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The euro effect: Credit contractions and cross-border banking dynamics in the EU during the 2008-2015 crisis years

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Abstract

In light of the 20th anniversary of the euro area (EA) as a currency union, and after its survival of both the global as well as the euro crisis that followed, the discussion among EA countries about the future of their membership is as pertinent as ever. In this thesis, I examine the relationship between EA membership and cross-border banking dynamics during the period in which both crises occurred. I explore if and, if so, how the euro affects international bank lending as well as contribute to the crisis' credit retrenchments. Using panel data on bilateral cross-border bank claims from 2008-2015, I decompose this 'euro effect' into three channels of contagion: a pairwise effect, where both banks are located in euro countries; a creditor effect, if only the creditor bank is part of the euro zone; and a debtor effect, capturing EA membership of the borrowing country. I find that mutual EA membership is negatively related to cross-border lending. Moreover, this pairwise effect is also related to credit retrenchments during the euro crisis, as I show that EA pairs contract their lending more during the crisis than any other country pair. My results do not provide strong evidence for a separate creditor or debtor channel driving these results. They highlight the area's vulnerability to the transfer of financial shocks, stressing the importance of an integrated yet stable euro policy.

Contents

1 Introduction

In recent decades, the international economy has become increasingly interconnected as a result of unprecedented intensified globalization. Even though a globalized financial system does provide the benefits of risk-sharing, lower economic volatility and efficient allocation of capital, it is also increasingly associated with some negative side effects, such as the spread of financial shocks (Stulz, 2005; Jordà, Schularick & Taylor, 2011; Maudos & de Guevara, 2015). Especially after the global financial crisis of 2007-2009, this deepened interdependence proved to be of particularly dramatic relevance to the financial sector. Especially in terms of international bank credit, which seems to be an important driver of domestic credit booms as well as subsequent credit contractions (Avdjiev, McCauley & McGuire, 2012). To this date, it is commonly suggested that the increased international financial interconnectedness did not only help facilitate the outstanding credit and risky debt buildup, which in turn was used to further inflate the subprime bubble that finally exploded, but also that it plausibly contributed to the fast global spread of negative consequences of both the crises (Gross, 2015; Lane, 2013b). It rapidly contaminated virtually all developed economies in all major parts of the global financial system (Danninger & Tytell, 2015). Particularly the United States and Western Europe experienced a period of intense financial distress in the years that followed the event that formally introduced the full-blown international banking crisis: the collapse of the American investment bank Lehman Brothers in September 2008.

However, across the Atlantic Ocean, the global financial crisis sufferedasymmetric effects across Europe and within the euro area. Also, as it turned out, for the European Union (EU) it would only be the start of yet another wave of recession. After the bankruptcy of Greece in 2009, the EU suffered from a prolonged version of the initial crisis, transforming into its own euro crisis, that broke out in May 2010 with Greece's request for international financial aid, the Financial Economic Assistance Program (FEP), and lasted until approximately 2013[1]. Still, many European economies still bear deep economic, political as well as social scars left by the financial trauma. The hesitant and slow response of the European Central Bank (ECB) to take policy measures to counter the ongoing events seems to have stagnated recovery. If anything, the crisis weakened the (vulnerable) euro area to a performance worse than before on a global level as well as relative to its own pace after the 1930s Great Depression (Mody, 2018).

A great part of the research done on the euro zone and the aftermath of the euro crisis has been focused on it being a manifestation of intra-European current account imbalances, heavy sovereign and private indebtedness as well as the loss of competitiveness of the Southern countries (Nölke, 2016). Especially with regard to the bankruptcy of Greece, which, of course, has been a pivotal event in the development of the euro crisis, the 'consensus view' tends to put a lot of stress on the debt dynamics concerning the reluctant (government) expenditures and lack of fiscal policy discipline within the EU (Baldwin & Giavazzi, 2015). These generally seem to be demand-side related causes and, even though they are highly relevant for the debate, they do not seem to cover the entire story. As Beck and Peydró (2015) pointed out, the demand-side related rise of public

[1] For the majority of the EU, the period of economic recovery and debt stabilization started around 2014(Pierluigi & Sondermann, 2018)

and private indebtedness was partly fuelled and facilitated by a supply-side originating credit boom, stemming from cheaper cross-border credit.

There is a growing amount of research that scrutinizes the flip side of the coin. As De Grauwe (2010) underlines as well: even though the root of the sovereign debt crisis may be embedded in the known current accounts deficits and government debt as a result of unstable debt accumulation of the private sector (with the exception of Greece), demand is often fueled by supply: credit provision. Indeed, before curtailment, comes stimulus and as suggested before, crises, or downturns, tend to be preceded by an inflow of cross-border credit coinciding with a higher degree of financial integration (Gourinchas & Obstfeld, 2012; Avdjiev et al., 2012). In Europe, as a whole, and more excessively in the euro zone. Other papers that investigated this part of crisis dissemination frameworks offered similar explanations and exploit the funding sources that stimulated spending.

More specifically, they point at the especially large intra-euro zone capital flows that emerged before the crisis (Gros, 2011; Baldwin & Giavazzi, 2015; Micossi, 2015). However, concerning the euro crisis, research into the importance of foreign credit inflow and the European interbank retrenchment that occurred afterwards is still of modest size. Lane (2013a) related this increase in cross-border credit among euro countries to the creation of the problematic external debt positions. As such, he revealed an important role of the intensified interconnectedness among EA financial markets and how it potentially increased a member country's vulnerability to international transmission of financial shocks. In a working paper Covi, Ziya Gorpe and Kok (2019) document the degree of interconnectedness of the EA banking system, based on bilateral linkages in terms of 'large exposure in Q3 2017. Their interbank network shows that approximately 90% of the large exposure stems from EA banking groups. In their study covering Eastern European countries, Ongena, Peydró and Van Horen (2015) show that when countries are more strongly interdependent on cross-border credit flows they, therefore, should be more affected by bilateral credit contractions than other countries. Several other studies have further explored these intra-EU and -EA banking dynamics and have found several reasons for the withdrawal, such as large spreads in credit default swaps (Laeven & Tressel, 2013) or increased borrower risk exposure (Bologna & Caccavaio, 2014). However, these studies do not seem to diversify between EA and non-EA banks within their case studies. As such, to what extent the interconnectedness of the euro zone differs from that of non-member countries and how this has played a role in explaining the spread of financial crisis among these countries is yet to be further explored. My purpose is to investigate whether membership of the euro zone among EU members has exacerbated the transmission of financial shocks among EA countries.

I am interested in the effect of EA membership on bilateral cross-border banking dynamics, with an additional interest in the credit contractions between EU countries during the euro crisis of 2009-2012. I hypothesize that, during the euro crisis, financial shocks, in terms of credit shifts, were adversely transmitted through the international banking sector between EU country pairs, depending on their (shared) EA membership. In this context, my paper makes a contribution to the existing literature since it examines the euro area not solely as a catalyst for financial integration and credit expansion, but rather as a propagator for credit contractions as well. Furthermore, I explore this possible relation in its effect on both credit positions as well as in terms of a pre- and post crisis changes in credit flows, i.e. curtailments.

My study differs from the established literature in three ways.

Firstly, I add a yet unexplored dimension to the estimation, namely the effect of EA membership across interbanking country pairs, the "euro effect" on bank lending. I do so by distinguishing between countries within and outside of the euro area while matching source to host countries in cross-border banking pairs.

