Financial Differences and Business Cycle Co-Movements in A Currency Area*

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Abstract

I propose a unitary framework to interpret the links between differences in financial structures and the monetary policy regimes on the one hand, and the correlation of business cycles on the other. Using a two-country micro-founded model with financial frictions I predict that a greater financial diversity should reduce cyclical correlation under a given monetary regime, and that moving from independent monetary policies to a hard peg or a common currency should increase it, for any given degree of financial diversity. I use the recent experience of EMU to test these ideas, and show that my model explains reasonably well the broad patterns of business cycle correlation observed recently among the main euro area countries.

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1 Introduction

The aim of this paper is to study how financial structures and monetary policy regimes (including exchange rate regimes) affect the pattern of business cycle correlation across countries. More specifically, I propose a unitary framework in which international business cycle co-movements are explained jointly by the differences between the financial systems and by the monetary policy regime adopted by the countries concerned.

The European Union is a prime example where my analysis is likely to be relevant. The 12 countries of the euro area have adopted a single currency but are still characterized by different financial structures, as a result of history, legal frameworks, collective preferences and politics[1]. Financial regulations, legislation and bank supervisory policies of these countries have not been unified but remain largely under national control – though pressures towards harmonization and the adoption of common standards, partly as a result of the single currency, are mounting. Of the remaining EU members, many (including several new entrants from Central and Eastern Europe) will adopt the euro before or around the end of this decade, and also in preparation for that are introducing financial market reforms. This process of currency unification and financial reform taking place at continental level provides an ideal testing ground for my theory. Examining the implications of this for business cycles is clearly important for many reasons, e.g. to determine the optimal monetary policy and to study the welfare properties of the currency area.

The approach I propose helps to rationalize, within a common framework, two separate bodies of recent empirical findings. First, the empirical literature on the transmission mechanism has highlighted the central role of financial and banking structures, particularly in Europe, in shaping the strength and the timing of the effects of monetary policy on the economy. Moreover, an increase in the cyclical co-movement of the euro area countries in recent years has been reported. On both aspects, a short survey of recent papers is provided in the next section. Against this background, my theoretical model predicts that a lesser financial diversity increases the cyclical correlation for any given monetary regime, whereas moving from independent monetary policies to a currency peg or even more to a common currency tends to increase it, for any given degree of financial distance. As I show, a model embodying these features explains well the empirical patterns of business cycle correlations, and changes thereof, observed recently among the main European countries.

The argument proceeds in three steps. First, I lay out a laboratory economy with two regions, where the effects of financial diversity and of alternative monetary regimes on business cycle co-movements can be analyzed within a unified theoretical framework. The model economy is a stochastic dynamic general equilibrium with optimizing agents, characterized by adjustment costs on prices in an imperfectly competitive framework, by imperfect financial integration and different degrees of financial fragility. The presence of sticky prices is essential to analyze the effects of

[1] The link between politics, legal frameworks and the financial systems are studied, for example, by La Porta et. al (1997). Cecchetti (1999) demonstrates that there is link between these aspects and the transmission mechanism of monetary policy in the euro area.

endogenous monetary policy response. Imperfect financial integration means here that households do not have access to a complete set of state contingent international securities. Financial frictions are introduced by postulating borrowing constraints on investment due to asymmetric information between borrowers and lenders[2]. Financial diversity is modelled in terms of asymmetric costs of bankruptcy and riskiness of investment projects. The external finance premium is proxied by the spread between bank lending rates (or corporate bond rates) over money market rates; the calibration is made with reference to the four largest euro area countries (Germany, France, Italy and Spain), with the UK and the US used as controls[3]. The external finance premium determines the tightness of the borrowing limit and is related to the conditions (i.e. the value) of the collateral in the economy. In this environment, the sensitivity of the borrowing limit to the collateral conditions is the key determinant of the link between financial fragility and the business cycle.

Second, the model is subject to monetary policy and productivity shocks calibrated using euro area data. I consider three monetary policy regimes. The first is a currency area in which monetary policy targets area-wide CPI inflation. In the second the two countries follow independent monetary policies, each targeting its own domestic CPI inflation. In the third, the home country targets its domestic CPI inflation and the foreign one unilaterally and credibly pegs its exchange rate[4]. In all three regimes, different elasticities of credit availability to collateral conditions between the two countries produce different business cycle responses to shocks, hence different degrees of persistence and volatility in real output and the other main macro variables. The differences in financial structures also generates differences in the return to capital investment which induces agents to relocate physical capital and investment projects abroad. Capital flows occur towards countries characterized by more profitable investment conditions - i.e. higher sensitivity of credit availability to leverage ratio. Due to both of these channels, lower business cycle co-movements arise as a result of higher financial distance.

The comparison across monetary regimes shows that, in the presence of financial differences, all macro variables are more synchronized in a currency area than under an independent policy regime. In both regimes, the different sensitivity of the borrowing conditions to collateral gives rise to different sensitivity of business cycle fluctuations to shocks. Under independent policies, however, the endogenous response of the national monetary policy to such differences in fluctuations tends to amplify the non-synchronism of cycles. Under the unilateral peg, the business cycle co-movements are very close to the ones arising under the currency area regime - the difference generated by the fact that in this regime the monetary policy target is the home country's inflation rate, not the one of the area, turns out to be small.

[2] See for closed economy models Bernanke, Gertler, Gilchrist (1999), Carlstrom and Fuerst (1997), Cooley and Nam (1998).

[3] This empirical measure embodies several features of the domestic financial system, including the degree of banking sector efficiency in terms of bankruptcy and operating costs, the importance of leverage as well as the riskiness of investment projects.

[4] At present, a few EU nations peg their exchange rates closely to the euro, like e.g. Denmark, Estonia, Lithuania and Slovenia.

The third step is to show that the model predictions broadly correspond to the data evidence. I do this for the four largest euro area countries[5], using the UK and the US as control cases. To do this, cross-country correlations of output, consumption, investment and employment generated by the model are compared with the empirical counterparts. The independent policies and the currency area regimes in the model are compared, respectively, with the pre-EMU and the post-EMU periods. The model successfully replicates the broad patterns of empirical correlations.

The paper is organized as follows. Section 2 reviews the empirical literature on the transmission mechanism in the euro area and documents the presence of differences in the financial markets. Section 3 presents the model, which is then calibrated in section 4. Section 5 shows the dynamic properties of the model under the different financial and monetary regimes. Finally, section 6 compares the model results with the data, and section 7 concludes. Tables and graphs are reported at the end of the paper.

2 Recent Literature and Stylized Facts

Two recent strands of literature are particularly relevant for this paper. The first, started in the late 1990s and increasingly active in recent times, focuses on the transmission of monetary policy in the euro area. A focal point in this literature has been the question of whether the monetary transmission mechanism differs across euro area countries, and if so, what role the financial structures play in generating these asymmetries. The second strand of literature concentrated on measuring the degree of cyclical coherence among these countries, mainly with the aim of determining whether the EMU is an "optimal currency area". The general conclusion of this literature is that cyclical convergence in Europe has increased during the EMU preparation phase, but that significant cyclical asymmetries still exist. Interestingly, this second line of research has remained so far unrelated to the first: the possibility that the differences in the transmission mechanism, stemming from the financial structures, may be themselves a factor of cyclical asynchrony, and the simultaneous effect produced by the change in monetary regime, do not seem to have been directly analyzed up to now.

Several authors have argued that the euro area monetary transmission mechanism is uneven across euro area countries, and have pointed at the financial systems as the reason for that. In particular, Cecchetti (1999) and Guiso et al. (1999) argued that deeply entrenched legal and institutional structures prevent a homogeneous response of the economy to monetary policy shocks, which of course have become identical after the introduction of the euro. Giovannetti and Marimon (1999) use VAR methodology to conclude that monetary policy shocks give rise in fact to differential transmission mechanisms, a conclusion shared by Mihov (2001). Ceccarelli and Rebucci

[5] At present, the main obstacle to an extensive empirical investigation along these lines is in the availability of statistical data. In several EU countries (most notably, the new members from Central and Eastern Europe) sufficient long, good quality statistics on national accounts are not available. This restricts the number of countries on which a meaningful analysis can be conducted.

(2003) confirm these results using Bayesian estimation methods, but point out that the differences refer more to the time profile of the responses, rather than to their overall magnitude. A comprehensive recent study conducted by the euro area central banks (Angeloni, Kashyap and Mojon (2003)) confirms the role of banking lending behavior in shaping certain features of the euro area transmission mechanism. Finally, Angeloni and Ehrmann (2003) using post-1999 data find that certain segments of the transmission mechanism may have become more similar across countries after the launch of EMU, though differences still persist.

For illustration, table (1) shows a few simple indicators of the financial structure for the main euro area countries. The reference periods differ somewhat across indicators, due to data availability. The first three columns refer to the banking sector: the return on assets (ROA) of the sector[6], the Thomson rating measure[7] and the marginal cost of long term bank financing recently published by the ECB[8]. These data show that there is a marked heterogeneity among bank structures. Looking at the rankings among the largest 4 countries, the ROA is lowest for Germany and highest for France and Spain. It may thus come as a surprise that the Thomson rating assigns the highest score to Germany. This is likely to depend largely on the highly protected condition of the German banking sector, still characterized by extensive state guarantee. The marginal lending rates suggest the following decreasing order: Germany, France, Italy, Spain. The last two columns of table (1) refer instead to the non-financial corporate sector: the ratio of external finance of firms to GDP[9] and a crude measure of leverage, calculated dividing the volume of outstanding loans by the total equity of the corporate sector in 2001[10]. Germany is again at the top of the list for external finance, followed by France, Italy and Spain. Leverage follows the same order, except that France is characterized by a lower value than the other countries. France seems to be atypical also because of a large presence of shares in both the asset and the liability side of the balance sheet of firms. This is likely to reflect the presence of a complex cross-ownership structure that could make simple measures of leverage less meaningful.

The other line of empirical literature we mentioned examines the extent of business cycle synchronization. Earlier studies (Artis and Zhang (1997), Angeloni and Dedola (1999)) find that cross-correlation of real cycles and inflation has risen in recent years among EMU participants. More recently Canova et al. (2002) also find that business cycle synchronization in Europe has been increasing over the 1990's. Interestingly Sensier et al. (2002) identify area specific common factors in business cycle fluctuations across countries belonging to currency areas while Heatcote and Perri (2001) find business cycle divergence across large currency blocs mostly in recent years.

[6] Data are an average over the 1990-1999 and are taken from IBCA Bankscope.

[7] See Cecchetti (1999). A lower value for this statistic identifies a more efficient banking system.

[8] This measures consists in the average interest rate charged in 2003Q1-2004Q2 by all banks on all new loans with maturity greater than one year. This indicator is of particular interest since it is based on a standardized European methodology.

[9] This indicator, taken from Cecchetti (1999), refers to the 1996.

[10] Own calculations using data from Angeloni, Kashyap and Mojon (2003).

3 A Two-Region Model with Financial Heterogeneity

There are two regions of equal size. Regions are symmetric in all respect but differ in the severity of the agency problem which characterizes the contractual relationship between the lender and the borrower.

Each economy is populated by two sets of agents, workers and entrepreneurs, that account for a total measure of one. Each agent is simultaneously consumer and investor. The assumption of agents' heterogeneity is essential in order to model the lender-borrower relationship. Workers are the owners of a monopolistic sector which produces different varieties using capital and labor and faces quadratic price adjustment costs à-la Rotemberg (1982)[11]. Varieties are then assembled into final goods by a competitive production unit. Domestic and imported final goods are also assembled by the competitive unit. Entrepreneurs invest in capital which they rent to the production sector and face idiosyncratic shocks on the return to investment. To finance capital entrepreneurs use internal funds as well as external borrowing. Indeed a financial intermediary collects funds from the workers - i.e. the lenders - and after pooling resources provides loans to the entrepreneurs - i.e. borrowers. As the loan contractual relationship is subject to an agency problem the borrowers must pay a premium on external finance.

