EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

WORKING PAPER NO. 183

MONETARY POLICY IN A WORLD WITH DIFFERENT FINANCIAL SYSTEMS

BY ESTER FAIA

October 2002

EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

WORKING PAPER NO. 183

MONETARY POLICY IN A WORLD WITH DIFFERENT FINANCIAL SYSTEMS[1]

BY ESTER FAIA[2]

October 2002

1 A special thank to my advisors Thomas Cooley, Mark Gertler, Fabrizio Perri and to Tommaso Monacelli. I thank seminar participants at the Bank of England, Bank of International Settlements, Duke University, European Central Bank, Federal Reserve Board, Federal Reserve of St. Louis and San Francisco, New York University, Stern School of Business, Tilburg University, University of Quebec a' Montreal, Universitat Pompeu Fabra and to the Society for Economic Dynamic Conference in New York and the European Economic Association conference in Venice. All errors are mine. The opinions expressed herein are those of the authors and do not necessarily represent those of the European Central Bank.

2 Correspondence to: Department of Economics, New York University, Mercer Street 269, New York, New York, 10012. E-mail address: ef284@nyu.edu.

Address	**Kaiserstrasse 29**
	D-60311 Frankfurt am Main
	Germany
Postal address	**Postfach 16 03 19**
	D-60066 Frankfurt am Main
	Germany
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

ISSN 1561-0810

Contents

Abstract

Major currency areas are characterized by important differences in financial structure that are clear in microeconomic data. Surprisingly, this fact is seldom discussed in the analysis of the international transmission of shocks. This paper attempts to fill this gap. First, I show some stylized facts about financial differences and cyclical correlations among the main OECD countries. Second, using a two-country model with monopolistic competition and sticky prices, calibrated to US and euro area data, I analyze the international transmission of shocks with different degrees of financial fragility in the two economies. I find, first, that financial diversity can account for heterogenous business cycle fluctuations. Differential responses to shocks are shown to occur with independent monetary policies - Taylor rules or rigid inflation targets - even with low degrees of economic and financial openness. Credible pegs help to increase the synchronization of cycles. Secondly, differences in persistence of the interest rates help to explain high persistence in the real exchange rate. Finally, weak financial systems can result in large welfare losses under symmetric and correlated shock.

JEL Classification Numbers: E3, E42, E44, E52, F41.

Keywords: financial diversity, monetary regimes, differential transmission mechanism, financial stability, welfare losses.

1 Non-Technical Summary

The aim of this paper is to show that differences in financial systems are an important determinant of business cycle correlations across countries and that they account for some stylized facts of the international transmission mechanism of shocks. To explore this idea the paper presents some empirical facts and a model economy whose aim is to replicate some features of the international transmission mechanism by introducing financial heterogeneity.

Major currency areas are characterized by important differences in financial structure that are clear in microeconomic data. Surprisingly, this fact is seldom discussed in the analysis of the international transmission of shocks. This paper attempts to fill this gap.

To this aim I, first, present evidence of the presence of differences in financial markets and for the fact that they account for asymmetries over the business cycle. Data show that a negative and significative relation exists between the correlation of output gaps and financial gaps, defined as the difference between indicators of banking efficiency.

Secondly, I examine an artificial economy with two countries characterized by different degree of financial fragility and identical policies that allows me to isolate the effect of financial differences over the business cycle. I use a two country model of stochastic dynamic general equilibrium with optimizing agents characterized by nominal rigidities in an imperfectly competitive framework, international financial markets for deposits, loans and state contingent bonds, and financial diversity in terms of fragility of banking systems and riskiness of investment projects.

I find, that financial diversity can account for heterogenous business cycle fluctuations. Differential responses to shocks are shown to occur with independent monetary policies - Taylor rules or rigid inflation targets - even with low degrees of economic and financial openness. Credible pegs help to increase the synchronization of cycles. The main intuition for this result stems in the fact that different degrees of financial fragility generate different persistence and sensitivity of the business cycles even to symmetric and correlated shocks.

Several other characteristics of the international business cycle are analyzed under the assumption that financial differences play a major role. For instance the paper shows that differences in persistence of the interest rates, generated by different degrees of borrowing constraints, help to explain high persistence in the real exchange rate.

Finally by exploring the welfare implications of the model I show that weak financial systems can result in large welfare losses under symmetric and correlated shock.

1 Introduction

Different countries and currency areas are typically characterized by different financial structures, as a result of history, legal frameworks, collective preferences, politics[1]. Financial structures are in turn among the key determinants of bank and asset risks. Micro data[2] for industrialized country show differences in banking systems in terms of return on assets, loan loss provisions, availability of external finance and efficiency indicators. At the same time, remarkable asymmetries in economic fluctuations have been documented across industrialized countries mostly during the last decade. For instance some countries like the UK and the US have highly correlated business cycle fluctuations, while other regions like the US, the Euro area and Asian countries are characterized by low or negative correlations over the cycle.

Financial markets may play a role in shaping the patterns of international transmission of shocks across countries[3]. However, asymmetries in the financial systems and corporate risk have not been incorporated in the analysis of the international transmission of shock and of macro policy interdependence. The open economy literature has studied international business cycle properties under different settings, but very little work has focused on the role of financial fragility and even less on the effect of asymmetries in such fragility. This paper explores this concept and argues that financial diversity can account for heterogenous business cycle fluctuations and help to explain some of the features of the international transmission mechanism across countries.

To this aim I, first, present evidence of the presence of differences in financial markets and for the fact that they account for asymmetries over the business cycle. Data show that a negative and significative relation exists between the correlation of output gaps and financial gaps, defined as the difference between indicators of banking efficiency[4]. Secondly, I examine an artificial economy with two countries characterized by different degree of financial fragility and identical policies that allows me to isolate the effect of financial differences over the business cycle. I use a two country model of stochastic dynamic general equilibrium with optimizing agents[5] characterized by nominal

[1] La Porta, Lopes-de Silanes, Shleifer, Vishny (1997), (1998), La Porta, Lopez-de Silanes, Shleifer (1999), Pagano and Volpin (2000).

[2] See dataset Bankscope from IBCA Fitch and OCSE Bank Profitability Report.

[3] This aspects is stressed, for example, in the latest IMF World Economic Outlook: "*Several observations hint at the role that structural factors and policy regimes play in determining the strength of the international business cycle linkages.... Co-movements in output gaps in United States, Canada and United Kingdom remained positive during the entire 1990's...The close affiliation in the business cycle of the United Kingdom with that of the United States, despite much more important trade links with Euro area countries may have been the result of strong financial market linkages..... Asymmetries in business cycles fluctuations across industrialized countries are likely to reflect differences in country sizes and financial depth"; IMF (2001), chapter 2.*

[4] Previous empirical works - for example Imbs (1999) - have shown that traditional channels of international transmission mechanism, such as trade, do not seem to be significant in the data for explaining business cycle correlations.

[5] Many recent contributions can be identified in the area of the New Open Economy whose aim is to build up a new generation of open economy models relying on stochastic general equilibrium frameworks with microfoundations.

rigidities in an imperfectly competitive framework, international financial markets for deposits, loans and state contingent bonds, and financial diversity in terms of fragility of banking systems and riskiness of investment projects. The reason for which sticky prices are introduced in the model is to allow a meaningful comparison between floating and fixed exchange rate regimes[6]. Financial fragility is introduced via borrowing constraints on investment due to the presence of asymmetric information between borrowers and lenders. Financial differences are modelled in terms of cost of bankruptcy, riskiness of investment projects and failure probability of firms; these elements are in turn determinants of the return on asset, the size of the loan loss, the size of the borrowing limit and its elasticity with respect to collateral and conditions of external finance. The sensitivity of the borrowing limit to the conditions of collateral and external finance is the key determinant of link between financial fragility and business cycle. The paper studies dynamic responses quantitative statistics and welfare costs for productivity and financial shocks. The analysis compares asymmetric versus symmetric and correlated shocks.

The model is calibrated on the US and the Euro area, for two reasons. First, the macroeconomic and policy interactions between these two areas have become, after the creation of the euro in 1999, the key issue in international economics[7]. Second, the asymmetries in the financial structure between these areas are well documented, and have often been advocated to explain the differences in the domestic transmission mechanism of monetary policy[8]. Nonetheless, the focus on the US and Europe is to some extent illustrative. The basic model presented in this paper can be used to analyze a number of other important issues, such as the implication of Japan's financial fragility on the international transmission process, or the macroeconomic interactions between financially asymmetric countries that are linked by a hard peg (e.g. a currency board).

To completely assess the role of financial differences I analyze their role under different specification of the monetary regimes and policy rules and under different degrees of economic and financial integration.

I first consider a regime of independent monetary policies, with a floating exchange rate, specified in two alternative ways: Taylor rules and rigid inflation targeting rules. When the monetary authority adopts the rigid inflation targeting rule it applies an infinite weight to domestic inflation[9];

For a complete reference of this literature see the homepage from Bryan Doyle or Benigno, Benigno, Ghironi.

[6]A useful comparison between floating and fixed exchange rates regimes requires the introduction of sticky prices. This assumption indeed allows to generate an international transmission mechanism that depends also on the movement of the terms of trade defined as relative prices between the two countries.

[7]A main contribution in the study of the international transmission mechanism between US and Europe is Chari, Kehoe and McGrattan (2000). Using a model for two symmetric countries with sticky prices and state contingent bonds, they address the key issue of the link between the data and the quantitative results of open economy models. A contribution concerning policy dependence between the two areas is in Obstfeld and Rogoff (2000).

[8]Cecchetti and al. (1999) provide an emprical study of the presence of asymmetries inside US, Europe and between the two areas as whole.

[9]Price stability has gained prominence as a central bank goal in recent times. For the ECB, price stability is the overriding goal, mandated by its Statute. The Fed's mandate is less clear. In a recent speech in St. Louis (

in the limit this rule implies that the nominal interest rate is set on a period by period basis equal to the wicksellian interest rate that reacts to state variables such as net worth of firms. I then consider also a regime of credible pegs. I explore the role of economic openness, defined as the ratio of exports over GDP, and financial openness, defined as the ratios of loans denominated in foreign currency, to see whether higher trading and financial interlinkages can contribute to amplify heterogenous business cycle responses. To complete the analysis of the impact of financial differences on the international transmission mechanism I analyze the relative pattern of interest rates and the dynamic of the exchange rate to show that the introduction of borrowing constraints can be useful to match some stylized facts.

I find that differential responses occur under identical and independent policies even under low degrees of economic and financial openness. The correlations of output gaps decrease when financial differences among countries increase. This result is robust to different parametrization. It holds for any kind of shock- i.e. asymmetric[10], symmetric and uncorrelated, symmetric and correlated - . The negative relation found in the model recall the one in the data.

The intuition for this result in the model is linked to the role of financial asymmetries. Having different degree of borrowing constraints generates different degrees of persistence and volatility for the responses of variables even with symmetric and correlated shocks.

With asymmetric shocks the model is able to reproduce a wide range of correlation values - i.e. from positive to negative - depending on the degree of difference between financial systems. In traditional models of open economy literature asymmetric shocks would always generate negative correlations of output as a consequence of the demand shift between the two countries[11]. Since data show that positive correlations can occur also under asymmetric shocks this result could be partly considered a puzzle. The transmission mechanism of the present model is instead enriched with an "indirect financial spillover" effect. For instance when a positive technology shock hit the home country the demand shift between domestic and foreign goods induces a decrease in foreign inflation; the consequent decrease in interest rates and in the cost of the loans generates an increase in asset prices and investment in the foreign country[12]. This positive financial effect associated with the international transmission mechanism of the present model can partly or completely offset the negative impact of the demand shift on the foreign country business cycle. The magnitude of the

October 2001), however, Greenspan has defined the Fed's goal in the following way: "price stability and the maximum sustainable growth in output that is fostered when prices are stable".

[10]These are shocks that are generated only in one of the two countries.

[11]The transmission mechanism in models like Chari, Kehoe and McGrattan (2001) or Gali' and Monacelli (2002) is mainly characterized by switching expenditure effects that induce negative correlation between consumption demand and output.

[12]The new open economy literature does not provide explanation of the link between total factor productivity shocks in the US and asset prices in Europe. This link is well documented and examined in other areas of macroeconomics: see for example Greenwood and Jovanovic (1999). The presence of the financial side in this paper's open economy model helps to explain this missing link in open economy models.

indirect financial spillover will depend on the relative degree of financial differences between the two countries. When the two countries have similar financial systems the positive financial spillover is able to offset the negative switching expenditure effect and consequently to generate positive correlations.

Synchronization in economic fluctuations is more pronounced under unilateral and bilateral credible pegs; when a fragile country sets the same interest rate of a more stable country asymmetric responses are reduced.

Some other features of the international transmission mechanism follow from the study. First, by adopting a rigid inflation target the monetary authorities of the two countries induce higher volatility of output and investment since the interest rates react to financial variables like net worth and spread financial instability to the all economy[13]. Second, the persistence of the real exchange rate increases when differences in borrowing constraints increase. Increasing differences in borrowing constraints generate increasing differences in the persistence of real interest rates; the gap in the interest rates persistence is absorbed by the real exchange rate through the uncovered interest rate parity[14]. Finally I explore the welfare implications and I show that external and correlated financial shocks result in higher welfare losses for the country that is more fragile in terms of risk perception.

The paper is organized as follows. Section 2 presents some statistical evidence, documenting the presence of differences in financial markets and their link with asymmetries over the business cycle. Section 3 presents the model economy. Section 4 includes the results. Conclusion, tables, graphs and appendices are reported at the end of the paper.

2 Evidence For The Presence and The Effect of Heterogenous Financial Markets

Various papers studying empirical evidence for international business cycles show that cyclical co-movements and business cycle correlations are not very well explained by trade[15]. Some attempts have been done to look for other sources of international transmission rather than trade. For instance Zimmerman (1995) shows that business cycle differences across countries can be explained by size and distance. Heatcote and Perri (1999) show that cross country correlations are the result of a combination of real regionalization and financial liberalization.

The aim of this section is to provide some evidence of the link between differences in financial markets and correlation of business cycle across countries. This section reports various stylized

[13]Gali' and Monacelli (2000) show in an open economy framework without capital that a price stability rule lead to higher volatility of real variables. In the present model the higher volatility is due also to financial factors.

[14]The high volatitlity and persistence of exchange rates is a central puzzle in the open economy litearture. For recent contributions see Chari, Kehoe and McGrattan (2000) and Obstfeld and Rogoff (2000).

[15]Ambler, Cardia and Zimmerman (2002), Baxter (1995), Imbs (1999).

facts that characterize both the profile of financial markets in industrialized countries and the international business cycle over the recent years. Finally a relation is shown to exist between micro data on financial differences and macro data on international business cycle correlation.

Micro data for financial markets and banking industry. Financial systems can be mainly characterized by bank health and asset risk. A more fragile system is indeed associated with lower bank efficiency and higher asset risk and as a consequence with higher borrowing constraints on investment.