Secondly, I decompose this possible euro effect into three possible contagion channels, following the work of Spiegel (2009), who proposes that the pre-crisis buildup in intra-EU bilateral bank claims can be decomposed into three contributing channels: (a) a "borrower effect", referring to the increased creditworthiness of a borrowing EA-member state compared to non-members; (b) a "creditor effect", as commercial banks located in the euro area might be more attractive as financial intermediaries; and (c) a "pairwise effect", as a joint membership of a currency union increases the efficiency and quality of transactions. His results suggest that the pairwise effect is the driving factor of the credit *expansion*. A possible explanation for this pairwise effect are closer bilateral (trade) links and the elimination of currency risks, easing intra-EA capital flows. I apply this three-channel framework and investigate whether the same could be true in reverse: explaining the rapid *contraction* of bilateral financial claims among lending pairs of euro members during the euro crisis. In the absence of the same currency risk, contractions could occur with the same ease as the expansions (Lane et al., 2015; Lane, 2013a). With the high degree of financial linkages between EA pairs, (sudden) stops of capital flows between banks located in member states could quickly travel through all other outstanding intra-EA links, portraying the "pairwise effect". Also, if increased the creditworthiness of EA member states fosters financial integration, movements in distrust could adversely affect credit flows within the monetary union. A separate "debtor" or "creditor" effect could stem from, respectively, a decrease in the creditworthiness of borrowing banks located in EA countries or a pullback from mostly stressed EA creditors in cross-border banking. I examine the alternative compositions of the euro effect to determine if and, if so, how euro area membership has played a role in the observed credit retrenchment of EU banks.

Thirdly, within my research I disentangle the various crisis periods that emerged between 2008-2015 and assess the impact of euro membership during each crisis. Even though my main focus is directed at cross-border bank dynamics during the euro crisis of 2009-2012, I also investigate whether the euro effect is a determinant of the credit curtailments during the preceding global financial crisis of 2008/2009 as well as the overall 'great retrenchment' period.

My results have found evidence for a negative pairwise euro effect on cross-border credit positions during the period of 2008-2015. Furthermore, EA membership also shows to be a significant driver of the credit retrenchments during the euro crisis period. This negative pairwise effect proves to be strong enough to explain the great retrenchments of the total crisis period as well, since I have found no relation between EA membership and the earlier credit reversion that took place during the preceding global crisis, which was mainly a non-EA phenomenon.

With increased worries about the euro's chances to endure a possible upcoming global slowdown or perhaps even another crisis, as well as growing skepticism about the ECB's capacity to successfully anticipate on these risks, my results on the effect of pairwise EA participation in terms of potential vulnerability to international financial shocks are relevant for European banking policy. As EA countries seem to contract there lending more vis-á-vis each other than towards non-EA countries during crisis periods, this points

to the fragility of the EMU for financial shock propagation and thus adds to the discussion on a reform of a more resilient banking system within the monetary union. As such, my results relate to the growing discussion on a more deeply integrated European "banking union", as introduced by the ECB in 2012, to back up the monetary union, foster financial stability and minimise the cost of bank failures(ECB, 2018; Cœuré, 2012). One of the missing elements of this banking union is the EU-wide deposit-insurance scheme to cushion cross-border propagation of credit shocks stemming from domestic bank or government failures. If such a scheme would increase domestic confidence in the European banking system, pairwise contagion concerns could possibly be alleviated. Furthermore, my results underline how the pre-crisis intra-EA banking integration quickly dissolved into a "great retrenchment" in credit claims and thus point to the fragility of the euro zone banking integration. Indeed, Hoffman, Maslov and Sørensen (2019) argue that the EA's bank-to-bank integration alone is not enough to foster the deep financial integration (i.e. including direct international bank-to-non-bank lending) necessary to diversify risk and withstand global crises. As such, this thesis contributes to the idea that in terms of financial stability, a banking union could potentially benefit from including and stimulating direct lending (bank-to-real sector) into the reforms.

The remainder of the paper is structured as follows: Chapter 2 provides a literature framework and background information on the developments of the financial integration in the EU leading up to the crisis. Chapter 3 examines the mechanisms through which EA membership affects international bank lending. Next, chapter 4, presents the methodology applied, followed by chapter 5 which discusses the data used. Chapter 6 provides the main results, chapter 7 covers several robustness checks and chapter 8 contains my concluding observations.

2 Developments in EU cross-border flows

This chapter provides a short overview of earlier research and background information on the financial integration of the EU and euro area, as well as observed consequences for the banking system.

2.1 Background: Towards 'eurofication'

Within Europe, the convergence among countries has been a long-term process that once started with the establishment of the European Economic Community (EEC) in 1958 and then gradually increased with the formation of a free trade area and customs union. This process eventually resulted in the establishment of the EU Single Market in 1993, shortly after which the Maastricht Treaty came into force and with it the creation of the EU (Diaz del Hoyo, Dorrucci, Heinz & Muzikarova, 2017). The formation of the EU not only brought about nominal and legal convergence, but also increased financial unification. The introduction of the euro in 1999 further encouraged the unified European markets. In joining the EU, all member states became part of the Economic Monetary Union (EMU), but some of the member states also replaced their national currency with the euro, thereby becoming a member of the euro area (EA).

2.2 Financial interconnectedness

The most straightforward effect the shared currency has brought about, is the interest rate convergences among the members' (real) short term three-month money market rates. In addition, the euro also decreased differentials among long-term interest rates across member states (Diaz del Hoyo et al., 2017; Dermine, 2003). In fact, from 1999 until 2009, just before the euro crisis took off, the annual spread of euro area ten-year sovereign government bonds was around zero (Lane, 2012). Furthermore, as argued by Kalemli-Ozcan, Papaioannou and Peydró (2010), cross-border financial integration among euro members can, to a large extent, be explained by the elimination of the currency risk in combination with legislative-regulatory harmonization in financial markets. As a result, it encouraged financial institutions to raise their cross-border operations as well as stimulate consumption- and property-related borrowing (Fagan & Gaspar, 2007). A greater pool of accessible liquidity provided incentives for euro area banks to expand their lending activities across borders, increasing financial interconnectedness among EU banks. Lane (2013b, 2006) provides additional evidence on the prevalence of dense cross-border financial integration, especially between countries within the euro area, using the 'IFI ratio'[1]. These increased interbank relations can have various consequences for (the composition of) economic development. In fact, as pointed out by McCauley, Bénétrix, McGuire and von Peter (2017) using cross-border lending data from the Bank of Interantional Settlements (BIS), in the pre-crisis period, international banking grew at a faster pace than global trade in goods and services.

[1] The IFI ratio, as introduced by Milesi-Ferretti and Lane (2003), is the sum of foreign assets and foreign liabilities expressed a as ratio of GDP.

2.3 Cross-border bank credit flows and accumulation

The vast international credit growth that accompanied the financial convergence across EA banks has been a widely documented phenomenon. Indeed, according to Darvas, Hüttl, Merler and Walsh (2015), financial integration, in terms of international debt flows within the euro area is mostly a result of currency unification. Hale and Obstfeld (2014) provide evidence on this and find that, after the euro unification, capital flows increased. In earlier work, Coeurdacier and Martin (2009) also found a positive euro effect on bilateral bank lending within the euro zone on interbank lending. Moreover, they found a diversion effect within the EU among EA and non-EA banks, resulting from less interest in non-euro equity among euro zone banks. Milesi-Ferretti and Tille (2011) show how cross-border lending among developed European country pairs increased at a substantial speed during the last years of the pre-crisis economic boom. Especially between 2004 and mid-2007, prior to the global financial crisis, following the described financial integration between European countries.

The apparent international credit buildup among European banks has been particularly fast-paced for globally active banks located in EU countries, and even more so for countries within the euro area. As can be inferred from figure 2.1, portraying the BIS' international bank data on all reporting countries pre- and post- both the global crisis and the euro crisis, the amount of cross-border claims from banks located in EA countries experienced an unparalleled increase from 2007 that continued until 2008Q2, their pre-euro crisis "peak level". Especially in comparison to banks located in all other reporting regions. Even though the global cross-border positions in other developed areas made a structural climb as well, the growth developed much less rapidly and ended at an earlier (more global) stage, at a slightly lower level (Figure 2.1).

