Monetary policy and the financial accelerator in a monetary union.*

Simon Gilchrist
Boston University, Federal Reserve Bank of Boston, and NBER

Jean-Olivier Hairault
EUREQua, Université Paris-1 Panthéon-Sorbonne.

Hubert Kempf
EUREQua, Université Paris-1 Panthéon-Sorbonne.

Preliminary Version

November 6, 2002

Abstract

In this paper, we consider the effect of a monetary union in a model with a significant role for financial market imperfections. We do so by introducing a financial accelerator into a stochastic general equilibrium macro model of a two country economy. We show that financial market imperfections introduce important cross-country transmission mechanisms to asymmetric shocks to supply and demand. Within this framework, we study the likely costs and benefits of monetary union. We also consider the effects of cross-country heterogeneity in financial markets. Both the presence of financial frictions and the use of a single currency have significant impacts on the international propagation of exogenous shocks. The introduction of asymmetries in the financial contract widens the differences in cyclical behavior of national economies in a monetary union, but financial integration compensates the loss of policy instruments.

JEL Classification: E00, E50, F00

Keywords: Financial Accelerator, Exchange Rate Policy

*We thank seminar participants at the Bank of England for helpful comments. We also thank the Fondation de la Banque de France for financial support. The views expressed in this paper are our own and should not be interpreted as those of the Federal Reserve Bank of Boston

1 Introduction

The impact and desirability of the European Monetary Union is the object of much debate among economists and policy makers. The abandonment of flexible exchange rates along with monetary policy autonomy has potential benefits that can only be realized at the cost of imposing limits on country-specific stabilization policy. The magnitude of these costs and benefits depend on the relative strengths of alternative transmission mechanisms for both real and monetary shocks throughout the euro zone. Eijffinger and de Haan (2000, p.147), summarizing the debate, argue that qualitatively, these channels differ widely among countries. National structures differ within Europe because of differences in consumption patterns and production specialization. Financial structures also differ widely across countries – some countries have well-developed and relatively efficient stock markets and financial institutions, while other countries rely heavily on information-intensive or collateral-based lending reflected in their national banking systems. Given this diversity across product markets and financial markets, it seems likely that exogenous shocks will have different impacts in the various member states composing the euro zone. In the presence of such heterogeneity, one needs to carefully consider whether or not a common currency amplifies or dampens the destabilizing influences of real and monetary shocks.

Recent studies have raised the issue of transmission channels through the distribution of credit, stressing the importance of financial frictions. Europe's financial system is segmented and heterogeneous. Lending institutions and their associated loan rates are country-specific. Borrower balance sheets are also heavily influenced by local market conditions and regionally determined asset valuations. In this environment, cross-country differences in borrowing costs are not well arbitraged. As a result, exogenous shocks will have different effects in the various member states composing the euro zone, making the loss associated with multiple monetary instruments possibly more severe. Such considerations must serve as a counterweight when assessing the gains to monetary union.

In this paper, we consider the influence of financial factors in the gains and losses associated with adopting a montary union. We find that the importance of financial frictions, the degree of financial heterogeneity and the extent of financial integration across countries have important implications for the monetary transmission mechansim, but that the currency regime itself does not necessarily modify the impact of shocks for a given structural financial system. Methodologically this implies that the precise characteristics of the financial environment must be taken into account when assesing the benefits of stabilization policy in a monetary union.

Among our results, three specific findings stand out. First, in the absence of heterogeneity across financial systems, the influence of destabilizing financial factors in response to country-specific shocks is relatively insensitive to the monetary regime – monetary union vs multiple currencies. Because the financial acclerator has important cross-country spill-overs, it acts as a coordinating device which increases cross-country co-movement and reduces international disparties. This lowers the benefits to multiple currencies. Second, by providing additional financial coordination, financial integration further reduces the benefit to multiple currencies relative to a monetary union. With heterogeneous financial systems, there are some potential gains to multiple currencies, even in response to common shocks, if both countries are willing to adopt strong anti-inflationary stances. These gains appear to be small however, suggesting that the heterogenous effects of financial frictions do not provide a strong motive for multiple currencies over a monetary union.

We explore these issues within a dynamic general equilibrium framework that emphasizes the role of financial market imperfections in the international transmission of exogenous disturbances. We incorporate realistic frictions with respect to the external financing of investment. We assume that, at least for some agents, bank lending is the major source of external finance, and that banking systems are country-specific but subject to market imperfections. In particular, bank loans are subject to information asymmetries whereby borrowers have more precise information about the true profitability of investment projects than do potential lenders. Banks specialize in information-intensive loans and can evaluate and monitor lenders, but can only do so by incurring costs. When risk-free interest rates rise, borrower balance sheets deteriorate, and banks increase the degree of monitoring to compensate for the increased riskiness of information-intensive loans. As monitoring costs rise, banks raise the spread between lending rates and the risk-free interest rate. Rising premiums on external finance cause further contractions in investment spending and output. In an international setting, idiosyncratic shocks may be rapidly transmitted across countries that share a common currency owing to their effect on foreign asset valuations and hence borrower net worth. In addition, a lack of financial integration implies that common shocks may have asymmetric effects, as some countries experience greater volatility in investment and output owing to the differential effects of such lending mechanisms.

The lending mechanism outlined above represents a transmission channel linking banking activity to real spending decisions. Countries where the share of investment financed through bank loans is important are likely to experience more potent effects of monetary policy through such a channel. This channel is also likely to be influential in countries where the health of the banking system is weak

Evidence concerning the existence of financially-based transmission channels is pervasive although the magnitude and relevance of these channels for various countries in the euro zone is still under discussion.[1] While a quantitative assessment of the macroeconomic significance of these channels for the euro zone is still needed, several studies indicate the fruitfulness of such research. Bernanke, Gertler and Gilchrist (1999) embed informational financial asymmetries in a dynamic general equilibrium macro model and address the quantitative relevance of financial frictions stemming from such asymmetries. Calibrating their

[1] For a summary of the empirical investigations on these channels, see Kashyap and Stein (1997).

model on US data, Bernanke, Gertler and Gilchrist suggest that the financial accelerator (propagating shocks on investment decisions through the lending behavior of financial intermediaries) can have quantitatively significant effects on macroeconomic activity over the business cycle.

Several recent studies have extended the BGG framework to an international environment. Gertler, Gilchrist and Natalucci (2000) develop a model of the financial accelerator for a small open economy under alternative exchange rate regimes. Natalucci (2001) considers a three-country model where two small economies interact with a larger "rest of the world" economy. Closely related to our work, Faia (2001) develops a two country model and focuses on the positive and normative properties of different exchange rate regimes. In this paper we also consider a two-country world economy and explicitly consider the effect of monetary unification – the consequences of having two large economies using the same currency and forming a currency area.

In a world economy with differentiated goods and exchange markets regulating the flows of capital and trade, the international transmission of shocks occurs through the exchange rate adjustment. A fully flexible exchange rate has insulating properties that dampens the external effect of country-specific shocks. Such flexibility alleviates the international consequences of nominal and real rigidities. Introducing financial frictions and wealth considerations implies additional effects of the exchange rate adjustment. International flows of savings and the adjustment of exchange rates influence real interest rates and real capital valuations in any financial connected country. In a financially imperfect economy, capital valuations influence collateral, and by extension terms of lending. This financial mechanism enhances the international propagation of local disturbances. The choice of the monetary regime has potentially important implications for this propagation mechanism. In particular, the adoption of a common currency severs the exchange rate linkages that influence the financial accelerator. Countries remain financially interdependent, but the adjustment of relative prices becomes more important with the abandonment of the exchange rate mechanism. In addition to direct pricing effects, these price adjustments have influence through their effect on the relative valuations of investors' wealth. In such an environment, the relative importance of the financial accelerator in the international propagation of disturbances may vary across monetary regimes.

The paper is organized as follows. Section 2 presents some stylized facts on financial integration in the euro zone. The evidence presented here suggests that European banks will continue to play a major role in the financing of investment and that financial frictions will have an important influence on the effect of decisions made by monetary policy-makers within the European System of Central Banks. Section 3 presents a two-country model of the world economy. This model is a two-country variant of the Dynamic New Keynesian framework. We consider four variants of our model – with and without financial frictions, and with and without monetary union. These four variants are calibrated and used to explore the effects of various external shocks to the world economy. These results are presented in Section 4. We investigate the dynamic behaviour of the world economy when financial frictions are present and likely to alter the transmission channels of exogenous disturbances. We assess the incidence of financial frictions and the monetary regime on the cyclical behavior of these two interdependent economies. We also consider the role of financial fragmentation between countries in a monetary union. This fragmentation leads to different credit arrangements between firms and banks in the two countries and as such, to different transmission channels for both monetary and real shocks. Throughout the paper, we assume that the primary role of monetary policy is to target inflation within the context of credible nominal interest rate rules.

