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EU Cross-Border Banking and Financial Crises: Empirical Evidence using the Gravity Model

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Abstract

This article considers the cross-border lending stock from 19 advanced countries as directed towards 28 European countries using quarterly data for the period 1999-2014. A "gravity" model is conditioned on distance and mass primarily measured by GDP as a benchmark adapted to explain the behaviour of cross-border lending stocks. We focus particularly on the role of EU integration on cross border banking, and show that there is no role for 'time zone' effects. The data permits an analysis of the effect of financial crises. These are differentiated by type into systemic banking crises and the Euro debt crisis Our results suggest that well-functioning institutions and EU Integration have a large effect on cross-border lending. However, there seems to be little impact from the single currency and from eliminating bilateral exchange rate volatility. These results are robust to a range of econometric specifications, samples, and institutional characteristics.

Keywords: Cross-border Banking, Exchange Rate Volatility, Gravity Model, Panel Estimation.
JEL classification: F21; F14; C23; G01

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1. Introduction

Understanding the drivers of cross-border asset movements has become a major topic of research in financial and international economics. The Bank for International Settlements (BIS) has indicated that in the decade up until 2012 cross-border banking increased significantly. This has occurred particularly between international banks and their non-bank customers. More specifically, it was reported in BIS (2011) that during the expansionary phase of the global economy, "cross-border lending to the cross-border banking and nonbanks components classified by residential banks" had tended to rise at a faster rate than the equivalent flow of credit.

Shin (2011) has shown that cross-border banking has had a critical role in the build-up of the global crisis, with European banks operating as a major financial intermediary with respect to the US banking sector and so competing in terms of size with the local financial sector. While, in the Euro zone, cross-border banking has been a leading factor in the build-up of housing bubbles and credit booms in countries such as Ireland and Spain (BIS, 2011). To understand better the financial crisis there has been a recent focus on cross-border banking at a gross and not a net level (Shin, 2011, and Borio and Disyatat, 2011), and we also use gross lending data.

The market trend towards cross-border banking has been enhanced in Europe by a number of EU policies trying to reduce legal barriers to achieving a single market for financial services. Generally, market integration was one of the primary purposes for the foundation of the EU. The EU single market for financial services has progressed at a slower pace when compared with other markets. EU policy action to foster financial market integration in the last two decades has translated into a number of regulatory initiatives aiming at overcoming legal barriers to cross-border banking activity among EU financial institutions. We test for the effects of these changes

We examine bilateral country-level data available from the BIS on cross-border lending from 19 advanced countries, the only home or source countries in the database, directed towards European countries using quarterly data for the period 1999-2014. The extent of this data gives us the capacity to analyse how the geography of cross-border banking is impacted by the financial crises. We consider whether EU has resulted in significantly more internal cross border banking, and also look at the effect of monetary integration on cross-border banking. A broad range of determinants of cross border lending are considered in order to be able to isolate the effects of recent financial crises and their aftermath. A larger set of observable macroeconomic indicators are adopted than in the earlier literature, and the distinction is made between expected and unexpected exchange rate developments.

Our key findings are that European integration has been an important factor driving the growth of cross border banking. In addition, well-functioning institutions are a driving force for cross border lending stocks. Furthermore, our results suggest that the Euro debt crisis has had a strong and long lasting negative impact on cross border lending, whilst other crises have had no lasting impact. The paper is organised as follows. Section 2 provides a brief review of the theoretical and empirical literature on cross border banking and financial stability. Section 3 describes the data. Section 4 outlines the econometric methodology. Section 5 discusses the empirical results and section 6 looks at the robustness of our results. We then conclude.

2. Cross-Border Banking

The primary basis for the analysis of cross border lending in this paper is the gravity model that considers the factors that push and pull cross border lending. A key set of components of gravity we use are a breakdown of proximity into distance, common borders, common languages and time zone difference. To these are added the conventional gravity variables that measure the mass of the respective economies. We also add specific risk factors such as exchange rate volatility and financial crises. The nature of the different crises is analysed further to see how they affect cross border lending.

Empirical Gravity models have already been employed in the analysis of financial flows (Portes and Rey, 2005; Buch, 2005; Claessens and van Horen, 2013) and it seems that distance and size matter for financial markets. In the international trade literature, distance is seen to be a proxy for transportation costs, whilst for international banking geographic distance can be seen to proxy informational frictions and/or monitoring costs (Brüggemann et al., 2012). Based on different panel methodologies the findings of such models indicate that geography, institutions and politics are core drivers of international banking activities.

Brüggemann et al. (2012) provide a theoretical motivation for an empirical gravity model of the distribution of the international assets of banks. They develop a model in which they consider a company (g) located in country (i), looking for a bank loan with specific maturity, volume, interest rates, or other contractual features. This search is undertaken in a number of countries (n), including the home country. The company selects a bank (k) in a specific country (j). The bank is seeking to obtain the best rate of return relative to risk on its loans subject to cost and the extent to which the loan offer is attractive to the customer. The following equation (1) is used to explain the lowest cost at which a bank can supply a loan:

$$C_{i,g,j,k} = \delta_1 r_j + \delta_2 \pi_{i,j} + \delta_3 a_j + \varepsilon_{i,g,j,k} \qquad (1)$$

Where this cost depends on factors such as geographic distance, which affects the cost of monitoring (π_{ij}). Total costs are measured by the average interest rate in a specific country (r_j), average bank characteristics (a_j) and a residual term capturing any unobservable cost and bank-company-specific traits ($\varepsilon_{i,g,j,k}$). The company compares the offers of banks located in different countries and chooses a specific bank that depends on the characteristics of the country pair. For a given distance, we would expect that larger home countries would offer more bank loans and larger customer countries would require more loans, and hence both countries should have influence based on the size of their economies in the model. This approach with cost minimising behaviour on the part of the borrower and the risk assessment by lenders lead to a gravity like explanation of international bank lending.

Many existing studies have emphasised the importance of banks that directly experience crisis in the home country. It is documented in the literature that banks decrease their local lending (Ivashina and Scharfstein, 2010) and their cross-border lending (Cetorelli and Goldberg, 2011; Milesi-Ferretti and Tille, 2011 among others). This also occurs with local lending by foreign offices (see Peek and Rosengren, 2000; Popov and Udell, 2012 and Cetorelli and Goldberg, 2011). However, the reduction in cross-border lending is limited to

banks which are geographically closer to the customer and that have a domestic office or strong historical ties to domestic banks (De Haas et al., 2013). Giannetti and Laeven (2012) suggest that there is a 'flight home effect', implying there may have been an increased propensity for banks to display home bias in the disposition of their loan portfolios. Herrmann and Mihaljek (2013) investigated the effect of the financial crisis and show country specific risk factors are important determinants of cross-border bank flows especially global financial market volatility, fiscal deficits and deteriorating banking sector performance. However, all these effects are seen as a temporary reaction to financial stress.

The European Union (EU) has been focused on enhancing cross border banking by forming a single market for financial services with a common legal framework and regulatory regime. To progress this, the EU has made operational the "passporting principle" (article 23 CRD) so financial organizations based in an EU member state are permitted to operate in all EU nation states. That is by subsidiaries, branches, or agencies established in other EU member states or from their home offices directly. We should therefore have seen a significant increase in cross border lending and in financial integration in the EU in the last 15 years. Papaioannou (2009) found that, the European integration process has encouraged cross-border banking activity between member states with EU membership being indicated as a factor increasing cross-border banking. They suggest the likely conduit being changes in banking law and the elimination of exchange rate risk. However, it is possible that the recent financial and Euro Area crises may have reversed some of these effects. Cerutti and Claessens (2013) have argued that in recent years international banks have sharply reduced direct foreign lending and lending to domestic affiliated subsidiaries'. They have suggested that the Euro Area crisis could have permanent effects, and we test that hyporthesis here.

3. Empirical Design and the Data

The dependent variable used for estimation is the level of bilateral loans by each lender country to each of the borrower countries[1]. This measure is retrieved for 19 advanced economies lending to European recipient countries from the Consolidated Banking Statistics provided by the BIS. This compares with studies by Herrmann and Mihaljeck (2013), and Cetorelli and Goldberg (2011) among others that use BIS aggregate country-level data on foreign bank and cross-border bank claims.

