Structural asymmetries and financial imbalances in the eurozone

Ivan Jaccard and Frank Smets*

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Abstract

This study investigates whether the dynamics and magnitude of financial imbalances observed in the eurozone could be explained by differences in intermediation technologies. In a two-country model in which capital can flow across borders through intermediaries, this mechanism generates procyclical net capital inflows in the region where the technological constraint is relatively more severe. As in the data, consumption and hours worked are more volatile and the trade balance countercyclical in the region endowed with the relatively less productive intermediation technology. Structural reforms aimed at improving the financial intermediation process reduce the welfare cost of business cycle fluctuations in the more constrained region and increase long-term consumption both at home and abroad.

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Extended Abstract

This study starts by documenting a series of stylized facts describing the correlation between various indicators of financial structure and the main business cycle regularities observed in the eurozone. The available evidence suggests that the rule of law, which is a proxy for a country's legal structure, is correlated to the average size of trade deficits or surpluses observed in 11 eurozone economies over the period 1996-2013. Moreover, aggregate consumption is on average more volatile and the trade balance more countercyclical in countries where the rule of law is weaker.

One potential explanation for the empirical facts documented in this paper is that the legal system of a country could contribute to financial imbalances by interfering with capital allocation decisions. In particular, the fact that the ratio of non-performing loans or the number of days required to enforce a contract is generally higher in eurozone economies in which the rule of law is weaker suggests that the legal structure of a country could affect the efficiency of its financial intermediation system.

The objective of this study is to evaluate this hypothesis by developing a dynamic general equilibrium model in which structural asymmetries across regions, which take the form of differences in financial intermediation technologies, are the main drivers of financial imbalances. This mechanism aims to capture the idea that a weaker legal structure affects the productivity of the financial intermediation system, by increasing the number of days and procedures required to enforce contracts for instance.

If differences in financial structure are the only source of heterogeneity, in the long-term, this mechanism generates a trade deficit in the region where the technological constraint is relatively more severe. Moreover, our framework can reproduce the procyclicality of net capital inflows and the higher consumption volatility observed in southern European economies. By amplifying lending cycles, our main result is that this particular source of cross-country asymmetry increases the welfare cost of business cycle fluctuations in the region that experiences procyclical net capital inflows.

If differences in the structure of financial intermediation across eurozone economies are the consequence of dissimilar legal structures, these asymmetries are likely to generate imbalances that could be very persistent. Our results suggest that structural reforms aimed at improving the quality of the financial intermediation process in the more constrained region could bring significant welfare gains. In our environment, a better financial intermediation system not only reduces the procyclicality of net capital inflows in the South but also raises average consumption levels in both regions.

1 Introduction

In Europe, the financial crisis has put the spotlight on the role played by financial imbalances within a currency union composed of heterogeneous countries. As illustrated by Figure 1, the introduction of the common currency was followed by a marked divergence in intra-euro area trade balances between surplus and deficit countries. The financial crisis triggered a sharp reduction in trade deficits in many southern European economies and a corresponding decline in trade surplus in northern eurozone countries, such as Germany. At the same time, while trade balances between northern and southern European economies tend to move in opposite directions, business cycle fluctuations across the major deficit and surplus countries have remained highly synchronized, even throughout the crisis period (see Figure 2).

Episodes of build-up in financial imbalances have been observed in many countries at many different point in times and have always been the subject of intense debates in both academic and policy circles. In this respect, the creation of the eurozone provides a unique laboratory to shed light on the structural determinants of financial imbalances within a group of countries, which while heterogeneous, share a common currency. If monetary policy is common, and in the absence of exchange rate fluctuations, how do structural differences across countries affect capital flows? What determines the cyclicality of financial imbalances? And what are the welfare implications of capital flows within a group of integrated trading partners?

This study addresses these questions by focussing on the role played by the financial intermediation process in explaining cross-country imbalances. The concern that differences in financial structure could be a major source of cross-country heterogeneity in Europe was documented in the early stages of the creation of the common currency. In Cecchetti (1999) for instance, differences in financial structure across European economies are attributed to their dissimilar legal structure. This argument, which also draws on the work of La Porta et al. (1997, 1998), rests on a series of empirical facts that demonstrate the impact of the legal system of a country on the structure of financial intermediation.

Following this literature, this study starts by documenting a series of stylized facts describing the correlation between various indicators of financial structure and the main business cycle regularities observed in the eurozone. The available evidence firstly shows that the rule of law, which is a proxy for countries' legal structure, is correlated to the average size of trade deficits or surpluses observed in 11 eurozone economies over

the period 1996-2013 (see section 2 and Figure 4). While only suggestive, the available evidence therefore suggests a link between the magnitude of financial imbalances and differences in legal structure. Moreover, the fact that aggregate consumption is on average more volatile in countries where the rule of law is weaker (see Figure 5) suggests that the legal structure of eurozone countries is also correlated with business cycle characteristics. Finally, as observed in the case of emerging market economies (e.g., Aguiar and Gopinath 2007), the volatility of consumption is generally higher in countries exhibiting strongly countercyclical trade balances (see Figure 3).

In section 2, we show that differences in rule of law across eurozone economies are likely to capture structural factors that affect the financial intermediation process. First, the strong negative relationship between rule of law indicators and ratios of non-performing loans (see Figure 6) suggests that legal structure indicators correlate with factors that affect the efficiency of financial intermediation. Moreover, bank lending rates to the non-financial sector are on average higher in countries where the rule of law is weaker (see Figure 8). Finally, as suggested by the correlation between the rule of law index and the number of days required to enforce a contract (see Figure 7), differences in rule of law across countries are also capturing institutional factors that are likely to affect the financial intermediation process.

One potential explanation that could rationalize these facts is that southern eurozone economies are endowed with less productive financial intermediation technologies, which could be due to factors affecting the efficiency of financial intermediation such as the legal system. The trade deficits, or capital account surpluses, observed in these economies could reflect optimal decisions by investors to sell domestic capital abroad rather than entrusting domestic intermediaries with the task of capital allocation. By increasing the accumulation of net foreign assets in economies endowed with more efficient intermediation structures, this mechanism could potentially explain the distribution of financial imbalances observed in the eurozone.

In section 3, we explore this mechanism formally by developing a two-country general equilibrium model in which capital can flow across borders through financial intermediaries. To simplify the analysis, we divide the eurozone in two country blocks, the North and the South, and given the particular financial architecture of the euro area economy, we address this question in a framework that departs from the existing literature on business cycles in two-country models with complete markets in several respects. First, given that in the eurozone about 80% of firm financing comes from the banking sector, we develop a model in which the allocation of savings is exclusively un-

dertaken by financial intermediaries. Second, to keep the theoretical model as simple as possible, we develop a model in which financial imbalances are determined by changes in net sales or purchases of a capital good that can be traded across borders. This approach allows us to analyze the determinants of financial imbalances by focussing on the capital account, which, from the balance of payment identity, can then be used to determine the magnitude and dynamics of intra-euro zone trade balances.

The primary role of financial intermediaries in our economy is to collect capital from the domestic household and then to decide which fraction to allocate to the domestic non-financial sector and which fraction to send abroad. In each country block, the financial sector produces a final capital good, which we refer to as financial services, by assembling domestic capital, capital obtained from the international capital market and hours worked. This final capital good, which takes one period to be assembled, is then rented to the domestic non-financial sector at an interest rate reflecting equilibrium conditions between the amount that the financial sector is willing to lend and the quantity demanded by firms in the non-financial sector.

In the artificial economy, cross-country heterogeneity in the structure of financial intermediation is represented by differences in production technology across economies. Technological differences in the financial intermediation process aim to capture the idea that a larger share of resources needs to be allocated to labor intensive tasks, such as monitoring or time spent enforcing contracts, in financial systems that are endowed with weaker legal structure. In our environment, these technological factors affect the financial intermediation process by altering the labor productivity of the financial sector. Since financial intermediation is the only intertemporal smoothing technology available in the economy, this technological constraint leads to lower levels of lending by intermediaries, and hence reduces output in the more constrained region.

If differences in financial structure are the only source of heterogeneity, in the long-term, this mechanism generates a trade deficit in the region where the technological constraint is relatively more severe. This result can be understood by examining the intertemporal trade-off faced by profit maximizing financial intermediaries when deciding how to allocate domestic capital between the domestic sector and the international capital market. While the payoff from selling capital abroad is instantaneous, producing financial services for the domestic economy requires time and labor input. The intertemporal trade-off comes from the fact that, on the one hand, selling capital abroad increases profits in the short-run but lowers the quantity of capital available to produce financial services, and as a result profits in the future. By contrast, the deci-

sion to increase production of financial services today lowers revenues in the short-term but increases the stock of financial services and hence profits in the long-term. The key is that the payoff from accepting higher costs today in exchange for higher profits in the future crucially depends on the financial intermediation technology available in the economy. In an economy endowed with a less productive technology, the higher costs generated by factors such as the country's legal structure, for example, reduce the payoff from operating the intermediation technology available at home and increases the relative payoff from selling domestic capital abroad.

In our environment, the steady state trade deficit in the constrained region, and corresponding surplus abroad, is therefore the product of a profit maximizing decision. Since in each country domestic intermediaries are owned by the domestic representative agent, this result can be understood as the outcome of an intertemporal choice between consumption today and higher income in the future. The novel insight is that this decision depends on the financial intermediation technology available in each economy. Our theory therefore predicts that countries endowed with less productive intermediation technologies, which in our model is the only instrument available to achieve intertemporal smoothing, will end up selling domestic capital on the international market to increase consumption. The consequence is that these economies will need to borrow from the rest of the world to finance higher levels of consumption and will therefore have to run a trade deficit, or a capital account surplus, in the long-term.