2 Financial integration and banks in the euro zone

The advent of the euro has already had a major impact on Europe's financial markets and this influence is likely to be reinforced in the years to come as non-financial agents conduct all transactions in euro. This last feature will without doubt foster competition among financial intermediaries throughout Europe.

This event came on top of previous decisions which had already shaken up the financial markets and institutions in Europe. Following the discussion of the Single Market Act, a number of European directives have been issued by the European commission. In particular, the Second Banking Directive set the principles of the "single passport" (a bank recognized in any country of the European Union is able to do business in the whole union) and the "home country control" (the control of any given bank is left to the public authority of its home country). Moreover, the logic of universal banking is recognized as the model for Europe. This perfectly illustrates the principles of European integration: recognizing the initial fragmentation and dissimilarities across Europe, current institutions are used as the building blocks for further integration. The tension between fragmentation and integration is at the core of any European venture and financial matters are no exception to this rule.

Looking at broad similarities between the euro zone and the US, based on size, wealth and external trade, many thought that the euro would rapidly become a world currency, on par with the dollar. However, this view has yet to materialize and the euro is not currently seen as a competitor to the dollar. This is probably due to the differences in the depth and liquidity of financial markets. Recent studies document important differences in financial markets of the euro zone and the US. The euro zone relies much more on bank credits than the US or the UK. Banking credit accounts for more than 50% of financial intermediation in the euro zone, much more than in the US (20%) and the UK (32%).[2] A further decomposition shows large differences within Europe: while banking credits represent 80% of financial intermediation in Ireland, they represent 25% in Denmark, and 39% in Finland.[3]

[2]See Hurst, Perée and Fischbach (1999), Table 1, p.86.
[3]See Cecchetti (1999), Table 4, p.16.

The banking sectors in European countries diverge sharply in many dimensions. Concentration in the banking industry varies widely among European countries with large banks playing a dominant role in countries such as Belgium, the Netherlands, and the UK, and small banks being relatively more important in Italy, Germany and Luxembourg[4]. Banks also differ in terms of their profitability and financial health – Belgian, Dutch and British banks are by and large financially sound while French and Italian banks appear to be in weaker financial health[5]. Although differences in profitability and size undoubtedly reflect underlying differences in relative efficiency, the fragmentation of the banking system along national lines is reinforced by the supervisory system existing in the euro zone. National regulatory authorities, which may or may not be the national Central Bank retain their control over national financial agents. These institutional structures are based on the separation between monetary and regulatory authority. The lender-of-last-resort capacity is also left at the national level, with the possibility for the European central bank to intervene actively so as to preclude the failure of a bank. While the assessment of such a system is beyond the scope of the present paper, [6], it reinforces the "centrifugal" aspect of the banking and financial sector in Europe.

Although capital markets remain fragmented (Gros et Lannoo, 1999), the risk-free financial markets have converged to the point where it is now possible to talk about a unique risk-free market. A proper index of this is the yield curves on public bonds at various maturity. Galati and Tsatsaronis (2001) refer to the bond market as "the success story" of the euro. Indeed the yield curves appear to have converged, with yield spreads below 30 basis points. This implies that banks throughout Europe face almost identical conditions for refinancing[7].

Two broad conclusions emerge from these stylized facts. The euro zone is structurally characterized by the predominance of bank credits, relative to securities; and important differences exist across European countries in the efficiency and competitiveness of their lending institutions. These factors are in turn viewed as a major cause of asymmetries in the transmission mechanism for monetary policy across European countries.[8] In this environment, the creation of the European Monetary Union creates a potential problem. Before the advent of the euro, differences in monetary policy impulses and transmission channels were mitigated by adjustments through exchange rates. Hence national monetary policies could be independent (more or less so given the exchange rates regimes put in place). After the euro, there is a unique monetary policy controlled by the European (System of) Central Bank(s). But this unique policy will have different consequences in the various member countries to the extent that transmission channels differ according to financing structures.

To assess these concerns, we conduct a theoretical analysis of the role of monetary policy in a monetary union within the context of a model that broadly

[4]See Kashyap and Stein (1999), Table 2, p.10.
[5]See Kashyap and Stein (1999), Table 3, p.12.
[6]see Favero et al., (2000) for a thorough discussion of this system.
[7]See Galati and Tsatsaronis (2001), Graph 3.2, p.7.
[8]Cecchetti, 1999, p.22

captures the stylized facts we have just summarized. We view the salient features of the European financial system to be: perfect mobility of savings; banks acting as financial intermediaries for the external financing of investment with informational asymmetries between lenders and borrowers that generates a spread between the risk-free and the lending interest rates; and segmentation of lending markets at the national level. In the next section, we provide a fully-articulated general equilibrium model that incorporates these features.

3 A Two-Country Model with Financial Accelerator

In this section, we develop a general equilbrium framework that allows us to consider various monetary and financial structures within one coherent framework. Regarding the international monetary order, we consider two polar cases: a system of multiple currencies with perfectly flexible exchange rates, and each country retaining full monetary sovereignty; and a single currency system formed by a monetary union. Regarding the financing of investment, we also study two polar cases: a frictionless lending environment where the expected rate of return on risky investment is equal to the risk-free interest rate; and an environment with financial frictions that introduces a wedge – an external finance premium – between the risk-free interest rate and the interest rate charged to investors.

3.1 The Core Model

The core model corresponds to a two-country monetary economy under a flexible exchange rate regime. Given the plurality of currencies, it is necessary to convert all prices in to the same currency unit. We use the domestic currency, which introduces the nominal exchange rate, e, in the foreign representative household program. The real value of any price is then expressed in the domestic composite good using the real exchange rate Γ for the foreign country real aggregates. Both countries are similar in size and structure. There is a continuum of agents of equal measure in each country. Labor is immobile. Each country is specialized in the production of one good but consumers in any country consume both goods. As a consequence, there is trade across countries. Households have access to a complete set of contingent assets. There is perfect risk sharing as far as consumers are concerned and saving flows are perfectly mobile between the two countries. There is imperfect competition on the good markets, allowing us to introduce nominal rigidities due to price contracts *à la Calvo*.

We first present the model without financial frictions and with flexible exchange rates. We then develop the various modifications entailed by the introduction of the financial accelerator and the existence of a common currency.

3.1.1 Households:

The representative infinitely-lived household in each country chooses consumption, C, and leisure, L, where $1 - L = H$ is equal to the working period remunerated at a rate of w which is expressed in terms of the good produced locally. Consumption, C, is a composite of the two goods indexed by 1 for the good produced in the domestic country and by 2 for the good produced in the foreign country[9].

$$C = \frac{C_1^{\gamma} C_2^{1-\gamma}}{\gamma^{\gamma}(1-\gamma)^{\gamma}} \tag{1}$$

Similarly the composite good for the foreign consumers is defined as:

$$C^* = \frac{C_1^{*1-\gamma} C_2^{*\gamma}}{\gamma^{\gamma}(1-\gamma)^{\gamma}} \tag{2}$$

with $\gamma \in [0, 1]$. We define a price index for te domestic country

$$P = P_1^{\gamma} P_2^{1-\gamma},$$

and for the foreign country

$$P^* = P_1^{*1-\gamma} P_2^{*\gamma}$$

with P_i (P_i^*) the price of the good i expressed in the home (foreign) currency. We assume throughout the paper that the law of one price holds.

Heterogeneity can arise among households according their international location due to the existence of asymmetrical shocks. $\mathcal{A}$ is a multivariate stochastic variable, denoting the state of nature, with a density function $f(\mathcal{A})$. We assume that households have access to contingent international claims $\mathcal{B}$ at prices v, implying perfect international risk sharing. To price the real interest rate R and the nominal interest rate R^n in each country, we assume the existence of non-contingent real claims, B, and nominal claimes, B^n, traded in local financial markets[10].