The BIS's, International Banking Statistics are divided into the Consolidated and the Locational accounts.[2] Consolidated banking statistics are appropriate to an investigation of bank lending determinants since they allow us to look at the exposure pattern by lenders and borrowers' nationality (Herrmann and Mihaljek, 2013) and this information is not available from other databases such as the IMF or the World Bank. The "foreign claims" data are drawn from the consolidated banking statistics.[3] The data used are on an immediate risk basis as they cover a longer time horizon and they enable data collection for each country

[1] A description of the BIS data on international bank lending, along with data definitions and sources can be found in Table (1)

[2] The BIS Locational Banking Statistics benefit from a long time horizon, broad country coverage, and dis-aggregation into assets (i.e. loans) and liabilities (i.e. deposits) vis-à-vis different customer groups. However, the Locational Banking Statistics are either disaggregated by reporting (e.g. bank) country or vis-à-vis for example customer.

[3] Foreign claims comprise cross-border claims of domestic banks and their foreign offices (in domestic and foreign currency), as well as local claims of reporting banks' foreign offices in domestic and foreign currency (BIS, 2003).

pair.[4] Cerutti and Claessens (2013), among others have used the Consolidated International Banking Statistics to examine bilateral lending between advanced and emerging economies over the period of the financial crisis. By comparison, Bruno and Shin (2014) use the Locational International Banking Statistics to analysis aggregate banking flows to emerging and advanced economies.

The dependent variable used for estimation is an aggregate of loans left outstanding by all lenders to each of the customer countries collected on a quarterly basis for the period 1999 Q1 to 2014 Q4 for European countries from bank sector to banks and non-bank sectors. The sample covers a large geographic range, which extends to 19 lending countries related to 29 individual customer countries (see the appendix). Following Cerutti (2013), the analysis considers exchange rate variations to adjust valuations of stocks. These corrections are critical to achieve a representation of the evolution of banks claims. To eliminate the impact of exchange rate valuation, we calculate quarterly exchange rate-adjusted stocks. Firstly, the original nominal stock is taken for the second quarter of 1999 and then successively the BIS's quarterly exchange rate adjusted changes are added. The BIS reports all stocks and flows in the US$ independent of the currency in which the initial cross-border loan transactions are denominated. To calculate exchange rate adjusted changes (changes in stocks that are free of exchange rate valuation effects), we first have to convert stocks at the previous quarter (T_0) and the current quarter (T_1) into their local currency by applying the US$ exchange rates, and then convert their changes from the local currency back into the US$ using period average exchange rates (BIS (2003)).

The set of variables we use follow from the 'push' and 'pull' factors observed in the previous empirical research considered above. There are three primary factors that relate to the size dimension or the mass of the relative economies, then tradelinks and finally distance. Economic size is measured by the product of the GDPs of lender countries and borrower countries. Generally, Gravity models stipulate that a positive coefficient for the size of both lender and borrower countries. However, banks in a lender country with a larger lender market are less dependent on business in foreign markets. Therefore home GDP could reduce cross border activity. Similarly, smaller borrower markets could attract more cross-border loans than larger ones, so the size of borrower GDP could be negative. The sign of GDP coefficients thus has to be empirically determined.

Obstfeld and Rogoff (2000) provide both theoretical and empirical evidence to show that information gathered from trading across goods markets should encourage transactions in financial assets. Rose and Spiegel (2004) indicates that an increase in the expected bilateral trade volume with a given country is associated with an increase in borrowing in that country. If these arguments are valid, then higher bilateral exports encourage financial inflows into the borrower countries.

Bilateral geographical distance can also be seen as a proxy for informational asymmetries and transaction costs between lender and borrower countries (de Haas and Van Horen, 2013). They show the greater the distance between the lender and borrower countries, the larger the cut in bank claims, and that distance is statistically significant. Mian (2006) shows that

[4] A disadvantage of the consolidated BIS data is that they also contain local claims that are denominated in a foreign currency. However, at least for the larger countries in the EU, this issue should be less important.

lending over larger distances could increase, but this is limited as a result of transaction and enforcement costs.

Buch et al. (2010) indicate the cross-country differences that could play a role in determining banks' cross-border activity are differences in language, culture and legal system. The calculation of distance in terms of other forms of proximity in a more generic sense may also be accounted for by a common official language, a common land border and in part by a dummy that accounts for membership of the European Union. In terms of potential misspecification these variables are useful to reduce variable omission as they are proxies for both financial, informational and other frictions between lender country and the borrower. Linguistic ties could diminish informational frictions for two reasons; the existence of a common language may reduce costs of communication during credit negotiations and language may serve as a proxy for cultural proximity as sharing a common language often coincides with common historical and cultural influences. This is consistent with the notion that transaction costs with a local presence are less, and cross border lending from the lender may be more feasible with the borrower from abroad who shares a language.

However, none of these variables captures the transaction costs related to the need for frequent interaction in real time between the parties. Distance does not fully capture this effect as telephone, e-mail and teleconference communication are close substitutes for face-to-face interaction. The time zone differential between the capital cities of the creditor and borrower countries is used as a variable in this research, as far as we can see for the first time in studies of cross border banking[5]. The transactions cost associated with time zone difference should be important in activities that require an interaction deal in real time. Hence cross border banking offers a perfect setting in which to show the effect of differences in time zones. International banking business still depends on a degree of personal contact even with the internet and modern telecommunications (see, Martin and Rey (2004)). With longer distances this should reflect travel cost and facility with a far away language and more likely cultural differences suggesting weaker business links (Ahearne et al., 2004).

The rate of return is measured using the differential in lending rates between the lender and the borrower countries. These are available as quarter averages of monthly data on three-month nominal interest rates in each lender country and borrower country. The nominal interest rate is used as banks compute all expected profit and loss using nominal rates and relative to the lender country this is not affected by deducting a single country inflation rate from both terms implying that the institution either considers the return relative to the local cost of borrowing at an internal rate or relative to the lender rate. This variable is predicted to be positively related to cross-border banking, as an increase in a country's interest rate increases its income from lending. The higher interest rates in the borrower country or, conversely, lower interest rates in the lender countries should lead to an increase in lending in the borrower economies.

There are a number of factors that could represent specific risks, such as those from political systems or from currency volatility. The Financial Freedom Index[6] is used as a proxy for

[5] The variable is constructed based on standard time zones, abstracting from the issue of daylight savings.

[6] Financial freedom is a measure of banking efficiency and the independence from government control and interference in the financial sector. This indicator is considered to assess an economy's total level of financial freedom that guarantees

other risk factors perceived by the lenders. This is a measure in the range 0-100 and used in relation to the lender country and borrower country. How this affects cross border lending would appear to be an empirical question with an index for the lender economies that is likely to be less important as they are more homogenous than the borrowers. The effect of exchange rate volatility on cross border banking has been discussed in the literature for emerging countries, but there is currently little agreement on the direction of these effects regarding developed economies. We include it is our robustness checks, along with an indicator of membership of the Currency Union.

In this paper we use GARCH(1,1) to construct a measure of volatility as this fits all our 184 cross exchange rates. The volatility measure of the nominal exchange rate is constructed by first taking the log difference of daily exchange rates calculated from data taken from the IFS database.[7] Daily conditional variances are used to construct an indicator of quarterly volatility. The details for each bilateral pair of currencies are given in Table in Appendix B.

Additionally, this study contributes to the research by examining the effect of currency union $CU_{i,j,t}$ [8] (the group of countries that adopt the Euro currency as their national currency) on cross border banking in the context of the EU. Moreover, the single currency has eliminated exchange rate risk for transactions within the Euro zone. This can be viewed as an indirect test of 'deep integration' as sharing the same legal tender not only eliminates exchange rate volatility, but constitutes a cut of the transactional and informational barriers that apparently play a major role in shaping international banking decisions.

A number of variables are devised to take account of different forms of crisis. Systemic crises are denoted by dummy variables that normally take the value zero, but take the value 1 for the four quarters related to the crisis period, and we also test for the permanent effect of systemic crises with a step dummy. The Euro Area crisis from 2011 is also denoted in this way in order that we can test for a sustained effect. It is important to differentiate between the effects of the impact of systemic crisis on home countries, the impact of systemic banking crises on host countries and the euro debt crisis on cross-border banking, and we do so in our experiments. In our sample 19 countries experienced systemic banking crises, with 17 in host economies and we assume that the UK and the US experienced separate crises in both 2007 and 2008 (see Appendix) and each has a dummy in that takes the value 1 for the four quarters after the inception of the crisis.

A major focus of this paper is on the impacts of European Integration on financial markets, and we include a dummy where both countries are members of the European Union, This enables us to assess the effect of the ongoing European integration in cross-border banking activities, and to draw conclusions for the UK on the impact of withdrawing from the Single Market in Financial Services. The EU Single Market Act and the subsequent Financial Service Action Plan purposed to remove both barriers in cross-border movements of capital by harmonising banking law and financial services' regulation. Data definitions and sources can be found in Table (1) below.

