Global Research Unit Working Paper #2019-014

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ABSTRACT

The euro-area financial crisis that erupted in 2009 was marked by negative confidence effects that had both domestic and international ramifications. Domestically, bank lending declined sharply. Internationally, the demand for the euro as a reserve currency fell precipitously. We investigate the effects of ECB policies on banks' lending, taking account of national and regional spillovers. We also assess the effects of ECB policies on euro reserve holdings. The results suggest that those policies were important for rebuilding confidence, thus supporting both bank lending and the use of the euro as a reserve asset.

Keywords: euro area financial crisis, monetary policy operations, European banks, spatial panel model
JEL Classification: E3, G01, G14, G21

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* We have benefitted from comments by Joshua Aizenman, Yin-Wong Cheung, and participants at the CityU-JIMF Conference "Global Safe Assets, International Reserves, and Capital Flow."
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1. Introduction

The eruption of the global financial crisis in August 2007 was followed by a liquidity crisis in the euro area that lasted for the better part of ten years and was characterized by three phases with an intensity that threatened the very existence of the euro. The collapse of Lehman Brothers in September 2008 marked the first phase of the liquidity crisis. Market funding for euro-area banks came to a sudden stop. In the absence of an integrated banking system that could share risks across countries, the burden of supporting banking systems fell on sovereigns to backstop their national banking systems. This circumstance led to negative feedback loops between national banking sectors and governments that peaked in 2011-12, marking a second phase of the crisis. Then, at the end of 2013, the euro area faced a credit crunch as the annual rate of bank loans to the private sector contracted by more than 2 percent; against this background, inflation began a downward drift and, by the end of 2014, moved into negative territory, marking a third phase of the crisis. Confidence in the euro, as indicated by its exchange rate against the U.S. dollar, plummeted; the euro fell from 1.40 dollars per euro in late 2013 to 1.05 a year later. With governments having to consolidate their fiscal positions, the ECB became the "only game in town." In each phase of the crisis, the ECB took measures to restore bank lending, eradicate redenomination risk and, by so doing, safeguard confidence in the euro as an international asset. In this paper we assess the effects of the ECB's monetary-policy operations on both (i) lending by euro-area banks and (ii) the use of the euro as an international reserve asset.

To examine, the effects of the ECB's liquidity providing operations on bank lending, we use confidential data to construct a series comprising borrowing from the ECB by euro-area banks. We also construct a sample of bank lending (gross loans) by 57 euro-area banks to assess the effects of borrowing from the ECB on bank lending; the data frequency is semi-annual and the data cover the period 2008:1 to 2016:2. We use spatial panel data estimation to capture spillover effects of ECB funding on lending. In this connection, we provide what we believe is a novel approach. Specifically, whereas the spatial framework is typically considered in a static setting, we estimate a dynamic spatial model so that we can shed light on the adjustment to shocks over time. In addition, we investigate several possible spatial weighting matrices in order to capture alternative spillover structures.

With regard to international reserves, our conjecture is that, holding other factors constant, the ECB's funding and nonstandard measures should have produced a rise in the holdings of the euro as an international-reserve asset, reflecting a positive confidence effect. Using quarterly data, our sample period here is 2003:Q1 through 2018:Q1. While the proportion of foreign exchange reserves held in euros declined over this period, we find that ECB policy had a positive effect on holdings of the euro, preventing a larger fall.

The remainder of the paper is structured as follows. Section 2 provides a brief account of the ECB's policies during the several stages of the euro-area financial crisis. Section 3 presents evidence of the effects of the ECB's funding operations on gross lending by euro-area banks, using a panel of individual banks in a spatial context. Section 4 assesses the ECB's funding and nonstandard operations on the demand for the euro as an international reserve asset. Section 5 concludes.

2. The ECB's Financing Operations and International Holdings of Euros: an Overview[1]

Following the September 2008 collapse of Lehman Brothers, financial markets froze and tensions spilled-over to the real economy, leading to the Great Recession. With the outbreak of the Greek sovereign debt crisis in late-2009 and early-2010, the financial crisis increasingly took

[1] This section draws on Praet (2017; 2018) and Hartmann and Smets (2018).

on a euro-centric character. During the period from late-2008 until late-2018, the ECB's policy responses became progressively more accommodative and unconventional. The following phases marked the ECB's policies.

October 2008 to early 2010. Beginning in October 2008, the ECB's regular refinancing operations -- its main refinancing operations (MROs), conducted on a weekly basis and longer-term refinancing operations (LTRO) -- were conducted under a fixed-rate tender procedure with full allotment against a wider range of collateral.[2] The ECB also lowered its main refinancing rate to the then-record low of 1 percent in May 2009, and inaugurated the Covered Bonds Purchase Programmes (CBPPs) aimed at improving liquidity conditions in covered bond markets.

June Early 2010 to June 2013. The severity of the crisis was such, however, that the banking sector, especially in the crisis countries (Cyprus, Greece, Italy, Ireland, Portugal, and Spain) remained under pressure. In the absence of a banking union, cross-border bank funding contracted sharply creating the conditions for a second phase of the crisis -- namely, the sovereign-debt crisis of 2011-12 and its amplification through bank-sovereign feedback loops. During this phase, sovereign borrowing costs spiked, especially in those countries hit hardest by the crisis (Gibson, Hall, and Tavlas, 2017). The result was a severe disruption of the monetary transmission process. During this second phase of the crisis, the ECB introduced several new non-standard measures as follows. The ECB initiated the Securities Markets Programme in May 2010, purchasing sovereign bonds of financially

[2] Prior to mid-2008, in each tender for financing, the counterparties bid both the amount of money they wanted to transact with the central bank and the interest rate at which they wanted to enter into the transaction. Thus, the most competitive bids (interest rates) were satisfied with priority until the total amount of liquidity to be provided by the central bank was exhausted.

stressed countries.[3] The SMP had the effect of transferring sovereign debt of these countries from the balance sheets of banks mainly in jurisdictions that had not been hit by the crisis to the ECB's balance sheet. The ECB progressively extended the maturity of its longer-term refinancing operations (from 3 months, in 2008, to 3 years, in 2011), the aim of which was to provide certainty of funding for banks.[4] It cut policy rates in several stages (in November and December 2011 and in July 2012) by a total of 75 basis points;[5] the cuts brought the deposit facility rate (DFR) to 0 percent in July 2012. The ECB expanded the collateral acceptable in its refinancing operations by introducing the Additional Credit Claims (ACC) framework and reducing the rating threshold for certain asset-backed securities (Hartmann and Smets, 2018, p. 30). Finally, in August 2012, the ECB announced that it would introduce an Outright Monetary Transactions (OMT) program, under which the ECB could purchase sovereign bonds in the secondary markets under strict conditions; the aim of the OMT was to reduce potentially self-fulfilling redenomination risk, which had become a key contributor to financial instability.[6]

July 2013 to December 2017. During the course of 2014, the euro area entered a prolonged slump. Inflation entered negative territory beginning in December 2014 and the risks of a prolonged deflation phase increased. Bank lending to the private sector was falling by about 2 percent per year and it appeared that the banking sector was entering another credit crunch. In July 2013, forward guidance on the key ECB interest rates was introduced in order to provide information about

[3] Sovereign bonds of the stressed countries were purchased from banks in both the stressed and the non-stressed countries.

[4] The LTRO's with a 3 year maturity were dubbed VLTRO's (Very Long Term Refinancing Operations).

[5] These reductions offset the earlier rate hikes of April and July 2011.