Let $s^t = \{s_0, ...s_t\}$ denote the history of events up to date t, where s_t denotes the event realization at date t. The date 0 probability of observing history s^t is given by $\rho(s^t)$. The initial state s^0 is given so that $\rho(s^0) = 1$. Henceforth, and for the sake of simplifying the notation, let's define the operator $E_t\{.\} \equiv \sum_{s_{t+1}} \rho(s^{t+1}|s^t)$ as the mathematical expectations over all possible states of nature conditional on history s^t.

3.1 Workers Behavior in the Each Region

Workers in each country are risk averse and infinitely lived. They consume a variety of goods, supply labor, invest in domestic and international asset markets and run the monopolistic production sector. In what follows I spell out the optimization problem of the domestic workers first. They maximize the following expected discounted sum of utilities:

$$E_t \left\{ \sum_{t=0}^{\infty} \beta^t [U(C_t) - V(N_t)] \right\} \tag{1}$$

where C denotes aggregate consumption in final goods and N denotes total labor hours. U is increasing, concave and differentiable while V is increasing, convex and differentiable. Workers receive at the beginning of time t a labor income of $W_t N_t$, where W_t is the nominal wage. In order to finance consumption at time t they invest in domestic deposits, D_t, which are denominated in

[11] The assumption of a symmetric price adjustment cost allows to model firm decisions within a single production sector. This happens despite the heterogeneity induced by the idiosyncratic shock to the return on capital investment. In the Bernanke, Gertler, Gilchrist (1999) aggregation within one single sector is not possible since the assumption of sticky prices a' la Calvo (1983) induce an extra source of firms heterogeneity.

units of domestic final good and pay a return, R_t^D, one period later. They also invest in a portfolio of internationally traded securities, B_t^*, which are denominated in units of foreign final good and pay a return, R_t^F, one period later. The sequence of budget constraints in units of final goods reads as follows:

$$C_t + D_t + B_t^* e_t^r \leq \frac{W_t}{P_t} N_t + \frac{\Theta_t}{P_t} + R_{t-1}^D D_{t-1} + R_{t-1}^F B_{t-1}^* e_t^r \tag{2}$$

where Θ_t are the nominal profits of the domestic monopolistic firms, whose shares are owned by the domestic residents, $e^r = \frac{eP^*}{P}$ is the real exchange rate while e is the nominal exchange rate. Under the currency area regime the nominal exchange rate is set equal to one. In this case the real exchange rate, $e^r = \frac{P^*}{P}$, equates the ratio of the CPI price levels.

Households choose the set of processes $\{C_t, N_t, D_t, B_t^*\}_{t=0}^{\infty}$ taking as given the set of processes $\{P_t,\ W_t,\ R_t^D, R_t^F\}_{t=0}^{\infty}$ and the initial wealth D_0, B_0^* so as to maximize (1) subject to (2). The following optimality conditions must hold:

$$U_{c,t} \frac{W_t}{P_t} = -U_{n,t} \tag{3}$$

$$U_{c,t} = \beta R_t^D E_t \{U_{c,t+1}\} \tag{4}$$

$$U_{c,t} = \beta R_t^F E_t \left\{ U_{c,t+1} \frac{e_{t+1}^r}{e_t^r} \right\} \tag{5}$$

Equation (3) gives the optimal choice of labor supply. Equation (4) is the Euler condition with respect to home deposits. Equations (5) is the Euler condition with respect to the foreign security.

Arbitrage condition and accumulation of assets. The real interest rate in the home region is given by the return on domestic deposits:

$$R_t = R_t^D$$

Due to imperfect capital mobility and/or in order to capture the existence of intermediation costs in foreign asset markets workers pay a spread between the interest rate on the foreign currency portfolio and the interest rate of the foreign country. This spread is proportional to the (real) value of the country's net foreign asset position:

$$\frac{R_t^F}{R_t^*} = -\zeta \left(e_t^r B_t^* \right) \tag{6}$$

where $\zeta > 0$[12], $\zeta' > 0$. In addition I assume that the initial distribution of wealth between the two countries is symmetric. Aggregating the budget constraints of the workers and substituting for (6)

[12] As shown in Schmitt-Grohe and Uribe (2001) and Benigno (2002) this assumption is needed in order to maintain the stationarity in the model. Schmitt-Grohe and Uribe (2001) also show that adding this spread - i.e. whose size has been found negligible in Lane and Milesi-Ferretti (2001) - does not change significantly the behavior of the economy as compared to the one observed under the complete asset market assumption or under the introduction of other inducing stationarity elements - see Mendoza (1991), Senhadji (1994).

I obtain the following law of motion for the accumulation of bonds:

$$e_t^r B_t^* \leq R_t^* \zeta\left(e_t^r B_t^*\right) e_t^r B_{t-1}^* + [\frac{\Theta_t}{P_t} + \frac{W_t}{P_t} N_t] - [D_t - R_{t-1} D_{t-1}] - C_t \tag{7}$$

Workers in the Foreign Region. I assume throughout that all goods are traded, that both countries face the same composition of consumption bundle and that the *law of one price* holds. This implies that $P_H(i) = eP_H^*(i), P_F(i) = eP_F^*(i)$ for all $i \in [0,1]$. Again under the currency union regime the nominal exchange rate is equal one.

Foreign workers face an allocation of expenditure and wealth similar to the one of the workers in the domestic region except for the fact that they do not pay an additional spread for investing in the international portfolio. The budget constraint of the foreign representative household reads (expressed in units of foreign consumption index) as follows:

$$C_t^* + B_t^* + D_t^* \leq \frac{W_t^*}{P_t^*} N_t^* + \frac{\Theta_t^*}{P_t^*} + R_{t-1}^* B_{t-1}^* + R_{t-1}^{D^*} D_{t-1}^* \tag{8}$$

The efficiency conditions for bonds' holdings and deposits read as follow:

$$U_{c^*,t} = \beta R_t^* E_t \left\{ U_{c^*,t+1} \right\} \tag{9}$$

$$U_{c^*,t} = \beta R_t^{D^*} E_t \left\{ U_{c^*,t+1} \right\} \tag{10}$$

The returns on the deposits and on the international securities are clearly equalized by arbitrage condition.

After substituting equation (6) into equation (5) and after imposing arbitrage between regional returns on international securities I obtain the following relation:

$$E_t \left\{ \frac{U_{c,t+1}^*}{U_{c,t}^*} \right\} = -E_t \left\{ \frac{U_{c,t+1}}{U_{c,t}} \frac{e_{t+1}^r}{e_t^r} \zeta\left(e_t^r B_t^*\right) \right\} \tag{11}$$

which states that marginal utilities across countries are equalized up to a spread for the country risk.

The nominal interest rate are defined as $R_t^{n*} = R_t^* \frac{P_{t+1}^*}{P_t^*}, R_t^n = R_t \frac{P_{t+1}}{P_t}$. Under the currency area regime equation 11 implies that nominal interest rates are equalized up to the country risk:

$$R_t^{*n} = R_t^n \zeta\left(e_t^r B_t^*\right) \tag{12}$$

3.2 The Entrepreneurs in Each Region

In what follows I derive the maximization problem for the entrepreneurs in the home region. The one for foreign entrepreneurs is exactly symmetric. The entrepreneurs are the borrowers in this economy. They consume and invest in capital. In each period they rent to firms in the production sector the existing capital stock that they own and finance investment in new capital. To finance the purchase of new capital they need to acquire a loan from a competitive intermediary that raises funds through deposits.

The return on capital is subject to an idiosyncratic shock, ω^j. At the beginning of each period the entrepreneur observes the aggregate shock. Before buying capital, the entrepreneur goes to the loan markets and borrows money from the intermediary by making a contract which is written before the idiosyncratic shock is recognized. The intermediary can privately observe the idiosyncratic shock only by paying a monitoring cost which is proportional to output production. As this informational asymmetry creates a moral hazard problem the entrepreneur needs to pay a premium to obtain external finance. As we shall see later in the section describing the optimal contract the assumption of a monitoring technology exhibiting constant returns to scale implies *linearity and symmetry* of the relationships which characterize the contracting problem. In turn the linearity of the optimal contract allows aggregation of entrepreneurial consumption and investment demand (simply summing across entrepreneurs). Hence we can spell out the consumption/investment problem of the entrepreneurs by imposing symmetry ex-ante. Finally I assume that entrepreneurs are risk neutral and that they have a survival probability ς[13]. Each Entrepreneur chooses a sequence $\{C_t^e,\, I_t,\, K_{t+1},\, L_t\}_{t=0}^{\infty}$ to maximize:

$$E_0 \sum_{t=0}^{\infty} (\varsigma\beta)^t C_t^e, \quad \varsigma\beta \leq \beta \tag{13}$$

subject to the following sequence of constraints:

$$\frac{Z_t}{P_t} K_t + L_{t+1} + \Sigma_t = C_t^e + I_t + R_t^L L_t \tag{14}$$

$$K_{t+1} = (1-\delta) K_t + I_t - \Phi\left(\frac{I_t}{K_t}\right) K_t \tag{15}$$

Equation (14) is the entrepreneurs' budget constraint in units of final goods. Wealth is derived from rental income $\frac{Z_t}{P_t} K_t$ for production, new loans L_t, and a transfer of wealth, Σ_t, from old agents. The presence of the transfer Σ_t assures that aggregate net wealth is different from zero in the steady state. Expenditure is allocated in final good consumption C_t^e, investment I_t and in the service of the predetermined loan debt, $R_t^L L_t$. Constraint (15) indicates that, when investing in capital, entrepreneurs face adjustment costs. The cost function $\Phi(\cdot)$ is convex and satisfies $\Phi(\delta) = 0$ and $\Phi'(\delta) = 0$, where δ is the depreciation rate of capital.

Let's define $\{\lambda_t, Q_t\}_{t=0}^{\infty}$ as the sequence of Lagrange multipliers on the constraints (14) and (15) respectively. The first order conditions of the above problem read as follows:

$$\lambda_t = 1 \tag{16}$$

[13] In this respect I follow Kiyotaki and Moore (1997) and Carlstrom and Fuerst (1997). This assumption assures that entrepreneurial consumption occurs to such an extent that self-financing never occurs and borrowing constraints on loans are always binding.

$$\lambda_t = \varsigma\beta E_t \left\{ R_t^L \lambda_{t+1} \right\} \tag{17}$$

$$Q_t \left[1 - \Phi' \left(\frac{I_t}{K_t} \right) \right] = \lambda_t \tag{18}$$

$$Q_t = \varsigma\beta E_t \left\{ \frac{Z_{t+1}}{P_{t+1}} \lambda_{t+1} + Q_{t+1} \left(1 - \delta + \frac{I_{t+1}}{K_{t+1}} \Phi' \left(\frac{I_{t+1}}{K_{t+1}} \right) - \Phi(\frac{I_{t+1}}{K_{t+1}}) \right) \right\} \tag{19}$$

Equation (16) simply states that, due to risk neutrality, the marginal utility of additional real income is constant. Equation (17) is the Euler efficiency condition on the loan holding. Equations (18) and (19) are the efficiency conditions on capital investment. Notice that the lagrange multiplier Q_t denotes the real shadow value of installing new capital and thus plays the role of the implicit price of capital (or asset price).

In the simulation experiments I will also assume that entrepreneurs plan production one period in advance. It can be shown that this simply amounts in satisfying the following condition for the price of capital:

$$E_{t-1} \left[1 - \Phi' \left(\frac{I_t}{K_t} \right) \right]^{-1} = E_{t-1} Q_t \tag{20}$$

This hypothesis helps to capture the hump shaped response of investment and a more persistent dynamic of output and investment in response to monetary shocks. However notice that this change in timing is in no way affecting the main qualitative and quantitative results of the model.