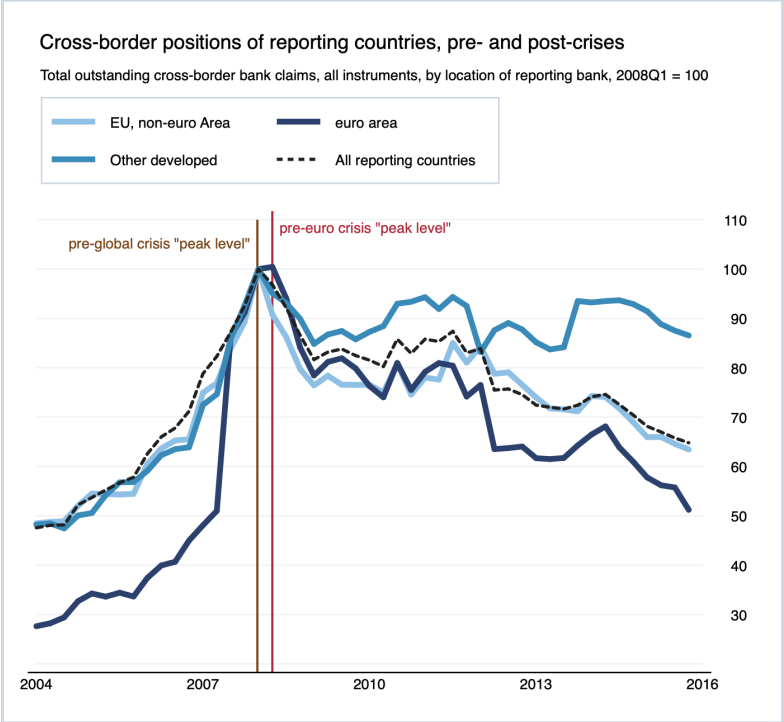
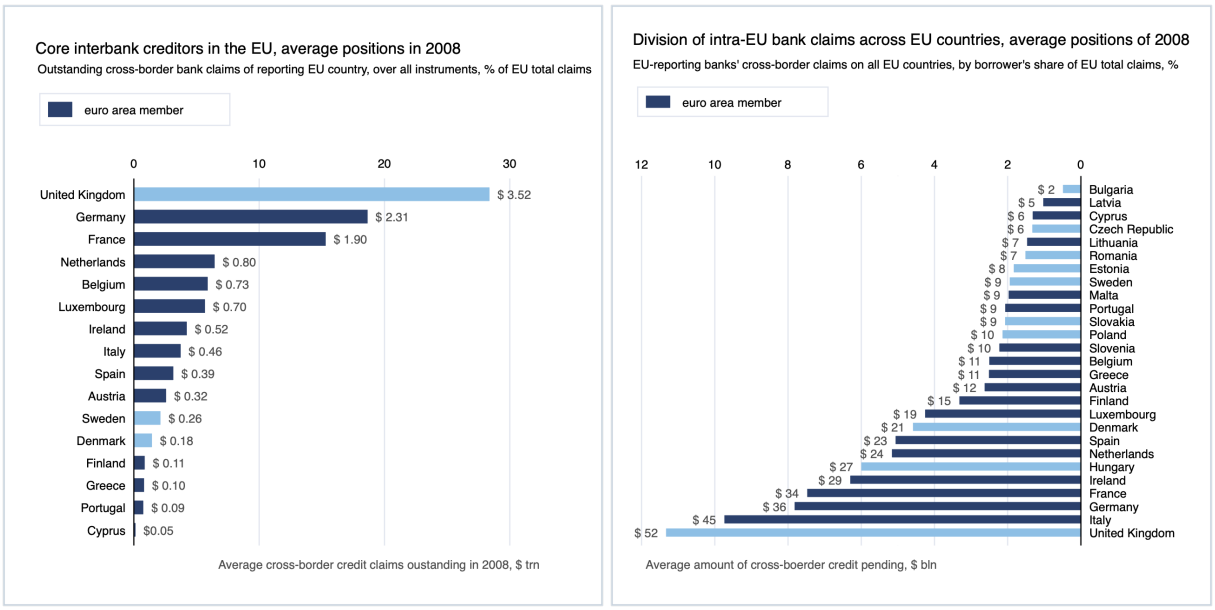


Figure 2.1: Total amount of all outstanding cross-border claims, by location of the *reporting* (source) bank. *Source:* BIS, UN, author's calculations. *Note:* Total outstanding claims of banks based in BIS reporting countries. Claims are expressed in all currencies, across all instruments.

A small number of countries dominated in the cross-border banking dynamics in Europe. As can been inferred from Figure 2.2a, the United Kingdom, Germany, France, the Netherlands and Belgium held about 75% of the total cross-border claims in the EU

by the end of 2008. Most of these intra-EU funds were extended to countries within the euro area (Figure 2.2b). Hale and Obstfeld (Hale & Obstfeld, 2014) found that among the aforementioned creditors, banks located in EA countries particularly increased their *borrowing* from non-EA countries and extended their *lending* towards other EA countries. This pattern was not only visible among the most advanced economies in the euro area. A large flow of credit, especially originating from Austria, Belgium, Germany, The Netherlands and France, sometimes referred to as the 'core countries' of the euro zone banking system, was directed towards the periphery countries, also called the GIIPS[2] (Micossi, 2015)(Baldwin & Giavazzi, 2015). Within the GIIPS countries, funds were extended both inside as well as outside of the euro area and EU (e.g. the US)[3] (Tressel, 2010). Hence, the euro-area-increased lending inflated balance sheets on both the deposit and liability side throughout core and periphery countries in the euro area.

Figure 2.2: Cross-border bank creditors and borrowers within the EU, by share of total claims in the EU, quarterly averages of 2008. *Sources:* BIS, Eurostat and author's calculations. *Note:* (a) total cross-border claims of all EU banks based in BIS reporting countries and (b) a decomposition of claims of EU-banks based in BIS reporting countries on all borrowing EU countries. Claims are expressed in dollars and as percentages of EU totals, across all instruments.



(a) Outstanding claims of all reporting EU banks

(b) Claims of EU reporting banks on all EU counterparties

Subsequently, after the great expansion in financial integration and outstanding claims, came the "great retrenchment" of credit and the "financial deglobalization" that followed suit[4]. However, other than the second term suggests, McCauley et al. (2017) highlight that this phenomenon was not global at all since it was predominantly driven by the European retrenchment in cross-border lending. In his study he provides evidence indicating that it was a consequence from the dominant role EU banks had accumulated

[2] These countries include Greece, Italy, Ireland, Portugal and Spain (GIIPS).

[3] Spain held the largest share of its claims on the UK (28,5%), and the US (16,2%), where Italy held the majority of claims on Germany (28,26%), the UK (5,8%) and the US (4,9%).

[4] "Financial deglobalisation" was first termed by Broda, Ghezzi and Levy-Yeyati (2009). By Caruana (2017) it was dubbed as "peak-finance", indicating that global finance had surpassed its highest level.

in the financial market throughout the years leading up to the global crisis. For the euro crisis, a critical piece of the so-called 'crisis puzzle', has also been the preceding increase of financial flows between euro zone countries, resulting in a credit supply boom (Lane, 2013a). During this boom period, EU and euro area banks ended up accounting for roughly 59% and 41% of all outstanding banking claims, respectively (Figure 2.3). By the end of 2015, these levels had dropped to 50% and 30%. Taken together, the euro area, Switzerland and the UK accounted for more than the entire level change in global banking between 2007 and 2016 (McCauley et al., 2017). What is more, in contrast to creditors in the rest of the world, cross-border banking in the euro area recovered at a much slower pace to never fully recover to their pre-crisis levels (Figure 2.1). This seems to have implications for the composition of the EA bilateral cross-border links as well. Where the positions towards other developed countries partly improved, the cross-border credit exposure of EA banks towards the EU and especially EA counterparties fell persistently (Figure 2.4).

