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Structural asymmetries and financial imbalances in the eurozone

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Abstract

Almost two decades after the introduction of the common currency, differences in institutional frameworks remain a major source of cross-country heterogeneity in the eurozone. We develop a two-country model with incomplete international markets in which the availability of credit depends on the country's institutional environment. Our main finding is that structural differences in domestic credit environments provide an explanation for the procyclicality of net capital inflows observed in the South of Europe. We show that frictions in domestic credit markets generate asymmetries in the transmission mechanism of shocks that are common to both regions.

- *Keywords:* Cross-border financial markets, eurozone crisis, incomplete international asset markets, structural reforms.
- *JEL:* F32, F20, G17.

Non-technical summary

The main thesis of this paper is that differences in financial structures are an important cause of asymmetry in the eurozone and that this specific source of cross-country heterogeneity has a critical impact on financial imbalances not only at business cycle frequencies but also in the long-run. We reach this conclusion by developing a two-region DSGE model that reproduces some salient features of the eurozone business cycle.

Our study is motivated by three main stylized facts that characterize the structure and dynamics of the eurozone economy. First, trade balances between the North and the South of Europe are strongly negatively correlated. Second, fluctuations in output growth between different parts of the monetary union are highly synchronized, and remained so even throughout the crisis period. And third, indicators of the quality of institutions, such as the rule of law index for instance, suggest that countries' legal structure is an important dimension along which the two regions have been diverging, or at least have failed to converge, since the common currency was introduced.

Our main assumption is that the ease at which contracts can be enforced impacts the functioning of credit markets by affecting firms' access to credit. In such an environment, we show that introducing differences in financial structures generates procyclical net capital inflows in the region where access to credit is relatively more restricted. Although shocks are common, our first result is that differences in financial structures across countries can generate asymmetries in the transmission mechanism of macroeconomic shocks. Moreover, structural asymmetries give rise to long-term imbalances between financially integrated regions. In our environment, these imbalances emerge as an equilibrium outcome and allow countries with less developed credit markets to finance persistent trade deficits with net capital inflows.

Our second main result is that these differences in financial structures, which in turn affect access to credit, exacerbate the welfare cost of business cycle fluctuations in the region that experiences procyclical net capital inflows. Our findings also suggest that an improvement in institutional frameworks in the region suffering from a more restricted access to credit not only raises potential output but also leads to a substantial reduction in the welfare cost of business cycle fluctuations in that region. Finally, well-developed cross-border financial markets act as a powerful risk-sharing mechanism against the effects of region-specific shocks.

1 Introduction

The damage caused by the financial crisis has revived the debate around the structure of the eurozone economy, a question that is central to the future of the common currency.[1] While a wide range of potential causes of instability have been suggested, the question of persistent imbalances is an issue that has always triggered passionate debates both in academic and policy circles. In particular, the persistent trade surpluses observed in Germany since the common currency was introduced are often considered as a potential obstacle to the well-functioning of the eurozone economy. This has revived the debate over whether macroeconomic policies aimed at curbing these surpluses could become necessary (e.g., Blanchard and Giavazzi 2002; IMF 2014; Wyplosz 2010; Bernanke 2015) and raises the more general question of the sustainability of financial imbalances in a currency union composed of heterogeneous countries.

The first objective of this paper is to contribute to this debate by documenting a series of stylized facts that characterize the dynamics of trade balances in the North and South of Europe. As illustrated by Figure 1 and 2, while it is true that trade balances between Germany and the South of Europe move in opposite directions, the first key stylized fact to keep in mind is that fluctuations in output growth across these different parts of the monetary union are highly synchronized, and remained so even throughout the crisis period. By contrast, as illustrated in Figure 3, the evolution of the rule of law index suggests that the quality of institutions is an important dimension along which the two regions have been diverging, or at least have failed to converge, since the common currency was introduced (see also Masuch et al. 2016).

These differences in the rule of law index illustrate that in some Southern European economies the lack of contract enforcement constitutes a major obstacle to the well-functioning of a market economy. Indicators measuring the quality of institutions for instance suggest that in 2014 the strength of legal right index was about 3 times higher in Germany than in Italy, which are two of the largest eurozone economies.[2] This indicator measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and therefore provides an indication of access to lending in a given country.[3]

[1] In the Five President Report, Europe's Economic and Monetary Union (EMU) is for instance compared to "a house that was built over decades but only partially finished".

[2] Source: World Development Indicators.

[3] Differences in this indicator for instance reflect structural factors such as the time needed to enforce a

The main thesis of this paper is that these differences in legal structure are an important cause of asymmetry between eurozone economies and that this source of heterogeneity has a critical impact on financial imbalances not only at business cycle frequencies but also in the long-run. We reach this conclusion by developing a DSGE model in which the quality of institutions affects the functioning of credit markets by influencing lender-borrower relationships. In the model economy that is envisioned, the link between contract enforcement and access to bank funding is captured through the introduction of an incentive compatibility constraint (e.g., Jermann and Quadrini 2012) whose tightness can vary across regions. This modelling device formalizes the idea that the legal structure of an economy is likely to play a key role in a debitor's decision to potentially default on its loan. In our setting, entrepreneurs compare the cost of defaulting and running away with a bank loan with the payoff from operating their business for a sufficiently long period of time. If the payoff from operating the firm while honoring their obligations is sufficiently high, entrepreneurs find it optimal to abide by the rules.

The central mechanism is that this decision critically depends on the institutional environment where lending is conducted, which is captured by a structural parameter affecting the tightness of this incentive compatibility constraint. Our main assumption is that the value of this parameter reflects the quality of a country's institutions and therefore affects the default decision by modifying the benefit that can be reaped from walking away with a loan rather than repaying its debt. By restricting access to financing, this mechanism captures the idea that a weaker institutional framework amplifies the asymmetric information problem inherent to credit transactions.

In such an economy, the equilibrium amount of credit extended by banks and available to firms is therefore determined by the country's institutional framework. Given that the focus of our analysis is the eurozone, and that in this region about 80 percent of firms' external debt financing comes from the banking sector (e.g., Draghi 2014), our mechanism focuses on the case of frictions between domestic banks and entrepreneurs.

Our first main result is that introducing differences in the quality of institutions in a two-country DSGE model generates procyclical net capital inflows in the region where access to credit is relatively more restricted. This result is obtained in a model in which a financial

contract. As an average over the period from 2003 to 2014, it took about 400 days to enforce a contract in Germany. In Italy, over the same period, the average number of days required to enforce a contract was higher than 1'200 days. Source: World Development Indicators.

asset whose price is endogenously determined can be traded across borders. In our model the quality of institutions directly impacts the availability of credit and hence the extent to which firms in the corporate sector are able to finance production. A key building block of our mechanism is that in each region this constraint on credit availability introduces a time-varying wedge into the marginal productivity of production factors. This wedge, whose tightness depends on the country's legal system, in turn creates a deadweight loss that reduces the effectiveness of the different margins of adjustment that agents can use to insure themselves against shocks. By affecting agents' ability to smooth consumption, asymmetries in the functioning of domestic credit markets generate differences in precautionary motives across regions. Introducing habit formation into the analysis amplifies these differences in precautionary motives and is needed to reproduce the most salient features of the data.

In response to a positive shock common to both regions, this mechanism gives rise to a larger increase in the demand for capital in the South, which is the more constrained economy. In good times, this higher demand for capital in the South is satisfied by financing part of the increase in domestic investment by borrowing from abroad, which in this model is achieved by reducing the region's net foreign asset position. The economy's domestic capital stock, which only depreciates slowly over time, is the most effective storage technology available to smooth consumption. As a result, agents in the more constrained region take advantage of the international asset market to build up larger capital stocks in good times. In boom periods, the South issues more debt than the North and the resulting current account deficit allows agents in the more constrained region to increase domestic capital accumulation beyond the level that could have been achieved in a closed economy.

Since an increase in domestic capital stock needs to be financed by credit, this mechanism also generates a lending boom in the South of a larger amplitude than in the North. While introducing differences in habit formation motives and capital adjustment costs across regions is needed to match the most salient features of the data, we show that differences in contract enforcement is the key source of asymmetry that generates procyclical net capital inflows in the South.

Our second main result is that introducing these differences in contract enforcement into an otherwise symmetric two-country model exacerbates the welfare cost of business cycle fluctuations in the region that experiences procyclical net capital inflows. Our results also suggest that an improvement in institutional frameworks in the South, which in our

environment corresponds to a relaxation of the walk-away constraint, leads to a substantial reduction in the welfare cost of business cycle fluctuations in that region. Moreover, we find that the cross-border financial market acts as a powerful risk-sharing mechanism against the effect of asymmetric shocks. Relative to a version of the model without cross-border financial flows, the welfare cost of business cycle fluctuations is substantially lower in a model in which agents can use international financial markets to insure themselves against region-specific shocks.

Our third main result is that our mechanism generates an average surplus of the trade balance in the North of a magnitude that is similar to the one observed in the data. This result is due to the introduction of a cross-border market for physical capital, which gives rise to net factor payments. While changes in net foreign asset positions essentially play no role in the steady state, imbalances can arise in our environment if net factor payments differ from zero.[4]

As far as long-run implications are concerned, our main model mechanism therefore predicts that, on average, the more financially constrained economy will run a trade deficit. This result can be better understood by examining the endogenous choice that determines cross-border factor payments in this model. Firms can use the domestic capital stock to increase domestic output and they internalize that any increase in production needs to be financed by credit. At the same time, firms can decide to rent the economy's domestic capital stock abroad instead of using it domestically. While this latter option comes at the cost of a lower level of production, its advantage is that it allows firms to decrease the amount of credit that they need to obtain from their domestic banking sector to finance production.

In this economy, we can show that the availability of domestic credit is the main determinant of long-term imbalances. In the South, the scarcity of credit forces firms to reduce their reliance on their domestic banking sector by renting the mobile production factor abroad instead of using it domestically. In the North, by contrast, the fact that obtaining credit is, in relative terms, easier constitutes a comparative advantage. Relative to the South, the better availability of credit in the North makes it easier to finance domestic production by using the foreign capital stock as an input. The resulting steady state trade deficit in the South is therefore financed by a net factor income, which the introduction of a cross-border market for physical capital made possible.

[4] In our model, the trade balance is given by the current account minus the net amount received for domestically-owned factors of production used abroad.

As far as steady state results are concerned, a potentially counterfactual implication of our mechanism is that it generates a positive net foreign asset position in the less financially developed region. The main mechanism relies on the stronger precautionary motive that is induced by these differences in contract enforcement. In terms of dynamics, this effect creates larger fluctuations in marginal utility in the South, which is key to explain the dynamics of net capital flows. In the steady state, however, a stronger precautionary motive in the less financially developed region also increases the demand for the foreign safe asset. As a result, this mechanism alone would generate an average net asset position that would be positive in the South, if differences in contract enforcement were the only source of cross-country heterogeneity. In the version of the model with all sources of heterogeneity, the model's ability to generate a negative net foreign asset position in the South is due to the introduction of an additional source of heterogeneity, which we need to match the difference in investment to output ratios observed across the two regions. In sum, our mechanism alone has the potential to reproduce the dynamics of capital flows as well as the average distribution of trade imbalances, but it cannot explain long-run net foreign asset positions.

Literature review. The starting point of our analysis is the basic two-country version of the standard one-sector stochastic growth model with complete asset markets (e.g, Backus et al. 1992; Baxter 1995). The first key departure from the baseline model is the introduction of restrictions in the extent to which international capital markets permit to pool risk across economies. Following Cole (1988), Baxter (1995), Baxter and Crucini (1995), Kollmann (1996), Arvanitis and Mikkola (1996), Boileau (1999), Heathcote and Perri (2002) and Corsetti et al. (2008) among others, we develop a model in which individuals have incomplete access to international risk-sharing. Relative to this latter strand of the literature, we consider a different asset structure by generalizing the analysis of capital movements popularized by Ruffin (1979) in the context of two-country versions of the Solow growth model. By generating cross-border factor payments, the introduction of a market for physical capital is the key ingredient that allows our framework to generate steady state imbalances. While factor payments are the main determinants of imbalances in the long-term, the around steady state dynamics is essentially driven by financial flows arising from cross-border issuances of safe financial securities.