The following data will stress heterogeneities in the degree of borrowing constraints, in bank structure and riskiness of investment. The section provides a parallel between those statistics and the parameters that in the model characterize the banking sector.

Table 3 shows data for corporate debt securities for the main currency areas[16]. It is already evident that borrowing constraints are tighter in the Euro area and Japan with respect to US and UK. Even though the Euro area and US are very similar in terms of populations and economic activity the markets for loans are much thinner in European countries. In the model the borrowing constraints are identified through a borrowing limit modeled as a function of collateral and conditions of external finance.

A close look at the data for the credit industry and the riskiness of investment projects reveal more specific dissimilarities across the countries. Table 4[17] shows data on return of assets - i.e. return on investment projects for banks -, loan loss provisions, external finance as percentage of GDP and Thomson rating[18] for EMU countries, the Euro area as a whole[19], the UK, the US and Japan. First note that there are many similarities between the American and British banking systems, while more pronounced differences emerge among the three major currency areas. For instance returns on assets are bigger than one in the US and the UK, but are lower than one for Japan, the Euro area as a whole and the vast majority of European countries. Loan loss provisions as percentage of the GDP are very low for the US and the UK but are higher for Japan and for the Euro area. Also, availability of external finance is much higher for English speaking countries. The Thomson rating, which provides an index for banking sector health, assigns the lowest value - i.e. highest banking efficiency - to the US and the highest value to Japan.

In the model I will present later loan loss provisions are identified by bankruptcy costs, the availability of external finance is identified by the borrowing limit and the return on assets corresponds to the return on investment.

[16] Data are taken from Angeloni, Gaspar, Issing and Tristani, (2000).

[17] These data are draw from S. Cecchetti (1999), "Legal Structure, Financial Structure, and The Monetary Policy Transmission Mechanism". The ultimate source of the data are dataset Bankscope from IBCA Fitch and OCSE Bank Profitability Report. In each country banks were chosen according to 1997 assets.

[18] The Thomson rating is an indicator of bank health. A lower value for this statistic identifies a more efficient banking system.

[19] The statistics for the Euro area as a whole have been calculated with a weighted average in which weights are given by the share of the population for each country.

Differences in business cycles. Along with the documented heterogeneity between financial markets stands some heterogeneity in business cycle fluctuations. Table 5 shows cross-correlations of output gaps for industrialized countries computed with the approximate bandpass filter proposed by Baxter and King (1999)[20]. The table illustrates that negative cross-correlations are found for the US and European countries and for US and Japan, while positive correlations are found between the UK and the US and between the Euro area and Japan. The evidence suggests that a link exists between financial diversity and heterogenous business cycles.

In the model presented later a higher bankruptcy cost and riskiness of investments determines an higher elasticity of the borrowing limit to financial conditions. Tighter borrowing constraints are in turn determinant of higher sensitivity in business cycles.

Empirical relation between financial diversity and business cycle asymmetry. A link exists between asymmetries in the business cycles and financial differences. The measure of the asymmetries in the business cycle is obtained by cross-correlation in output gaps. Output gap is defined as the difference between the series for the log of the real GDP and the trend calculated with the Hodrick-Prescott filter[21]. The data used for GDP are quarterly data from the 1985 to 2000. The measure for the financial gap is given by cross absolute differences of the Thomson rating presented in table 4. The rating represents a synthetic measure of the bank health and for this reason it seems the most appropriate index to approximate the financial gap. The scatter plot and the regression line in figure 1 show a *negative relation* between asymmetries in business cycles and differences in financial system. The negative relation is even stronger if output gap is calculated with the band-pass. Table 6 also show that the relation is significant.

3 A Model Economy with Financial Heterogeneity

There are two regions of equal size. Each country is inhabited by a continuum of agents with measure one . Capital and labor are immobile across countries. All goods are tradable and international capital markets are complete in the Arrow-Debreu sense. Each economy is symmetric for everything apart from the microfoundations of the contracting problem between borrowers and lenders.

Each economy is populated by two sets of agents, workers and capitalists. Each agent is simultaneously consumer, investor and owner of the producing sectors in the economy. There is a complete separation of risk between the two agents since the workers can insure themselves for consumption movements, while entrepreneurs do not have access to insurance markets. There are three different units of the production sector[22]. The first unit acts as a competitive sector that

[20]Those calculations have been drawn from the Economic Outlook report of the IMF for the 2001.
[21]See among others, Clarida', Gali' and Gertler (1998), Chari, Kehoe and McGrattan (1998).
[22]For a similar structure see King and Watson (1998), King and Wolman (1998), Chari, Kehoe and McGrattan

produces a homogenous good using capital and labor and performing static decision to determine input demands. The second unit acts as a monopolistic competitive sector that produces a differentiated good using the homogenous good as an input and sets prices a' la Calvo. The third unit produces and sells capital to the homogenous good producers: this unit determines the price of capital solving a dynamic problem for the maximization of the discounted sum of future profits. Each country is experiencing at each period one of the infinite events s_t, whose history is defined by $s^t = \{s_0, ...s_t\}$ and whose probability is given by $\pi(s^t)$. The initial realization s_0 is given.

3.1 Workers Behavior in Home and Foreign Country

Workers are risk averse and infinite lived. They consume a variety of goods, supply labor, invest in domestic and international asset markets and run the monopolistic production unit that face a random pricing technology. These agents can fully insure themselves against the risk coming from the random pricing technology since they have access to state contingent portfolios. Finally I assume that they also invest in deposits since the demand for this asset comes from the presence of the intermediary. The introduction of deposits is redundant from an asset pricing perspective but it is necessary to satisfy market clearing conditions for the general equilibrium. The utility of each agent i in each country $s = H, F$, where H stands for home and F for foreign, is given by:

$$\sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t)[(U_s(C(s^t)) - V_s(N(s^t)] \tag{1}$$

U is increasing, concave and differentiable and V is increasing, convex and differentiable, C is a Dixit-Stiglitz-Spence aggregator[23] of C_H, the consumption demand for home goods, C_F the consumption demand for foreign goods, and C_s are in turn CES aggregator for each variety of good $C(\tau)$[24] and N are hours worked. The households receive a nominal labor income $W(s^t)N(s^t)$ at the end of period t. At time t agents decide to invest in $D(s^t)$ and $D^*(s^t)$ in deposits, expressed in units of domestic and foreign consumption index, that pay $R(s^t)D(s^t)$ and $R^*(s^t)D^*(s^t)$ one period

(2000), Monacelli (2000).

[23]The quantity of the composite consumption good is given by:

$$C \equiv [(1-\gamma)^{1/\eta} C_H^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} C_F^{\frac{\eta-1}{\eta}}]^{\frac{\eta}{\eta-1}}$$

where C_H and $C_F$denote respectively consumption of home goods and foreign goods, η represents the elasticity of substitution between home and foreign consumption at time t, and γ is the share of foreign consumption in the index and also represents the degree of openness.

[24]The indices for home and foreign consumption are given by Dixit-Stiglitz aggregators over a continuum of goods with the property of constant elasticity of substitution over time:

$$C_s(i, s^t) = \left(\int_0^1 C_s(\tau, s^t)^{\frac{\varepsilon-1}{\varepsilon}} d\tau \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

where ε denotes the intertemporal elasticity of substitution and τ denotes the variety of goods.

later. They also decide to purchase a portfolio, $B(s^{t+1})$, in real state contingent securities that can be internationally traded and that pay one unit at time $t+1$ given the occurrence of state s_{t+1}. The price kernel of the one-period bond is $d(s^{t+1}|s^t)$. The budget constraint in real terms will then read like this:

$$C(s^t) + \sum_{s_{t+1}} d(s^{t+1}|s^t)B(s^{t+1}) + D(s^t) + D^*(s^t)e^r(s^t) \leq \tag{2}$$

$$\leq \frac{W(s^t)}{P(s^t)}N(s^t) + T(s^t) + B(s^t) + R(s^{t-1})D(s^{t-1}) + R^*(s^{t-1})D^*(s^{t-1})e^r(s^{t-1})$$

where $e^r(s^t) = \frac{e(s^t)P^*(s^t)}{P(s^t)}$ is the real exchange rate. The households choose the set of processes $\{C(\tau, s^t), C_H(s^t), C_F(s^t), C(s^t), N(s^t)\}_{t=0}^{\infty}$ and assets $\{B(s^{t+1}), D(s^t), D^*(s^t)\}_{t=0}^{\infty}$ so as to maximize (1) subject to (2) and (7), taking as given the set of processes $\{P(s^t), W(s^t), R(s^t), R^*(s^t), d(s^{t+1}|s^t)\}_{t=0}^{\infty}$ and the initial condition $B(s_0) + D(s_0) + D^*(s_0)$. As a result of the maximization problem I get the following optimality conditions: let $P_H = \left(\int_0^1 P_H(\tau)^{\frac{\varepsilon-1}{\varepsilon}} d\tau\right)^{\frac{\varepsilon}{\varepsilon-1}}$ [25] and $P \equiv [(1-\gamma)P_H^{1-\eta} + \gamma P_F^{1-\eta}]^{\frac{1}{1-\eta}}$ [26]

$$\frac{C_H(\tau, s^t)}{C_H(s^t)} = (\frac{P_H(\tau, s^t)}{P_H(s^t)})^{-\varepsilon} \tag{3}$$

$$C_H(s^t) = (1-\gamma)(\frac{P_H(s^t)}{P(s^t)})^{-\eta}C(s^t); C_F(s^t) = \gamma(\frac{P_F(s^t)}{P(s^t)})^{-\eta}C(s^t). \tag{4}$$

$$\beta\frac{\pi(s^{t+1})}{\pi(s^t)}\frac{U_c(C(s^{t+1}))}{U_c(C(s^t))} = d(s^{t+1}|s^t); R(s^t)^{-1} = \sum_{s_{t+1}} d(s^{t+1}|s^t) \tag{5}$$

$$U_c(C(s^t)W(s^t)/P(s^t) = -U_N(N(s^t)) \tag{6}$$

$$lim_{j\longrightarrow\infty} \sum_{s_{t+1}} d(s^{t+j+1}|s^t)(D(s^{t+j+1}) + D^*(s^{t+j+1}) + B(s^{t+j+1})) \geq 0 \tag{7}$$

[25] $P_s = \left(\int_0^1 P_s(\tau)^{1-\epsilon} d\tau\right)^{\frac{1}{\varepsilon-1}}$ for $s = H, F$, is defined as the price that minimizes the expenditure given the optimal quantity of consumption and $P_s(\tau)$ is the price of each variety i in country s . Since there is no international price discrimination $P_F(\tau) = eP_H^*(\tau)$, $\forall\tau \in [0,1]$, where e is the nominal exchange rate expressed as the price of foreign currency in terms of the home currency and $P_H^*(\tau)$ is the price of foreign good τ denominated in foreign currency.

[26] Similarly $P(s^t) \equiv [(1-\gamma)P_H^{1-\eta}(s^t) + \gamma P_F^{1-\eta}(s^t)]^{\frac{1}{1-\eta}}$ is defined as the price that minimizes expenditure given the optimal allocation of consumption.

Equations (3) and (4) define the optimal decision for each variety of the consumption index and for the fraction of domestic and foreign produced goods, equation (6) defines the optimal choice for labor supply by setting the intratemporal marginal rate of substitution between consumption and labor equal to the real wage. Equations (5) determine the price of one unit of the state contingent portfolio at time $t+1$ in units of consumption at time t[27] and an arbitrage condition between deposits and bonds: the expected return on the state contingent portfolio is set equal to the return on the risk free deposit. Finally equation (7) is an optimal condition on accumulation of assets and ensures determinacy of the equilibrium.

The workers in the foreign country face exactly the same maximization problem and hold a certain fraction of domestic state contingent bonds. Analogous first order conditions should then hold for foreign workers. In particular the first order condition with respect to bond holding from foreign consumers[28] is:

$$\beta \frac{\pi(s^{t+1})}{\pi(s^t)} \frac{U_c(C^*(s^{t+1}))}{U_c(C^*(s^t))} \frac{1}{e^r(s^{t+1})} = \frac{d(s^{t+1}|s^t)}{e^r(s^t)} \tag{8}$$

Given the condition for international risk sharing $(\frac{U_c(C(s^{t+1}))}{U_c(C(s^t))} = \frac{U_c(C^*(s^{t+1}))}{U_c(C^*(s^t))}(\frac{e^r(s^{t+1})}{e^r(s^t)}))$ and the arbitrage conditions between deposits at international level $(R(s^t) = R^*(s^t)(\frac{e^r(s^{t+1})}{e^r(s^t)}))$, and between deposits and bonds, $R(s^t)^{-1} = \sum_{s_{t+1}} d(s^{t+1}|s^t)$, an expectational version of the uncovered interest parity holds:

$$\sum_{s_{t+1}} d(s^{t+1}|s^t)[R(s^t) - R^*(s^t)(\frac{e^r(s^{t+1})}{e^r(s^t)})] = 0 \tag{9}$$

3.2 The Entrepreneurs in the Home and Foreign Country

Entrepreneurs are risk neutral and they have a probability of dying ς: they consume, they run production in the competitive unit and they invest in non-state contingent loans in order to finance the purchase of capital. Each entrepreneur, j, acting as a firm receives a loan in order to finance the purchase of capital from a competitive intermediary that raises funds trough deposits. Firms are heterogenous since they are hit by an idiosyncratic shock to the return on capital investment, ω^j. Entrepreneurs acting as consumers optimize a life time utility that takes a linear form on a

[27]For a formalization of a complete market structure that defines the price of state contingent securities in open economy see Chari, Kehoe and McGrattan (2000). The role of international risk sharing has been studied also in Cole and Obstfeld (1991), Helpman and Razin (1978).

[28]I denote the foreign workers with the same index i since the two countries are perfectly symmetric from the workers perspective.

period by period basis $(\sum_{t=0}^{\infty}\sum_{s^t}\beta^t\varsigma^t\pi(s^t)C^e(s^t)))$[29] Given that utility is linear in consumption the optimization with respect to consumption subject to their evolution of assets, to the initial condition and the exogenous state of the economy gains a trivial solutions: agents will consume everything at the final date of their life [30]. Aggregate consumption at each date t will be equal to:

$$C^e(s^t) = \zeta(NW(s^{t-1}) - W^e(s^t)) \tag{11}$$

where NW is the real value of the aggregate wealth and $W^e(s^t)$ is a transfer of wealth to new born entrepreneur.