By reducing the potential for consumption smoothing in economies endowed with weaker intermediation structures, this mechanism also provides a potential explanation for the higher consumption volatility observed in southern eurozone economies. As we discuss in section 5, differences in intermediation technologies also reproduce the facts that hours worked are generally more volatile and the trade balance more countercyclical in the South. These empirical facts can be explained in a model in which common technology shocks across the two country blocks are the only source of business cycle fluctuations. While introducing more shocks would increase the number of degrees of freedom, the assumption of common shocks can be justified by the fact that, at business cycle frequency, the correlation between output fluctuations in northern and southern eurozone economies is higher than 0.9 over the period from 1996 to 2014 (see Figure 9). Together with the high degree of business cycle synchronization, the divergence in trade balances observed in the eurozone can therefore be explained by common shocks.

Section 6 studies the welfare implications of financial imbalances by focussing on the impact of cross-border capital flows on the cost of business cycle fluctuations (e.g.,

Lucas 2003). Our main finding is that this mechanism generates business cycle fluctuations that are more costly in the region where the technological constraint is relatively more severe. In our environment, the cyclical behaviour of intra-euro area trade balances observed in the data is reproduced by generating procyclical net capital inflows in southern eurozone economies, and countercyclical net capital inflows in the North. Procyclical net capital inflows in the South implies that the region's trade deficit must be reduced during periods of recession, precisely when the marginal utility to consume is highest. By amplifying lending cycles and consumption volatility, this mechanism exacerbates the welfare cost of business cycle fluctuations in the more constrained region. For agents living in the North, by contrast, the asymmetry between financial sectors generates countercyclical net capital inflows that reduce the welfare cost of business cycle fluctuations by helping agents in this region to better self-insure against shocks.

Relative to the benchmark IRBC model (e.g., Backus, Kehoe and Kydland 1992, 1995), we introduce frictions in international asset markets (Cole 1988, Baxter 1995, Baxter and Crucini 1995, Kollmann 1996, Arvanitis and Mikkola 1996, Boileau 1999, Heathcote and Perri 2002) by assuming that a financial sector is needed to channel deposits from households to the non-financial sector and that capital can flow across borders only through financial intermediaries. Following King and Plosser (1984), Goodfriend and McCallum (2007) and van den Heuvel (2008), the financial industry produces financial services by operating a production technology that requires different inputs. Relative to the standard neoclassical growth model (e.g., Kydland and Prescott 1982, King, Plosser and Rebelo 1989, King and Rebelo 1999), the introduction of intermediaries that need one period to produce financial services affects the model propagation mechanism by generating fluctuations in the shadow price of financial services. In our environment, this propagation mechanism depends on the dynamics of asset prices, and is amplified by combining habit formation with capital adjustment costs (e.g., Jermann 1998, Jaccard 2014). By amplifying the effects of structural asymmetries, this mechanism increases the volatility of cross-border capital flows and brings the model into closer conformity with the data.

While in our environment heterogeneity in financial structure is the most important quantitative source of financial imbalances, the lower consumption volatility and trade surplus observed in the North are in part explained by differences in attitude towards risk. As in Fogli and Perri (2015), the magnitude of financial imbalances therefore depends on agents' precautionary motives and higher savings in the North are in part channeled into foreign assets. Relative to Mendoza et al. (2009a, 2009b),

our mechanism focuses on technological constraints rather than factors affecting countries' capacity to borrow. In the eurozone, the fact that countries with weaker rule of law are also countries where the largest deficits are observed suggests that these asymmetries are unlikely to capture differences in borrowing constraints. Finally, an important implication of our mechanism is that it generates differences in factor intensity across country blocks, as weaker legal structures in the more constrained region force intermediaries to spend resources on labor intensive tasks. As suggested by the empirical facts documented in Niepmann (2013), in our economy, cross-border capital flows therefore arise from differences in financial intermediation efficiencies and differences in relative factor intensities across countries.

2 Data description

The objective of this section is to document the main commonalities and specificities observed in the eurozone by presenting a series of stylized facts. Table 1 reports HP-filtered standard deviation of output for 11 euro zone countries (see Appendix A for a description). The HP-filtered standard deviation of consumption, investment and hours relative to output, where all variables are expressed in logarithms, which are denoted σ_c/σ_y, σ_N/σ_y, σ_x/σ_y respectively, is reported in columns two to four. The fifth column reports for each country the correlation between the logarithm of real output, $\log(y_t)$ and the trade balance, tb_t.

The first striking empirical regularity that emerges from the statistics presented below is that there are important differences in consumption volatility across euro area economies. Relative to output, consumption volatility is particularly high in Portugal, Spain, Ireland and Greece, while it is significantly lower in countries like Austria and Germany. As shown in column 5, the European business cycle is also characterized by significant differences in the cyclicality of the trade balance. The correlation between output and the trade balance is positive and particularly high in Austria and Germany. In contrast, the trade balance is strongly countercyclical in southern European economies such as Greece, Spain and Portugal.

Figure 3 in the appendix shows the relationship between consumption volatility and the cyclicality of the trade balance. As observed in the case of emerging market economies (e.g., Aguiar and Gopinath 2007), in the eurozone, the volatility of consumption is generally higher in countries exhibiting strongly countercyclical trade balances. A countercyclical trade balances implies that the trade deficit in these countries wors-

ens during boom periods and improves during recessions and therefore that net capital inflows are procyclical. By contrast, countries such as Germany and Austria where the trade balance is procyclical, reduce their trade surplus during periods of recessions, which implies that net capital inflows are countercyclical in these economies.

TABLE 1: EURO AREA 1996Q1-2014Q3

	σ_y	σ_c/σ_y	σ_N/σ_y	σ_x/σ_y	$\rho(tb,y)$
	(1)	(2)	(3)	(4)	(5)
Austria	1.34	0.47	0.63	2.9	0.67
Belgium	1.01	0.54	0.85	2.87	0.09
Finland	2.01	0.66	0.6	3.36	0.32
France	0.99	0.73	0.73	3.93	-0.06
Germany	1.63	0.41	0.66	3.17	0.7
Greece	2.1	1.31	0.86	4.5	-0.6
Ireland	2.53	0.91	1.14	3.75	-0.25
Italy	1.3	0.77	0.62	2.85	0.4
Netherlands	1.39	0.74	0.76	3.06	0.41
Portugal	1.2	1.28	1.1	4.37	-0.5
Spain	1.09	1.19	1.25	3.57	-0.69

Table 2 below reports the average trade balance to output ratios (see column 6) for the 11 euro zone countries under study as well as series of measures that have been used in the literature as proxies for the efficiency of financial structures or the degree of financial development. A detailed description of the data source is provided in Appendix A. Column 7 reports the average value of the rule of law index computed by the World Bank for the period 1996-2013. This index captures perceptions of the extent to which agents have confidence and abide by the rules and provides a measure of the ease at which contracts can be enforced in different countries. Column 8 reports the average bank lending rates to non-financial corporations and refers to new businesses with a maturity of less than a year and amounts smaller than or equal to 1 mio. Given that in the euro area, the vast majority of non-financial corporations are composed of small and medium enterprises (about 99% of non-financial corporations), we choose to use interest rates on small loans, since loans less than or equal to 1 mio are the main source of financing for SMEs. Column 9 is the average ratio of non-performing loans to total gross loans computed by the World Bank. Finally, column 10 reports the average number of days required to enforce a contract in the 11 euro zone economies under study.

TABLE 2

	Trade bal. output rat. (6)	Rule of law index (7)	Bank lend. rates NFCs (8)	Non-perf. loans (9)	Days to enforce (10)
Austria	1.6	1.85	3.4	2.5	397
Belgium	1.2	1.3	3.5	2.7	505
Finland	2.1	1.9	3.6	0.5	302
France	0	1.4	3.5	4.3	390
Germany	3.8	1.6	4.3	3.9	396
Greece	-8.7	0.7	5.9	10.9	957
Ireland	10.9	1.6	4.8	7.4	552
Italy	0.3	0.5	4.3	8.9	1254
Netherlands	7.7	1.8	3.8	2.3	514
Portugal	-7.1	1.1	6.3	4.0	563
Spain	-0.1	1.2	4.6	1.9	514

Potential sources of cross-country heterogeneity

In the literature initiated by the creation of the single currency, differences in financial structure were identified as one of the most important causes of cross-country heterogeneity. According to Cecchetti (1999) for instance, differences in financial structures are the proximate cause for national asymmetries in the monetary policy transmission mechanism. When it comes to the determinants of this heterogeneity, the evidence reported by Cecchetti suggests that differences in legal structures could play an important role. As established by the work of La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997, 1998), the structure of finance in a country depends on the rights accorded to shareholders and creditors. The structure of financial intermediation is therefore a product of the country's legal structure. As argued by Danthine, Giavazzi, Vives and von Thadden (2000), if these disparities in legal structure depend on country's historical heritage, they are likely to generate differences in the structure of financial intermediation that could be very persistent.

As shown by Figure 4, one striking feature of the statistics presented in Table 2 is the strong positive correlation between the rule of law indicator and the trade balance to output ratio (column 6 and 7) that is observed in the euro area. Countries where the rule of law is weaker are on average more likely to run a trade balance deficit than countries where contracts can be more easily enforced and where agents are more

confident in the rules of society. Moreover, as shown in Figure 5, the standard deviation of consumption, relative to output, is also negatively correlated with the rule of law index. As illustrated by Figure 6 and 7, in the main euro zone economies, we can observe a strong correlation between the rule of law index and broader indicators of financial efficiency such as the ratio of non-performing loans or the number of days required to enforce a contract, which suggests that the rule of law index could also capture institutional differences that are likely to affect the financial intermediation process.

Comparison with Backus et al. (1994)

Relative to the stylized facts reported by Backus, Kehoe and Kydland (1994), an interesting difference is that the sign of the output trade balance correlation in Germany and Finland has changed over time. The Table below reports this correlation for various subperiods. As reported by Backus et al. using data until the beginning of the 1990s, the output trade balance correlation is negative in both Finland and Germany in the pre-1991 sample. By contrast, this correlation is positive for the 1991-2013 sample period and is highest from 1999 to 2009, which corresponds to the euro area period excluding the sovereign debt crisis episode.

	Before 1991q1	1991q2-2013q2	1995q1-2013q2	1999q1-2009q4
Finland	-0.58	0.18	0.25	0.36
Germany	-0.23	0.27	0.46	0.50

For Germany, one natural explanation is that the German reunification has been an important structural change. The structural changes brought about by the banking crisis of the early 1990's could also potentially explain why this relationship has changed in Finland.