[6] Earlier, on July 26, 2012, ECB President Mario Draghi had delivered a speech in which he stated that: "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." That speech is widely considered to have marked the turning point in market speculation about redenomination risk. In the event, the OMT has never been enacted.

future monetary policy intentions.[7] In June 2014, the ECB employed the following instruments to achieve the objective of influencing the entire constellation of interest rates: (1) negative interest rates on the deposit facility, in order to encourage interbank activity; (2) targeted longer-term refinancing operations (TLTROs) that provided funding to banks at favourable terms conditional on the amount of loans made by the banks to the private sector. Since late 2014, the ECB has conducted four programmes for purchases of assets, referred to as the Asset Purchase Programme (APP), which included purchases of both private sector and public sector bonds. Over time, these measures boosted the growth momentum of the euro area and raised inflation from the negative rates recorded in 2014 and again in 2016.[8]

3. Effects of ECB Policies on Bank Lending in a Spatial Setting

The main transmission mechanism through which this improved performance was achieved was the bank lending channel. ECB funding directed to bank lending consists of the standard financing operations – MRO and LTRO – as well as the non-standard VLTRO and TLTRO. The relevant data used in this paper are available at the individual bank level.[9]

It is worth noting at the outset that, in contrast to most previous studies that have dealt with the lending channel and the determination of bank lending,[10] we do not use a log specification. There are several reasons

[7] Following its meeting in July 2013, the ECB communicated that it expected its key interest rates to remain at present or lower levels for an extended period of time.

[8] Gibson et al. (2016) examine the impact of the ECB's Securities Market Programme and the two Covered Bond Purchase Programmes on sovereign spreads and covered bond prices.

[9] The data measure end-period funding received by each bank.

[10] See for example Bernanke and Blinder (1988), Angeloni, Kashyap and Mojon (2003), Ehrmann and Gambacorta, Martinez-Pages, Sevestre and Worms (2003), Ehrmann and Worms (2004), Ashcraft (2006), Ivashina and Sharfstein (2008) and Cohen-Cole et al (2008). A recent exception to the non-log specification is Gibson et al. (2019).

for this circumstance. First, the standard model used in the literature is not well-specified in terms of its long-run equilibrium, and it mixes levels of variables and differences in variables in a way which is incorrect. Specifically, previous studies have typically specified the dependent variable in terms of changes and do *not* include the dependent variable in levels' form. Consequently, they are not able to provide a long-run solution. We address this issue using an error correction model that correctly separates the long run from the dynamics. Second, since many of the observations on ECB funding to individual banks are zero, a log specification is inappropriate.[11]

We also need to take into account the possibility that ECB funding may have indirect effects. In particular, as the ECB feeds these interventions into individual banks balance sheets, the banks then interact with other financial and non-financial corporations, thereby impacting on economic activity. Hence, bank lending and economic activity in the euro area are inter-connected. Thus, it may be the case that, in an expanding economy, an increase in lending of one bank feeds through to increases in lending for other banks. Similarly, in a stagnant or contracting market a decrease in lending of one bank may spillover to decreases in lending by other banks. ECB funding may also create other spillover effects. For example, economic agents might gain confidence that the entire banking sector will be protected when they observe that individual banks are supported with ECB funding. Alternatively, it may be the case that, on realizing that a particular bank requires funding from the ECB, confidence in other banks might decline.

In order to account for these spillover effects, we estimate our bank lending equation in a spatial setting. The spatial model allows us to take account of the fact that banks are highly interconnected. Specifically, the spatial model uses a weighting matrix to impose a set of restrictions on possible spillover effects so that these effects can be estimated.

[11] Approximately one-third of the ECB funding data are zero.

Thus, the model allows us to account for the fact that individual banks typically respond to the funding received by other banks from the ECB. As indicated above, a particular bank may receive funding from the ECB, and this support may affect confidence in other banks. Such an effect is not captured by the model conventionally used in the bank-lending literature since that model, whether static or dynamic, does not capture inter-action effects among banks.

Our final balanced panel consists of 57 banks from the following euro area countries – Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.[12] The original data were both annual or semi-annual. We interpolated the annual data to correspond with the semi-annual data available for the majority of banks in the sample. The sample period is 2008:S2 to 2016:S1, providing a total of 912 observation.[13]

Following a general to specific approach, our final long-run equation for gross loans (GL) is specified as:

$$GL_{i,t} = \beta_0 + \beta_1(LIAB - ECBF)_{i,t} + \beta_2(ECBF)_{i,t} + \beta_3\left(\frac{LIQ}{A}\right)_{i,t} + \beta_4\left(\frac{NPL}{GL}\right)_{i,t} + \beta_5(LR)_{i,t} + \rho_1 W_{i,t} GL_{k,t} \quad (1)$$

where LIAB is total liabilities, ECBF is ECB funding, LIQ is liquid assets, A is total assets, NPL is non-performing loans, LR is the lending rate, *i*

[12] The original unbalanced sample consisted of 88 banks; it spanned the period 2007S1-2016S2, where S denotes the semi-annual frequency. Even though the number of banks is fairly small, considering that more than 2500 banks received ECB funding at some point of time during our sample period, the total amount of ECB funding accounted for is non-negligible. Our balanced bank sample accounts for more than 50% of total funds provided by the ECB during most of the period considered.

[13] It should be noted that reducing our sample did not qualitatively or quantitatively impact on the long-run equation or the ECM equation reported in Appendix A.

refers to bank, *i* and *t* to the time period.[14] Since the model is a spatial lag dependent variable model, *W* is an $i \otimes T$ weighting matrix.[15] It is worth noting that the concept of a spatial lag differs from the conventional use of a lag. Thus, in the present context, a spatial lag determines the effect of all other banks' (k≠i) lending on bank's *(i)* lending in the current period, weighted together by the W matrix.

We expect total liabilities to have a positive impact on gross loans as it is a proxy for size, while the share of liquid assets is expected to have a negative effect, since liquid assets act as a substitute for loans. An increasing share of non-performing loans is anticipated to have a negative effect on gross loans. We also expect rising lending rates to have a negative effect on the demand for loans. Finally, our spatial lag variable may be either positive or negative.[16]

Following, again, a general-to-specific approach, our dynamic loan equation is estimated in an error correction form with a spatial lagged dependent variable, as follows.[17]

$$\Delta GL_{i,t} = \gamma_{0,i} + \sum \gamma_{1,k} \Delta(LIAB - ECBF)_{i,t-k} + \sum \gamma_{2,k} \Delta(ECBF)_{i,t-k} +$$
$$\sum \gamma_{3,k} \Delta\left(\frac{LIQ}{A}\right)_{i,t-k} + \sum \gamma_{4,k} \Delta\left(\frac{NPL}{GL}\right)_{i,t-k} + \sum \gamma_{5,k} \Delta(LR)_{i,t-k} + \sum \gamma_{6,k} \Delta(RGDP)_{i,t-k} +$$
$$\sum \gamma_{7,n} \Delta GL_{i,t-n} + \rho_2 W_{ik,t} \Delta GL_{k,t} + \delta\,(GL_{i,t-1} - (\beta_0 + \beta_1 (LIAB - ECBF)_{i,t-1} +$$

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[14] ECB funding is subtracted from the banks' total liabilities in order to avoid double counting as the ECB requires collateral in order to provide funding. Bank level data is from Fitch Solutions; funding data is from the ECB

[15] Other specifications of spatial lagged models were estimated. However, they turned out to be either insignificant or did not add to the analysis.

[16] In our initial estimations, country-specific variables like GDP were not significant or entered with the wrong sign and were excluded from the long-run equation. Moreover, as our sample period is predominantly characterized by monetary loosening, we do not interact the interest term on loans with bank characteristics as other studies do.