Individual wealth is given by the difference between return on investment and cost of deposit. At time t entrepreneurs receive capital income $R^k(s^t)Q(s^{t-1})K^j(s^{t-1})$ paid, in units of domestic consumption goods, for capital invested at time $t-1$, where $R^k(s^t)$ is the expected real return received at time t, $K^j(s^{t-1})$ is the quantity of capital,and $Q(s^{t-1})$ is the price of capital. The individual and the aggregate return on capital depend on future expectations for the price of capital given the presence of adjustment costs. At time $t-1$ entrepreneurs finance the purchase of new capital acquiring a loan from the intermediary $L^j(s^{t-1}) = Q(s^{t-1})K^j(s^{t-1}) - NW^j(s^{t-1})$, whose cost is given by the market return for the safe asset paid at the end of time $t-1$, $R(s^{t-1})$, and an external finance premium paid to the intermediary at time t, $\psi(s^t)$. Later on the external finance premium will be derived as a function of the net wealth/capital ratio. Finally notice that a fraction ξ of the debt can be denominated in foreign currency. The aggregate wealth at time t is given by the evolution of wealth of the entrepreneurs that are still in the economy:

$$NW(s^t) = \varsigma[R^k(s^t)Q(s^{t-1})K(s^{t-1}) - (1 + \psi(\bullet) + R(s^{t-1})\frac{P(s^t)}{P_H(s^t)})[(1-\xi) + \xi e_t^r] \tag{12}$$

$$(Q(s^{t-1})K(s^{t-1}) - NW(s^{t-1})) + W^e(s^t)]$$

The presence of the transfer $W^e(s^t)$ assures that net wealth are different from zero in the steady state, even tough its presence does not play any particular role along the cycle. The assumption is necessary for the correct definition of the contracting problem (see Gale and Hellwig 1985).

[29]The assumption of finite lived agents implies as in Bernanke, Gertler and Gilchrist (1998) and in Carlstrom and Fuerst (1996,2000) that agents future discount more heavily and do not have incentive to delay consumption. This assures that entrepreneurial consumption occurs to such extent that self-financing never occurs and borrowing constraints are always binding.

[30]A second assumption consistent with No-Ponzi schemes on the evolution of assets and linear utility is that each consumer has a constant fraction of consumption over his life. In this case the following Eurler condition holds:

$$U_c(C^e(j, s^t)) = \beta\gamma R^k(s^t)U_c(C^e(j, s^t))\} \tag{10}$$

3.3 The Production Sector

As mentioned before the production sector can be divided in three units: a competitive units producing an homogenous good, a monopolistic unit differentiating the homogenous good and an investment unit.

The competitive production unit is owned by finite lived agents, the entrepreneurs. There is a continuum of firms indexed by j. Firms have an exogenous probability of failure that correspond to the probability of dying for entrepreneurs (ς). The sector produces a homogenous good, hiring capital and labor and assembling them trough a Cobb-Douglas production function: $Y = AN^{\alpha}K^{1-\alpha}$, A is the technology shock, N is the labor input demand, K is capital input demand. . Each firm is subject to a multiplicative idiosyncratic shocks on the return of capital, ω^j, whose distribution define the default states. 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. With the money borrowed from the intermediary, the entrepreneur goes to the factor market to hire capital. The optimizing decision of labor and capital is made by solving a static optimization problem for cost minimization[31]. The firms sets the real marginal cost of labor (real wage) and capital in each period equal to the value of the marginal productivity. By combining the two optimality conditions for input demands one can express the real marginal cost of production as

$$mc^j(s^t) = \frac{1}{A(s^t)}\left(\frac{W(s^t)}{\alpha P(s^t)}\right)^{\alpha}\left(\frac{MPK^j(s^t)}{(1-\alpha)P(s^t)}\right)^{1-\alpha}$$

The investment unit decision determines the optimal investment pattern to maximize its present discounted value. This leads to the following efficiency conditions:

$$Q(s^t) = \left[\phi'\left(\frac{I(s^t)}{K(s^{t-1})}\right)\right]^{-1} \tag{13}$$

$$Q(s^t)R^k(s^{t+1}) = mc(s^{t+1})\alpha\frac{Y(s^{t+1})}{K(s^t)} + Q(s^{t+1})\left(1-\delta+\phi\left(\frac{I(s^{t+1})}{K(s^t)}\right) - \frac{I(s^{t+1})}{K(s^t)}\phi'\left(\frac{I(s^{t+1})}{K(s^t)}\right)\right) \tag{14}$$

$mc(s^t)$ is the real marginal cost, $Q(s^t)$ is the real price of capital and δ is the depreciation rate, $I(s^t)$ is aggregate i investment and is represented from a Dixit-Stiglitz aggregator of different varieties, $\phi(\frac{I(s^t)}{K(s^{t-1})})$ is a production function for capital that embeds adjustment costs. The first equation determines the price of capital, while the second is the law of motion of price of capital (i.e. the

[31] First order conditions for K^j and N^j are:

$$\frac{1}{mc^j}\frac{W}{P} = (1-\alpha)\frac{Y^j}{N^j};\ \frac{1}{mc^j}MPK = \alpha\frac{Y^j}{K^j}$$

where mc^j is the real marginal cost.

expected return on capital) that takes into account the future marginal product of rented capital and the effect of capital accumulation on next period capital stock and investment costs. The law of motion of aggregate capital is:

$$K(s^t) = (1-\delta)K(s^{t-1}) + I(s^t) - \phi(\frac{I(s^t)}{K(s^{t-1})})K(s^{t-1}) - X(s^t)K(s^{t-1}) \tag{15}$$

where $X(s^t)K(s^{t-1}) = \int_0^{\bar{\omega}} c_m \omega dF(\omega) R^k(s^t)Q(s^{t-1})K(s^{t-1})$ is the loss in capital due to the payment from the bank of the monitoring cost, c_m, under the default state for the borrower, $\omega \in [0, \bar{\omega}]$.

The monopolistic competitive unit has the task of differentiating the homogenous good. It is a monopolistic competitive sector and in choosing the optimal price they optimize in a Calvo fashion. The optimizing behavior of this sector will provide the pricing function for the final good. In each period the agent faces a fixed probability of adjusting prices $(1-\vartheta)$. In this event the agent chooses the price $P_s(\tau, s^t)$ with $s = H, F$ for each variety produced so as to maximize the expected utility resulting from sale revenues minus nominal marginal costs in each of the future states in which the price commitment still applies. Combining the results on optimal allocation for each variety for the domestic and foreign demands, I get the total demand for each variety τ:

$$Y^d(\tau, s^{t+k}) = (\frac{P_H(\tau, s^t)}{P_H(s^{t+k})})^{-\varepsilon}(C_H(s^{t+k}) + C_H^*(s^{t+k}) + C^e(s^{t+k}) + I(s^{t+k})) \tag{16}$$

where C_H and C_H^* are the aggregate domestic and foreign demand for goods produced in the home country. The maximization is performed taking as given $P(s^t), P_H(s^t), P_F(s^t)$ and $Y^d(\tau, s^t)$ and subject to the aggregate demand curve(16). The solution to the maximization problem of the firm producing good τ for the home country is:

$$P_H^{new}(\tau, s^t) = \mu \frac{\sum_{k=0}^{\infty} \sum_{s^t} (\vartheta)^k d(s^{t+k}|s^t) Y_H(\tau, s^{t+k}) MC(\tau, s^{t+k})}{E_t \sum_{k=0}^{\infty} (\vartheta)^k d(s^{t+k}|s^t) Y_H(\tau, s^{t+k})} \tag{17}$$

where μ is a mark-up, ϑ is the probability that the price is fixed in each period and $d(s^{t+k}|s^t)$ is the stochastic discount factor. The new price is determined as a constant mark-up over the discounted future stream of marginal costs. Embedded in the maximization problem of the monopolistic sector is the assumption that the producers set the price of their goods in domestic currency. The price of that good in the foreign market is then determined in accord with the prevailing exchange rate.

3.4 The Financial Intermediary and Differences in Financial Systems

The financial intermediary collects domestic and international deposits from resident households and provides domestic and international deposits to resident firms, by solving a costly state verification problem[32]. An agency problem between the bank and the entrepreneur arises because of the impossibility for the intermediary to observe the idiosyncratic shock, ω^j, without paying a fixed monitoring cost. Since both agents involved in the contract are risk neutral optimality requires that the bank makes zero profit, that the entrepreneur does not suffer losses on average and that there is a unique cut-off value for the idiosyncratic shock that divides default from non-default states. The contract is intrinsically incentive compatible since it is assumed that the entrepreneur pays a fixed repayment in the non-default states -i.e. no incentive to lie - and the bank gets everything is left in the default states - maximum recovery property.

The characteristic of the financial system in each country are defined by two primitive variables: the variance of investment return defined by the standard deviation of the idiosyncratic shocks to the return on capital, ω^j and the monitoring cost (c_m) that the bank pays in bankruptcy states. The intermediary requires the same repayment schedule on both domestic and international loans, since the default probability depends on the riskiness of resident firms and is independent from the currency in which the loan is denominated. The agency problem is solved by assuming that the intermediary chooses the optimal demand for loans $L^j(s^t)$ - i.e. the optimal demand of capital - and the repayment schedule[33] - i.e. the cut-off value $\overline{\omega}^j$ for the default states - so as to maximize the expected return of the risk neutral entrepreneur subject to a participation constraint for the risk neutral intermediary and a participation constraint for the borrower for given values of $R^k(s^t), Q(s^t)$. I assume that the idiosyncratic shock ω^j is distributed according to $F(\omega^j)$[34]. At time t firm j in country chooses $K^j(s^t)$, $\overline{\omega}^j$ to

$$MaxE_t\{\int_{\overline{\omega}^j}^{\infty}(\omega^j-\overline{\omega}^j)R^k(s^{t+1})Q(s^t)K^j(s^t)dF(\omega)\} \tag{18}$$

$$[1-F(\overline{\omega}^j)](R_L(s^t)(1-\xi)L^j(s^t)+R_L^*(s^t)\xi L^j(s^t))+(1-c_m) \tag{19}$$

$$\int_0^{\overline{\omega}^j}\omega^j dF(\omega)\}R^k(s^{t+1})Q(s^t)K^j(s^t)=(R(s^t)D(s^t)+R^*(s^t)D^*(s^t))(\frac{P(s^t)}{P_H(s^t)})$$

[32] The design of the optimal contract in this open economy framework follows the contracting problem considered in Gale and Hellwig (1985). The design of the contract in the general equilibrium follows Bernanke, Gertler and Gilchrist (1998) and Cooley and Nam (1998). Finally as in Faia and Monacelli (2001) I set a fraction of the loan as denominated in foreign currency: this will allow me to analyze the role of the financial openness in the context of asymmetric financial frictions.

[33] The optimality of the contract is achieved by assuming that the intermediary asks for a fixed repayment schedule over the non-default states. This implies that the contract is incentive compatible. In addition a maximum recovery property is required: in the default states the intermediary gets everything is left. For the optimality of these conditions see Gale and Hellwig (1985). Given those conditions the cut-off value for default states can replace the repayment schedule as choice variable in the maximization.

[34] The distribution has an increasing hazard rate.

$$\overline{\omega}^j R^k(s^{t+1})Q(s^t)K^j(s^t) = (R_L(s^t)(1-\xi)L^j(s^t) + R_L^*(s^t)\xi L^j(s^t)) \tag{20}$$

$$L^j(s^t) = Q(s^t)K^j(s^t) - NW^j(s^t)$$

where $\overline{\omega}^j$ is value of the shock that divides the random space into default and solvency regions, $R_L(s^t)$ and $R_L^*(s^t)$are the repayment schedules required for loans denominated in domestic and foreign consumption units, ξ is the fractions of the loans denominated in foreign consumption index, c_m is the monitoring cost paid by the lender. The fraction of debt denominated in foreign currency will act as *financial exposure.* Equation (18) is the expected return to the entrepreneur, equation (19) is the participation constraint of the lender, equation (20) is the participation constraint for the borrower.

Using the first order condition one can define a negative relation between the capital/net worth ratio and the "external finance premium"- i.e. the ratio between the return on investment and the return on deposits:

$$\frac{Q(s^t)K^j(s^t)}{NW^j(s^t)} = \Psi^{-1}(\frac{R^k(s^{t+1})}{R^{loan}(s^t)}) \tag{21}$$

where $\psi' < 0$, and $R^{loan}(s^t) = \xi R^*(s^t) + (1-\xi)R(s^t) = \xi R(s^t)\frac{e^r(s^{t+1})}{e^r(s^t)} + (1-\xi)R(s^t)$. By aggregating equation (21) over all firms one gets a condition for the external finance premium in the general equilibrium: $\frac{R^k(s^{t+1})}{R^{loan}(s^t)} = \Psi(\frac{Q(s^t)K(s^t)}{NW(s^t)})$. Since $Q(s^t)K(s^t) = NW(s^t) + L(s^t)$ using equation 21 one can derive a relation for the optimal borrowing limit:

$$L(s^t) = NW(s^t)(\Psi^{-1}(\frac{R^k(s^{t+1})}{R^{loan}(s^t)}) - 1)$$

Notice that the borrowing limit depends positively from the amount of collateral, $NW(s^t)$, and negatively from the size of the external finance premium.

The net wealth ratio, the cut-off value, the elasticity of the external finance premium and consequently the borrowing limit are functions of the primitive parameters identified by the riskiness of the investment project defined as the variance of the distribution function $F(\omega^j)$, the business failure probability ζ and the monitoring cost. In the parametrization the primitive parameters will change across the two countries in order to define three different scenarios in terms of relative financial fragility. A solution to the first order conditions of the contract is in Appendix 8.

3.5 The Equilibrium Conditions

The following equilibrium conditions on demand must hold for home and foreign country[35]:

$$Y(s^t) = C_H(s^t) + C_H^*(s^t) + I(s^t) + X(s^t)K(s^t) \tag{23}$$

$$Y^*(s^t) = C_F(s^t) + C_F^*(s^t) + I(s^t) + X(s^t)K(s^t) \tag{24}$$

Market clearing condition for bonds requires these asset to be in zero net supply:

$$B(s^t) + B^*(s^t) = 0 \tag{25}$$

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

$$D(s^t) + D^*(s^t)e^r(s^t) = L(s^t) = (Q(s^t)K(s^t) - NW(s^t)) \tag{26}$$

4 The Monetary Policy Rules

To assess the robustness of the link between financial differences and transmission mechanism I compare different monetary regimes - i.e. independent policies versus fixed exchange rate regimes. The paper will indeed show that heterogenous cycles are more likely to occur under floating exchange rate regimes than under fixed. Since an increasing number of countries under independent policies are adopting price stability rules I also compare Taylor rule versus rigid inflation targeting. As it will be shown later the two rules imply similar conclusions in terms of international transmission mechanism but can generate different volatilities of real variable mostly for very fragile countries.