Aggregate statistics

To simplify the theoretical analysis, we now divide the countries listed in Table 1 and 2 into two different groups, namely the North and the South. This classification is based on the value of the rule of law index reported in Table 2, which as discussed above provides a measure of the quality of financial intermediation structures in the two country regions. Greece, Italy, Portugal and Spain are the four countries with the lowest rule of law index and are included in the South, which leaves Austria, Belgium,

Finland, France, Germany, Greece and the Netherlands in the North.[1]

TABLE 3: AGGREGATE 1996Q1-2014Q3

	σ_y	σ_c/σ_y	σ_N/σ_y	σ_x/σ_y	$\rho(tb,y)$	$E(tb/y)$
	(1)	(2)	(3)	(4)	(5)	(6)
North	1.30	0.45	0.65	3.09	0.63	2.6
South	1.10	0.85	0.83	3.15	-0.2	-1.3

The statistics shown in Table 2 summarizes the main source of business cycle heterogeneity observed across the two country blocks. On average, in the euro zone, consumption and hours worked are significantly more volatile in the South. Moreover, as indicated by the negative correlation between output and the trade balance, net capital inflows are on average significantly more procyclical in the South than in the North, where the trade balance is strongly procyclical. Finally, while northern European economies have a stronger rule of law and tend to run trade surpluses, countries in the South are on average trade deficit countries.

3 The model

The economy is composed of two representative countries that are linked by an international capital market that gives rise to cross-border capital flows between financial sectors. International markets are incomplete and each domestic economy is composed of a representative agent, a financial intermediary, and a representative firm. Lending and borrowing of capital between the two financial intermediaries is the only source of trade. International linkages between the two financial sectors are introduced by assuming that in each country, financial intermediation requires a capital good that is produced abroad. The imperfect substitutability between domestic and foreign capital gives rise to an optimal portfolio allocation decision between capital collected from the domestic household and capital obtained on the international capital market. The financial services produced by the financial intermediaries are then rented to firms in the final good sector.

[1] Given that for Ireland times series since 1996Q1 are not available, Irish data are not included in the aggregate statistics reported below.

3.1 The competitive equilibrium

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. The market structure is similar across country blocks. Differences in structural parameters across the two blocks will be the only source of cross-country heterogeneity. Technology and preferences are consistent with balanced growth and stationary variables are denoted using capital letter. Small letters are used for detrended variables and the deterministic growth rate along the balanced growth path is denoted γ. Since the market structure across the two blocks is identical, we focus the analysis on the Northern economy.

The final-goods producing sector in the North

The optimization problem of the firm is static and its objective is to maximize total profits, π_F, by optimally choosing the number of hours worked to hire from the representative agent, N_F, and the quantity of financial services, y_L, that is obtained from the financial sector, where r_L is the lending rate. The final output good of the firm, which is denoted y, is produced via a Cobb-Douglas production function:

$$y_t = A_t y_{Lt}^{\alpha} N_{Ft}^{1-\alpha}, \tag{1}$$

where α is the capital share. The state of technology, which is denoted A, and which is common across countries, is subject to random disturbances that capture the effects of aggregate supply shocks. Managers in the final-goods producing sector maximize profits

$$\max_{N_{Ft}, y_{Lt}} \pi_{Ft} = y_t - w_t N_{Ft} - r_{Lt} y_{Lt}, \tag{2}$$

subject to (1), and taking as given the exogenous state of technology, which evolves according to the following stochastic process:

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_{At}, \tag{3}$$

The financial intermediaries

The key assumption is that the production of financial services is determined by a production function that relates the quantity of output that financial intermediaries can produce to factors of production. The quantity of new loans that is supplied by

the financial sector, *i.e.* $\gamma y_{Lt+1} - (1-\delta_L) y_{Lt}$, cannot exceed a fraction μ of the financial intermediary's capital stock, k :

$$\gamma y_{Lt+1} - (1 - \delta_L) y_{Lt} \leq \mu_t k_t, \tag{4}$$

where μ is the financial multiplier.

The financial intermediary capital stock has a domestic and a foreign component:

$$k_t = (d_t - b_t)^{\xi} \widetilde{b}_t^{1-\xi} \tag{5}$$

The capital deposited by the domestic household in the domestic financial sector is denoted d, and b is the amount that the domestic financial sector invests abroad. $d - b$ is therefore the share of domestic capital that is allocated to the domestic economy. The quantity of capital that the domestic financial intermediary receives from abroad is denoted $\widetilde{b}$, where $0 \leq \xi \leq 1$ is a technology parameter that measures the degree of financial openness.

The financial multiplier, μ, is endogeneized by assuming that the production of financial services depends on the number of hours worked that loan officers spend allocating the production of financial services to prospective borrowers. The number of hours worked by loan officers is denoted, N_B. To keep the analysis tractable, we assume that the interaction between μ, k and N_B is given by the following relationship:

$$\mu_t = \left(\frac{N_{Bt}}{k_t} \right)^{1-\phi} \tag{6}$$

where $0 \leq \phi \leq 1$ is a parameter that measures the efficiency of financial intermediation.[2] The financial intermediation process is less efficient the lower the value of ϕ. A less efficient financial sector needs a higher number of loan officers per unit of capital in order to produce a given quantity of financial services and this lower productivity affects the steady state quantity of financial services that the intermediary can produce. As will be discussed in section 4, the value of the financial multiplier and therefore of the quantity of financial services that will be produced critically depends on the parameter ϕ, which provides a measure of the economy's financial intermediation structure.

Revenues of the financial intermediary consist of two distinct components. First, the financial intermediation activity generates a revenue from lending y_L to the domestic

[2] This implies a production function with capital and labor as inputs that follows a Cobb-Douglas form.

firms, where r_L is the interest rate on loans. Second, the domestic bank receives a revenue from selling its domestic capital abroad, *i.e.* $p_B b$, where p_B is the price at which it sells domestic capital to the foreign financial intermediary.

The costs associated with loan production are firstly given by the remuneration of household capital, d, that the domestic household deposits with the financial sector, where the deposit rate is denoted r_D. The production of financial services requires labor and w is the wage rate paid to workers in the financial sector. The cost of obtaining foreign capital is given by $\widetilde{p}_B\widetilde{b}$, and $\widetilde{p}_B$ is the price of foreign capital that is paid to the foreign financial intermediary. So at periods t, profits in the financial sector are given as follows

$$\pi_{Bt} = r_{Lt}y_{Lt} + p_{Bt}b_t - w_t N_{Bt} - r_{Dt}d_t - \widetilde{p}_{Bt}\widetilde{b}_t, \tag{7}$$

Each period, bank managers optimally choose production factors and the level of production to maximize shareholder value, which is given by the infinite discounted sum of future cash-flows:

$$\max_{y_{Lt+1}, d_t, b_t, \widetilde{b}_t, N_{Bt}} E_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t}{\lambda_0} \pi_{Bt},$$

subject to constraints (4) to (7), where $\beta^t \frac{\lambda_t}{\lambda_0}$ is the stochastic discount factor of the domestic representative agent, who owns the financial intermediary.

Households

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

$$\pi_{Tt} + w_t N_{Bt} + w_t N_{Ft} + r_{Dt}d_t = c_t + x_t, \tag{8}$$

and the representative agent divides his or her time between leisure activities, L, hours worked in final goods-producing sector, N_F, and time spent working as a loan officer in the financial intermediation sector, N_B :

$$L_t = 1 - N_{Bt} - N_{Ft}, \tag{9}$$

where agents total labor income is denoted $wN_B + wN_F$.

Total income also consists of revenue from depositing capital in the banking sector, $r_D d$. The representative agent owns the domestic intermediary and the final goods-

producing firms and total dividend income is denoted π_T. Total revenue is allocated between consumption expenditures, c, and the amount invested in capital deposited with the financial intermediary, which we denote x.

The law of motion governing the accumulation of capital is subject to adjustment costs:

$$\gamma d_{t+1} = (1-\delta_D)d_t + \left(\frac{\theta_1}{1-\epsilon}\left(\frac{x_t}{d_t}\right)^{1-\epsilon} + \theta_2\right) d_t, \tag{10}$$

where ϵ is the parameter controlling the supply elasticity of household capital, and where θ_1 and θ_2 are parameters that are calibrated to ensure that adjustment costs have no impact on the deterministic steady state of the economy (e.g., Baxter and Crucini 1993, Jermann 1998). This assumption implies that adjustment costs will not generate any direct resource costs and will only affect the elasticity of the investment to capital ratio to changes in Tobin's Q. Finally, we assume that agents' habit stock is slow moving and that its dynamics evolves according to the following law of motion:

$$\gamma h_{t+1} = m h_t + (1-m) c_t \left(\psi + L_t^{\upsilon}\right), \tag{11}$$

where h denotes the habit stock and m is a parameter that governs the speed at which the habit stock depreciates (e.g., Jaccard 2014). The labor supply parameter υ controls the Frisch elasticity of labor supply, while ψ determines the steady state time allocation.[3] The representative household decides optimally how to divide his or her time and how to allocate resources between the two domestic sectors by maximizing lifetime expected utility

$$\max_{c_t, N_{Bt}, N_{Ft}, x_t, d_{t+1}, h_{t+1}} E_0 \sum_{t=0}^{\infty} \beta^t \log\left(c_t(\psi + L_t^{\upsilon}) - h_t\right),$$

subject to constraints (8) to (11).