The instantaneous utility U depends on three arguments: consumption, real balances and leisure. The utility function is assumed to be separable:

$$U(C_t, \frac{M_{t-1}}{P_t}, L_t) = \log C_t + \theta_M \log\left(\frac{M_{t-1}}{P_t}\right) + \theta_H \frac{L^{1-\sigma}}{1-\sigma} \quad \text{with} \quad \theta_M > 0, \theta_H > 0.$$

$\frac{M_{t-1}}{P_t}$ is the present real value of the money stock transferred from the previous period.

The domestic country representative household is assumed to maximize the expected discounted sum of its utility flows:

[9] The foreign country variables will be denoted by a $\star$.

[10] We are conscious that these claims are redundant given the existence of contingent claims. At the equilibrium, the different interest rates are related to each other by no-arbitrage conditions, namely un-covered interest parity and Fisher formula.

$$W^H(\mathcal{B}_{t-1}, B_{t-1}, B^n_{t-1}, M_{t-1}) = \max U\left(C_t, \frac{M_{t-1}}{P_t}, 1-H_t\right) + \beta \int W^H(\mathcal{B}_t, B_t, B^n_t, M_t) f(\mathcal{A}) d\mathcal{A}$$

subject to the budget constraint:

$$P_tC_t + P_t \int v_t \mathcal{B}_t d\mathcal{A} + P_tB_t + B^n_t + M_t \leq P_t\mathcal{B}_{t-1} + P_tR_{t-1}B_{t-1} + R^n_{t-1}B^n_{t-1} + M_{t-1} + P_tw_tH_t + \tau_t.$$

We may write this budget constraint in terms of domestic composite good units:

$$C_t + \int v_t\mathcal{B}_t d\mathcal{A} + B_t + \frac{B^n_t}{P_t} + \frac{M_t}{P_t} \leq \mathcal{B}_{t-1} + R_{t-1}B_{t-1} + \frac{R^n_{t-1}}{P_t}B^n_{t-1} + \frac{M_{t-1}}{P_t} + w_tH_t + \frac{\tau_t}{P_t} \qquad (\lambda_t)$$

where τ is the total lump-sum transfers received by the domestic households from the monopolistic firms and from the central bank.

The first-order conditions for the domestic households are (respectively the leisure, consumption, money, real bond, nominal bond and contingent bonds demands):

$$\theta v'(1-H_t) = \lambda_t W_t \tag{3}$$

$$u'_{C_t} = \lambda_t \tag{4}$$

$$\beta E_t\left(u'_{m_t} + \frac{\lambda_{t+1}}{\pi_{t+1}}\right) = \lambda_t \tag{5}$$

where $m_t = \frac{M_t}{P_t}$ denotes the domestic money stock in terms of domestic composite good and π the CPI inflation rate.

$$\beta E_t\left(\frac{\lambda_{t+1}R_t}{\lambda_t}\right) = 1 \tag{6}$$

$$\beta E_t\left(\frac{\lambda_{t+1}R^n_t}{\pi_{t+1}\lambda_t}\right) = 1 \tag{7}$$

$$\beta\frac{\lambda_{t+1}}{\lambda_t} f(A) = v_t \tag{8}$$

The country 2 representative households maximizes the expected discounted sum of its utility flows:

$$W^{H*}(\mathcal{B}^*_{t-1}, B^*_{t-1}, B^{n*}_{t-1}, M^*_{t-1}) = \max U\left(C^*_t, \frac{M^*_{t-1}}{P^*_t}, 1-H_t\right) + \beta \int W^{H*}(\mathcal{B}^*{}_t, B^*_t, B^{n*}_t, M^*_t) f(\mathcal{A}) d\mathcal{A}$$

subject to the following budget constraint (where e denotes the nominal exchange rate):

$$\begin{aligned} & e_t P_t^* C_t^* + P_t \int v_t \mathcal{B}^*{}_t d\mathcal{A} + e_t P_t^* B_t^* + e_t B^{n_t *} + e_t M_t^* \\ \leq \quad & P_t \mathcal{B}^*{}_{t-1} + e_t P_t^* R_{t-1}^* B_{t-1}^* + e_t R_{t-1}^{n*} B_{t-1}^{n*} + e_t M_{t-1}^* + e_t P_t^* w_t^* H_t^* + e_t \tau^*. \end{aligned}$$

Let Γ denote the real exchange rate: $\Gamma = \frac{eP^*}{P}$. The foreign household budget constraint may be written in terms of domestic composite good units:

$$\begin{aligned} & \Gamma_t C_t^* + \int v_t \mathcal{B}^*{}_t d\mathcal{A} + \Gamma_t B_t^* + \frac{e_t}{P_t} B_t^{n*} + \frac{e_t}{P_t} M_t^* \\ \leq \quad & \mathcal{B}^*{}_{t-1} + \Gamma_t R_{t-1}^* B_{t-1}^* + \frac{R_{t-1}^{n*} e_t}{P_t} B_{t-1}^{n*} + \frac{e_t}{P_t} M_{t-1}^* + \Gamma_t w_t^* H_t^* + \frac{e_t}{P_t} \tau^* \quad (\lambda_t^*). \end{aligned}$$

The foreign households first-order conditions are:

$$\theta v'(1 - H_t^*) = \lambda_t^* W_t^* \Gamma_t \tag{9}$$

$$u'_{C_t^*} = \lambda_t^* \Gamma_t \tag{10}$$

$$\beta E_t \left(u'_{m_t^*} + \frac{\lambda_{t+1}}{\pi_{t+1}} \Delta e_{t+1} \right) = \lambda_t \tag{11}$$

where $m_t^* = \frac{M_t^* e_t}{P_t}$ denotes the foreign money stock in terms of domestic composite good.

$$\beta E_t \left(R_t^* \frac{\Gamma_{t+1} \lambda_{t+1}^*}{\Gamma_t \lambda_t^*} \right) = 1 \tag{12}$$

$$\beta E_t \left(R_t^{n*} \frac{\Gamma_{t+1} \lambda_{t+1}^*}{\Gamma_t \lambda_t^* \pi_{t+1}^*} \right) = 1 \tag{13}$$

$$\beta \frac{\lambda_{t+1}^*}{\lambda_t^*} f(\mathcal{A}) = v_t. \tag{14}$$

From equations (6), (7), (12) and (13) derived from the demand for real and nominal bonds we obtain the Fisher formula:

$$R_t^n = R_t E_t \pi_{t+1} \tag{15}$$

$$R_t^{n*} = R_t^* E_t \pi_{t+1}^* \tag{16}$$

From the equations (8) and (14) derived from the contingent claims demand, we obtain the risk sharing condition:

$$\frac{\lambda_{t+1}}{\lambda_t} = \frac{\lambda_{t+1}^*}{\lambda_t^*} \tag{17}$$

Considering this last equation and the equations (6) and (12), we obtain implicitly the un-covered interest rate parity which expresses in a more traditional way the fact that international arbitrage is allowed through access to contingent claims.

3.1.2 Production

The entrepreneurs in both countries produce imperfectly substitutable goods with capital and labor. In both countries, fluctuations arise from persistent shocks to aggregate productivity. Each country specializes in the production of a single good. More particularly, national entrepreneurs produce wholesale goods in competitive markets and then sell their output to national retailers who are monopolistic competitors. The latter differentiate the wholesale goods at no resource cost and sell them to households. Given that the retailers are price-setters, this allows us to introduce nominal rigidities. To assume that the entrepreneurs are monopolistically competitive would complicate the analysis of the financial contract when we will later take into account financial imperfections.

Retail sectors: The retail goods form the national composite aggregate that are converted into consumption and investment goods, and whose price index defines the aggregate price level P_1 and P_2^*. Profits from retail activity are rebated lump-sum to households. We model nominal rigidities by means of the Calvo (1983) pricing assumption: a given retailer is free to change his price in a given period only with probability $1-\zeta$. The retailer pricing decision implies the "new Phillips curve"

$$\pi_{1t} = -\kappa\mu_t + \beta E_t\{\pi_{1,t+1}\}$$

where

$$\pi_{1t} = \log(P_{1t}/P_{1,t-1})$$

and

$$P_{1,t} = \mu_t P_{1,t}^w$$

with μ the mark-up and $P_{1,t}^w$ the price of the wholesale good produced in the domestic country. As usual in Calvo-style price contracts, $\kappa = \frac{(1-\zeta)(1-\zeta\beta)}{\zeta}$.