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easy and effective access to financing opportunities for businesses in the country. An overall score on a scale of 0 to 100 is given to a country's financial freedom through deductions from the ideal score of 100.

[7] The original conversion rates were determined by the Council of the European Union based on a recommendation from the European Commission using market rates as of the 31st December 1998.

[8] Dummy variable that equals 1 if countries i and j use the same currency at time t and 0 otherwise, see Appendix C4

Insert Table (1) here

4. Econometric methodology

The variables considered above are incorporated within the specification of the Gravity model. In addition to the push and pull factors considered in the previous literature, indicators to capture country specific financial efficiency are important determinants of cross-border lending. Here the recent literature is extended to link the determinants of cross-border banking and financial stress indicators (see Buch et al., 2010; McGuire and Tarashev, 2008; and World Bank, 2008).

Underlying the model there is a set of country specific variables that capture the gravitational effects related to equation (1). Several of the variables are dummies that operate like classic fixed effects when the data are pooled across country transactions. A single model specification with the addition of such variables would capture country specific heterogeneity in this way. An alternative to the fixed effects specification is the random effects estimator that captures heterogenity in the structure of the error.

The primary Gravity model specification is presented in equation (2.) below.

$$\begin{aligned}\mathrm{Log(L)}_{i,j,t} = {} & a_{i,j} + b_1\mathrm{LogGDP}_{i,t} + b_2\mathrm{LogGDP}_{j,t} + b_3\mathrm{LogBEXP}_{i,j,t} + b_4\mathrm{LogDIS}_{i,j} \\ & + b_5\mathrm{RateDiff}_{j,i,t} + b_6\mathrm{finfreedom}_{i,t} + b_7\mathrm{finfreedom}_{j,t} + b_8\mathrm{border}_{i,j} \\ & + b_9\mathrm{Lang}_{i,j} + b_{10}\mathrm{EU}_{i,j,t} + b_{11}\mathrm{TimDiff}_{i,j,t} + b_{12}FC_t + b_{13}\mathrm{SYS}_{j,t} \\ & + \varepsilon_{i,j,t}. \qquad (2)\end{aligned}$$

In terms of right-hand side variables in equation (2), the fundamental drivers of cross border lending are accounted by the lender (push) and borrower (pull) factors that figure in the previous section. Where (*i*) and (*j*) indicate the "lender" and "borrower" country respectively and *t* denotes the time dimension of the sample in quarters. Where the log denotes the natural logarithm and the dependent variable $L_{i,j,t}$ is the exchange rate-adjusted stock of cross-border loans in quarter *t* from banks in lender country (*i*) to the borrower country (*j*). that is bank and non-bank sectors of borrower EU markets, respectively. *GDP* appears in equation (2) separately for country (*i*) and (*j*) to determine the relative effect of the size of a country market. $BEXP_{i,j,t}$ measures bilateral exports from the lender to borrower country and $DIS_{i,j}$ is the geographic distance. The following dummy variables take values 0 or 1: $Lang_{i,j}$ captures a common official language, $border_{i,j}$ a common land border and $EU_{i,j,t}$ membership of the EU by both countries. The variable $RateDiff_{j,i,t}$ is the spread between the lending interest rate in the borrower country relative to the lender country. While $TimDiff_{i,j}$ captures the time zone differential and *finfreedom* is the Financial Freedom Index entered separately for lender country (*i*) and borrower country (*j*). The errors $\varepsilon_{i,j,t}$ are assumed to be identically and independently distributed (IID) random error terms that are mean zero with variance $\sigma^2_{i,j,t}$ Equations (2) is estimated by the random effects model to capture heterogeneity not explained by the underlying specification of the model.

We investigate financial crises by including variables that distinguish between the Euro crisis denoted by the variable FC_t and $SYS_{j,t}$ which is a systemic banking crisis dummy variable related either to a borrower or lender (host and home) country experiencing a crisis in quarter *t*. For brevity we do not separately denote here that the Euro and the Home and Host Systematic dummies are also entered as permanent step indicators in one set of experiments. We also use a Systematic dummy for each of the UK and US crises in 2007 which we see as separate from the later crisis.

Consideration in computing the standard errors is given to controlling for clustering[9] and thus accounting for cross-sectional dependence. Even were random effects estimation adequate to control for clustering at the country-pair level, robust and cluster–robust VCE estimators are useful; as is explained by Wooldridge (2013). When borrower-country clustering is controlled for, in most cases higher standard errors are obtained. This occurs as there is a trade-off between bias and a loss of precision in the calculation of robust standard errors so it was decided that it may be better to adjust the error at the country-pair level.[10] These methods ensure that serial correlation is absent in our sample, and hence there is no need for a lagged dependent variable[11]. The Lagrange multiplier (LM) test due to Breusch and Pagan (1980) is also employed to test for the appropriateness of our model specification and further discriminate between a random effect specification and OLS[12]. In pooling the model both intercept and the coefficients on the explanatory variables are seen to be the same for each of the cross-sectional units. The null hypothesis of the LM test is that there is zero co-variation across the cross sectional entities. When the null is accepted, then there is no significant behaviour in any of the error components across such units.

5. Empirical Findings

Our primary focus is on the direct effect of the factors affecting the stocks of cross border lending to European Markets from advanced economies.[13] The results summarized in Table 2 initially relate to the conventional Gravity model above. Column 1 contains just distance, trade, relative GDP and the financial freedom indicators, and all are significant. In column 2 we add a time zone indicator, as this is expected to reflect the need for electronic facetime interaction in banking. It appears significant. In column 3 we look at indicators particularly relevant tour European focus, with common borders, common languages and membership of the EU as explanatory variables. The border effect is marginally significant and negative. The effects of the EU and of language are also significant, but positive, raising cross border

[9] Clustering, in the context of panel data involves computing standard errors and test statistics that are robust to any form of serial correlation and heteroscedasticity (Wooldridge, 2013). Additionally, Arellano (1987) proposed that clustering with a panel country pair produces an estimator that is robust to cross-sectional heteroscedasticity and within-panel (serial) correlation.

[10] Among others, the following authors have investigated this: Blank et al. (2009), Victoria and Scharfstein (2010), Kleimeier et al. (2013), Cerutti and Claessens (2013), De Hass and Van Horen (2013), Buch et al. (2014), Bologna and Caccavaio (2014), Reinhardt and Riddiough (2015), Papi et al. (2015) and Acharya et al. (2015).

[11] Even if we did include a lagged variable, we would not need to instrument, as we have T in excess of 30. See Nickell (1981)

[12] Breusch and Pagan (1980) first developed an LM test for random coefficient variation and Baltagi and Li (1990) modified this for the panel case. In this study, the test is used to determine whether individual (or time) specific variance components are significant. An LM statistic is under the null of correct specification of the model and follows a chi-squared distribution with one degree of freedom when the simple form of the test is conducted.

[13] All estimations were undertaken in STATA 13.0.

lending. When we combine these indicators with time zone in column 4 that variable is no longer significant. This is not surprising given the density of countries in the EU, and the fact that they largely share one time zone, and cover only 3, whereas countries like the US, Canada and Australia have more time zones within them. We keep time zone indicators in our other experiments in Tables 2 and 3, but we would suggest that as they are not significant, they were acting for the impacts of European integration on cross border banking.

The EU coefficient estimate is economically and statistically highly significant; this implies that cross border banking between member states has been much higher than we would expect given the normal determinants of cross border banking. This would suggest substantial gains to integration for the banking sector, and that integration in the banking sector would appear to have taken the form of increased cross-border lending and rather than aquisitions and mergers as occurs in the US. Given our dependent variable is in logs we can say that membership of the EU raises cross border banking by 60 percent in comparison to the lvel we would otherwise have seen.

Insert Table 2 here

The next five regressions are estimated including a set of dummy variables to explain the effects of systemic banking crises. The presence of systemic crises in the borrower country in column 5 seems to lead to an increase in cross border lending as compared to what might have been expected giventhe falls in GDP when there is a crisis. Specifically, borrowers whose banking systems respond to the direct effect of a crisis may feel the impact of overall credit restrictions early (Kleimeier et al., 2013)[14]. Financial crises provide a particularly strong push towards cross-border loans stocks. Crises in home, or lender, countries also seem to have little immediate impact on lending, as the impact is positive, once again suggesting that lending falls much less than might have been expected given the fall in GDP. However, the earlier lender country crises in the UK and the US in 2007 had little (positive) impact on lending, as we can see from column 7 of table 2. This may reflect the much smaller falls in output associated with the 2007 crisis than were seen after the 2008 crisis that followed. In columns 8 and 9 we combine the crises. As the UK and US crises are also included in the Home dummy when we combine the two crises in one regression we get an offsetting effect that is significant for the UK and US crises. In general, we can conclude that cross border lending did not fall as much as we would have expected in the wave of banking crises we experienced in the last decade It probably helped support output in host countries during this period. We note that the other coefficients in the model are little affected.