In order to derive the aggregate consumption function it is worth to notice that the probability of dying for the entrepreneurs corresponds, by law of large numbers, to the fraction of entrepreneurs that effectively die in each period. The population is held steady by the birth of a new entrepreneur for each dying one. Under those assumptions entrepreneurs behave as permanent income consumers since they consume a constant fraction, ς, of their end of period wealth, NW_t, net of transfers to future generations:

$$C_t^e = \varsigma(NW_t - \Sigma_t) \tag{21}$$

For notational convenience let's define $\mathcal{Y}_t^k \equiv \frac{Z_t}{P_t} + Q_t \left(1 - \delta + \frac{I_t}{K_t} \Phi' \left(\frac{I_t}{K_t} \right) - \Phi(\frac{I_t}{K_t}) \right)$ as the *real income* from holding one unit of capital. Hence the *return* from holding a unit of capital between t and $t+1$ reads as:

$$R_{t+1}^k \equiv E_t \{ \frac{\mathcal{Y}_{t+1}^k}{Q_t} \} \tag{22}$$

3.3 The Loan Contract Between the Borrower and the Financial Intermediary

At the *end of period* t a continuum of entrepreneurs (indexed by j) needs to finance the purchase of new capital K_{t+1}^j that will be used for production in period $t+1$. In order to acquire a loan the entrepreneurs have to engage in a financial contract *before* the realization of an idiosyncratic shock, ω^j (with a payoff paid after the realization of the same shock). The idiosyncratic shock has positive support, is independently distributed (across entrepreneurs and time) with a lognormal distribution, $F(\omega)$, with unitary mean, and density function $f(\omega)$. The return of the entrepreneurial investment is observable to the outsider only through the payment of a monitoring cost $\mu \mathcal{Y}^k_{t+1} K^j_{t+1}$, which is proportional to the expected return on capital purchased at the end of period t .

Before entering the loan contract agreement each entrepreneur owns end-of-period internal funds for an amount NW^j_{t+1} and seeks to finance the purchase of new capital $Q_t K^j_{t+1}$. It is assumed that the required funds for investment exceed internal funds. Hence in every period each entrepreneur seeks for a loan (in real terms):

$$L^j_{t+1} = Q_t K^j_{t+1} - NW^j_{t+1} \geq 0 \tag{23}$$

The financial contract assumes the form of an optimal debt contract à la Gale and Hellwig (1983). When the idiosyncratic shock to capital investment is above the cut-off value which determines the default states the entrepreneurs repay an amount R^L_{t+1}[14]. On the contrary, in the default states, the bank monitors the investment activity and repossesses the assets of the firm.

Default occurs when the return from the investment activity $\omega^j_{t+1} \mathcal{Y}^k_{t+1} K^j_{t+1}$ falls short of the amount that needs to be repaid $R^L_{t+1} L^j_{t+1}$. Hence the *default space* is implicitly defined as the range for ω such that :

$$\omega^j_{t+1} < \varpi^j_{t+1} \equiv \frac{R^L_{t+1} L^j_{t+1}}{\mathcal{Y}^k_{t+1} K^j_{t+1}} \tag{24}$$

where ϖ^j_{t+1} is a cutoff value for the idiosyncratic productivity shock.

3.4 The optimal debt contract

Let's define by $\Gamma(\varpi^j)$ and $1 - \Gamma(\varpi^j)$ the fractions of net capital output received by the lender and the entrepreneur respectively. Hence we have:

$$\Gamma(\varpi^j_{t+1}) \equiv \int_0^{\varpi^j_{t+1}} \omega^j_{t+1} f(\omega) d\omega + \varpi^j_{t+1} \int_{\varpi_{t+1}}^{\infty} f(\omega) d\omega$$

Expected monitoring costs are defined as

$$\mu M(\varpi^j_{t+1}) \equiv \mu \int_0^{\varpi^j_{t+1}} \omega^j_{t+1} f(\omega) d\omega$$

with the *net share* accruing to the lender being $\Gamma(\varpi^j_{t+1}) - \mu M(\varpi^j_{t+1})$. The real return paid on deposits is given by the safe rate, R_t, which as such corresponds, for the lender, to the opportunity cost of financing capital[15]. The *participation constraint* for the lender states that the expected

[14] In every period t this amount must be independent from the idiosyncratic shock in order to satisfy incentive compatibility conditions.

[15] This is also so because of the intra-period nature of the contract.

return from the lending activity should not fall short of the opportunity cost of finance:

$$\mathcal{Y}^k_{t+1} K^j_{t+1} (\Gamma(\varpi^j_{t+1}) - \mu M(\varpi^j_{t+1})) \geq R_t (Q_t K^j_{t+1} - NW^j_{t+1}) \tag{25}$$

The contract specifies a pair $\left\{ \varpi^j_{t+1}, K^j_{t+1} \right\}$ which solves the following maximization problem:

$$Max \ (1 - \Gamma(\varpi^j_{t+1})) \mathcal{Y}^k_{t+1} K^j_{t+1} \tag{26}$$

subject to the participation constraint (25). Let χ_t be the lagrange multiplier on (25). First order conditions with respect to ϖ^j_{t+1} and K^j_{t+1} read as follows:

$$\Gamma'(\varpi^j_{t+1}) = \chi_t (\Gamma'(\varpi^j_{t+1}) - \mu M'(\varpi^j_{t+1})) \tag{27}$$

$$\frac{R^k_{t+1}}{R_t} \left((1 - \Gamma(\varpi^j_{t+1})) + \chi_t (\Gamma(\varpi^j_{t+1}) - \mu M(\varpi^j_{t+1})) \right) = \chi_t \tag{28}$$

In addition, with $\chi_t > 0$, (25) must hold with equality.

3.4.1 Aggregation

Two assumptions make aggregation feasible: 1) A constant fraction ς of entrepreneurs remain alive in every period. 2) The optimal contract involves both a cut-off value and an external finance premium which are linear with respect to the capital-wealth ratio of each entrepreneur.[16]

3.4.2 Premium on External Finance and Leverage Ratio

Combining (27) and (28) and aggregating yield the following relation between the return on capital and the safe return paid on deposits:

$$R^k_{t+1} = \rho(\varpi_{t+1}) R_t \tag{29}$$

where

$$\rho(\varpi_{t+1}) = \left[\frac{(1 - \Gamma(\varpi_{t+1}))(\Gamma'(\varpi_{t+1}) - \mu M'(\varpi_{t+1}))}{\Gamma'(\varpi_{t+1})} + (\Gamma(\varpi_{t+1}) - \mu M(\varpi_{t+1})) \right]^{-1} \tag{30}$$

with $\rho'(\varpi_{t+1}) > 0$. Let's define $rp_t \equiv \frac{R^k_{t+1}}{R_t}$ as the *premium on external finance*. This ratio captures the difference between the cost of finance reflecting the existence of monitoring costs and the safe interest rate (which per se reflects the opportunity cost for the lender). By combining (25) with (30) one can write a relationship between the ex-post external finance premium, rp_t, and the capital expenditure and net worth ratio, $\frac{Q_t K_{t+1}}{NW_{t+1}}$:

[16] Carlstrom and Fuerst (1997), Bernanke, Gerlter and Gilchrist (1999).

$$\frac{R^k_{t+1}}{R_t} = rp_t(\frac{Q_t K_{t+1}}{NW_{t+1}}) \tag{31}$$

with $rp^{'}(\frac{Q_t K_{t+1}}{NW_{t+1}}) > 0$[17]. An increase in net worth or a decrease in the leverage ratio reduces the optimal cut-off value, as shown by equation (24). By reducing the size of the default space it also reduces the size of the monitoring cost and the external finance premium. Equation (31) can also be written in terms of borrowing limits:

$$L_t = NW_t[rp_t^{-1}(\frac{R^k_{t+1}}{R_t}) - 1] \tag{32}$$

3.4.3 Net Worth Accumulation

Aggregate net worth at the end of period t is proportional to the realization of capital income:

$$NW_{t+1} = \varsigma(1 - \Gamma(\varpi_{t+1}))\mathcal{Y}^k_t K_t \tag{33}$$

By lagging (25) of one period and combining with (33) one can describe the evolution between period t and $t+1$ of aggregate nominal net worth as:

$$\begin{aligned} NW_{t+1} \quad = \quad & \varsigma R^k_t Q_{t-1} K_t \\ & -\varsigma\left(R_t + \frac{\mu M(\varpi_t) R^k_t Q_{t-1} K_t}{Q_{t-1}K_t - NW_t}\right)(Q_{t-1}K_t - NW_t) \end{aligned} \tag{34}$$

where $\frac{\mu M(\varpi_t) R^k_t Q_{t-1} K_t}{Q_{t-1}K_t - NW_t}$ is the ex-ante external finance premium which augments the nominal safe return on deposits R_t and which is required by the bank to cover the monitoring costs. We can then rewrite the net worth accumulation equation as follows:

$$NW_{t+1} = \varsigma[R^k_t Q_{t-1} K_t - \left(R_t + rp_{t-1}(\frac{Q_{t-1}K_t}{NW_t})\right)(Q_{t-1}K_t - NW_t)] \tag{35}$$

3.5 Demand Aggregation

The final good X is obtained by assembling domestic and imported intermediate goods via the aggregate production function:

$$X_t = \left((1-\gamma)^{\frac{1}{\eta}} X_{H,t}^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} X_{F,t}^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}} \tag{36}$$

[17] The specific form of this relation depends upon assumptions on the probability distribution of idiosyncratic shocks. Necessary and sufficient conditions to the uniqueness of the solution for the cut-off value, ϖ, require a probability distribution featuring a decreasing hazard rate - i.e. a uniform or a lognormal. Here I assume a lognormal distribution.

where $X_{H,t} \equiv \left(\int_0^1 X_{H,t}(i)^{\frac{\vartheta-1}{\vartheta}} di\right)^{\frac{\vartheta}{\vartheta-1}}$ and $X_{F,t} \equiv \left(\int_0^1 X_{F,t}(i)^{\frac{\vartheta-1}{\vartheta}} di\right)^{\frac{\vartheta}{\vartheta-1}}$ are composite aggregates of domestic and imported intermediate goods respectively. The composite final good can be then used for consumption and investment. Optimal demand for each variety of the final good are given by[18]:

$$X_{H,t}(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\vartheta} X_{H,t}; \quad X_{F,t}(i) = \left(\frac{P_{F,t}(i)}{P_{F,t}}\right)^{-\vartheta} X_{F,t} \tag{37}$$

$$X_{H,t} = (1-\gamma)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} X_t \ ; \quad X_{F,t} = \gamma\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} X_t \tag{38}$$

where $P_{H_t} \equiv \left(\int_0^1 P_{H,t}(i)di\right)^{\frac{\vartheta}{\vartheta-1}}$, $P_{F,t} \equiv \left(\int_0^1 P_{F,t}(i)di\right)^{\frac{\vartheta}{\vartheta-1}}$, $P_t \equiv [(1-\gamma)P_{H,t}^{1-\eta} + \gamma P_{F,t}^{1-\eta}]^{\frac{1}{1-\eta}}$ are the respective price indices.

