The pro-cyclical effects of financial integration in the euro area

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Abstract

This paper investigates the role of financial integration as an additional channel in the macro-economic adjustment process of countries inside EMU. To this end, we include changes in cross-border bank portfolios in a New-Keynesian IS equation for the euro area. We also employ confidential bilateral data on cross-border claims and liabilities to establish a panel cointegration relationship between GDP, housing prices and net bank capital flows. Our results indicate that since the introduction of the euro, financial integration has acted as an additional pro-cyclical force in the macro-economic adjustment process of EMU member countries.

Keywords: monetary union; regional effects, international bank portfolios; monetary transmission; financial integration

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1. Introduction

From the start of EMU, macro-economists have recognized that a "one size fits all" monetary policy may complicate the monetary adjustment process inside a currency union. Initially, the discussion centered on the pro-cyclical role of inflation differentials within a monetary union. As financial integration equalizes nominal risk-free interest rates within the union, real interest rates in countries with high inflation are reduced, inducing further demand-side inflationary pressures and potentially destabilizing a heterogeneous union. This argument is also known as the "Walters critique" (Walters 1990). Until the outbreak of the crisis the Walters critique was seen as a mere theoretical issue with little policy relevance. The euro area seemed to be doing just fine. The 10th anniversary publication of the European Commission (European Commission 2008) noted that EMU "has secured macroeconomic stability" and that Europe has become a "pole of macroeconomic stability". Yet the same report describes how over time macroeconomic imbalances between member states had built up. These came to the surface following the collapse of Lehman.

While the original Walters critique centers on the real interest rate channel, financial integration and innovation may have exacerbated their pro-cyclical role, by making funding more easily available for booming regions within the euro area. Indeed, the European Commission (2008) notes that this combined effect has been underestimated in the first decade of the euro's existence and belatedly warns that: "a combination of integrated financial markets and inflation persistence risks divergences across countries." Recent evidence indeed points to a role for cross-border capital flows in aggravating this problem and fostering economic imbalances.

The goal of the present paper is to empirically investigate the role of international bank portfolios in the macro-economic adjustment process of EMU member countries. On top of the traditional pro-cyclical effects of regional inflation differentials, we show that changes in cross-border bank portfolios are an additional driver of macroeconomic divergences. Our analysis consists of two parts. We first estimate a New-Keynesian IS equation for a panel of euro area members. This shows the operation of the traditional transmission channels – i.e. the real interest rate channel, the wealth channel and the real exchange rate channel – within the euro area. As a novelty, we investigate how financial integration may compound the perverse – i.e. pro-cyclical – operation of the real interest rate channel in a monetary union. Secondly, we use the bilateral nature of the confidential cross-border banking data that we have been granted access to by the BIS, to estimate a panel cointegrating relationship between GDP, housing prices and net cross-border bank liabilities between pairs of euro area countries. We show that both housing prices and net bank liabilities work to amplify regional imbalances within the euro area. In all, our evidence confirms that since the

introduction of the euro, financial integration has acted as an additional pro-cyclical force in the macro-economic adjustment process within the union.

This paper is organized as follows. In section 2, we briefly review the literature on the role of inflation differentials in a monetary union and the effect of financial integration on economic convergence. Section 3 describes our dataset, reports preliminary statistics and includes our empirical specification. In section 4 we present and discuss the empirical evidence. Section 5 concludes.

2. Cross-border financial flows and the macro-economic adjustment process

Standard analysis of the macroeconomic adjustment process within a currency union focuses on the role of inflation differentials (European Commission 2008; Arnold and Kool 2004). When a country sets its own monetary policy, it will increase the nominal interest rate in the presence of a positive output gap and high inflationary expectations according to some version of the Taylor-rule. As a result, the real interest rate will increase. Via a range of potential transmission channels – including an effect on asset prices – this will over time lead to a reduction of economic growth, a decrease in the output gap and a reduction of inflationary expectations. The appreciation of the domestic currency in nominal and real terms will worsen a country's competitiveness and reduce its net exports. Here, the real interest rate channel and the real exchange rate channel reinforce each other in cooling down the economy.