We also wish to look at the effects of the Euro Area Sovereeign debt crisis that started in 2011. This spilled over in to the banking systems of the countries involved, but it is not classified as a banking crisis in Laeven and Valencia (2013). We introduce it in Table 3, first as a crisi in its own right and then in combination with the preferred dummies from our banking crisis investigation in Table 2. It is important to test whether crises have had a permanent effect on cross border lending, especially in Europe where it had risen most rapidly, and where the Sovereign debt crisis led to a regulatory response. The first two columns of Table 3 test this for the host country effects of systemic crisis in 2008, and we can see there is a significant effect in the short term, but no long term effect. The Euro debt

[14] We experimented with quarterly dummies and time periods longer than one year for crises, but these alternatives added little.

crisis, which started in quarter 3 in 2011, had a strong adverse effect on cross border banking in European markets, as we can see from the next two colums of Table 3[15]. The Euro Crisis had more of an impact on cross border banking than previous crises as it brought to the fore the necessity for specific lender country regulation of banks, and therefore reduced the incentive to undertake foreign banking. As the cooefficent on the permanent the Euro Area crisis dummy is significant it appears to have permanently reduced cross border banking in the region, reversing part of the previous increase in finanacial integration. However, there is some evidence tat cross border lending from elsewhere did not fall as much as the coefficient on time difference becomes larger in absolute magnitude, is negative and signficant at the 10 percent level.

In columns 5 and 6 we look at the temporay and permenent effects of home country systemic crises, and we can see that the short run effects are larger than the long run effects, and in both cases the effects are positive. This suggests that the impacts on lending are rather less than our model would suggest. We prefer to use the larger, short run home country dummy in column 7 where we combine crises. This brings out the unique nature of the Euro Sovereign debt crisis, emphahsisng the regulatory response from a number of countries to protect the integrity of their banking systems that reduced cross border lending within Europe.

Insert Table 3 here

Our other results are similar across experiments. We find that although both push and pull factors had an impact on cross border lending during the period of study, in general home factors dominated over host factors, suggesting that the simple gravity model approach did not explain all of the patterns we observe. For all the regressions, the size variable for both the lender and borrower is a positive and significant determinant of cross-border lending. This is not inconsistent with Papaioannou (2009) and Alfaro et al. (2008). It is noticeable that economic size for the lender country is more important than that of the borrower country for cross-border lending for all the empirical results in Table (2), and in general it is a third larger. The size of the lender countries may be a stronger determinant in explaining cross-border lending from advanced economies to European markets because of agglomeration and efficiency effects of scale in banking.

The results for the lending rate differential in the case of cross-border lending was positive, but not significant. Our result supports a common finding in empirical studies that showed that interest rates and interest rate differentials do not play as important a role as economic theory suggests in terms of cross border lending. Kleimeier et al. (2013) found that interest rate differentials are not important when they studied cross border lending from 23 countries to 165 countries.

With respect to the other factors, the regression results show bilateral exports have a positive and statistically significant effect on cross-border banking between lending and borrowing countries. The positive correlation between exports and lending can be explained, as exports have traditionally been a key avenue for the international expansion of bank lending. Further,

[15] We experimented with quarterly dummies, and these varied in significance by quarter, but were present for a long period after the onset of the crisis. A single, permanent dummy was preferred.

a strong export relationship between two economies may help enhance information flow between lenders and borrowers, which should enhance lending (see Rose and Spiegel, 2004).

Financial freedom, seen as a proxy for banking risk as well as efficiency in lender and borrower financial systems was positively related to cross border lending. The coefficient is larger and more significant in home countries, suggesting that lenders from countries such as Switzerland, the UK and the US as well as Canada and Australia can rely on their domestic institutions when entering in to contracts to potentially less well governed European markets.

The bilateral distance coefficient is negative and significant at the 1% level across all regressions indicating a decrease in the volume of lending with geographical distance between lender and borrower countries. This is consistent with the cross-border financial flow research as can be observed from the findings in Portes and Rey (2005), Buch (2005) and Degryse and Ongena (2005) suggesting distance makes it more difficult to monitor borrowers because of increasing transaction costs.

6. Robustness and Sensitivity Analysis

In this section some robustness checks are considered with respect to extra variables related to the exchange rate and financial centres. In particular, we add major financial centre dummies to investigate whether they impact on the pattern of cross border lending. We also test for risk factors with the addition of a new exchange rate volatility variable, adding to the literature related to European markets. We undertake tests including a currency union dummy for countries that adopted the Euro as their national currency These results are presented after we controlled for other factors that are simultaneously influencing cross border banking.

6.1 Exchange Rate Volatility

The general conclusion from our robustness checks on exchange rate variability is that it has little effect on cross border bank lending. The results in Table (4) indicate that our first measure of variability based mainly on Garch(1,1) indicators is that exchange rate volatility has not had a significant effect on cross border lending to European countries[16]. These results are in line with individual country studies such as Düwel and Lipponer (2011) who study German bank's foreign lending. They note that the extent to which the Euro Union favours lower exchange rate volatility, it is only marginally beneficial to cross border lending.

The Euro Area dummy variable is positive, but not significant across all the results in Table (4). This suggests that currency union in these groups did not significantly affect the stock of cross border lending. In contrast, the EU dummy is positive and statistically significant suggesting that regional integration may have removed key barriers to cross border lending among European countries. This indicates that the process of European integration may cause the insignificance of the Euro dummy as these two variables are not orthogonal. They

[16] In terms of the measures used to capture volatility, potential endogeneity between cross-border banking and nominal exchange rates should not be a problem (see Herrmann and Mihaljek, 2013). The volatility in the bilateral exchange rate is an indicator of financial instability and exchange rate risk and this has been represented in the estimation work by an average of the end of quarter variance of daily bilateral exchange rates.

are both positive though the EU dummy coefficient becomes less important when the currency union dummy variable is added.

Neither of the indicators in this section are significant. Additionally, estimates of the other parameters in Table 4 across all regressions are comparable with the results presented in Table (2). Hence, we can see our results are robust to the exclusion of indicators of exchange rate related risks.

Insert table 4 here

6.2 Financial Centre effects

In the financial services sector, internationalisation played a critical role in the recent crises, increasing challenges for firms, regulators and investors. There has been an increase in the discussion of International financial centres (see Park and Essayyad, 1989). It is suggested that such centres have unique features, which benefit international banking in general and the borrower country. They spur the multinational banks growth by providing a preferable fiscal and regulatory climate. From the point of view of multinational banks, establishing a presence in financial centres is termed "going where the business is" (see Tschoegl, 2000). Thus, to meet other banks via subsidiaries and/or branches to develop specific business lines and that is inter-bank activities or trading in the wholesale financial market. Furthermore, financial centres provide agglomeration economies, which benefit bank revenues, reduce their costs and are supposed to encourage innovation.

The consolidated banking statistics used here capture some of the problems caused when some exposure is related to financial centres as some account is made of locational banking (see Herrmann and Mihaljek, 2013).[17] Even given the special nature of the dataset used, the robustness of these results is checked by including a dummy variable for countries hosting a financial centre (see Table 5), as classified by the IMF such as the United Kingdom, Luxemburg and Switzerland.

As is seen from these regressions, the UK dummy has no real no impact on cross border lending, and is only significant at the 5 percent level in one of our six experiments. Cross border lending from the UK may be higher than we might expect, given other factor, by 60 per cent of more, but it is not clear that the UK has any unique advantages. On the other hand, the Luxemburg dummy has a significant positive effect in all experiments. This can be interpreted as evidence that lower regulatory barriers or lower information costs increase the volume of international bank activity in that centre. Recently, Luxembourg developed as a centre for private banking and currently it is the largest European centre for the domicile of investment funds (IMF, 2009). Growth may have been enhanced by tax and regulatory advantages in addition to Luxembourg's swift implementation of EU directives (OECD, 2008, 2010). In addition, it clear that there is a significant role for the Swiss dummy, as it is significant in five of our six experiments. This may reflect the specific tax and secrecy advantages offered by that country over the period in hand. However, recent regulatory changes have removed some of the advantages given by Swiss law, and these may be less important for bank lending than for depositors.