Market equilibrium

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

$$w, \widetilde{w}, r_L, \widetilde{r}_L, p_B, \widetilde{p}_B, r_D, \widetilde{r}_D, \lambda, \widetilde{\lambda}, q_D, \widetilde{q}_D, q_L, \widetilde{q}_L, \varphi, \widetilde{\varphi}$$

[3] All parameters in the utility function are calibrated to ensure that consumption and leisure are always normal goods.

where q_D and $\widetilde{q}_D$ denote the price of capital in the two regions countries, λ and $\widetilde{\lambda}$ is marginal utility, q_L and $\widetilde{q}_L$ is the shadow price of financial services, φ and $\widetilde{\varphi}$ is the Lagrange multiplier associated with habit accumulation equation, and quantities:

$$y_L, \widetilde{y}_L, y, \widetilde{y}, c, \widetilde{c}, h, \widetilde{h}, x, \widetilde{x}, d, \widetilde{d}, b, \widetilde{b}, N_B, \widetilde{N}_B, N_F, \widetilde{N}_F$$

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

$$A_t y_{Lt}^{\alpha} N_{Ft}^{1-\alpha} + p_{Bt} b_t = c_t + x_t + \widetilde{p}_{Bt} \widetilde{b}_t,$$
$$A_t \widetilde{y}_{Lt}^{\alpha} \widetilde{N}_{Ft}^{1-\alpha} + \widetilde{p}_{Bt} \widetilde{b}_t = \widetilde{c}_t + \widetilde{x}_t + p_{Bt} b_t,$$

for all states, for t=1...∞, and given initial values for the six endogenous state variables $y_L, \widetilde{y}_L, h, \widetilde{h}, d$ and $\widetilde{d}$.

Financial imbalances

In the context of our model, the trade balance or net exports in the North are defined as:

$$tb_t = y_t - c_t - x_t,$$

Similarly, the balance of payment identity can be defined as follows:

$$0 = tb_t + ka_t,$$

where the capital account in the North, which we denote ka_t, records net sales or purchases of assets with the rest of the world

$$ka_t = p_{Bt} b_t - \widetilde{p}_{Bt} \widetilde{b}_t$$

The first component of the capital account, $p_{Bt} b_t$, is the amount of domestic capital that is purchased by foreign investors (or domestic assets sold abroad by the North) and $\widetilde{p}_{Bt} \widetilde{b}_t$ is the amount of foreign capital that is purchased by domestic residents (or foreign assets purchased by the North). A surplus of the trade balance in the North is therefore equivalent to a deficit of the capital account of equal magnitude since in this case investors in the North must be net buyers of foreign assets, *i.e.* $\widetilde{p}_{Bt} \widetilde{b}_t > p_{Bt} b_t$. As will be discussed in section 6, movements in the capital account and in the trade balance can therefore be decomposed into a price effect and a quantity effect.

4 Calibration and results

The structural parameters of the model can be estimated using the aggregate statistics shown in Table 3. The structure of the model allows us to consider three main sources of cross-country heterogeneity. On the household side, differences in attitudes towards risk, which are proxied by the two habit parameters, m in the North and $\widetilde{m}$ in the South, and differences in the cost of adjusting the stock of capital deposited in the banking sector, i.e. ϵ and $\widetilde{\epsilon}$, are the two main sources of demand-side heterogeneity. Differences in financial structure are captured by the two technology parameters in the production function of financial services, which are denoted ϕ and $\widetilde{\phi}$.

These parameters are estimated by selecting six empirical moments that best characterize the heterogeneity observed between the two country blocks. The sources of heterogeneity are then identified by estimating these key structural parameters using a procedure that minimizes the distance between the data and the corresponding theoretical moments. First, the fact that consumption is more volatile in the South than in the North, i.e. 0.85 vs. 0.45, can be exploited to identify the key sources of cross-country heterogeneity. In our environment, consumer's ability to achieve consumption smoothing will be partly determined by the quality of the financial intermediation technology, which is captured by the parameters ϕ and $\widetilde{\phi}$. The difference in consumption volatility between the two country blocks will not only reflect differences in financial structure but will also depend on the two habit formation parameters m and $\widetilde{m}$, which affect the elasticity of intertemporal substitution and therefore the dynamics of consumption.

Second, the fact that hours worked are more volatile in the South (i.e. 0.83 vs. 0.65 in the North) can also be exploited to identify the two habit parameters m and $\widetilde{m}$. With this preference specification, an increase in the intensity of habit formation leads to a reduction in the volatility of the composite of consumption and leisure. The fact that this is in part achieved by reducing the wealth elasticity of labor supply (e.g., Jaccard 2014) implies that the habit parameter will not only be identified by consumption volatility but also by the dynamics of hours worked. Finally, the two capital adjustment costs parameters ϵ and $\widetilde{\epsilon}$ can be identified using the statistics on investment volatility reported in Table 3.

To keep the analysis tractable, we assume that the remaining parameters are identical across country blocks. The production technology of the final output good is homogenous across countries and the first technology parameter α, which represents the output share of the financial intermediation sector, is calibrated to reproduce the

fact that in the euro area as a whole financial intermediation broadly defined represents about one third of total value added.[4] Given the lack of precise estimates on foreign direct investment, the degree of financial openness parameter, ξ, is set to 0.5, which implies an average leverage ratio for the euro area as a whole, *i.e.* $E(\widetilde{b}/d+b/\widetilde{d})$ of about 50%. The subjective discount factor β and the deterministic growth rate, γ, are set to 0.992 and 1.005 respectively, which are standard values used in the literature. The depreciation rates parameters of respectively household capital and financial services, which, in the North are denoted δ_D and δ_L, respectively are both set to 0.025, which implies an annual depreciation rate of capital of 10% (e.g., King and Rebelo 1999).

In both countries, 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 1 in each country block and that agents spend on average 20% of their time on work related activities, which in our model represents hours worked in the non-financial and intermediation sectors. The common factor takes the form of technology shocks in the final good sectors. Setting the shock standard deviation σ_A to 0.008 and the persistence parameter, ρ_A, to 0.979 allows the model to broadly reproduce the HP-filtered volatility of output observed in the two regions.

Results

The loss function is minimized for the following combination of parameter values:

TABLE 4

ϵ	$\widetilde{\epsilon}$	ϕ	$\widetilde{\phi}$	m	$\widetilde{m}$
3.02	4.03	0.81	0.62	0.84	0.5

As illustrated by the results shown in Table 5, the fact that the model is not able to exactly match the volatility of consumption and hours in the North and overstates the steady state magnitude of financial imbalances illustrates that common technology shocks cannot be the only driving force of the eurozone business cycle. At the same time, these results demonstrate that a model in which common shocks are the only source of fluctuations is still able to reproduce some of the most salient features of the cross-country heterogeneity observed in the data. First, it is possible to reproduce the facts that while investment volatility is similar across country blocks, hours worked

[4] See ECB Monthly Bulletin, Table 5.2. Financial intermediation regroups information and communication, finance and insurance, real estate (but not construction), professional business and support services.

and consumption are substantially more volatile in the South. Second, whereas the model is calibrated to match the volatility of consumption, investment and hours, it is still possible to reproduce the direction of net capital flows observed in the data since the model reproduces the sign of the correlation between the trade balance and output observed in the two country blocks. As in the data, the trade balance is countercyclical, and net capital inflows are therefore procylical in the South. This mechanism therefore explains why countries where consumption is more volatile and the trade balance counterycyclical are deficit countries in the long-term. In addition, the fact that the trade balance is more procyclical in the region where output is more volatile is consistent with the facts documented by Hoffmann et al. (2014).

Since the more constrained economy finances consumption and investment by selling capital abroad, this mechanism also generates differences in steady state levels of output. The surplus in the North is achieved by accumulating foreign capital, which is then used to increase production. Relative to the case in which the two blocks are symmetric, the degree of heterogeneity in financial structure that is needed to match the data implies that the northern economy is on average about 1.5 times larger than the southern block.

TABLE 5: MODEL VS. DATA

	σ_y		σ_c/σ_y		σ_N/σ_y		σ_x/σ_y	
	Data	Model	Data	Model	Data	Model	Data	Model
North	1.30	1.29	0.45	0.52	0.65	0.57	3.09	3.09
South	1.10	1.0	0.85	0.85	0.83	0.83	3.15	3.15

	$\rho(tb, y)$		$E(tb/y)$	
	Data	Model	Data	Model
North	0.63	0.99	2.6	4.9
South	-0.2	-0.99	-1.3	-7.0

5 The adjustment to common shocks

In Figure 10 below, the red continuous line shows the impulse response of consumption, c, financial services, y_L, the quantity of capital that is sold abroad, b, and the trade balance, tb in the North to a positive technology shock. The blue dashed line shows the corresponding impulse responses for the southern economy. As shown by the bottom left panel, the quantity of capital that intermediaries in the two blocks sell abroad is the main source of business cycle asymmetry in this model. In response to a positive

technology shock, the quantity that agents in the North sell abroad is larger than the quantity that they receive, and as illustrated by the top right panel, this difference in the dynamics of capital flows leads to a lending boom in the South. This lending boom in turns generates a more persistent increase in consumption (see top left panel) in the South. The smaller magnitude of the lending boom in the North illustrates that during boom periods, the cross-border capital market is used to channel deposits from households in the North to non-financial corporations in the South. Finally, as illustrated by the bottom right panel, the model is able to reproduce the diverging pattern in trade balances observed in the data.

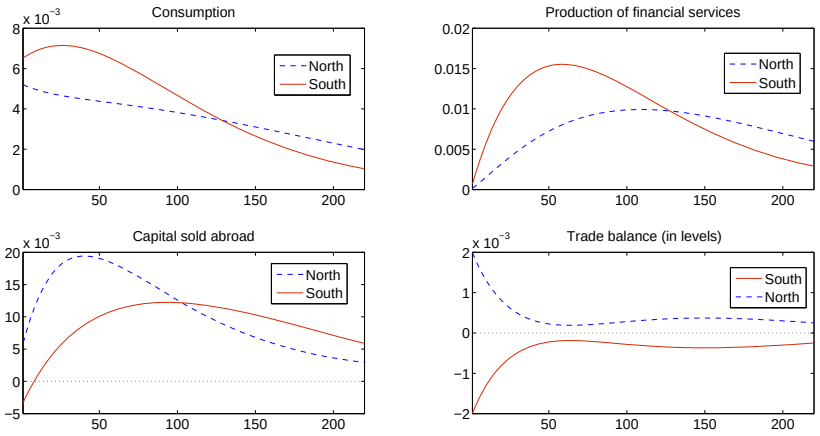

Figure 10: Impulse response to a common technology shock. Except for the trade balance which is shown in levels, all variables are expressed in log deviation from steady state.