Under independent policies, an active monetary policy sets the short term nominal interest rate by reacting to endogenous variables. I will consider the general class of the Taylor rules of the following form (in log-linear form):

$$(1 + R^n(s^t)) = (\pi_H(s^t))^{b_\pi}(e(s^t))^{b_e} \tag{27}$$

where $R^n(s^t) = R(s^t)\frac{P(s^{t+1})}{P(s^t)}$, and b_π, b_e are the weights that the monetary authority puts on the deviation of inflation, output and exchange rate from the target levels. To get determinacy of the

[35]In equilibrium the market clearing condition implies:

$$Y(\tau, s^t) = C_H(\tau, s^t) + C_H^*(\tau, s^t) + C^e(\tau, s^t) + I(\tau, s^t); Y^*(\tau, s^t) = C_F(\tau, s^t) + C_F^*(\tau, s^t) + C^{*e}(\tau, s^t) + I(\tau, s^t). \tag{22}$$

The aggregation problem has been solved by assuming that the aggregate consumption, investment and output in home countries can be represented trough a CES aggregator and that aggregate outputs can be approximated by the sum of individuals output at least in a neighborhood of the steady state. There is no trade on investment goods, meaning that each country uses its own production of capital goods as input.

equilibrium the parameter on inflation will be set equal to 1.5. I identify a regime of pure *floating exchange rate* with a Taylor rule of the form (27) in which $b^e = 0$. When $b^e = 0.99$- i.e. $\frac{b_e}{1-b_e} \rightarrow \infty$ - the rule identifies a regime of *fixed exchange rates*[36]. In the limit this last rule corresponds to the case in which the monetary authority sets the interest rate equal to the interest rate of the other country.

To fit the case of large currency areas more closely I will also explore the case of independent policies where monetary authorities implement *rigid inflation targeting*[37]. In this case the policy maker applies an infinite weight on domestic inflation setting the nominal interest rate equal to the wicksellian interest rate that eventually depends on the state of the economy - i.e. exogenous shocks, capital and net worth- and by a given policy rule for the other country. In the limit case the price stability rule for the home country will then look like this:

$$R(s^t) = f(R^*(s^t), K(s^{t-1}), NW(s^{t-1}), A(s^t)) \tag{28}$$

For the foreign country the rule will just be specular. To identify this regimes various techniques have been proposed[38]; here I will get the dynamics of the variables by imposing zero domestic inflation and zero marginal cost to the model.

5 Calibration

The model is parametrized as followed. The two country are assumed to be symmetric in preference and technology specifications but asymmetric in terms of financial conditions. Time is taken to be measured in quarters.

Preferences: I set the discount factor $\beta = 0.99$, so that the annual interest rate is equal to 4 percent. As in most of the literature on RBC, I set the elasticity of substitution between domestic and foreign goods η equal to 1.5. The parameters on consumption and labor in the utility function are set equal to one to generate a log utility and a unity supply of labor[39]. I let the degree of trading openness to vary between $\gamma = 0.15$ and $\gamma = 0.4$.

Technology: the share of capital in the production functions $\alpha = 0.3$, the quarterly depreciation rate $\delta = 0.025$, the steady state mark-up value $\mu = 1.2$.The probability of adjusting prices in

[36]For a similar specification see Monacelli (1999) and Benigno P. and G. Benigno (2000).

[37]A rationale for the price stability rules as being a Nash equilibrium for open economies is found in Benigno G. and Benigno P. (2000).

[38]In particular in models with capital see Neiss and Nelson (2000) whose claim is that a price stability rule should imply an equilibrium characterized by zero inflation not only now and in the future but even in the past. The resulting level of potential ouput and potential interest rate can be described as moving average porcesses of exogenous shocks. On the other side Woodford (2000) notice that the rule should condition on actual predetermined variables as if past equilibrium were characterized by sticky price behaviors.

[39]These values are compatible with those of a steady state trade balanced growth path.

each period ϑ is set equal to 0.75, a value consistent with an average period of one year between price adjustment. The elasticity of the price of capital with respect to investment output ratio $\phi = 0.5$.

Financial frictions parameters: the financial frictions scenarios are identified according to three primitive parameters: 1) the corporate risk of firms identified by the variance of the idiosyncratic shock $\overline{\omega}^j$, 2) the monitoring cost for the bank, c_m, 3) the survival rate of firms, ς. The solution of the contract in the steady state will lead to values for the 1) elasticity of external finance premium to collateral, $\psi(\bullet)$, 2) net wealth ratio or leverage ratio, $\frac{K}{NW}$, in steady state, 3) the external finance premium in the steady state, ψ^{ss} (this will be defined in annual basis points), 4) the optimal cut-off value $\overline{\omega}^j$ and consequently the default probability $F(\overline{\omega}^j)$. The elasticity of the external finance premium to collateral also plays a role in determining the sensitivity of the borrowing limit to financial conditions.

The asymmetries between the two countries will be build up by assuming three different financial scenarios for the foreign country given one particular scenario for the home country. All the three primitive parameters are crucial in order to define a financial scenario. The monitoring costs is a measure of the loan losses and the bankruptcy costs that a bank incurs by giving a loan to a defaulting firm. The distribution and the moments of the idiosyncratic shocks are necessary to define the degree of riskiness for investment projects. The survival rate of firms is an indicator of the riskiness of the financial systems as a whole since it describes the aggregate evolution of the business sector. A very fragile system in the foreign country is identified by a situation in which monitoring costs for banks, perceived financial risk and exit ratio for firms are high. In the solution to the financial contract this leads to high values for the elasticity and the steady state value of the external finance premium, low leverage, high default probability. Finally low leverage and high elasticity of external finance premium to collateral determine a tighter a borrowing limit and a lower return on asset.

The parametrization strategy[40] is based on the following criterion: I set the monitoring costs using as reference the micro data presented before on bankruptcy costs, I keep the default probability as fixed and then I set the volatility so as to get an external finance premium that corresponds to the value found in the data for the difference between the rate on Treasury bill and the prime lending - i.e. a value of 200 basis point for the US economy -. The following tables 1,2, show the

[40] The first order conditions for the contract are three equations in three unknwons. One needs to specify the three primitive parameters to get the three unknowns. There are infinite combinations of these values. Mainly those three situations can arise: a) Both the monitoring cost and the volatility of the idiosyncratic shocks increase and as a result the external finance premium and its elasticity increase. b) Only the monitoring cost increases while the volatility of the idiosyncratic shock remains fixed or decreases. As a result both the external finance premium and its elasticity increase. c) Only the volatility of the idiosyncratic shock increases while the monitoring cost remains fixed. As a result the external finance premium and its elasticity increase.

Several other combinations can be derived, but the main message is that it is enough an increase in the monitoring cost to get an increase in the external finance premium and in the sensitivity of the business cycle.

Table 1: **Financial Scenarios for Primitive Parameters.**

Primitive parameters	Scenario 1	Scenario2	Scenario3
$\sigma_{\overline{\omega}^j}$	0.26	0.28	0.30
c_m	0.05	0.12	0.3
ς	0.973	0.973	0.973

Table 2: **Financial Scenarios for Financial Contract Parameters in The Steady State.**

Model parameters	Scenario 1	Scenario2	Scenario3
$\frac{K}{NW}$	2.5	2.1	1.9
ψ^{ss}	280	330	340
$\psi(\bullet)$	0.02	0.053	0.08
$\%F(\overline{\omega}^j)$	13.6	5.4	1.9

parametrization for three possible financial scenarios for the foreign country given the a baseline parametrization with low external finance premium for the home country.

Exogenous shocks: The persistence of the shocks varies between 0.8 and 0.9. The volatility of the shock is calibrated to get output volatility that are close to the ones in the data for the US and the Euro area.

The equilibrium of the model is characterized as the solution of the system of expectation difference equations of the loglinearized form[41]. For a solution of the steady state of the model see *Appendix 9.* Finally *Appendix 10* will provide a definition of the competitive equilibrium in this case and a brief outline of the loglinearized version of the model.

6 Financial Asymmetries with Identical Policies

The model can now answer the following questions: Do countries show differential business cycle fluctuations given differences in the financial system? If so, under which conditions are those differential responses more pronounced? The answer to these questions highlights the international

[41]The loglinearized system can be described by a general homogenous matrix equation:

$$E_t \sum_{i=-m}^{n} A_i X_{t+i} = 0, t \geq 0$$

where m is the number of leads, n is the number of lags, A_i are the structural coefficient matrices, and $A_n(n=1)$ is not full-rank. I apply the solution method developed by Anderson and Moore (1985) which enables us to deal with possibly singular systems, unlike the Blanchard-Khan (1980).

business cycle properties of the model and the transmission mechanism generated in this new set-up. To isolate the effect of asymmetries the following analysis assumes identical policies and different type of shocks - i.e. asymmetric, symmetric, uncorrelated and correlated. I will consider productivity[42] and financial shocks - i.e. shocks to the cost of the loan[43] or to net worth[44]. To examine the impact of financial differences the discussion will proceed according to the following steps. First, I explore the case of two countries with symmetric financial systems and asymmetric shocks; this allows me to clarify the intuition behind the transmission mechanism in the model. Secondly, I show the main result that business cycle heterogeneity occurs under independent policies. Third I perturb the economy with respect to the benchmark case by considering different monetary regimes and different degree of openness to completely assess the role of financial differences under alternative set-ups. Finally I discuss some properties of the international transmission mechanism mainly referring to the pattern of exchange rates.

Productivity and Financial Shocks With Taylor Rules. I first describe for an illustrative purpose the mechanism of the model when both countries have the same degree of financial fragility and a positive technology shock hit the home economy. In figure 2 domestic output increases, domestic inflation decreases and this induces via a Taylor rule a decrease of nominal and real interest rates. The consequent reduction in the external finance premium also improves financial conditions by increasing investment, net wealth and price of capital in the home country. The foreign country experiences real and financial effects too. Part of the transmission is explained by a demand effect already present in the previous literature called *switching expenditure effect.* The decrease in domestic inflation shifts demand in the home country in favor of domestic goods. The decrease in foreign goods demand also reduces foreign inflation and foreign output[45]. The demand effect generates a negative correlation of output between the two countries. The combination of the switching expenditure effect and of a conventional financial accelerator effect produces an indirect *financial spillover* from the home to the foreign country. Indeed given the decrease in foreign inflation, foreign nominal interest rates decrease as a consequence of the endogenous response of monetary policy. The decrease in the nominal interest rate and consequently in the cost of the loan improves financial conditions and generates an asset price boom in the foreign country. Depending on its magnitude the financial spillover effect can partly or completely offset the negative influence of the shift in demand. The financial spillover that is missing in traditional models of international

[42]A productivity shocks $A(s^t)$ affects the production of the economy $(Y(s^t) = A(s^t)K^{1-\alpha}(s^t)N^{\alpha}(s^t))$ and follows an AR(1) process of the type: $A(s^t) = \rho A(s^{t-1}) + \varepsilon_A$.

[43]These shocks can be generated by revisions in expectations or confidence crisis. The shock in the model will be represented as a permanent shock to the cost of external finance.

[44]These shocks can be generated by defaulting firms and induce wealth movements between the two types of agents. In the model the shock is represented by a permanent shock to the evolution of net wealth.

[45]The *absorption effect,* that increases domestic demand due to increase in income, seems to be negligible since in this model the increase in output is more likely to generate an increase in investment expenditure than an increase in the consumption of workers.

business cycle can explain why an increase in total factor productivity for one of the two countries can generate an increase in asset prices for the foreign country[46].

If the two countries show different degrees of financial sensitivity differential responses occur. Since the credit channel accounts for the transmission mechanism of this model business cycle fluctuations tend to diverge when higher differences in the financial system emerge. In particular when the foreign country is relatively more fragile foreign variables are relatively more volatile and persistent. Table 7 and 8 show a systematic comparison of cross-country correlations of output for different type of productivity and financial shocks - i.e. asymmetric, symmetric, uncorrelated and correlated - and with increasing differences in financial system (from scenario 1 to scenario 3). A negative relation emerges between output fluctuations and differences in financial system. When shocks are correlated the negative relation is stronger under financial shocks. With asymmetric shocks the model is able to reproduce a wide range of correlation values - i.e. from positive to negative - depending on the degree of difference between financial systems. Contrary to traditional models of the open economy literature where asymmetric shocks always generate negative correlations in output the present model shows that positive correlation might occur when financial systems are very close. This is due to the fact that when borrowing constraints have the same strength the positive effect due to the *indirect financial spillover* is able to offset the negative *switching expenditure effect.* This result is more consistent with the data that show positive correlations of output for countries with similar financial systems even with asymmetric shocks.

Remark 1 *The correlation among the business cycles of two countries is a decreasing function of the degree of financial diversity.*

Economic Openness. An increase of the trade intensity produces different effects according to the type of shock, productivity versus financial shock. With productivity shock an higher degree of openness induces positive correlation of cycle mostly under asymmetric shocks (see table 7). The intuition of this results can be followed by looking at the effects of a positive technology shock in the home country. With higher economic openness there is an higher decrease in inflation for the foreign country due to the switching expenditure effect. The decrease in inflation generates a decrease in interest rates and boosts the foreign economy too through the increase in investment.

With a shock to the cost of the loan higher trading intensity leads to reduction in the correlation of cycles up to negative values, see table 8. Following a decrease in the cost of the loan in the home country, domestic output and inflation increase. Since inflation in the foreign country increases, the foreign interest rate increases and consequently financial conditions worsen. The increase in domestic output is then associated with a decrease in foreign output due to a decrease in investment. When trading intensity increases the increase in foreign inflation and consequently the decrease in foreign investment and output are higher.

[46] See Greenwood and Jovanovic (1999).

Remark 2 *A higher degree of economic openness enhances asymmetries in cycles between the two countries given the presence of structural differences in financial systems and with financial shocks. On the other side higher degrees of trading intensity increase the correlation of cycles when productivity shocks occur.*

The *persistence of the real exchange* rate increases when financial differences increase. When simulating a symmetric and correlated productivity shock the persistence of real exchange rate goes from 0.76 in scenario1 to 0.82 in scenario 2 to 0.87 in scenario 3. The value of the persistence of real exchange rate between Europe and US is about 0.83[47]. Since scenario 2 approximate closely the parametrization for US and Europe, the numbers generated by the calibrated model resemble pretty much the numbers in the data. As noticed in Chari,Kehoe and McGrattan sticky price models were not able to generate enough persistence to match the one shown in the data[48]. The introduction of financial frictions and financial differences in this model seems to help in this direction. The intuition for the result of the present model can be found in the persistence associated with the real interest rates. Borrowing constraints on investment increase persistence of real interest rates. If the foreign country suffers of tighter borrowing constraints the foreign interest rate is relatively more persistent. The real exchange rate will then absorb the difference in the persistence of the interest rates between the tow countries through the uncovered interest rate parity.