[17] Moreover, in order to capture individual-bank effects like differences in the quality of management, differences in sectoral loan diversification and other bank specific characteristics which may affect loan growth, we estimate our error correction model in a fixed-effects setting; the fixed effects are at the bank level.

$$\beta_2(ECBF)_{i,t-1} + \beta_3\left(\frac{LIQ}{A}\right)_{i,t-1} + \beta_4\left(\frac{NPL}{GL}\right)_{i,t-1} + \beta_5(LR)_{i,t-1} - \rho_1 W_{i,t} GL_{k,t}) \quad (2)$$

The key issue for both our long-run equation and our dynamic error correction model for bank lending is how to specify the weighting matrix *W*. Typically, a measure of physical distance is used to define the weighting matrix.

3.1 Specification of W

To set the stage for our empirical results, the following points merit comment. First, a notable characteristic of the banks in our sample during the period under investigation is the significant retrenchment of bank lending during the period under investigation. (see Chart 1). Gross loans for our 57 banks declined by almost €1 trillion (or by about 10 percent) from peak to trough. Moreover, we noted that these 57 banks account for a significant amount of ECB funding. This implies that, in a spatial-dependent-variable setting, if banks are retrenching we would expect our spatial dependent variable to be negative.[18]

Second, a stylized fact of the euro area crisis was its regional aspect, with countries in the southern part of the area being more affected by contagion than countries in the nothern part. In order to capture this regional aspect of contagion in what follows, we distinguish between two groups of euro-area countires: (1) the crisis countries -- Greece, Ireland, Portugal, Spain, and Italy -- which we call the South, and (2) countries which were less affected by the crisis -- Austria, Belgium, France, Germany, and the Netherlands -- which we call the North.

Third, the national banking systems in the euro area differ significantly. In our sample, the banks in the countries of the North are, in many

[18] By contrast, in an expansionary period we would expect, a priori, our spatial lag to be positive.

respects, Anglo-Saxon in nature, meaning that they have moved away from traditional retail banking; thus, a significant proportion of their assets and liabilities derive from sources other than loans and deposits. By contrast, banks in the countries representing the South have more 'traditional' banking structures. This circumstance is evident as the share of gross loans to total assets is significantly higher for banks in the South than for banks in the North (see Table 1).

The dependence of the banks in the South on loans rendered them more vulnerable than banks in the North to the shock that hit the real economies of these countries. While the Northern banks were able to retrench their balance sheets through other means (see Table 2), the Southern banks were forced to embark on a vicious circle of retrenching their balance sheets by recalling loans, which further exacerbated the economic downturns in the countries concerned, and forced banks to retrench their balance sheets even more. The implication here is that while banks in the North probably used ECB funding as a precautionary measure, banks in the South probably used such funding more actively for lending purposes.

We try to incorporate these stylized differences between the 'North' and 'South' into our spatial framework. Specifically, our spatial approach allows for spillovers within the 'South' and within the 'North' but not between the 'South' and 'North'. These spillovers, within the North (NN) and within the South (SS), are represented by two different weighting matrices -- W_1 and W_2. In the first weighting matrix, W_1, we allow for limited spillovers across countries, while in the second weighting matrix, W_2, we allow for equal spillovers across countries. Specifically, under the W_1 weighting scheme, all banks within, say, Spain, have a full spillover with each other, while banks between Spain and Greece have a limited spillover with each other, and no spillover with banks in the North. Correspondingly, all banks within, say, Germany, have a full spillover with each other, but only a limited spillover with banks in France and no spillover with banks in the South. Under W_2, banks in

Germany have a full spillover with all other banks in the North, but no spillover with banks in the South; correspondingly, all banks in, say, Italy, have a full spillover with all other banks in the South, but no spillover with banks in the North.

The above weighting schemes may, however, be somewhat restrictive since the weights are arbitrarily set. Therefore, we also investigate the effects of using four additional weighting schemes, three of which depend on economic characteristics. In particular, we investigate the effects of the following weighting matrices: (1) W_3 : full spillovers are allowed from the North to the South, but not from the South to the North. (2) W_4 : weights are calculated as the correlation of annualized quarterly growth rates of GDP – as a measure of co-variation of economic activity. (3) W_5 : weights are calculated as the co-variation of country level average lending rates – that is, as a measure of financial co-variation. (4) W_6 : weights are calculated as shares of bilateral trade among countries which can be viewed as a proxy measure of real economic spillovers among countries.[19]

3.2 Spatial Estimation

3.2.1 The Long run

For each weighting matrix we estimate a spatial regression where we capture any spillover from a particular bank's lending activity to another bank. We estimate our spatial models using maximum likelihood.[20] We note that from the weighting schemes we investigated, only the W_1 and W_2 weighting matrices were significant in capturing spillover effects; those two weighting schemes produced higher pseudo R^2 and significantly higher pseudo likelihood values. Moreover, the W_1 and W_2

[19] All weighting matrices are presented in Appendix B. Weighting matrices based on correlations and on trade are based on data up to 2008 in order to avoid any endogeneity issues with our dependent and independent variables.
[20] See Anselin (1988), Kapoor et al. (Lee (2004), Kapoor et al. (2007) and Lee and Yu (2010). All spatial autoregressive error models were insignificant and are, thus, excluded.

weighting matrices were the only ones that passed the Wald test of spatial dependence at the 1% level (see Appendix B). In what follows, we focus our discussion on the results based on the W_1 and W_2 weighting scheme. The results obtained using W_3, W_4, W_5, and W_6 are provided in Appendix B.

The main findings for our long-run equations, based on W_1 *and* W_2 are reported in Table 3, which, for purposes of comparison, includes results based on a standard OLS panel data estimation. The upper panel shows the estimated coefficients and the estimated spatial dependent variable; these are the direct effects of the explanatory variables on gross loans. In the lower panel, we let the spatial dependent variable 'feed' through the system, thus obtaining the total economic effects.

For model 1 -- which uses the weighting matrix W_1 -- the direct effects indicate that an increase of total liabilities of €1 billion implies an increase of gross lending of €380 million, while an increase of €1 billion in ECB funding increases gross loans by €2.5 billion, thus implying a significant multiplier associated with bank lending. At the same time, an increase in liquid to total assets by 1 percentage point decreases loans by €1.29 billion, while an increase of 1 percentage point of NPLs to gross loans (for example from 5 to 6 percent) decreases gross loans by €930 million. Finally, an increase in the lending rate by 1 percentage point (for example from 5 to 6 percent) decreases gross loans by €9.12 billion.[21] The spatial dependent variable is negative, with a coefficient of -0.28, implying a negative spillover among the banks in the region. Since the period under investigation was characterized by a stagnant - or even contracting - market, this result is plausible. In other words, because of the negative spatial lag, the total effects on gross loans are less than if spillovers had not been taken into account.

As mentioned, the direct effect of ECB funding in model 1 implies that if a bank receives funding from the ECB, the bank would increase its

[21] In our long-run equation GDP is either insignificant or wrongly signed.

lending by 2.5 times the amount of funding received. However, allowing for spillover effects, as shown in the lower panel of Table 3, the total effect of ECB funding is 1.98. Thus, even during a period of significant retrenchment of banks' balance sheets with non-negligible negative spillovers, there is still a significant positive multiplier effect from central bank funding.

The main difference with model 2 -- which uses the weighting matrix W_2, thus allowing for stronger spillovers within a region than does W_1 -- is the larger magnitude of the estimated spatial dependent variable. The larger negative spatial effects imply lower total effects of ECB funding because the 'crowding out' effect is larger. Nevertheless, as shown in the lower panel of Table 3 under model 2, the total effects lead to a multiplier of 1.65 on bank lending.