A financial accelerator mechanism

Our specification of the production function of financial services, which in the North takes the following form:

$$\gamma y_{Lt+1} - (1 - \delta_L) y_{Lt} \leq \mu_t k_t$$

gives rise to an endogenous amplification mechanism that works through the effect of the shadow price of financial services, q_L, on the demand for production factors. The dynamics of the asset price q_L is characterized by the following optimality condition[5]:

[5]For the southern economy, the shadow price of financial services is given as follows:

$$q_{Lt} = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} \left[(1 - \delta_L) q_{Lt+1} + r_{Lt+1} \right]$$

which expresses the price of the financial sector's stock of financial services as the infinite discounted sum of future lending rates that the financial intermediary will charge to firms, and where $\beta E_t \lambda_{t+1} / \lambda_t$ is the stochastic discount factor of the agent, who is the owner of the financial intermediary.

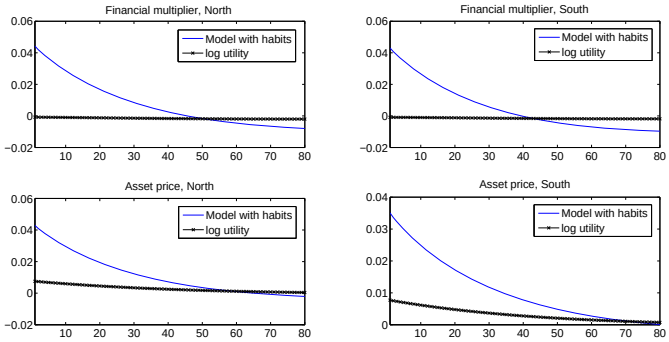

Figure 11: Impulse response to a positive technology shock. Benchmark model vs. model without habits.

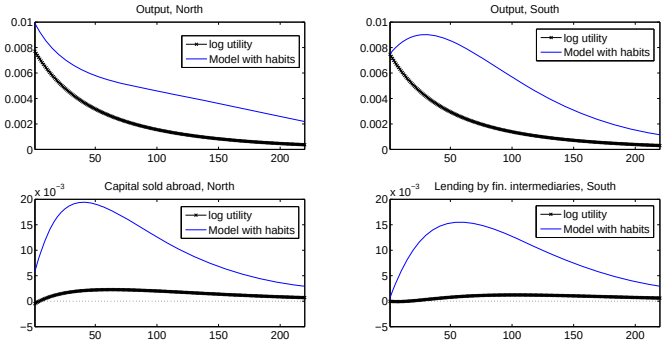

Figure 12: Impulse response to a positive technology shock. Benchmark model vs. model without habits.

Changes in q_L affect the real economy by amplifying the fluctuations in the financial multiplier μ_t, which depends on the quantity of loan officer per unit of capital, N_B/k,

$$\widetilde{p}_{Lt} = \widetilde{\beta} E_t \frac{\widetilde{\lambda}_{t+1}}{\widetilde{\lambda}_t} \left[(1 - \delta_L) \widetilde{p}_{Lt+1} + \widetilde{r}_{Lt+1} \right]$$

chosen by managers in the financial sector. After rearranging terms, the dynamics of the labor to capital ratio is determined by the following optimality condition, which characterizes the financial sector optimal demand for labor:

$$\frac{N_B}{k} = \left(\frac{(1-\phi)q_{Lt}}{w_t}\right)^{1/\phi}$$

This condition illustrates that the intermediary's desired labor to capital ratio, N_B/k, depends on the value of the asset price, q_L, and on the real wage, w. If q_L is sufficiently volatile, a positive shock that raises the value of the stock of financial services can generate an increase in the labor to capital ratio, which increases the value of the financial multiplier, μ. The increase in μ further stimulates lending by the financial sector, which in turn raises production in the final good sector and therefore total output in the economy.

As documented in the asset pricing literature (e.g., Jermann 1998), in standard production economy models, an increase in the volatility of asset prices can be achieved by combining habit formation with capital adjustment costs. To illustrate the quantitative magnitude of this financial accelerator mechanism, Figure 11 compares the impulse responses of $q_L, \widetilde{q}_L, \mu$ and $\widetilde{\mu}$ obtained in the benchmark model with a case in which the effects of habit formation in both countries are switched off by setting $m = \widetilde{m} = 1$. Without habits, as shown in the lower panel of Figure 11, the impact of technology shocks on q_L and $\widetilde{q}_L$ are of several orders of magnitude smaller. If asset prices are not sufficiently volatile, a positive technology shock only has a small impact on the financial multiplier (see the upper panels of Figure 11) because in this case, the effect of the asset price on the labor to capital ratio is offset by the increase in wages triggered by the shock. Without habits, the multipliers μ and $\widetilde{\mu}$ hardly react and this financial accelerator mechanism can no longer amplify the effects of technology shocks.

Figure 12 compares the response of output, capital sent abroad by intermediaries in the North and lending in the South in the benchmark model with a version of the model without habits. As shown by the large difference in dynamics obtained in the two different cases, the role played by this amplification mechanism is quantitatively important. This mechanism also affects the dynamics of output, which becomes less volatile in the model without habits. The lower volatility of asset prices obtained when this propagation mechanism is turned off decreases the quantity of cross-border capital flows. As a result, the response of output in the two regions becomes very similar, which illustrates that in the case of common shocks, cross-border capital flows are the

main source of business cycle asymmetry in this model.

6 What explains the level and the cyclicality of financial imbalances?

The structure of the model allows for many differences in structural parameters. In this section, we study how the following sources of cross-country heterogeneity affect financial imbalances: (i) differences in attitudes towards risk, (ii) differences in adjustment costs, and (iii) differences in financial structure. 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.[6] This property of the model can be exploited to gain intuition into how these different sources of heterogeneity affect the level and the cyclicality of financial imbalances. The level of financial imbalances and the ouput-trade balance correlation obtained in the symmetric case are reported in column 2 of Table 7 and corresponds to the following calibration:

$$\epsilon = \widetilde{\epsilon} = 3.02,\ \phi = \widetilde{\phi} = 0.81,\ m = \widetilde{m} = 0.5$$

Columns 3 to 5 in Table 7 below show the marginal contribution of each of these three sources of cross-country heterogeneity relative to the symmetric benchmark.

Differences in attitudes towards risk

Model 1 (see column 3 in Table 7) reports the model implications in the case in which $m = 0.5$ and $\widetilde{m} = 0.81$ is the only source of cross-country heterogeneity. The results obtained in this case demonstrate that differences in attitudes towards risk could potentially explain the procyclicality of net capital inflows observed in the South. When agents in the North are more risk averse, the model generates a trade surplus in that region and, as reported in Table 7, predicts that net capital inflows in the South should be procyclical, which is in line with what is observed in the data. Intuitively, the case $\widetilde{m} > m$ corresponds to a situation in which agents' elasticity of intertemporal substitution in consumption is lower in the North. By making agents' desire to smooth consumption more pressing in the North, differences in attitudes towards risk generate

[6] Without asymmetries, the assumption that $\xi < 1$ still implies that capital is traded but in this case shocks have no effects on the level or the cyclicality of net capital outflows because $\widetilde{p}_{Bt}\widetilde{b}_t = p_{Bt}b_t$ for all t.

countercyclical net capital inflows in the region where agents are more risk averse, which contribute to reduce consumption volatility. By contrast, since it generates procyclical net capital inflows in the South, the resulting cyclicality of net capital flows increase consumption volatility in that region, which becomes more volatile than in the North when $m < \widetilde{m}$ is the only source of cross-country heterogeneity.

TABLE 7

	Data	Symmetric case	Model 1 $\widetilde{m} > m$	Model 2 $\widetilde{\epsilon} < \epsilon$	Model 3 $\widetilde{\phi} < \phi$
	(1)	(2)	(3)	(4)	(5)
$\rho(tb, y)$	0.63	0	0.99	-0.99	0.99
$\rho(\widetilde{tb}, \widetilde{y})$	-0.2	0	-0.99	0.99	-0.99
$E(tb/y)$	2.6	0	0.13	-0.23	5.0
$E(\widetilde{tb}/\widetilde{y})$	-1.3	0	-0.13	0.23	-7.1

Table 7: $\rho(tb, y)$ and $\rho(\widetilde{tb}, \widetilde{y})$ is the correlation between the trade balance and output in the North and in the South. $E(tb/y)$ and $E(\widetilde{tb}/\widetilde{y})$ is the average trade surplus/deficit in the two regions.

By raising the volatility of marginal utility, the second main effect of an increase in risk aversion for consumers in the North is to strengthen precautionary saving motives. Relative to the symmetric case, this stronger precautionary motive in the North stimulates capital accumulation, which in this environment can be achieved either by accumulating a larger quantity of foreign asset, *i.e.* $\widetilde{b}$ in this case, or by decreasing the quantity of domestic capital that is sold abroad. In the case $m < \widetilde{m}$, the northern economy therefore becomes a net saver and runs a small trade surplus in the steady state.

Differences in capital adjustment costs

Model 2 shows what happens to financial imbalances when we move from the perfectly symmetric case to the case in which higher adjustment costs in the South are the only source of cross-country heterogeneity. As shown by the results reported in column 4, if higher adjustment costs in the South is the only source of heterogeneity, the model generates a surplus in South and a deficit in the North. This result illustrates that the increase in precautionary saving motives obtained within this class of models is due to the combination of habits and adjustment costs (e.g., Jermann 1998). Everything

else equal, a higher degree of adjustment costs or an increase in the intensity of habits increases the volatility of marginal utility. In an open economy, and if differences in habits or adjustment costs are the only source of cross-country heterogeneity, a stronger precautionary motive increases aggregate savings and generates a steady state surplus in the region in which marginal utility is most volatile (e.g., Fogli and Perri 2015).