3.6 Production and Pricing of Intermediate Goods

Each domestic household owns an equal share of the intermediate-goods producing firms. Each of these firms assembles labor (supplied by the workers) and entrepreneurial capital to operate a constant return to scale production function for the variety i of the intermediate good:

$$Y_t(i) = A_t F(N_t(i), K_t(i)) \tag{39}$$

where A_t is a productivity shifter common to all entrepreneurs. Each firm i has monopolistic power in the production of its own variety and therefore has leverage in setting the price. In so doing it faces a quadratic resource cost of adjusting prices equal to:

$$\varkappa_t(i) = \frac{\omega_p}{2}\left(\frac{P_{H,t}(i)}{P_{H,t-1}(i)} - 1\right)^2$$

where the parameter ω_p measures the degree of nominal price rigidity. The higher ω_p the more sluggish is the adjustment of nominal prices. In the particular case of $\omega_p = 0$ prices are flexible. The problem of each domestic monopolistic firm is the one of choosing the sequence $\{K_t(i), N_t(i), P_{H,t}(i)\}_{t=0}^{\infty}$ in order to maximize expected discounted real profits:

$$E_0\left\{\sum_{t=0}^{\infty} \beta^t U_{c,t} \frac{\Theta_t}{P_{H,t}}\right\} \tag{40}$$

subject to the constraint:

$$Y_t(i) = A_t F(N_t(i), K_t(i)) \geq \left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\vartheta} X_t^W \tag{41}$$

[18] Optimal demands are derived solving the following maximization: $\{X_{H,t}(i), X_{F,t}(i)\}_{t=0}^{\infty}$ to maximize $P_t X_t - \int_0^1 P_{H,t}(i) X_{H,t}(i) di - \int_0^1 P_{F,t}(i) X_{F,t}(i) di$.

where $\Theta_t \equiv P_{H,t}(i)Y_t(i) - (W_t N_t(i) + Z_t K_t(i)) - P_{H,t}\varkappa_t(i)$[19] and where $X_t^W \equiv X_{H,t} + X_{H,t}^*$ is world demand for the domestic intermediate variety i. Since adjustment costs are symmetric across firms and since ultimately all firms will charge the same price we can impose symmetry conditions. Let's denote by $\{mc_t\}_{t=0}^{\infty}$ the sequence of lagrange multipliers on the constraint (41) and by $\widetilde{p}_{H,t} \equiv \frac{P_{H,t}(i)}{P_{H,t}}$ the relative price of variety i. The first order conditions of the above problem read as follows:

$$\frac{W_t}{P_{H,t}} = mc_t A_t F_{n,t} \tag{42}$$

$$\frac{Z_t}{P_{H,t}} = mc_t A_t F_{k,t} \tag{43}$$

$$\begin{aligned} 0 \quad = \quad & U_{c,t} X_t^W \widetilde{p}_{H,t}{}^{-\vartheta} \left((1-\vartheta) + \vartheta mc_t\right) - U_{c,t}\omega_p \left(\pi_{H,t}\frac{\widetilde{p}_{H,t}}{\widetilde{p}_{H,t-1}} - 1\right)\frac{\pi_{H,t}}{\widetilde{p}_{H,t-1}} \\ & + \beta U_{c,t+1}\omega_p \left(\pi_{H,t+1}\frac{\widetilde{p}_{H,t+1}}{\widetilde{p}_{H,t}} - 1\right)\pi_{H,t+1}\frac{\widetilde{p}_{H,t+1}}{\widetilde{p}_{H,t}{}^2} \end{aligned} \tag{44}$$

where $\pi_{H,t} \equiv \frac{P_{H,t}}{P_{H,t-1}}$is the gross inflation rate. Notice that the lagrange multiplier mc_t plays the role of the *real* marginal cost of production.

3.7 The Equilibrium Conditions

I focus attention on a *symmetric* equilibrium where all domestic producers charge the same price. This implies that:

$$\widetilde{p}_{H,t} = 1, \text{ for all } t \tag{45}$$

In such an equilibrium equation (44) will simplify to:

$$\begin{aligned} U_{c,t}\left(\pi_{H,t} - 1\right)\pi_{H,t} \quad = \quad & \beta E_t\left\{U_{c,t+1}\left(\pi_{H,t+1} - 1\right)\pi_{H,t+1}\right\} \\ & + U_{c,t} A_t F(.)\frac{\vartheta}{\omega_p}\left(mc_t - \frac{\vartheta - 1}{\vartheta}\right) \end{aligned} \tag{46}$$

The world net supply of bonds is zero. Market clearing for domestic variety i must satisfy:

$$\begin{aligned} Y_t(i) \quad & = \quad X_{H,t}(i) + X_{H,t}^*(i) + \varkappa_t(i) + U_t(i)K_t(i) \\ & = \quad \left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\vartheta}\left[\left(\frac{P_{H,t}}{P_t}\right)^{-\eta}(1-\gamma)X_t + \left(\frac{P_{H,t}^*}{P_t^*}\right)^{-\eta}\gamma^* X_t^*\right] + \varkappa_t(i) + U_t K_t(i) \end{aligned} \tag{47}$$

[19] Under the assumption of Cobb-Douglas production technology it is possible to show that the term $(W_t N_t + Z_t K_t)$ is equal to the marginal cost for firms.

for all $i \in [0,1]$ and t. Where $U_t = \mu M(\varpi_t) R_t^k Q_{t-1}$ and represents an output loss due to the presence of monitoring costs. Plugging (47) into the definition of aggregate output $Y_t \equiv \left[\int_0^1 Y(i)^{1-\frac{1}{\vartheta}}\, di\right]^{\frac{\vartheta}{\vartheta-1}}$ and recalling that $P_{H,t} = e_t P_{H,t}^*$ we can express the resource constraint as:

$$Y_t = \left(\frac{P_{H,t}}{P_t}\right)^{-\eta} (1-\gamma)\; X_t + \left(\frac{P_{H,t}}{e_t P_t^*}\right)^{-\eta} \gamma^* X_t^* + \frac{\omega_p}{2}\left(\pi_{H,t} - 1\right)^2 + \mu M(\varpi_t) R_t^k Q_{t-1} K_t \qquad (48)$$

For the foreign country a similar condition holds. Market clearing in the final good sector for both countries implies:

$$X_t = C_t + I_t + C_t^e \qquad (49)$$

$$X_t^* = C_t^* + I_t^* + C_t^{*e} \qquad (50)$$

Finally the real demand for loan has to be equal to the real supply of loans for both countries:

$$D_t = L_{t+1}; D_t^* = L_{t+1}^* \qquad (51)$$

3.8 The Monetary Policy Regimes

Currency Area. I assume a *unified monetary policy* that sets the nominal interest rate endogenously. Since the model is tailored for the euro area I assume that the monetary authority targets a weighted average of CPI inflation rates and output in the area:

$$R_t^n = (R_{t-1}^n)^{\chi}((\frac{\pi_t + \pi_t^*}{2})^{b_\pi})^{1-\chi}((\frac{y_t + y_t^*}{2})^{b_y})^{1-\chi} m_t \qquad (52)$$

where $R_t^n = R_t \frac{P_{t+1}}{P_t}$ and b_π is the weight that the monetary authority puts on the deviation of CPI inflation and is set equal to 1.5. m_t is a temporary monetary policy shock. Following recent estimates by Smets and Wouters (2003) I set $b_y = 0.5$. In addition following Clarida, Gali' and Gertler (2000) and Rotemberg and Woodford (1997) I assume that monetary policy applies a certain degree χ of interest rate smoothing. Aside from being consistent with most evidence on monetary policy rules the interest rate smoothing helps to generate more persistent effect of monetary policy shocks.

Independent Policies. To assess the role of the EMU I will compare the results of the model for the currency area with the ones arising under a regime of independent monetary policies that target their respective CPI indices:

$$R_t^n = (R_{t-1}^n)^{\chi}((\pi_t)^{b_\pi})^{1-\chi}((y_t)^{b_y})^{1-\chi} m_t; R_t^{n*} = (R_{t-1}^{*n})^{\chi}((\pi_t^*)^{b_\pi})^{1-\chi}((y_t^*)^{b_y})^{1-\chi} m_t^* \qquad (53)$$

I assume the two rules being perfectly symmetric and the monetary shocks being symmetric and correlated as well.

Unilateral Peg. Finally I examine the comparison between a currency area and a unilateral currency peg. In the first case both regions agree to delegate the monetary policy to a common monetary authority. In the second case the home region sets the nominal interest rate by targeting its own CPI inflation rate while the foreign region sets the nominal interest rate equal to the one of the home region. This outcome is also achieved under the assumption that the foreign monetary authority follows a rule of the type:

$$R_t^{n*} = (R_{t-1}^{*n})^{\chi}((\pi_t^*)^{b_\pi})^{1-\chi}((y_t^*)^{b_y})^{1-\chi}(e_t)^{\frac{b_e}{1-b_e}} m_t^* \tag{54}$$

and with a coefficient $b_e = 0.99$. In other words I assume that the foreign monetary authority applies an infinite weight on the exchange rate variability[20].

4 Calibration

The model is parametrized as indicated in tables (2) and (3). The countries are symmetric in all respect but differ in their financial systems. Time is measured in quarters.

Preferences. I set the workers' discount factor $\beta = 0.99$, so that the annual interest rate is equal to about 4 percent. I assume that the per-period utility takes the following form: $\frac{C_t^{1-\sigma}}{1-\sigma} + \frac{N_t^{1+\tau}}{1+\tau}$. I set the elasticity of substitution between domestic and foreign goods η equal to 1.5 as in Backus, Kehoe and Kydland (1992). The parameter on consumption in the utility function is set equal to 1.0 to ensure a steady state balanced growth path. The parameter on labor in the utility function, τ, is set equal to 3,which implies a labor supply elasticity of $\frac{1}{3}$[21]. I set the steady state ratio of exports over GDP, γ, equal to 0.2, a value compatible with data for euro area countries - i.e. see Kollmann (2004). Finally, I assume that the steady state net asset position is symmetric between the two countries. Following Schmitt-Grohe and Uribe (2002) and consistently with Lane and Milesi-Ferretti (2002) I set the elasticity of the spread on foreign bonds to the net asset position equal to 0.000742.

Production. The share of capital in the production function, α, is equal to 0.35. The quarterly depreciation rate, δ, is set equal to 0.03. Following Basu and Fernald (1997), I set the value added mark-up of prices over marginal cost equal to 0.2. This generates a value for the price elasticity of demand, ϑ, of 6. Given the assigned value for the price mark-up and consistently with the Sbordone (1998) estimates of the elasticity to marginal cost in the Phillips curve I set the price adjustment cost parameter equal to $\omega_p = 17.5$. The adjustment cost parameter on investment has been set to 1.2. The latter has been chosen so as to generate a volatility of investment higher than the volatility of consumption as observed in the data. In order to test the robustness of the results, checks have been performed on several alternative parameter combinations. The results remain essentially unchanged.

Financial frictions parameters. The asymmetries between the two countries are built assuming three different financial scenarios for the foreign country given one particular scenario for

[20] See also Monacelli (2004).

[21] Sensitivity analysis on this parameter ranging from a value of 2 to the value of 3, shows that quantitative results remain unchanged.

the home country. The differences in financial structures are calibrated so as to correspond to the four largest countries of the euro area - i.e. Germany, France, Italy and Spain -. For these countries I calculate historical averages over the last ten years of the spread between lending rates on all outstanding loans and money market rates with maturity up to one year. I obtain a value of 450 basis points for Germany, of 350 basis points for France, of 250 basis points for Italy and 150 basis points for Spain, all at annual rate[22]. These measures correspond to the external finance premium of the theoretical model. I then calibrate the home country using data for Germany, which is the largest country of the euro area and its monetary anchor, and I set the foreign country under three alternative scenarios which correspond respectively to the calibration for France, Italy and Spain[23]. Clearly those scenarios correspond to an increase in financial distance with respect to Germany.

Shocks. I simulate the model under monetary policy and productivity shocks.

The monetary policy shock, m_t, is assumed to have zero persistence. Volatility and cross-correlation of the shocks are calibrated using data for monetary policy shocks of individual euro area countries[24]. For the independent policy regime the standard deviations of the shocks is set to 1.0007 percent and the cross- correlation to 0.5. In the currency area regime the standard deviation of the single monetary policy shock is set to 1.0007 percent.

The productivity shock is calibrated using the value obtained in Smets and Wouters (2003) who estimate a dynamic general equilibrium model for the euro area. Hence volatility of the technology shock is set to 0.006, persistence of the technology process is set to 0.9, while cross-correlation is set to 0.258.

[Table (2) about here]

[Table (3) about here]

5 Quantitative Results under Different Monetary and Financial Regimes

In this section I explore the implications of the model along two dimensions. First, I compare the transmission mechanism across different scenarios concerning the structures of the financial sectors.

[22] Data show that there has not been convergence in financial structures over the last years. Indeed the dispersion in the external finance premium across countries has been of 1.87 in the last decade and of 1.27 in the previous decade.

[23] In the model the external finance premium is obtained as solution to a costly state verification contract which depends on a set of primitive parameters - i.e. the survival probability of firms, the monitoring cost and the volatility of idiosyncratic shock. I set the survival probability of firms to 0.97 so as to generate an annual default probability of firms of 5.6%. The latter value is compatible with both empirical and theoretical studies for industrialized countries. I then set the monitoring cost and the volatility of the idiosyncratic shock so as to generate the numbers obtained in the data for the external finance premia. The latter are in turn determinants of the sensitivity of the external finance to the collateral conditions.