Next, consider a comparison of the direct effects of both model 1 and model 2 with the corresponding effects based on OLS estimation (model 3), also shown in Table 3. The main difference in terms of coefficients is on the coefficient of NPL/Gross loans. The other coefficients do not differ very much. However, the indirect effects, operating through the spatial terms, imply significant differences with respect to the effects of ECB funding. Specifically, OLS estimation suggests a multiplier effect of 2.65, which is close in magnitude to the direct effects estimated under models 1 and 2; however, OLS estimation fails to account for the negative spatial spillovers and, thus, overstates the multiplier effects.

3.2.2 The Short run

Using the residuals from our respective long-run spatial equations in Table 3, we estimated spatial (and non-spatial) dynamic error correction models. Table 4 presents the dynamic loan equations. They all seem to be well-specified, with the residual from the long-run equation having the correct sign and being highly significant.

Our spatial dependent variable is positive and significant for both weighting matrices, implying positive spillovers of changes in gross loans. We note that these results do not contradict the negative spillovers obtained in our long-run equation. In particular, the long-run equation spillovers capture the general retrenching observed in the data, while the positive spillovers in the error correction model imply that the changes in gross loans in a particular bank, whether negative or positive, are transmitted in the economy. This implies that the positive impact of ECB funding on gross loans in the short run is reinforced; thus, the result could be thought of as having positive systemic effects over-and-above the direct effects on bank lending.

For our spatial models -- *i.e.*, models 1 and 2 -- the magnitude of the total effect of the error-correction term, coupled with the total dynamic adjustment, implies a half-life of almost 2½ years for a permanent shock. Moreover, as shown in the panel, "Total Effects," in Table 4, the fairly high point-estimate (of 0.22) of ECB funding on loan growth, together with the error-correction, implies that a €1 billion increase of ECB funding leads to a €1 billion increase in gross loans within 2½ years.[22] For the non-spatial model, the error correction term and the dynamic adjustment coefficients also imply -- in monetary terms -- that a €1 billion increase of ECB funding leads to a €1 billion increase in gross loans within 2½ years. However, this result is due to the larger long-run effect of ECB funding implied in Table 3. In terms of the half-life of a permanent shock, the difference is significant since the non-spatial estimation implies a half-life of about 3½ years.

On balance, our results imply that ECB funding provided to euro area banks has had significant positive multiplier effects. While our spatial approach implies lower positive multiplier effects from ECB funding than the OLS panel data model, the effects are nevertheless substantial. Our spatial estimation also indicate that central bank funding, apart from

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[22] We should note that the full long-run impact is reached asymptotically.

positive direct effects, also had positive systemic effects, which are evident from the positive spillovers in our dynamic spatial error correction estimation. Finally, the large difference in the speed of adjustment between a spatial and a non-spatial approach (as measured by the half-life of a shock) indicates that the speed through which the monetary transmission mechanism acts is accelerated by positive spillovers.

4. Effects of ECB Policies on Euro Reserve Holdings

The notion that, following the onset of the global financial crisis and its subsequent transfiguration into a euro-specific crisis, the ECB's funding operations supported bank lending (at least in part) through a confidence channel has a natural extension to the area of the demand for the euro as an international-reserve asset. After all, a key determinant of the demand for currencies as international reserves is the confidence accorded by investors (in this case, central banks) to the institution (or country) that issues a particular currency. In what follows, we investigate the effects of the ECB's policies on the use of the euro as an international-reserve asset.

In general countries hold foreign exchange reserves in order to enable them to import and to provide a safety net in the event of international turbulence on, say, foreign exchange markets. Thus, the demand for reserves is likely to depend on income and development levels, the opportunity cost of holding reserves, a country's rating as well as its exchange rate regime.[23] Chart 2 shows the time series for total reserves in euro as a percentage of allocated reserves in the world as a whole.

[23] All other factors held equal, a country with a fixed exchange-rate regime is likely to hold a larger quantity of reserves than a country with a flexible exchange-rate regime.

As shown in Chart 2 after rising from around 24 percent in 2003 to 28 percent in 2008, beginning in 2009, a significant decline occurred in the share of the euro in international reserves -- from around 28 percent in 2009 to about 20 percent in 2017. Moreover, as documented in Aizenman, Cheung, and Qian (2018), during the period 2008 to 2017 the share of the 'big four currencies" -- that, is, the U.S. dollar, the euro, the pound sterling, and the Japanese yen -- in total reserves fell from around 98 percent to about 92 percent. In other words, the outbreak of the global financial crisis marked the beginning of a downward trend in the holdings of all the major currencies as reserves, and especially of the euro.

Two points about our empirical approach merit comment. First, our empirical procedure is *not* to estimate standard demand-for-reserves equations in order to discern the impact of the ECB's funding operations and nonstandard measures on the use of the euro as a reserve currency.[24] Our procedure is to estimate a full dynamic VAR and the accompanying vector error correction model (VECM). In contrast to a single equation demand-for-reserves equation, which assumes that all the variables explaining reserve holdings are exogenous, the VAR approach treats all the variables under consideration as endogenous. The motivation for our use of the VAR approach is that the ECB's funding and nonstandard measures during the crisis period were, by-and-large, a *response* to the crisis and, thus, cannot be treated as exogenous. In addition, the VAR allows us to evaluate the responses of all the variables in the system to a shock in ECB funding and nonstandard measures; our interest is in the response of international-reserve holdings of euros. Second, we then extend the typical VAR analysis; specifically, instead of exclusively estimating impulse response functions -- the usual procedure followed in the literature -- associated with ECB funding and

[24] The effects of the global financial crisis on the holdings of international reserves using linearly static and dynamic panel estimations have been performed by Aizenman, Cheung, and Ito (2015) and Aizenman, Cheung, and Qian (2019), respectively.

nonstandard measures, we also convert the VAR into a complete macroeconometric model. By so doing, we are able to estimate the effects of a *sustained* increase in ECB funding and nonstandard measures, instead of a one-time increase. In this way, we are able to capture the actual effects of the ECB's policies, which after all, were sustained during the period under consideration.

We start with a simple VAR to examine the impulse response of euro reserves to the ECB's policies. The data frequency period is quarterly and the sample period is 2003:Q4 to 2018:Q1. To capture the effect of the ECB's policies, we use the ECB funding (via the various refinancing operations) plus its nonstandard intervention through the various bond buying measures (the SMP, APP, etc.), denoted as "ECB". ECB interventions more than quadrupled -- to be specific, the quantity of interventions rose by a multiple of 4.9 -- during the period under consideration here.[25] The remaining variables (all expressed in logs) are as follows:

1. Euro reserves held outside the euro area divided by the euro-area price level -- denoted as "REALRES".[26] The price index used to deflate reserves is the euro-area "harmonized index of consumer prices" or HICP.
2. Real global GDP -- denoted as "WGDP."
3. The size of the Federal Reserve's balance sheet -- denoted as "FEDRES"
4. To capture exchange rate value effects, we use the exchange rate of the dollar in terms of the euro -- denoted as "DOLEUR".
5. To capture financial market volatility, we use the VIX index.[27]

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[25] Source: ECB. We take the differences between ECB funding operations and nonstandard measures between 2008Q1 (ie before the crisis) and 2018Q1 (the end of our data.

[26] Source: Composition of Foreign Exchange Reserves, IMF and Thomson-Reuters Datastream.

[27] The VIX index is a measure of constant 30-day expected volatility of the US stock market (S&P 500 index).