The final effect on the dynamics of net capital flows can be better understood by decomposing the total effect into a price and a quantity effect. Using the balance of payment identity, the trade balance in the North can be expressed as follows:

$$tb_t = \widetilde{p}_{Bt}\widetilde{b}_t - p_{Bt}b_t$$

Given the assumptions made in section 4, and in particular the assumption of no difference in subjective discount factors, the dynamics of $\widetilde{p}_{Bt}$ and p_{Bt} are almost identical.[7] Without loss of generality we firstly set $\widetilde{p}_{Bt} = p_{Bt}$, and to gain intuition into the main model mechanism, we then linearize this condition around the model's deterministic steady state.[8] Up to a first-order approximation, the dynamics of the trade balance in the North is approximately equal to:

$$\widehat{tb}_t = \frac{p_B\widetilde{b}}{tb}\widehat{\widetilde{b}}_t - \frac{p_B b}{tb}\widehat{b}_t + \frac{\left(\widetilde{b} - b\right)p_B}{tb}\widehat{p}_{Bt} \tag{12}$$

where variables with a hat are expressed in percentage deviation from steady state, and $\widetilde{b}, b, p_B$ and tb denote steady state values. This expression illustrates that variations in the price of capital, $\widehat{p}_{Bt}$, will not affect the dynamics of net capital flows as long as the condition $\widetilde{b} = b$ holds. Therefore, since up to a first-order approximation, the introduction of habits and adjustment costs do not affect $\widetilde{b}$ and b, the dynamics of the trade balance is solely driven by quantities when differences in these two parameters are the only source of cross-country heterogeneity.[9]

Without any significant impact of $\widehat{p}_{Bt}$, the dynamics of capital flows can be explained by the ratio of marginal utilities $\lambda/\widetilde{\lambda}$, which provides a measure of relative "hunger". If, as in the case studied under Model 2, marginal utility in the South is

[7] The parameters $\mu, \widetilde{\mu}$ and $\beta, \widetilde{\beta}$ are similar across country blocks.

[8] All the moments reported in the paper are computed using a second-order approximation using the toolkit developed by Adjemian et al. (2014). A first-order approximation is nevertheless sufficient to illustrate what are the main drivers of trade balance dynamics.

[9] The effects of habit formation and adjustment costs only affect $E(b)$ and $E(\widetilde{b})$ through higher-order terms and have no effects on b and $\widetilde{b}$, which denote steady state values in the case without uncertainty.

more volatile than in the North, a positive technology shock will raise $\lambda/\widetilde{\lambda}$. Intuitively, this generates a trade deficit in the North because consumers will satisfy this increase in relative "hunger" either by selling a larger fraction of their domestic capital abroad, and increase $\widehat{b}_t$, or by accumulating less foreign capital, which leads to a reduction in $\widehat{\widetilde{b}}_t$. Selling domestic capital abroad or reducing foreign capital accumulation allows them to trade future income for current consumption, and if higher adjustment costs in the South were the only source of cross-country heterogeneity, net capital inflows would be countercyclical in that region and procyclical in the North, which is at odd wiht the data.

Differences in financial structure

Model 3 shows what happens to the level and cyclicality of financial imbalances when we move from the perfectly symmetric case to the case in which differences in financial structure are the only source of cross-country heterogeneity. The results shown in column 5 of Table 7 illustrate that this is the key source of heterogeneity that allows the model to reproduce the direction of capital flows as well as the magnitude of financial imbalances observed in the data.

Financial structure and steady state imbalances

Relative to the symmetric benchmark, and as illustrated by the first two rows of Table 8 below, a less efficient financial intermediation system in the South implies a relatively lower steady state quantity of financial services, i.e. $E(y_L)/E(\widetilde{y}_L) > 1$. This reduces the long-run potential of the more constrained region and, relative to the symmetric case, lowers the relative size of the southern economy, *i.e.* $E(\widetilde{y}) < E(y)$. In the steady state, the lower competitiveness of financial intermediaries in the South leads to a reallocation of domestic savings towards the financial sector of the northern countries. The presence of a cross-border capital market allows agents in the South to take advantage of the more efficient technology available abroad by selling a large fraction of their domestic capital stock abroad. Similarly, agents in the North allocate most of the domestic savings to their relatively more efficient domestic financial system and only send a small fraction of domestic capital abroad. In equilibrium, the region where the technological constraint is more severe therefore attracts lower quantities of foreign capital and sends a larger share of domestic savings abroad than its counterpart. The resulting asymmetry in cross-border capital flows, *i.e.* $E(\widetilde{b}) > E(b)$, generates a trade deficit, or capital account surplus, in the region whose financial sector is relatively less developed and a corresponding surplus in the region endowed with the relatively

more efficient intermediation structure.

TABLE 8: STEADY STATE EFFECTS

	Symmetric Case $\phi = \widetilde{\phi} = 0.7$	Diff. Fin. Structure $\phi = 0.81$, $\widetilde{\phi} = 0.62$
$E(y_L)/E(\widetilde{y}_L)$	1	3.0
$E(y)/E(\widetilde{y})$	1	1.4
$E(r_L)/E(\widetilde{r}_L)$	1	0.48
$E(b)/E(\widetilde{b})$	1	0.55
$E(\lambda)/E(\widetilde{\lambda})$	1	0.77

Financial structure and the dynamics of net capital flows

Compared to the results obtained under Model 1 and 2, the main difference is that changes in the price at which countries are trading capital affects the dynamics of net capital flows in the case $\widetilde{\phi} < \phi$. In terms of equation (12), the fact that in this case we have that $\widetilde{b} > b$ implies that the dynamics of the trade balance will be influenced by changes in $\widehat{p}_{Bt}$. In this case, the valuation effects induced by changes in the price at which capital is traded on the international market has a direct effect on financial imbalances, since it affects the value of net sales or purchases of assets registered in the capital account.

As before, it is useful to decompose the final effect into a quantity and a price effect. First, as discussed earlier, the dynamics of b and $\widetilde{b}$ can be linked to the behaviour of marginal utilities $\lambda/\widetilde{\lambda}$, which provides a measure of relative hunger. Like adjustment costs, a less efficient financial intermediation system reduces the potential for intertemporal smoothing and raises the volatility of marginal utility. Since the technological constraint is more severe in the South, in response to a positive shock, marginal utility declines by less in North than in the South. In relative terms, marginal utility of the northern consumers increases, and this increase in relative "hunger" is satisfied by selling a larger fraction of domestic capital abroad, or by reducing the quantity of capital accumulated from abroad. As discussed in the case of Model 1 and 2, without valuation effects, this quantity effect would drive the dynamics of the trade balance, and a positive shock that increased output in the two regions would create a trade deficit in the North, which would be inconsistent with the positive correlation between output and the trade balance observed in this region.

In the case $\widetilde{\phi} < \phi$, the key is therefore that these structural differences in intermediation structure create steady state imbalances that generate valuation effects. Given

that the price of capital, $\widehat{p}_{Bt}$, is procyclical, agents in the North who are net buyers of foreign capital, *i.e.* $\widetilde{b} > b$ when $\widetilde{\phi} < \phi$, pay a higher price to accumulate foreign capital during boom periods. Similarly, consumers in the South who are net sellers of domestic capital, receive a higher price during periods of economic boom. During expansion periods, this valuation effect therefore improves the trade surplus in the North and worsens the trade deficit in the South. Relative to Model 1 and 2, introducing differences in financial structure, which in turn gives rise to steady state differences in cross-border capital flows therefore allows Model 3 to explain why net capital inflows are procyclical in the South.

7 Welfare implications of financial imbalances

This section studies how the direction of capital flows induced by differences in financial structure affects the welfare cost of business cycle fluctuations. As in section 6, the effects of heterogeneity in financial structure are isolated by firstly considering the case of perfect symmetry between the two blocks, which is obtained by setting:

$$\epsilon = \widetilde{\epsilon} = 3.02,\ \phi = \widetilde{\phi} = 0.81,\ m = \widetilde{m} = 0.5$$

Column 2 of Table 8 below reports the volatility of consumption and two measures of the welfare cost of business cycle fluctuations that is generated by the model in this special case. Without asymmetry, as shown by the last two rows of column 2, agents in this economy would be ready to abandon a bit less than 4% of their annual consumption or accept a 5.3% reduction in their annual wage to be able to live in a deterministic world that would not be subject to any business cycle fluctuations.

Column 3 shows what happens to the symmetric allocation when differences in financial structure of the magnitude that we estimated, *i.e.* $\phi = 0.81$ and $\widetilde{\phi} = 0.62$, is the only source of cross-country heterogeneity. As already explained in section 6, a lower degree of financial development in the South generates procyclical net capital inflows in that region and countercyclical net capital inflows in the North. As can be seen by comparing the volatility of consumption in column 2 and 3, everything else equal, a less efficient financial intermediation system in the South makes consumption smoothing more difficult to achieve. Similarly, consumption volatility in the North decreases, and as in the data, the model with differences in intermediation structure can explain why consumption is more volatile in the South than in the North.

Table 8

	(1) Data		(2) Symmetric		(3) $\widetilde{\phi} < \phi$		(4) Benchmark	
	North	South	North	South	North	South	North	South
$corr(tb, y)$	0.63	-0.2	0	0	0.99	-0.99	0.99	-0.99
σ_c/σ_y	0.45	0.85	0.54	0.54	0.52	0.75	0.52	0.85
$E(\frac{c_t - c}{c})$	-	-	3.94	3.94	2.55	6.85	1.58	7.05
$E(\frac{w_t - w}{w})$	-	-	5.31	5.31	3.67	8.70	2.66	8.80

Procyclical net capital inflows in the South means that agents borrow in good times by selling domestic capital abroad and therefore that the corresponding trade deficit has to be reduced during periods of recession. The cyclical behaviour of net capital flows in the South therefore implies that borrowing needs to be reduced precisely when marginal utility is high and the desire to consume most pressing. By reducing the potential for intertemporal smoothing in the South, the dynamics of net capital flows therefore creates an additional source of risk that exacerbates the welfare cost of business cycle fluctuations in that region.