[17] The use of the locational banking statistics in a Gravity model might pose a problem when some exposure is related to banks in financial centres.

The results are affected by the inclusion of the Language, Border and EU dummies. Without them Luxembourg looks like it has 250 more lending than would be expected, whilst when we include these controls it has only 170 percent more than we would have expected. The Swiss have a significant coefficient once the controls are included, and the results suggest that there is 60 percent more cross border bank lending by the Swiss than we would otherwise have expected. Additionally, estimates of the other parameters in Table 5 across all regressions are comparable with the results presented in Table (2). This confirms that the inclusion of country specific dummy variables to capture financial centres does not noticeably impact the results, and hence omitting them from Table 2 does not bias the coefficients or change our broader conclusions.

Insert Table 5 here

7. Conclusion

Our results have implications both for the academic study of international financial markets, and especially cross border banking, and for policy makers and commentators on the world economy. These implications flow from our finding that European integration has been a major factor in increasing cross border banking, raising it by around 60 percent in European Union countries as compared to the level we would otherwise have seen. However, we would conclude that the formation of the Euro Area in and of itself, has done little to raise these asset stocks. Ignoring a specific role for the European integration agenda and its effects will bias academic results in the area. It is also useful for those involved in the policy debate in the UK and Europe to note that departure from the Single Market in Financial Services is likely to reduce cross border banking in the UK by around 40 percent, effectively moving it further offshore without making it any closer to Japan or the USA.

Politicians and academics also need to take in to account our conclusion that gains in integration can be reversed. We show clear evidence that the Euro crisis that followed on from the Greek debt problem may have permanently reduced cross border banking in the European Union by 20 percent, removing perhaps half of the gains in integration in this market that were made over the previous 15 years. More careful design of interrelated financial markets and their regulation would probably have removed this effect. In particular, restraints on the internationalisation of government debt within the Single Market may well have put stronger constraints on Greek governments.

There is evidence that some financial centres rise above the constraints of distance, size and barriers to capital movements, but it is clear that London is not one of these at least in cross border bank lending. We find that Luxembourg has a specific role to play in this market, with lending stocks almost twice as high as might have been anticipated given other factors. The UK and Switzerland show some positive impact from economies of agglomeration, but these are not significant for the UK. Financial centre effects need to be investigated more thoroughly in other markets before we can assess whether London can hold on to its position as a leading centre once it is outside the Single Market.

It has been common to use a 'time zone' indicator in many academic studies, but our results suggest that this is only significant, at least in this sample, if we do not take proper account of the impacts of European integration on cross border banking. The time zone effect is

supposed to reflect the need to personal interaction in financial markets, and one might presume that this is particularly important in bank lending across borders. However, this appears not to be the case once on takes account of the density of countries in Europe and the existence of a Single Market. Time zone effects in other studies need to be re-evaluated in this context.

We also look at the role of financial crises and their impact above and beyond the more usual push and pull factors that enter the gravity model. We would conclude that banking crises increase cross border lending stocks in the short run as compared to where they would otherwise have been, indicating that there is some degree of inertia in lending. As such, cross border lending probably helps sustain activity in host countries affected by crises. In general banking crises do not have permanent effects on cross border bank lending, although they may do so if they change institutions in host or borrower countries. However, the Euro Area Sovereign debt crisis that started in 2011 appears to have had a lasting impact on cross border lending, especially within the Euro Area. This may reflect increased home country regulation of banks in the region as the authorities attempted to reduce spillovers from crises in Greece and elsewhere.

We look at indicators for financial freedom and they appear to be significant for home countries. Crises may induce policy makers to reduce financial freedom in order to reduce the probability of another crisis occurring, but this will in turn reduce cross border lending and hence limit the efficiency of international capital markets. This may harm growth prospects in poorer economies.

All academic studies are limited by data constraints, and we can only analyse lending from 19 home countries. It would be useful to know if our results hold in other host markets (although our sample does include the majority of advanced economies). It would also be useful to know whether time zone effects found in studies of other markets are also artefacts of omission of other more relevant mutable variables that have stronger policy implications than immutable time.

Bibliography

Acharya, V.V., Eisert, T., Eufinger, C. and Hirsch, C.W. (2015) 'Real effects of the sovereign debt crisis in europe: Evidence from syndicated loans', Available at SSRN 2612855.

Ahearne, A.G., Griever, W.L. and Warnock, F.E. (2004) 'Information costs and home bias: an analysis of US holdings of foreign equities', Journal of International Economics, 62(2), pp. 313-336.

Alfaro, L., Kalemli-Ozcan, S. and Volosovych, V. (2008) 'Why doesn't capital flow from rich to poor countries? An empirical investigation', The review of economics and statistics, 90(2), pp. 347-368.

Arellano, M. (1987) 'Practitioners' Corner: Computing Robust Standard Errors for Within groups Estimators*', Oxford Bulletin of Economics and Statistics, 49(4), pp. 431-434.

Baltagi, B.H. and Li, Q. (1990) 'A Lagrange multiplier test for the error components model with incomplete panels', Econometric Reviews, 9(1), pp. 103-107.

BIS. (2003) 'Guide to the International Financial Statistics', BIS Papers No 14 Monetary and Economic Department (February 2003).

BIS. (2011) 'Annual Report 2010/2011', Basle, 26 June.

Blank, S., Buch, C.M. and Neugebauer, K. (2009) 'Shocks at large banks and banking sector distress: The Banking Granular Residual', Journal of Financial Stability, 5(4), pp. 353-373.

Bologna, P. and Caccavaio, M. (2014) 'Euro area (cross-border?) banking', Bank of Italy occasional paper, (228).

Borio, C.E. and Disyatat, P. (2011) 'Global imbalances and the financial crisis: Link or no link?', BIS Working Papers 346, May.

Breusch, T.S. and Pagan, A.R. (1980) 'The Lagrange multiplier test and its applications to model specification in econometrics', The Review of Economic Studies, 47(1), pp. 239-253.

Brüggemann, B., Kleinert, J. and Prieto, E. (2012) A Gravity equation for bank loans.Universities of Frankfurt, Graz.

Bruno, V. and Shin, H.S. (2014) 'Cross-Border Banking and Global Liquidity*', The Review of Economic Studies, pp. rdu042.

Buch, C.M. (2005) 'Distance and International Banking', Review of International Economics, 13(4), pp. 787-804.

Buch, C.M., Kesternich, I., Lipponer, A. and Schnitzer, M. (2010) 'Financial Constraints and the Margins of FDI', Deutsche Bundesbank. Discussion Paper 29/2009.

Cerutti, E. (2013) Banks' Foreign Credit Exposures and Borrowers' Rollover Risks Measurement, Evolution and Determinants. International Monetary Fund.

Cerutti, E. and Claessens, S. (2013) 'The great cross-border bank deleveraging: Supply side characteristics', PSE/BdF/NYFed/CEPR Workshop on the Economics of Cross-Border Banking, Paris (December 13–14, 2013).

Cetorelli, N. and Goldberg, L.S. (2011) 'Global banks and international shock transmission: Evidence from the crisis', IMF Economic Review, 59(1), pp. 41-76.

Claessens, S. and Van Horen, N. (2013) 'Impact of foreign banks', Netherlands Central Bank, Research Department (No. 370).

De Haas, R. and Van Horen, N. (2013) 'Running for the Exit? International Bank Lending During a Financial Crisis', Review of Financial Studies, 26(1), pp. 244-285.

Degryse, H. and Ongena, S. (2005) 'Distance, lending relationships, and competition', The Journal of Finance, 60(1), pp. 231-266.

Drehmann, M., & Juselius, K. (2014). Evaluating early warning indicators of banking crises: Satisfying policy requirements. International Journal of Forecasting, 30(3), 759-780.

Düwel, C., Frey, R. and Lipponer, A. (2011) Cross-border bank lending, risk aversion and the financial crisis. (No. 2011, 29) Discussion Paper Series 1: Economic Studies.

ECB, (2007) 'Financial Integration in Europe.' European Central Bank, Frankfurt.

Giannetti, M. and Laeven, L. (2012) 'The flight home effect: Evidence from the syndicated loan market during financial crises', Journal of Financial Economics, 104(1), pp. 23-43.

Herrmann, S. and Mihaljek, D. (2013) 'The determinants of cross-border bank flows to emerging markets', Economics of Transition, 21(3), pp. 479-508.