The foreign condition is analogous:

$$\pi_{2t} = -\kappa\mu_t^* + \beta E_t\{\pi_{2,t+1}\}$$

where

$$\pi_{2t} = \log(P_{2t}/P_{2,t-1})$$

and

$$P_{2,t} = \mu_t^* P_{2,t}^w$$

with $P_{2,t}^w$ the price of the wholesale good produced in the foreign country.

Entrepreneurs: The wholesale goods are produced by entrepreneurs who combine physical capital and labor with a constant return to scale technology.

$$Y_t = a_t K_{t-1}^{\alpha} H_t^{1-\alpha}$$

Fluctuations arise from persistent shocks to aggregate productivity a_t which, along with a_t^*, we assume follows a first-order vector-autoregressive process

$$\begin{aligned} \begin{pmatrix} \log a_t \\ \log a_t^* \end{pmatrix} &= \begin{pmatrix} \rho & \rho^* \\ \rho^* & \rho \end{pmatrix} \begin{pmatrix} \log a_{t-1} \\ \log a_{t-1}^* \end{pmatrix} + \begin{pmatrix} (1-\rho) & -\rho^* \\ -\rho^* & (1-\rho) \end{pmatrix} \begin{pmatrix} \log a \\ \log a^* \end{pmatrix} \\ &+ \begin{pmatrix} 1 & \psi \\ \psi & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t \\ \varepsilon_t^* \end{pmatrix} \end{aligned} \tag{18}$$

where a and a^* are the means of the processes followed by a_t and a_t^* respectively. ε_t and ε_t^*, which represent the innovations to productivity variables, share the same variance σ_a^2 and are such that $E(\varepsilon_t) = E(\varepsilon_t^*) = 0$, $E(\varepsilon_t \varepsilon_t^{*'}) = 0$. ψ is a positive parameter which determines the contemporaneous correlation between domestic and foreign technological shocks. This is the only source of aggregate disturbances in the model. We assume that investment in each country is an index of the two goods 1 and 2 with the same structure than the consumption one (equations (1) and 2). Capital evolves according to the following dynamic equation:

$$K_t = (1-\delta)K_{t-1} + I_t$$

We assume there are capital adjustment costs Φ_t, given by the following equation:

$$\Phi_t = \frac{\phi}{2} \frac{(K_t - K_{t-1})^2}{K_{t-1}}$$

The representative firm maximizes its expected discounted sum of profit flows:

$$W^F(K_{t-1}) = \max \left(\frac{P_{1,t}^w}{P_t} Y_{1,t} - \Phi_t - I_t - w_t H_t + \int v_t W^F(K_t) d\mathcal{A} \right)$$

subject to the following constraint:

$$K_{t+1} = (1-\delta)K_t + I_t \qquad (q_t)$$

The labor and investment domestic demands derive from the following first-order conditions:

$$\mu_t W_t = (1-\alpha) Z_t^{1-\gamma} \frac{Y_t}{H_t}$$

with $Z = \frac{P_1}{P_2}$ the terms of trade.

$$q_t = 1 + \Phi_I'$$

$$1 = \beta E_t \left(\frac{\lambda_{t+1}}{\lambda_t} R_{t+1}^K \right) \tag{19}$$

with R_t^K the return of capital expressed in term of domestic composite good:

$$R_t^K = \frac{\left(\frac{\alpha Z_t^{1-\gamma}}{\mu_t} \frac{Y_t}{K_{t-1}} - \delta + q_t \right)}{q_{t-1}} \tag{20}$$

Firms in country 2 face an analogous program and maximize the expected discounted sum of profit flows:

$$W^{F*}(K^*_{t-1}) = \max\left(\frac{P^w_{2,t}}{P^*_t}\Gamma_t Y_{2,t} - \Gamma_t(\Phi^*_t + w^*_t H^*_t + I^*_t) + \int v_t W^{F*}(K^*_t)d\mathcal{A}\right)$$

subject to the following constraint:

$$K_t = (1-\delta)K_{t-1} + I_t \qquad (q_t).$$

The first-order conditions are:

$$\mu^*_t W^*_t = (1-\alpha)Z_t^{\gamma-1}\frac{Y^*_t}{H^*_t}$$

$$q^*_t = (1+\Phi'_{I^*})\Gamma_t$$

$$1 = \beta E_t\left(\frac{\lambda_{t+1}}{\lambda_t}R^{K*}_{t+1}\right) \qquad (21)$$

with R^{K*}_t the return of foreign physical capital expressed in the domestic composite good:

$$R^{K*}_t = \frac{\left(\frac{\alpha Z_t^{\gamma-1}}{\mu^*_t}\frac{Y^*_t}{K^*_{t-1}}\Gamma_t + q^*_t - \delta\Gamma_t\right)}{q^*_{t-1}} \qquad (22)$$

Considering the equations (8), (14), (19) and (21), it must be emphasized that the expected return of physical capital are equalized across countries, and equal the risk-free interest rate.

3.1.3 The money supply rule

Given the current debate over monetary rules, particularly in relation to the EMU, we consider active monetary policy rules aimed at targeting the inflation rate. We assume that the target is a constant mean inflation rate, which for simplicity, we set to be zero. In future research, we intend to consider policy rules that also target output. In the case of multiple currencies, the two policymakers use the following policy rules:

$$R^n_t = \rho_R R^n_{t-1} + \rho_\pi \pi_t$$

and

$$R^{n*}_t = \rho_R R^{n*}_{t-1} + \rho_\pi \pi^*_t.$$

We consider two cases: strong inflation targeting and weak inflation targeting. With strong inflation targeting, policy makers react strongly to a discrepancy between the actual inflation rate and its target value. In this case, the policy maker may be viewed as following a non-accomodative policy. With weak inflation targeting, the policy maker is unwilling to take active measures to supress output movements in order to counteract inflationary pressures. The alternative policies are parameterized as either high or low values of ρ_π.

3.2 Introducing a financial accelerator

In the core model, the Modigliani-Miller theorem holds: financial structure is both indeterminate and irrelevant to real economic outcomes. However, when credit markets are characterized by asymmetric information and agency problems, the Modigliani-Miller irrelevance theorem no longer applies. A convenient way to formalize these frictions is by introducing a financial accelerator as in Bernanke, Gertler and Gilchrist (1999). The key mechanism involves the negative link between the external finance premium s (the difference between the cost of funds raised externally and the opportunity cost of funds internal to the firm) and the net worth of borrowers N (defined as the liquid assets plus collateral value of illiquid assets less outstanding obligations).

The inverse relationship between external finance premia and the strength of the balance sheet arises because, when borrowers have little wealth to contribute to project financing, the potential divergence of interests between the borrowers and the lenders is greater, implying increased agency costs. In equilibrium, lenders must be compensated for higher agency costs by a large premium. Because borrower net worth is pro-cyclical, through the behavior of profits and asset prices, the financial accelerator enhances swings in borrowing and thus in investment, spending and production.

As modeled by Bernanke, Gertler and Gilchrist(1999) the return on capital for any individual entrepreneur (equations (20) and (22)) is sensitive to both aggregate and idiosyncratic risk.[11]. Lenders must pay a fixed auditing cost if they want to observe an individual entrepreneur's realized return. In this environment, uncollateralized external finance is more expensive than internal finance.

Entrepreneurs are assumed to be risk-neutral, so that they bear all the aggregate risk, and have finite horizons. Each one has a constant probability η of surviving to the next period. This assumption precludes the possibility that entrepreneurs accumulate enough wealth to be fully self-financing: the entrepreneurs who die consume a fraction $1-\nu$ of their accumulated resources and depart from the scene. Since we assume a worldwide pool of savings from non-financial agents, we are de facto assuming that banks have access to the same supply of financial resources. This corresponds to full integration of savings supply for the world economy.

In the presence of the financial accelerator, the equations (19) and (21) are modified to allow for a premium on external finance s that is due to the existence of monitoring costs:

$$E_t R^K_{t+1} = s_t R_t$$

$$E_t R^{K*}_{t+1} = s^*_t R^*_t \frac{\Gamma_{t+1}}{\Gamma_t}.$$

The external finance premium is negatively related to the share of the capital

[11] See Bernanke, Gertler and Gilchrist (1999) for a precise presentation of the properties of this stochastic variable and for the derivation of the optimal financial contract.

investment that is financed by entrepreneur's own net worth:

$$s_t = S\left(\frac{q_t K_t}{N_t}\right)$$

$$s_t^* = S\left(\frac{q_t^* K_t^*}{N_t^*}\right)$$

It can be shown that the function S is strictly increasing and convex over the relevant range (Bernanke, Gertler and Gilchrist (1999)).

