shock in a monetary union can be analysed and related to the degree of financial integration. More precisely, the impact of a financial crisis in the rest of the union (country S) will be simulated successively by a fall of the rate of accumulation and of the equities' prices. A decrease of the rate of accumulation in the rest of the union diffuses to the country N. The higher the financial integration is, the more the diffusion effect is marked. Figure 2 gives the effect on the GDP of country N. In financial autarky (model 1.1) the country N is less touched. By contrast, with a high degree of financial integration (model 1.2b) the negative impact is more important, due to the reduction of capital income coming from the rest of the union. The simulation also confirms that intra-zone credit alone has no impact on the diffusion mechanisms (model 1.3). The negative values of the stabilization coefficients, computed in the same way as before, illustrate also the negative diffusion effects due to financial integration (table 4).

Figure 2: Effect on country N GDP of a decrease of the rate of accumulation of country S

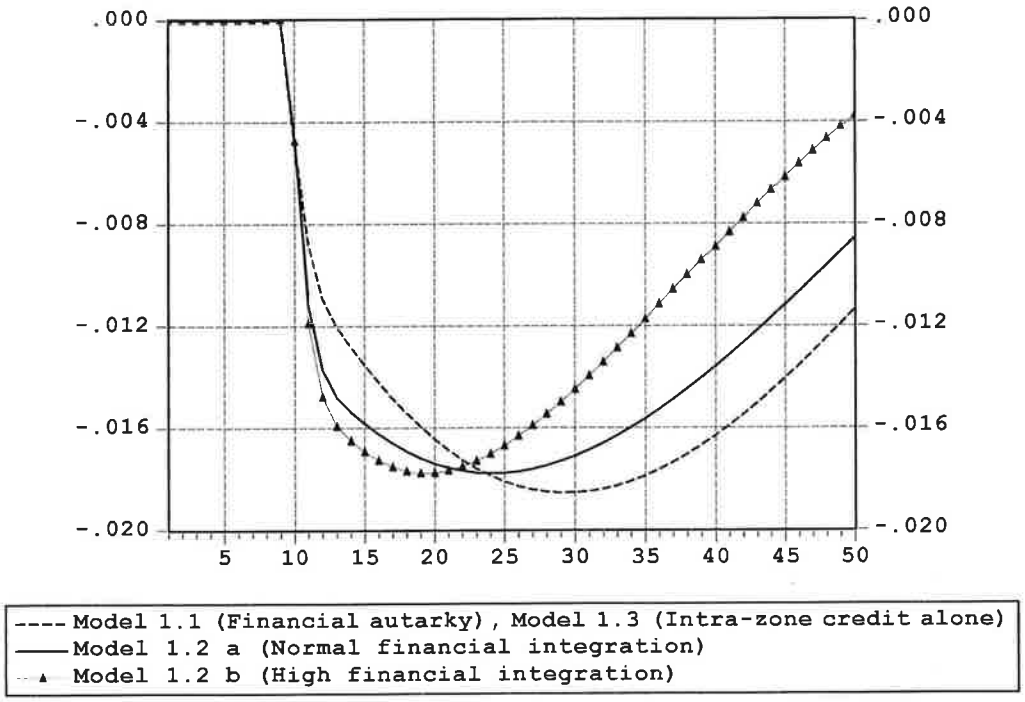


Table 4: Stabilization coefficients after a decrease of the rate of accumulation and a decrease of equities' prices in country S

Decrease of the rate of accumulation in country S

	t=13	*t=15*	*t=20*
Model 1.2 a Normal financial integration	-23.0%	-17.0%	-5.8%
Model 1.2 b High financial integration	-32.4%	-25.1%	-8.0%
Model 1.3 Intra-zone credit alone	0.0%	0.0%	0.0%

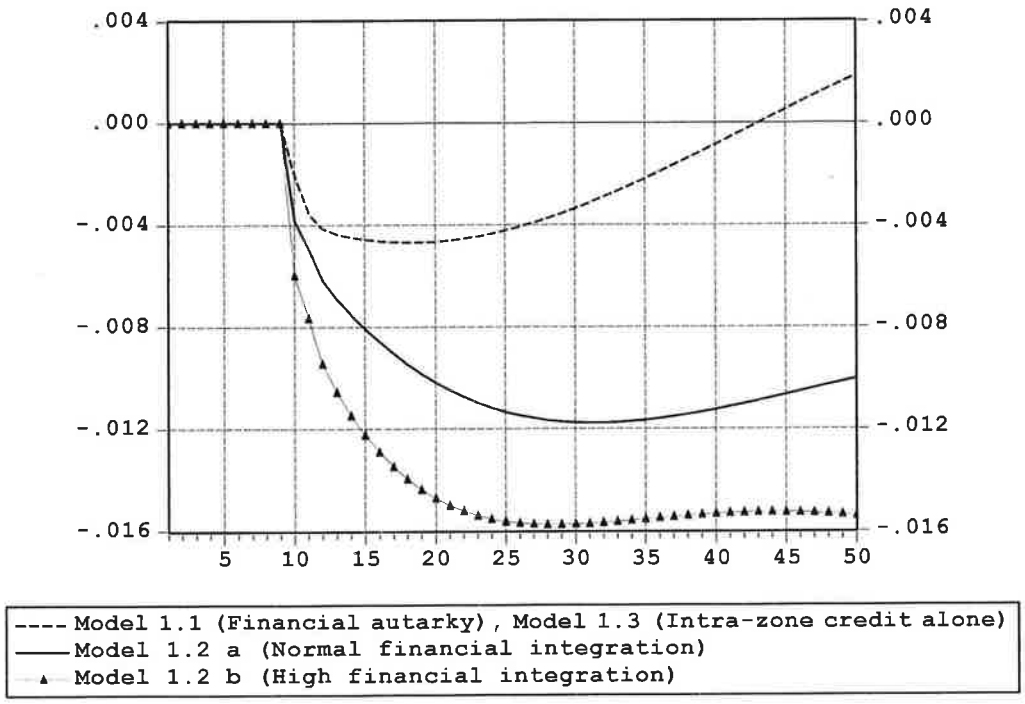
Decrease of equities' prices in country S