6. The interest rate (INT) is the overnight rate on euro.[28]

The VAR results are reported in Appendix C. Our primary interest is in the impulse response of a shock to the ECB's balance sheet. This effect is shown in Chart 3. The impulse response shows a significant positive effect of ECB measures on reserve holdings.[29] The effect builds up quickly, with the peak effect lasting for about 3 quarters; the effect then slowly declines. Appendix C also shows all the responses in our system to a shock to the ECB's funding and nonstandard measures.

To examine whether this is a valid relationship, we tested to see if there is a cointegrating relationship underlying the VAR. As reported in Table 5, when testing cointegration for these seven variables we found a single cointegrating vector based on the maximum eigenvalue test. We then re-estimated the VAR with the imposition of a single cointegrating vector, producing the results reported in Table 6 for the long run part of the model. The first row of Table 6 shows the coefficients of the cointegrating regression; the second row shows the loading weights for each equation in the dynamic VECM. The results suggest a positive long-run effect of ECB measures on euro reserves. The coefficient (0.02) on ECB operations implies that the five-fold increase in the ECB's monetary operations and nonstandard measures that took place during the crises raised the holdings of euro reserves by 10 percent. There are also positive effects from world GDP and interest rates. The policy actions of the Federal Reserve had a negative effect as did the exchange rate. An increase in uncertainty from the VIX raised euro reserves. The loading weights are insignificant for interest rates, ECB funding, the Federal Reserve actions and the exchange rate, indicating that these variables are weakly exogenous and that, in the long run, they are not determined within this system. However, these variables are

[28] Variables 2-6 are from Thomson-Reuters Datastream.

[29] The impulse responses functions are estimated using the Cholesky decomposition.

endogenous in the short run, indicating that ECB policy responded to the crisis. The system determines reserves, world GDP and uncertainty. The VEC residual serial correlation test fails to reject the null of no serial correlation (The p-values are: p=0.92 for lag 1, p=0.95 for lag 2 and p=0.3 for lag 3) and the White test fails to reject the null of no heteroscedasticity (p=0.17).

In order to investigate the effect of a lasting increase in ECB measures, we now compliment the above by treating the standard VAR as an econometric model. We exogenize the ECB funding variable and then increase it five-fold (roughly the increase which took place between 2008 and 2018). We then simulate the model and calculate the effect that this would have had on euro reserves. Of course, this procedure is not entirely accurate since the ECB did not increase its interventions in one go, but this approach allows us to derive an alternative estimate of the long-run effect of such a shock.

Chart 4 shows the adjustment of the VECM model. The figure traces the change in (the log of) reserves as a result of an exogenous five-fold increase in ECB funding and nonstandard measures. The long-run effect is around 0.08, after an initial overshooting – up to 0.14 – which implies that ECB's policies led to a 8 percent rise in reserves holdings in euros, which is close to our earlier finding using the cointegrating vector.

5. Conclusions

The three phases of the euro-area crisis were marked by negative confidence effects that had both domestic and international financial consequences. Domestically, bank lending declined sharply, as firms did not want to borrow under the conditions offered and banks, unwilling to lend, deleveraged. Internationally, the demand for the euro as an international reserve asset fell precipitously.

The main issues addressed in this paper is the effect of ECB policy actions on (1) lending by euro-area banks and (2) the demand for the euro in central banks' portfolios. Using a spatial modeling framework that accounts for spillover effects among banks, both nationally and regionally, we found that the ECB's funding policies had a positive multiplier effect on bank lending, although not as large as the corresponding multiplier produced by a model that fails to account for spillover effects. Moreover, the spatial results indicated a substantial rise in the speed of adjustment of bank lending from ECB policies compared with the results that do not take spillovers into account. Our results with respect to the effect of ECB policies (both funding and nonstandard measures) also implied a substantial positive demand effect for the euro as an international reserve asset. Both sets of results support the view that ECB policies were important in limiting the impact of the crisis on economic activity and rebuilding confidence. They were thus, crucial elements in supporting economic activity and eliminating redenomination risk.

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Chart 1: Descriptive totals Loans and Funding

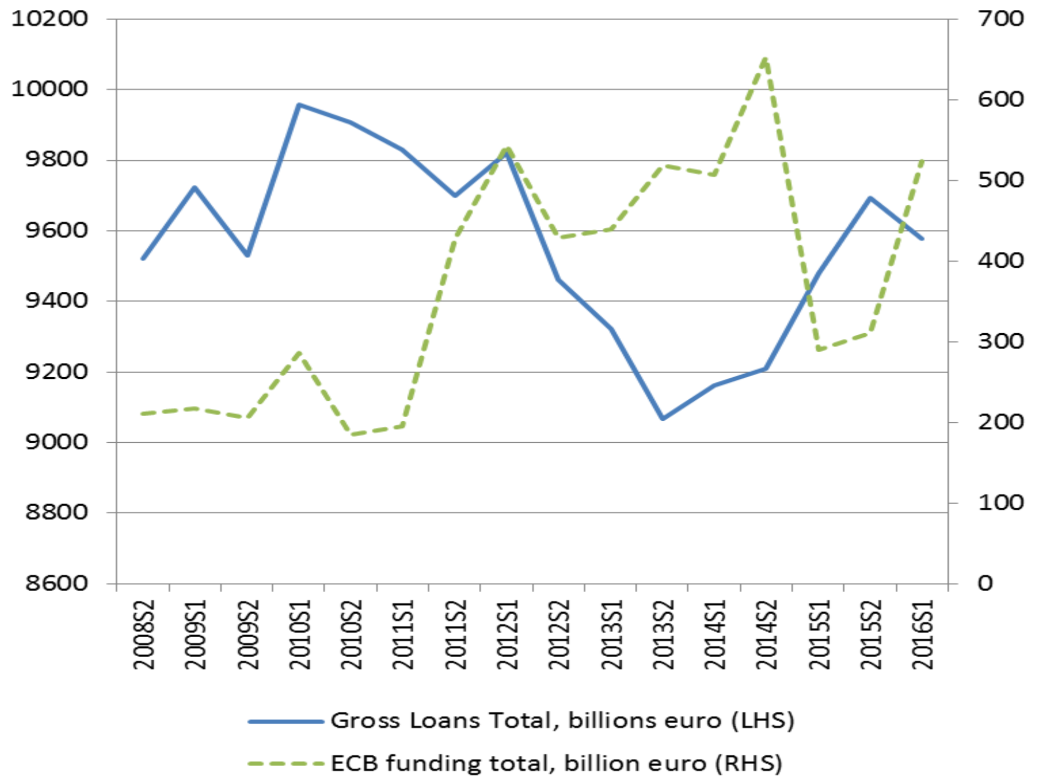
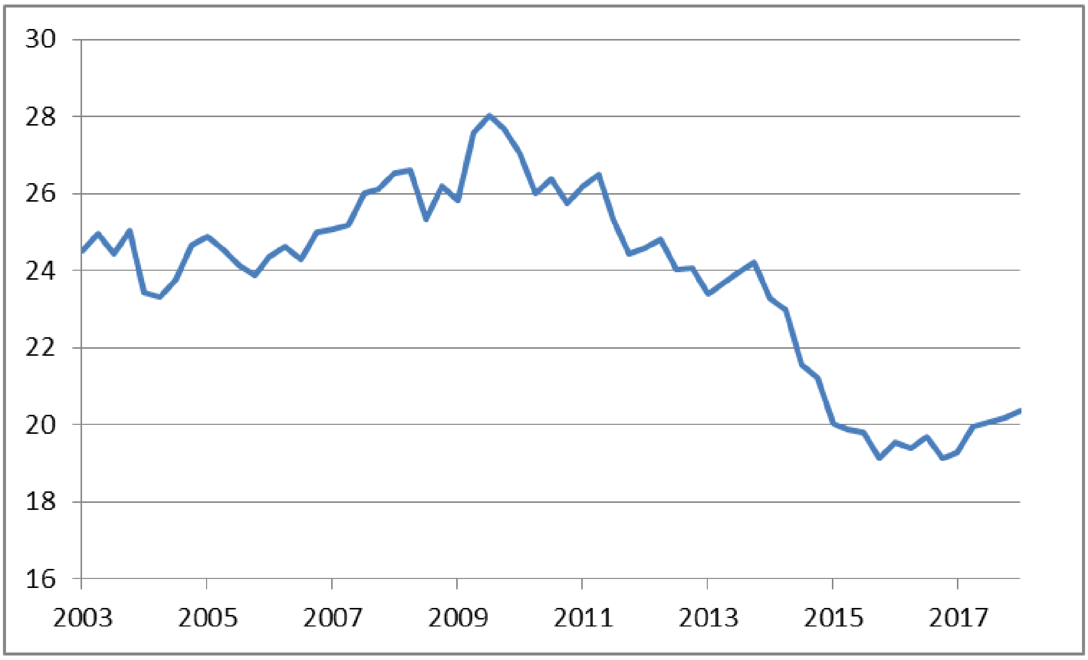