Remark 3 *Persistence of real exchange rates increases when financial differences increase.*

A weakness of the insulation property of exchange rates emerges in this setting. The exchange rate works like a shock absorber and shows differential responses, but this does not prevent either country by having more pronounced fluctuations when higher differences in financial system occur. Figure 3, shows impulse responses of home and foreign variables with a positive foreign shock to net worth. The improvement in the financial wealth increases output, demand and inflation for the foreign country. On impact, output and financial variables are more responsive when the foreign country is characterized by increasing values of elasticity of external finance premium. A higher level of persistence arises when the financial system is more stable. This is due to the higher persistence of inflation and interest rates. The home country gets a positive burst from the favorable switching effect even though the increase in output is partly depressed by an increase in inflation and interest rate that adversely affects financial conditions and consumption. Consumption shows a non-stationary pattern since there is a movement of wealth from workers to entrepreneurs.

Remark 4 *The insulation property of exchange rates is weakened by financial differences.*

[47]See Chari, Kehoe and McGrattan (2001).

[48]Statistics presented in Chari, Kehoe and McGrattan (2001) show that sticky price models can generate values for the persistences of the real exchange rate that go from 0.48 to 0.70 depending on alternative assumptions for untility and international asset markets.

Financial Openness. An increase in the financial openness - i.e. a positive fraction of loans denominated in foreign currency as defined in Faia and Monacelli (2000) - enhances the differential responses of home variables due to the additional effect that changes in the exchange rate have on the cost of the loan. To the extent home loans are denominated in foreign currency a collapse in the exchange rates moves wealth from domestic borrowers to foreign lenders, and viceversa with an increase in the exchange rates. Since it has been shown that the exchange rates have more persistent fluctuations when financial differences increase, the wealth shift will be higher under the second and the third scenario leading to more pronounced business cycle asymmetries.

Remark 5 *A higher degree of financial openness leads to higher asymmetries in business cycle fluctuations across the two countries. A collapse in the exchange rate moves wealth from domestic borrowers to foreign lenders.*

Productivity and Financial Shocks With Rigid Inflation Targeting Rules. Table 9, 10, 11 show volatilities[49] for home and foreign variables under the three regimes considered - i.e. Taylor rule, rigid inflation targeting and credible pegs. Under a regime of strict inflation targeting the volatilities of both real and financial variables increase. As in Gali' and Monacelli (2000) and Monacelli (2000) output does seem to respond more under this rule. With zero inflation the nominal interest rate is set on a period by period basis equal to the wicksellian interest rate that reacts to shocks, capital and net worth of firms. The reaction of the nominal interest rate to net worth spreads the financial instability to the all economy.

Remark 6 *A rigid inflation targeting rule increases volatility of both, financial and real variables.*

Credible Pegs. The main findings concerning a regime of credible exchange rates are: 1) The impulse responses under the three different financial scenarios appear to be similar. This result holds independently of the degree of economic and financial openness; 2) The cycles of the two economies show a high degree of positive correlation.

When the foreign country is pegged to the home country it gains stability. Since the foreign interest rate is set equal to the domestic interest rate the impact of financial differences is mitigated and cycles are more synchronized. Also since there is no switching expenditure effect the correlations are in general positive, see table 11.

Remark 7 *Synchronization among cycles increases under credible pegs.*

[49]See Appendix 5 for the procedure used in calculating second moments.

6.0.1 Welfare Properties

The aim of this section is to provide a ranking of policy rules and a measure of the cost of the frictions. To analyze the cost of frictions I use the welfare measure defined in Lucas (1987). The measure is model independent and suitable for the experiments considered. It gives the cost of business cycle fluctuations in terms of consumption and employment volatility. Appendix 11 shows the derivations of the welfare measure that has the following form:

$$\upsilon = [\frac{1}{2}((1-\sigma)E(\hat{c}_t)^2 + (1+\phi)E(\hat{n}_t)^2]$$

The welfare costs of business cycles are given by the fraction of non-steady state consumption that households would be willing to give up in order to be indifferent between a constant sequence of consumption and working hours and the stochastic sequences of the same variables under the monetary regime considered. The costs of the business cycle are increasing with respect to consumption and employment volatilities. Consequently the gain is a decreasing function of the volatilities in consumption and employment.

Table(12) shows results for the welfare ranking in terms of welfare gains. When an external financial shock hits both economies, the country that suffer more is the one with the highest degree of fragility. The foreign country shows the lowest gain under the third scenario. Under Taylor rules the welfare gain is decreasing for both countries when the differences in financial systems are increasing, but the fall is more pronounced for the more fragile country. Note that there is a significant fall in welfare gain when passing to a rigid inflation targeting rule: almost 20% of the steady state consumption is lost. Finally when the home country is pegging to a country with higher degrees of fragility, it gets big losses (data are not reported since welfare is negative). On the other side with credible pegs the foreign country gets higher gains than under Taylor or rigid inflation targeting rules and the gains are increasing with the degree of fragility. In this case the foreign country benefits from the stability that it gains when pegging to a less fragile country.

7 Conclusion

The focus of this paper is the role that financial market asymmetries play in the international transmission of shocks. Although financial asymmetries are systematically invoked to explain differences in the domestic transmission of monetary policy or other shocks, they have so far not been used in the analysis of international interdependence.

The first step in this paper is to show some stylized facts concerning international correlation of business cycles and financial asymmetries. I find that there is a strong link between them. Across a sample of OECD countries, there is a significant negative association between correlation of cycles and the differences in the financial structures or in the relative degree of financial risk. This link is robust to the inclusion of third factors like bilateral trade integration and geography. In fact, financial asymmetries seem to explain cyclical co-movements between pairs of countries much better than bilateral trade flows.

As a second step, I build a two-country stochastic dynamic general equilibrium model with optimizing agents characterized by nominal rigidities in an imperfectly competitive framework, international financial markets for deposits, loans and state contingent bonds, and financial diversity in terms of fragility of banking systems and riskiness of investment projects. Financial differences are modelled in terms of the following parameters: cost of bankruptcy, variability of investment projects, failure probability of firms and elasticity of external finance premium for loans with respect to collateral. The model is calibrated for the US and the euro area, and analyzed under two types of shocks. Productivity and financial shocks are considered in the form of asymmetric and symmetric/correlated shocks. Under independent policies two types of monetary policy rules are analyzed in order to fit the case of large currency areas: Taylor rule and "price stability" rule.

Many interesting results emerge. First, the model generates differential business cycles under identical and independent monetary policies. Cyclical asymmetries increase with financial asymmetries. Under (identical) price stability rules, the volatility of real and financial variables increases relative to when Taylor rules are used, in line with previous literature. Under fixed exchange rates, cycles become more synchronized. The model provides an alternative explanation for the high persistence shown in the data by the real exchange rate. Indeed when countries experience different degree of borrowing constraints, interest rates show different degrees of persistence. The real exchange rate absorbs the difference in persistence when equilibrating the domestic and the foreign interest rate in the uncovered interest parity. Finally, several welfare properties emerge: for example, the financially weak country suffers more than the strong country when hit by an external shock.

Although the analysis of this paper is referred to the US and the euro area, the basic ideas have, I believe, more general validity. The model could be directly applied to examine, for example, issues related to the international impact of Japan's financial fragility, or the macroeconomic interaction between financially asymmetric countries linked by a hard peg (e.g. a currency board). All this is left for future research.

References

[1] Ambler, S., E. Cardia and C. Zimmermann , 2002, "International Transmission of the Business Cycle in a Multi-Sectoral Model", European Economic Review, 46(2), pages 273-300.

[2] Anderson, G. and G. Moore (1985), "A Linear Procedure for Solving Linear Perfect Foresight Models", *Economics Letters, 17, 247-252.*

[3] Angeloni, I., V. Gaspar, O. Issing and O. Tristiani (2001), Monetary Policy in the Euro Area, Cambridge University Press.

[4] Akerlof, G. (1970), "The Market for Lemons: Quality Uncertainty and The Market Mechanism", *Quarterly Journal of Economics,* 85, August, 488-500.

[5] Backus, D.K., P.J. Kehoe and F.E. Kydland, (1992), "International real business cycles", Journal of Political Economy 101, 745-775.

[6] Baxter, M. and M. Crucini (1994), "Business Cycles and the Asset Structure of Foreign Trade", Interanational Economic Review 36, 821-854.

[7] Ball, L. (1998), "Policy Rules for Open Economies", in J. Taylor, ed., *Monetary Policy Rules*, University of Chicago Press, Chicago, IL.

[8] Benigno, G., P. Benigno (2000), "Monetary Policy Rules and the Exchange Rate", manuscript, Bank of England, New York University.

[9] Bernanke, B. and M. Gertler (1989) "Agency Costs, Net Worth, and Business Fluctuations", *American Economic Review*, 79, March 1989, 14-31.

[10] Bernanke, B., M. Gertler and S. Gilchrist (1999), "The Financial Accelerator in a Quantitative Business Cycle Framework", in J.B. Taylor, and M. Woodford, eds., *Handbook of Macroeconomics*, Amsterdam: North-Holland.

[11] Calvo, G. (1983), "Staggered Prices in a Utility Maximization Framework", *Journal of Monetary Economics*, 12, 383-98.

[12] Carlstrom, C. and T. Fuerst (1997), "Agency Costs, Net Worth and Business Fluctuations: A Computable General Equilibrium Analysis", *American Economic Review,* 87, 893-910.

[13] Stephen G. Cecchetti, 1999. "Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism," NBER Working Papers 7151, National Bureau of Economic Research, Inc.

[14] Chari, V.V., Patrick Kehoe and Ellen R. McGrattan (2000), "Can Sticky Price Models Generate Volatile and Persistent Real Exchange Rate", NBER Working Paper 7869.

[15] Clarida, R., J. Gali, and M. Gertler (2000), "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory", *Quarterly Journal of Economics*, 115 (1), February, 147-180.

[16] Cole, H. and M. Obstfeld, 1991, "Commodity Trade and International Risk Sharing: How Much Do Financial Markets Matter?", Journal of Monetary Economics.

[17] Cooley, T. and V. Quadrini (1999), "Monetary Policy and the Financial Decision of Firms", manuscript, New York University.

[18] Faia, E. (2001), "Stabilization Policy in A Two-Country Model and The Role of Financial Frictions", European Central Bank w.p. #56.

[19] Faia E. and T. Monacelli (2002), "Financial Exposure, Exchange Rate Regimes and Fear of Floating", mimeo, New York University and Boston College.

[20] Gale, D. and M. Hellwig (1985), "Incentive-Compatible Debt Contracts: The One-Period Problem", *Review of Economic Studies,* 52, 647-663.

[21] Galí, J. and T. Monacelli (2000), "Optimal Monetary Policy and Exchange Rate Volatility in A Small Open Economy", manuscript, Universitat Pompeu Fabra and Boston College.

[22] M. Gertler, Gilchrist S. and F.M. Natalucci (2001) "External Constraints on Monetary Policy and The Financial Accelerator", mimeo, New York University and Boston University.

[23] Goodfriend M. and R. King (2000), "The Case for Price Stability", European Central Bank Conference on "Price Stability" 2000.

[24] Greenwood, J. and B. Jovanovic, 1999. "The IT Revolution and the Stock Market," RCER Working Papers 460, University of Rochester - Center for Economic Research (RCER).

[25] Heathcote, J. and F. Perri (2001), "Financial Globalization and Real Regionalization", Stern School of Business.

[26] Helpman E. and A. Razin, 1978, "The Protective Effect of a Tariff under Uncertainty", Journal of Political Economy.

[27] Imbs, J., 1998. "Co-Fluctuations, "Cahiers de Recherches Economiques du Département d'Econométrie et d'Economie politique (DEEP), Université de Lausanne, Ecole des HEC, DEEP.

[28] King, R. G. and M. W. Watson, 1996, "Money, Interest Rates and the Business Cycle", Review of Economics and Statistics, p. 35-53.

[29] King, R. G. and A. L. Wolman, 1996. "Inflation Targeting in a St. Louis Model of the 21st Century," NBER Working Papers 5507, National Bureau of Economic Research, Inc.

[30] Kiyotaki, N. and J. Moore (1997), "Credit Cycles", *Journal of Political Economy*, 105, April , 211-48.

[31] La Porta, R., F. Lopez-de-Silanes, A. Shleifer and R. Vishny, 1999. "Investor Protection: Origins, Consequences, Reform," Harvard Institute of Economic Research Working Papers, Harvard - Institute of Economic Research.

[32] La Porta, R., F. Lopez-de-Silanes, A. Shleifer and R. Vishny, 1997. "Legal Determinants of External Finance," NBER Working Papers 5879, National Bureau of Economic Research, Inc.

[33] McCallum, B. and E. Nelson (1999). "Nominal Income Targeting in an Open-Economy Optimizing Model", *Journal of Monetary Economics, 43: 533-578.*

[34] Monacelli, T. (2001), "New International Monetary Arrangements and the Exchange Rate", mimeo, Boston College.

[35] Neiss, K. and E. Nelson, 2001, "The real interest rate gap as an inflation indicator", Bank of England working paper.

[36] Obstfeld, M. and K. Rogoff, 2000, "New directions for stochastic open economy models", Journal of Inter national Economics.

[37] Pagano, M. and P. Volpin, 2001. "The Political Economy of Finance," CSEF Working Papers, Centre for Studies in Economics and Finance (CSEF), University of Salerno, Italy.

[38] Rotemberg, J. and M. Woodford (1997), "An Optimizing Based Econometric Framework for the Evaluation of Monetary Policy", in B. Bernanke and J. Rotemberg, eds., *NBER Macroeconomics Annual*, Cambridge, MA, MIT Press.

[39] C. Sims (1999), "Solving Linear Rational Expectations Models, mimeo", Princeton University.

[40] Taylor, J. (1999), *Monetary Policy Rules,* University of Chicago Press, Chicago, IL.

[41] Townsend, R. M., 1979, "Optimal Contracts and Competitive Markets with Costly State Verification," Journal of Economic Theory, V.21: 265-293.

[42] C. Zimmermann, 1997, "International Real Business Cycles among Heterogeneous Countries", European Economic Review, 41(1), pages 319-355.

[43] Woodford, M. (1999), "Inflation Stabilization and Welfare", manuscript, Princeton University.