	t=13	*t=15*	*t=20*
Model 1.2 a Normal financial integration	-58.4%	-76.7%	-118.6%
Model 1.2 b High financial integration	-142.0%	-168.1%	-216.3%
Model 1.3 Intra-zone credit alone	0.0%	0.0%	0.0%

Similarly, the simulation of a negative shock on the stock exchange in the rest of the union (country S) underlines the importance of diffusion effects in a monetary union with financial integration. A decrease of equities' prices in country S has a strong negative impact on the GDP of country N, as it is illustrated by figure 3. In financial autarky (model 1.1) the shock's diffusion goes only through the foreign trade and remains limited. With normal financial integration (model 1.2a) the shock is also transmitted through assets portfolios and capital losses of country N firms and households. The negative impact on GDP is even more

important in case of high financial integration (model 1.2b). As before, intra-zone credit alone has no impact on diffusion effects (model 1.3). The stabilization coefficients illustrate the amplitude of these effects in case of normal or high financial integration (table 4).

Figure 3: Effect of a fall of country S equities' prices on GDP of country N



Adjustment with global credit rationing (model 2)

In model 2 there is a global credit rationing and country N firms cannot obtain from banks all the demanded credit. Therefore their investment is constrained by the total flow of available finance which depends specially of the credit supplied by banks. Like previously, adjustment mechanisms are analysed through a loss of competitiveness in country N facing the rest of the union. The loss of competitiveness induces an increase of country N imports and a decline of production and profit. Firms demand more credit but are rationed by banks of both countries[4]. Results are different according to the various versions of the model (figure 4).

As previously, there is no stabilizing effect by the intra-zone credit. Model 2.1 (financial autarky) and model 2.3 (with only intra-zone credit) give the same results. By contrast,

[4] In the baseline, before the shock, credit supply is slightly larger than demand and there is no credit rationing. But, following the shock, production and profit decrease, which worsen firms' financial structure and incites banks to ration credit. For technical reasons bank rationing takes place from the first year of the shock in model 2.1 and 2.3, but only after one year in models 2.2a and 2.2b.

financial integration (via the stock market) has a stabilizing effect in the event of global rationing of enterprises. This stabilization effect is all the more marked as financial integration is important (models 2.2a and 2.2b).

Figure 4: Effect of a loss of country N competitiveness on GDP of country N

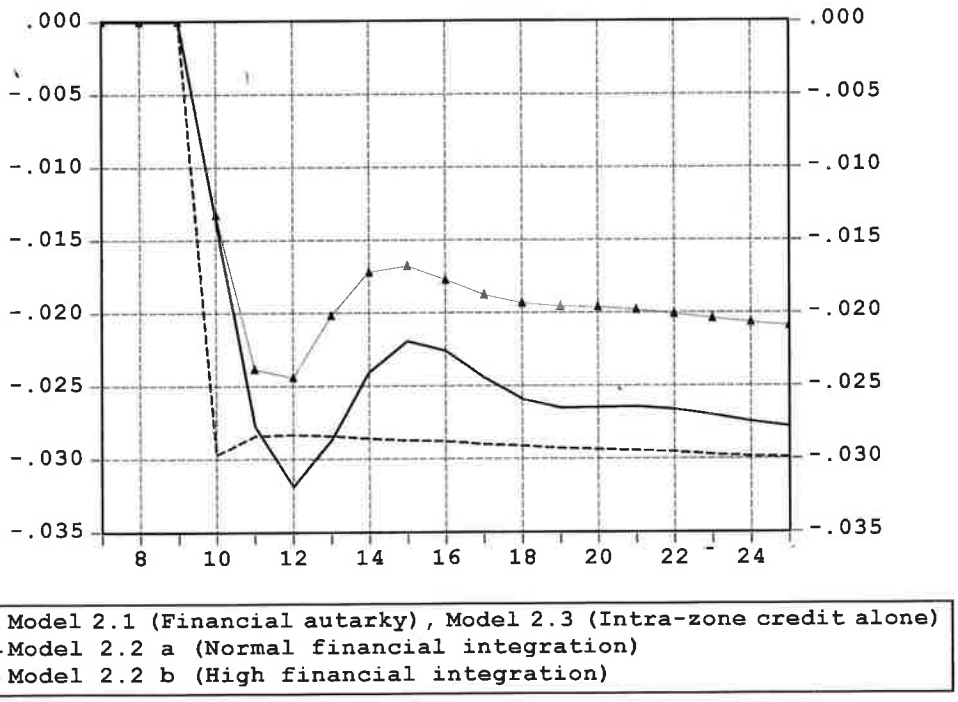


Table 5: Stabilization coefficients after a loss of country N competitiveness

	t=13	*t=15*	*t=20*
Model 2.2 a Normal financial integration	-0.9%	23.7%	9.8%
Model 2.2 b High financial integration	29.0%	41.4%	33.2%
Model 2.3 Intra-zone credit alone	0.0%	0.0%	0.0%