Chart 2: Percentage of allocated reserves held in euro



Source: Composition of Foreign Exchange Reserves, IMF

Chart 3: Effect of a shock to ECB's balance sheet on holdings of reserves in euro.

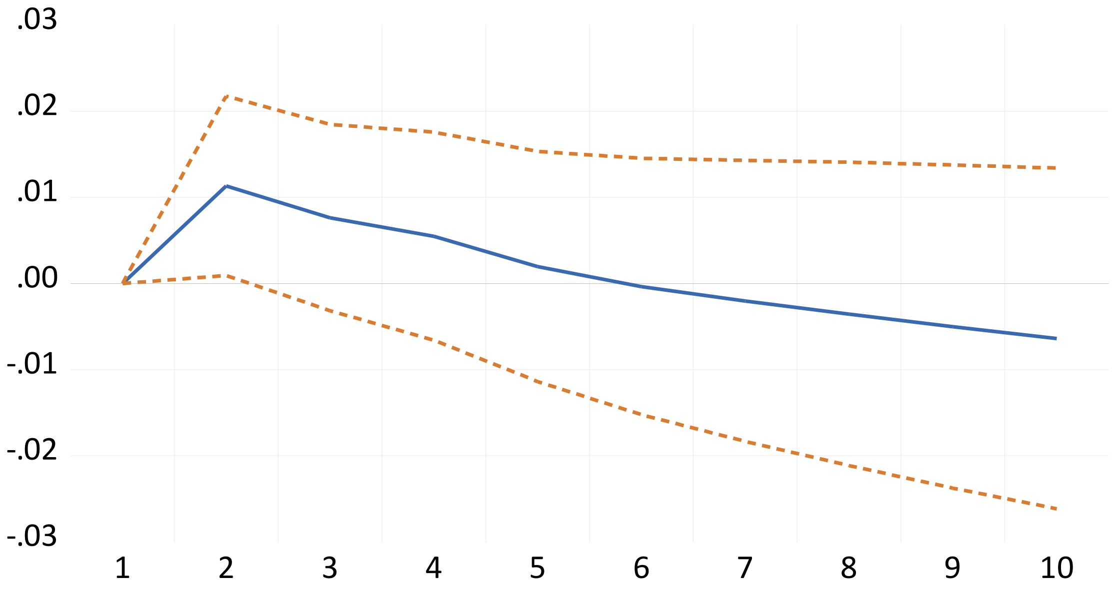


Chart 4: Change in euro reserves following an increase in ECB funding

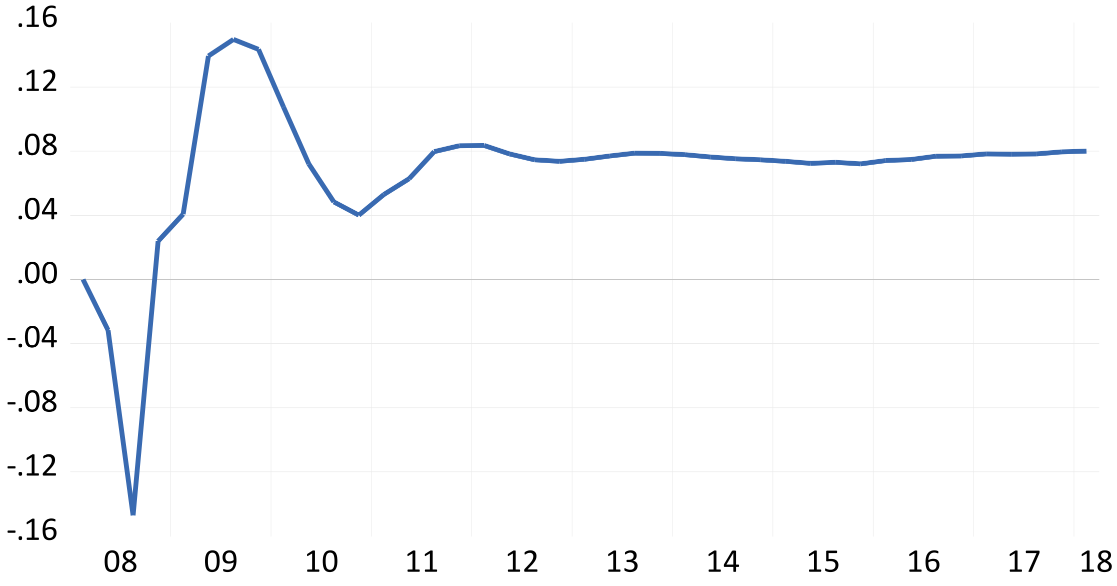


Table 1: Descriptive Statistics North vs South (average 2008:S2-2016:S1)

	Gross Loans to Assets	Total Liabilities to Gross Loans	NPL to Gross Loans	Liquid to Total Assets
South	0.64	1.47	0.10	0.06
North	0.42	2.29	0.04	0.14

Table 2: Descriptive Statistics North vs South

		% Change Peak to Trough	% Change Period Total
South	Assets	0.8%	8.2%
	Loans	-4.7%	0.0%
North	Assets	-17.4%	-11.0%
	Loans	-4.8%	1.0%

Table 3: Spatial Long-Run Equation for Gross Loans

Dependent Variable: Gross Loans

	Model 1		Model 2		Model 3-OLS	
	Coef.	z-score	Coef.	z-score	Coef.	t-stat.
W_1*Gross Loans	-0.28	-4.3				
W_2*Gross Loans			-0.39	-5.15		
Total Liabilities	0.38	56.26	0.38	56.82	0.38	22.5
ECB funding	**2.5**	8.27	**2.27**	7.43	**2.65**	**6.06**
Liq. assets/Tot. assets	-1.29	-3.97	-1.23	-3.87	-1.65	-6.01
NPL/gross loans	-0.93	-2.72	-0.99	-2.93	-0.48	-2.83
Lending Rate	-9.12	-3.14	-8.66	-3.03	-7.37	-2.75
Constant	124	7.17	140.6	7.71	72.13	6.53
Wald test of spatial terms:	$X^2(1)=18.53$; $Pr.>X^2=0$		$X^2(1)=26.52$; $Pr.>X^2=0$			
N. obs		912		912		912
R^2 adj		0.84		0.84		0.84
Ml est, wald Chi2		4807.67		4881.57	F-stat	348
Delta-Method	**W_1**		**W_2**			
	dy/dx	z-score	dy/dx	z-score		
Total Effects:						
Total Liabilities	0.3	20.31	0.28	18.65		
ECB funding	**1.98**	7.52	**1.65**	6.52		
Liq. assets/Tot. assets	-1.02	-3.71	-0.9	-3.63		
NPL/Gross loans	-0.74	-2.8	-0.72	-3		
Lending Rate	-7.21	-3.21	-6.31	-3.07		