Appendix

8 Solution of the Contract in the Steady State

The first order conditions to the maximization problem of the intermediary are derived here. Let us define $k^j(s^t) = \frac{K^j(s^t)}{L^j(s^t)}$ where and $\psi(s^t) = \frac{R^k(s^t)}{\xi R(s^t)+(1-\xi)R^*(s^t)}$. Let us rearrange the constraints using the fact that the last three constraints hold with strict equality; we can then substitute them in the objective function and in the first constraint. After rearranging the constraints and using Leibniz rule to differentiate the integral function with respect to $\overline{\omega}^j$ we get the following first order conditions with respect to $k^j(s^t)$, $\overline{\omega}^j$ and the Lagrange multiplier ϕ are:

$$E\{(\int_{\overline{\omega}^j}^{\infty}(\omega^j - \overline{\omega}^j)dF(\omega)) + \phi[(1-F(\overline{\omega}^j)) + (1-c_m)\int_0^{\overline{\omega}^j}\omega^j dF(\omega^j)]\}(\psi(s^t)) - \phi = 0 \tag{29}$$

$$[1-F(\overline{\omega}^j)] - \phi[(1-F(\overline{\omega}^j)) - c_m F'(\overline{\omega}^j] = 0 \tag{30}$$

$$E\{[1-F(\overline{\omega}^j)] + (1-c_m)\int_0^{\overline{\omega}^j}\omega^j dF(\omega^j)\}(\psi(s^t)k^j(s^t)) = [k^j(s^t)-1] \tag{31}$$

There is a one to one relation between the capital/net worth ratio ($k^j(s^t)$) and the ratio between the risk free interest rate and the cost of loan ($\psi(s^t)$ that is the external finance premium) and this relation is negative. Assuming an interior solution for $\overline{\omega}^j$[50] and using equation (30), we can derive ϕ as an increasing function of $\overline{\omega}^j$. By substituting $\phi(\overline{\omega}^j)$ in (29) one can derive a one to one relation between the external finance premium and $\overline{\omega}^j$: so $\psi(s^t) = f(\overline{\omega}^j)$. By substituting $\omega^j = f^{-1}(\psi(s^t))$ in (31) one can derive a one to one relation $k^j(s^t) = \Psi^{-1}(\psi(s^t))$. Inverting the last relation one gets the external finance premium for each firm j:

$$\psi(s^t) = \{\frac{R^k(s^{t+1})}{R^{loan}(s^t)}\} = \Psi(\frac{NW^j(s^t)}{Q(s^t)K^j(s^t)}) \tag{32}$$

with $\Psi' < 0$ (the negative sign of Ψ' can be proved by simply substituting $\overline{\omega}^j = f^{-1}(\psi(s^t))$ into the (31) and taking derivative of $k^j(s^t)$ with respect to $\psi(s^t)$).

[50] This can be proved by showing that a value of $\overline{\omega}^j = 0$ does not satisfies all the three FOC togheter when a spacific distribution - e.g. a normal distribution - for $F(\omega^j)$ is chosen. Alternatively one can notice that for the set of points for which the constraint is satisfied with equality the gradient of the objective function is parallel to the gradient of the constraint; this is a necessary and sufficient condition for an intirior solution.

In addition by solving the set of first order conditions in the steady state for given values of the primitive parameters, the variance of $F(\overline{\omega}^j)$ and the monitoring cost , we get certain values for the external finance premium in the steady state, its elasticity over the cycle and the net wealth/capital ratio. The set of first order conditions represents a systems of three equation in three variables. By assuming a lognormal distribution for the idiosyncratic shock and by assigning specific values to the primitive parameters, a simulation of the contract in the steady state produces values for the external finance premium, its elasticity and the net wealth/capital ratio that are compatible with the optimality of the financial contract. See the calibration session for the specific values assigned to the two countries.

9 The Steady State of the Economy

Let us characterize the perfect foresight steady state of the two country world economy. When financial systems are symmetric we can assume $Y = Y^*$ and derive the same steady state ratios for both economies. When different financial systems are the case and in particular when the foreign country is more financially fragile and less efficient than the home country we can assume $Y > Y^*$ and derive two different sets of steady state ratios for the two economies. In any case we can set $A = 1$. Let's derive the steady state ratios of variables for the home economy; this could be equal or different to the one of the foreign countries depending on the level of output in the steady state. Markups are constant in the steady state, implying a product wage $MC = \frac{1}{\mu}$. From the Euler in steady state we get $R = \frac{1}{\beta}$.Given that $Q = 1$ and $MPK = mc * \alpha\frac{Y}{K} = \frac{1}{\mu} * \alpha\frac{Y}{K}$, the return on capital in steady state is $R^k = \frac{1}{\mu}\alpha\frac{Y}{K} + (1-\delta) = R + \varkappa$,where $\varkappa$ is the risk premium in steady state. From that I get $\frac{Y}{K} = \frac{\mu(R^k-1+\delta)}{\alpha}$. The law for capital accumulation in the steady state holds as $K = K(1-\delta) + \phi(\frac{I}{K})K - XK$ where $XK = \int_0^{\overline{\omega}^j} \omega dF(\omega)c_m R^k QK$ represents the loss of capital due to the cost of monitoring in steady state and $\frac{I}{K} = \delta + X$ in the steady state. Using the last ratio we get that:$\frac{I}{Y} = \frac{(\delta+X)\alpha}{\mu(R^k-1+\delta)}$. Consider a steady state where initial costs are normalized so that $e^R = 1$ and the terms of trade $tot = 1$. This implies that in a balance growth path trade balance are equal to zero or that $C_F = C_{H^*}$. Given this assumption the following equality holds: $\frac{C_H}{Y} = \frac{\gamma}{1-\gamma}\frac{C_F}{Y} = \frac{\gamma}{1-\gamma}\frac{C_{H^*}}{Y}$. Using this equality and the resource constraint in steady state we find that in steady state the following ratios hold: $\frac{C_H}{Y} = \gamma[1-\frac{(\delta+X)\alpha}{\mu(R^k-1+\delta)}]$; $\frac{C_F}{Y} = (1-\gamma)[1-\frac{(\delta+X)\alpha}{\mu(R^k-1+\delta)}] = \frac{C_{H^*}}{Y}$. In the loglinearized version of the resource constraint $\zeta_h = \frac{C_H}{Y}$, $\zeta_{h^*} = \frac{C_{H^*}}{Y}$,$\zeta_{I_h} = \frac{K}{Y}$.

10 The Competitive Economy

10.1 The Open Economy Relations

The loglinearized expressions for the optimal allocations of consumption between home and foreign goods for the home and the foreign economy are:

$$\hat{c}_t^H = -\eta(\hat{p}_t^H - \hat{p}_t) + \hat{c}; \hat{c}_t^F = -\eta(\hat{p}_t^F - \hat{p}_t) + \hat{c}_t \tag{33}$$

$$\hat{c}_t^{H*} = -\eta(\hat{p}_t^{H*} - \hat{p}_t^*) + \hat{c}_t^*; \ \hat{c}_t^{F*} = -\eta(\hat{p}_t^{F*} - \hat{p}_t^*) + \hat{c}_t^*. \tag{34}$$

Let us now define the terms of trade as: $tot_t = \frac{P_{F,t}}{P_{H,t}} = \frac{e_t P^*_{F,t}}{P_{H,t}}$. The loglinearized expression for the terms of trade is: $\hat{tot}_t = \hat{p}_t^F - \hat{p}_t^H = \hat{e}_t + \hat{p}_t^{*F} - \hat{p}_t^H$. Combining this expression with the loglinearized expression for the consumption index for the home country $\hat{p}_t = [(1-\gamma)\hat{p}^F + \gamma\hat{p}^H]$ and rearranging the consumption allocation as function os the terms of trade I get:

$$\hat{c}_t^H = \eta(1-\gamma)\hat{tot}_t + \hat{c}_t; \ \hat{c}_t^F = -\eta\gamma\hat{tot}_t + \hat{c}_t. \tag{35}$$

Assuming $\hat{tot}_t = -\hat{tot}_t^*$ for the foreign country I get:

$$\hat{c}_t^{*H} = \eta(1-\gamma^*)\hat{tot}_t + \hat{c}_t^*; \ \hat{c}_t^{*F} = -\eta\gamma^*\hat{tot}_t + \hat{c}_t^*. \tag{36}$$

Let us now look at the loglinearized expression for the UIP. By loglinearizing the uncovered interest rate parity in expectational term, a standard form of the uncovered interest parity holds:

$$\hat{r}_t^n - \hat{r}_t^{n*} = E_t\{\Delta e_{t+1}\} \tag{37}$$

where $\hat{r}_t^n = \log(\frac{R_t^n}{R^n})$ and $\hat{r}_t^{n*} = \log(\frac{R_t^{n*}}{R^{n*}})$.By using the terms of trade equation in log deviations and first differencing equation (37) and combining the two expressions I get:

$$\widehat{tot}_t = (\hat{r}_t^{n*} - E_t\{\hat{\pi}^*_{F,t+1}\}) - (\hat{r}_t^n - E_t\{\hat{\pi}_{H,t+1}\}) + E_t\{\widehat{tot}_{t+1}\}. \tag{38}$$

In addition one can show that:

$$\pi_t = \pi_{H,t} + \gamma\Delta\hat{tot}_t; \ \pi_t^* = \pi^*_{Ft} - \gamma^*\Delta\widehat{tot}_t. \tag{39}$$

Defining the real exchange rate as $e_t^R = \frac{e_t P_t^*}{P_t}$ the following relation between the real exchange rate and the terms of trade holds: $\hat{e}^R{}_t = (1-2\gamma)\hat{tot}_t$.

10.2 The Competitive Equilibrium Relations

Definition 1 *An equilibrium for the economy described is:*

a) A collection of allocations $\{C(\tau, s^t), C_H(s^t), C_F(s^t), N(s^t)\}_{t=0}^{\infty}$ *for home workers, allocations* $\{C^*(\tau, s^t), C_H^*(s^t), C_F^*(s^t), N^*(s^t)\}_{t=0}^{\infty}$*, assets* $\{B(s^{t+1}), D(s^t), D^*(s^t)\}_{t=0}^{\infty}$ *for home workers,* $\{B^*(s^{t+1}), D^*(s^t), D(s^t)\}_{t=0}^{\infty}$ *for foreign workers, and an aggregate consumption function for home entrepreneurs* $\{C^e(s^t)\}_{t=0}^{\infty}$ *and for foreign entrepreneurs* $\{C^{*e}(s^t)\}_{t=0}^{\infty}$*;*

b) Allocation and prices for domestic goods $\{Y_H(s^t), P_H(s^t)\}_{t=0}^{\infty}$ *and for labor and investment demands in the home country* $\{N(s^t), I(s^t)\}_{t=0}^{\infty}$*; allocation and prices for foreign goods* $\{Y_F(s^t), P_F(s^t)\}_{t=0}^{\infty}$ *and for labor and investment demands in the foreign country* $\{N^*(s^t), I^*(s^t)\}_{t=0}^{\infty}$*;*

c) aggregate price level $\{P(s^t), P^*(s^t)\}_{t=0}^{\infty}$*, bond prices* $\{d(s^{t+1}|s^t)\}_{t=0}^{\infty}$*,*

price of capital $\{Q(s^t), Q^*(s^t)\}_{t=0}^{\infty}$*;*

d) predetermined variables $\{K(s^t), NW(s^t), K^*(s^t), NW^*(s^t)\}_{t=0}^{\infty}$*,equilibrium exchange rate* $\{e(s^t)\}_{t=0}^{\infty}$*, and individual transfer and taxes that satisfy the following conditions:*

(i) taking as given prices,workers allocation solve workers' maximization, (ii) given prices entrepreneurs' consumption comes from individual optimization, (iii) the price set by each differentiated good producer solves his maximization problem, (iv) input demands solve maximization problem of competitive firms, (v) investment demand solves dynamic optimizing decisions, (vi), given transfer government budget is in balance, (vii) markets clear.

10.3 The Loglinearized Version of The Model

What follows is a list of the complete loglinearized model for the home country. Similarly the relation applies to the foreign country.

- Aggregate Demand.

$$\widehat{y}_t = (\zeta_h - \zeta_{h^*})(\eta(1-\gamma)\widehat{tot}_t) + \zeta_h \widehat{c}_t + \zeta_{h^*}\widehat{c}_t^* + \zeta_{I_h}\widehat{i}_t \tag{40}$$

$$\widehat{c}_t = E_t\{\widehat{c}_{t+1}\} - \frac{1}{\sigma}(\widehat{r}_t^n - E_t\{\pi_{H,t+1}\}) + \frac{\gamma}{\sigma}E_t\{\Delta\widehat{tot}_{t+1}\} \tag{41}$$

$$E_t(\widehat{r}_{t+1}^k) - \widehat{r}_t - \gamma\widehat{tot}_t = -v[\widehat{nw}_t - (\widehat{q}_t + \widehat{k}_t)] \tag{42}$$

$$\widehat{r}_{t+1}^k = (1-g)(\widehat{y}_{t+1} - \widehat{k}_t + \widehat{mc}_{t+1}) + g(\widehat{q}_{t+1} - \widehat{q}_t) \tag{43}$$

$$\widehat{q}_t = \varphi(\widehat{i}_t - \widehat{k}_{t-1}) \tag{44}$$

$$\widehat{tot}_t = (\widehat{r}_t^* - E_t\{\pi_{F,t+1}^*\}) - (\widehat{r}_t - E_t\{\pi_{H,t+1}\}) + E_t\{\widehat{tot}_{t+1}\} \tag{45}$$

- Aggregate Supply Block.

$$\hat{y}_t = \hat{a}_t + \alpha\hat{k}_{t-1} + (1-\alpha)\hat{n}_t \tag{46}$$

$$\hat{y}_t + \hat{mc}_t - \sigma\hat{c}_t = (1+\tau)\hat{n}_t + (1-\gamma)\hat{tot}_t \tag{47}$$

$$\pi_{H,t} = \beta E_t(\pi_{H,t+1}) + \lambda(\hat{mc}_t) \tag{48}$$

- Law of Motion for State Variables.

$$\hat{k}_t = \delta\hat{i}_t + (1-\delta)\hat{k}_{t-1} \tag{49}$$

$$\hat{nw}_t = a_1\hat{r}_t^k + a_2\hat{r}_{t-1} + a_3\hat{q}_t - a_4\hat{k}_{t-1} + a_5\hat{nw}_{t-1} + a_6\hat{y}_t + a_7\Delta\hat{tot}_{t+1} \tag{50}$$

- Evolution of Processes for the Stochastic Variables (shock to technology, preferences and exchange rates):

$$\begin{bmatrix} \hat{a}_t \\ \hat{a}_t^* \end{bmatrix} = \begin{bmatrix} \rho & \\ & \rho^* \end{bmatrix} \begin{bmatrix} \rho & \\ & \rho^* \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ \varepsilon_t^* \end{bmatrix} \tag{51}$$

with $E_t\{\varepsilon_t, \varepsilon_t^*\} = . \begin{bmatrix} \sigma_\varepsilon^2 & \theta \\ \theta & \sigma_\varepsilon^{*2} \end{bmatrix}$

- $\zeta_h = (1-\gamma)[1 - \frac{\delta\alpha}{\mu(R^k-1+\delta)}]$, $\zeta_{h^*} = \frac{\gamma}{1-\gamma}\zeta_h, \zeta_I = \frac{\delta\alpha}{\mu(R^k-1+\delta)}$;
- $g = \frac{(1-\delta)}{(1-\delta)+\alpha\frac{Y}{K}}$, $\nu = \frac{\psi(R^k/R)}{\psi'(R^k/R)}$, $\varphi = [(\phi(\frac{I}{K})^{-1})'(\frac{I}{K})/(\phi(\frac{I}{K})^{-1})'']$, $\delta = \phi(\frac{I_t}{K_t}) = \frac{I_t}{K_t}$;
- $\lambda = \frac{(1-\vartheta)(1-\beta\vartheta)}{\vartheta}$;
- $a_1 = [\varsigma R^k\frac{K}{NW} - \varsigma\psi\frac{K}{NW} + \varsigma\psi], a_2 = [\varsigma\beta^{-1}(\frac{K}{NW} - 1) + \varsigma\psi\frac{K}{NW} - \varsigma\psi], a_3 = [\varsigma R^k\frac{K}{NW} - \varsigma\psi\frac{K}{NW} - \varsigma\frac{K}{NW}\beta^{-1}]$;
- $a_4 = [\varsigma R^k\frac{K}{NW} - \varsigma\beta^{-1}\frac{K}{NW} - \varsigma\psi\frac{K}{NW}], a_5 = [\varsigma\beta^{-1} + \varsigma\psi], a_6 = \frac{(1-\alpha)(1-\Omega)}{NW}, a_7 = (1-\xi)\varsigma\beta^{-1}(\frac{K}{NW} - 1)$.