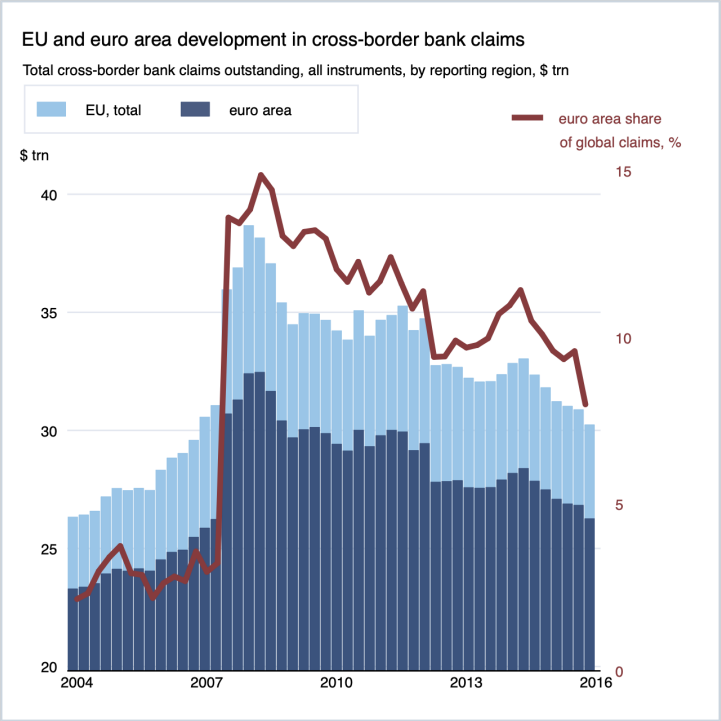


Figure 2.3: Total amounts of outstanding cross-border claims of EU and euro area banks vis-á-vis the world (left), and the share of euro area interbank lending as a percentage of total cross-border claims (right). *Source:* BIS, author's calculations. *Note:* Total quarter-end amounts of cross-border claims of EU banks based in BIS reporting countries. Claims are expressed in dollars, across all instruments.

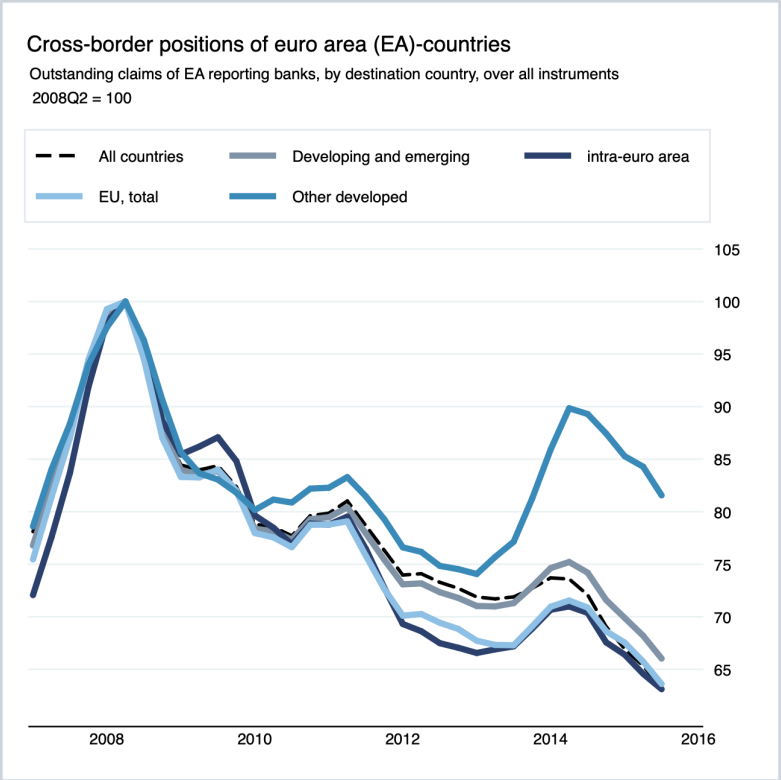


Figure 2.4: Euro area (EA) reporting bank's outstanding cross-border claims, by location of *destination* (host) country. *Source:* BIS, author's calculations *Note:* Total outstanding claims of banks based in BIS reporting countries. Claims are expressed in all currencies, across all instruments. Countries are grouped according to economic development according to the according to the classification of the United Nations Human Development Index (HDI)[5].

2.4 Shock transmission in the euro crisis

Literature on financial networks shows that increased interconnectedness can absorb shocks and diversify risk, but can also cause financial contagion and shock transmission (Minoiu & Reyes, 2013) (Anindita & Husodo, 2017). A wide range of studies has been devoted to investigate the role of a globalized banking sector in channeling financial shocks, initially following the work of Peek and Rosengren (1997, 2000). Caccioli, Shrestha, Moore, and Farmer (2014) studied bank interconnectedness and financial contagion through overlapping portfolios. Kalemli-Ozcan, Papaioanno and Perri (2013) focused on the relation between financial integration and synchronization. They found that country pairs that are financially more strongly integrated are associated with convergent business cycles during crisis periods, compared to non-crisis periods. This suggests that financial crises induce co-movement among countries that have stronger bilateral banking linkages. Several other studies found evidence on the fact that banks reliant on international wholesale funding spread the financial shocks during the global financial crisis. Emter, Schmitz and Tirpák (2019) have recently studied the significant retrenchment in cross-border lending within the EU after the financial crisis. They argue cross-border loans and deposits to be the most direct channel of international bank lending, and also the most affected by the retrenchment after the crisis. Their results point to non-performing loans as an important determinant for the impediment to cross-border lending. Furthermore, they devote the remainder of their paper to several policy-related factors related to lending curtailment. Even though they do find that prudential policies regarding bank levies may have had an indirect effect on the composition cross-border lending, their results show no overall adverse effect on cross-border banking in the EU.

[5] The HDI is calculated by taking the geometric mean of the normalized indices for each of the three key dimensions for human development: a long and healthy life, knowledge and a decent living standard.

Ongena et al. (2015) have shown that a financial shock is indeed transmitted within the international banking sector. Their model suggests bank interconnectedness via co-lending in the syndicated loan market. Particularly, they find that, compared to domestic banks borrowing *only locally*, both internationally-borrowing banks and foreign owned banks reduced their credit supply more during the crisis. However, the above mentioned papers did not investigate to what extent membership of the EA could have played a role. That is to say, did the transmission of financial shocks differ among EA and non-EA countries?

3 Mechanisms and channels

In this chapter, I present some possible channels through which internationally lending and borrowing countries' (joint) membership of the euro area could have disproportionately affected cross-border banking between EU countries.

Financial service trade flows generally follow a complicated track through different vehicles and are therefore difficult to observe directly. There are different ways to define and infer the value of these financial dynamics. In the General Agreement on Trade in Services (GATS) of the World Trade Organization (WTO) a four-legged system for financial trade is defined, from which financial services are mainly provided in two ways: (1) cross-border flows, and (2) commercial presence of financial establishments (FDI) (Kono & Schuknecht, 1999). As underwritten by Claessens (2017), cross-border credit flows (mode 1) are the most dominant and direct channel through which banks engage in international interbank lending. Changes in cross-border positions (the total amount of cross-border loans and deposits outstanding at a counterparty country) reflect the amount of credit contraction between country pairs.

As mentioned before, Ongena et al. (2015) based their hypothesis on the idea that financial shocks travel through the international banking system by means of credit contractions across internationally operating banks. They considered a bank to be an international borrower if it borrowed at least once from the international syndicated loan or bond market[1]. The international syndicated loan market serves as a good indicator for international wholesale funding as it represents a significant part of international bank claims (Gadanecz & Von Kleist, 2002). Over the past 30 years it has evolved into a dominant vehicle for cross-border funding generation for financial and non-financial firms through the international capital market (Ivashina & Scharfstein, 2010). However, it only covers a fraction of the total loans for European banks as reported by Acharya, Eisert and Eufinger (2014). This coincides with the findings of Nirei, Caballero and Sushko (2016), stemming from their simulated micro-founded model of the syndicated loan market. They reported only a moderate contribution to international shock propagation as a result of a bank's engagement in (and withdrawal from) the international syndicated loan market. As demonstrated by Emter et al. (2019) bilateral cross-border loans were a predominant driver of banking retrenchments in the EU during the financial crisis. In their paper they approximated these changes in credit by using a panel model as well as a cross-sectional difference model approach in two samples: all EU-countries and EA countries only. Within both samples, they compare the amount of outstanding bilateral cross-border claims between two periods: pre-crisis (2005-2007) and post-crisis (2013-2015). They find that the amount of cross-border claims *between* EU banks have declined drastically within the euro area and non-euro area, whereas domestic borrowing *within* one EU country has mainly remained on the same level as the pre-crisis period.