IMF, Luxembourg: (2009) Article IV Consultation-Staff Report; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for Luxembourg, IMF Country Report No. 09/178.

IMF (2009a) 'Regional Economic Outlook, Europe -Addressing the Crisis', May 2009. International Monetary Fund, Washington.

Ivashina, V. and Scharfstein, D. (2010) 'Bank lending during the financial crisis of 2008', Journal of Financial Economics, 97(3), pp. 319-338.

Kleimeier, S., Sander, H. and Heuchemer, S. (2013) 'Financial crises and cross-border banking: New evidence', Journal of International Money and Finance, 32, pp. 884-915.

Laeven, L. and Valencia, F. (2013) 'Systemic banking crises database', IMF Economic Review, 61(2), pp. 225-270.

Martin, P. and Rey, H. (2004) 'Financial super-markets: size matters for asset trade', Journal of International Economics, 64(2), pp. 335-361.

McGuire, P. and Tarashev, N.A. (2008) 'Bank health and lending to emerging markets', BIS Quarterly Review, December.

Mian, A. (2006) 'Distance constraints: The limits of foreign lending in poor economies', The Journal of Finance, 61(3), pp. 1465-1505.

Milesi-Ferretti, G. and Tille, C. (2011) 'The great retrenchment: international capital flows during the global financial crisis', Economic Policy, 26(66), pp. 289-346.

Nickell, S. (1981) 'Biases in dynamic models with fixed effects', Econometrica: Journal of the Econometric Society, pp. 1417-1426.

Obstfeld, M. and Rogoff, K. (2000) 'The six major puzzles in international macroeconomics: is there a common cause?', in NBER Macroeconomics Annual 2000, Vol 15. MIT press, pp. 339-412.

OECD (2008), Luxembourg, OECD Economic Surveys, vol. 2008/12

OECD (2010), Luxembourg, OECD Economic Surveys, vol. 2010/5

Papaioannou, E. (2009) 'What drives international financial flows? Politics, institutions and other determinants', Journal of Development Economics, 88(2), pp. 269-281.

Papi, L., Presbitero, A.F. and Zazzaro, A. (2015) 'IMF lending and banking crises', IMF Economic Review, 63(3), pp. 644-691.

Park, Y.S. and Essayyad, M. (1989) International banking and financial centers. Springer Science & Business Media.

Peek, J. and Rosengren, E.S. (2000) 'Collateral damage: Effects of the Japanese bank crisis on real activity in the United States', American Economic Review, pp. 30-45.

Popov, A.A. and Udell, G.F. (2010) 'Cross-border banking and the international transmission of financial distress during the crisis of 2007-2008', ECB Working Paper, No. 1203

Portes, R. and Rey, H. (2005) 'The determinants of cross-border equity flows', Journal of International Economics, 65(2), pp. 269-296.

Reinhardt, D. and Riddiough, S.J. (2015) 'The two faces of cross-border banking flows', Available at SSRN 2427644.

Rose, A.K. and Spiegel, M.M. (2004) 'A Gravity Model of Sovereign Lending: Trade, Default, and Credit', IMF Staff Papers, pp. 50-63.

Shin, H.S. (2011) 'Global banking glut and loan risk premium', IMF Economic Review, 60(2), pp. 155-192.

Tschoegl, A.E. (2000) 'International banking centers, geography, and foreign banks', Financial markets, institutions & instruments, 9(1), pp. 1-32.

Wooldridge, J. (2013) 'Introductory econometrics: A modern approach'. 5th ed. Mason, OH: South-Western

World Bank (2008) 'The Changing Role of International Banking in Development Finance', Global Development Finance

Appendix A Countries in the sample

Lender Countries (19)	European Borrower Country	Systemic Banking[18] Crisis Year-Quarter	Year joined Euro
Australia	Austria	2008-Q4	1999
Austria (2008q4)	Belgium	2008-Q4	1999
Belgium (2008q4)	Bulgaria	-	-
Canada (2008q4)	Croatia	-	-
Switzerland(2008q4)	Cyprus	-	2008
Germany (2008q4)	Czech Republic	-	-
Denmark(2008q4)	Denmark	2008-Q4	-
Spain (2008q4)	Estonia	-	2011
Finland	Finland	-	1999
France(2008q4)	France	2008-Q4	1999
United Kingdom (b)	Germany	2008-Q4	1999
Greece(2008q4)	Greece	2008-Q4	2001
Ireland(2008q4)	Hungary	2008-Q4	-
Italy(2008q4)	Ireland	2008-Q4	1999
Japan	Italy	2008-Q4	1999
Netherlands (2008q4)	Latvia	-	2014
Portugal (2008q4)	Lithuania	-	-
Sweden	Luxembourg	2008-Q4	1999
United States (b)	Malta	-	2008
	Netherlands	2008-Q4	1999
	Poland	-	-
	Portugal	2008-Q4	1999
	Romania	-	-
	Slovakia	-	2009
	Slovenia	2008-Q4	2007
Crisis date in brackets	Spain	2008-Q4	1999
	Sweden	2008-Q4	-
(b) Crises US and UK 2007q3 and 2008q4	Switzerland	2008-Q4	-
	United Kingdom	2007-Q4	-

[18] Laeven and Valencia (2013) and Drehmann and Juselius (2014).

Appendix B Measure of Bilateral Exchange rate volatility

	AU	CA	CH	EMU	DK	GB	GR	JP	SE	US
EMU	G(1.1)	G(1.1)	G(1.1)	\	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
BG	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
HR	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
CY	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
CZ	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
DK	G(1.1)	G(1.1)	G(1.1)	G(1.1)	-	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
EE	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
GR	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	-	G(1.1)	G(1.1)	G(1.1)
HU	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
LV	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
LT	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
MT	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
PL	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
RO	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
SK	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
SI	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
SE	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	-	G(1.1)
CH	G(1.1)	G(1.1)	-	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)
GB	G(1.1)	G(1.1)	G(1.1)	G(1.1)	G(1.1)	-	G(1.1)	G(1.1)	G(1.1)	G(1.1)

Note: G(1.1): GARCH(1.1), G(1.2):

Table (1)

The variables and their sources are summarized as following

Variable	Variable description	Data sources
$L_{i,j,t}$	the log of the quarter, the exchange-rate adjusted stocks of cross-border loans in millions of US dollar from the lender to the borrower country.	BIS
$GDP_{i,t}$, $GDP_{j,t}$	Millions of US dollars, volume estimates, fixed purchasing power parities, OECD reference year 2005, quarterly levels, seasonally adjusted.	OECD
$BEXP_{i,j,t}$	bilateral quarter exports from the lender to borrower country.	DataStream (Thomson-Reuters)
$DIS_{i,j}$	The geographical distance measured in kilometres.	CEPII Distance Database (www.cepii.fr)
$TimDiff_{i,j,t}$	Variable accounting for the time differential in between the capital cities of the lender and borrower countries.	Britanica atlas, Encyclopaedia Britanica Inc. 1994
$RateDiff_{j,I,t}$	The spread of lending interest rates between the borrower and the lender country, available as quarter averages of monthly data on three-month nominal interest rates in each lender country and borrower country.	International Financial Statistics
$FinFreedom_{i,t}$, $FinFreedom_{j,t}$	An index of financial freedom.	Heritage Foundation 2015 www.heritage.org
$Border_{i,j}$	Dummy variable that equals 1 when both countries share a common land border	World Factbook
$Lang_{i,j}$	Dummy variable that equals 1 when both countries share a common official language	www.cepii.fr
$SYS_{j,t}$	Dummy variable that equals 1 when borrower country experiences a systemic banking crisis in quarter T, otherwise 0. This can also be a step dummy or under a different name when there is a systemic banking crisis in a home country.	(see Appendix)
FC_t	Dummy variable equal to one in the quarter 4 in year 2008 and first three quarters in year 2009 otherwise 0, to pick up the effect of the global financial crisis And equal to one in the quarter 4 in year 2011 and all quartrers in year 2012, to capture the effcet Euro debt crisis, otherwise 0. This can also be a step dummy	
$EU_{i,j,t}$	Dummy variable that equals 1 if countries i and j are EU members at time t and 0 otherwise.	(see Appendix)

**Quarterly data over the period 1999 Q1 to 2014 Q4

Table 2 Determinants of cross border lending stocks from advanced to EU countries