Entrepreneurial net worth reflects the equity stake that entrepreneurs have in their firm, V, and a transfer D from the fraction of entrepreneurs who die each period

$$N_t = \eta V_t + (1-\eta) D_t$$

$$N_t^* = \eta V_t^* + (1-\eta) D_t^*$$

with

$$V_t = R_t^K q_{t-1} K_{t-1} - E_{t-1} R_t^K \left(q_{t-1} K_{t-1} - N_{t-1}\right)$$

$$V_t^* = R_t^{K*} q_{t-1}^* K_{t-1}^* - E_{t-1}\left(R_t^{K*} \frac{\Gamma_t}{\Gamma_{t-1}}\right)\left(q_{t-1}^* K_{t-1}^* - N_{t-1}^*\right).$$

Entrepreneurial equity equals gross earnings on holdings of equity from $t-1$ to t less repayment of borrowing. As the entrepreneurs are risk neutral, they bear all the aggregate risk.

3.3 Moving to a monetary union

Until now the model has been developed under the assumption of a flexible exchange rate regime. With the introduction of a monetary union, household behaviors are modified to recognize the existence of one currency and one central bank which follows a unique policy rule:

$$R_t^n = \rho_R R_{t-1}^n + \rho_\pi \left(\frac{\pi_t + \pi_t^*}{2}\right).$$

The prices of the goods i, P_i, are denominated in the common currency. The domestic-country representative-household program is identical to the one developed for the flexible exchange-rate economy, while the foreign-country representative-household budget constraint is different, since it is no longer necessary to convert foreign nominal variables by the use of the nominal exchange rate:

$$\begin{aligned} & P_t^* C_t^* + \int v_t \; \mathcal{B}_t^* d\mathcal{A} + P_t^* B_t^* + B_t^{n*} + M_t^* \\ \leq \quad & P_t^* \mathcal{B}_{t-1}^* + P_t R_{t-1}^* B_{t-1}^* + P_t^* R_{t-1}^n B_{t-1}^{n*} + M_{t-1}^* + P_t^* w_t^* H_t^* + \tau^* \end{aligned}$$

We may this budget constraint in terms of domestic composite good units as:

$$\Gamma_t C_t^* + \int v_t \ \mathcal{B}_t^* d\mathcal{A} + \Gamma_t B_t^* + \frac{1}{P_t} B_t^{n*} + \frac{1}{P_t} M_t^*$$
$$\leq \quad \mathcal{B}_{t-1}^* + \Gamma_t R_{t-1}^* B_{t-1}^* + \frac{R_{t-1}^n}{P_t} B_{t-1}^{n*} + \frac{1}{P_t} M_{t-1}^* + \Gamma_t w_t^* H_t^* + \frac{1}{P_t} \tau^*$$

where Γ remains the real exchange rate: $\Gamma = \frac{P^*}{P}$. The equation (11) is modified in the following way:

$$\beta E_t \left(u'_{m_t^*} + \frac{\lambda_{t+1}}{\pi_{t+1}} \right) = \lambda_t$$

with $m^* = \frac{M^*}{P}$. The pricing of the nominal interest rate becomes:

$$\beta E_t \left(R_t^{n*} \frac{\lambda_{t+1}^*}{\lambda_t^* \pi_{t+1}} \right) = 1$$

We can then obtain equality of the nominal interest rates: $R_t^{n*} = R_t^n$, implying that we still have both the fisherian equations.

3.4 Financial frictions, financial heterogeneity, financial integration.

The degree of financial market imperfections is determined by the cost of monitoring associated with lending contracts. In the extreme case of no financial market imperfections, monitoring costs are zero and the expected return on capital equals the risk free rate of return. With monitoring costs, the expected return on capital exceeds the risk free return. By allowing countries to differ in the size of monitoring costs, we create heterogeneous financial markets across countries. Such heterogeneity can be ascribed to the differences in the efficiency of national lending institutions. These differences in efficiency create differences in both steady-states and macrodynamics across countries. In terms of steady-states, differences in monitoring costs imply differences in the effective return on capital across countries. The country with the higher monitoring cost has a higher required return on capital and hence a lower capital-labor ratio. Asymmetries in monitoring costs also produce dynamic asymmetries. In particular, higher monitoring costs imply a higher elasticity of the premium on external funds to a change in the balance sheet position. Hence the country with higher monitoring costs will exhibit greater volatility owing to financial market imperfections.

In the absence of financial integration, entrepreneurs have access to country-specific projects, whose value is determined by the rate of return on capital in that country. Entrepreneurs are unable to engage in cross-country investment projects, as such they are "national" firms. In this environment, overall net worth of the entrepreneurial sector is also country specific, evolving over time in response to domestic asset price movements. As a result, external finance premia differ systematically across countries over time.

In the presence of financial integration, entrepreneurs have access to projects in both countries and are "multi-national" firms who may operate in either domestic and foreign markets. Such multi-nationals are affected by the macroeconomic characteristics of both countries. These multi-nationals invest funds in either country. When doing so, they are subject to the financial characteristics of that country which may differ owing to differences in monitoring costs. When contracting with a financial intermediary however, the multi-national presents a unique asset structure which includes assets covering the whole zone. Formally, the "capital expenditures/ net worth" ratio for a multinational firm, upon which its external finance premium is fixed, is the same for investment projects in either country. As a result, financial integration implies equalization of the external finance premia across countries. This is true with either homogeneity or heterogeneity in the banking system.

4 The Role of the Financial Accelerator in the International Propagation of Shocks

In this section, we report the results obtained by simulating the dynamics generated by the four variants of our general model. In the exercise that follow, we denote "NMK" the new macro-keynesian model without financial accelerator, while the version incorporating the financial accelerator corresponds to the curve "FA. We shall concentrate on the impact of an exogenous real disturbance occuring in the domestic country, that is a shock to a_t.[12] We first consider the case of structural symmetry between the two economies and asymmetric shocks. We then reverse this and study the impact of structural asymmetry (in financial frictions) when shocks are symmetric between the two countries.

4.1 Calibration

The procedure for calibrating is traditional: we choose share parameters for preferences and production such that means of ratios of aggregate times series are equal to analogous ratios for the theoretical economy's steady state. For numerous parameters, we use the same calibration as in Bernanke, Gertler and Gilchrist (1999). We adopt a symmetrical calibration between the two countries.

First we choose standard values for the taste and technology parameters. The depreciation rate δ is set at 0.025. α which corresponds to the labor share of output is calibrated in order to replicate a labor share of 64%. ϕ, the adjustment cost parameter, is calibrated in order to get an elasticity of the price of capital with respect to the investment capital ratio equal to 0.25. The discount factor is fixed at 0.99 and the auto-regressive coefficients ρ_a and ρ_a^* of the supply shock

[12] We could also study demand shocks, by means of introducing public expenditures, or by assuming that the taste parameter is stochastic. This is for the present time, outside the scope of the paper, even though these extensions are natural and easily introduced in the model. On the contrary, a monetary shock on the supply side of the money market is affected by the monetary regime and cannot be the proper vehicle for comparisons.

will be equal to 0.906 and 0.088. The value of γ gives us a 15% stationary ratio of imports to GDP. σ is set such that the individual labor supply elasticity is 0.5, which is in the range of values reported by MaCurdy (1981).

The non-standard parameters concern the financial dimension of the model and the nominal rigidities. Following Bernanke, Gertler and Gilchrist (1999), we choose parameters (death rate of entrepreneurs, variance of the idiosyncratic productivity shock and the scale of monitoring costs) to obtain the following stationary values: a value of 2 for the ratio of capital to net worth, an external finance premium of two hundred basis points and an annualized failure rate of three percent. Finally the probability ζ a retailer does not change its price is fixed at 0.5, implying an average price duration of two quarters.

4.2 Financial frictions with asymetric shocks

In the first series of experiments, we assume that the two countries exhibit a financial accelerator and that they are identical in all respects. To introduce heterogeneity, we assume an asymmetric supply shock affecting country 1 which diffuses to the other country with a lag. The immediate supply shock in country 1 followed by the delayed diffusion to country 2 implies that country one experiences a relative supply shock while country 2 experiences a relative demand shock along the transition path.

We first consider the influence of the financial accelerator on model dynamics. We then consider the influence of alternative policy rules (weak vs strong inflation targeting) and alternative policy regimes (monetary union vs multiple currencies). We also consider the effect of financial integration in this environment.