The year of the shock, higher financial integration allows country N companies of not being rationed. At short term, the comparison of models 2.1 (financial autarky) and 2.2-a (financial integration) may be noticed. The decline of GDP is larger the year of the shock in model 1 (financial autarky). But in t +1, GDP rebounds in financial autarky. Indeed, as banks do not give the credit requested by companies, the credit crunch forces companies to reduce their investments. In addition, firms issue fewer shares following the decline of private income (the loss of competitiveness reduces the income of private agents who therefore require fewer shares). Firms pay lower dividends and thereby restore their profit. This temporary adjustment in period t +1 allows companies to invest more. In model 2.2-a, credit rationing occurs in t +1

after the shock of loss of competitiveness. As in autarky, credit rationing forces companies to invest less. However, as country S holds a part (25%) of the country N shares, the demand of shares depends partly of country S economic activity.

At first the GDP of country S is stimulated by the trade shock, as country N imports more goods from country S. But in a second time, banks ration country N and the GDP decline reduces the country S exports and thus its income. The investment financing becomes more difficult than in autarky where demand of action does not depend on country S income. After period 13 GDP is recovering in model 2.2-a through the restoration of profit rate and rising demand of shares from the companies. In model 2.2-b, there is a stronger stabilization of GDP. The first shock (increase of exports S) allows the country N to benefit from the feedback effects of higher income of country S. Issue of shares decreases less than in the other two models, limiting the decline in investment. After the rationing of country N banks, GDP recovers as in model 2.2-a. The negative effect on output is mitigated by the fact that banks do not ration credit to periods 14 and 15. The external financing through shares can relax the financing constraint imposed by country N banks.

Adjustment with credit rationing by domestic banks (Model 3)

We now assume that only domestic banks ration credit. Banks from the rest of the union do not ration and a smoothing effect of asymmetric shocks may be obtained through this channel. In order to measure this stabilization effect, the version 3 of the model (with only intra-zone credit and without other foreign assets) is slightly modified. We first assume that domestic banks of country N ration credit of country N firms and do not finance the rest of the union. The variation of the credit supply of domestic banks of country N is supposed constant.

$$\Delta CRED^{N} = \Delta CRED^{sN} = \Delta CRED^{sN}_{N} = \eta 0$$

$$\Delta CRED^{N}_{S} = 0$$

Banks of the rest of the union (country S) supply credit without rationing to firms of country S ($CRED^{dS}_{S}$) and of country N ($CRED^{dS}_{N}$). Consequently they supply credits requested by country N firms for financing their investments (ΔL^{dN}).

$$CRED^{dS} = CRED^{dS}_{S} + CRED^{dS}_{N}$$

$$\Delta L^{dN} = I^{dN} - UP^{N} - p^{N}_{e} . \Delta E^{N} + p^{N}_{e} . \Delta E^{N}_{eN} + p^{S}_{e} . \Delta E^{S}_{eN}$$

$$\Delta L^{dN} = \Delta CRED^{dN}_{N} + \Delta CRED^{dS}_{N}$$

$$\Delta L^{N} = \Delta CRED^{sN}_{N} + \Delta CRED^{dS}_{N} = \eta 0 + \Delta CRED^{dS}_{N}$$

Country N firms are financed both by domestic credit ($CRED^{sN}_{N}$) and credit from the rest of the union ($CRED^{dS}_{N}$). The share of foreign credit is simply linked to the degree of openness.

$$CRED^{dS}_{N} = \left(\frac{X^{N}}{Y^{N}}\right).L^{dN}$$

In the standard version of the model (model 3.3a) this share of foreign credit is stable around 25%, close to the observed data. In another version (model 3.3b) a higher level of intra-zone credit (75%) is introduced in order to appreciate the effect of a deeper integration[5].

Finally, in this model 3 with credit rationing by domestic banks, firms are constrained at domestic level, but not vis-à-vis the rest of the union. Banks of the rest of the union (country S) do not ration country N firms, which may constitute an adjustment mechanism facing asymmetric shocks. The identity between model 3.1 (financial autarky) and model 3.3 (with intra-zone credit), which was observed in the previous cases, will not prevail.

Adjustment mechanisms are analyzed once again in case of a loss of competitiveness in country N. The increase of country N imports has a negative impact on production. The situation in autarky (model 3.1) is similar to the one studied in case of overall rationing on country N firms (model 2.1). Firms of country N have domestic credit as the sole source of bank financing. Credit rationing by domestic banks leads to a stronger recession than in the case where companies can underwrite loans abroad from the rest of the union (model 3.3a and 3.3b). Figure 5 illustrates this evolution. In the short term, the stabilization by external borrowing is around 9% in case of a moderate, but realistic, degree of intra-zone credit (model 3.3-a). In model 3.3-b (with a higher degree of intra-zone credit), stabilization of production via the intra-zone credit is 22% (table 6). However, in the long term a reversal between the three models can be observed.