[24] Data on monetary policy shocks are obtained as residuals from the VAR estimated in Mojon and Peersman (2000). Their identification procedure is particularly suitable in our case since it allows for differences in monetary policy regimes across countries.

Second, I also compare, for each financial regime, the transmission mechanism arising in a currency area with that arising under our two alternative monetary arrangements: an independent monetary policy regime and a unilateral credible peg.

Central bank preferences are assumed to be the same in all cases. In the currency area, the common monetary authority sets the interest rate so as to target the area-wide CPI inflation, i.e. a simple average of the inflation rates in the two countries (assumed equal). Under independent policies, each monetary authority targets its own CPI inflation rate. Under a unilateral peg, the home country targets its own inflation rate, while the foreign one pegs its exchange rate which requires setting its nominal interest rate equal to the one of the home country. Finally I assume that under the independent policy regime two symmetric and correlated monetary shocks hit the nominal interest rates set by each monetary authority, while under the unilateral peg I assume an idiosyncratic monetary shock affecting the home region. In all cases productivity shocks are set as described in the calibration section.

5.1 Currency Area

Before examining the model statistics it is instructive to consider the impulse responses to monetary policy shocks only. This illustrates the properties of the monetary transmission mechanism of the present model. Figures (1) and (2) show, for the home and the foreign countries respectively, impulse responses to a common monetary policy shock under the three financial scenarios. In each case the home country is parametrized as in the first column of table (3), while the parametrization for the foreign country is moved from scenario 1 to scenario 3 of the same table. This comparison allows to explore the effects of an increase in the financial distance.

In both countries a monetary expansion reduces the nominal interest rate, inducing a decrease in the cost of the loan and an increase in investment demand. The net worth of firms increases, both due to the jump reduction in the interest rate, and following the increase in investment, thereby inducing a decrease in the external finance premium. The consequent increase in credit availability induces further increase in investment demand, hence amplifying the initial positive boost in capital spending. The dependence of net worth from past values tends to increase the persistence of the impulse response functions and the assumption of one period investment delays induces an hump shape dynamics for investment. Those effects are analogous to the ones present in the "financial accelerator" literature in closed economies[25]. Here, however, two further dimensions come about, due to the open economy context. First, due to financial heterogeneity a differential transmission mechanism arises in response to the common monetary policy shock. Second, due to the differentiation in production opportunities there are capital flights toward the region with the more profitable investment opportunities despite the absence of asymmetric shocks to productivity.

In particular when moving from the first to the third scenario the foreign country experiences a lower increase in investment demand and net worth while the domestic one experiences an op-

[25] See Bernanke, Gertler and Gilchrist (1999), Kiyotaki and Moore (1997), Carlstrom and Fuerst (1997).

posite effect albeit small. The reason is that in a currency area the two national economies face different borrowing conditions due to the different riskiness of investment projects, hence different marginal productivity of capital and production structures. Capital flows occur towards countries characterized by higher sensitivity of the investment demand in response to decrease in the cost of loans - the home country in our case. Hence, as one moves from the first to the third scenario there are increasing capitals flows from the foreign to the home country. A current account worsening at home mirrors an appreciations in the real exchange rate. Furthermore, there is a differential effect on domestic and foreign inflation, hence leading to an inflation differential. Given the increase in aggregate demand in both countries, both domestic and foreign inflations increase; however the foreign inflation is more volatile than the domestic one.

Table (4) shows cross-correlations[26] of output, investment, consumption , employment, price of capital and inflation in response to the common monetary policy shock and to symmetric and correlated productivity shocks. All the correlations are positive but decreasing when moving from scenario 1 to scenario 3. In other words co-movements decrease when financial distance increases. It is worth noticing that the change in the cross-correlations of output and investment across the three scenarios is bigger than the change in the cross-correlations of employment. The reason is as follows. In a sticky price model output changes are driven by the demand side (consumption and investment) in the short run and by the supply side at longer frequencies. This is contrast with a flexible price model where output is driven by employment and productivity. Countries with similar financial accelerator parameters have similar investment and output dynamics, but not necessarily similar employment dynamics due to the countercyclicality of the marginal cost of capital in the financial accelerator.

Table (4) also shows second moments of output, investment, consumption, employment and the price of capital. As one moves from scenario 1 to scenario 3 (lower financial frictions in the foreign country), the volatilities of the foreign price of capital declines, as one would expect. Consequently, the volatility of foreign investment also declines. On the contrary, a (small) increase is observed in the volatility of foreign consumption and employment. This is due to the fact that the volatilities of the real exchange rate and the terms of trade increase. Indeed in general equilibrium, relative consumption between countries is linked to the real exchange rate, while the dynamic of labor effort is linked to the dynamic of the terms of trade through the labour market equilibrium condition[27].

[26] Given the reduced form of the log-linearized model $E\{X_t\} = AX_{t-1} + b\varepsilon_t$, where X_t is the matrix of the endogenous variables, A is the transition matrix and ε_t is the vector of the exogenous shocks and given the variance covariance matrix of shocks, $\Psi = b * \Sigma_\varepsilon * b'$, the second moments matrix, Ω, for the endogenous variables is given by $\Omega_{as} = \lim_{k \longrightarrow \infty}\{\sum_{i=0}^{k}(A^i)\Psi(A^i)'\}$. The numbers reported in the tables have been calculated by approximating Ω_{as} by Ω_{k+1} so that the $\max[\Omega_{k+1} - \Omega_k] \geq 1.0e-0.8$, with max being the maximum distance between any two elements of the matrix $\Omega_{k+1} - \Omega_k$.

[27] Combining equations (3) and (42) we obtain: $-\frac{U_{n,t}}{U_{c,t}}\frac{P_t}{P_{H,t}} = mc_t A_t F_{n,t}$,where $\frac{P_t}{P_{H,t}} = [(1-\gamma) + \gamma \frac{P_{F,t}}{P_{H,t}}^{1-\eta}]^{\frac{1}{1-\eta}}$. This condition shows the link between labor effort and the terms of trade.

5.2 Independent monetary policies

Figures (3) and (4) show impulse responses to symmetric and correlated monetary policy shocks respectively for home and foreign variables under the independent policies regime and assuming the same three financial scenarios. As before, in each case the home country is parametrized as in the first column of table (3), while the parametrization for the foreign country is moved from scenario 1 to scenario 3 of the same table.

The transmission mechanism is qualitatively similar to the one experienced by the currency area. However, in this case the differential responses are more pronounced. This is because in this case not only the external finance premium but also the risk-free component of the interest rate differ across regions, due to the independent and endogenous response of the regional monetary authorities.

Table (5) shows cross-correlations of output, investment, consumption, employment, price of capital and inflation in response to symmetric and correlated monetary policy and productivity shocks. As before co-movements decrease when financial distance increases. However, now all correlations are lower than under the currency area regime. The table also shows second moments of output, investment, consumption, employment and price of capital. The pattern of volatilities across scenarios is very similar to the one observed in the currency area regimes except that now all values are slightly lower.

5.3 Unilateral peg

I now examine the case where a country unilaterally decides to peg its exchange rate to another country, thereby adopting its monetary policy. What makes this case interesting is the fact that such regime was adopted as an intermediate step by a number countries wishing to join the European currency area later. Most of these countries were small and relatively open. In the 1990s, examples of countries opting for a unilateral peg before joining EMU were the Netherlands and Austria. Presently, unilateral hard pegs are in force e.g. in Estonia (which follows a currency board with the euro) and Slovenia (which unilaterally euroised), both of which plan to become full euro area members within this decade. The key difference between this regime and the currency area is that the domestic monetary authority targets its own inflation rate, while disregarding that of the foreign country, whereas in the currency area the target inflation rate is an average of the two inflation rates. I assume that the unilateral currency peg is fully credible − this is a key assumption, to which I will return later. Against this background, the question I ask is how the macroeconomic outcomes under this peg compare with those resulting from a currency area regime. To make the experiment more realistic I assume that the foreign country - the one pegging the exchange rate - has a higher degree of openness ($\gamma^* = 0.4$) than the home country ($\gamma = 0.2$).

Figure (5) shows impulse responses of home and foreign variables under the usual three financial scenarios and assuming a positive monetary policy shock at home. The key finding is that under this arrangement the dynamic pattern of variables in the two regions is very similar to the one that arises under the currency area regime (though obviously not identical). Table (6) shows cross-correlations and second moments of output, investment, consumption, employment, price of capital and inflation and second moments for output, investment, consumption, employment and asset price in both countries in response to a domestic monetary policy shocks and to symmetric and correlated productivity shocks. As before co-movements decrease when financial distance increases. The values of all correlations are basically equal to the ones that arise under the currency area regime. Volatilities are also very similar to the ones of the currency area[28]. Notice that the volatility of the real exchange rate in this case is slightly lower than the one obtained under the currency area regime. This shows that under the unilateral peg the inflation differentials between the two regions are very small.

The similarity between the quantitative properties of the two alternative regimes depends on the fact that in this experiment the inflation rate gap between the two countries is not large enough to produce different results depending on whether the monetary policy targets the home country inflation only or a combination of the two inflation rates. All this critically hinges on the assumption of full credibility of the hard peg. The expected future exchange rate remains fixed under a peg only if the announced policy is credible. In practice, however, as shown by many cases of failed currency pegs, credibility cannot be assured. A single currency area is the only arrangement that makes exchange rates irrevocable in a credible way.

5.4 Summary of model results

The results in this section can be summarized as follows:

Result 1: For each monetary regime, the cyclical co-movements across countries decrease when the financial distance increases.

Result 2: In presence of structural differences in financial markets, regional co-movements are higher in the case in which the two countries share the same monetary policy than when each one retains its own independent policy.

Result 3: Under a unilateral peg, with different degree of trade openness, business cycle co-movements are broadly similar to those experienced under a currency area.

6 Comparing Model Predictions with the Data

The last step is to match the predictions of the model with the observed co-movements of the economic cycles. Our goal is to show that the model can broadly reproduce the variation in business cycle co-movements observed across space and time, based on differences in the degree of financial distance and in the monetary regimes. We use the recent experience of Europe as testing

[28] This similarity holds even if we reverse the experiment and assume that the country pegging the exchange rate is financially more fragile than the home country.

ground. Evidently, the empirical fit can only be imperfect due to the stylized nature of the model and to the fact that other factors may have entered the picture, in addition to the two we study. Nonetheless, a good match between model and data will be prima facie evidence that the model possesses explanatory power.

We first look at our four euro area countries (Germany, France, Italy, Spain), before and after EMU. Then, for comparison, we will look at the US and the UK. These two countries are useful control cases since they are large trading partners of the four countries, and have not adopted the euro nor pegged to it. As proxies of the business cycle I will consider four variables: output, private consumption, gross private capital formation and total employment[29].

6.1 Euro area countries

The sample periods are chosen so as to strike a balance between the need of keeping the sample size sufficiently long in the post-EMU period (for the earlier period no data limitations exist), and that of properly measuring the correlations after the introduction of the euro. My sample for the second period starts in 1997, thus including two years before the actual launch of the euro, based on the fact that in these two years monetary policy among the future euro area members was closely in line[30]. The two samples are then: pre-EMU: 1971-1996; post-EMU: 1997-2004Q1. All data are in logs and de-trended using a Hodrick Prescott filter[31]. The business cycle correlations are calculated between the de-trended variables for Germany and the corresponding ones for each of the other three countries – France, Italy and Spain.

Table (7) shows the correlations obtained from the data and the corresponding ones from the model. The model correlations for the independent policy regime and the currency area regimes are compared respectively with empirical cross-correlations for the pre-EMU and the post-EMU period.