Our work also builds on the literature that studies the dynamics and long-run determinants of global imbalances between countries with heterogeneous financial markets. In

Mendoza et al. (2009), financial integration between two countries in different stages of financial development generates the evolution of imbalances between the United States and China observed over the last decades. In their model, differences in the degree of financial development are captured by two structural parameters characterizing the degree of contract enforcement and the extent to which limited liability is applied. In Caballero et al. (2008), the main mechanism relies on differences in countries' ability to generate financial assets from real investments. They show that a collapse in asset market in one region leads to an increase in the demand for foreign assets, which in turn generates an improvement in the country's net foreign asset position.

Relative to these two influential studies, the main difference is that in our model the effects of structural asymmetries are amplified by introducing a particular habit formation motive into the analysis (e.g., Jaccard 2014). Augmenting the baseline model with habit formation helps to generate differences in precautionary motives, which in turn leads to the more volatile response of credit in the more financially constrained region. Our starting point is therefore a model mechanism that has been used in the asset pricing literature to generate more realistic asset pricing implications in the context of production economy models (e.g., Jermann 1998).

In the context of two-country DSGE models, precautionary motives and risk considerations also play a central role in the analysis of Gourio et al. (2013) and Fogli and Perri (2015). When differences in contract enforcement are the only source of cross-country heterogeneity, our model predicts that the volatility of output and consumption should be higher in the region experiencing procyclical net capital inflows, which is in line with the stylized facts on emerging market economies documented in Aguiar and Gopinath (2007).[5]

This paper also contributes to the literature initiated by the euro area crisis. Reis (2013) emphasizes the role played by frictions leading to a misallocation of resources (see also Mongelli et al. 2016). Gopinath et al. (2017) document a significant loss in total factor productivity in South Europe and develop a small open economy model with heterogeneous firms that is able to rationalize these novel empirical findings. In their model, the decline in total factor productivity is due to a misallocation of resources that is caused by a capital wedge. In our setting, the size of the wedge distorting the allocation of labor and capital depends on the parameters characterizing the quality of the institutional framework as well

[5] See also Schmitt-Grohé and Uribe (2016) for a more recent overview of the stylized facts.

as the extent to which external financing is needed to finance production.

Fernández-Villaverde and Ohanian (2015) argue that the stagnation observed in some European economies can be attributed to sluggish productivity growth originating from political economy distortions (see also Fernandez-Villaverde et al. 2013). Using a large panel of countries, Challe et al. (2016) document that persistent capital inflows are systematically followed by a decline in the quality of domestic institutions and develop a model in which government intervention plays a role in allocating resources to the private sector.

In our analysis, while financial markets act as a powerful risk-sharing mechanism against the effect of asymmetric shocks, short-term cross-border financial flows also facilitate pro-cyclical booms and busts in credit in the less financially developed country. In this sense, our mechanism is also related to the approach followed by Boissay, Collard and Smets (2016) who showed how short-term interbank flows can increase the procyclicality of bank balance sheets.

Finally, concerns that diverging economic structures could lead to asymmetries in the monetary policy transmission mechanism were documented in the early stages of the euro area's existence.[6] In Cecchetti (1999) for instance, differences in financial structure across European economies are attributed to their dissimilar legal structure (see also Danthine et al. 1999). This argument, which also draws on the work of La Porta et al. (1997, 1998), is motivated by a series of empirical facts demonstrating the impact of the legal system of a country on the structure of financial intermediation. In the same vein, Cacciatore et al. (2016) focus on product and labor market deregulation and study the implications of asymmetric deregulation for the conduct of optimal monetary policy in the eurozone.

2 Motivating stylized facts

Figure 1 compares the evolution of trade balances since the introduction of the common currency in Germany with Southern Europe, where to simplify Southern Europe only consists of Spain, Portugal and Italy. Figure 2 shows the evolution of year-over-year output growth in both regions for the period 1995-2016.

Figure 1 is constructed using data on trade balances in goods with respect to the rest of the eurozone. Clearly, trade balances between Germany and the South of Europe tend

[6] Differences in the transmission mechanism of monetary policy are for instance documented by Ehrmann (1998)

to move in opposite directions. From 1999 to 2008, during the pre-crisis period, the rising surplus in the North was accompanied by a corresponding increase in deficit in the South. In 2008 and 2009, the subprime crisis led to a sharp reduction in deficits in Southern European economies, which was matched by a decline in surplus in Germany. While a slight reversal in trade flows was observed in 2009, the outbreak of the European sovereign debt crisis in 2010 amplified the reduction in surpluses and deficits observed in the two regions. The economic recovery that started to materialize in 2013 led to a gradual increase in surpluses in the North that was accompanied by an increase in deficits in the South.

As illustrated in Figure 2, the strong negative co-movement between trade balances across the eurozone will have to be explained in a model able to simultaneously generate a strong positive co-movement in output growth between the two regions. While trend growth in the post-crisis sample has been markedly lower in the South, at business cycle frequency, fluctuations in output growth across the two regions have remained remarkably synchronized, even throughout the crisis period.

From the perspective of net capital flows, the divergence in trade balances observed in the pre-crisis sample as well as the abrupt reversal in trade flows observed during the subprime and sovereign debt crises episodes suggest that net capital inflows are procyclical in the South and countercyclical in the North. Many different explanations have been proposed to rationalize the dynamics of capital flows observed in the eurozone and covering all possible explanations would be beyond the scope of this paper.[7] But given the high degree of output synchronization observed across the two regions, it seems difficult to argue that asymmetric shocks are a main driver of net capital flows and output growth in the eurozone. This paper focuses instead on the case of asymmetric economic structures and assumes that the eurozone business cycle is driven by a common shock.

As illustrated by Figure 3, which shows the evolution of the rule of law index across the two regions, almost two decades after the introduction of the common currency, differences in legal structures remain a major source of cross-country heterogeneity.[8] This indicator, which also includes factors such as the extent to which agents have confidence in the rules of society, has declined markedly in the South and seems to indicate that the quality of institutions across the North and the South of Europe is an important dimension along which the two

[7] See for instance Milesi-Ferretti and Tille (2011) and Lane (2013) among others for a review.

[8] The rule of law index for South Europe is a weighted average constructed using GDP weights. See data appendix.

regions have diverged. In terms of percentile rank, the contrast between Germany and some Southern European economies is also striking. As an average over this period, the percentile rank for Germany stood at 93, while Italy is ranked at the 66th percentile, suggesting a significant difference in the quality of institutions across countries composing the monetary union.

Finally, as illustrated by Figure 4 below, another key structural difference between the two regions is the fact that non-financial corporations in the South are considerably more reliant on bank funding than firms in the North. As an average over the period from 2003 to 2016, the loans to non-financial corporations to output ratio amounted to about 2.32 in the South, while this ratio is significantly lower and reaches only 1.35 in the North.

3 The model

The economy is composed of two regions, the North and the South, that are linked by a market for physical capital, which gives rise to cross-border factor payments, and by a financial market that can be used to trade securities. International markets are incomplete and each domestic economy is composed of a representative agent, a financial intermediary, and a representative firm. A role for banks is introduced by assuming that in each region the non-financial sector needs to obtain a loan to pay workers and foreign as well as domestic capital owners in advance. The extent to which external financing is needed is determined by the tightness of the loan-in-advance constraint. Institutional differences are captured by introducing a "walk away" constraint that links the amount of external financing that non-financial corporations can obtain to the quality of the country's institutional framework.

3.1 The competitive equilibrium in the North

The notation $\widetilde{y}$ is adopted to denote variables, such as output, that represent prices or quantities in the South and y will be the corresponding counterpart in the North. Technology and preferences are consistent with balanced growth and stationary variables are denoted using capital letters. Small letters are used to denote detrended variables and the deterministic growth rate along the balanced growth path is denoted by γ. Since the market structure across the two blocks is identical, we focus the analysis on the Northern economy.

The non-financial corporate sector

The final output good, which is denoted by y, is produced by firms in the non-financial corporate sector using hours worked N and domestic capital a. Domestic capital and hours worked are both supplied by the domestic household. Each period, managers in the non-financial sector also have to decide how to allocate the amount of domestic capital received from households between capital used for producing the final good and capital that is rented abroad. The amount of domestic capital allocated to domestic production is denoted by k while b represents the share of domestic capital that is rented abroad. This portfolio allocation decision gives rise to the following constraint:

$$a_t = k_t + b_t, \tag{1}$$

and in period t, profits in the non-financial sector are given as follows:

$$\pi_{Ft} = y_t + r_{Bt} b_t - r_{At} a_t - w_t N_t - \widetilde{r}_{Bt} \widetilde{b}_t - r_{Lt} l_t, \tag{2}$$

where r_B denotes the rate at which domestic capital is rented abroad, r_A is the cost of renting domestic capital from the domestic consumers, w is the wage paid to workers. On the firms' side, international linkages are introduced by assuming that, in each region, the technology used by firms to produce the final output good requires foreign capital as an input. From the perspective of firms in the North, foreign capital is denoted by $\widetilde{b}$ and $\widetilde{r}_B$ is the cost of renting foreign capital from the foreign non-financial sector. The total cost from obtaining external finance from the domestic banking sector is denoted by $r_L l$, where r_L is the cost of borrowing funds from the domestic financial intermediary.

The production function takes a Cobb-Douglas form with constant returns to scale:

$$y_t = A_t \left[(a_t - b_t)^{\xi} \widetilde{b}_t^{\,1-\xi} \right]^{\alpha} N_t^{1-\alpha}, \tag{3}$$

where $k = a - b$ is the quantity of domestic capital allocated to the production of the final output good. The labor share is denoted by $1 - \alpha$, while $1 - \xi$ is the share of foreign capital used by firms in the North. ξ can be interpreted as a measures of the degree of capital openness and the case of autarky can be obtained by setting ξ to 1, since cross-border factor payments disappear in this case. The technology shock that is common to both regions is denoted by A_t and follows an autoregressive process of order one:

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_{At},$$

where ε_{At} is a random disturbance that is normally distributed and ρ_A is the autoregressive parameter. Technology shocks are the only source of business cycle fluctuations and are common to both country blocks.

A role for banks is introduced by assuming that firms need to obtain a loan to pay inputs in advance. The loan-in-advance constraint can be expressed as follows:

$$l_t \geq \eta \left(w_t N_t + \widetilde{r}_{Bt} \widetilde{b}_t + r_{At} a_t - r_{Bt} b_t \right), \tag{4}$$

where η is the parameter that determines the tightness of the constraint. The model reduces to a frictionless economy when η is set to 0. In the South, the tightness of the loan-in-advance constraint is denoted by $\widetilde{\eta}$.

The impact of the legal system on credit is captured by assuming that entrepreneurs in the final-good sector default and run away with the funds borrowed from banks, if the value of their debt exceeds the net present value from operating the firm for a sufficiently long period of time (e.g., Jermann and Quadrini 2012). Bankers understand this incentive structure and make sure that entrepreneurs always have the incentive to reimburse the loan so that default never occurs in equilibrium. This incentive compatibility constraint, which is internalized by entrepreneurs, implies that the maximum amount that firms can borrow is given as follows:

$$\mu l_t \leq V_t, \tag{5}$$

where V denotes the present value from operating the firm. For simplicity, V is expressed as the infinite discounted sum of future profits, which can be expressed in recursive form as follows:

$$V_t = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} \left[\pi_{Ft+1} + V_{t+1} \right], \tag{6}$$

Since firms in the final-good sector are owned by the representative agent, managers use the stochastic discount factor of the agent, which is denoted by $\beta E_t \lambda_{t+1}/\lambda_t$ to discount future profits. The impact of the country's institutional framework on agents' access to credit is captured by the parameter μ. A lower value for μ decreases the payoff from defaulting

and therefore makes it less likely that the case $\mu l > V$ will occur. A lower value for this parameter therefore corresponds to an improvement in the country's institutional framework and reduces debtors' incentives to walk away with the loan. By lowering the payoff from defaulting, a lower value for μ implies that for a given value of V, more credit will be extended to firms. Our interpretation of this parameter is therefore that it captures the ease at which contracts can be enforced.