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[5] In the model 3.3b $CRED^{dS}_{N} = 3.\left(\frac{X^{N}}{Y^{N}}\right).L^{dN}$

Figure 5: Effect of a loss of country N competitiveness on GDP of country N

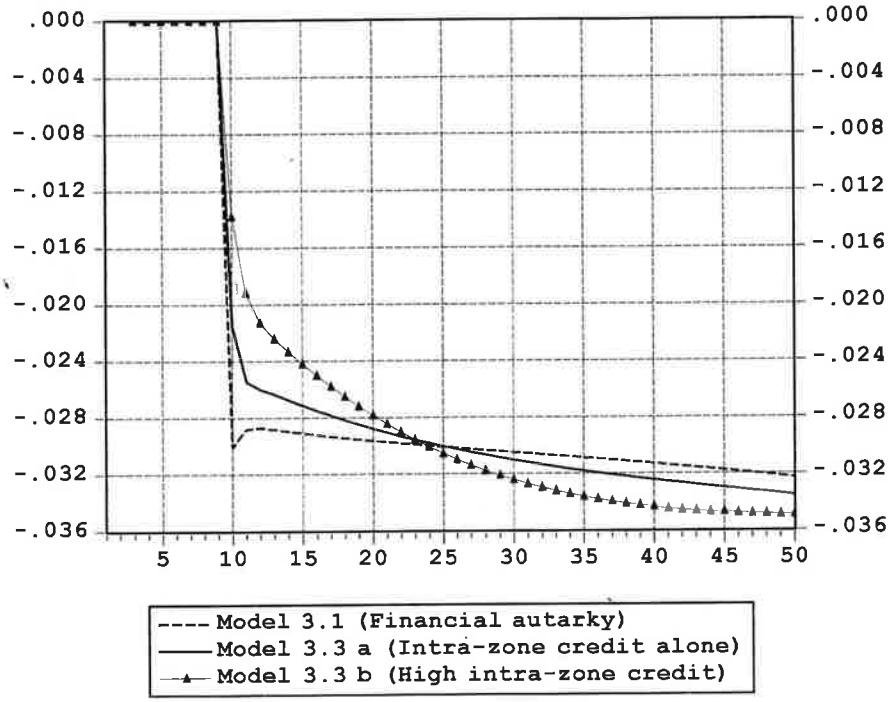

Table 6 : Stabilization coefficients

	t=13	*t=15*	*t=20*
Model 3.3 a Intra-zone credit alone	8.6%	6.7%	2.9%
Model 3.3 b High intra-zone credit	22.1%	16.8%	16.6%

The decline of GDP in the financial autarky case is less important in the long run than in the case where companies can obtain finance from the rest of the union. This reversal is primarily a consequence of the credit dynamics. Initially the credit to country N firms increases in models 3.3a and 3.3b, allowing companies to invest more, compared with the case of financial autarky. But in the long run, the decline of consumption pulls down production and corporate profit. The investment declines more sharply reducing demand for loans (desired by companies). In autarky, where rationing is constant, the economy is more stable over the long term.

Adjustment with credit rationing by non resident banks (Model 3 bis)

A higher intra-zone integration of credit may also be a vehicle for the diffusion of negative shocks inside the monetary union. We consider the case of country N firms facing credit rationing by non resident banks of the rest of the union (country S) in order to estimate contagion effects on the production of country N. We assume now that country N banks do not ration country N firms and supply all the credits requested ($\Delta CRED^{dN}_{N}$). For sake of simplicity we also assume that they do not finance country S firms ($\Delta CRED^{N}_{S} = 0$).

The banks of the rest of the union (country S) ration their credit supply ($\Delta CRED^{sS} = \lambda_s$) which is shared between country S firms ($\Delta CRED^{sS}_{S}$) and country N firms ($\Delta CRED^{sS}_{N}$).

$$\Delta CRED^{sS} = \Delta CRED^{sS}_{S} + \Delta CRED^{sS}_{N}$$

Country S firms are completely rationed while country N firms are only rationed by banks of the rest of the union (country S), but can get their requested credits from the domestic banks. The effective distributed credits to country N firms (ΔL^N) and to country S firms (ΔL^S) are given by the following equations:

$$\Delta L^N = \Delta CRED^{dN}_{N} + \Delta CRED^{sS}_{N}$$

$$\Delta L^S = \Delta CRED^{sS}_{S}$$

We simulate the impact of a bank crisis in the rest of the union (country S) with a dramatic credit rationing (decrease of λ_s) and we estimate the contagion effect on country N. We compare the case of financial integration with intra-zone credit (model 3_{bis}.3) with the financial autarky where country N firms do not receive credit from the rest of the union (model 3_{bis}.1). Figure 6 describes the dynamics of GDP of country N following this brutal credit rationing. Logically, in financial autarky the GDP decreases much less than in the case of intra-zone credit. In the model 3_{bis}.3-b where the share of intra-zone credit is very high (almost 75% of total loans), the diffusion of the shock of credit rationing from country S to country N is very important.