Variables	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)	Column (7)	Column (8)	Column (9)
$LogGDPhome_{,t}$	1.3747***	1.4284***	1.3394***	1.3642***	1.3257***	1.3191***	1.3625***	1.3269***	1.3160***
	(0.1625)	(0.1721)	(0.1617)	(0.1702)	(0.1694)	(0.1714)	(0.1702)	(0.1718)	(0.1703)
$LogGDPhost_t$	1.3227***	1.3206***	1.0348***	1.0350***	1.0274***	0.9991***	1.0342***	1.0007***	1.0060***
	(0.1270)	(0.1270)	(0.1266)	(0.1266)	(0.1256)	(0.1267)	(0.1266)	(0.1270)	(0.1264)
$LogBEXP_{i,j,t}$	0.2243***	0.2219***	0.1874***	0.1864***	0.1869***	0.1924***	0.1863***	0.1945***	0.1925***
	(0.0532)	(0.0531)	(0.0496)	(0.0497)	(0.0496)	(0.0502)	(0.0497)	(0.0504)	(0.0502)
$LogDIS_{i,j}$	-1.2928***	-0.8526***	-1.1969***	-0.9418***	-0.9522***	-0.9483***	-0.9419***	-0.9485***	-0.9515***
	(0.1328)	(0.1924)	(0.1436)	(0.1973)	(0.1963)	(0.1942)	(0.1972)	(0.1946)	(0.1947)
$RateDiff_{j,j,t}$	0.0087	0.0088	0.0094	0.0094	0.0082	0.0085	0.0095	0.0079	0.0077
	(0.0076)	(0.0076)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)
$FinFreedomhome_{,t}$	0.0103***	0.0104***	0.0088***	0.0089***	0.0078**	0.0080***	0.0089***	0.0074**	0.0073**
	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
$FinFreedomhost_{,t}$	0.0012	0.0012	0.0008	0.0008	0.0000	0.0004	0.0008	0.0003	0.0000
	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
$Border_{i,j}$			-0.6075*	-0.4711	-0.4675	-0.4349	-0.4687	-0.4506	-0.4528
			(0.3221)	(0.3194)	(0.3164)	(0.3137)	(0.3194)	(0.3148)	(0.3144)
$Lang_{i,j}$			1.3357***	1.3966***	1.3982***	1.3916***	1.3964***	1.3931***	1.3947***
			(0.2950)	(0.2993)	(0.2985)	(0.2936)	(0.2991)	(0.2948)	(0.2955)
$EU_{i,j,t}$			0.6052***	0.6019***	0.6061***	0.5863***	0.6022***	0.5813***	0.5895***
			(0.0922)	(0.0929)	(0.0920)	(0.0921)	(0.0928)	(0.0921)	(0.0917)
$TimDiff_{i,j,t}$		-0.1929**		-0.1032	-0.0910	-0.0887	-0.1029	-0.0893	-0.0867
		(0.0789)		(0.0796)	(0.0792)	(0.0791)	(0.0796)	(0.0792)	(0.0790)
Host Crisis (4q)					0.4340***				0.2196***
					(0.0369)				(0.0476)
Home Crisis (4q)						0.3807***		0.4345***	0.3113***
						(0.0341)		(0.0374)	(0.0480)
UK/US (4q)							0.0436	-0.3975***	-0.2714***
							(0.0650)	(0.0750)	(0.0842)
Constant	-22.9250***	-26.5156***	-19.2500***	-21.3022***	-20.5296***	-20.2724***	-21.2715***	-20.3831***	-20.2251***
	(1.9131)	(2.6535)	(1.8349)	(2.6394)	(2.6234)	(2.6375)	(2.6410)	(2.6450)	(2.6303)
Observations	27407	27407	27407	27407	27407	27407	27407	27407	27407
Cluster country pairs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country pairs	513	513	513	513	513	513	513	513	513
R^2	0.5142	0.5076	0.5266	0.5235	0.5264	0.5268	0.5235	0.5271	0.5277
R^2 -within	0.2244	0.2245	0.2381	0.2382	0.2461	0.2467	0.2382	0.2479	0.2491
R^2 - between	0.5555	0.5537	0.5711	0.5707	0.5730	0.5733	0.5707	0.5735	0.5740
LM test $\sim\chi^2(1)$	4500***	4400***	4500***	4500***	4500***	4500***	4500***	4500***	4500***

Note: The dependent variable is the log of exchange-rate adjusted volume of cross-border loans in millions of US dollar between the lender - borrower country. For each independent variable, the second row shows the standard error, which is heteroskedasticity robust and clustered by pair country. LM test for random effect. 27407 obs, cluster country pairs, ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 3 Temporary and Permanent Crisis Effects on cross border lending

Variables	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)	Column (7)
$LogGDPhome_{,t}$	1.3257***	1.2928***	1.3752***	1.5227***	1.3191***	1.2821***	1.4369***
	(0.1694)	(0.1604)	(0.1662)	(0.1644)	(0.1714)	(0.1652)	(0.1615)
$LogGDPhost_t$	1.0274***	1.0301***	1.0416***	1.0876***	0.9991***	0.9879***	1.0510***
	(0.1256)	(0.1264)	(0.1257)	(0.1276)	(0.1267)	(0.1286)	(0.1268)
$LogBEXP_{i,j,t}$	0.1869***	0.1815***	0.1895***	0.1989***	0.1924***	0.1758***	0.2006***
	(0.0496)	(0.0492)	(0.0498)	(0.0508)	(0.0502)	(0.0482)	(0.0509)
$LogDIS_{i,j}$	-0.9522***	-0.9550***	-0.9359***	-0.9133***	-0.9483***	-0.9646***	-0.9276***
	(0.1963)	(0.1960)	(0.1981)	(0.2063)	(0.1942)	(0.1925)	(0.2013)
$RateDiff_{j,j,t}$	0.0082	0.0093	0.0095	0.0088	0.0085	0.0084	0.0077
	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)
$FinFreedomhome_t$	0.0078**	0.0084***	0.0089***	0.0092***	0.0080***	0.0088***	0.0080***
	(0.0031)	(0.0032)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
$FinFreedomhost_t$	0.0000	0.0008	0.0007	-0.0002	0.0004	0.0012	-0.0007
	(0.0024)	(0.0024)	(0.0025)	(0.0025)	(0.0024)	(0.0024)	(0.0025)
$Border_{i,j}$	-0.4675	-0.4323	-0.4867	-0.6211*	-0.4349	-0.3682	-0.5638*
	(0.3164)	(0.3143)	(0.3202)	(0.3375)	(0.3137)	(0.3079)	(0.3267)
$Lang_{i,j}$	1.3982***	1.3960***	1.3963***	1.3994***	1.3916***	1.3870***	1.3965***
	(0.2985)	(0.2979)	(0.3009)	(0.3133)	(0.2936)	(0.2893)	(0.3054)
$EU_{i,j,t}$	0.6061***	0.6099***	0.6034***	0.6156***	0.5863***	0.5804***	0.6073***
	(0.0920)	(0.0930)	(0.0927)	(0.0926)	(0.0921)	(0.0920)	(0.0914)
$TimDiff_{i,j,t}$	-0.0910	-0.0837	-0.1066	-0.1424*	-0.0887	-0.0781	-0.1179
	(0.0792)	(0.0789)	(0.0794)	(0.0816)	(0.0791)	(0.0786)	(0.0801)
Host Crisis (4q)	0.4340***						0.2418***
	(0.0369)						(0.0437)
$EU_{2011,q3,}$ (4q)			-0.0838**				
			(0.0363)				
Host Crisis Per		0.0672					
		(0.0548)					
$EU_{2011,q3}$ Per				-0.1998***			-0.1593***
				(0.0470)			(0.0473)
Home Crisis (4q)					0.3807***		0.2126***
					(0.0341)		(0.0386)
Home crisis , Per						0.1025**	
						(0.0508)	
Constant	-20.5296***	-20.1130***	-21.6195***	-24.3555***	-20.2724***	-19.3457***	-22.6380***
	(2.6234)	(2.6171)	(2.5955)	(2.6494)	(2.6375)	(2.5976)	(2.5991)
Observations	27407	27407	27407	27407	27407	27407	27407
Cluster country pairs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country pairs	513	513	513	513	513	513	513
R^2	0.5264	0.5261	0.5233	0.5185	0.5268	0.5262	0.5236
R^2 -within	0.2461	0.2386	0.2388	0.2464	0.2467	0.2396	0.2538
R^2 - between	0.5730	0.5729	0.5706	0.5663	0.5733	0.5732	0.5706
LM test $\sim\chi^2(1)$	4500***	4400***	4500***	4500***	4500***	4500***	4500***