Managers in the final goods-producing sector maximize the discounted value of future dividends:

$$\max_{N_t, b_t, \widetilde{b}_t, a_{t+1}, l_t} E_0 \sum_{t=0}^{\infty} \widehat{\beta}^t \frac{\lambda_t}{\lambda_0} \pi_{Ft}, \tag{7}$$

subject to equations (1) to (6) and where $\widehat{\beta}$ is the modified discount factor (e.g., Kocherlakota 1990).

Households

The period t budget constraint of the representative household is given by the following equation:

$$\pi_{Tt} + r_{At} a_t + r_{Dt} d_t + w_t N_t + p_{St} \gamma s_{t+1} + \widetilde{s}_t = c_t + i_t + \kappa d_t + s_t + \varsigma s_t + \widetilde{p}_{St} \gamma \widetilde{s}_{t+1}, \tag{8}$$

and the representative agent divides his or her time between leisure activities L, and hours worked in final goods-producing sector N :

$$L_t = 1 - N_t, \tag{9}$$

The wage rate received by workers is denoted by w and total income also consists of a revenue from depositing funds in the banking sector, $r_D d$, where r_D denotes the rate at which deposits are remunerated. The representative agent owns the domestic intermediary as well as firms in the final goods-producing sector and total dividend income is denoted by π_T. Consumption expenditures are denoted by c, and a is the stock of domestic capital accumulated by the agent. Households incur a monitoring cost when supplying deposits to the banking sector. The monitoring cost takes the form of a fixed cost that is proportional to the amount deposited and is denoted by κ. With this structure, the supply of deposit will therefore be completely elastic.

The presence of a cross-border financial market also allows households in the North to share risk by issuing a domestic risk-free asset that is purchased by agents in the South. In period t, the revenue from selling a domestically issued risk-free asset to consumers in the South is denoted by $p_S s$, where p_S denotes the asset price. On the expenditures side, the coupon paid in period t by domestic agents to remunerate bondholders who purchased the quantity of safe asset issued in $t-1$ is denoted by s. To ensure that the problem is well-behaved, we further assume that issuing financial assets is costly and that issuers incur a fixed cost that is proportional to the stock of safe asset available at time t. The fixed cost of issuing debt is denoted by ς.

Similarly, agents in the North have access to a one-period risk-free bond that is issued by agents in the South. On the expenditure side, the quantity of foreign bonds purchased at time t is denoted by $\widetilde{s}$, where $\widetilde{p}_S$ is the price of the bond issued by agents in the South. On the revenue side, $\widetilde{s}$ denotes the payment received from holding the quantity of foreign bonds that was purchased in period $t-1$. The issue of steady state indeterminacy is avoided by assuming that agents in each country derive utility from holding the stock of safe asset issued by consumers in the other region. In the North, a demand for safe assets is therefore obtained by introducing $\widetilde{s}$ directly into the utility function. We simplify the analysis by abstracting from domestic issuance of bonds purchased by domestic agents, since domestic flows have no effect on the current account.

Following Baxter and Crucini (1993) among others, we assume that capital accumulation is subject to an adjustment cost and adopt the following functional form:

$$\gamma a_{t+1} = (1-\delta)a_t + \left(\frac{\theta_1}{1-\epsilon}\left(\frac{i_t}{a_t}\right)^{1-\epsilon} + \theta_2\right) a_t, \tag{10}$$

where i denotes investment and δ is the depreciation rate of capital. The parameter that determines the elasticity of Tobin's Q with respect to changes in the investment to capital ratio is denoted by ϵ. The two constant θ_1 and θ_2 are calibrated to ensure that the introduction of adjustment costs has no effect on the deterministic steady state of the model.

Relative to the specification of preferences studied in Jaccard (2014), we assume that habits are formed over a composite good consisting of consumption, the stock of safe asset and leisure. The law of motion for the habit stock is given as follows:

$$\gamma x_{t+1} = m x_t + (1-m) c_t^{\varkappa} \widetilde{s}_t^{1-\varkappa} (\psi + L_t^{\upsilon}), \tag{11}$$

where m is the habit parameter that controls the speed at which the habit stock depreciates. The share of consumption in utility is denoted by $\varkappa$. Each period, the representative household chooses optimally consumption, hours worked, the quantity of deposits to allocate to the banking sector, investment and controls the evolution of its capital stock, its habits stock, its stock of foreign asset and the stock of safe asset issued to foreigners by maximizing lifetime expected utility,

$$\max_{c_t,N_t,d_t,i_t,a_{t+1},x_{t+1},s_{t+1},\widetilde{s}_{t+1}} E_0 \sum_{t=0}^{\infty} \widehat{\beta}^t \log\left[c_t^{\varkappa} \widetilde{s}_t^{1-\varkappa}(\psi + L_t^{\upsilon}) - x_t\right],$$

subject to constraints (8) to (11).

Banks

In each country block, the provision of credit is undertaken by a regional banking sector that simply channels funds from households to firms in its domestic non-financial sector. Profits in the banking sector are given as follows:

$$\pi_{Bt} = r_{Lt} l_t - r_{Dt} d_t,$$

We assume that the technology used by banks to transform deposits into loans is linear in deposits:

$$l_t = z d_t,$$

where z is an exogenous technology parameter measuring the efficiency of the financial intermediation sector.

Market equilibrium

A competitive equilibrium in the economy is a sequence of prices:

$$w, \widetilde{w}, r_L, \widetilde{r}_L, r_D, \widetilde{r}_D, \lambda, \widetilde{\lambda}, V, \widetilde{V}, \varpi, \widetilde{\varpi}, \psi, \widetilde{\psi}, p_S, \widetilde{p}_S$$

where ϖ and $\widetilde{\varpi}$ denote the Lagrange multipliers associated with the loan-in-advance constraints in the two regions, ψ and $\widetilde{\psi}$ are the Lagrange multipliers associated with the incentive

compatibility constraints in each region, λ and $\widetilde{\lambda}$ marginal utility, and quantities:

$$l, \widetilde{l}, y, \widetilde{y}, c, \widetilde{c}, i, \widetilde{i}, d, \widetilde{d}, a, \widetilde{a}, b, \widetilde{b}, N, \widetilde{N}, k, \widetilde{k}, s, \widetilde{s}$$

that satisfy households and firms efficiency conditions as well as the two resource constraints:

$$y_t + r_{Bt} b_t + \widetilde{s}_t + \gamma p_{St} s_{t+1} = c_t + i_t + \widetilde{r}_{Bt} \widetilde{b}_t + \kappa d_t + (1 + \varsigma) s_t + \gamma \widetilde{p}_{St} \widetilde{s}_{t+1},$$

$$\widetilde{y}_t + \widetilde{r}_{Bt} \widetilde{b}_t + s_t + \gamma \widetilde{p}_{St} \widetilde{s}_{t+1} = \widetilde{c}_t + \widetilde{i}_t + r_{Bt} b_t + \widetilde{\kappa} \widetilde{d}_t + (1 + \widetilde{\varsigma}) \widetilde{s}_t + \gamma p_{St} s_{t+1},$$

for all states, for t=1...∞, and given initial values for the six endogenous state variables $a, \widetilde{a}, x, \widetilde{x}, s$ and $\widetilde{s}$.[9]

Financial imbalances

In the context of our model, the trade balance or net exports in the North is given by domestic absorption, which can be defined as follows:

$$tb_t = y_t - c_t - i_t - \kappa d_t - \varsigma s_t,$$

Similarly, in the South, the trade balance is given as follows:

$$\widetilde{tb}_t = \widetilde{y}_t - \widetilde{c}_t - \widetilde{i}_t - \widetilde{\kappa} \widetilde{d}_t - \widetilde{\varsigma} \widetilde{s}_t,$$

and the aggregate market clearing condition implies that:

$$tb_t = -\widetilde{tb}_t$$

If the two blocks are perfectly symmetric, it can be shown that trade balances are always equal to zero in this model. By contrast, it is possible to generate non-zero trade balances even in the steady state once structural heterogeneity is introduced into the analysis.[10]

[9] In each country, the aggregate resource constraint is obtained by substituting the expressions for profits in the budget constraint of the households, who owns the domestic banking and corporate sectors.

[10] A simple illustration of this result can for instance be found in Mark (2001).

4 Calibration

Whenever possible, we use available empirical evidence to calibrate the main structural parameters of the model. A first set of parameters is chosen to match long-run steady state ratios following standard practice in the real business cycle literature. As second set of parameters is calibrated to maximize the model's ability to reproduce a series of key stylized facts characterizing the dynamics of the main business cycle aggregates in the North and South of Europe.

Labor supply, subjective discount factor and capital share

To our knowledge, differences in labor supply characteristics or capital intensities are not significant sources of cross-country heterogeneity in the eurozone. We therefore assume that these parameters are identical across country blocks and calibrate them using values that are considered standard in the real business cycle literature (e.g., King, Plosser and Rebelo 1988; King and Rebelo 1999). The two labor supply parameters, υ and ψ in the North and $\widetilde{\upsilon}$ and $\widetilde{\psi}$ in the South, are set to ensure that the Frisch elasticity of labor supply is approximately equal to 3 in each country block and that agents spend on average 20% of their time on work related activities. The capital share parameters α and $\widetilde{\alpha}$ are set to 1/3. We also assume that the subjective discount rates of time preference β and $\widetilde{\beta}$ are identical across country blocks and set this parameter value to 0.99, which is a standard choice.

Cross-border asset market

The introduction of a cross-border market for safe assets adds four structural parameters into the analysis. The fixed cost of issuing the safe asset and the utility share of the safe asset stock in the North and South are denoted by ς and $\widetilde{\varsigma}$, and $1-\varkappa$ and $1-\widetilde{\varkappa}$, respectively. In the absence of evidence suggesting otherwise, we assume that the structure of the cross-border asset market is identical across country blocks. In each country, the fixed cost of issuance is set to 0.01, which implies that a cost amounting to one percent of the total stock of debt must be paid each period to issue debt internationally. The consumption share in the utility function is set to 0.99, implying a utility weight for the safe asset stock of 0.01 in each country.

Deterministic growth rates

Over the period from 1996 to 2016, the average quarterly growth rate of output stood at 0.35% and 0.27% in North and in the South, respectively. Once uncertainty is taken into

account, it is not possible to reject the null hypothesis that the estimated mean growth rates are equal across country blocks. We therefore assume a common deterministic trend rate γ and set this parameter value to 1.003, which is in line with these estimates.

Financial intermediation

Given that lending and borrowing costs are a potentially important source of cross-country heterogeneity, we use harmonized data on lending and borrowing rates to calibrate the set of parameters associated with the structure of financial intermediaries across the two regions. Real rates are obtained by deflating the nominal values computed for each country using the corresponding harmonized index of consumer prices.

Given the simplifying assumption that deposit rates in each region are determined by monitoring costs, the two parameters κ and $\widetilde{\kappa}$ can be used to calibrate the average cost of funding in each country block, that is $E(r_D)$ and $E(\widetilde{r}_D)$, respectively, and we use data on deposit rates to calibrate these two parameter values.[11] As an average over the period from 2000 to 2016, the average real rate paid on deposits with maturity of less than a year to non-financial corporations, households and non-profit institutions serving households stood at 0.08%, 0.15%, 0.11% and 0.43% in Germany, Italy, Spain and Portugal, respectively. Using GDP weights to compute a weighted average, we obtain an average deposit rate of 0.16% in the South vs. 0.08% in the North. The 95% confidence interval for the estimated mean ranges from -0.19% to 0.36 in the North and from -0.09% to 0.40% in the South. Given that the difference in average deposit rates across the two country blocks is not statistically significant, we set κ equal to $\widetilde{\kappa}$. Setting the common monitoring cost parameter to 0.0003 implies a value for the steady state annualized deposit rate in the two regions of 0.12%.