The coefficients of (de) stabilization are also very high in the short and medium term (table 7). In autarky, the country N is only indirectly affected by the rationing of country S's banks through the trade channel. Country S's banks ration firms of their country credit which induces a fall of business investment and production in country S. This sharp drop in income has an impact on foreign trade. Country S imports less, thereby reducing the country N's exports. This decline is spread to households and firms and depresses consumption and investment. But the recession in financial autarky is smaller than in case of intra-zone credit.

In the model 3_{bis}.3-b, where the intra-zone credit is large, the tightening of credit conditions in the country S leads to a strong and long recession in country N. In model 3_{bis}.3-a (average but more realistic degree of intra-zone credit), the country N's GDP is less affected, but the negative impact appears clearly at short and medium term by comparison with the situation of financial autarky. In the long run, a resumption of GDP can be observed in country N with the model 3_{bis}.3-a. This is due to the support given by domestic credit which is not rationed and can compensate in the long run the credit rationing by non resident banks.

Figure 6: Effect of credit rationing by country S banks on the GDP of country N

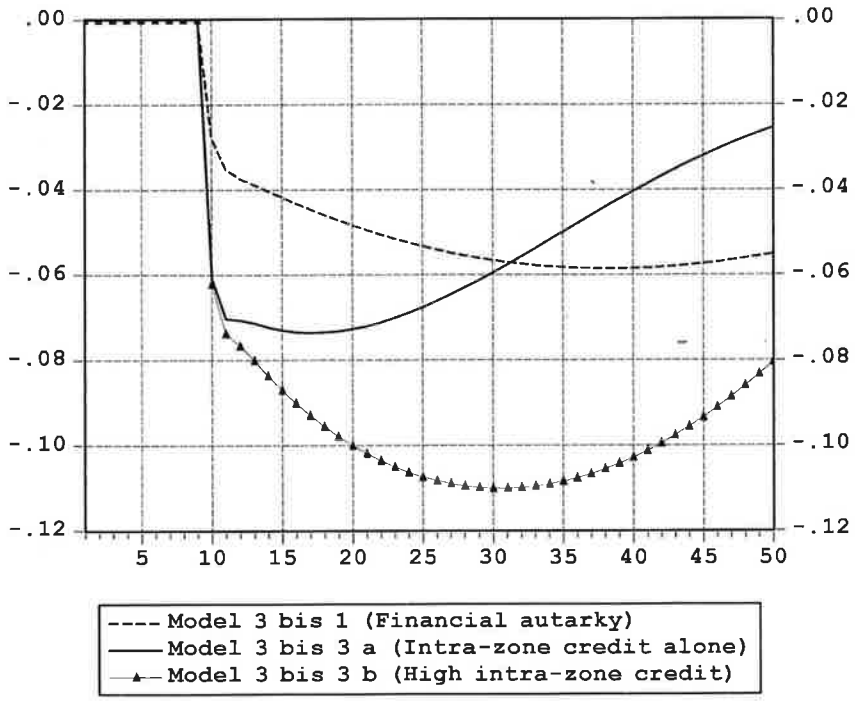

Table 7: Stabilization coefficients in case of credit rationing by country S banks

	t=13	*t=15*	*t=20*
Model 3 bis 3 a Intra-zone credit alone	-83.5%	-74.4%	-50.2%
Model 3 bis 3 b High intra-zone credit	-106.1%	-108.2%	-106.7%

Treasury bills rationing (Model 4)

The Greek and Irish crisis of spring and autumn 2010 highlighted the importance of external financing in a monetary union. The increase in public and external debt was reflected in the financial markets by raising interest rates on the Greek and Irish titles. In standard SFC

models, the issue of government securities is not constrained. State can finance its deficit without restriction. In order to take into account the constraints of financing public deficit, we modify the standard model and introduce rationing on government securities. In addition, we will endogenize the interest rates to assess the impact of debt burden on the economy.

We return to the initial model, where credit is not rationed, but we assume now that government bonds of country N may be rationed by country N banks due to the degradation of the economic situation. The goal here is to compare, in an economy with treasury bills rationing, the effect of a negative shock on output in a case of financial autarky (model 4.1) and in case of intra-zone credit (model 4.3). Securities issued by country N government and underwritten by country N banks are rationed according to the balance sheet of banks. The following equations describe the treasury bills issued by country N government (ΔBT^N) and the treasury bills rationed by country N banks (ΔBT_N^N).

$$\Delta BT^N = G^N + r_n.BT_{-1}^N + B_{-1}^N - T^N - TB^N - T€B^N - p_b^N.\Delta B^N$$

$$\Delta BT_N^N = \text{m0}.(\Delta H^N + \Delta L_N^N)$$

H^N = banks reserves requirement at the central bank

L_N^N = Credits supplied by country N's banks to country N's firms.