Note: The dependent variable is the log of the quarter, the exchange-rate adjusted volume of cross-border loans in millions of US dollar between the lender - borrower country. For each independent variable, the first row shows the coefficient and the second row shows the standard error, which is heteroskedasticity robust and clustered by pair country. LM test for random effect. 27407 obs, cluster country pairs, ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 4 Determinants of cross border lending stocks with exchange rate volatility and Euro dummy

Variables	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)
$LogGDPhome_{,t}$	1.3802***	1.3377***	1.3015***	1.2954***	1.4906***	1.4091***
	(0.1626)	(0.1620)	(0.1613)	(0.1633)	(0.1557)	(0.1531)
$LogGDPhost_{,t}$	1.3085***	1.0364***	1.0292***	1.0012***	1.0857***	1.0503***
	(0.1295)	(0.1278)	(0.1268)	(0.1279)	(0.1286)	(0.1278)
$LogBEXP_{i,j,t}$	0.2196***	0.1886***	0.1892***	0.1950***	0.1995***	0.2016***
	(0.0523)	(0.0495)	(0.0494)	(0.0500)	(0.0505)	(0.0506)
$LogDIS_{i,j}$	-1.2896***	-1.1972***	-1.1772***	-1.1677***	-1.2659***	-1.2200***
	(0.1327)	(0.1437)	(0.1429)	(0.1442)	(0.1430)	(0.1414)
$RateDiff_{j,i,t}$	0.0089	0.0094	0.0081	0.0084	0.0088	0.0076
	(0.0075)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)
$FinFreedomhome_{,t}$	0.0101***	0.0089***	0.0079**	0.0081***	0.0091***	0.0080***
	(0.0032)	(0.0032)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
$FinFreedomhost_{t}$	0.0015	0.0007	-0.0001	0.0002	-0.0002	-0.0007
	(0.0025)	(0.0025)	(0.0025)	(0.0024)	(0.0025)	(0.0025)
$CU_{i,j,t}$	0.1109	-0.0406	-0.0498	-0.0586	0.0234	-0.0049
	(0.1499)	(0.1456)	(0.1444)	(0.1443)	(0.1453)	(0.1440)
$EXV_{i,j,t}$	-0.1761	-0.1426	-0.1691	-0.1980	-0.1593	-0.2016
	(0.1286)	(0.1288)	(0.1296)	(0.1241)	(0.1307)	(0.1299)
$Border_{i,j}$		-0.5993*	-0.5775*	-0.5402*	-0.8118**	-0.7166**
		(0.3226)	(0.3202)	(0.3188)	(0.3357)	(0.3272)
$Lang_{i,j}$		1.3331***	1.3415***	1.3356***	1.3150***	1.3253***
		(0.2954)	(0.2947)	(0.2900)	(0.3077)	(0.3006)
$EU_{i,j,t}$		0.6107***	0.6158***	0.5970***	0.6161***	0.6108***
		(0.0899)	(0.0892)	(0.0893)	(0.0898)	(0.0887)
Host Crisis (4q)			0.4354***			0.2421***
			(0.0370)			(0.0437)
Home Crisis (4q)				0.3828***		0.2141***
				(0.0342)		(0.0388)
$EU_{2011,q3}$ Per					-0.1998***	-0.1581***
					(0.0469)	(0.0472)
Constant	-22.7884***	-19.2599***	-18.7303***	-18.5235***	-21.5133***	-20.2831***
	(1.9155)	(1.8370)	(1.8260)	(1.8383)	(1.8099)	(1.7848)
Observations Number	27406	27406	27406	27406	27406	27406
Cluster country pairs	Yes	Yes	Yes	Yes	Yes	Yes
Country pairs	513	513	513	513	513	513
R^2	0.5154	0.5264	0.5289	0.5292	0.5229	0.5272
R^2 -within	0.2246	0.2382	0.2462	0.2468	0.2463	0.2538
R^2 - between	0.5569	0.5707	0.5729	0.5731	0.5672	0.5711
LM test $\sim\chi^2(1)$	4500***	4500***	4500***	4500***	4500***	4500***

NOTE: This table provides robustness checks for Table (4.2), by including bilateral exchange rate volatility and common currency dummy variables.The dependent variable is the log of the quarter, the exchange-rate adjusted volume of cross-border loans in millions of US dollar between the lender - borrower country. For each independent variable, the first row shows the coefficient and the second row shows the standard error, which is heteroskedasticity robust and clustered by pair country. LM test for random effect.
***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 5. Determinants of cross border lending stocks from advanced to EU countries - adding host financial centres effect

Variables	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)
LogGDPhome $_t$	1.3451***	1.3236***	1.2910***	1.2832***	1.4659***	1.3918***
	(0.1583)	(0.1581)	(0.1582)	(0.1590)	(0.1525)	(0.1505)
LogGDPhost $_t$	1.3315***	1.0360***	1.0287***	0.9991***	1.0904***	1.0535***
	(0.1291)	(0.1296)	(0.1290)	(0.1297)	(0.1309)	(0.1306)
LogBEXP$_{i,j,t}$	0.2269***	0.1895***	0.1896***	0.1954***	0.2025***	0.2036***
	(0.0532)	(0.0497)	(0.0496)	(0.0502)	(0.0509)	(0.0509)
LogDIS$_{i,j}$	-1.2347***	-1.1551***	-1.1373***	-1.1258***	-1.2197***	-1.1771***
	(0.1303)	(0.1413)	(0.1409)	(0.1416)	(0.1412)	(0.1398)
RateDiff$_{j.i,t}$	0.0091	0.0096	0.0083	0.0086	0.0090	0.0078
	(0.0076)	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0071)
FinFreedomhome$_{,t}$	0.0103***	0.0088***	0.0078**	0.0080***	0.0091***	0.0080***
	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
FinFreedomhost $_t$	0.0011	0.0007	-0.0001	0.0003	-0.0003	-0.0008
	(0.0025)	(0.0024)	(0.0024)	(0.0024)	(0.0025)	(0.0025)
Border$_{i,j}$		-0.4725	-0.4553	-0.4137	-0.6739**	-0.5859*
		(0.3255)	(0.3237)	(0.3217)	(0.3383)	(0.3308)
Lang$_{i,j}$		0.9776***	0.9875***	0.9798***	0.9528***	0.9649***
		(0.3282)	(0.3278)	(0.3232)	(0.3385)	(0.3327)
EU$_{i,j,t}$		0.6051***	0.6087***	0.5893***	0.6192***	0.6101***
		(0.0928)	(0.0921)	(0.0921)	(0.0925)	(0.0914)
Luxemburg	2.5149***	1.7072**	1.6920**	1.6673**	1.8247**	1.7694**
	(0.8018)	(0.8170)	(0.8120)	(0.8123)	(0.8379)	(0.8273)
Switzerland	0.2140	0.6120**	0.6110**	0.6187**	0.6086**	0.6127**
	(0.2595)	(0.2835)	(0.2797)	(0.2806)	(0.2995)	(0.2905)
UK	0.1054	0.7754*	0.7890*	0.8649**	0.6188	0.7103
	(0.4137)	(0.4429)	(0.4382)	(0.4379)	(0.4634)	(0.4533)
SYS$_{j.t}$ (4q)			0.4346***			0.2421***
			(0.0369)			(0.0437)
Home Crisis (4q)				0.3816***		0.2138***
				(0.0340)		(0.0387)
EU$_{2011,q3}$ Per					-0.1982***	-0.1580***
					(0.0470)	(0.0473)
Constant	-23.2143***	-19.4939***	-18.9879***	-18.7587***	-21.7267***	-20.5382***
	(1.8902)	(1.8236)	(1.8167)	(1.8230)	(1.8009)	(1.7806)
Observations Number	27407	27407	27407	27407	27407	27407
Cluster country pairs	Yes	Yes	Yes	Yes	Yes	Yes
Country pairs	513	513	513	513	513	513
R^2	0.5234	0.5359	0.5384	0.5393	0.5317	0.5364
R^2 -within	0.2244	0.2380	0.2460	0.2466	0.2462	0.2536
R^2 - between	0.5686	0.5833	0.5855	0.5864	0.5790	0.5833
LM test ~$\chi^2(1)$	4400***	4400***	4400***	4400***	4400***	4500***

NOTE: This table provides robustness checks for Table (2), by including host financial centres dummy variables. The dependent variable is the log of the quarter, the exchange-rate adjusted volume of cross-border loans in millions of US dollar between the lender - borrower country. For each independent variable, the first row shows the coefficient and the second row shows the standard error, which is heteroskedasticity robust and clustered by pair country. LM test for random effect. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.