Since the financial efficiency parameters z and $\widetilde{z}$ drive a wedge between deposit and lending rates, we use data on short-term loans to non-financial corporations to calibrate these two parameters. As an average over the period from 2003q1 to 2016q3, the real interest rate paid by non-financial corporations for loans with a maturity of less than a year stood at 1.64%, 1.57%, 1.55% and 3.41% in Germany, Italy, Spain, and Portugal, respectively. Using country weights to compute an aggregate measure of the cost of lending in the South of Europe, we obtain an average borrowing rate in that region of 1.68%. Given that the difference in average short-term real lending costs is not statistically significant, i.e. 1.66% in Germany vs. 1.68% in the South, we assume that the two parameters capturing

[11] See data appendix.

the efficiency of financial intermediation are identical across the two regions. Setting this parameter to 0.0659 implies a steady state borrowing cost of 1.67%.

Capital openness

The degree of financial openness in each country is captured by the two parameters ξ and $\widetilde{\xi}$. While differences in capital openness could potentially constitute an important source of cross-country heterogeneity, it is difficult to find evidence suggesting that this could indeed be the case. According to the well-known Chinn-Ito index (e.g., Chinn and Ito 2006) of financial openness for instance, economies across the eurozone display a degree of financial openness that is nowadays very similar. A significant amount of heterogeneity was observed in the 80's and at the beginning of the 90's but since the common currency was introduced, financial openness has never been a relevant source of cross-country heterogeneity. In our calibration, this is captured by setting ξ equal to $\widetilde{\xi}$, which implies that the degree of financial openness is the same in both regions. This parameter value is then chosen to ensure that the average trade balance to output ratio observed in the North can be matched. As an average over the period from 1999 to 2016, the average trade balance to output ratio in the North stood at 1.31%.

Capital depreciation rates

The depreciation rate parameters δ and $\widetilde{\delta}$ are calibrated to ensure that the average investment to output ratios observed in the data can be matched. As an average over the period from 1996 to 2016, the average investment to output ratios stood at 0.20 in the North and 0.22 in the South.

Moment matching procedure

The remaining parameters are calibrated to maximize the model's ability to jointly reproduce a series of stylized facts characterizing the dynamics of the main business cycle aggregates in both regions. This first set of empirical facts consists of the standard deviation of output, consumption, investment and labor productivity in both regions. To impose some further discipline to the analysis, we also include the loan to output ratios in the set of empirical moments to be matched. This is to ensure that the degree of financial friction that will be obtained will remain consistent with long-term evidence on the extent to which firms in both regions rely on external financing. The corresponding ten empirical moments

are reported in Table 1, where the 95% confidence intervals for the estimated means and standard deviation have been added in brackets.

The ten remaining parameters to calibrate include the two habit and adjustment costs parameters, which are denoted by m, $\widetilde{m}$, ϵ and $\widetilde{\epsilon}$ and which affect the volatility of output, consumption, investment and labor productivity. In each country block, the ease at which contracts can be enforced is captured by the two parameters μ and $\widetilde{\mu}$. For any given values of V and $\widetilde{V}$, a weaker institutional environment, which in this model implies higher values for μ and $\widetilde{\mu}$, makes it less likely that the incentive compatibility constraint will be satisfied. A tighter incentive compatibility constraint not only reduces the equilibrium quantity of loans that firms will obtain but also affects the volatility of all business cycle aggregates. It is therefore difficult to associate these two parameters with one moment in particular. In equilibrium, the loan to output ratios also critically depend on the value of the two financing-in-advance parameters η and $\widetilde{\eta}$, which we also include in the set of parameters to calibrate using this moment matching procedure. As discussed in section 2, the extent to which non-financial corporations rely on bank lending is an important source of structural heterogeneity across the two regions. This is accounted for by choosing values for η and $\widetilde{\eta}$ that maximize the model's ability to match the average loan to output ratios observed in the data (*i.e.*, 1.35 in the North and 2.32 in the South). Finally, the shock standard deviation and shock persistence parameters σ_A and ρ_A are the last two degrees of freedom that can be exploited to match this set of moments. The outcome of this moment matching procedure is shown in Table 1, which reports the combination of parameter values that maximizes the model's ability to reproduce these stylized facts.

Table 1: Benchmark Calibration

σ_A	ρ_A	ϵ	$\widetilde{\epsilon}$	m	$\widetilde{m}$	μ	$\widetilde{\mu}$	η	$\widetilde{\eta}$	δ	$\widetilde{\delta}$
0.0076	0.97	0.0	0.11	0.3	0.987	0.5	10	1.37	3.23	0.012	0.042

Results

As illustrated in Table 2, the model with one single aggregate technology shock does reasonably well at matching the 10 moments that were targeted. It is possible to reproduce the significant difference in consumption and investment volatilities observed across the two regions in a model able to jointly match long-term ratios, such as the investment to output or loan to output ratios.

The lower consumption volatility observed in the North can be reproduced by setting the habit parameter in the North to 0.3 vs. 0.987 in the South, implying a stronger habit formation motive in the surplus region. Similarly, the lower investment volatility and higher consumption volatility in the South can be replicated by introducing adjustment costs that are higher in the South. In a model with one single source of shocks, it would not be possible to generate differences in investment and consumption volatilities of this magnitude without introducing heterogeneity in the extent to which contracts can be enforced. As illustrated in Table 1, a much higher value for $\widetilde{\mu}$ is required in order to generate the higher volatility of consumption and lower volatility of investment observed in the South, implying an institutional framework that is weaker in the South than in the North, as suggested by the stylized facts discussed in section 2.

Table 2: Business Cycle Moments

	Data			Data	
	Estimated [95% CI]	Model		Estimated [95% CI]	Model
σ_y	1.55 [1.34, 1.82]	1.44	$\sigma_{\widetilde{y}}$	1.23 [1.06, 1.45]	1.39
σ_c	0.50 [0.44, 0.59]	0.59	$\sigma_{\widetilde{c}}$	1.03 [0.89, 1.21]	1.00
σ_i	5.08 [4.41, 6.0]	4.44	$\sigma_{\widetilde{i}}$	3.81 [3.31, 4.50]	3.55
σ_w	0.87 [0.75, 1.02]	0.75	$\sigma_{\widetilde{w}}$	0.70 [0.61, 0.83]	0.83
$E(l/y)$	1.35 [1.32, 1.37]	1.35	$E(\widetilde{l}/\widetilde{y})$	2.32 [2.23, 2.41]	2.32
Additional Long-run Implications					
$E(i/y)$	0.20 [0.20, 0.21]	0.20	$E(\widetilde{i}/\widetilde{y})$	0.22 [0.21, 0.22]	0.22
$E(tb/y)$	1.31 [1.10, 1.52]	1.31			

Note. In this table, σ_x denote the HP-filtered standard deviation of the time-series x expressed in logs. $E(x)$ is the unconditional mean of variable x.

One first limitation of the model is its inability to match the fact that productivity per hours worked in more volatile in the North than in the South. In both cases, the model generated volatilities lie at the boundary of the 95% confidence bands. Second, and as already discussed in section 2, our simplifying assumptions concerning the supply of deposits imply that deposit rates are constant. Time-variation in deposit rates could be obtained by introducing shocks to the two monitoring cost parameters κ and $\widetilde{\kappa}$. Third, while in both

regions it is possible to reproduce the fact that credit is more volatile than output, the model fails to generate fluctuations in credit that are as volatile as in the data. Assuming that the two bank efficiency parameters z and $\widetilde{z}$ are subject to random fluctuations would help to address this issue.

Are the constraints always binding?

We verified that the constraints are always strictly binding by checking that in both regions the Lagrange multipliers associated with the financing-in-advance and walk away constraints (see equations 4 and 5 for the Northern economy) are always strictly positive in a large sample of simulated data. We also solved a version of the model without the financing-in-advance constraints, without the walk away constraints, and without both constraints and verified that the constraints are always strictly binding.

5 The direction of net capital flows

As illustrated by the comparison reported in Table 3, the model calibrated to reproduce the stylized facts shown in Table 1 can also explain the direction of net capital flows observed in the eurozone over the business cycle. The high correlation between output in the two regions can be reproduced and the model is successful at generating the strong negative co-movement in trade balances observed across regions.

In the North, the trade balance is given as follows:

$$tb_t = y_t - c_t - i_t - \kappa d_t - \varsigma s_t,$$

An equivalent expression can be derived by decomposing the trade balance into capital flows arising from factor payments and trade in financial assets:

$$tb_t = (\widetilde{p}_{St}\gamma\widetilde{s}_{t+1} - \widetilde{s}_t) - (p_{St}\gamma s_{t+1} - s_t) + \widetilde{r}_{Bt}\widetilde{b}_t - r_{Bt}b_t,$$

Figure 1 shows the response of the trade balance in both regions to a positive technology shock and decomposes it into two components. In both pictures, the black dotted line shows the contribution of factor payments. In the North, the contribution of factor payments is given by the term $\widetilde{r}_{Bt}\widetilde{b}_t - r_{Bt}b_t$. The red dotted line shows the contribution of financial flows or current account to the overall dynamics of the trade balance, which is in the North is

captured by the difference between the amount purchased, *i.e.* $\widetilde{p}_{St}\gamma\widetilde{s}_{t+1} - \widetilde{s}_t$, and the amount issued domestically and purchased by agents in the South, *i.e.* $p_{St}\gamma s_{t+1} - s_t$.

As can bee seen from Figure 1, financial flows arising from trade in financial assets have a dominating impact on the overall dynamics of the trade balance. Both components move in the same direction but the cyclicality of the trade balance is mainly driven by financial flows.

In response to a positive technology shock, this illustrates that the model generates net capital flows from the North to the South. In the South, this trade balance deficit is firstly financed by a net revenue from renting capital abroad, which implies that in good times $\widetilde{r}_B\widetilde{b}$ exceeds $r_B b$. In terms of financial flows, the increase in trade deficit in the South that occurs during periods of booms implies that $(\widetilde{p}_{St}\gamma\widetilde{s}_{t+1} - \widetilde{s}_t)$ must exceed $(p_{St}\gamma s_{t+1} - s_t)$, and therefore that the South finances its trade deficit by issuing debt that is purchased by agents in the North. The presence of an international capital market therefore allows households in the South to consume and invest in excess of what can be produced domestically. Similarly, production exceeds domestic absorption in the North during boom periods, as the quantity of capital exported by the region increases.

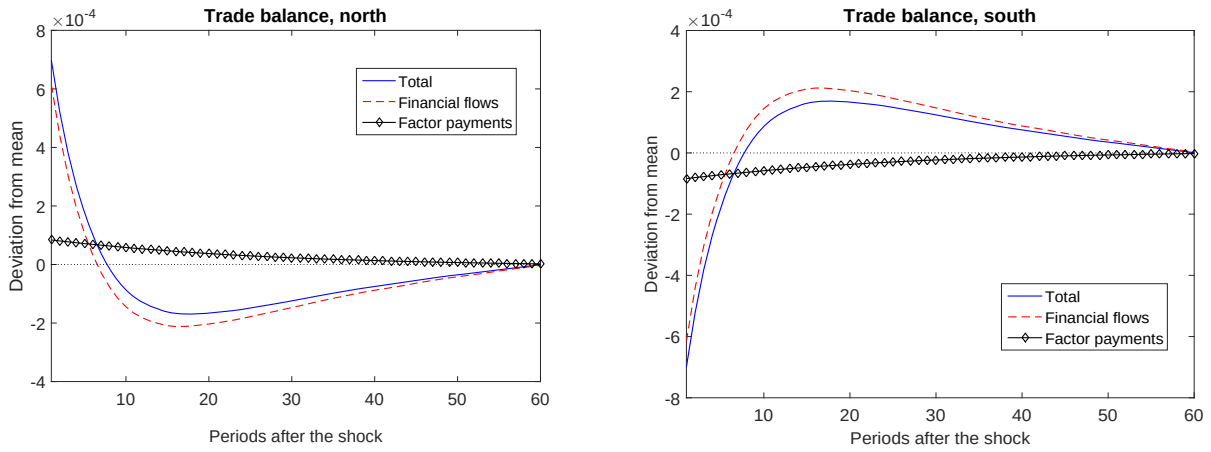

Figure 1. Trade balance, factor payments vs. financial flows.