After a country joins a monetary union, the real interest rate channel changes face. The central bank of the monetary union conducts a uniform monetary policy using an interest rate rule, now using the output gap and expected inflation in the union as a whole. Asymmetric shocks within the currency union may cause divergences between business cycles and inflation patterns in the member states. In the neutral case where the area-wide output gap is zero and expected inflation for the union is sufficiently low, the monetary authorities will have no reason to change the nominal interest rate. A member country that at that time enjoys a business cycle upturn (relative to the union) will have an above-average economic growth rate, output gap and inflation rate. Depending on the degree of inflation persistence, residents will also have higher inflationary expectations. With a uniform nominal interest rate, the domestic real interest rate will be lower than in the rest of the union. Lower real interest rates discourage savings and stimulate consumption and investment. Now, the real interest rate channel no longer acts as a brake on the cycle but instead accelerates regional economic developments. Within the union, the real exchange rate channel remains intact. A booming regional economy still leads to a real appreciation, not via changes in the nominal exchange rate but via a change in relative prices between the domestic economy and the rest of the union. Again, the regional inflation differentials take

care of the adjustment process. The elimination of adjustment through the nominal exchange rate will, however, reduce the size and speed with which the real exchange rate adjusts. Finally, regional inflation differentials may lead to direct or indirect wealth effects with macro-economic implications. The direct channel involves the effect of inflation on nominal asset prices for e.g. stocks and real estate. Indirectly, inflation may induce changes in wealth through its effect on real interest rates.

The channels described here can be modeled using the IS-curve from a small New Keynesian macro-economic model (see e.g. Svensson 1997; Smets 1997; Ball 1998; and Goodhart and Hofmann 2005):

$$y_{t+1} = \alpha_1 y_t - \alpha_2 (i_t - \pi_t) + \alpha_3 q_t + \alpha_4 h_t + \eta_{t+1} \quad (1)$$

The extended IS curve in equation (1) relates the output gap (y) to its own lagged value, the lagged ex-post real rate of interest, defined as the nominal interest rate (i) minus inflation (π) and the lagged values of two other financial variables, the real exchange rate (q) and real housing wealth (h).

Prior to EMU, most analyses assumed that the real exchange channel would dominate the real interest rate channel and that macro-economic stabilization and convergence within a currency union would occur automatically. This was the period in which the idea of an endogenous optimal currency area became in vogue (Frankel and Rose 1998). Since then, however, several empirical studies have found that inflation differentials are quite persistent (Angeloni and Ehrmann 2004; Beck *et al.* 2009) and that the real interest channel may be more important than the real exchange channel (IMF 2004; Arnold and Kool 2004). A number of studies discuss the real interest rate effect for individual countries, see Honohan and Leddin (2006) for Ireland and López-Salido *et al.* (2005) for Spain. Roubini *et al.* (2007) argue that pro-cyclical real interest rate effect may have been at work in Spain, Portugal, the Netherland, Greece and possibly Italy. In contrast, Hofmann and Remsperger (2005) confirm the equilibrating effect of the real exchange rate effect and downplay the pro-cyclicality due to the real interest rate effect.

Still Enderlein (2006 p. 1139) concludes that "the key mechanism behind welfare distribution in a currency union is the primacy of the real interest rate effect over the real exchange rate effect". The overall support for the primacy of the real interest rate channel adds to the mixed evidence in support of business cycle synchronization in the euro area (Inklaar *et al.* 2008). These findings have thrown into doubt the supposedly endogenous nature of the optimal currency area criteria, according to which, as De Grauwe and Mongelli (2005 p. 24) note, the common currency "precludes future competitive devaluations, facilities foreign direct investment and the building of long-term relationships, and may over time encourage

forms of political integration. This will promote reciprocal trade, economic and financial integration and it will foster business cycle synchronization among the countries sharing a single currency". In the midst of the euro crisis, this vision of an endogenous currency area seems to be a long way off and the competing Walters critique seems to be validated.

Prior to starting EMU, little attention was paid to the effects of financial integration on the synchronization of business cycles in the euro area. The deregulation of financial markets in recent decades and the strong cyclical movements in asset prices in several countries have, however, led to a stronger emphasis on the macro-economic importance of capital flows and asset prices. While financial integration may help absorb macroeconomic disturbances by providing risk-sharing opportunities and by fostering an efficient reallocation of resources, it can also, if not accompanied by appropriate policies, amplify divergences among participating countries. Further, with the current account constraint seemingly removed, it can result in asset booms. In the absence of currency risk, their funding through an integrated financial market may be sustained for too long.

Recently, a number of papers have explored the increase of financial integration in the euro area and its effect. An analysis of bilateral foreign assets and liabilities of banks by the European Commission (2008) and Spiegel (2009) shows a positive and significant impact of the euro on bilateral financial linkages. Lane (2008) also documents the transformation of the European financial system and notes the impressive level of unification in money and bond markets, the integration of wholesale banking and the increase in direct cross-border investments (prior to the post-2008 turmoil). While stressing the long term advantages of financial integration (by raising productivity, accelerating convergence and facilitating international risk sharing), Lane (2008) also points to the risk that financial integration may lead to divergences in the wealth dynamics, due to regional property-related boom-and-bust cycles. Lane's (2008) view that financial integration will lead to long-term economic convergence is challenged by Kalemni-Ozcan *et al.* (2010), who document a negative effect of financial integration on business cycle synchronization. This outcome fits in with the view that cross-border capital flows may "fuel" the pro-cyclical real interest rate and wealth channels and lead to macro-economic divergences.