The comparison shows that the model is quite successful in matching the data. First, in both the data and the model there is a clear tendency for the correlations to increase when moving from the independent policy regime (pre-EMU) to the currency area regime (post-EMU), for each level of financial distance, and to decrease with the increase of the financial distance, for each policy regime. This is the main qualitative prediction of the model and is matched by the data very closely. Second, also the absolute levels of the correlations and the size of their changes when moving across regimes are not dissimilar between the model and the data. Consider, for example, the increase in correlation when moving from independent policies to the currency area (the column labelled as "Regime differences" reported in the right-hand side of the table (7)). For the Germany-France pair, the increase from the data is 0.17, 0.41 and 0.24 respectively for output, investment and consumption, against 0.27, 0.37 and 0.11 predicted by the model. A summary measure of the

[29] I do not consider the evolution of labor hours simply because these data are not available for European countries.
[30] See Angeloni and Dedola (1999).
[31] The filter has been applied on data ranges which cover at least one cycle.

model's ability to explain the increase in cyclical co-movements when moving from the pre-EMU to the post-EMU regime can be given by the simple average of the correlations increases for this three variables. The simple average of the three is 0.27 vs. 0.25 (see Table (8)), which suggests that the model explains on average 91 percent of the increases in correlation that occurs in these three expenditure components when one moves from independent monetary policies to a common currency under scenario 1 (Germany versus France). The result is similar for the Germany-Italy pair (0.24 vs. 0.21, or 90 percent), and somewhat worse for the Germany-Spain pair (0.41 vs. 0.19, or 46 percent). Interestingly, the data matching is significantly less good for employment, a variable for which the model systematically over-predicts the increase in correlation occurred between the pre-EMU and the post-EMU periods. On reflection this does not come as a surprise, however, if one considers that the model calculates employment around a full employment steady state, whereas all four countries have enacted, in the transition between the pre-EMU and the post-EMU regimes, labor market policies that have changed their structural employment levels.

The other dimension along which the table results are interesting is by column, i.e. when one considers changes in the financial distance for any given type of monetary regime. The differences between the country pairs are reported in the lower section of the table (7) in the column labelled as "Countries/scenarios differences". Consider again the average of the differential correlations of output, investment and consumption (lower section of Table (8)). One sees that the historical data predict a decrease in correlation, when the financial distance rises from the first scenario (Germany vs. France) to the second (Germany vs. Italy) of 0.06 in the pre-EMU and of 0.10 in the post-EMU. The model counterparts are 0.05 and 0.08. Between the first and the third scenario the match is very good for the post-EMU period (0.13 in the data vs. 0.15 in the model), but not so good in the pre-EMU period (0.27 in the data against 0.09 in the model); this is conceivably due to the fact that, before EMU, the monetary policy was much less tightly coordinated between Germany and Spain than it was between Germany and the other two countries[32].

Note further that the changes in the correlations between the first and the second scenarios are small relative to the ones between the first and the third scenarios, both in the data and in the model, which shows that the model calibration captures the fact that the distance between France and Italy is lower than that between France and Spain.

In conclusion: the model is quite successful in mimicking the changes in the patterns of business cycle correlations among the four main euro area countries. Specifically, the model's prediction that cyclical correlation would increase when moving from autonomous monetary policy to a currency area, and decrease with the increase of the financial distance, correspond to what observed in the data both qualitatively and quantitatively.

[32]The cross-country correlation of the estimated VAR residuals estimated by Peersman and Mojon (2002) are, for the Germany-Spain VAR, 0.08, and for the Germany-France and Germany-Italy pairs, 0.2 and 0.16 respectively. If we include this further difference in the model, the match with the data becomes almost perfect.

6.2 Control Countries: UK and US

Table (9) shows analogous results referred to the US and the UK. Since both countries maintained floating exchange rates in both periods, the regime does not change. The model is calibrated using comparable measures of the external finance premium; given the dominant role of the corporate bond market in both countries, the premia are proxied by the spreads of B-rated corporate bonds over riskless rates of similar maturity. In the US, this premium rose between the two periods from 1.6 to 2.4 percent, in the UK between 1.0 and 1.8.

The results show a very good fit for the US: taking again the average of output, investment and consumption the correlation between the tho period rises by 0.11 in the data, and by 0.08 in the model. The match is somewhat lower for the UK, 0.23 vs. 0.12. In thinking about these results one should consider that a number of other aspects have changed in the economies concerned between the two periods, besides the financial distance. In particular, most euro area countries have enacted market-friendly reforms in the labor market. The fact that these reforms are not incorporated in my model explains why the model tends to underrepresent the change in the cyclical co-movements across the two periods[33].

7 Conclusions

The recent empirical literature has stressed, so far separately, two aspects concerning the relation between monetary policy and business cycles. First, the transmission of monetary policy depends on the country's financial structure. Second, the international transmission of shocks among open economies depends on the monetary policy and exchange regime.

In this paper I propose a unitary framework linking together these two areas of research. In the first part of the paper, using a standard 2-country stochastic dynamic general equilibrium model with financial accelerator I show that, first, the cyclical correlation among the main cyclical variables increases when moving from an independent monetary policy regime with floating exchange rate to a currency area, and, second, decreases if the difference in the financial structures increase. My proxy of the financial diversity is the premium paid by firms to obtain external finance. In the second part of the paper I compare the prediction of the model, calibrated to the main euro area countries (Germany, France, Italy, Spain), with the empirical correlations observed among the same countries before and after the European monetary unification, and show that the model captures well the broad features of the data.

It needs stressing that the analysis of the paper is positive, not normative. The focus was on modelling and explaining the cyclical co-movements (or lack thereof), not on analyzing their

[33] If one considers the comparisons across countries, whose results are not reported here for brevity, the model performs equally well. For example, in pre-EMU period the model explains two thirds of the higher correlation of the Germany vs. France pair relative to the Germany vs. US pair, and about half of the higher correlation relative to the Germany vs. UK pair. Post-EMU, the corresponding percentages are 135 and 81 percent.

welfare implications. The latter are, however, a natural possible extension. The optimal degree of convergence and cyclical co-movement inside the euro area is an open question at this stage. A micro-founded model like the one used here could be used, for example, to answer questions on the welfare gains from different structural reforms in the financial markets.

In closing, one aspect in which the matching of the model is less than satisfactory should be mentioned, because it indicates an area where the model could be enriched in the future. The model does not make much progress, relative to the literature, towards resolving the well-known consumption-output correlation puzzle - namely the fact that empirical cross-correlations of output tend to be higher than the ones predicted by standard open economy general equilibrium models. This reflects probably the fact that borrowing constraints are operative only at the level of investment. The addition of borrowing constraints on the consumer side would presumably tend to reduce the cross-correlations of the demand components. Verifying this goes beyond the scope of this paper and is left for future research.

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Table 1: **Indicators of the banking sector and of the financial conditions of firms.**

Countries	Return on Asset	Thomson rating	MC Loans*	External Finance**	Leverage***
Austria	0.37	2.38	4.22	46.00	...
Belgium	0.52	2.00	4.62	60.00	29.00
Finland	-0.08	2.83	4.24	34.00	31.00
France	0.93	0.10	4.42	49.00	30.00
Germany	0.32	1.97	4.72	58.00	87.00
Ireland	2.95	1.83	4.48	13.00	...
Italy	0.87	2.57	4.20	37.00	59.00
Netherlands	6.99	2.10	4.61	48.00	72.00
Spain	0.98	1.79	3.88	11.00	47.00

...:missing data.

*Rate applied on new loans with maturity greater than one year. Source ECB.

**This is measured as percentage of GDP.

***Percent ratio of bank debt to equity, non-financial corporate sector. Source AKM (2003).

Table 2: **Model parameters and shock calibration.**

Parameters and shocks	Mnemonics	Values
Workers Discount factor	β	0.99
Elasticity of home and foreign goods	η	1.5
Parameter on consumption utility	σ	1
Parameter on labor dis-utility	τ	3
Share of exports over GDP	γ	0.2
Elasticity of spread to bond accumulation	ζ	0.000742
Share of capital in Cobb-Douglas production	α	0.35
Capital depreciation rate	δ	0.03
Elasticity of variety demand	ϑ	6
Prices adjustment cost	ω_p	17.5
Adjustment cost parameter	Φ	1.2
Persistence of monetary process	ρ_m, ρ_{m^*}	0
Persistence of area wide monetary shock	$\rho_{m^{EU}}$	0
Standard deviations of monetary shocks	$\sigma_m, \sigma_{m^*}, \sigma_{m^{EU}}$	1.0007%
Correlation of monetary shocks	$Corr(\varepsilon_m, \varepsilon_{m^*})$	0.5
Persistence of technology process	ρ_A, ρ_{A^*}	0.9
Standard deviation of technology shock	σ_A, σ_{A^*}	0.006
Correlation of technology shocks	$Corr(\varepsilon_A, \varepsilon_{A^*})$	0.258

Table 3: **Calibration of the financial scenarios.**

Contract parameters*	Mnemonics	Home country	Foreign country		
			Scenario 1	Scenario 2	Scenario 3
Steady state leverage ratio	$\frac{K}{NW}$	2	2	2	2
Steady state EFP	rp^{ss}	$\frac{0.045}{4}$	$\frac{0.035}{4}$	$\frac{0.025}{4}$	$\frac{0.015}{4}$
Elasticity to leverage ratio	$rp(\cdot)$	0.07	0.056	0.025	0.015
Survival probability	ς	0.97	0.97	0.97	0.97

* All parameters in the table are quarterly frequency.

Table 4: **Cross-correlations and standard deviations under three alternative financial scenarios and in response to common monetary policy shock and symmetric and correlated productivity shocks under the currency area regime.**

Model statistics	Mnemonics	Scenario 1	Scenario 2	Scenario 3
Output cross-correlation	$Corr(Y, Y^*)$	0.78	0.63	0.52
Investment cross-correlation	$Corr(I, I^*)$	0.98	0.94	0.89
Consumption cross-correlation	$Corr(C, C^*)$	0.93	0.88	0.84
Employment cross-correlation	$Corr(N, N^*)$	0.94	0.94	0.94
Asset price cross-correlation	$Corr(Q, Q^*)$	0.98	0.93	0.86
Inflation cross-correlation	$Corr(\pi, \pi^*)$	0.99	0.99	0.99
Home output st. dev.	σ_Y	2.60	2.70	2.70
Foreign output st. dev.	σ_{Y^*}	2.30	1.79	1.66
Home (investment st. dev./output st. dev.)	σ_I/σ_Y	3.24	3.27	3.28
Foreign (investment st. dev./output st. dev.)	$\sigma_{I^*}/\sigma_{Y^*}$	2.92	1.91	1.37
Home (consumption st. dev./output st. dev.)	σ_C/σ_Y	0.77	0.77	0.77
Foreign (consumption st. dev./output st. dev.)	$\sigma_{C^*}/\sigma_{Y^*}$	0.84	0.96	1.01
Home (employment st. dev./output st. dev.)	σ_N/σ_{Y^*}	0.69	0.68	0.68
Foreign (employment st. dev./output st. dev.)	$\sigma_{N^*}/\sigma_{Y^*}$	0.80	1.03	1.11
Home (asset price st. dev./output st. dev.)	σ_Q/σ_Y	2.36	2.36	2.37
Foreign (asset price st. dev./output st. dev.)	$\sigma_{Q^*}/\sigma_{Y^*}$	2.14	1.53	1.29
Real exchange rate st. dev.	σ_{rer}	0.66	0.83	0.93

Table 5: **Cross-correlations and standard deviations under three alternative financial scenarios and in response to common monetary policy shock and symmetric and correlated productivity shocks under the independent policies regime.**