In the North, by contrast, the international capital market provides a margin of adjustment that allows agents to self-insure against unexpected shocks. The price of capital being procyclical, the amount paid to purchase foreign capital declines during periods of recession. By reducing the amount spent on foreign asset accumulation, the dynamics of capital flows therefore attenuates the adjustment in consumption that is required to compensate for the decline in output. Relative to the symmetric case shown in column 2, this favorable cyclical property of net capital flows facilitates consumption smoothing in the North and lowers the two measures of welfare cost of business cycle fluctuations in this region.

Column 4 reports the results in the case in which all three sources of cross-country heterogeneity are introduced, which corresponds to the calibration discussed in section 4. A model calibrated to match the volatility of consumption, investment and hours across country blocks therefore predicts that the welfare cost of business cycle fluctuations is significantly higher in the region that experiences procyclical net capital inflows.

The effects of structural reforms on average consumption

The results shown in Table 8 illustrate that an increase in the efficiency of financial intermediation in the South decreases the welfare cost of business cycle fluctuation in

this region. At the same time, a reduction in the procyclicality of net capital inflows in the South comes at the expense of a higher welfare cost in the North. To further explore the effect of an increase in the efficiency of the intermediation process in the South on the economy as a whole, Figure 12 below shows the effect of a variation in the financial structure parameter $\widetilde{\phi}$ on mean consumption levels in the two regions. The case $\widetilde{\phi} = 0.61$ corresponds to the benchmark calibration discussed in section 4.

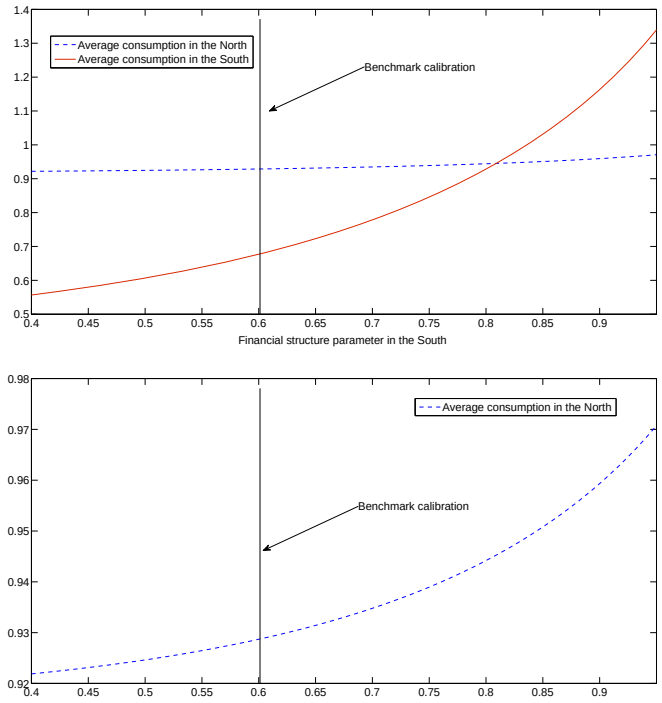

Fig. 12- Upper panel: structural reforms and average consumption levels per quarter, $E(c)$ and $E(\widetilde{c})$. Lower panel: average consumption in the North only.

The sensitivity analysis reported in Figure 12 firstly illustrates that an improvement in the efficiency of financial intermediation in the South not only reduces the procyclicality of net capital inflows but also increases mean consumption in this region. Second, while an improvement in the South increases the welfare cost of business cycle fluctuation in the North, as shown by the blue dotted line, agents in the North are compensated for this higher welfare cost by an increase in average consumption. In terms of consumption levels, both regions therefore benefit from a more efficient financial intermediation system at home or abroad.

8 Conclusion

This study develops a dynamic general equilibrium model in which asymmetries across trading partners take the form of differences in financial intermediation technologies. Our quantitative analysis suggests that this mechanism is able to reproduce some of the most salient features of the cross-country heterogeneity observed in the data. First, consumption and hours worked are more volatile in the South and the region where consumption is more volatile exhibits a countercyclical trade balance. And second, this mechanism generates a trade deficit in the region endowed with the less efficient intermediation system and increases the welfare cost of business cycle fluctuations by generating procyclical net capital inflows in this region.

If, as suggested by the facts documented in section 2, these differences in the structure of financial intermediation across eurozone economies are the result of differences in legal structures, these structural asymmetries are likely to generate imbalances that could be very persistent. Our results suggest that structural reforms aimed at improving the quality of the financial intermediation process in the more constrained region could bring significant welfare gains. In our environment, a better financial intermediation system not only reduces the procyclicality of net capital inflows in the South but also raises average consumption levels in both regions.

These results are obtained in a relatively stylized version of a two-country neoclassical growth model and abstract from many potentially important aspects. In particular, they depend on hypotheses concerning the structure of international asset markets, including the assumption that capital can flow across borders only through financial intermediaries. In addition, the model does not contain a fiscal block and thus abstracts from cross-country heterogeneity resulting from differences in fiscal policy.

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10 Appendix A: Data description

Data source
OECDNAQ/Haver for gross domestic product (y), private consumption of households (c), gross capital formation (x), and the trade balance in goods and services (tb), 1996Q1-2014Q3 (1997Q1-2014Q3 for Ireland)
Statistical office of the European Communities/Haver y, c, x, n and tb for Greece, and intra-euro area trade balances (1999Q1-2014Q3) Figure 1
OECDNAQ/Haver for hours worked (N), 1996Q1-2014Q3 (1998Q1-2014Q3 for Ireland)
ECB/Haver for bank lending rates (r_L). Loans to nonfinancial corporations, new business, amount less or equal to 1mio, maturity less than a year, 2000M1-2014M10.
World Bank/Haver for Rule of law index, 1996-2013, ratio of non-performing loans to gross total loans, 1998-2014, time required to enforce a contract, 2003-2014.

11 Appendix B

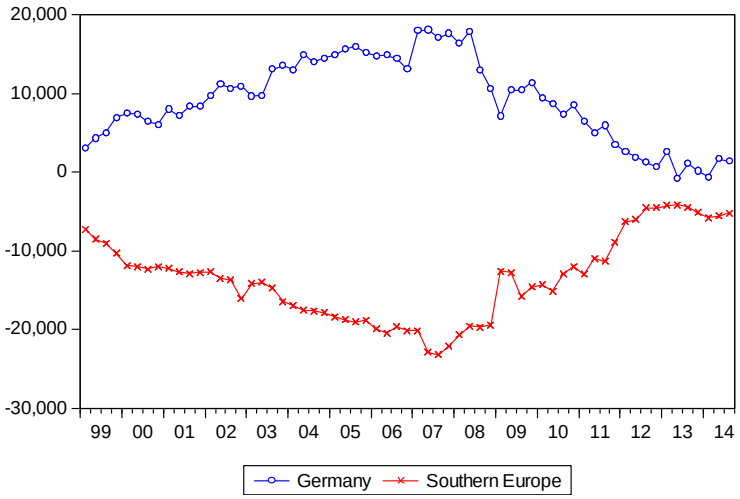

FIG. 1-Intra euro area trade, 1999Q1-2013Q3. Trade balance in mio, Germany vs. Southern eurozone (Greece, Italy, Portugal and Spain).

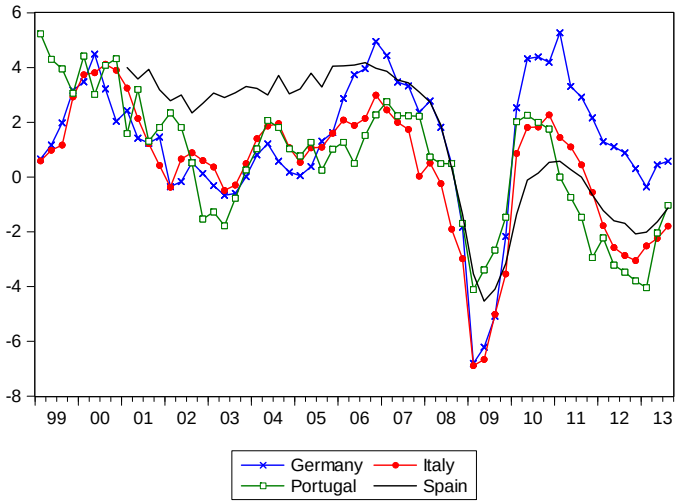

FIG. 2-Output growth synchronization across euro zone economies, 1999Q1-2013Q3.

12 Appendix C

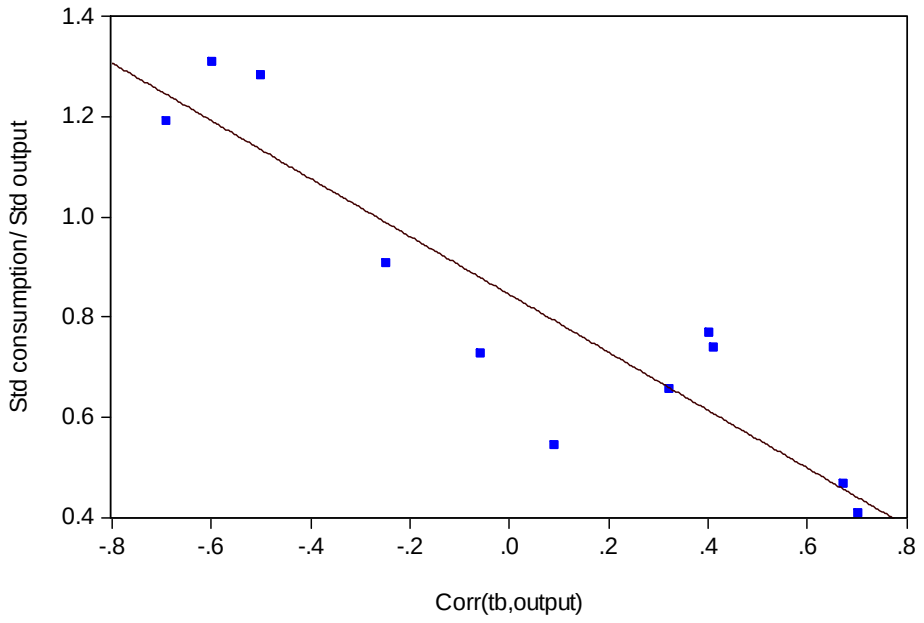

FIG. 3-y axis: Relative standard deviation of consumption, σ_c/σ_y. x axis: correlation between output and the trade balance in goods and services for the period 1996Q1-2014Q3.