These different views on the macroeconomic role of financial integration warrant a closer empirical examination. Given the predominance of banks in Europe's financial landscape, it is of special interest to focus on the role of cross-border bank capital flows. The current research aims to include changes in cross-border bank portfolios as an additional driver of macroeconomic divergences in the euro area. To this end, we employ a confidential version of the locational banking statistics provided by the BIS to examine bilaterally whether there the long-term relationship between financial integration and GDP is positive (as in Lane 2008) or negative (as in Kalemni-Ozcan *et al.* 2010).

3. Data and methodology

In order to measure the impact of intra-European bank capital flows on macroeconomic divergences in the euro zone, we use a confidential version of the locational banking statistics provided by the Bank of International Settlements (BIS). This dataset contains quarterly data on the bilateral cross-border bank assets and liabilities for nine EMU member countries: Germany, Ireland, the Netherlands, France, Belgium, Italy, Portugal, Spain and Greece, for the period 1999–2010. We choose to use the locational instead of the consolidated banking statistics provided by the BIS, since these have a more explicit geographic dimension. As such, they allow us to relate the assets and liabilities located in country A or B to macroeconomic conditions in country A or B.[1] We have converted the data from dollars to euros.

From this dataset, we can construct a measure capturing bank capital flows within the euro zone. First of all, we can derive the net cross-border liabilities of a member country vis-à-vis the rest of the euro zone. For this, we use the net liabilities vis-à-vis the other countries in our euro zone sample. A positive value indicates that there is a net bank capital inflow from the rest of the euro zone to country *i*. A negative value indicates a net outflow from the rest of the euro zone to country *i*. Second, we know the bilateral claims and liabilities of these member countries, and can construct a net liabilities position on a country-pair basis.

In part one of our analysis, we use the net cross-border liabilities of country *i* vis-à-vis the rest of the euro zone to estimate an extended version of the IS-curve similar to that used in Goodhart and Hoffman (2005):

$$y_{i-EZ,t+1} = \alpha_{0,i} + \alpha_1 y_{i-EZ,t} + \alpha_2 r_{i-EZ,t} + \alpha_3 q_{i-EZ,t} + (\alpha_4 + \alpha_5 * c_{i-EZ,t})\Delta h_{i-EZ,t} + \alpha_6 \Delta c_{i-EZ,t} + \varepsilon \qquad (2)$$

In this specification, $y_{i-EZ,t}$ denotes the output gap in member country *i* during period *t* minus the average output gap of the euro zone sample in that period (or the output gap differential vis-à-vis the euro zone). Data on gross domestic product for the EMU member countries are taken from the OECD Statistics. From these we obtain data on quarterly (seasonally-adjusted) real GDP. As a measure of the output gap we use the percentage gap between real GDP and potential real GDP, calculated using a standard Hodrick–Prescott filter with a smoothing parameter of 1600 (Goodhart and Hoffman 2005). We include a lagged dependent variable.

[1] The locational statistics are based on the balance-of-payments principle; data are not consolidated, and they include assets and liabilities vis-à-vis banks' own affiliates abroad. As such, the data reflect the cross-border portfolio of parent banks depending on the location of the counterparty, not ownership ties. In contrast, the consolidated statistics consolidate intra-concern positions among banks and their foreign affiliates. Thus, for instance the French subsidiary of a German bank is counted as a German entity (see e.g. Blank and Buch 2010 and Milesi-Ferretti and Tille 2011).

Next, the national real interest rate, denoted $r_{i,t}$, is the difference between 10-year government bond yields (taken from the IMF's International Financial Statistics) and inflation or the year-on-year change of a country's consumer price index (CPI, obtained from the OECD). The real interest rate differential with the euro zone average is denoted $r_{i-EZ,t}$. The coefficient α_2 is expected to have a negative sign. The real exchange rate differential ($q_{i-EZ,t}$) equals 100 times the logarithm of the GDP deflator in country *i* relative to the GDP deflator for the euro sample (derived from the OECD). We expect the coefficient α_3 to be negative, as a real appreciation would have a negative effect on output gap differentials. We check the robustness of this measure by using, alternatively, data on real effective exchange rates provided by the OECD. In this case, we calculate the real exchange rate differential as 100 times the logarithm of the real effective exchange rate index (REER) in country *i* relative to the average real effective exchange rate for the euro sample.