4.2.1 The financial accelerator

In figures 1 we plot the effect of an asymmetric shock to technology on a number of variables of interest, including output, investment and inflation. In figure 2 we plot nominal interest rates, the terms of trade and real exchange rates, and the premia on external funds. For each plot, the solid line denotes the model with the financial accelerator, while the dashed line denotes the model without. Figures 1 and 2 present results for the model with multiple currencies subject to a relatively weak inflation targeting policy. We consider this our baseline case.

In the absence of financial frictions, the asymetric supply shock causes an immediate boom in output, investment and employment in country 1 and very little response to country 2. As the technology shock diffuses, country 2 catches up to country one and output and investment respond in that country as well. With nominal price rigidities, the inflation rate falls in country 1, owing to the positive supply shock, and rises in country 2, owing to the increased demand for goods – both investment and consumption – that is generated by the world-wide wealth effects of such a shock. As a result of the relative supply shock, the terms of trade fall and the domestic currency depreciates. In the absence of financial frictions, there is very little cross-country transmission mechanism, and both output and investment in country 2 closely parallels the path of technology.

Financial market imperfections are most noticable for their strong cross-country transmission mechanism. The increase in technology raises investment demand and asset prices, causing an increase in net worth and a reduction in the external finance premia in both country 1 and country 2. Worldwide investment increase from 2% to 4% owing to the financial accelerator. A full 50% of the increase in investment owing the financial accelerator occur through the cross-country transmission mechanism working through asset prices and net worth. As a result, investment in country 2 increase 1% in response whereas the initial response is zero, absent financial market imperfections. In terms of aggregrate output, these investment effects are moderated by offsetting reductions in consumption. Overall, the financial accelerator causes an increase in world output on the order of 10% relative to the benchmark model without financial frictions.

4.2.2 Strong vs weak inflation targeting policy

In figure 3 we report the results of the same shock for output, investment and inflation in the case of strong monetary policy. For comparison purposes, tables 1 and 2 report unconditional standard deviations of inflation and output for models where the sole source of shocks is asymmetric supply shocks. Strong inflation targeting eliminates nearly all of the excess investment volatility produces by the cross-country transmission mechanism associated with the financial accelerator. In particular, in the foreign country, investment in the model with the financial accelerator tracks the response of investment in the model without a financial accelerator. This result stems immediately from the fact that the financial accelerator operates through an aggregate demand channel whose output and inflation effects move in the same direction. By targeting inflation at the country level, a country can stabilize aggregate demand and isolate itself from the international spill-overs associated with foreign asset-price booms. Strong inflation targeting also has important implications for inflation dynamics. Without the financial accelerator, both strong and weak inflation targeting produce opposing movements in country inflation. In either case, inflation volatility is relatively low and strong inflation targeting reduces it even further (from 0.05 to 0.008). Offsetting movements in inflation occur because the technology shock to country 1 produces deflation in country 1 and inflation in country 2 where the initial response is driven by through aggregate demand rather than aggregate supply. The financial accelerator produces a strong aggregate demand channel in both countries. By effectively dampening the aggregate demand consequences of the financial accelerator, strong inflation targeting causes a large reduction in aggregate inflation volatility (0.185 to 0.034). Although aggregate inflation is reduced substantially with strong inflation targeting, the model still exhibits large volatility of inflation at the country level however (Table 2).

4.2.3 Monetary Union vs Multiple currencies with flexible exchange rates

We now consider the effects of monetary union. This case is graphically depicted in figure 4 (weak policy) and figure 5 (strong policy). With monetary union, policy makers lose an instrument which may be used to offset the aggregate demand effects of asymmetric shocks. There is very little difference in aggregate output or aggregate inflation volatility with versus without a monetary union however. Rather, the main difference is in the country-specific inflation rates whose volatility rises substantially in the monetary union case (from 0042 to 0.288).

These differences in country specific inflation rates across the monetary regimes are starkest in the case of strong monetary policy. With weak monetary policy, the monetary authority does not react very much, so there is little gain to having two instruments to fight individual country inflation. As a result, individual country inflation is much higher than aggregate inflation in either regime.With strong monetary policy and multiple currencies, each policy maker reacts effectively against country-specific inflation. Both country-specific and aggregate inflation volatilities are of the same order of magnitude (and very small). In the case of monetary union, the monetary authority effectively reduces aggregate inflation but does so at the cost of relatively large variation in individual country inflation rates.

4.2.4 Financial Integration

For the case of asymmetric shocks, we also consider the effects of financial integration. The results are plotted in figure 6 (weak policy) and figure 7 (strong policy) which provides the response to output, investment and inflation under the financial accelerator with vs without multiple currencies.

The main effect of financial integration is to strengthen the cross-country transmission mechanism produced by the financial accelerator. The asset price effects of a boom in country one are more strongly transmitted to investment demand in country 2. Hence financial integretation increases co-movement between the two countries in response to asymmetric shocks. With weak monetary policy especially, financial integration increases the overall volatility of investment that is due to the financial accelerator. Investment in the foreign country rises by 1.6% while investment in the domestic country rises by 3% so that total investment is far more volatile with financial integration than without it. This result undoubtedly reflects a strengthening of feedback mechanisms between investment demand and asset prices in the case of financial integration – a stronger feedback mechanism implies a larger effect on investment through the financial accelerator.

Perhaps more importantly from a policy perspective is the finding that, with financial integretation, there is almost no difference between the multiple currency regime and the single currency regime, except for country-specific inflation rates, which are more volatile with a single-currency regime. With financial integration, the aggregated demand effects owing to the financial accelerator are common across the two countries, and are now well stabilized with a single policy variable.

4.3 Financial Heterogeneity with symmetric shocks

As summarized in section 2, the heterogeneity of the financial system is an important institutional feature of the Eurozone. We consider the effects of financial heterogeneity within the context of symmetric shocks to technology. We formalize financial asymmetries by assuming that the two countries differ in terms of the monitoring costs associated with enforcing contracts. Country 1 has higher monitoring costs than country 2, which implies both a higher external finance premium higher, ceteris paribus, and a more elastic response of the external finance premium to movements in net worth. . To focus on the consequences of financial asymmetries, we consider a symmetric real shock to technology that affects both countries in exactly the same way.

Without financial asymmetries, and identical monetary policy(ies), the behavior of the two countries would be the same, independently of the monetary regime: in the multiple currency case, the nominal exchange rate would remain equal to one, and the terms of trade would not be. With financial asymmetries, the responses to the common disturbance will differ in the two countries – in particular, the differences in external finance premia will generate differences in investment behavior which will spill over into other aspects of the dynamic response.These results are summarized in figures 7-8 and tables 3 and 4.[13]

By introducing an asymmetric response to symmetric shocks, financial heterogeneity raise the potential benefits to multiple currencies. In terms of the volatility of aggregate output and inflation, these benefits appear to be modest however as we see little increase in either, owing to the adoption of a common monetary policy. At the country level, monetary union causes a modest increase in the heterogeneity of output and a more pronounced increased in inflation at the country level. The inflation volatility outcome is particularly degraded in the case of the less efficient country. This appears to be more true in the case of a strong policy. Moving to a single currency actually makes country 1 much worse off in terms of inflation volatility (from 0.057 to 0.0887) whereas country 2 actually benefits from a reduction in inflation volatility (from 0.0425 to 0.0246). Hence their assessment of monetary union are likely to depend on their financial institutions. From an aggregate point of view, there appears to be little loss to adopting a monetary union in the case of financial heterogeneity. But from a country point of view, monetary union may incur non-negligible costs. With a weak policy, inflation volatility may actually increase for the efficient country under the adoption of monetary union.

[13] We only provide graphical analysis of the multiple currencies vs monetary union in the case of strong inflation targeting.

5 Conclusion

This paper develops a fully articulated model of a world economy with two countries and a financial accelerator mechanism. The model allows us to study the dynamic consequences of alternative assumptions regarding the international monetary regime and the presence of financial frictions. Taking into consideration the case of real disturbances only, we obtain the following findings: The financial accelerator has an amplifying role in the dynamics of aggregate real variables and contributes to the business cycle in a significant way. In a two-country model, the financial accelerator increase the degree of cross-country transmission and hence increase the degree of co-movement across countries in response to asymmetric shocks. In the exercises considered above, the existence of a common currency in lieu of multiple currencies does not have a major impact on aggregate dynamics of either inflation or output. The common currency may substantially increase the volatility of inflation at the country level however, a result which is greatly enhanced by the presence of a financial accelerator. A broad conclusion from this research is that the presence of financial market imperfections does not obviously enhance the desirability of multiple currencies. Again, this conclusion stems from the fact that the financial accelerator acts like a coordination device which decreases the disparities in the transmission of shocks across countries.