[1] Following other studies that have used syndicated loan data to investigate how financial crises affect cross-border interbank lending, such as De Haas and van Horen (2013, 2012) and Giannetti and Laeven (2013)

3.1 The euro effect

I am interested in the role of euro area membership (or "the euro effect", as I will call it for the remainder of the paper) in the movements and amounts of interbank lending across EU countries in light of the post-global and intra-euro crisis credit retrenchments. In identifying this "euro effect" I follow the work of Spiegel (2009), who investigated whether the increase in cross-border banking claims can be attributed to the euro as a result of three separate channels: a "borrower effect", a "creditor effect" and a "pairwise effect". More specifically, I group country pairs based on their membership to the euro area (EA), and formulate four possible "euro categories" in which the bilateral links can be sorted: (1) EA pairs (both banks are located within the euro area), (2) non-EA pairs (neither bank is located in an EA country), (3) EA source pairs (the creditor bank is located in an EA country) and (4) EA host pairs (the borrowing bank is located within the EA). Note that in category (3) and (4) the counterparty entity does not have a fixed assignment and may be both an EA or a non-EA country. By means of this categorization, I intend to examine the effect of EA membership on interbank linkages and financial shock transmission. Departing from Spiegel's (2009) findings, who concluded that the "pairwise euro effect" is the most dominant contributor to the increase in EA members' bilateral bank claims, I hypothesize that euro area membership can affect the EU bilateral bank claim *decrease* in a similar way, depending on the combination of their respective euro adoption. In essence, I expect that because of the higher degree of intra-EA financial interconnectedness and interdependence brought about by both the pre-crisis credit build-up as well as the overall unification of the EA after the euro adoption, a negative credit shock (e.g. credit contractions during a crisis) travels more quickly and with a greater magnitude through these bilateral links, making the euro area country pairs more vulnerable to these dynamics. In its turn, a shock will then negatively affect the bilateral interbank lending of country pairs that have (mutual) EA membership, especially when both countries are EA countries. In other words, I expect the "pairwise effect", as represented in group (1), to be the strongest.

Following Emter et al. (2019), I restrict my sample to cross-border bank lending in the form of outstanding claims in loans and deposits. First and foremost, cross-border bank credit flows tend to expand and contract faster than overall credit (Avdjiev et al., 2012). Moreover, compared to all the other types of investments, global bank flows were the major drivers of the credit retrenchment of the euro crisis (Milesi-Ferretti & Tille, 2011). Especially in Western-Europe, cross-border flows traveling in- and outside of the region were dominated by bank flows (F. Allen, 2011). Furthermore, I particularly wish to focus on bank lending through loans and deposits, as they tend to be of short-term and should therefore be an good channel for sudden financial shocks, such as credit contractions and expansions (Hale, Candelaria, Caballero & Borisov, 2011)(McGuire & Sushko, 2015). It is especially useful to look at short-term cross-border lending when exploring the euro effect on the credit reversal, as a great deal of the cross-border lending during the euro crisis was of short-term nature, underlining the vulnerability of the integrated banking system (Lane, 2013a). In fact, when looking at the channel composition of within-EU cross-border positions in more detail, it can be inferred that the greatest flow reversals were suffered by contractions in loans and deposits. Taken together, the choice to narrow my sample down to cross-border loans and deposits to study the effect of euro area membership on the cross-border contraction of bank credit, should not affect the external validity of the research.

4 Methodology

4.1 Initial model specification: the pairwise effect

To get a first insight of the euro effect as a possible determining factor in bilateral cross-border bank lending, I conduct a panel analysis based on the gravity approach as demonstrated by Emter et al. (2019) using the full panel of the dataset over the total period 2008-2015 at annual frequency, using the following log-linear OLS estimation:

$$C_{ijt} = \beta_0 + \beta_1 EAijt^{pair} + \beta_1 non\text{-}EA_{ijt}^{pair} + \delta X_{ijt} + \phi_i + \omega_j + \gamma_t + \varepsilon_{ijt} \tag{4.1}$$

Here, C_{ijt} represents the log of the bilateral cross-border position of a BIS reporting EU (source) country *(i)* vis-á-vis a counterparty (host) country *(j)* at year t between 2008 and 2015 [1]. A countrys cross-border position is determined by the total at-year-end dollar amount of outstanding bank claims, in terms of bilateral cross-border bank loans and deposits between banks located in source *(i)* and host *(j)* countries. The main explanatory variables are the dummy variables EA_{ijt}^{pair}, which equals one if the interbank transaction took place between two euro area member countries and is zero otherwise, and the dummy $non\text{-}EApair_{ij}$, which equals one if the interbank transaction took place between two banks that are both located outside of the euro zone and is zero otherwise. Furthermore, X_{ijt} is a vector of control variables, which varies across the specification. They enter the model for both source and host countries and will be discussed in more detail below. Both ϕ_i and ω_i control for unobserved country fixed effects in source *(i)* and host countries *(j)*, while γ_t captures all year-fixed effects.

In this estimation model, I only consider the "pairwise effect", that captures the effect of both countries in the pair being an EA member, i.e. $EA_{ijt}^{pair} = 1$, or neither country being an EA-member, i.e. $non\text{-}EA_{ijt}^{pair} = 1$. Consequently, the benchmark group includes all 'unequal' country pairs, i.e. country pairs of which only *one* counterparty is part of the euro area, regardless if the country is a source or host a country. As earlier mentioned, however, the euro effect may not be restricted to this "pairwise" impact only, and could also travel through the additional creditor (source country) and debtor (host country) effects, which can be depicted by the respective indicator variables EA_{it}^{source} and EA_{jt}^{host}. More specifically, $EA_{it}^{source} = 1$ if the source country is a EA country regardless of the host country. $EA_{jt}^{host} = 1$ if the host country is a EA country, regardless of the source country.

[1] I take the log of cross-border claims as I expect the relation between cross-border positions (in USD) and the explaining variables throughout the sample to be non-linear. As the countries differ substantially across pairs, a one-on-one relationships in dollar value seems implausible. This is in line with earlier research and confirmed when evaluating the residuals plots of the logged model compared to a unlogged version, see figure B.3 in Appendix B.

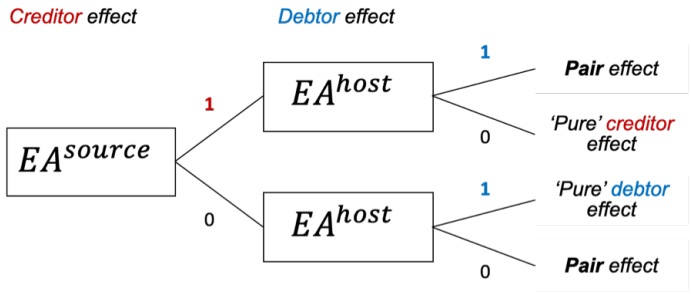


Figure 4.1: Representation of channels for all three euro effects: a creditor, a debtor and a pairwise effect

4.2 Main estimation model

As Figure 4.1 mechanically demonstrates, this might make it complicated to identify the "pure" effect the channel. Hence, in order to observe all three possible channels separately, I elaborate the specification, by separately adding the indicator variables of the three of the four country pair 'euro categories'[2]:

$$C_{ijt} = \beta_0 + \beta_1 EA_{ijt}^{pair} + \beta_2 EA_{it}^{source} + \beta_3 EA_{jt}^{host} + \delta X_{ijt} + \phi_i + \omega_j + \gamma_t + \varepsilon_{ijt} \tag{4.2}$$

The specification presented in equation 4.2 above, will be regarded as the baseline specification in the remainder of this paper. I consider various compositions of equation 4.2, based on the four source-host euro category indicators, throughout the specification[3]. However, the effect of EA membership can be captured through multiple euro channels (as portrayed in Figure 4.1) likely leading to collinearity between the explanatory euro effect variables[4]. This makes it difficult to clearly observe the individual effects of the channels and would give concern for the little explanatory power of the individual determinants. To circumvent this, following Spiegel (2009), I create various sub-samples to investigate the separate source (creditor) and host (debtor) channels in more detail. Apart from validating if the pairwise effect is indeed not contaminated by other euro channels, separating the debtor and creditor effects can also be useful to determine whether stressed source or host countries drive the credit contractions.