In financial autarky, bank rationing implies that the government must adjust its fiscal policy. Assuming that banks are unwilling to finance the entire deficit, the state is forced to cut public expenditures (model 4.1a). Another alternative would be to raise taxes to increase state revenue. In this case, taxes depend on the banks rationing (model 4.1b).

$$\Delta G^N = \Delta BT_N^N - r_n.BT_{-1}^N - B_{-1}^N + T^N + TB^N + T€B^N + p_b^N.\Delta B^N$$

$$\Delta T^N = G^N + r_n.BT_{-1}^N + B_{-1}^N - TB^N - T€B^N - p_b^N.\Delta B^N - \Delta BT_N^N$$

By contrast, if the State can sell its treasury bills in the rest of the union (country S), the budgetary policy is no more constrained. Purchase of treasury bills by banks of country S adjusts the gap between issued securities and securities held by domestic banks:

$$\Delta BT_S^N = \Delta BT^N - \Delta BT_N^N$$

We simulate a loss of competitiveness of country N and compare the damping of the shock in financial autarky (Model 4.1a or 4.1b) and with extra-zone finance (Model 4.3). The worsening trade balance reduces country N's national income. Therefore tax revenues fall and the public deficit becomes larger. The need for government funding increases but banks are rationing the demand of public securities. This treasury bills rationing forces the State to pursue a restrictive policy which augments the slow down. On the contrary, with extra-zone finance, the funding requirement is met by country S's banks (model 4.3).

Intra-zone financing of treasury bills stabilizes part of the shock. In t+3 after the shock, stabilization by external financing is 15%. At medium term, this stabilization is around 20%. Restrictive fiscal policy in financial autarky amplifies long-term recession. It may be noted that in this case fiscal policy (model 4.1b) is less costly than the decline of public spending (model 4.1a). About 3% of the shock can be stabilized by higher taxes compared to a policy of reduced public expenditure (figure7 and table 8).

Figure7: Impact of a loss of country N competitiveness on GDP of country N

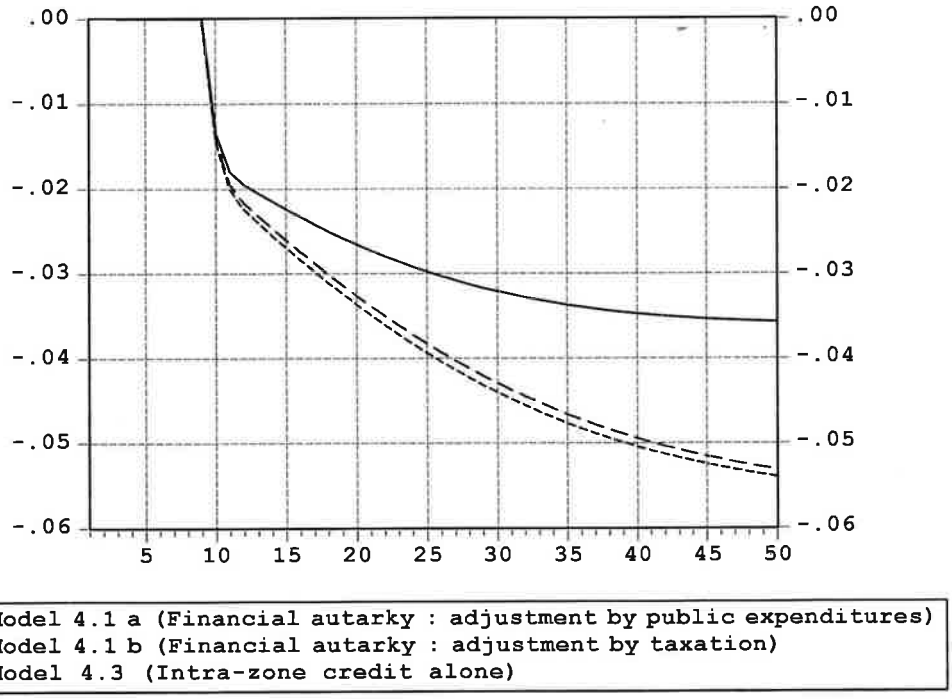

Table 8 : Stabilization coefficients

	t=13	*t=15*	*t=20*
Model 4.3 Intra-zone credit alone	14.7%	17.0%	21.1%
Model 4.1 b Financial autarky : adjustment by tax	3.5%	3.4%	3.1%

Variable interest rate (Model 5)

In addition to the quantitative adjustment of fiscal policy, financial conditions may also worsen. Facing rising public deficit, banks of country N can finance part of the deficit, but at higher rates. Interest rate on government securities will depend positively on the demand of securities:

$$r_n = \frac{(BT_N^N - \beta 0)}{\beta 1}$$

Regarding intra-zone financing by the rest of the union (country S), we assume also that the interest rate depends on the demand of securities by country S's banks.

$$r_n = \frac{(BT_S^N - \beta 0)}{\beta 1}$$

Fiscal policy takes into account the interest burden related to external financing (Model 5.3a).

$$G^N = G^N{}_{baseline} - (r_n * BT_{-1}^N)$$

Interest rates on bonds and loans (respectively rb_n and rl_n) are modeled in the same manner as the rates on Treasury bills (r_n). As bond prices represent the inverse of interest rates, the effect of a change in the rate on the bonds will lead to capital gains/losses. But, in order not to overestimate this effect on GDP, we introduce a lag vis-à-vis the rate on government securities (r_n).Therefore, the equation of interest rates on bonds is:

$$rb_n = rb_{n_{-1}} * (1 - a) + a * r_{n_{-1}}$$

rb_n=interest rate on bonds, r_n=interest rate on treasury bills

Interest rates on loans will be simply supposed equal to the rate on treasury bills:

$$rl_n = r_n$$

rl_n= interest rate on loans from banks of country N

As previously, we compare the effect of a loss of competitiveness in country N in the case of financial autarky with endogenous interest rates and restrictive fiscal policy through expenditures cut or increasing taxes (model 5.1a or 5.1b) and in the case of intra-zone finance, also with rising interest rates (model 5.3). The evolution of GDP after the shock of competitiveness is illustrated by the figure 8. At short term, in financial autarky domestic banks finance a part of the public deficit, but with higher interest rates which increases the

deficit. The government is forced to adopt a restrictive policy which accentuates the slow down. By contrast, at short term, external financing can cushion the recession thanks to larger funds which authorizes a less restrictive policy.