TABLE 3

	Data	Model
$\rho(y, tb)$	0.38 [0.16, 0.56]	0.77
$\rho(\widetilde{y},\widetilde{tb})$	-0.66 [-0.50, -0.77]	-0.69
$\rho(tb,\widetilde{tb})$	-0.61 [-0.74, -0.44]	-1.0
$\rho(y,\widetilde{y})$	0.79 [0.70, 0.86]	0.99

Table 3. HP-filtered correlation.

5.1 Deconstructing the mechanism

In the case of common shocks and without any source of cross-country heterogeneity, the two country blocks are perfectly symmetric. In this special case, the trade balance is equal to zero both in the steady state and over the business cycle.[12] This property of the model can be exploited to gain intuition into how structural asymmetries affect the cyclicality and level of financial imbalances.

Figure 2 below shows the response of the trade balance, output and credit to a common technology shock in the case in which differences in contract enforcement are the only source of cross-country heterogeneity. Relative to the benchmark calibration shown in Table 1, all other sources of heterogeneity are eliminated by considering the case in which the depreciation rate, habit formation, adjustment costs and financing-in-advance parameters are identical across regions.[13] As illustrated by the top left panel, relative to the symmetric benchmark, introducing differences in contract enforcement is sufficient to explain the cyclical behaviors of capital flows observed in the eurozone. By implying that contracts are more difficult to enforce in the South, this asymmetry generates a positive correlation between the trade balance and output in the North, which implies procyclical net capital inflows in the South. Agents in the South therefore finance their trade deficit by issuing debt during periods of economic booms and must reduce borrowing during periods of recession. The top right panel, which shows the financial flow or current account component of the trade

[12] Without asymmetries, the assumptions that $\xi = \widetilde{\xi} < 1$ and $\varkappa = \widetilde{\varkappa} < 1$ still implies that capital is traded across border but in this case shocks have no effects on the level or the cyclicality of net flows as $tb_t = \widetilde{tb}_t = 0$ for all t.

[13] To illustrate how the mechanism works, the two contract enforcement parameters μ and $\widetilde{\mu}$ are set to 5 and 10, respectively. The other parameters are set to the values obtained for the Southern economy: $\delta = \widetilde{\delta} = 0.042$, $m = \widetilde{m} = 0.987$, $\epsilon = \widetilde{\epsilon} = 0.11$ and $\eta = \widetilde{\eta} = 3.23$.

balance, confirms that in this case the dynamics of the trade balance is mainly driven by trade in financial assets. As illustrated by the bottom right panel, this relative difference in contract enforcement generates an increase in credit that is considerably more pronounced in the South than in the North. The lending boom that occurs in the South then leads to a stronger response of output.[14]

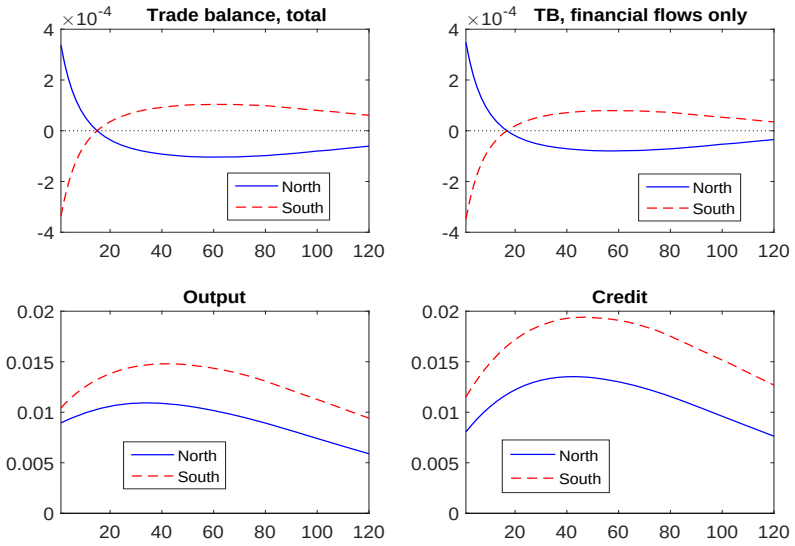

Figure 2. Response of the trade balance, output and credit to a positive technology shock in the case where $\mu < \widetilde{\mu}$ is the only source of cross-country heterogeneity. The response of the trade balance is shown in deviation from its steady state level. The response of output and credit is expressed in log deviation from steady state.

The mechanism without habits

Figure 3 shows the same impulse response in the case in which we abstract from habit formation by setting $m = \widetilde{m} = 1$. As can be seen by comparing Figures 2 and 3, without habit formation, the model looses much of its ability to generate asymmetric responses to common shocks. The dynamics of output and credit becomes very similar across regions and the lower volatility obtained in this case reflects that the model's endogenous propagation mechanism is considerably weaker in a model in which consumption smoothing is not a priority. Moreover, as can be seen from the top left and right panels of Figure 3, the more

[14]Since the trade balance is negative in the South, impulse responses in the two upper panels of Figure 2 are reported in level deviation from steady state rather than log deviations.

homogeneous response of consumption and output to common shocks leads to cross-border capital flows of a much smaller magnitude in the model without habits.

This impact of risk attitudes on the volatility of capital flows can be illustrated by comparing how habit formation affects the standard deviation of the trade balance. Table 4 below reports the coefficient of variation obtained in the two cases and compares the model implications with the data.[15] While the model cannot generate fluctuations in the trade balance that are sufficiently volatile in the case $m = \widetilde{m} = 1$, this example illustrates that this mechanism has the potential to generate fluctuations in net flows that can be significant.

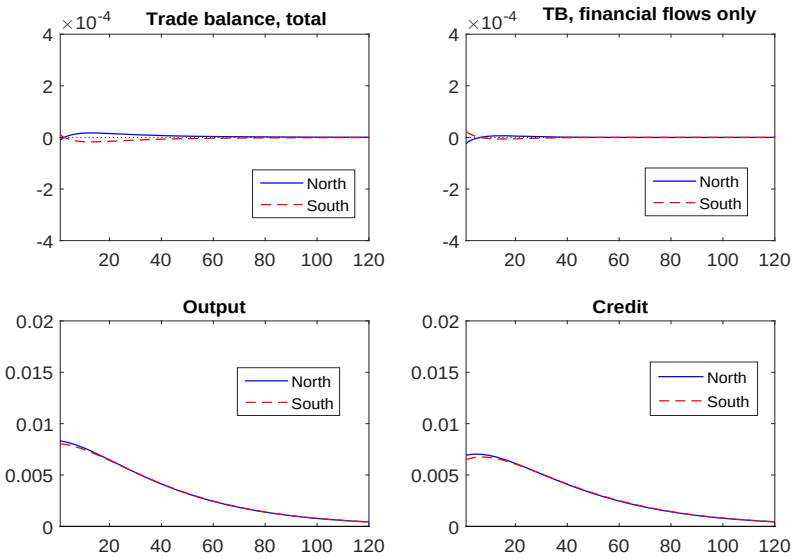

Figure 3. Case $\mu < \widetilde{\mu}$ without habit formation.

As shown by the bottom right panel of Figure 2, the larger amplitude of the response of credit obtained in the South illustrates that the credit market is the key source of asymmetry. This asymmetric response in turn leads to differences in output and consumption dynamics, which leads to the cross-border capital flows shown in the top panels of Figure 2. As we explain below, the key is that a common positive technology shock induces a larger expansion in credit in the South, which generates a relaxation of the walk away constraint that is stronger in the South than in the North when $\mu < \widetilde{\mu}$ is the only source of cross-country

[15] Given that the trade balance can take negative values, we report the coefficient of variation of the unfiltered level of the trade balance rather than HP-filtered log-levels by scaling the standard deviation with the sample mean.

heterogeneity. This is illustrated in Figure 4, which shows the response of the two Lagrange multipliers associated with the walk away constraints in both regions.

TABLE 4

	Data	Habits	No Habits
$\frac{\sigma(tb)}{E(tb)}$	0.67	1.08	0.07

Note: Case $\mu < \widetilde{\mu}$. The coefficient of variation is the standard deviation divided by the sample mean. The habit model is the case in which $m = \widetilde{m} = 0.987$. The model without habits corresponds to the case $m = \widetilde{m} = 1$.

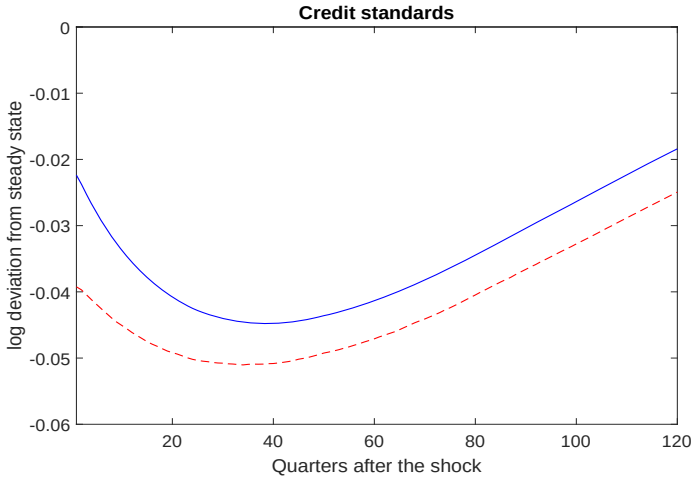

Figure 4.

Since the two Lagrange multipliers provide an indication of the ease at which credit can be obtained, the decline shown in Figure 4, can be interpreted as a loosening of credit standards applied to loans for non-financial corporations. The larger decline in $\widetilde{\psi}$ relative to ψ shows that, in response to a positive shock, this relaxation of credit standards is more pronounced in the South.

Investment and precautionary saving

Why is the precautionary saving motive stronger in the South? Habit formation induces a stronger consumption smoothing motive, while financial frictions make this objective more

difficult to achieve. As documented in the asset pricing literature (e.g., Jermann 1998), combining frictions that reduce the potential for intertemporal smoothing with habit formation increases the volatility of marginal utility. In terms of the consumption and saving decision, theses larger fluctuations in marginal utility create a stronger demand for assets in good times, since purchasing assets when consumption is high allows agents to transfer wealth from today to tomorrow, which is how consumption smoothing is achieved in this class of models.

In our case, this effect is stronger in the less financially developed economy because financial frictions are tighter in this region. The intuition for this result is that the financing-in-advance and incentive compatibility constraints distort the allocation of resources by introducing a time-varying wedge into the marginal productivity of production factors. This wedge, in turn, creates a deadweight loss that reduces the effectiveness of the different margins of adjustment that agents use to insure themselves against shocks.

Given the stronger precautionary motive in the South, whether this mechanism generates procyclical or countercyclical net capital flows depends on the particular margin that agents choose to smooth consumption. In response to a shock, agents can either adjust their net foreign asset position, which is the current account margin, or use the investment margin to adjust their domestic capital stock.

For the calibration that we are considering, the key is that investment is the preferred adjustment margin that agents in the South use to achieve their consumption smoothing objective. In response to a positive shock, consumption increases and since the increase in domestic production is not sufficient to finance the desired level of investment, the optimal choice is to borrow from abroad to finance part of the increase in domestic capital.

Whether the trade balance in the South increases or decreases in response to a positive shock depends on the intensity of capital adjustment costs. As shown in Table 1, for the case under consideration, a low degree of capital adjustment costs is needed to match the volatility of investment in the South. Low capital adjustment costs imply that investment is an effective hedge against business cycle fluctuations. In this case, agents in the South find it optimal to reduce their net foreign asset position $s - \widetilde{s}$ to finance an increase in domestic investment in good times. In response to a positive shock, domestic capital accumulation is therefore financed by running a current account deficit and the country's net foreign asset position deteriorates.