Table 4: Spatial Error Correction Models for changes in Gross Loans

Dependent Variable: D(Gross Loans)

	Model 1		Model 2		Model 3-OLS	
	Coef.	z-score	Coef.	z-score	Coef.	t-stat.
W_1*D(Gross Loans)	0.18	2.01				
W_2*D(Gross Loans)			0.16	1.68		
D(Gross Loans(-1))	-0.2	-5.06	-0.19	-4.89	-0.2	-4.92
D(Total Liabilities)	0.2	15.7	0.21	15.88	0.207	15.46
D(Total Liabilities(-1))	0.06	4.41	0.06	4.28	0.065	4.26
D(ECB funding)	0.18	2.12	0.18	2.12	0.168	1.89
D(Real GDP)	0.09	1.89	0.09	1.93	0.08	1.62
Error Correction (-1)	-0.12	-5.67	-0.13	-5.95	-0.11	-5.04
Wald test of spatial terms:	$X^2(1)$= 4.06; Pr.>X^2= 0.04		$X^2(1)$)=2.81; Pr.>X^2= 0.09			
N. obs		741		741		741
R-sq adj		0.35		0.36		0.31
Ml est, wald Chi2		425.74		427.61	F-stat	50.01

Delta-Method	**W_1**		**W_2**			
	dy/dx	z-score	dy/dx	z-score		
Total Effects:						
D(Gross Loans(-1))	-0.24	-4.48	-0.23	-4.35		
D(Total Liabilities)	0.25	9	0.24	8.75		
D(Total Liabilities(-1))	0.08	4.04	0.07	3.93		
D(ECB funding)	0.22	2.08	0.21	2.07		
D(Real GDP)	0.11	1.86	0.11	1.89		
Error Correction (-1)	-0.14	-4.9	-0.15	-4.98		

Table 5: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5%- Critical Value	Prob.**
None *	0.66	62.6	46.2	0.0004
At most 1	0.40	29.8	40.1	0.44

Table 6: the estimated cointegrating vector from the ECM and its loading weights.

	Euro reserves	RGDP	INT	ECB	Fed	Exch. rate	VIX
coefficient	−1	4.6	0.62	0.02	−0.19	−0.32	0.05
Loading weight	0.07	−0.01	0.08	−0.1	0.2	0.01	0.6
t-statistic	−2.1	(4.1	(0.8	(0.8	−1	−0.3	−2

Appendix A

Results from the unbalanced panel with 88 banks 2007:S1-2016:S2. Non spatial approach.

Table A1: Long-Run Equation for Gross Loans

Dependent Variable: Gross Loans		
	Coefficient	t-statistic
Total Liabilities	0.38	24.28
ECB funding	2.56	6.73
Liquid assets/Total Assets	-1.67	-6.29
NPL/Gross Loans	-0.44	-3.46
Lending Rate	-4.12	-2.37
constant	58.47	7.02
N. obs		1285
R-sq adj		0.83
F(5, 1279)		407

Table A2: Error correction model for changes in gross loans

Dependent variable: D(Gross Loans)		
	Coef.	t
D(Gross Loans(-1))	-0.12	-3.26
D(Gross Loans(-2))	0.16	4.42
D(Total Liabilities(-1))	0.04	2.74
D(Total Liabilities(-2))	-0.05	-3.33
D(ECB funding)	0.25	2.74
Real GDP		
D(Real GDP(-1))	0.10	2.74
Error Correction (-1)	-0.12	-6.21
N. obs		1093
N. Groups		77
R-sq within:		0.09

Appendix B

Assuming two Northern and two Southern countries with two banks in each country a stylized representation of all our W matrices is as follows:

W1 North-North; South-South spillovers

		N1		N2		S1		S2	
		B1	B2	B1	B2	B1	B2	B1	B2
N1	B1	0	1	0.5	0.5	0	0	0	0
	B2	1	0	0.5	0.5	0	0	0	0
N2	B1	0.5	0.5	0	1	0	0	0	0
	B2	0.5	0.5	1	0	0	0	0	0
S1	B1	0	0	0	0	0	1	0.5	0.5
	B2	0	0	0	0	1	0	0.5	0.5
S2	B1	0	0	0	0	0.5	0.5	0	1
	B2	0	0	0	0	0.5	0.5	1	0

W2 North-North; South-South spillovers

		N1		N2		S1		S2	
		B1	B2	B1	B2	B1	B2	B1	B2
N1	B1	0	1	1	1	0	0	0	0
	B2	1	0	1	1	0	0	0	0
N2	B1	1	1	0	1	0	0	0	0
	B2	1	1	1	0	0	0	0	0
S1	B1	0	0	0	0	0	1	1	1
	B2	0	0	0	0	1	0	1	1
S2	B1	0	0	0	0	1	1	0	1
	B2	0	0	0	0	1	1	1	0

W3 North-South spillovers

		N1		N2		S1		S2	
		B1	B2	B1	B2	B1	B2	B1	B2
N1	B1	0	1	0.5	0.5	0	0	0	0
	B2	1	0	0.5	0.5	0	0	0	0
N2	B1	0.5	0.5	0	1	0	0	0	0
	B2	0.5	0.5	1	0	0	0	0	0
S1	B1	0.5	0.5	0.5	0.5	0	1	0.5	0.5
	B2	0.5	0.5	0.5	0.5	1	0	0.5	0.5
S2	B1	0.5	0.5	0.5	0.5	0.5	0.5	0	1
	B2	0.5	0.5	0.5	0.5	0.5	0.5	1	0

W4-5 GDP growth rates and lending rate correlations

		N1		N2		S1		S2	
		B1	B2	B1	B2	B1	B2	B1	B2
N1	B1	0	1	1	1	$\rho_{N1,S1}$	$\rho_{N1,S1}$	$\rho_{N1,S2}$	$\rho_{N1,S2}$
	B2	1	0	1	1	$\rho_{N1,S1}$	$\rho_{N1,S1}$	$\rho_{N1,S2}$	$\rho_{N1,S2}$
N2	B1	1	1	0	1	$\rho_{N2,S1}$	$\rho_{N2,S1}$	$\rho_{N2,S2}$	$\rho_{N2,S2}$
	B2	1	1	1	0	$\rho_{N2,S1}$	$\rho_{N2,S1}$	$\rho_{N2,S2}$	$\rho_{N2,S2}$
S1	B1	$\rho_{N1,S1}$	$\rho_{N1,S1}$	$\rho_{N2,S1}$	$\rho_{N2,S1}$	0	1	1	1
	B2	$\rho_{N1,S1}$	$\rho_{N1,S1}$	$\rho_{N2,S1}$	$\rho_{N2,S1}$	1	0	1	1
S2	B1	$\rho_{N1,S2}$	$\rho_{N1,S2}$	$\rho_{N2,S2}$	$\rho_{N2,S2}$	1	1	0	1
	B2	$\rho_{N1,S2}$	$\rho_{N1,S2}$	$\rho_{N2,S2}$	$\rho_{N2,S2}$	1	1	1	0