We proxy housing wealth using national house price indices obtained from various sources: Eurostat, INSEE (France), CBS (Netherlands), ESRI (Ireland), and the Ministry of Housing (Spain). These housing price indices are deflated by the national GDP deflator to derive real housing prices. Real housing wealth is calculated using the year-on-year percentage changes in real housing prices.[2] Real housing wealth differentials ($\Delta h_{i-EZ,t}$) are defined as the difference between real housing wealth in country *i* and average real housing wealth of the euro zone sample. We expect their effect to be positive.

As a novel feature in equation (2), we include changes in net liabilities vis-à-vis the euro zone ($\Delta c_{i-EZ,t}$) to measure the impact of intra-European bank capital flows. A country's net cross-border liabilities are equal to that country's bilateral loans and deposits liabilities vis-à-vis the other countries in the euro sample, minus that country's bilateral claims versus the same set of countries. Taking a flows instead of stocks approach, we include changes in this net external position in the model. This variable is scaled, by dividing it by nominal GDP (see also Abiad *et al.* 2009). We expect a positive coefficient for the capital flows variable, as increased capital inflow to a country causes a positive output gap differential with the euro zone average.

Finally, since we expect bank capital flows to interact with wealth effects in generating macroeconomic divergences within the monetary union, we include an interaction effect between real housing wealth differentials and our capital flows variable. For this purpose, we demean both $\Delta h_{i-EZ,t}$ and $\Delta c_{i-EZ,t}$ (see Ozer-Balli and Sørensen 2010) and expect a positive interaction effect. Tables 1 and 2 provide some descriptive statistics for the variables included in our analysis. There is no problem of multicollinearity (see table 2).

[2] Some researches use national owner-occupied housing stock times national housing prices (e.g. Case *et al.* 2005), yet price rather than volume effects drive inter-temporal variation in this variable, such that house price development is a fair indicator of the development of housing wealth over time.

[insert tables 1 and 2 here]

In part two of our analysis, we use the net cross-border liabilities in country *i* vis-à-vis country *j* to measure the impact of intra-European bank capital flows on macroeconomic divergences, this time on a bilateral basis. The dataset provided to us by the BIS offers rich, bilateral data for 36 country-pairs (cross-sections), for the period 1999 – 2010. Following Blank and Buch (2010), who use a similarly structured dataset, we test for the presence of a cointegrating relationship between real GDP differentials on the one hand, and interest/ house price differentials and net bilateral liabilities on the other hand. To do this, we specify our variables in levels, rather than deviations from trend (as with our output gap measure) or changes, and test for the presence of cointegration. We arrive at the following specification (compare Blank and Buch 2010):

$$y_{i-j,t} = \alpha_{0,i-j} + \alpha_1 r_{i-j,t} + \alpha_2 + \alpha_3 c_{i-j,t} + \alpha_4 h_{i-j,t} + \varepsilon \qquad (3)$$

In this specification, $y_{i-j,t}$ denotes the logarithm of real GDP in home country *i* during period *t* minus the logarithm of real GDP in country *j* in that period. The real interest rate differential ($r_{i-j,t}$) is equal to the real interest rate in country *i* minus the real interest rate in country *j*. Bank capital flows, defined using net bilateral liabilities ($c_{i-j,t}$), are equal to the logarithm of real cross-border liabilities in country *i* vis-à-vis country *j*, minus the logarithm of real cross-border claims in country *i* vis-à-vis country *j*. Cross-border claims and liabilities are deflated using a GDP deflator. Finally, real house price differentials ($h_{i-j,t}$) are equal to the logarithm of real house prices in country *i* less the logarithm of real house prices in country *j*.[3] The countries included in our sample are the same nine member countries as before.

First, we test for the presence of cointegration. Next, we estimate a panel cointegrated regression model. Due to the non-stationarity of these levels variables, OLS estimation of (3) would yield inconsistent errors, and hence the testing of hypotheses would be misleading. We deal with this, by applying the dynamic OLS (DOLS) methodology introduced by Stock and Watson (1993). We follow Mark and Sul (2003) in applying this in a panel context. Panel DOLS allows for the short-run dynamics through the inclusion of leads and lags of the first differences of the independent variables in the regression. Kao and Chiang (1999) find that DOLS outperforms both OLS and fully modified OLS (FM-OLS) estimators in panel cointegrated regression models. Since we use quarterly data, we choose two leads and two lags of the first differences of the explanatory variables. The following section presents and discusses our results.

[3] We do not include real exchange rate differentials, as these turn out to be consistently insignificant in empirical tests (see also section 4).

4. Results

Figure 1A and B plot the net bank liabilities and real GDP differentials of our nine euro area countries vis-à-vis the euro area average. With the exception of Italy, these graphs confirm that countries that have witnessed above-average GDP growth prior to the credit crisis also seem to have benefitted from a net inflow of bank capital.