Model statistics	Mnemonics	Scenario 1	Scenario 2	Scenario 3
Output cross-correlation	$Corr(Y, Y^*)$	0.51	0.42	0.35
Investment cross-correlation	$Corr(I, I^*)$	0.62	0.59	0.55
Consumption cross-correlation	$Corr(C, C^*)$	0.82	0.80	0.78
Employment cross-correlation	$Corr(N, N^*)$	0.34	0.33	0.33
Asset price cross-correlation	$Corr(Q, Q^*)$	0.64	0.62	0.57
Inflation cross-correlation	$Corr(\pi, \pi^*)$	0.50	0.39	0.30
Home output st. dev.	σ_Y	2.52	2.52	2.52
Foreign output st. dev.	σ_{Y^*}	2.22	1.77	1.65
Home (investment st. dev./output st. dev.)	σ_I/σ_Y	3.25	3.27	3.28
Foreign (investment st. dev./output st. dev.)	$\sigma_{I^*}/\sigma_{Y^*}$	2.90	1.87	1.34
Home (consumption st. dev./output st. dev.)	σ_C/σ_Y	0.75	0.73	0.77
Foreign (consumption st. dev./output st. dev.)	$\sigma_{C^*}/\sigma_{Y^*}$	0.80	0.90	0.93
Home (employment st. dev./output st. dev.)	σ_N/σ_{Y^*}	0.78	0.77	0.77
Foreign (employment st. dev./output st. dev.)	$\sigma_{N^*}/\sigma_{Y^*}$	0.88	1.12	1.20
Home (asset price st. dev./output st. dev.)	σ_Q/σ_Y	2.36	2.38	2.38
Foreign (asset price st. dev./output st. dev.)	$\sigma_{Q^*}/\sigma_{Y^*}$	2.11	1.44	1.19
Real exchange rate st. dev.	σ_{rer}	0.95	0.97	1

Table 6: **Cross-correlations and standard deviations under three alternative financial scenarios and in response to monetary policy shock and symmetric and correlated productivity shocks under the unilateral peg regime.**

Model statistics	Mnemonics	Scenario 1	Scenario 2	Scenario 3
Output cross-correlation	$Corr(Y, Y^*)$	0.79	0.62	0.49
Investment cross-correlation	$Corr(I, I^*)$	0.99	0.94	0.85
Consumption cross-correlation	$Corr(C, C^*)$	0.94	0.90	0.87
Employment cross-correlation	$Corr(N, N^*)$	0.93	0.93	0.93
Asset price cross-correlation	$Corr(Q, Q^*)$	0.99	0.93	0.85
Inflation cross-correlation	$Corr(\pi, \pi^*)$	0.99	0.99	0.99
Home output st. dev.	σ_Y	2.56	2.57	2.57
Foreign output st. dev.	σ_{Y^*}	2.38	1.83	1.70
Home (investment st. dev./output st. dev.)	σ_I/σ_Y	3.33	3.35	3.36
Foreign (investment st. dev./output st. dev.)	$\sigma_{I^*}/\sigma_{Y^*}$	2.82	1.78	1.22
Home (consumption st. dev./output st. dev.)	σ_C/σ_Y	0.80	0.77	0.76
Foreign (consumption st. dev./output st. dev.)	$\sigma_{C^*}/\sigma_{Y^*}$	0.80	0.91	0.93
Home (employment st. dev./output st. dev.)	σ_N/σ_{Y^*}	0.74	0.73	0.73
Foreign (employment st. dev./output st. dev.)	$\sigma_{N^*}/\sigma_{Y^*}$	0.77	0.98	1.04
Home (asset price st. dev./output st. dev.)	σ_Q/σ_Y	2.43	2.45	2.46
Foreign (asset price st. dev./output st. dev.)	$\sigma_{Q^*}/\sigma_{Y^*}$	2.07	1.45	1.20
Real exchange rate st. dev.	σ_{rer}	0.61	0.74	0.82

Table 7: **Comparison between cross-correlations generated by the model and empirical cross-correlations across regimes.**

		pre-EMU		post-EMU		Regime differences	
Countries/scenarios	Variables	Data	Model*	Data	Model	Data	Model*
Germany-France (scenario1)	Output	0.65	0.51	0.82	0.78	0.17	0.27
	Investment	0.49	0.62	0.9	0.99	0.41	0.37
	Consumption	0.47	0.82	0.71	0.93	0.24	0.11
	Employment	0.63	0.34	0.86	0.94	0.23	0.60
Germany-Italy (scenario2)	Output	0.61	0.42	0.80	0.63	0.19	0.21
	Investment	0.42	0.59	0.79	0.94	0.37	0.35
	Consumption	0.38	0.8	0.53	0.88	0.15	0.08
	Employment	0.63	0.33	0.51	0.94	-0.12	0.61
Germany-Spain (scenario 3)	Output	0.40	0.35	0.72	0.52	0.32	0.17
	Investment	0.13	0.55	0.77	0.89	0.64	0.34
	Consumption	0.26	0.78	0.54	0.84	0.28	0.06
	Employment	0.62	0.33	0.84	0.94	0.22	0.61
Countries/scenarios differences							
Scenario1-Scenario3	Output	0.25	0.16	0.1	0.26		
	Investment	0.36	0.07	0.13	0.1		
	Consumption	0.21	0.04	0.17	0.09		
	Employment	0.01	0.01	0.02	0.00		
Scenario1-Scenario2	Output	0.04	0.09	0.02	0.15		
	Investment	0.07	0.03	0.11	0.05		
	Consumption	0.09	0.02	0.18	0.05		
	Employment	0.00	0.01	0.35	0.00		

* In the model pre-emu phase corresponds to independent policies, post-emu phase to currency area

Table 8: **Differences across regimes and scenarios: average results for output investment and consumption (calculated from Table7).**

Regimes differences			
	Data	Model	Percentage explained by the model
Scenario 1	0.27	0.25	91%
Scenario 2	0.24	0.21	90%
Scenario 3	0.41	0.19	46%
Countries/scenarios differences			
	Data	Model	Percentage explained by the model
Scenario 1- Scenario 3, pre-EMU	0.27	0.09	33%
Scenario 1 - Scenario 3, post-EMU	0.13	0.15	112%
Scenario 1- Scenario 2, pre-EMU	0.06	0.05	70%
Scenario 1- Scenario 2, post-EMU	0.10	0.083	81%

Table 9: **Comparison between cross-correlations generated by the model and empirical cross-correlations (US and UK).**

		pre-EMU*		post-EMU*		Differences		Averages		
Countries	Variables	Data	Model	Data	Model	Data	Model	Data	Model	%
Germany-US	Output	0.54	0.39	0.50	0.48	-0.04	0.09	0.11	0.08	72%
	Investment	0.42	0.58	0.70	0.62	0.28	0.04			
	Consumption	0.36	0.72	0.44	0.82	0.08	0.10			
Germany-UK	Output	0.38	0.30	0.73	0.47	0.35	0.17	0.23	0.12	51.47%
	Investment	0.16	0.49	0.12	0.62	-0.04	0.13			
	Consumption	0.21	0.76	0.58	0.81	0.37	0.05			

* The pre and post-EMU differ due to a change in external finance premium

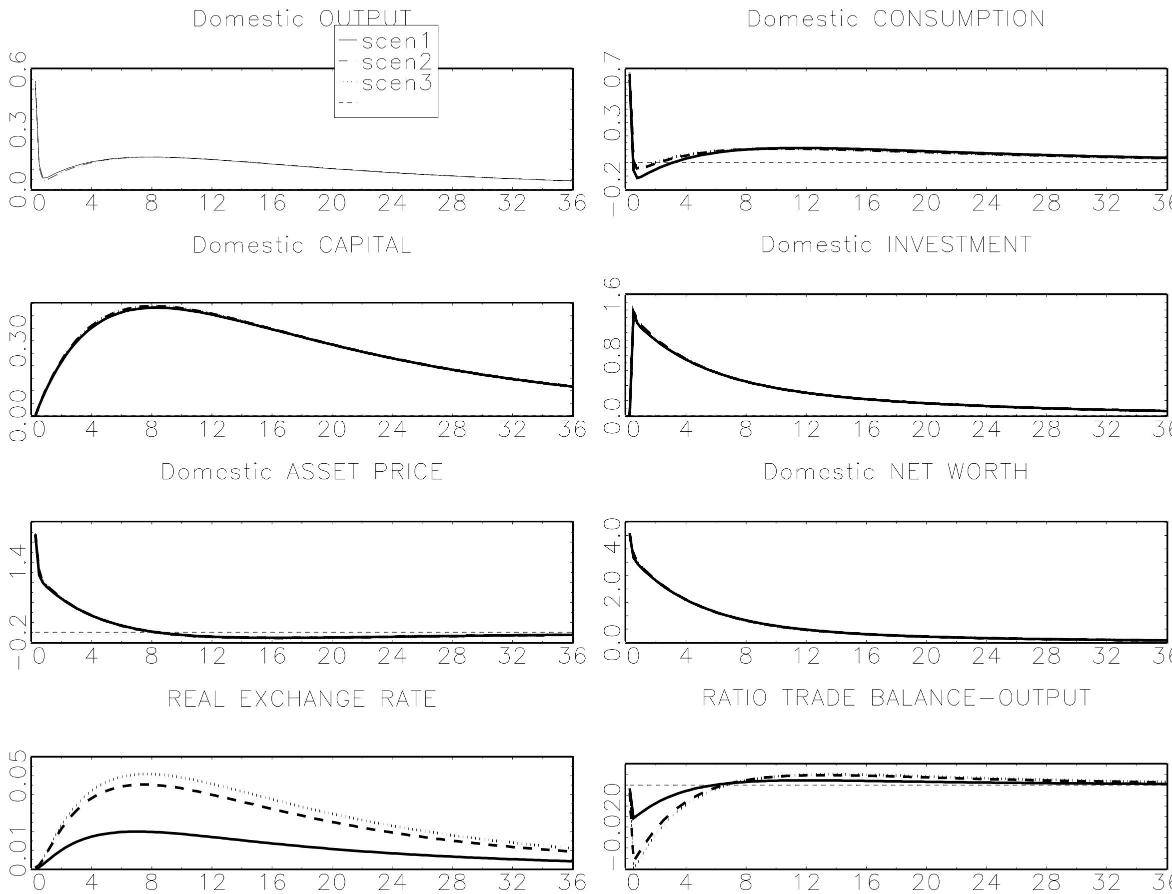

Figure 1: **Impulse responses of domestic variables. Common monetary policy shock under currency area regime.**

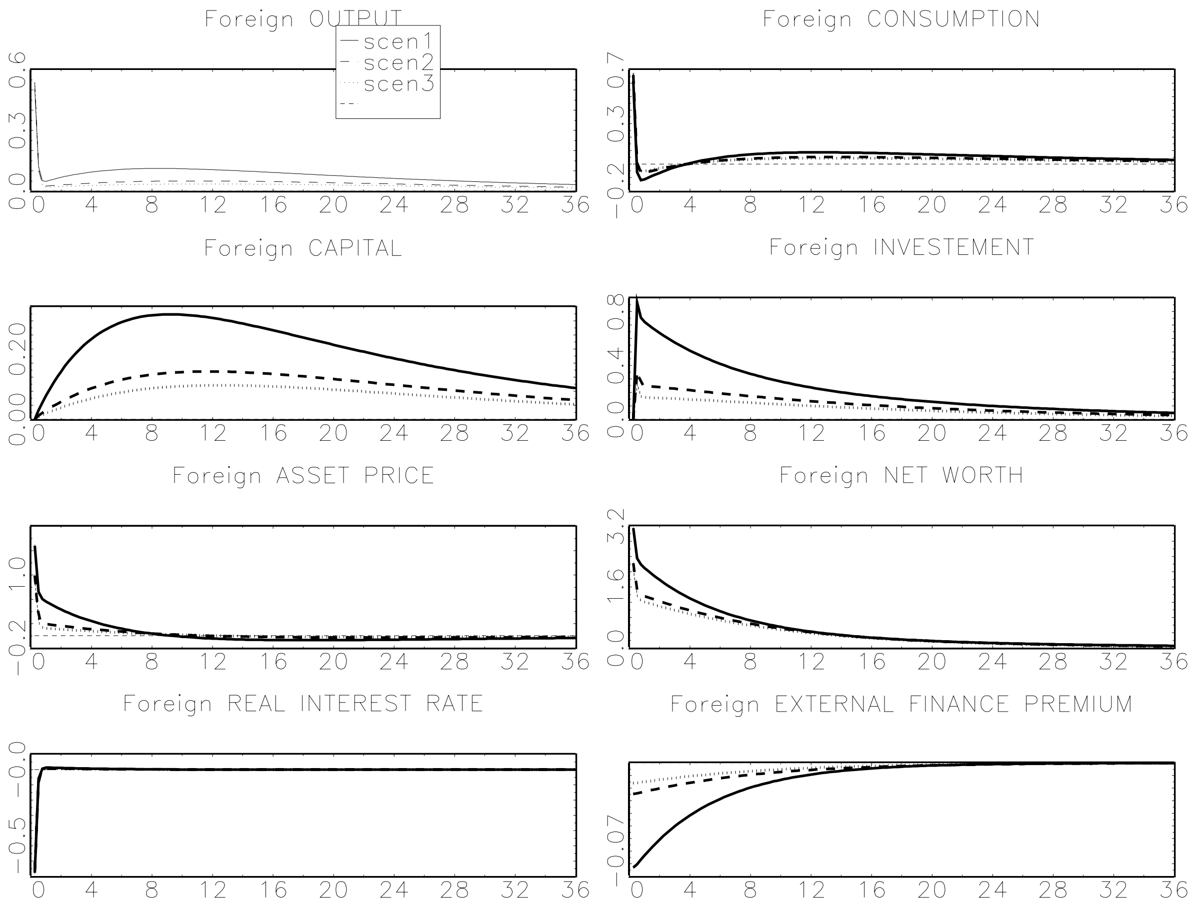

Figure 2: **Impulse responses of foreign variables. Common monetary policy shock under currency area regime.**