References:

Bernanke B., M. Gertler and S. Gilchrist, 1999, "The Financial Accelerator in a Qunatitative Business Cycle", in J. B. Taylor and M. Woodford (eds), *Handbook of Macroeconomics*, North-Holland.

Cecchetti S., 1999, "Legal Structure, Financial Structure and the Monetary Policy Transmission Mechanism", *Federal Reserve Bank of New York Economic Policy Review*, July, 9-28.

Faia E., 2001, "Stabilization Policy in a Two Country Model and the Role of Financial Frictions", European Central Bank working paper no XX.

Galati G. and K. Tsatsaronis, 2001, "The Impact of the Euro on Europe's financial Markets", Bank for International Settlements working paper no 100.

Gertler M., S. Gilchrist and F.M. Natalucci, 2001, "External Constraints on Monetary Policy and the Financial Accelerator", mimeo, New York University.

Gros D. and K. Lannoo, 1999, "The Structure of Financial Systems and Macroeconomic Instability", *EIB Economic Papers*, vol. 4, 61-69.

Hurst C. , E.Pere and M. Fischbach, 1999, "On the Road to Wonderland? Bank Restructuring after EMU", *EIB Economic Papers*, vol.4, 83-103.

Kashyap A.K. and J.C. Stein, 1999, "The Role of Banks in Monetary Policy: a Survey with Implications for the European Monetary Union", *Federal Reserve Bank of Chicago Economic Perspectives*, September-October, 2-18.

Townsend R. M., 1979, "Optimal Contracts and Competitive Markets with Costly State Verification", *Journal of Economic Theory*, 1011-1046.

Table 1: Volatilities under asymmetrical shocks and weak targeting

	Multiple Currencies			Monetary Union		
	NMK	FA	FI	NMK	FA	FI
Y_i	3.20	3.67	3.59	3.21	3.62	3.61
Y_A	2.95	3.42	3.38	2.98	3.40	3.41
π_i	0.15	0.21	0.24	0.32	0.34	0.38
π_A	0.05	0.185	0.185	0.051	0.185	0.185

Table 2: Volatilities under asymmetrical shocks and strong targeting

	Multiple Currencies			Monetary Union		
	NMK	FA	FI	NMK	FA	FI
Y_i	3.24	3.57	3.56	3.25	3.60	3.51
Y_A	3.0	3.31	3.33	3.02	3.37	3.31
π_i	0.033	0.042	0.048	0.325	0.288	0.342
π_A	0.008	0.034	0.034	0.008	0.034	0.034

Table 3: Volatilities under symmetric shocks and weak targeting

	Multiple Currencies			Monetary Union		
	NMK	FA	FAHo	NMK	FA	FAHo
Y	4.24	4.94	4.85	4.22	5.01	4.80
Y^*	4.24	4.64	4.85	4.22	4.69	4.80
Y_A	4.24	4.79	4.85	4.22	4.85	4.80
π	0.072	0.306	0.260	0.0724	0.311	0.260
π^*	0.072	0.229	0.260	0.0724	0.227	0.260
π_A	0.072	0.267	0.260	0.072	0.268	0.260

Table 4: Volatilities under symmetric shocks and strong targeting

	Multiple Currencies			Monetary Union		
	NMK	FA	FAHo	NMK	FA	FAHo
Y	4.24	4.87	4.68	4.22	4.85	4.71
Y^*	4.24	4.63	4.68	4.22	4.59	4.71
Y_A	4.24	4.75	4.68	4.22	4.72	4.71
π	0.0124	0.0570	0.0486	0.0124	0.0887	0.0487
π^*	0.0124	0.0425	0.0486	0.0124	0.0246	0.0487
π_A	0.0124	0.0497	0.0486	0.0124	0.0501	0.0487

Figure 1: Asymmetric Shock, Multiple Currencies ($\rho_i = 0.15$).

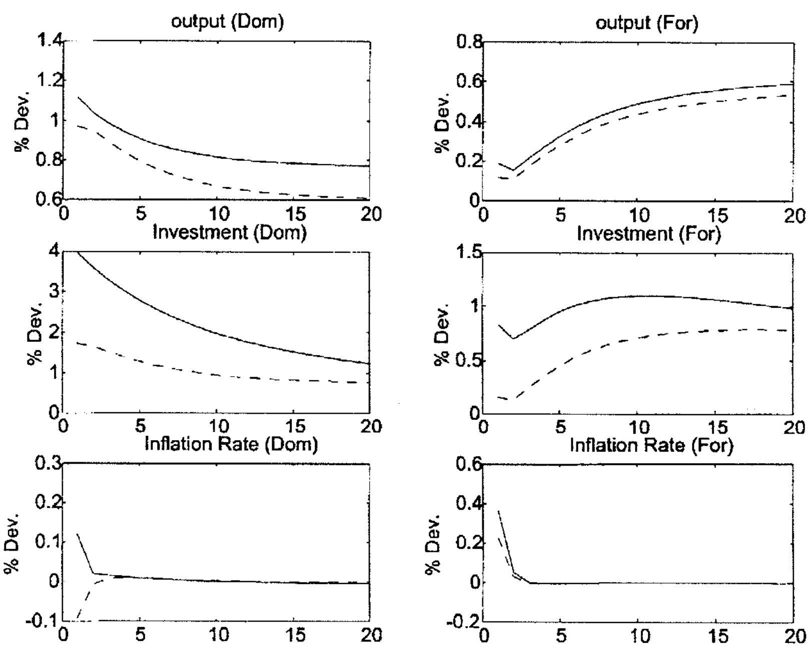

Figure 2: Asymmetric Shock, Multiple Currencies ($\rho_i = 0.15$)

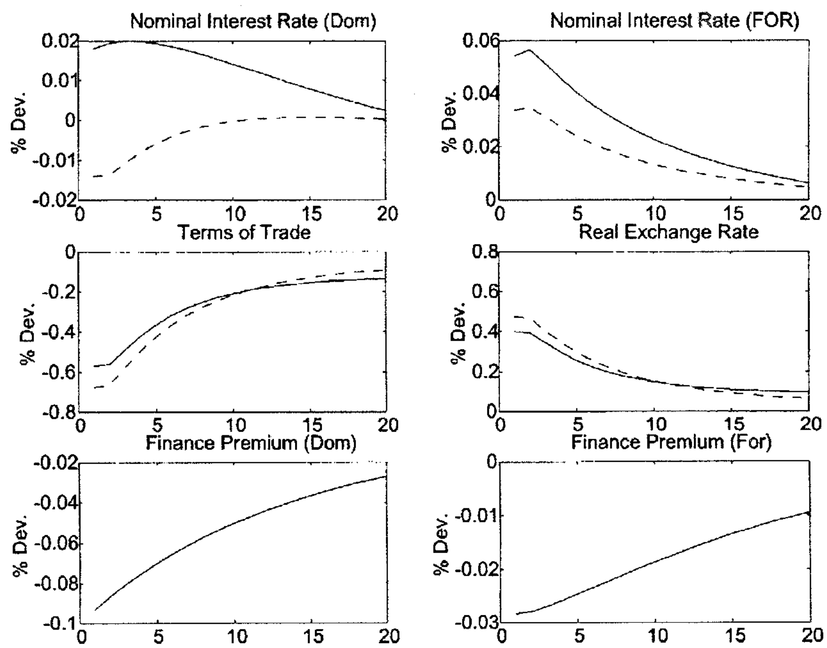

Figure 3: Asymmetric shock, multiple currencies ($\rho = 1.5$).