It would not be possible to obtain the same result by simply introducing higher capital adjustment costs in the South instead of a higher degree of financial frictions. To illustrate this point, we also studied a version of the model with similar degrees of contract enforcement and higher adjustment costs in the South. With similar degrees of habit intensity across regions, higher capital adjustment costs in the South would indeed create a stronger precautionary motive in that region. However, high capital adjustment costs in the South also reduce the effectiveness of the investment margin. As a result, increasing the region's net foreign asset position in good times to compensate for the insufficient increase in domestic capital is the most effective strategy to achieve consumption smoothing in this case. In the South, this increase in the region's net foreign asset position leads to a net outflow of capital, which in turn generates a surplus of the trade balance. Introducing higher adjustment costs in the South instead of a higher degree of financial frictions would therefore generate procyclical fluctuations in the trade balance in that region, which is the opposite from what we observe in the data.

Capital accumulation and credit

As illustrated in Figure 2, after a positive shock, this mechanism generates a credit boom in the South. The relative dynamics of credit can be linked to domestic capital accumulation in each country. Intuitively, the extent to which domestic credit is needed depends on whether the economy's domestic capital stock, *i.e.* a in the North and $\widetilde{a}$ in the South, is used domestically or rented abroad. Renting the domestic capital stock abroad instead of using it domestically reduces firms' need for credit. By contrast, a corresponding increase in credit is required to finance any increase in the economy's domestic capital stock. The link between credit and domestic capital accumulation can be illustrated by examining the equilibrium condition on the market for mobile capital in the South. In this particular market, the supply of domestic capital that is rented abroad is given as follows:

$$\widetilde{r}_{Bt} = \widetilde{\alpha}\widetilde{\xi}\frac{\widetilde{y}_t}{\widetilde{a}_t - \widetilde{b}_t}\frac{1}{1+\widetilde{\eta}\frac{\widetilde{\varpi}_t}{\widetilde{\lambda}_t}}$$

where $\widetilde{\varpi}_t/\widetilde{\lambda}_t$ is the financing wedge. Similarly, the demand for $\widetilde{b}$ in the North is given by the following condition:

$$\widetilde{r}_{Bt} = \alpha(1-\xi)\frac{y_t}{\widetilde{b}_t}\frac{1}{1+\eta\frac{\varpi_t}{\lambda_t}}$$

Equilibrium in this market therefore implies that:

$$\widetilde{\alpha}\widetilde{\xi}\frac{\widetilde{y}_t}{\widetilde{a}_t-\widetilde{b}_t}\frac{1}{1+\widetilde{\eta}\frac{\widetilde{\varpi}_t}{\widetilde{\lambda}_t}}=\alpha(1-\xi)\frac{y_t}{\widetilde{b}_t}\frac{1}{1+\eta\frac{\varpi_t}{\lambda_t}}$$

Next, using the fact that:

$$\widetilde{l}_t=\frac{\widetilde{\eta}\widetilde{y}_t}{1+\widetilde{\eta}\frac{\widetilde{\varpi}_t}{\widetilde{\lambda}_t}},\text{ and } l_t=\frac{\eta y_t}{1+\eta\frac{\varpi_t}{\lambda_t}}$$

This condition can be expressed as follows:

$$\frac{\widetilde{l}_t}{l_t}=\frac{\widetilde{\eta}}{\eta}\frac{\alpha(1-\xi)}{\widetilde{\alpha}\widetilde{\xi}}\left[\frac{\widetilde{a}_t}{\widetilde{b}_t}-1\right]$$

This formula illustrates that, in relative terms, the dynamics of credit in the South is tightly linked to the economy's capital stock $\widetilde{a}$. If the total capital stock of the economy increases more rapidly than the quantity rented abroad, credit in the South must also increase faster than in the North. Since our mechanism generates a stronger precautionary motive in the South, after a positive technology shock, the demand for domestic capital increases by more in the South than in the North. The dynamics of capital accumulation in the South therefore explains the larger credit expansion in that region.

5.2 The welfare cost of uncertainty

The first column of Table 5 reports the welfare cost of uncertainty obtained in each country by comparing average consumption in the economy subject to business cycle fluctuations with the case in which the shock standard deviation is set to zero. The difference provides a measure of the welfare cost of uncertainty. Relative to a deterministic economy without shocks, consumption is higher in a world subject to exogenous shocks, reflecting the fact that in equilibrium risk needs to be remunerated by a higher average consumption level. The difference between the deterministic and stochastic economies, which can be interpreted as a risk premium, therefore provides a measure of the welfare cost of uncertainty. As shown in Table 5, relative to a world without shocks, agents in the North require a consumption level that is about 1.3% higher. In the South, this measure reaches almost 3%, which reflects that agents in this region require a higher risk premium to be compensated for the effects of business cycle fluctuations. The welfare cost calculations reported in column 1 correspond

to the benchmark calibration that reproduces the stylized facts shown in Table 2.

In the South, the procyclicality of net capital inflows implies that agents borrow by issuing debt in good times and therefore that they need to close their trade deficits during periods of recession. The cyclical behavior of net capital flows in that region therefore implies that borrowing needs to be reduced precisely when marginal utility is high and the desire to consume most pressing. By amplifying fluctuations in credit, the dynamics of net financial flows therefore creates an additional source of risk that exacerbates the welfare cost of business cycle fluctuations in the region that experiences procyclical net inflows. In the North, by contrast, the cross-border financial market provides a margin of adjustment that allows agents to self-insure against unexpected shocks since it implies that borrowing can increase during periods of recession. This favorable cyclical property of net financial flows facilitates consumption smoothing in the North and implies a lower welfare cost of business cycle fluctuations in that region.

As illustrated by column 2 of Table 5, which reports the case in which $\mu < \widetilde{\mu}$ is the only source of structural asymmetry, this difference in welfare cost across regions is mainly driven by the contract enforcement parameter. To illustrate how the cyclicality of net financial flows exacerbates the cost of business cycle fluctuations, we considered the case where $\mu < \widetilde{\mu}$ is the only source of asymmetry in a version of the model that abstracts from trade in financial assets. As explained above, since movements in the trade balance are mostly due to fluctuations in financial flows when $\mu < \widetilde{\mu}$ is the only source of cross-country heterogeneity, the trade balance remains almost constant in the version of the model that abstracts from trade in financial assets. Relative to a version of the model without cross-border financial flows, we find that credit in the South is about 29% more volatile in the benchmark version in which financial assets are traded across borders. In the South, consumption is also about 20% more volatile when the region experiences procyclical net financial inflows of the magnitude obtained when $\mu < \widetilde{\mu}$ is the only source of structural asymmetry. The third column of Table 5 reports these welfare costs measure in the case without trade in financial assets and in which $\mu < \widetilde{\mu}$ is the only source of cross-country heterogeneity. By comparing column 2 and 3, it is therefore possible to isolate the contribution of cross-border financial flows on the welfare cost of business cycle fluctuations. Our results therefore suggest that the procyclicality of cross-border financial flows contributes to exacerbate the welfare cost of business cycle fluctuations in the South when the economy is hit by common shocks. In

the North, relative to the case in which a financial market is available, the welfare cost of business cycle fluctuations increases when financial assets cannot be traded across borders. This illustrates that the countercyclicality of financial flows induced by this mechanism facilitates consumption smoothing in the North. While cross-border financial flows can have a destabilizing effect on the economy that experiences procyclical net inflows, as can be seen by comparing the second and the third columns of Table 5, the quantitative magnitude of this effect however remains fairly modest.

The higher volatility of credit obtained in the version of the model with cross-border financial flows illustrates that, in good times, the larger increase in credit in the South is in part financed by funds originating from households in the North. The financial market is used to channel funds from savers in the North to non-financial corporations in the South through cross-border financial flows and the procyclicality of these net inflows in the South contributes to fuel the credit boom that occurs in good times.

Table 5: Common Shocks

		$\mu < \widetilde{\mu}$ only	
	Benchmark	Trade in assets	No trade in assets
$\frac{E(c)-c}{c}$	1.30	0.45	0.47
$\frac{E(\widetilde{c})-\widetilde{c}}{\widetilde{c}}$	2.86	3.46	3.09

Table 6: Asymmetric Shocks

	$\mu < \widetilde{\mu}$ only	
	Trade in assets	No trade in assets
$\frac{E(c)-c}{c}$	0.05	0.06
$\frac{E(\widetilde{c})-\widetilde{c}}{\widetilde{c}}$	2.46	3.37

The case of asymmetric shocks

The results shown in Table 5 illustrate that in the case of common shocks, cross-border financial flows contribute to exacerbate the welfare cost of business cycle fluctuations in the region endowed with the relatively weaker institutional framework. Another natural question to ask is whether the presence of a cross-border financial market provides an insurance against asymmetric shocks. To address this question, Table 6 reports the corresponding welfare cost measure in the case in which asymmetric technology shocks that only affect the South are

the sole drivers of business cycle fluctuations. In this case, the welfare cost of business cycle fluctuations in the South stands at 2.5% in the version of the model that allows for trade in financial assets. Relative to this latter case, the welfare cost measure increases from 2.5% to 3.4% when the cross-border financial market is shut down. This illustrates that well-developed financial markets contribute to moderate the effect of region specific shocks by increasing the potential for risk-sharing. The fact that the cost of business cycle fluctuations is more than 30% higher in the model without trade in assets illustrates that cross-border financial flows act as an insurance mechanism against asymmetric shocks that is quantitatively important.

6 Long-term imbalances

While the dynamics of the trade balance is mainly determined by financial flows, factor payments are by large the most important drivers of steady state imbalances. In the model calibrated to match the moments shown in Table 2, 99% of the average surplus generated by the model can be attributed to factor payments, with financial flows contributing only to about 1% of the overall surplus. Since the steady state impact of the current account is only marginal, this section focuses on the contribution of factor payments to the determinants of long-term imbalances.

The contribution of factor payments to the trade balance in the North, which we denote by tb_t^B, can be expressed as follows:

$$tb_t^B = \widetilde{r}_{Bt}\widetilde{b}_t - r_{Bt}b_t,$$

In the North, the demand for foreign capital is given by the first-order condition with respect to $\widetilde{b}$:

$$\widetilde{r}_{Bt} = \alpha(1-\xi)\frac{y_t}{\widetilde{b}_t}\frac{1}{1+\eta\frac{\varpi_t}{\lambda_t}},$$

In the South, the corresponding optimality condition implies that:

$$r_{Bt} = \widetilde{\alpha}(1-\widetilde{\xi})\frac{\widetilde{y}_t}{b_t}\frac{1}{1+\widetilde{\eta}\frac{\widetilde{\varpi}_t}{\widetilde{\lambda}_t}},$$

Using the demand for inputs as well as the loan-in-advance constraint in the non-financial sector in both regions, the following expressions for credit can be derived:

$$l_t = \frac{\eta y_t}{1+\eta\frac{\varpi_t}{\lambda_t}} \text{ and } \widetilde{l}_t = \frac{\widetilde{\eta}\widetilde{y}_t}{1+\widetilde{\eta}\frac{\widetilde{\varpi}_t}{\widetilde{\lambda}_t}},$$

These conditions can be combined to derive the following expression for the average contribution of factor payments to the trade balance:

$$E(tb_t^B) = \frac{\alpha(1-\xi)}{\eta}E(l_t) - \frac{\widetilde{\alpha}(1-\widetilde{\xi})}{\widetilde{\eta}}E(\widetilde{l}_t),$$

In the special case in which $\mu < \widetilde{\mu}$ is the only source of cross-country heterogeneity, we have that $\alpha = \widetilde{\alpha}$, $\xi = \widetilde{\xi}$ and $\eta = \widetilde{\eta}$ and the contribution of factor payments to the average trade balance therefore depends on the relative quantity of credit available in the two regions. Since the ease at which contracts can be enforced affects agents' access to credit, a weaker degree of contract enforcement in the South leads to an average quantity of credit that is relatively lower in that region, *i.e.* $E(\widetilde{l}) < E(l)$, implying that $E(tb^B) > 0$. The less financially constrained region is a net exporter of capital in the steady state, while the country where the constraint is relatively tighter is a net recipient of capital inflows.