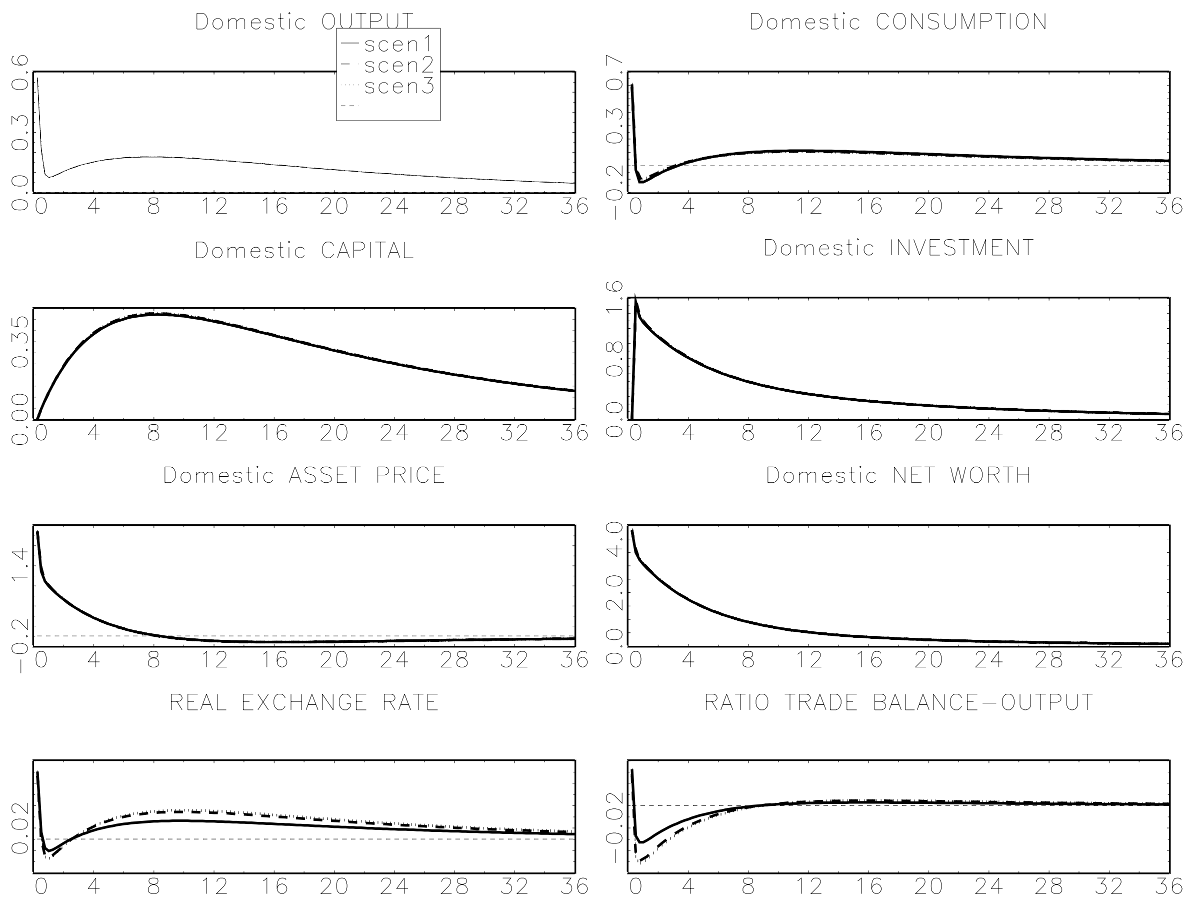

Figure 3: **Impulse responses of domestic variables. Symmetric and correlated monetary policy shocks under independent policies regime.**

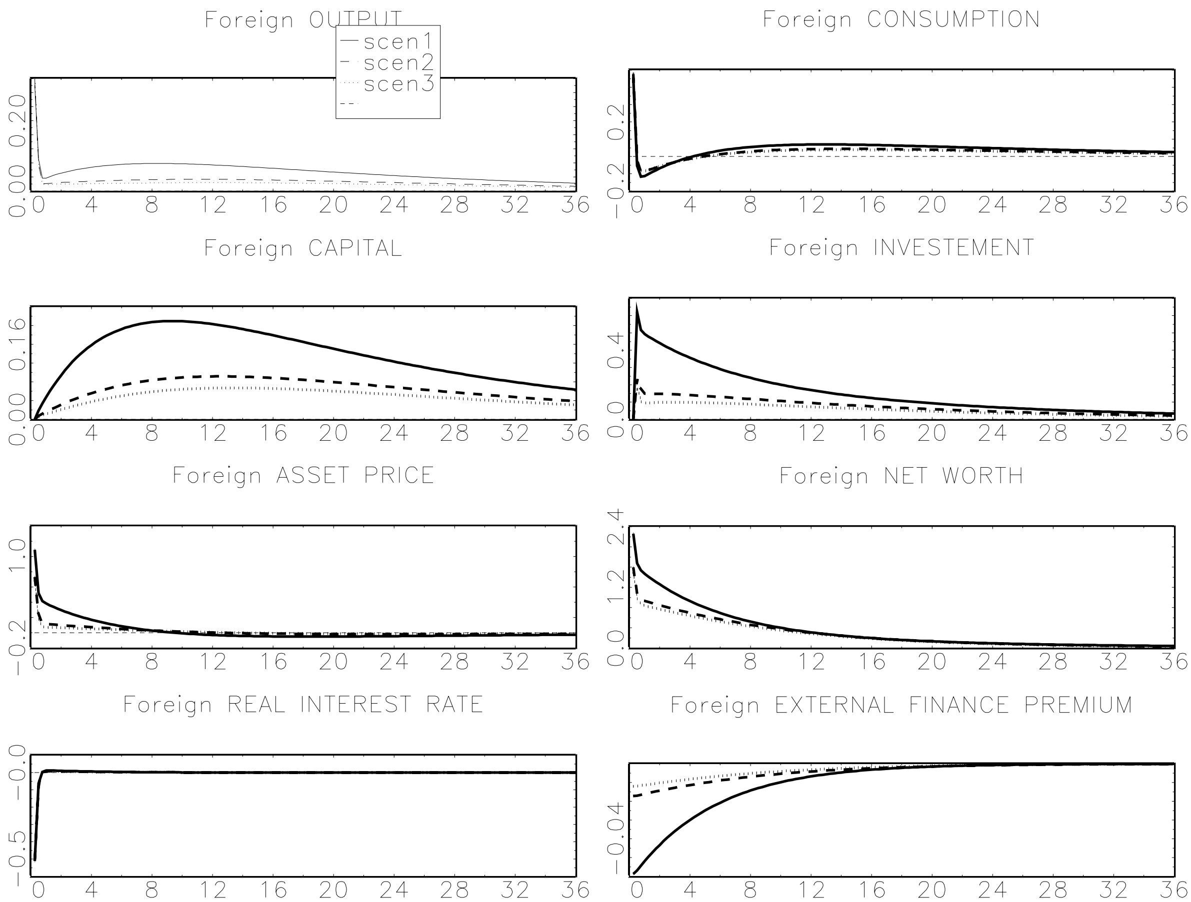

Figure 4: **Impulse responses of foreign variables. Symmetric and correlated monetary policy shocks under independent policies regime.**

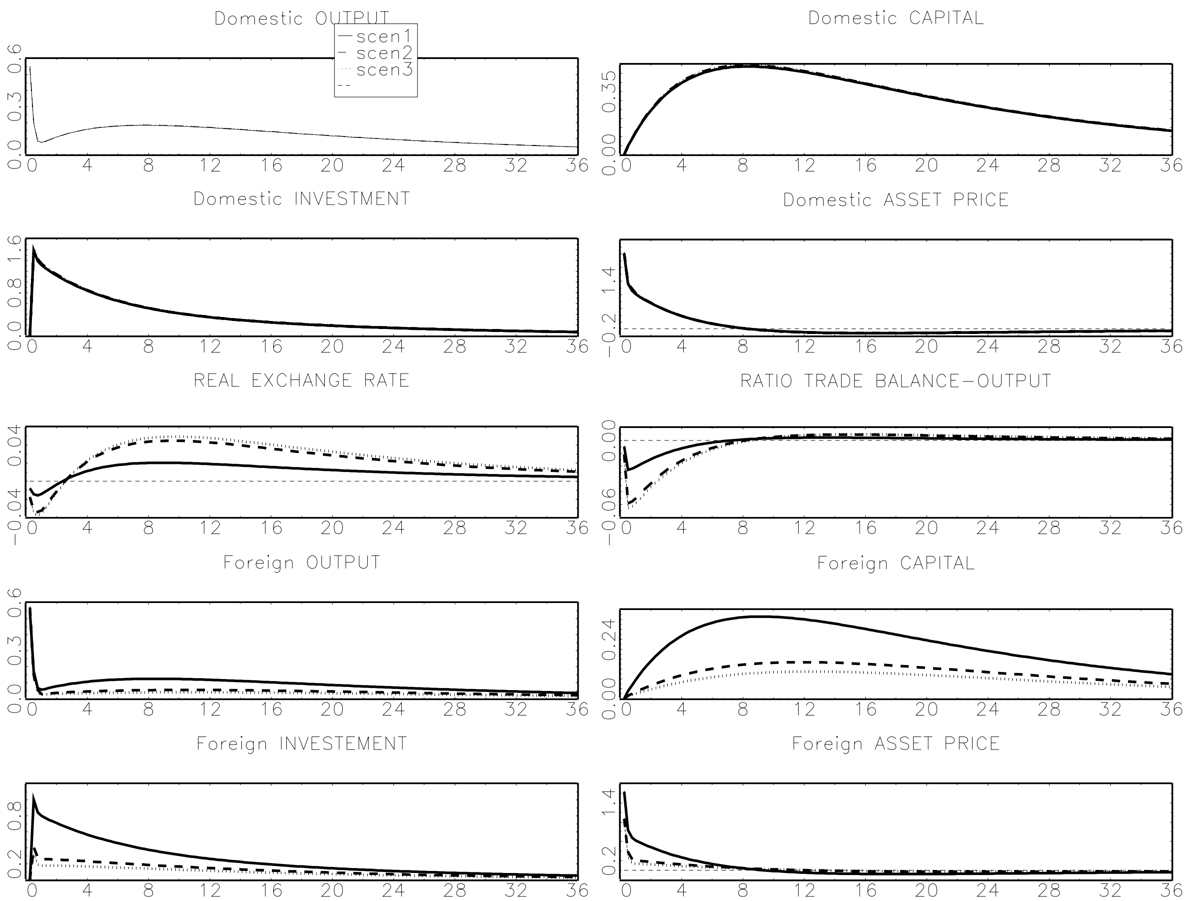

Figure 5: **Impulse responses of domestic and foreign variables. Domestic monetary policy shock under unilateral peg.**