4.3 Isolated creditor and debtor effects

First of all, to isolate the "creditor effect" of EA membership on bilateral cross-border lending:

$$C_{ijt} = \beta_0 + \beta_1 EA_{it}^{source} + \delta X_{ijt} + \gamma_t + \varepsilon_{ijt} \tag{4.3}$$

[2] The fourth category, non-EA pairs, is omitted to prevent the dummy variable trap.

[3] In these specifications, I do not include country-fixed effects as the EA-membership indicator is a constant attribute of each country in the now included third or fourth category of country pairs. Hence, that variable will already capture all the time-invariant variation as country-fixed effects. E.g. when comparing claims between Belgium and France (both EA-members) or Belgium and Sweden (only Belgium is an EA-member), the EA-membership of Belgium remains fixed and will absorb all of the time-invariant differences that is specific to that country.

[4] The correlation coefficients between the EA_{ijt}^{pair} dummy and EA_{ijt}^{source} and EA_{ijt}^{host} indicators have positive values of 0.6811 and 0.5608, respectively, see Table A.2 in Appendix A

Here, the subsample consists out of all observations from bank pairs consisting of all source countries (both EA and non-EA) lending to non-EA host countries only. Thus, this subsample captures the "pure" creditor effect of euro area membership, as the sample of host countries remains fixed to those countries outside of the euro area and is therefore uncontaminated by varying debtor or pairwise effects in euro membership.

Similarly, the specification that isolates the 'debtor effect" of EA membership:

$$C_{ijt} = \beta_0 + \beta_1 EA_{it}^{source} + \delta X_{ijt} + \gamma_t + \varepsilon_{ijt} \tag{4.4}$$

Here, the subsample consists out of all observations from pairs of all host countries (both EA and non-EA) borrrowing from non-EA source countries only. In parallel to specification 4.3 it captures the "pure" debtor effect of euro area membership, as the sample of source countries remains fixed to those countries outside of the euro area. The above mentioned methodologies should enable me to disentangle the creditor and debtor effect from the pairwise effect.

4.4 Main explanatory and control variables

To capture as many unobserved effects as possible, the matrix X_{ijt} includes a standard set of bilateral gravity-model control variables, based on well-established financial literature[5] and macroeconomic controls. Data on gravity variables include *Bilateral Trade, Bilateral Distance, Common Language and Common Legal Origin.* The latter three variables partly capture bilateral closeness geographical, institutional and cultural which usually proxies the level of information asymmetry between countries (Portes & Rey, 2005). A lower level of information asymmetry could serve as a propagating factor in financial integration and may also affect intra-EU cross-border credit flows between countries. Bilateral trade is included in order to capture the degree of trade openness. As between close trading partners there exists the possibility of information spillovers from the goods to the financial sector possibly affecting ciross-border banking patterns(Aviat & Coeurdacier, 2007). Moreover, international financial flows are found to be correlated to underlying trade patterns (Lane & Milesi-Ferretti, 2008; Mishra, 2007). Country-specific differences in institutional quality, such as a government's effectiveness, could also plausibly curb a country's cross-border interbank loans. For example, as shown by Bremus and Fratzcher (2015) regulatory quality serves as a pull-factor for bilateral cross-border bank claims. To control for differences in institutional quality, I include the average score of the *World Banks Worldwide Governance Indicators (WGI)*[6].

Even though both crises had consequences throughout the EU, not all EU countries were equally affected on an economic level. Differences in domestic economic environment of both creditor and debtor country could have implications for bilateral lending patterns, which is why I also add macroeconomic control variables to my model. For example, a higher inflation (an overheating economy) rate could result in a decrease in cross-border

[5] As first introduced by Tinbergen (1962)), The gravity model helps explain the pattern of bilateral trade flows in the goods sector. Following Portes, Rey and Oh (2001), many papers have focused on applying the gravity model to explain international banking flows as well, with one of the most recent studies conducted by Brei and Von Peter (2018), who compare cross-border bank positions with domestic positions.

[6] Within the WGI, the World Bank reports aggregate and individual governance indicators over 200 countries and territories, which include: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption

loans demanded by borrowing countries whereas relatively faster economic growth, depicted by the GDP growth rate, could encourage cross-border lending on both the demand as well as the supply-side (Bruno & Shin, 2014; Cerutti, Claessens & Ratnovski, 2014). To correct for these post-crisis as well as general differences in economic growth and circumstances, I include controls for *Inflation* and *Real GDP Growth*, all annually measured over the entire studied period for both host and source countries. I also include controls for a country's annual level of *GDP per capita*. Furthermore, as my research focuses on credit flow developments within the banking sector, country specific bank sector performance may also affect the lending and borrowing behavior of a certain country. After all, countries with more profitable banks may be less encouraged to attract cross-border credit for their operations. As thoroughly explained in the paper by Emter et al. (2019), a country's ratio of *non-performing loans to gross loans (NPL)* is a general indicator for asset quality and will therefore function as one of my bank sector performance measures. Other performance measures include *Return on Equity* as well as the *Leverage Ratio* for both host and source countries. Lastly, I also include variables for *Short-term interest rates* and *Long-term Interest Rates*[7] to control for differences in monetary policy among both host and source countries[8].

The use of bilateral data should allow for separation between supply-side and demand-side factors, and, as bank systems of various creditor (source) countries face similar demand from a certain borrowing (host) country, relative differences in bilateral lending should reflect supply-side differences (Claessens, 2017). However, this might overlook specific creditor-debtor effects, such as mutual adoption of a unified currency like the euro. As earlier explained, I attempt to disentangle these effects by using the isolated specifications in equations 4.3 and 4.4. To further limit the possibility of any unobserved credit-debtor effects, I include separate controls for source and host country fixed effects in the baseline estimation model, apart from the extensive list of previously mentioned control variables for both counterparties. In addition, I cluster the errors at the country-pair level to prevent any within error correlation.

4.5 The euro as credit shock propagator during the euro crisis

Next, I explore if the euro effect could be a possible determinant in the observed interbank credit contractions during the crisis and examine whether pairs consisting of 'euro banks curtailed their international lending more during the euro crisis than 'non-euro banks'. Again, the identification strategy relies on the differences in credit contraction between country-pair types, based on their EA membership. In other words, if credit contractions were indeed transferred through the channels of the euro area, EA country pairs should curtail interbank lending more compared to countries that were not a part of the EA during the euro crisis. The empirical specification is similar as before, but transformed into a cross-sectional difference model that compares the differences in average credit positions between the pre-crisis (2005-2008) and post-crisis (2013-2015) periods. Based

[7] According to the definition of Eurostat (2019b), Long-term interest rates are related to the prices at which long-term debt securities (government bonds with maturity of 10 years) are traded on the financial market.