W6 Trade weights

		N1		N2		S1		S2	
		B1	B2	B1	B2	B1	B2	B1	B2
N1	B1	0	$\Sigma Imp_{N1}/GDP$	$\Sigma Imp_{N1,N2}/\Sigma GDP_{N1,SN2}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$
	B2	$\Sigma Imp_{N1}/GDP$	0	$\Sigma Imp_{N1,N2}/\Sigma GDP_{N1,SN2}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S3}$
N2	B1	$\Sigma Imp_{N1,N2}/\Sigma GDP_{N1,SN}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	0	$\Sigma Imp_{N2}/GDP$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{N2,S2}/\Sigma GD_{PN2,S2}$	$\Sigma Imp_{N2,S2}/\Sigma GDP_{N2,S2}$
	B2	$\Sigma Imp_{N1,N2}/\Sigma GDP_{N1,SN}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N2}/GDP$	0	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S2}$	$\Sigma Imp_{N2,S2}/\Sigma GD_{PN2,S2}$
S1	B1	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	0	$\Sigma Imp_{S1}/GDP$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$
	B2	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N1,S1}/\Sigma GDP_{N1,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S1}$	$\Sigma Imp_{S1}/GDP$	0	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$
S2	B1	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N2,S2}/\Sigma GD_{PN2,S2}$	$\Sigma Imp_{N2,S1}/\Sigma GDP_{N2,S2}$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$	0	$\Sigma Imp_{S2}/GDP$
	B2	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S2}$	$\Sigma Imp_{N1,S2}/\Sigma GDP_{N1,S3}$	$\Sigma Imp_{N2,S2}/\Sigma GDP_{N2,S2}$	$\Sigma Imp_{N2,S2}/\Sigma GD_{PN2,S2}$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$	$\Sigma Imp_{S2,S1}/\Sigma GDP_{S2,S1}$	$\Sigma Imp_{S2}/GDP$	0

Long run Equations using alternative Weighting matrices (W3-W6)

	Coef.	z
Dependent Variable: Gross Loans		
Total Liabilities	0.38	55.54
ECB funding	2.60	8.36
Liq. assets/Tot. assets	-1.64	-5.23
NPL/gross loans	-0.43	-1.29
Lending Rate	-6.85	-2.38
Constant	47.12	2.35
W3		
Gross Loans	**0.10**	**1.55**
Wald test of spatial terms:	chi2(1)	2.39
Prob > chi2		0.12
Log pseudolikelihood =		-5284.59
Pseudo R2		0.84

	Coef.	z
Dependent Variable: Gross Loans		
Total Liabilities	0.38	55.07
ECB funding	2.61	8.54
Liq. assets/Tot. assets	-1.58	-4.95
NPL/gross loans	-0.68	-1.81
Lending Rate	-8.92	-2.71
Constant	89.34	4.42
W4		
Gross Loans	**-0.06**	**-1.09**
Wald test of spatial terms:	chi2(1)	1.20
Prob > chi2		0.27
Log pseudolikelihood =		-5285.13
Pseudo R2		0.84

	Coef.	z
Dependent Variable: Gross Loans		
Total Liabilities	0.38	55.73
ECB funding	2.69	8.83
Liq. assets/Tot. assets	-1.65	-5.26
NPL/gross loans	-0.49	-1.47
Lending Rate	-7.96	-2.76
Constant	33.28	1.62
W5		
Gross Loans	**0.25**	**2.55**
Wald test of spatial terms:	chi2(1)	6.49
Prob > chi2		0.01
Log pseudolikelihood =		-5284.23
Pseudo R2		0.84

	Coef.	z
Dependent Variable: Gross Loans		
Total Liabilities	0.38	54.98
ECB funding	2.65	8.69
Liq. assets/Tot. assets	-1.66	-5.26
NPL/gross loans	-0.45	-1.25
Lending Rate	-7.27	-2.50
Constant	70.13	5.00
W6		
Gross Loans	**0.01**	**0.28**
Wald test of spatial terms:	chi2(1)	0.08
Prob > chi2		0.78
Log pseudolikelihood =		-5285.65
Pseudo R2		0.84

Appendix C

The results of the VAR model including international reserves in euros

	REALRRES	WGDP	INT	ECBTOT	FEDRES	DOLEUR	VIX
REALRES(-1)	0.50	0.00	0.23	-0.33	-0.66	0.50	1.57
	[3.11]	[0.60]	[1.00]	[-0.59]	[-0.88]	[3.58]	[1.44]
REALRRES(-2)	0.42	0.01	-0.09	0.46	0.96	-0.39	1.17
	[2.16]	[1.08]	[-0.34]	[0.69]	[1.07]	[-2.37]	[0.90]
WGDP(-1)	0.74	1.46	8.74	-10.49	-12.52	4.57	-20.60
	[0.24]	[13.19]	[2.07]	[-1.02]	[-0.91]	[1.79]	[-1.03]
WGDP(-2)	-0.40	-0.49	-8.23	11.32	14.28	-4.80	16.63
	[-0.14]	[-4.69]	[-2.06]	[1.16]	[1.09]	[-1.98]	[0.87]
INT(-1)	-0.11	0.00	0.95	0.44	-0.34	-0.19	0.79
	[-0.80]	[0.76]	[5.01]	[0.93]	[-0.55]	[-1.61]	[0.87029]
INT(-2)	0.07	-0.01	-0.12	-0.53	-0.07	0.25	-0.32
	[0.58]	[-2.04]	[-0.70]	[-1.33]	[-0.13]	[2.55]	[-0.40]
ECBTOT(-1)	0.08	0.00	-0.12	0.67	-0.15	-0.06	0.07
	[1.76]	[-1.29]	[-1.81]	[4.15]	[-0.69]	[-1.46]	[0.23]
ECBTOT(-2)	-0.08	0.00	0.03	0.16	0.00	0.08	-0.64
	[-1.57]	[0.50]	[0.46]	[0.92]	[0.01]	[1.79]	[-1.84]
FEDRES(-1)	-0.05	0.00	-0.19	-0.14	0.38	0.01	0.22
	[-1.17]	[-1.56]	[-3.53]	[-1.06]	[2.11]	[0.31]	[0.85]
FEDRES(-2)	-0.02	0.00	0.03	-0.01	0.02	0.00	0.08
	[-0.49]	[1.00]	[0.53]	[-0.06]	[0.08]	[0.07]	[0.27]
DOLEUR(-1)	-0.40	0.00	0.77	-1.03	-0.95	1.37	-0.63
	[-2.14]	[0.35]	[2.93]	[-1.60]	[-1.10]	[8.61]	[-0.50]
DOLEUR(-2)	0.41	0.00	-0.49	0.67	1.60	-0.57	1.00
	[2.62]	[0.17]	[-2.18]	[1.22]	[2.19]	[-4.19]	[0.94]
VIX(-1)	0.00	0.00	-0.01	0.09	0.10	0.00	0.13
	[-0.16]	[-1.57]	[-0.28]	[1.04]	[0.81]	[0.15]	[0.74]
VIX(-2)	0.01	0.00	-0.02	0.09	0.02	-0.01	0.10
	[0.24]	[-0.21]	[-0.54]	[1.14]	[0.18]	[-0.72]	[0.63]
C	0.33	0.03	-0.94	-1.67	-2.33	-0.73	-11.93
	[0.49]	[1.31]	[-0.97]	[-0.71]	[-0.74]	[-1.25]	[-2.61]

't' statistics in parenthesis

The impulse response functions