Equation (40) is obtained by substituting in the loglinearized version of the resource constraint the demand for domestic and foreign consumption good. Equation (41) is the loglinear Euler equation after substituting the expression for the CPI domestic inflation. Equation (42) is the loglinear external finance risk premium. Equation (43) is the loglinear expected return on capital. Equation (44) is the loglinear Tobin's q. Equation (45) is the loglinear UIP expressed in real terms. Equation (46) is the loglinear production function of the competitive sector. Equation (47) is obtained by loglinearizing the equilibrium condition for the labor market. Equation (48) is the Phillips curve. For the foreign country we have the same set of equations.

11 The Welfare Measure

If C_t and N_t are the equilibrium stochastic processes of consumption and labor corresponding to a particular monetary policy, the cost of business cycles under such policy will be measured by υ that satisfies the certainty equivalence relation:

$$U((1-\upsilon)C_t) - V(N_t) = E_t\{U(C_t) - V(N_t)\} \tag{52}$$

where E_t is the mathematical expectation. The business cycle associated with a particular monetary policy will be costly if υ is positive. Let's assume that consumption and labor are distributed as Gaussians. From the first order

approximation to the equation (12), the measure υ can be approximated by:

$$\upsilon \approx \frac{E_t(U(C_t, N_t)) - U(C_{ss}, N_{ss})}{U_{\hat{c}}(\hat{c}_{ss}, \hat{n}_{ss})} \tag{53}$$

where $E_t(U(C_t, N_t))$ is the expected utility, $U(C_{ss}, N_{ss})$ is the utility evaluated at the steady state and $U_{\hat{c}}(\hat{c}_{ss}, \hat{n}_{ss})$ is the first derivative of the utility with respect to the logarithm of C_t around the logarithm of C. Assuming that $\log(\frac{y_y}{y_{ss}}) = 0$ where $y = C, N$, then we can write the second order Taylor expansion for the expected utility as:

$$\begin{aligned} E_t(U(C_t, N_t)) \quad &\approx \quad U(C_{ss}, N_{ss}) + \frac{1}{2} C_{ss}(1-\sigma) \exp(1-\sigma)\hat{c}_t E(\hat{c}_t)^2 && (54) \\ &+\frac{1}{2} N_{ss}(1+\phi) \exp(1+\phi)\hat{n}_t E(\hat{n}_t)^2 +'' O'' && (55) \end{aligned}$$

where $E(\hat{c}_t)^2$ and $E(\hat{n}_t)^2$ are the second moments of consumption and labor. Assuming the following utility function $U_t = \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi}$ and substituting (54) in (53) we get:

$$1 - \upsilon = 1 - [\frac{1}{2}((1-\sigma)E(\hat{c}_t)^2 + (1+\phi)E(\hat{n}_t)^2]. \tag{56}$$

12 Volatilities of the Model

Volatility was computed using the following approximation procedure over the matrix of the second moments. Lets define the reduced form of the loglinearized model as follows:

$$E\{X_t\} = AX_{t-1} + b\varepsilon_t$$

where $X_t$is the matrix of the endogenous variables at time t, A is the transition matrix and ε_t is the vector of the exogenous shocks which are assumed i.i.d. with unitary covariance. Let $\Psi = b * \Sigma_\varepsilon * b'$ denote the variance covariance matrix of exogenous shocks. The matrix of the second moments Ω of the endogenous variables is:

$$\Omega_{as} = \lim_{k \longrightarrow \infty} \{\sum_{i=0}^{k} (A^i)\Psi(A^i)'\}.$$

I calculated the second moments by approximating Ω_{as} by Ω_{k+1} so that the $\max[\Omega_{k+1} - \Omega_k] \geq 1.0e - 0.8$, where max stands for the maximum distance between any two elements of the matrix $\Omega_n - \Omega$.

Table 3: **Summary of financial statistics for major industrialized areas.**

Data	Euro Area	US	UK	Japan
Population	292.2	272.9	126.5	58.7
Share of World GDP	18.8	21.9	7.6	3.2
Corporate Debt Security	7.4	31.2	18.4	11

Table 4: **Bank Industry Health and Importance of External Finance.**

Data	Return on Assets	Loan loss	Ext Fin as % of GDP	Thomson Rating
EMU countries				
Austria	0.38	0.59	46	2.38
Belgium	0.52	0.17	60	2
Finland	0.50	0.78	34	2.83
France	0.36	0.24	49	2.28
Germany	0.44	0.18	58	1.97
Greece	1.11	0.18	3	2.50
Ireland	1.57	0.17	13	1.83
Italy	0.33	0.62	37	2.57
Netherlands	0.75	0.26	48	2.10
Portugal	0.91	0.42	19	2.30
Spain	0.76	0.32	11	1.79
Euro area	0.50	0.32	40.76	2.16
UK	1.28	0.18	45	2.04
US	1.42	0.10	64	1.73
Japan	0.01	0.75	39	3.32

Table 5: **Emprical Cross-Correlations of Output Gaps.**

Cross-Correlations	US	Japan	Germany	France	Italy	UK	Canada
United States							
Japan	-0.60						
Germany	-0.57	0.53					
France	-0.10	0.05	0.72				
Italy	-0.28	0.38	0.75	0.74			
United Kingdom	0.68	-0.36	-0.38	-0.14	0.15		
Canada	0.79	-0.66	-0.38	0.15	0.08	0.82	

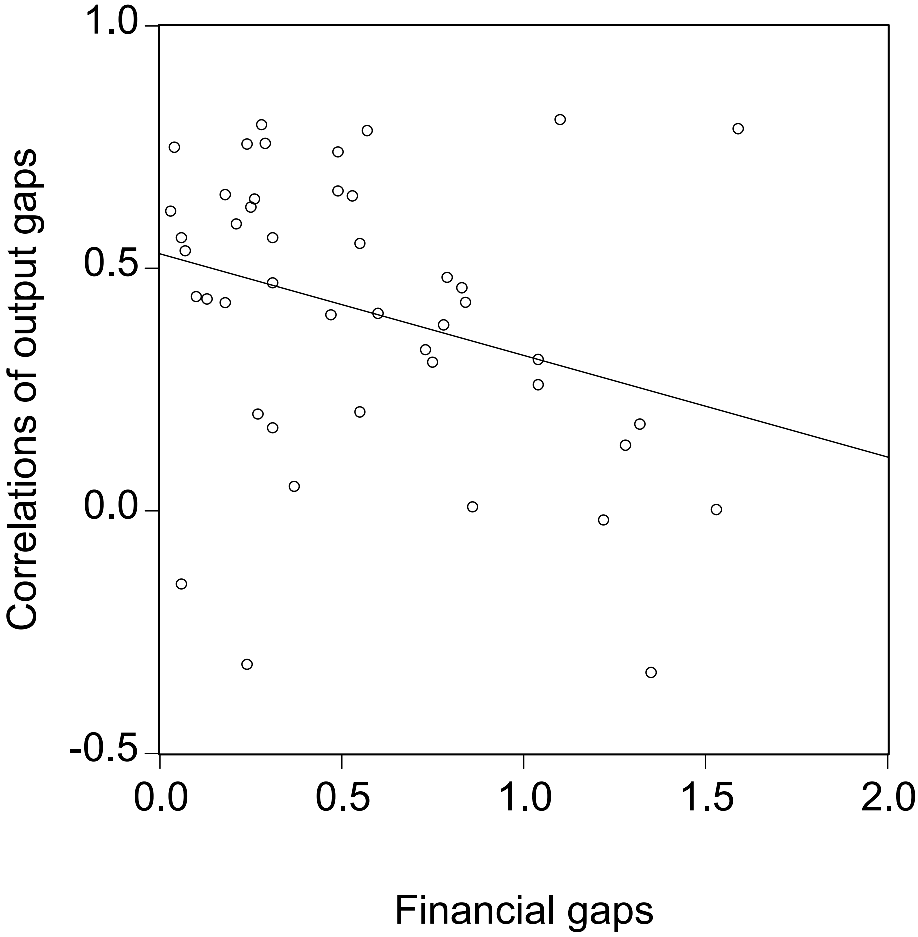


Figure 1: **Relation between correlations of output gaps and financial gaps**

Table 6: **Regression of correlation of output gaps over financial gap.**

Dep var: Corr of ouptu gap	Coef	St Dev	t-stat	Prob
Constant	0.53	0.07	7.5	0.0000
Financial Gap	-0.21	0.09	-2.12	0.0403

Table 7: **Cross-correlation of ouptut: Productivity Shocks**

Taylor rule - Productivity Shocks	Scenario 1	Scenario2	Scenario3
Asymmetric Shocks, $\gamma = 0.15$	-0.14	-0.46	-0.57
Asymmetric Shocks, $\gamma = 0.4$	0.12	0.06	-0.17
Symmetric and Uncorrelated, $\gamma = 0.15$	-0.009	-0.017	-0.02
Symmetric and Uncorrelated, $\gamma = 0.4$	0.016	0.0046	-0.0027
Symmetric and Correlated, $\gamma = 0.15$	0.20	0.18	0.17
Symmetric and Correlated, $\gamma = 0.4$	0.21	0.20	0.19

Table 8: **Cross-correlation of ouptut: Financial Shocks.**

Taylor rule - Financial Shocks	Scnario 1	Scenario 2	Scenario3
Asymmetric Shocks, $\gamma = 0.15$	0.22	-0.72	-0.81
Asymmetric Shocks, $\gamma = 0.4$	-0.84	-0.90	-0.91
Symmetric and Uncorrelated, $\gamma = 0.15$	-0.02	-0.13	-0.15
Symmetric and Uncorrelated, $\gamma = 0.4$	-0.17	-0.22	-0.26
Symmetric and Correlated, $\gamma = 0.15$	0.18	0.0057	0.026
Symmetric and Correlated, $\gamma = 0.4$	0.027	-0.07	-0.15

Table 9: **Second Moments and Correlations for Domestic and Foreign Varaiables with Taylor rules: Correlated Productivity Shock.**

Second Moments - Taylor rule	Scenario 1	Scenario 2	Scenario3
Domestic Ouptut σ_y^2	1.78	1.78	1.78
Domestic Investement σ_I^2	2.05	2.05	2.06
Domestic Price of Capital σ_q^2	0.89	0.89	0.89
Foreign Output $\sigma_{y^*}^2$	1.78	1.84	1.85
Foreign Invetement $\sigma_{I^*}^2$	2.05	2.48	2.53
Foreign Ouptut $\sigma_{q^*}^2$	0.89	1.10	1.13
$Corr(y_t, y_t^*)$	-0.0079	-0.015	-0.021

Table 10: **Second Moments and Correlations for Domestic and Foreign Varaiables with Inflation Targeting: Correlated Productivity Shock.**

Second Moments - Inflation Targeting	Scenario 1	Scenario 2	Scenario3
Domestic Ouptut σ_y^2	1.89	1.89	1.89
Domestic Investement σ_I^2	2.26	2.26	2.27
Domestic Price of Capital σ_q^2	0.98	0.98	0.98
Foreign Output $\sigma_{y^*}^2$	1.89	1.96	1.97
Foreign Invetement $\sigma_{I^*}^2$	2.26	2.77	2.85
Foreign Ouptut $\sigma_{q^*}^2$	0.98	1.22	1.27
$Corr(y_t, y_t^*)$	-0.0046	-0.012	-0.017

Table 11: **Second Moments and Correlations for Domestic and Foreign Varaiables with Credible Pegs: Correlated Productivity Shock.**

Second Moments - Credible Pegs	Scenario 1	Scenario 2	Scenario3
Domestic Ouptut σ_y^2	1.63	1.63	1.63
Domestic Investement σ_I^2	2.03	2.02	2.03
Domestic Price of Capital σ_q^2	0.88	0.88	0.88
Foreign Output $\sigma_{y^*}^2$	1.78	1.85	1.84
Foreign Invetement $\sigma_{I^*}^2$	2.15	2.64	2.70
Foreign Ouptut $\sigma_{q^*}^2$	0.94	1.17	1.22
$Corr(y_t, y_t^*)$	0.16	0.14	0.14

Table 12: **Welfare Measure - Symmetric and Correlated Financial Schock**

Welfare - Symmetric Financial shocks	Scenario 1	Scenario2	Scenario3
Taylor rules - Home Welfare	0.866	0.862	0.862
Taylor rule - Foreign Welfare	0.866	0.806	0.793
Rigid Inflation Target - Home Welfare	0.66	0.66	0.66
Rigid Inflation Target - Foreign Welfare	0.66	0.6	0.6
Credible Peg - Home Welfare	-	-	-
Credible Peg - Foreign Welfare	0.88	0.824	0.86

Figure 2: **Impulse response functions for home and foreign variables given a home productivity shocks with no difference in financial systems**