[8] There are no Estonian sovereign debt securities that are issued occasionally, and long-term rates on government bonds are not dissimulated past December 2010. With the adoption of the euro as from 1 January 2011, the compilation methodology of analytical accounts of monetary financial institutions and central bank has changed and data comparison with previous periods is not feasible.

on the empirical models of Emter et al. (2019) and Bremus and Fratzscher (2015), the time-varying independent variables enter the model as differences between the averaged values of the two periods:

$$\Delta \ln C_{ij} = \beta_0 + \beta_1 EA_{ij}^{pair} + \beta_2 Non\text{-}EA_{ij}^{pair} + \delta X_{ij} + \varepsilon_{ij} \tag{4.5}$$

In equation 4.2, $\Delta \ln C_{ij} = ln(C_{ij}^{post\text{-}crisis}) - ln(C_{ij}^{pre\text{-}crisis})$ represents the natural log change in bilateral cross-border banking claims of BIS reporting country *(i)* on counterparty country *(j)*, between the pre- and post-euro crisis periods, observed between 2009 and 2012, to examine the euro effect on the *development* of the cross-border credit contractions during euro zone sovereign debt crisis. The main explanatory variables, EA_{ij}^{pair} and $non\text{-}EA_{ij}^{pair}$ are the same dummy variables as in equation 4.1 and 4.2, the baseline panel specification. Also, just as before in equation 4.2, due to unobserved creditor and debtor effects, these estimators may only partly capture the "pure" pairwise effect of EA membership on financial shock transmission. In order to sort out the three channels, I once again separately add the individual indicator dummy variables for the country pairs' 'euro categories':

$$\Delta \ln C_{ij} = \beta_0 + \beta_1 EA_{ij}^{pair} + \beta_2 EA_{i}^{source} + \beta_3 EA_{j}^{host} + \delta X_{ij} + \varepsilon_{ij} \tag{4.6}$$

I consider various specifications of equation 4.6, entering the various dummy variables EA_{ij}^{pair}, EA_{i}^{source} and EA_{j}^{host} into the model one by one. As before in equation 4.2, to get an insight of the separate debtor and creditor euro effects, I simultaneously condition for the three euro effect dummies and compare them to non-EA country pairs, the benchmark group. Once again, due to the problem of collinearity between the different estimators, as noted in section 4.2, the size and significance of the individual creditor and debtor effects on credit contractions may be more difficult to successfully identify[9].

However, because of the cross-sectional setting of this second analysis, the number of observations within the sample becomes significantly smaller than before. For that reason, restricting the sample even further to completely isolate the separate creditor and debtor euro effects, as demonstrated in equations 4.3 and 4.4, would likely put too much strain on the remaining data points in terms of explanatory power of the independent variables. Therefore, I restrict this part of the analysis to simply approximating the "pure" creditor and debtor effects as described before and pairwise effect of equation 4.5 remains of main interest.

As in the the panel set in the previous section, the matrix variable X_{ij} consists out of the same gravity-type, economic and bank sector-specific control variables. In contrast to the time-varying control variables the time-invariant gravity variables enter the model in log-levels.

Lastly, I also include the averaged pre-crisis levels of both cross-border credit and bilateral trade. I do so to control for a possible 'reversion to the mean'-effect. A phenomenon that occurred during the global financial crisis, where investors withdrew more credit from destinations in which the pre-crisis cross-border levels were relatively the largest (Galstyan & Lane, 2013). This would imply that during a crisis banks mainly contract their cross-border capital out of the countries in which they have invested the most, regardless of their EA membership.

[9] The correlation coefficients between the EA_{ij}^{pair} dummy and EA_{i}^{source} and EA_{j}^{host} indicators have positive values of 0.5342 and 0.7015, respectively, see Table A.3 in Appendix A.

5 Data

This chapter describes the data used in my analysis as well as its sources and the relevant adjustments I made to the data.

5.1 Data on cross-border banking

In my research I have used bilateral country-level data on cross-border bank positions of countries within the European Union (EU). The bilateral lending data is available via the unrestricted version of the Bank of International Settlement's (BIS) residence-based locational banking statistics (LBS) database. The LBS provides quarterly information on balance sheet positions (i.e. outstanding claims and liabilities) of globally active banks located in BIS reporting countries against counterparties situated in other countries worldwide. The locational statistics are compiled by the BIS, following the balance of payment statistics as defined by the International Monetary Fund (IMF).

The detailed breakdown of the LBS data set provides information about the currency composition of banks' balance sheets and allows for distinction between the different instruments used in financial transactions as well as the financial sector of the counterparty country (e.g. banks/non-banks and the private/public sector). This makes a distinction between international banking activities in the bank and non-bank sector possible. The LBS captures around 95% of all cross-border interbank business (BIS, 2018b).

I have gathered quarterly data on all 28 EU countries, which I accumulate to annual amounts and categorize according to the residence of the banks and the adoption of the euro as the country's single currency[1]. That is to say, the residency of the entity matters for it's country classification. For example, a Spanish affiliate of a German bank is considered a Spanish entity. In order to ensure all banks in my sample are subject to the same level of financial regulation and monetary policy and governance as executed and designed by the European Commission and the European central Bank (ECB), I have only selected banks of which the home country or majority shareholder is situated within an EU member state. Over the time series, the composition of these member states may vary, which is why I control for the year of EU and EA entry. Within my sample, 18 countries already were euro area members before 2008. These include: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain. Estonia joined the EU in 2004, but only adopted the euro as per 2011[2] and will therefore be considered a non-euro country for the majority of the time series. As my identifying assumption is based on the pre-crisis established integration of the euro countries, and Estonia only joined the euro area when the crisis was already at its peak level, one of the robustness tests will exclude Estonia form the sample. The 8 remaining non-EA countries thus consist of: Bulgaria, Czechia, Denmark, Hungary, Latvia, Poland, Romania, Sweden and the United Kingdom. Croatia will be included as the 9th country within the non-euro sample starting from 2013, the year it joined the EU.

[1] Banks include both the headquarter as well as a foreign subsidiary located in a country.
[2] Estonia joined the EA starting January 1st, 2011.

Not all the EU countries within my data set report to the BIS[3]. Therefore, within my sample the 15 reporting EU-countries make up the set of 'source countries', or creditors, while the total amount of 28 EU-countries function as 'host countries', or debtors (see Table A.1 in Appendix A for a detailed specification).

5.2 Adjustments and limitations to BIS dataset

For the locational banking data, banks report their stock positions (e.g. amounts of outstanding cross-border claims/liabilities) to the BIS in the currency in which their claims are denominated. Subsequently, positions in non-dollar currencies are converted into US dollars at the exchange rate prevalent at the end of each reporting period. As interbank transactions are distributed over the whole period, currency movements *within* a single period still affect the current US dollar values of non-dollar stock positions and therefore the actual underlying cross-border credit *flows* (the period-to-period changes). In addition, sometimes the reported BIS data contain 'breaks-in-series', which refer to a change in compilation of the reported stock positions. This also affects the comparability of data between two consecutive periods[4]. However, the availability of a currency breakdown of the LBS data, combined with the reporting of the above mentioned breaks, enables the BIS to calculate and report the break- and foreign exchange rate-adjusted changes, the "FX-adjusted changes". These FX-adjusted changes approximate the corrected underlying credit flows from period t_0 to period t_1, adjusted for both the break- as well as the exchange rate valuation effects within that period. The BIS calculates these adjusted changes by first converting the dollar-denominated amounts into their original currency, applying the respective end-of-period US dollar exchange rates. Thereafter, the differences in amounts outstanding are calculated in original currency terms and finally reconverted into US dollar amounts, using period *average* exchange rates (BIS, 2019).[5]

When looking at the amount of credit claims between euro countries and countries with divergent currencies, the adjustments in exchange rate movements should be taken into account when focusing on the impact of a common currency region. To ensure that my data are corrected for break and exchange rate adjustments, I constructed the *adjusted* end-of-period amounts of outstanding cross-border claims between country i and country j using these FX-adjusted changes. Following Emter et al. (2019), I did this by starting from the latest unadjusted stock position within my sample of which I subtracted the corresponding within-period FX-adjusted change and continued this procedure throughout the whole panel[6]. For example, the quarter-end stock position of country pair ij in period t_{2014Q4} was calculated by subtracting the FX-adjusted flow that happened *within* quarter t_{2014Q4} (from t_{2014Q4} to t_{2015Q1}) from the exchange

[3] The euro area sample among the BIS reporting countries consists of 12 euro area countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. The remaining 3 non-euro area EU reporting countries are Denmark, Sweden and the United Kingdom

[4] Breaks in series may arise from: changes in the population of reporting institutions, including the addition of new reporting countries; changes in reporting practices; or methodological improvements

[5] It is worth noting that the use of an average exchange rate may result in the over- or under-reporting of outstanding amounts, when differences between the exchange rate on the specific transaction dates and the average rate exist (Avdjiev & Hale, 2019).