[insert Figure 1A and 1B here]

We next test for non-stationarity of the time series included in specification (2). Table 3 presents the results of our panel unit root tests. We are able to reject the null hypothesis of a unit root for all variables, except for real interest rate and real housing wealth differentials. This is somewhat counterintuitive, as these variables do not provide cause to suspect the presence of a unit root, and could be due to a small sample problem.[4] We proceed in a pragmatic manner. We will first present the results of specification (2). Next, we turn to our panel cointegration tests and our cointegrated regression analysis, which use a larger sample and deal with non-stationarity explicitly, to see whether the measured relationships hold.

Table 4 provides the results of our panel regression. Equation (2) is estimated using GLS with cross-section weights, to account for the presence of cross-section heteroskedasticity, and uses White period standard errors.

[insert tables 3 and 4 here]

Table 4 shows that all variables have the correct sign and are significant at the 1% level, with the exception of real exchange rate differentials. The coefficient for real interest rate differentials, r_{i-EZ}, is negative and significant, conform our hypothesis that when a domestic real interest rate is lower than that in the rest of the union, this discourages savings and stimulates consumption and investment, thus increasing output gap differentials relative to the union. A one percent decrease in the real interest rate differential (approximately one standard deviation) leads to an increase of y_{i-EZ} with 0.098 one quarter later. Real exchange rate differentials or q_{i-EZ} do not exert a significant effect. Using the alternative REER-based measure of real exchange rate differentials does not alter this result. A one per cent increase in a country's housing wealth differential, denoted Δh_{i-EZ}, increases next quarter's y_{i-EZ} with 0.019. A one standard deviation increase (4.4%) increases it with 0.08. Bank capital inflows exert a significant, positive effect on output gap differentials. A one standard deviation increase in inflows (0.19) increases y_{i-EZ} by 0.14 one quarter later. This is a rather

[4] We check whether restating real interest rate and housing wealth differentials in first (second) differences (in the case of housing wealth) affects our results. This leaves all coefficients unaffected. Yet, the coefficients for these two variables are now insignificant.

strong effect. Finally, also the interaction effect with housing wealth differentials tests positive and significant. Our results for equation (2) corroborate those of Goodhart and Hoffman (2005), analyzing international data, who find a significant effect of real interest rates and real property prices on output gaps, but fail to find an important role for the real exchange rate (see also Arnold and Kool 2004). The perverse, pro-cyclical effects of the real interest rate channel, national housing prices and bank capital flows thus appear to dominate the anti-cyclical real exchange rate channel. Novel is our finding that net bank capital inflows from the rest of the euro zone significantly increase output gap differentials relative to the union.

We now turn to the second part of our empirical analysis. Table 5 provides the results of our panel cointegration tests. We include both Kao (1999) and Pedroni (1999) tests for cointegration. The Pedroni *v*-statistic and ϱ-statistic fail to reject the null of no cointegration. However, the Kao ADF-statistic, as well as the Pedroni PP-statistic and ADF-statistic reject the null of no cointegration. We therefore proceed with the cointegrated regression analysis.

Table 6 provides the results for our panel cointegrated regression model. Equation (3) is estimated using GLS with cross-section weights, to account for the presence of cross-section heteroskedasticity. Standard errors are calculated using the White cross-section method, which is robust to cross-equation (contemporaneous) correlation as well as different error variances in each cross-section.

[insert tables 5 and 6 here]

The cointegrated regression analysis yields results that are qualitatively similar to those obtained in the empirical test of the extended IS equation for the euro area. In this specification, following Blank and Buch (2010), y_{i-j} denotes the logarithm of real GDP in country *i* minus the logarithm of real GDP in country *j*. The real interest rate differential is equal to the real interest rate in country *i* minus that in country *j*. It displays a negative coefficient, significant at the 1% level. A one percent decrease in this differential would thus increase y_{i-j} by 0.003 one quarter later. Given that these are log level differences (not output gap differentials such as in table 4), this is an economically significant effect. Next, net cross-border liabilities of country *i* vis-à-vis country *j* exert a significant, positive effect on the GDP differential in the next period, increasing y_{i-j} by 0.009. Also this corroborates the results for specification (2). Finally, house price differentials or h_{i-j}, measured as the logarithm of real house prices in country *i* minus the logarithm of real housing prices in country *j*, exert a significant, positive effect on bilateral GDP differentials. A one unit increase in this differential increases y_{i-j} by 0.108 in the next period.