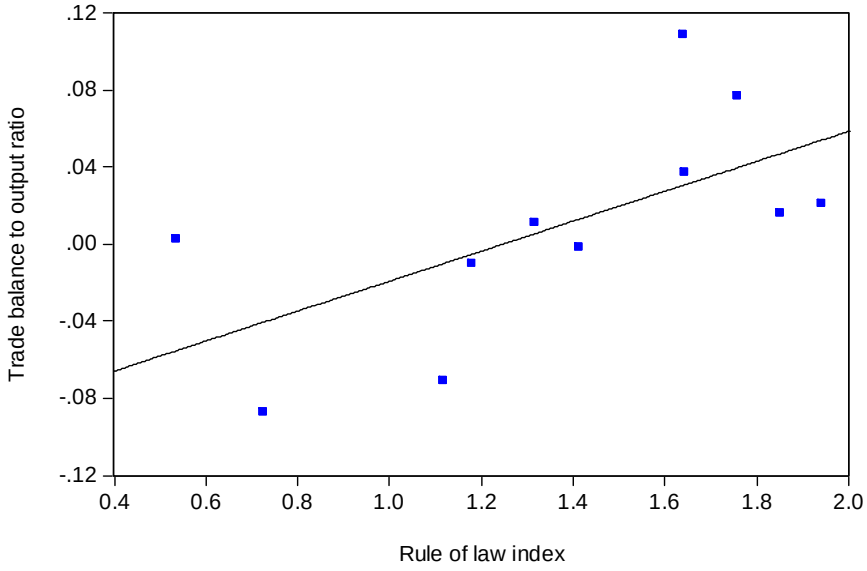

FIG. 4- x axis: Rule of law index. y axis: Trade balance to output ratio, 1996-2013

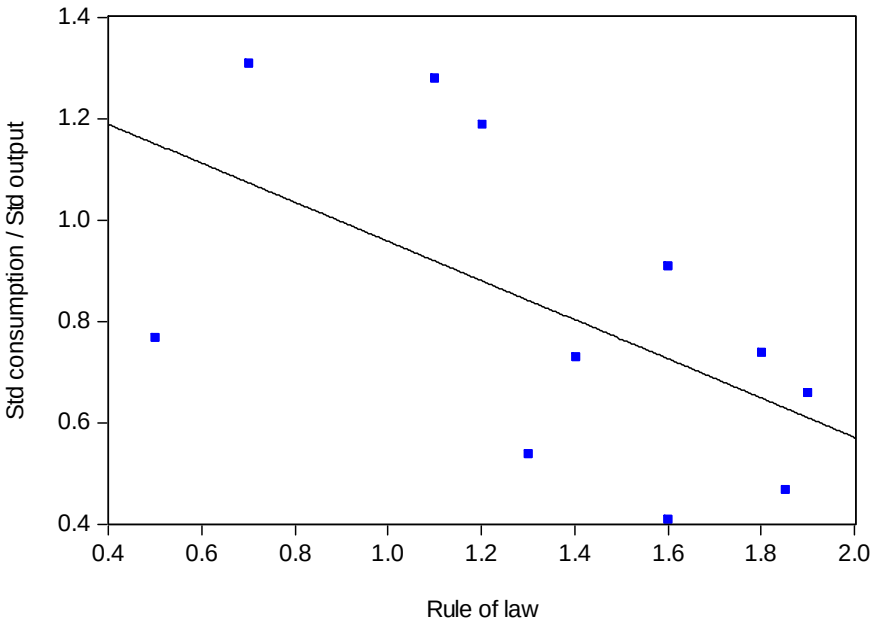

FIG. 5- x axis: Rule of law index. y axis: Consumption standard deviation divided by output standard deviation, 1996-2013

13 Appendix D

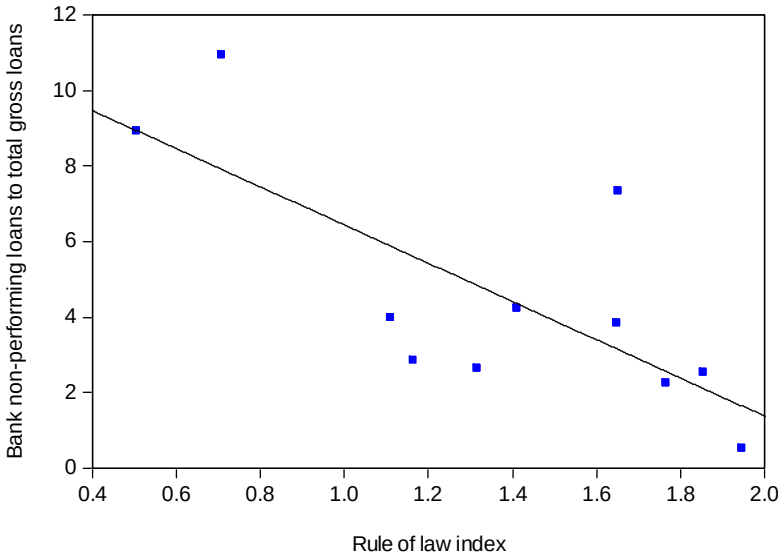

FIG. 6-Rule of law index and non-performing loans, 1998-2013.

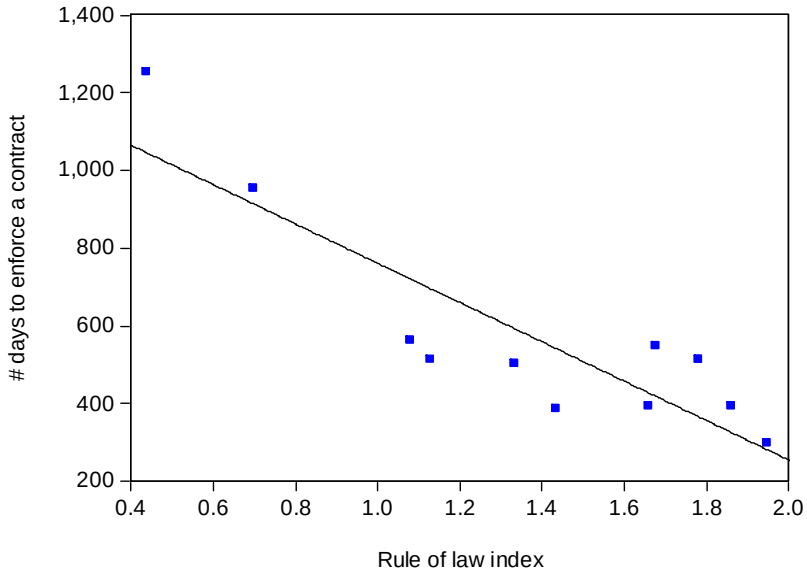

FIG. 7-Rule of law index and time to enforce a contract, 2003-2013.

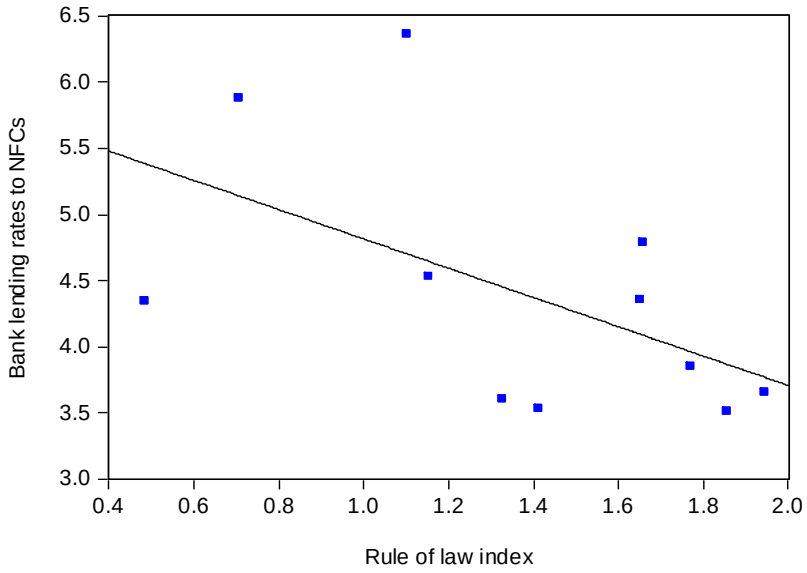

FIG. 8-Rule of law index and bank lending rates, 2000-2013.

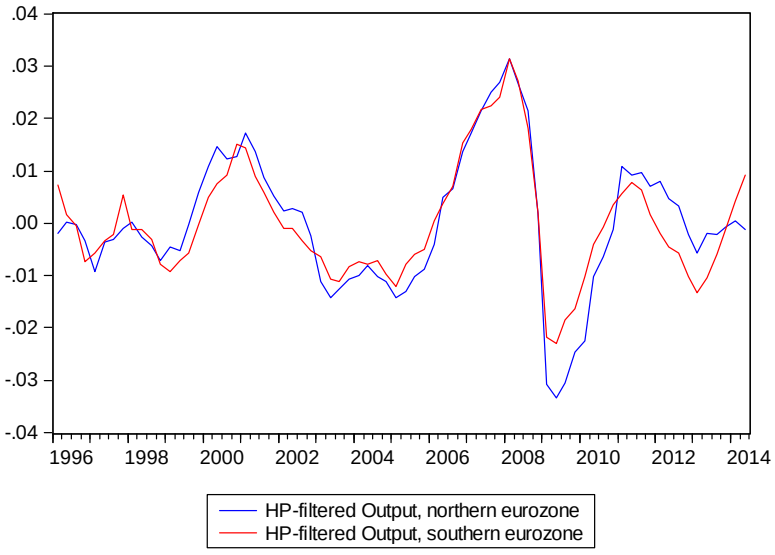

FIG. 9-Aggregate output, HP-filtered data 1996Q1-2014Q3.