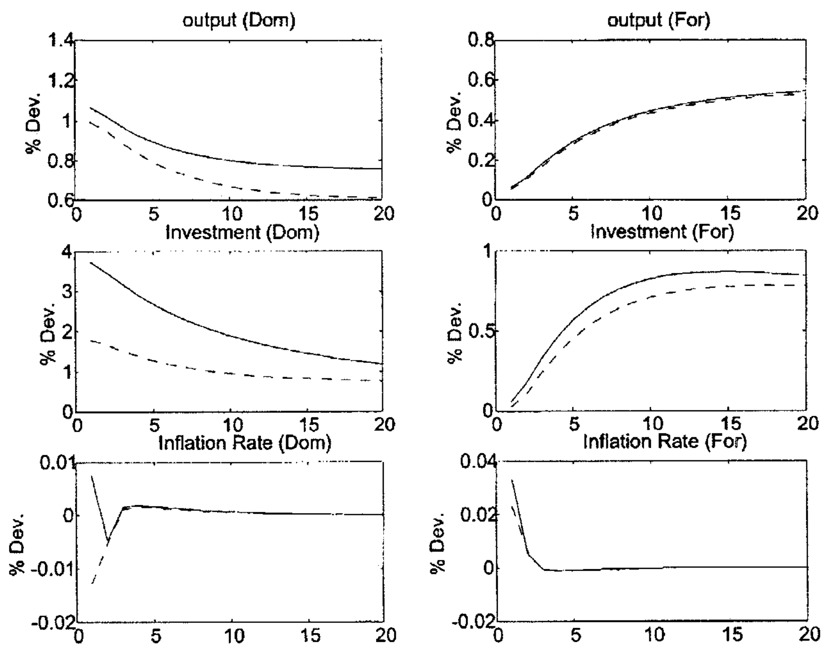

Figure 4: Asymmetrical shock, monetary union ($\rho = 0.15$).

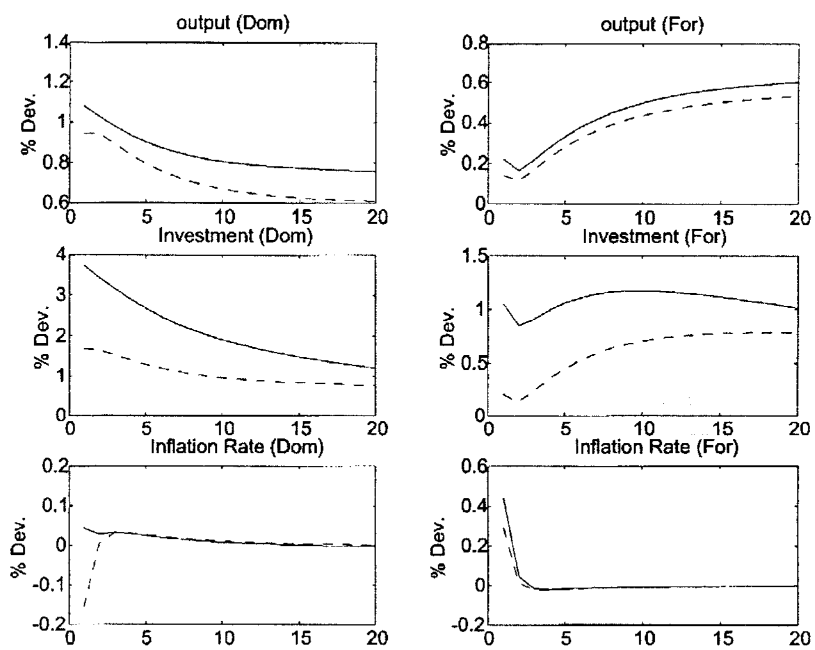

Figure 5: Asymmetrical Shock, Monetary Union ($\rho_i = 1.5$).

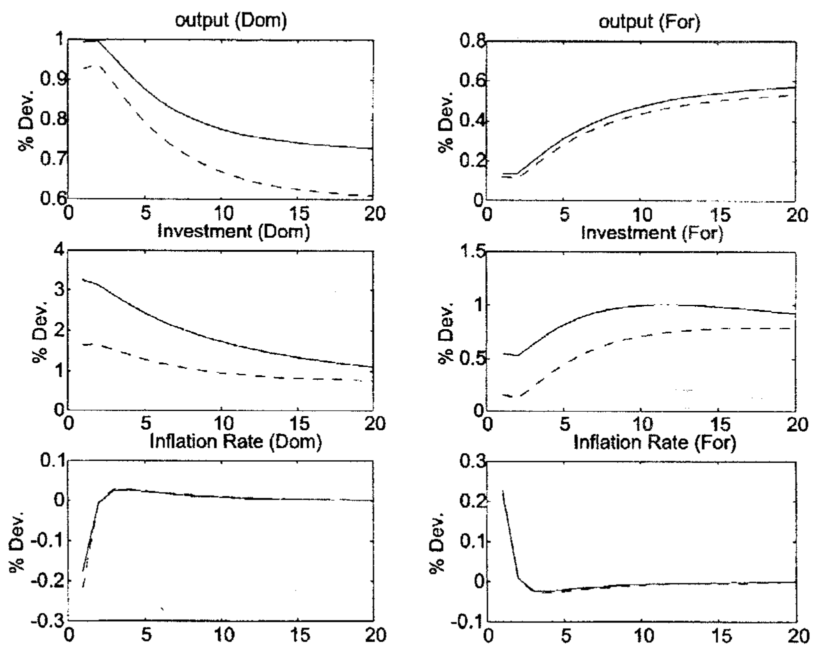

Figure 6: Integration vs non-integration ($\rho_i = 1.5$)

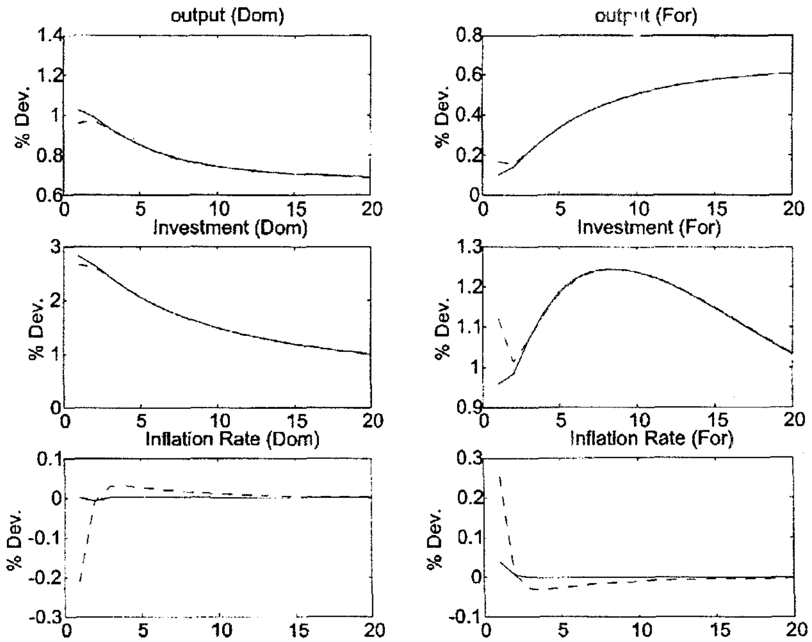

Figure 7: Response to a symm. shock, multiple currencies ($\rho = 1.25$).

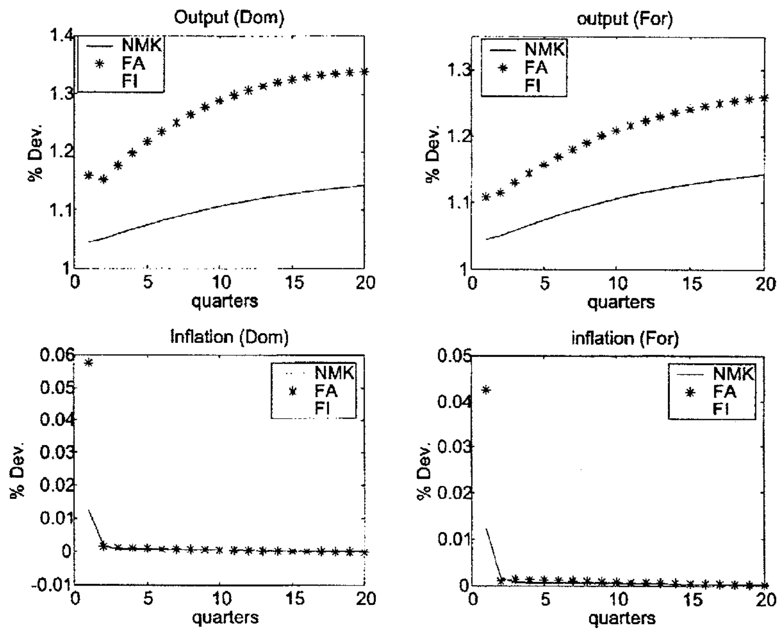

Figure 8: Response to a symm. shock, monetary union ($\rho = 1.25$).