Analyzing the bilateral cross-border banking data provided to us by the BIS, we thus find evidence for the existence a panel cointegrating relationship between GDP, housing prices and net cross-border bank liabilities between pairs of euro area countries. The results in table 6 support the view that the real interest rate channel, housing prices and bank capital flows augment output differentials, arising from table 4. Taken together, table 4 and 6 provide consistent evidence that both housing prices and net bank liabilities work to amplify regional imbalances within the euro area. This supports the results obtained by Kalemni-Ozcan *et al.* (2010) and contradicts the predictions of for example Lane (2008).

5. Conclusions

The deregulation of financial markets in recent decades and the strong cyclical movements in asset prices in several countries have led to a stronger emphasis on the macro-economic importance of capital flows and asset prices. While financial integration may help absorb macroeconomic disturbances by providing risk-sharing opportunities and fostering reallocation of resources, it can also, if not accompanied by appropriate policies, amplify divergences among the participating countries. Further, with the current account constraint removed, it can result in asset booms (and busts).

This paper empirically investigates the role of international bank portfolios in the macro-economic adjustment process of EMU member countries. We include changes in cross-border bank portfolios in a New-Keynesian IS equation for the euro area, and employ confidential bilateral data on cross-border claims and liabilities to establish a panel cointegration relationship between GDP, housing prices and net bank capital flows. The results of both analyses show that housing prices as well as net cross-border bank liabilities work to amplify macroeconomic divergences between member countries. In all, our evidence confirms that since the introduction of the euro, financial integration has acted as an additional pro-cyclical force in the macro-economic adjustment process within the union.