For the benchmark calibration shown in Table 1, it is still possible to generate an average surplus in the North despite the fact that in this case we have that $E(\widetilde{l}) > E(l)$. In the version of the model with all sources of heterogeneity, the steady state deficit obtained for the South is due to the fact that in this case a higher financing-in-advance parameter, *i.e.* $\widetilde{\eta} > \eta$ is needed to account for the fact that in the data the loan to output ratio is on average higher in the South than in the North.

This result illustrates that differences in the degree of contract enforcement not only explains the direction of financial flows over the business cycle but also the long-term distribution of financial imbalances observed across the eurozone. While changes in net foreign asset positions, or current accounts, only play a very marginal role in the steady state, structural asymmetries however give rise to differences in net foreign asset positions. This point is illustrated in Figure 5, which shows how a change in contract enforcement in the South affects the evolution of the stock of foreign assets held in each region, *i.e.* $E(p_S s)$ and $E(\widetilde{p}_S\widetilde{s})$. To illustrate the main mechanism at work, the upper panel of Figure 5 shows the case in which differences in contract enforcement is the only source of cross-country hetero-

geneity. The intersection between the two lines corresponds to the symmetric case where $\mu = \widetilde{\mu} = 0.5$. The blue continuous and red dotted lines show the average stock of safe asset issued in the North and South, respectively. The upper panel of Figure 5 illustrates that a deterioration in the legal framework in the South increases the stock of foreign asset held in that region. Therefore, if differences in contract enforcement were the only source of structural asymmetry, net foreign asset positions would be positive in the South and negative in the North since in this case we have that $E(p_S s) > E(\widetilde{p}_S \widetilde{s})$ if $\mu < \widetilde{\mu}$. A weaker institutional framework reduces the access to credit and hence the potential for consumption smoothing. In the steady state, this effect raises the demand for the foreign safe asset in the region experiencing a deterioration in its legal environment. The long-term effect of a change in the degree of contract enforcement on net foreign assets positions is therefore in line with the findings reported by Mendoza et al. (2009).

The lower panel of Figure 5 shows the same sensitivity analysis but in the case in which a first-order rather than a second-order approximation is used to solve the model. In this case, the effect of a deterioration of the institutional framework in the South has the opposite effect on net foreign asset positions. This illustrates that the long-term effect of contract enforcement on net foreign asset positions shown in the upper panel of Figure 5 is essentially due to a precautionary motive. In an economy subject to shocks, a tightening of credit constraints exacerbates the effect of uncertainty by making it more difficult for agents to insure themselves against shocks. The weaker the institutional environment, the stronger the precautionary motive becomes, which explains why foreign asset holding in the South increase as the legal environment deteriorates. In a deterministic world by contrast, as shown by the lower panel of Figure 5, a deterioration in the quality of domestic institutions leads to a decline in households' holding of foreign assets, which is proportional to the decline in consumption they experience.

This latter result can be better understood by analyzing the model's optimality conditions. In the deterministic version of the model, the steady state amount of net foreign assets held by agents in the South can be expressed as follows:

$$s = \frac{\widetilde{\beta}}{\beta\left(1+\varsigma\right)-\widetilde{\beta}} \frac{1-\widetilde{\varkappa}}{\widetilde{\varkappa}} \widetilde{c}$$

Similarly, in the North, foreign asset holding in the deterministic steady state is given as follows:

$$\widetilde{s} = \frac{\beta}{\widetilde{\beta}(1+\widetilde{\varsigma}) - \beta} \frac{1-\varkappa}{\varkappa} c$$

Since in the case we are considering, $\mu < \widetilde{\mu}$ is the only source of cross-country asymmetry, this expression illustrates that under certainty equivalence the steady state stock of foreign asset held by agents in both regions is proportional to their consumption levels. Since a reduction in access to credit in the South lowers average consumption in that region, up to a first-order approximation, the case $\mu < \widetilde{\mu}$ implies $c > \widetilde{c}$ and thus that $\widetilde{s} > s$. This demonstrates that the result $E(p_S s) > E(\widetilde{p}_S \widetilde{s})$ when $\mu < \widetilde{\mu}$ is essentially due to a precautionary motive, which can only be captured using higher-order solution methods (e.g., Adjemian et al. 2014).

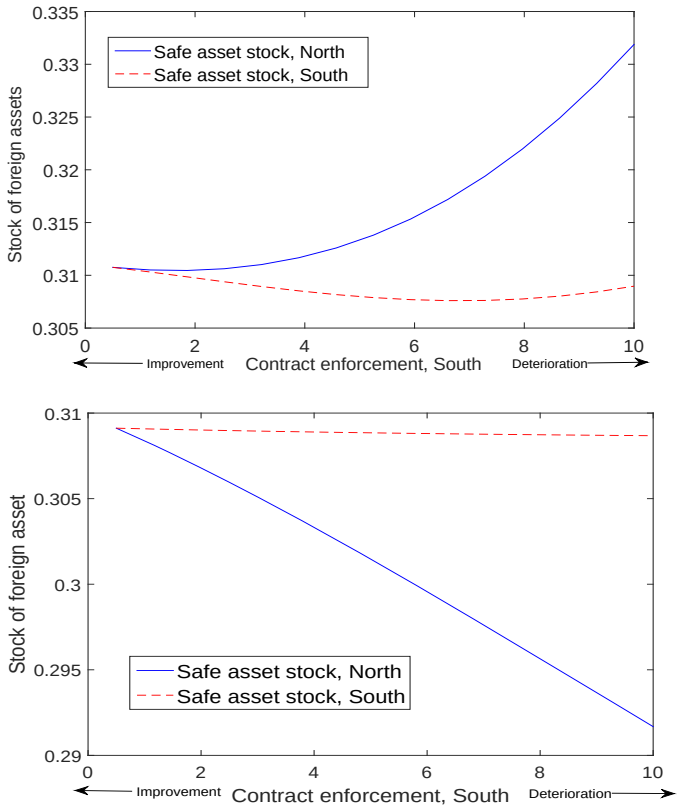

Figure 5. Safe asset stocks when contract enforcement is the only source of cross-country heterogeneity. Second-order vs. first-order approximation.

In the version of the model with all sources of heterogeneity that is able to reproduce the facts shown in Table 2, we obtain a net foreign asset position that is positive in the North and negative in the South, *i.e.* $E(\widetilde{p}_S\widetilde{s}) > E(p_S s)$. This result is mainly driven by the difference in depreciation rates that is needed to match the investment to output ratios observed in the two regions. As shown in Table 2, the average investment to output ratio is on average higher in the South than in the North. In the calibration exercise performed in section 4, this difference is accounted for by selecting a higher depreciation rate in the South than in the North. The higher depreciation rate of capital in the South has a first-order impact on capital accumulation that reduces total output in that region. The higher level of output in the North in turn implies a higher steady state consumption level and therefore, up to a first-order approximation, that $\widetilde{s} > s$. While risk plays an significant role in our economy and does increase the steady state stock of asset held by agents in the South, the first-order effect induced by the higher depreciation rate of capital in the South has a dominating impact on the distribution of foreign asset holdings. Introducing this difference in capital depreciation rates, which is needed to match the difference in investment to output ratios in the two regions, therefore allows the model to generate an average net foreign asset position that is positive in the North and negative in the South.

7 Structural reforms

Following the literature that aims to evaluate the effects of structural reforms initiated by the work of Blanchard and Giavazzi (2003), we now simulate the effects of an improvement in institutions in the South. Starting from the model that replicates the stylized facts shown in Table 2, what is the impact of a structural reform in the South that eliminates the asymmetry in financial structures by bringing the quality of institutions in the South to the level observed in the North? As shown by Table 7, the first main effect of an improvement in contract enforcement in the South is to lower the welfare cost of business cycle fluctuations in that region, which decreases from 2.9% to 0.45%. The large effect that is obtained on the cost of uncertainty suggests that this mechanism has important welfare implications.

It is interesting to note that an improvement in the quality of institutions in the South also leads to a small reduction in the welfare cost of business cycle fluctuations in the North. This effect is essentially driven by the increase in financial integration that results from

an improvement in contract enforcement in the South. Intuitively, in the long-term, the increase in output in the South induced by the structural reform raises the quantity of safe asset issued in that region, as the increase in total income makes it easier to finance the fixed cost of issuing securities. In equilibrium, this increase in the supply of safe assets abroad implies a higher holding of foreign assets in the North. This increase in availability of safe assets in turn makes it easier for agents in the North to insure against shocks since smaller variations in asset holdings are needed to stabilize consumption.

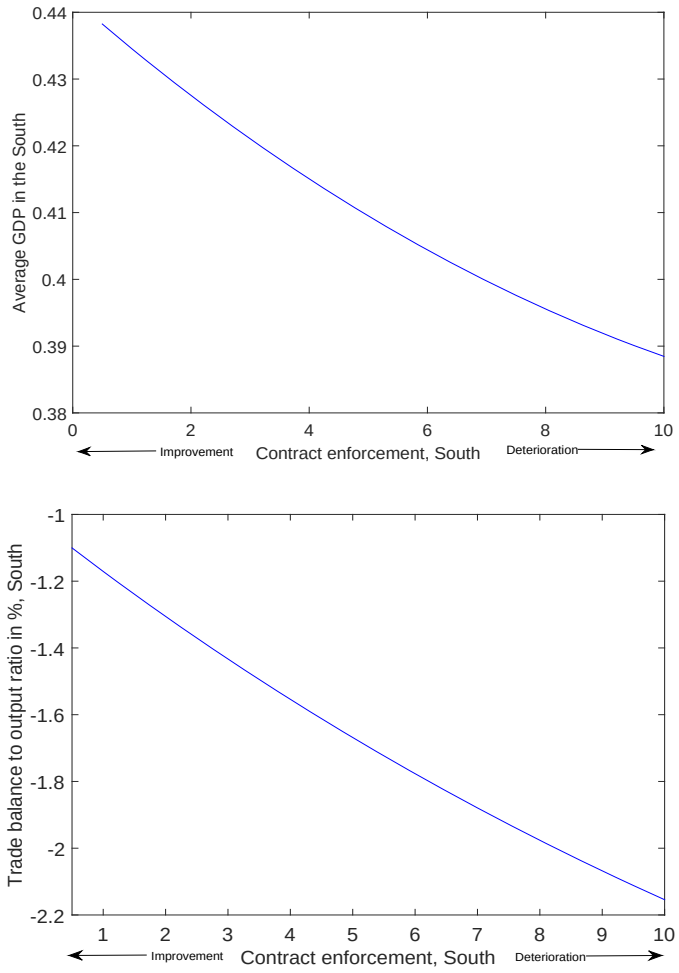

Figure 6.

To isolate the effect of financial market integration, we have also compared the effect of

structural reforms in a version of the model that abstracts from trade in assets. In this case, an improvement in institutions in the South still lowers the welfare cost of business cycle fluctuations in that region. The difference is that in this case structural reforms in the South increase the welfare cost of business cycle fluctuations in the North. This illustrates that the decline in the welfare cost in the North in response to structural reforms in the South is driven by this financial integration effect, which acts as a risk-sharing mechanism from which both regions benefit.

TABLE 7

	Benchmark	Structural reforms
$\frac{E(c)-c}{c}$	1.30	1.25
$\frac{E(\widetilde{c})-\widetilde{c}}{\widetilde{c}}$	2.86	0.45

Note: Impact of a structural reform that brings the quality of contract enforcement in the South $\widetilde{\mu}$ to the level in the North, μ.