But at medium-long run, a reversal appears. Without external financing the State pursues a more restrictive fiscal policy which reduces the public deficit and makes the State less dependent on financial markets. With intra-zone finance, non resident banks contribute to finance a larger deficit of country N. But public debt increases continuously and interest rates reache exorbitant levels, generating a cumulative process. The slowdown is accentuated by expenditures cut and the fall of investment which is more marked in model 5.3.

In financial autarky, the relative decline of GDP is stabilized at -5% in the long term. GDP does not dive as in the model with external financing The shock of competitiveness shows that a crisis may appear because of excessive leverage vis-à-vis the financial markets. Maintaining a funding too costly plunges the economy into a cumulative recession that could lead to payment default.

Figure 8: Impact of a loss of country N competitiveness on GDP of country N

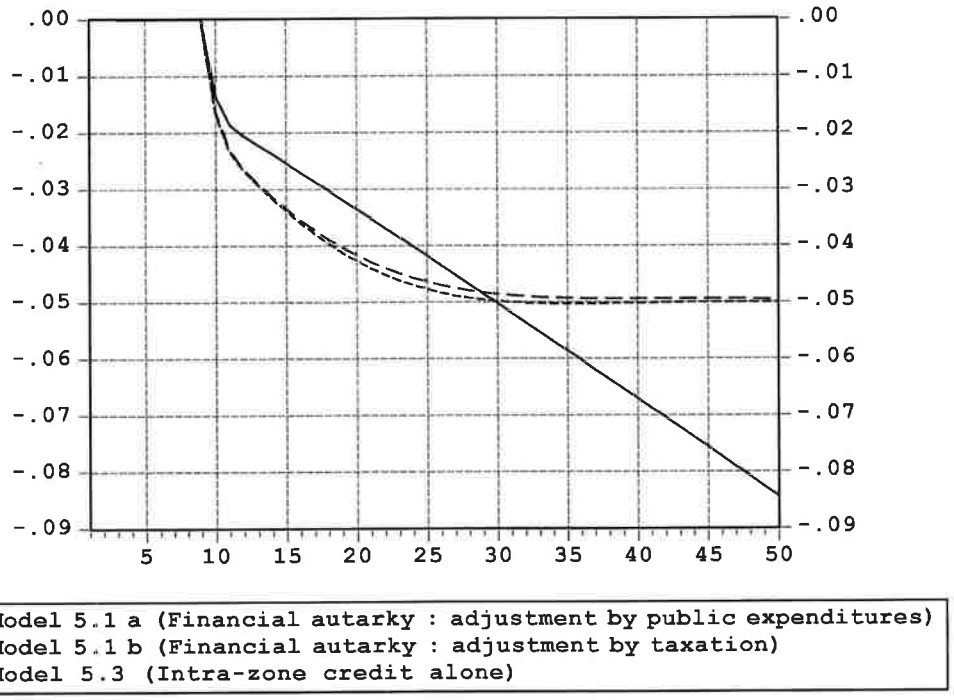

Table 9 : Stabilization coefficients

	t=13	*t=15*	*t=20*
Model 5.3 Intra-zone credit alone	24.2%	25.0%	21.4%
Model 5.1 b Financial autarky : adjustment by tax	0.8%	1.1%	2.3%

In financial autarky, the relative growth of GDP has stabilized at -5% in the long term. GDP does not dive as in the model with external financing to the extent that the State pursues a more restrictive fiscal policy in the short term which makes it less dependent on financial markets.

Financial openness can finance larger deficits, but the level can reach exorbitant interest rates cut spending and especially private investment (the interest rate on long-term increasing more with external financing, the fall investment will be higher in the variants of model 3).

The shock of competitiveness shows that a crisis may appear because of excessive leverage vis-à-vis the financial markets. Maintaining a funding too costly plunges the economy into a cumulative recession that could lead to the payment default.

CONCLUSION

An approach based on a "stock flow consistent" model of a monetary union with two countries along the lines of Godley and Lavoie has been proposed. The model describes assets and liabilities of all the agents and analyses financial integration in a consistent manner. Using different versions of the model, a whole set of simulations has been realized to study adjustments facing asymmetric shocks. Several results have been obtained.

Foreign asset holdings have a stabilising role, but the capital income stabilising coefficient seems smaller than the one obtained by the "risk sharing" approach. By contrast, foreign loans (intra-zone credit) have no specific stabilization effects. This is due to the credit mechanism in a monetary union and to the key role played by refinancing by the central bank. Inside a monetary union, domestic credit and foreign credit from another member of the union are of the same type. There is no increase of the stabilization coefficient to expect from development of intra-euro zone credit. This is true without credit rationing or with global credit rationing by domestic and non resident banks.