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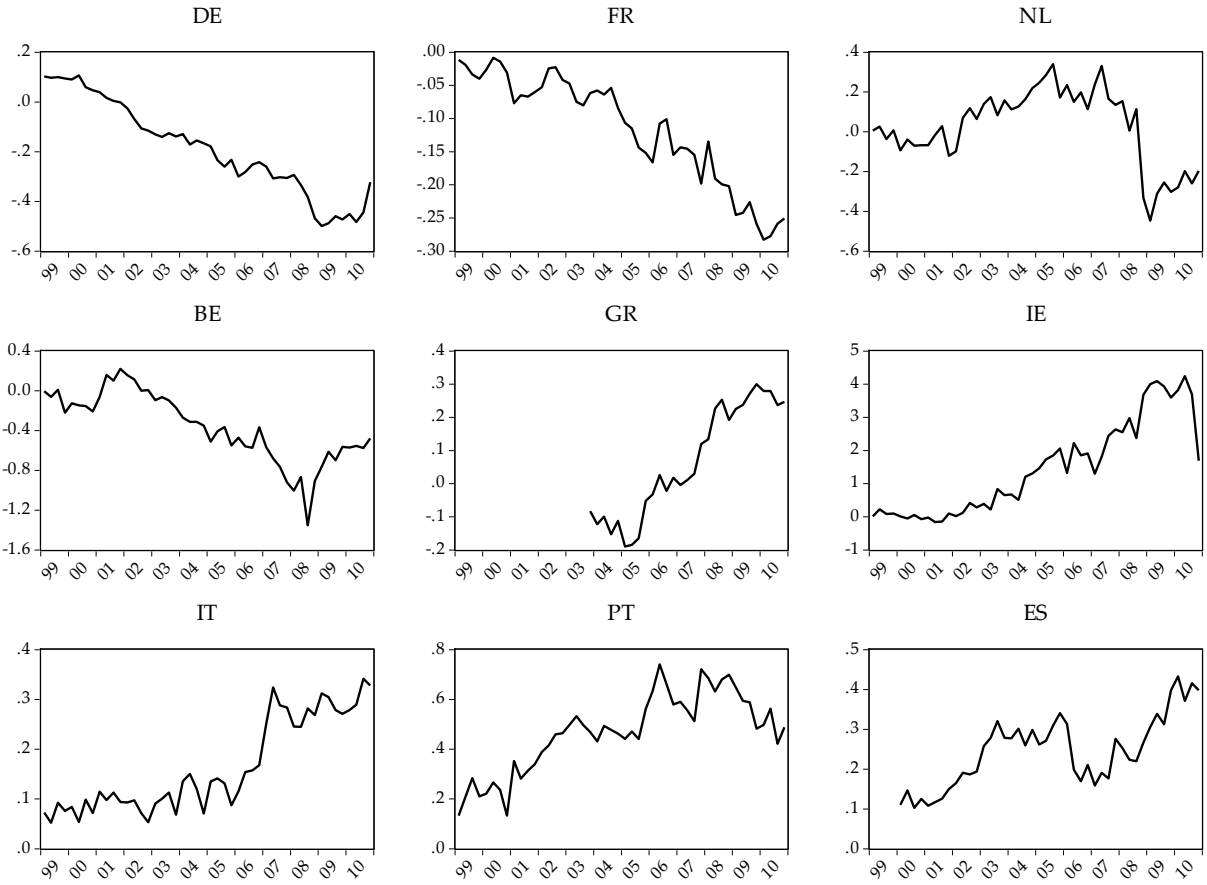
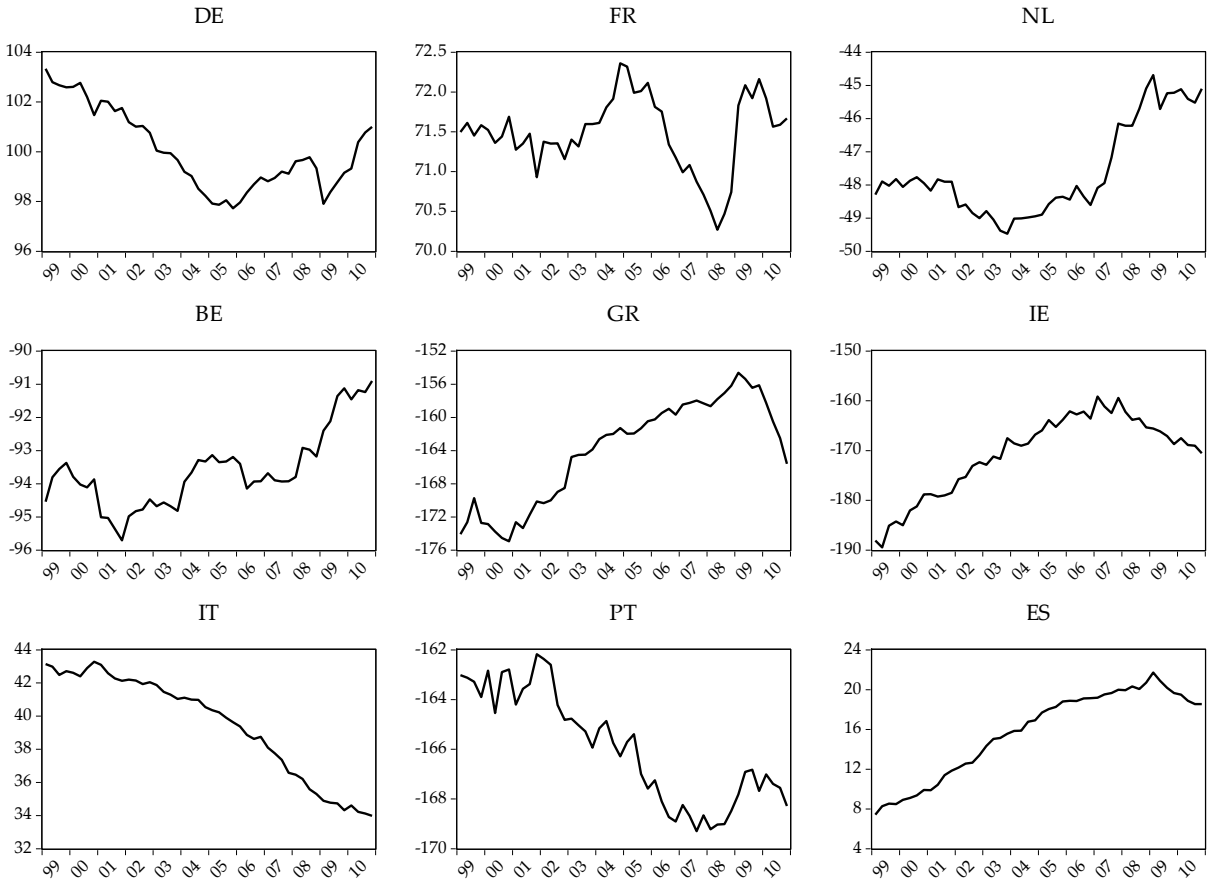
Figures and tables

Figure 1A: Net cross-border liabilities vis-à-vis the rest of the euro zone



Note: This figure shows a country's net cross-border liabilities vis-à-vis the rest of the euro zone, scaled by nominal GDP, for the period 1999Q1 – 2010Q4. These are derived using a country's bilateral loans and deposits liabilities vis-à-vis the other countries in the euro sample, as documented in the BIS locational banking statistics, minus that country's bilateral claims versus the same set of countries (both in EUR billion). The variable is subsequently scaled, by dividing it by the country's nominal GDP.

Figure 1B: Real GDP differentials vis-à-vis the euro zone average



Note: This figure shows real GDP differentials vis-à-vis the euro zone average for our sample of euro countries, for the period 1999Q1 – 2010Q4. These differentials are defined as 100 times the logarithm of real GDP in a country, divided by the euro sample average.