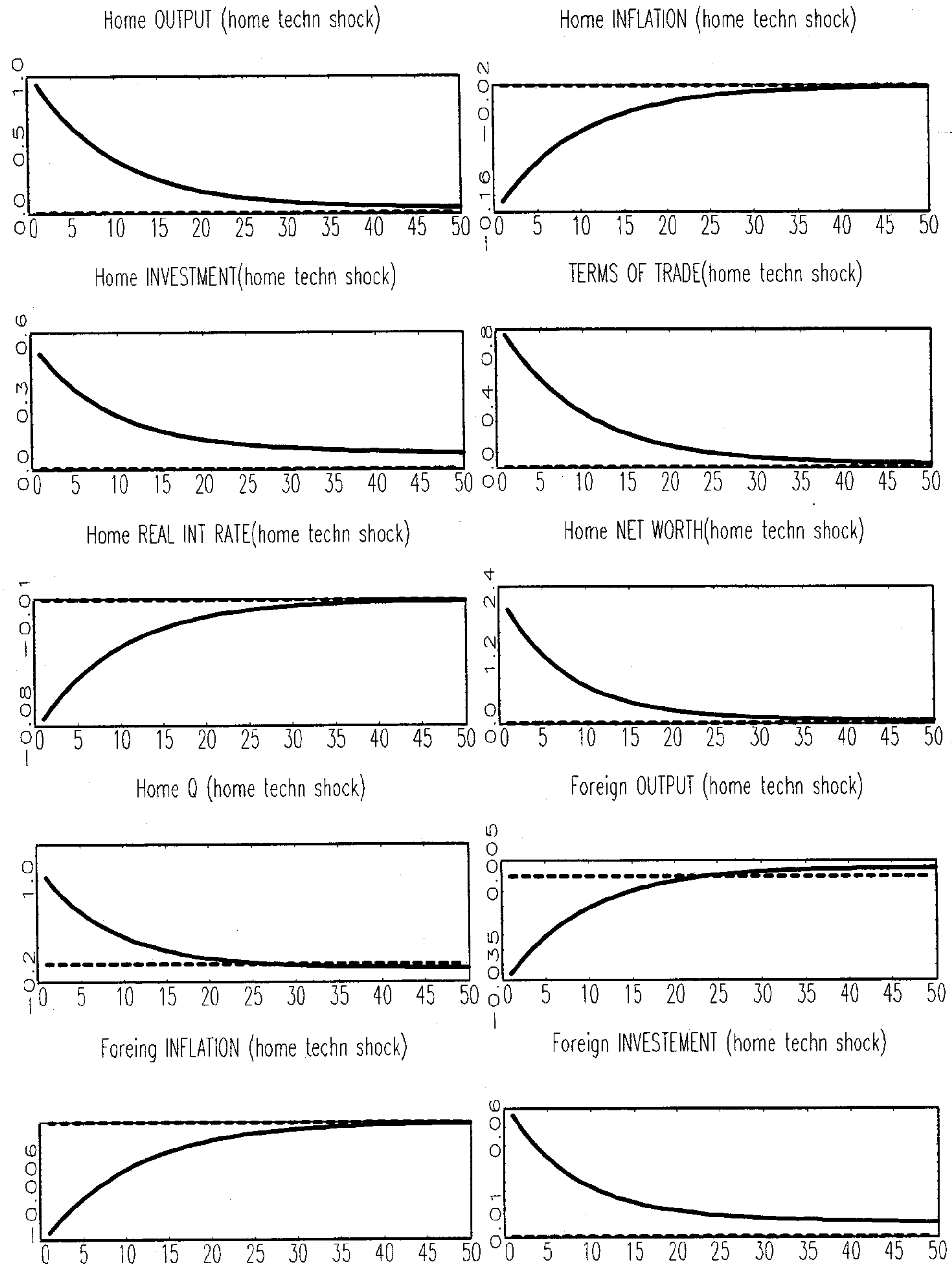
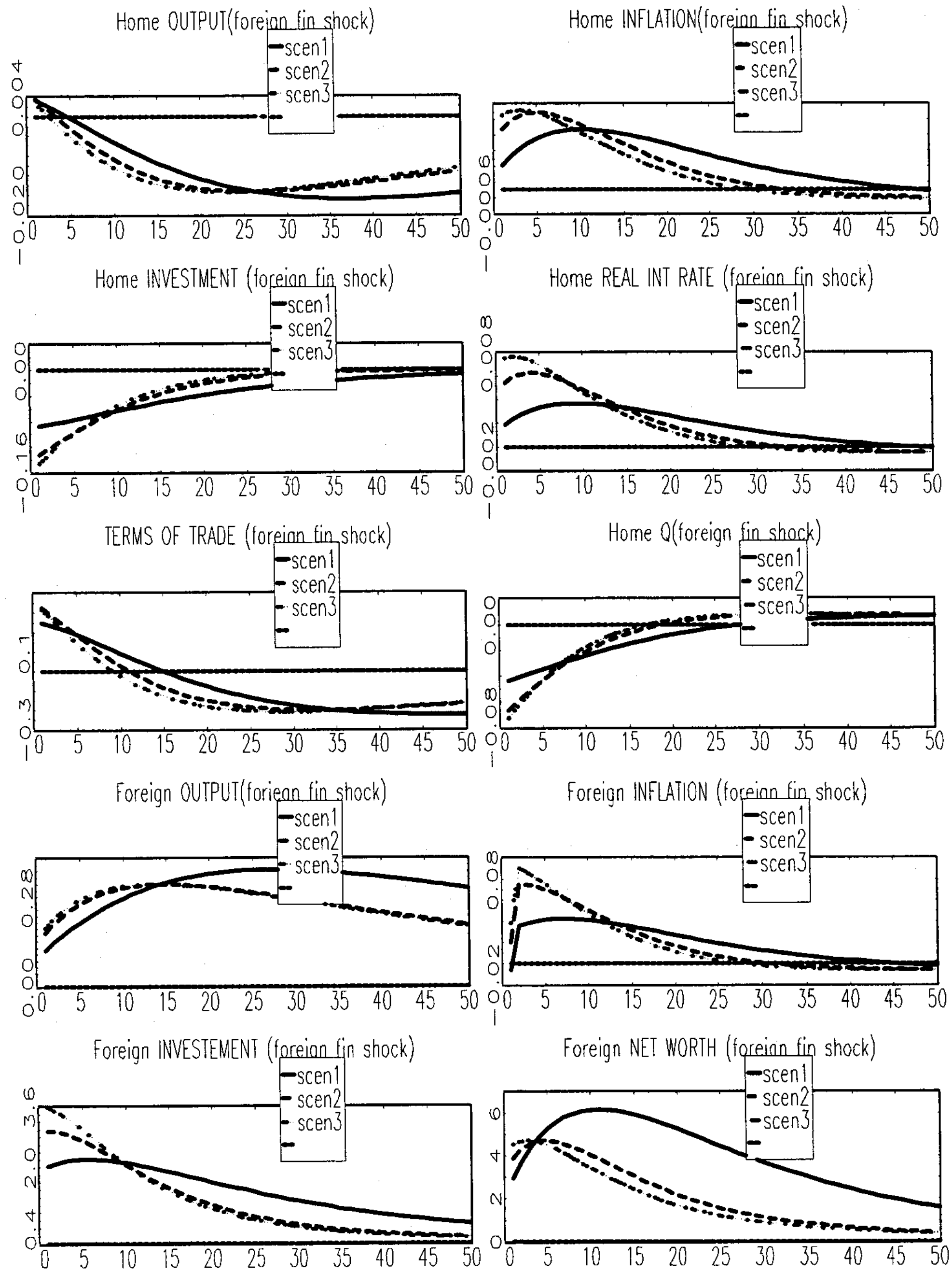


Figure 3: **Impulse response functions for home and foreign variables given a foreign financial shock under three alternative financial scenarios**



European Central Bank working paper series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (http://www.ecb.int).

113 "Financial frictions and the monetary transmission mechanism: theory, evidence and policy implications" by C. Bean, J. Larsen and K. Nikolov, January 2002.

114 "Monetary transmission in the euro area: where do we stand?" by I. Angeloni, A. Kashyap, B. Mojon, D. Terlizzese, January 2002.

115 "Monetary policy rules, macroeconomic stability and inflation: a view from the trenches" by A. Orphanides, December 2001.

116 "Rent indices for housing in West Germany 1985 to 1998" by J. Hoffmann and C. Kurz., January 2002.

117 "Hedonic house prices without characteristics: the case of new multiunit housing" by O. Bover and P. Velilla, January 2002.

118 "Durable goods, price indexes and quality change: an application to automobile prices in Italy, 1988-1998" by G. M. Tomat, January 2002.

119 "Monetary policy and the stock market in the euro area" by N. Cassola and C. Morana, January 2002.

120 "Learning stability in economics with heterogenous agents" by S. Honkapohja and K. Mitra, January 2002.

121 "Natural rate doubts" by A. Beyer and R. E. A. Farmer, February 2002.

122 "New technologies and productivity growth in the euro area" by F. Vijselaar and R. Albers, February 2002.

123 "Analysing and combining multiple credit assessments of financial institutions" by E. Tabakis and A. Vinci, February 2002.

124 "Monetary policy, expectations and commitment" by G. W. Evans and S. Honkapohja, February 2002.

125 "Duration, volume and volatility impact of trades" by S. Manganelli, February 2002.

126 "Optimal contracts in a dynamic costly state verification model" by C. Monnet and E. Quintin, February 2002.

127 "Performance of monetary policy with internal central bank forecasting" by S. Honkapohja and K. Mitra, February 2002.

128 "Openness, imperfect exchange rate pass-through and monetary policy" by F. Smets and R. Wouters, February 2002.

129 "Non-standard central bank loss functions, skewed risks, and certainty equivalence" by A. al-Nowaihi and L. Stracca, March 2002.

130 "Harmonized indexes of consumer prices: their conceptual foundations" by E. Diewert, March 2002.

131 "Measurement bias in the HICP: what do we know, and what do we need to know?" by M. A. Wynne and D. Rodríguez-Palenzuela, March 2002.

132 "Inflation dynamics and dual inflation in accession countries: a "new Keynesian" perspective" by O. Arratibel, D. Rodríguez-Palenzuela and C. Thimann, March 2002.

133 "Can confidence indicators be useful to predict short term real GDP growth?" by A. Mourougane and M. Roma, March 2002.

134 "The cost of private transportation in the Netherlands, 1992-1999" by B. Bode and J. Van Dalen, March 2002.

135 "The optimal mix of taxes on money, consumption and income" by F. De Fiore and P. Teles, April 2002.

136 "Retail bank interest rate pass-through: the new evidence at the euro area level" by G. de Bondt, April 2002.

137 "Equilibrium bidding in the eurosystem's open market operations" by U. Bindseil, April 2002.

138 "New" views on the optimum currency area theory: what is EMU telling us?" by F. P. Mongelli, April 2002.

139 "On currency crises and contagion" by M. Fratzscher, April 2002.

140 "Price setting and the steady-state effects of inflation" by M. Casares, May 2002.

141 "Asset prices and fiscal balances" by F. Eschenbach and L. Schuknecht, May 2002.

142 "Modelling the daily banknotes in circulation in the context of the liquidity management of the European Central Bank", by A. Cabrero, G. Camba-Mendez, A. Hirsch and F. Nieto, May 2002.

143 "A non-parametric method for valuing new goods", by I. Crawford, May 2002.

144 "A failure in the measurement of inflation: results from a hedonic and matched experiment using scanner data", by M. Silver and S. Heravi, May 2002.

145 "Towards a new early warning system of financial crises", by M. Fratzscher and M. Bussiere, May 2002.

146 "Competition and stability – what's special about banking?", by E. Carletti and P. Hartmann, May 2002.

147 “Time-to-build approach in a sticky price, stricky wage optimizing monetary model, by M. Casares, May 2002.

148 “The functional form of yield curves” by V. Brousseau, May 2002.

149 “The Spanish block of the ESCB-multi-country model” by A. Estrada and A. Willman, May 2002.

150 “Equity and bond market signals as leading indicators of bank fragility” by R. Gropp, J. Vesala and G. Vulpes, June 2002.

151 “G-7 inflation forecasts” by F. Canova, June 2002.

152 “Short-term monitoring of fiscal policy discipline” by G. Camba-Mendez and A. Lamo, June 2002.

153 “Euro area production function and potential output: a supply side system approach” by A. Willman, June 2002.

154 “The euro bloc, the dollar bloc and the yen bloc: how much monetary policy independence can exchange rate flexibility buy in an interdependent world?” by M. Fratzscher, June 2002.

155 “Youth unemployment in the OECD: demographic shifts, labour market institutions, and macroeconomic shocks” by J. F. Jimeno and D. Rodriguez-Palenzuela, June 2002.

156 “Identifying endogenous fiscal policy rules for macroeconomic models” by J. J. Perez, and P. Hiebert, July 2002.

157 “Bidding and performance in repo auctions: evidence from ECB open market operations” by K. G. Nyborg, U. Bindseil and I. A. Strebulaev, July 2002.

158 “Quantifying Embodied Technological Change” by P. Sakellaris and D. J. Wilson, July 2002.

159 “Optimal public money” by C. Monnet, July 2002.

160 “Model uncertainty and the equilibrium value of the real effective euro exchange rate” by C. Detken, A. Dieppe, J. Henry, C. Marin and F. Smets, July 2002.

161 “The optimal allocation of risks under prospect theory” by L. Stracca, July 2002.

162 “Public debt asymmetries: the effect on taxes and spending in the European Union” by S. Krogstrup, August 2002.

163 “The rationality of consumers’ inflation expectations: survey-based evidence for the euro area” by M. Forsells and G. Kenny, August 2002.

164 “Euro area corporate debt securities market: first empirical evidence” by G. de Bondt, August 2002.

165 “The industry effects of monetary policy in the euro area” by G. Peersman and F. Smets, August 2002.

166 “Monetary and fiscal policy interactions in a micro-founded model of a monetary union” by R. M.W.J. Beetsma and H. Jensen, August 2002.

167 “Identifying the effects of monetary policy shocks on exchange rates using high frequency data" by J. Faust, J.H. Rogers, E. Swanson and J.H. Wright, August 2002.

168 “Estimating the effects of fiscal policy in OECD countries” by R. Perotti, August 2002.

169 “Modeling model uncertainty” by A. Onatski and N. Williams, August 2002.

170 “What measure of inflation should a central bank target?” by G. Mankiw and R. Reis, August 2002.

171 “An estimated stochastic dynamic general equilibrium model of the euro area” by F. Smets and R. Wouters, August 2002.

172 “Constructing quality-adjusted price indices: a comparison of hedonic and discrete choice models” by N. Jonker, September 2002.

173 “Openness and equilibrium determinacy under interest rate rules” by F. de Fiore and Z. Liu, September 2002.

174 “International monetary policy coordination and financial market integration” by A. Sutherland, September 2002.

175 “Monetary policy and the financial accelerator in a monetary union” by S. Gilchrist, J.O. Hairault and H. Kempf, September 2002.

176 “Macroeconomics of international price discrimination” by G. Corsetti and L. Dedola, September 2002.

177 “A theory of the currency denomination of international trade” by P. Bacchetta and E. van Wincoop, September 2002.

178 “Inflation persistence and optimal monetary policy in the euro area” by P. Benigno and J.D. López-Salido, September 2002.

179 “Optimal monetary policy with durable and non-durable goods” by C.J. Erceg and A.T. Levin, September 2002.

180 “Regional inflation in a currency union: fiscal policy vs. fundamentals” by M. Duarte and A.L. Wolman, September 2002.

181 “Inflation dynamics and international linkages: a model of the United States, the euro area and Japan” by G. Coenen and V. Wieland, September 2002.

182 “The information content of real-time output gap estimates, an application to the euro area” by G. Rünstler, September 2002.

183 “Monetary policy in a world with different financial systems” by E. Faia, October 2002.