Finally, Figure 6 reports a steady state analysis that analyses the sensitivity of output and of the trade balance to output ratio in the South to a change in $\widetilde{\mu}$. The result shown in the upper panel illustrates that in this model the ease at which contracts can be enforced also has major long-term implications. As shown by the upper panel, this sensitivity analysis suggests that potential output in the South would be about 13% higher if the region were endowed with institutions of the quality we assumed for the North. The negative relationship between $\widetilde{tb}/\widetilde{y}$ and $\widetilde{\mu}$ pictured in the lower panel of Figure 6 demonstrates that agents in the South compensate for the decline in income caused by a weakening of their institutional framework by borrowing from abroad. The effect of a deterioration of a country's legal system is therefore equivalent to a tax that penalizes production in regions where contracts are more difficult to enforce.

Relative to a symmetric two-country model, introducing asymmetric financial structures generates steady state differences in output across regions. As shown by the lower panel of Figure 6, these differences in production across countries are compensated by net capital inflows in the region suffering from a more restricted access to credit that is needed to finance a steady state trade deficit. Introducing asymmetric financial structures between two

financially integrated economies therefore leads to the emergence of equilibrium imbalances that act as a risk-sharing mechanism.

8 Conclusion

This paper argues that asymmetries in the dynamics of business cycle aggregates across countries can arise in models where common shocks are a main source of business cycle fluctuations. Although shocks are common, differences in endogenous propagation mechanisms generate business cycle fluctuations that are more costly in the region that experiences procyclical net capital inflows. Given the high degree of output synchronization and strong negative co-movement between trade balances observed across the North and South of Europe, the mechanism studied in this paper should be particularly relevant in the context of the eurozone business cycle.

Understanding the implications of structural asymmetries also matters for the design of macroeconomic policies. As our analysis demonstrates, in the long-term, imbalances between two trading partners are a natural consequence of diverging economic structures. In our model economy, persistent financial imbalances between two financially integrated regions necessarily emerge if the two blocks are asymmetric and the magnitude of these long-term imbalances increases with the degree of cross-country heterogeneity. The extent to which financial imbalances are desirable depends on whether they can be justified by economic fundamentals and our contribution to this debate is to formalize the link between structural asymmetries and imbalances both in the short and long-run.

In our environment, the key assumption is that the ease at which contracts can be enforced affects the functioning of credit markets by exacerbating the asymmetric information problem inherent to credit transactions. Given that the eurozone is a predominantly bank-based financial system, and given the body of evidence suggesting that legal systems across the monetary union are a major source of cross-country heterogeneity, this paper highlights the case of frictions impairing the functioning of credit markets. Of course, this does not mean that other sources of cross-country heterogeneity are not relevant. Additional candidate explanations complementary to ours for instance include the case of structural asymmetries resulting from differences in fiscal policies (e.g., Gourinchas et al. 2016), differences in labor market structures, or differences in expectations about future incomes (e.g., Hoffmann et al.

2014; Siena 2014).

Regardless of the particular source of heterogeneity that is considered, the more general point of this paper is that persistent financial imbalances between two financially integrated regions that are subject to common shocks will necessarily emerge if the two blocks are asymmetric, and the magnitude of these long-term imbalances critically depends on the degree of cross-country heterogeneity. While discussing all potential sources of structural asymmetries is beyond the scope of the present paper, we hope that our framework will serve as a useful benchmark to evaluate other explanations that have not yet been studied in the literature.

9 References

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10 Appendix A

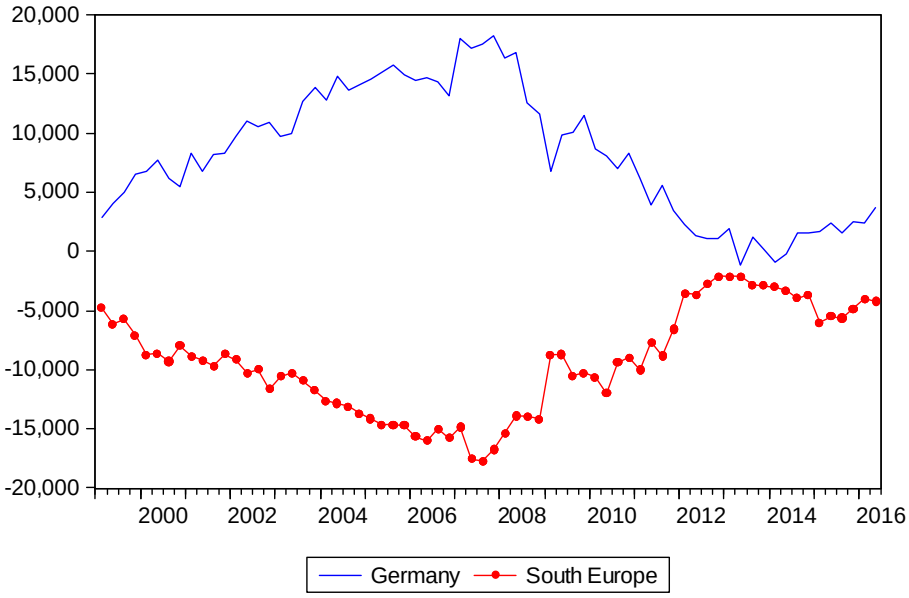

Figure 1: Trade balance Germany and South Europe vs. euro zone in mio €. South Europe consists of Portugal, Spain and Italy.

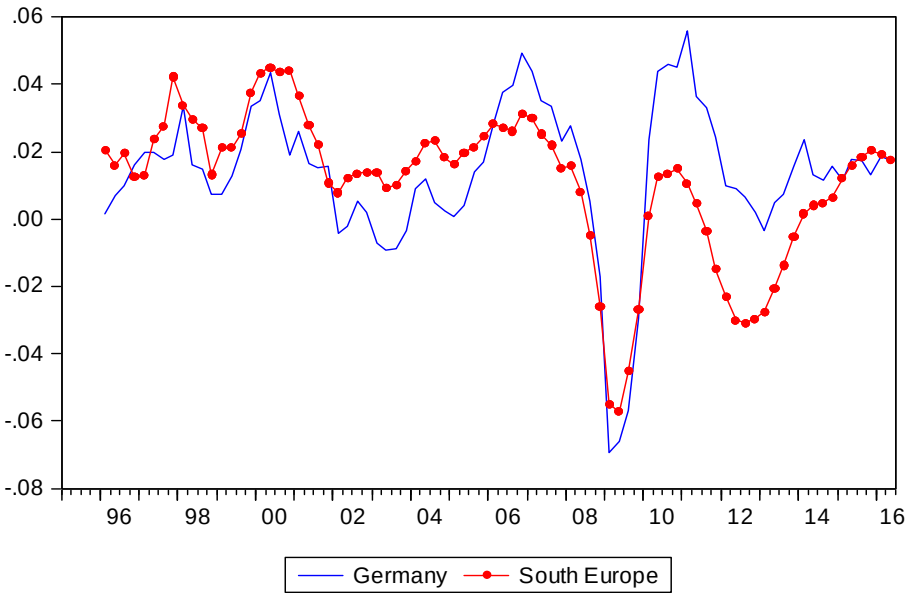

Figure 2: Year-over-year change in output, quarterly data. South Europe consists of Portugal, Spain and Italy.

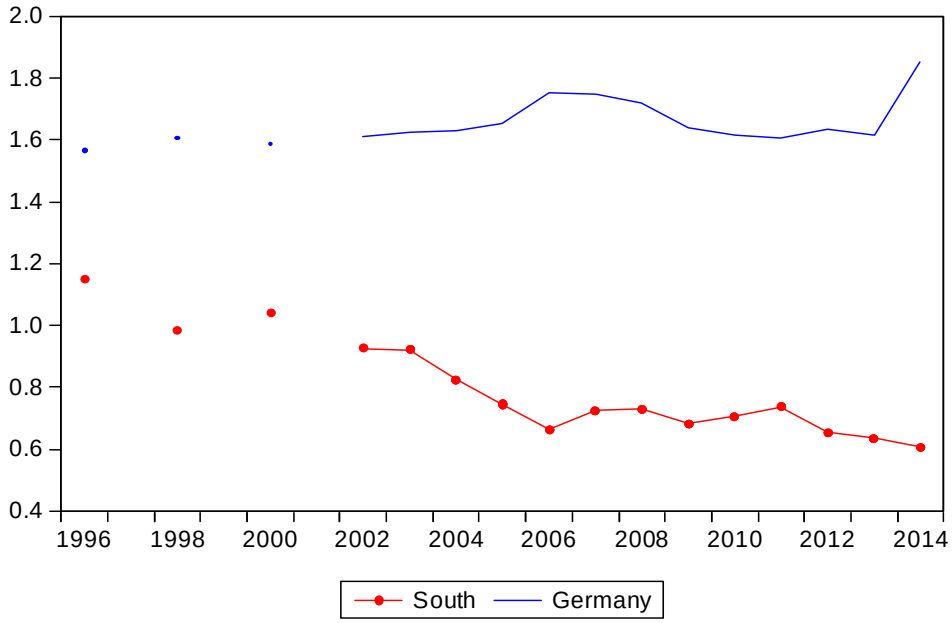

Figure 3: Rule of law index. Weighted average of Italy, Portugal and Spain for the South.

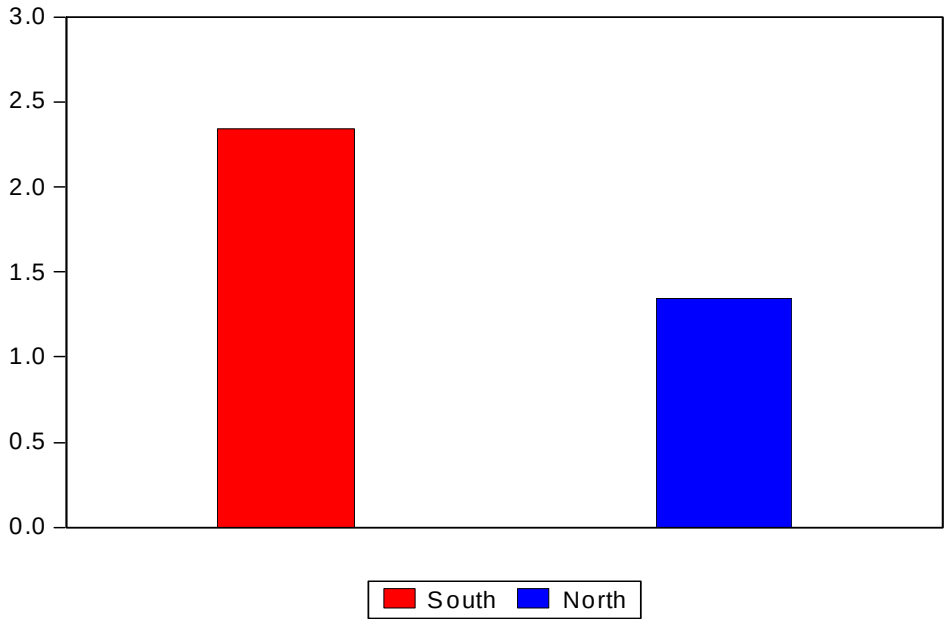

Figure 4: Loan to output ratio. South Europe consists of Portugal, Spain and Italy.

11 Appendix B: Data description

Variable	Data description	Data source
Trade balance (tb)	Trade in goods by broad economic categories with Eurozone.	Statistical Office of the European Communities.
Real GDP (y)	Mio of chained 2010 euros.	Statistical Office of the European Communities.
Rule of law index (μ)	Proxy for quality of contract enforcement.[16]	World Bank/NRGI /Brookings.
Loans (l)	Loans to Non-financial corporations. adjusted for sales and securitization.	ECB.
Deposit rates (r_D)	New business, maturity less than a year Non-financial corporations, Households and NPISHs.	ECB
Lending rates (r_L)	New business, maturity less than a year Loans to non-financial corporations.	ECB
	Real rates computed using the Harmonized index of consumer prices(overall index).	ECB

[16] The rule of law index captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

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