Table 1: Descriptive statistics

Variable	Obs.	Mean	St. dev.	Min.	Max.
real GDP	432	206.92	180.47	27.90	607.40
liabilities vis-à-vis euro zone	413	137.08	80.03	4.38	329.56
claims vis-à-vis euro zone	413	136.68	118.59	4.96	511.98
net liabilities vis-à-vis euro zone	413	0.40	74.57	-297.98	168.41
GDP deflator	424	98.44	8.02	75.90	115.10
real effective exchange rate	432	98.01	5.73	79.63	115.86
real house prices	424	116.79	39.27	69.20	242.98
output gap	432	0.02	1.60	-6.26	6.96
real housing wealth	395	2.42	5.48	-17.85	15.38
long-term interest rate	432	4.46	0.89	2.42	11.03
inflation	405	2.30	1.46	-6.30	6.24
$y_{i-EZ,t}$	432	0.02	1.07	-6.09	4.89
$r_{i-EZ,t}$	405	0.00	1.15	-3.08	6.54
$q_{i-EZ,t}$	424	-0.05	3.17	-15.64	10.94
$\Delta h_{i-EZ,t}$	395	0.00	4.40	-15.24	9.21
$\Delta c_{i-EZ,t}$	387	0.00	0.19	-2.24	1.23

Note: GDP, (net) liabilities and claims are in EUR billion and derived from the BIS locational banking statistics. GDP deflator, real exchange rate and house prices are indices. Output gap, interest rates, inflation and real housing wealth are in percent. Statistics are calculated across all 9 euro countries included in our sample, and for the full time period (1999Q1 - 2010Q4).

Table 2: Correlation matrix

	$y_{i-EZ,t}$	$r_{i-EZ,t}$	$q_{i-EZ,t}$	$\Delta h_{i-EZ,t}$	$\Delta c_{i-EZ,t}$
$y_{i-EZ,t}$	1				
$r_{i-EZ,t}$	-0.288	1			
$q_{i-EZ,t}$	0.134	-0.146	1		
$\Delta h_{i-EZ,t}$	0.093	-0.368	-0.121	1	
$\Delta c_{i-EZ,t}$	-0.006	-0.195	0.201	0.039	1

Note: Ordinary Pearson product-moment correlations. All variables have been demeaned. Period 1999Q1 - 2010Q4.

Table 3: Panel unit root tests

	Obs.	Statistic	*p*-value
$y_{i-EZ,t}$	419	-2.130	0.017
$r_{i-EZ,t}$	385	3.490	1.000
$q_{i-EZ,t}$	419	-3.172	0.001
$\Delta h_{i-EZ,t}$	365	1.772	0.962
$\Delta c_{i-EZ,t}$	378	-19.694	0.000

Note: Levin Lin Chu (common unit root, individual effects, automatic lag selection).

Table 4: Regression results

Dependent variable: $y_{i-EZ,t+1}$

	Coeff.	*t*-stat.	
intercept	-0.021	-6.35	***
$y_{i-EZ,t}$	0.663	17.56	***
$r_{i-EZ,t}$	-0.098	-3.35	***
$q_{i-EZ,t}$	0.011	1.17	
$\Delta h_{i-EZ,t}$	0.019	3.95	***
$\Delta c_{i-EZ,t}$	0.760	2.69	***
$\Delta(h_{i-EZ,t} * c_{i-EZ,t})$	0.073	2.23	***
N	374		
Adj. R^2	0.457		

Note: 9 countries (cross-sections), period 1999Q1 - 2010Q4. Fixed effects, White period standard errors, p <.10*, p <.05**, p <.01***.

Table 5: Panel cointegration tests

	Statistic	*p*-value
Kao		
ADF *t*-statistic	-2.704	0.003
Pedroni		
panel *v*-statistic	-1.974	0.976
panel ϱ-statistic	-0.856	0.196
panel PP-statistic	-3.422	0.000
panel ADF-statistic	-3.526	0.000
group ϱ-statistic	0.876	0.810
group PP-statistic	-1.952	0.026
group ADF-statistic	-2.036	0.021

Note: 36 country-pairs (cross-sections), period 2001Q4 - 2010Q4. Included series: real GDP, interest and house price differentials, and net bilateral liabilities.

Table 6: Cointegrated regression results

Dependent variable: $y_{i-j,t}$

	Coeff.	*t*-stat.	
intercept	0.578	1,002	***
$r_{i-j,t}$	-0.003	-3.46	***
$c_{i-j,t}$	0.009	3.64	***
$h_{i-j,t}$	0.108	17.52	***
N	1,365		
Adj. R^2	1.000		

Note: 36 country-pairs (cross-sections), period 2000Q3 - 2010Q2. Fixed effects, White period standard errors, p <.10*, p <.05**, p <.01***.