However, when non resident banks, contrary to domestic ones, do not ration credit or buy Treasury bills without restriction, intra-zone credit have a stabilization effect. But, when interest rates increase due to banks' reluctance to finance more issue of Treasury bills, intra-zone credit from the rest of the union has no more stabilizing effect due to its increasing cost.

This can be regarded as an illustration of the last Greek crisis and as an argument in favour of a direct finance by the Central Bank or by a European Monetary Fund which could be created.

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ANNEX : Transaction matrix (table 10)

	COUNTRY N								COUNTRY S						
	Households N	Firms N		Government N	Banks N		Central Bank		Households S	Firms S		Government S	Banks S		∑
Goods N	$-C^N$	$+Y^N$	$-I^N$	$-G^N$					$-X^N$	$+IM^N$					0
Goods S	$-X^S$	$+IM^S$							$-C^S$	$+Y^S$	$-I^S$	$-G^S$			0
Wages	$+W^N$	$-W^N$							$+W^S$	$-W^S$					0
Interest on loans		$-r_{-1}L^N_{-1}$			$+r_{-1}L^N_{N-1}$								$+r_{-1}L^N_{S-1}$		0
					$+r_{-1}L^S_{N-1}$					$-r_{-1}L^S_{-1}$			$+r_{-1}L^S_{S-1}$		0
Interest on deposits	$+i_{d-1}.BD^N_{-1}$				$-i_{d-1}.BD^N_{-1}$				$+i_{d-1}.BD^S_{-1}$				$-i_{d-1}.BD^S_{-1}$		0
Interest on refinancing					$-i_{b-1}.RF^N_{-1}$		$+i_{b-1}\left(RL^N_{-1}+RL^S_{-1}\right)$						$-i_{b-1}.RF^S_{-1}$		0
Interest on bonds	$+B^N_{N-1}$			$-B^N_{-1}$					$+B^N_{S-1}$						0
	$+B^S_{N-1}$								$+B^S_{S-1}$			$-B^S_{-1}$			0
Interest on bills				$-r.BT^N_{-1}$	$+r.BT^N_{N-1}$								$+r.BT^N_{S-1}$		0
					$+r.BT^S_{N-1}$							$-r.BT^S_{-1}$	$+r.BT^S_{S-1}$		0
Dividends	$+DIV^N_{hN}$	$+DIV^N_{eN}$ $-DIV^N$							$+DIV^N_{hS}$	$+DIV^N_{eS}$					0
	$+DIV^S_{hN}$	$+DIV^S_{eN}$							$+DIV^S_{hS}$	$+DIV^S_{eS}$ $-DIV^S$					0
Tax	$-T^N$			$+T^N$					$-T^S$			$+T^S$			0
				$+TB^N$	$-TB^N$							$+TB^S$	$-TB^S$		0
				$+T\epsilon B^N$			$-T\epsilon B$					$+T\epsilon B^S$			0
Profit		$-UP^N$	$+UP^N$							$-UP^S$	$+UP^S$				0
					$-PB^N$	$+PB^N$							$-PB^S$	$+PB^S$	0
Deposits	$-\Delta BD^N$					$+\Delta BD^N$			$-\Delta BD^S$					$+\Delta BD^S$	0
Currency	$-\Delta H^N_h$					$-\Delta H^N$		$+\Delta H$	$-\Delta H^S_h$					$-\Delta H^S$	0
Loans			$+\Delta L^N$			$-\Delta L^N_N$								$-\Delta L^N_S$	0
						$-\Delta L^S_N$					$+\Delta L^S$			$-\Delta L^S_S$	0
Refinancing						$+\Delta RF^N$		$-\Delta RF^N-\Delta RF^S$						$+\Delta RF^S$	0
Bonds	$-p^N_b.\Delta B^N_N$			$+p^N_b\,\Delta B^N$					$-p^N_b.\Delta B^N_S$						0
	$-p^S_b.\Delta B^S_N$								$-p^S_b.\Delta B^S_S$			$+p^S_b.\Delta B^S$			0
Bills				$+\Delta BT^N$		$-\Delta BT^N_N$								$-\Delta BT^N_S$	0
						$-\Delta BT^S_N$						$+\Delta BT^S$		$-\Delta BT^S_S$	0
Equities	$-p^N_e.\Delta E^N_{hN}$		$-p^N_e.\Delta E^N_{eN}$ $+p^N_e.\Delta E^N$						$-p^N_e.\Delta E^N_{hS}$		$-p^N_e.\Delta E^N_{eS}$				0
	$-p^S_e.\Delta E^S_{hN}$		$-p^S_e.\Delta E^S_{eN}$						$-p^S_e.\Delta E^S_{hS}$		$-p^S_e.\Delta E^S_{eS}$ $+p^S_e.\Delta E^S$				0
∑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 11: Main parameters for calibration

Equities	400	Dividends received from foreign	7	Distribution of Equities held	
Bonds	23	Interest (Bonds) received from foreign	0,2	Households	50%
Loans	50	Interest (Loans) received from foreign	0,2	Firms	50%
Bills	26	Interest (Bills) received from foreign	0,1	Foreign Dividends determined by detention of foreign equities	
Capital	410	GDP	100		
Elasticities		propensity to consume a1	0,75	GDP growth	2% per year
		Wealth elasticity a2	0,04		
		effect of profit rate on investment k1	0,5	accumulation of capital	7% per year
		Propensity to import mu1	1		