[6] When adjusted flows are missing, but the original, unadjusted amounts are reported by the BIS, I use the original, unadjusted reported values in my calculations. This is the case for less than 1% of the quarterly data points and should therefore not be of great influence to the data.

rate-unadjusted cross-border quarter-end position in period t_{2015Q1}.

The LBS data has some limitations. As mentioned before, a limited set of EU countries report to the BIS. On top of that, some of these officially listed reporting countries do not allow their data to be published in the public version of the LBS database. Most likely because of confidentiality flags by the individual central banks.[7] As a result, the amount of cross-border observations (loans and deposits) from Germany, Spain and Portugal are too low to be included in my panel set and the amount of BIS reporting countries is reduced to 11 remaining source countries of which cross-border values are paired in all existing bilateral source-host combinations. The limitations that the exclusion of these countries might bring to the interpretation of my estimation results, especially a large net creditor country as Germany, will be discussed in chapter 7.

Furthermore, especially in the period before 2007, the LBS database often lacks separate cross-border values for the bank sector. However, this limitation can be corrected manually following the procedure first applied in the paper by Emter et al. (2019). When cross-border claims on banks are missing, but the statistics for both the non-banks as well as total claims are available, I replace the data gap by subtracting all non-bank values from the total claims[8]. This makes sense as, for each time period, the total amount of cross-border claims is the summation of the total claims in the bank and non-bank sectors.

Lastly, I studied the BIS data on an annual rather than an on a quarterly frequency, as the data availability is larger on this higher level of aggregation. A few, very small, negative stock values were reported after correcting the BIS data for FX-adjusted changes. However, as these values make up an negligible amount of the data, they were excluded from the analysis.

5.3 Data on gravity and macroeconomic variables

Besides data on loans and deposits, different control variables in the empirical work are taken from various sources. The gravity variables bilateral distance, common language and legal origin are taken from the CEPII Gravity database. In addition, bilateral trade openness is measured by the sum of bilateral export and import, relative to the GDP-level of the reporting source country of reference (Yanikkaya, 2003). Trade data is gathered from the IMF's Direction of Trade Statistics database. The macroeconomic control variables are available through the ECBs Statistical Data Warehouse (SDW), the World Banks's Global Finance Development database, Eurostat and the IMFs Internationals Financial Statistics (IFS) database. Variables on bank performance come from the IMF's Financial Soundness Indicators (FSI) database, the World Bank and the ECB's Consolidated Banking Statistics (CBS). Performance variables are measured pretax for greater cross-country comparability of the data, unaffected by differences in tax systems. To gauge monetary policy on the long- and short-term, I gathered short-term interest rate data (i.e. 3-month money market interest rates) from Eurostat and data on long-term interest rates (i.e. the yield of ten-year government bonds) from the ECB's database on

[7] These data are only visible in the restricted version of the BIS data available to reporting central banks, or, in some cases, in the confidential version of the data only available at the BIS in Basel.

[8] By applying this method I am able to successfully reduce the amount of missing values to less then 6%.

harmonized long-term interest rates statistics (IRS)[9]. Lastly, in order to take governance structures into account, I employed the World Bank's measure of Governance Indicators (WGI). In my specification, the average WGI-score represents the calculated average of all the six governance indicators, each determined and estimated by the World Bank. Tables 5.1 and 5.2 summarize the main characteristics of the variables used in the analyses.

[9] The harmonized long-term interest rate statistics as compiled by the ECB for convergence assessment purposes report primary market yields for Cyprus. The same applies to Bulgaria and Romania up to December 2005, Slovenia up to October 2003 and Lithuania up to October 2007

Table 5.1: Descriptive statistics for panel analyses, period 2008-2015

	Definition/unit	Source	Obs.	Stand. dev.	Mean
Country pair variables					
Cross-border claims[b]	Total amount of cross-border bank loans and deposits between source and host, in natural log	BIS LBS	2195	3.7416	21.3649
EA-country pair	Dummy =1, if both EU countries are euro countries, changing composition[b]	European Commission	2195	.4990515	.467426
Source EA-country	Dummy =1, if only the reporting (source) country is a euro country	European Commission	2195	.4500781	.7179954
Host EA-country	Dummy =1, if only the destination (host) country is a euro country, changing composition[b]	European Commission	2195	.4722054	.6646925
Non-EA-country pair	Dummy =1, if neither EU country is a euro country, changing composition[b]	European Commission	2195	.2785549	.084738
Common language	Dummy =1, if source and host countries share an offical common language	CEPII	2195	.2702229	.0792711
Common legal origin	Dummy =1, is countries share a common legal origin	CEPII	2195	.430246	.2451025
Bilateral trade[a]	Total trade volume (X + M) from source's perspective, normalised for GDP, in natural log	IMF DOTS, CEPII	2195	2.09245	3.933352
Bilateral distance	Physical distance (in km) between two countries' capitals, in natural log	CEPII	2195	.5898666	7.07363
Source-country-specific variables					
NPL[b]	Non-performing loans to gross loans ratio in banking sector	IMF FSI	2122	7.278721	5.195554
ROE[b]	Return on equity of banking sector, percentage	World Bank	2144	13.00156	3.452973
Leverage ratio[b]	Leverage ratio of banking sector (total assets/total equity)	ECB CBS	2172	4.561163	19.18788
WGI average[b]	Average score over 6 governance indicators	World Bank	2195	.384576	1.469477
Long-term interest rate[a]	Long-term interest rates (yield of debt securities issued, 10 years maturity)	ECB IRS	2195	2.951452	3.422068
Short-term interest rate[b]	Short-term interest rates (three-month money market rate)	Eurostat	2195	1.463515	1.22494
Real GDP growth rate[b]	Growth rate of RGDP to previous year, seasonally adjusted, percent change	IMF IFS	2195	4.030599	1.22494
Inflation rate[b]	Percent change of Harmonized Index of Consumer Prices (HICP)	Eurostat	2195	1.460173	1.674989
GDP per capita[b]	Current GDP per capita, in natural log	CEPII	2195	.3390541	10.81913
Host-country-specific variables					
NPL[b]	Non-performing loans to gross loans ratio in banking sector	IMF FSI	2168	7.732324	7.791505
ROE[b]	Return on equity of banking sector, percentage	World Bank	2146	12.26095	4.204864
Leverage ratio[a]	Leverage ratio of banking sector (total assets/total equity)	ECB CBS	2186	5.719004	15.19876
WGI average[b]	Average score over 6 governance indicators	World Bank	3196	.4823724	1.08219
Long-term interest rate[a]	Long-term interest rates (yield of debt securities issued, 10 years maturity)	ECB IRS	2121	2.671675	4.214597
Short-term interest rate[b]	Short-term interest rates (three-month money market rate)	Eurostat	2195	2.38704	1.901785
Real GDP growth rate[b]	Growth rate of RGDP to previous year, seasonally adjusted, percent change	IMF IFS	2195	3.951726	.6932221
Inflation rate[b]	Percent change of Harmonized Index of Consumer Prices (HICP)	Eurostat	2195	2.24616	2.04861
GDP per capita[b]	Current GDP per capita,[a] in natural log	CEPII	2195	.6471878	10.20042

[a] Measured in US dollars, $.
[b] All time-varying variables are on the year-level.
[c] Composition of EA-host countries changes in: 2007 (when Slovenia joins the euro zone), in 2008 (when Malta and Cyprus join), 2009 (Slovakia joins), and in 2011 (Estonia joins).

Table 5.2: Descriptive statistics for cross-sectional analyses, pre- (2005-2008) and post-euro crisis (2013-2015)

	Definition/unit	Source	Obs.	Stand. dev.	Mean
Country pair variables					
EA-country pair	Dummy =1, if both EU countries are euro countries, changing composition[b]	European Commission	565	.4873309	.4287611
Source EA-country	Dummy =1, if only the reporting (source) country is a euro country	European Commission	565	.449223	.720354
Host EA-country	Dummy =1, if only the destination (host) country is a euro country, changing composition[b]	European Commission	565	.4767441	.609292
Non-EA-country pair	Dummy =1, if neither EU country is a euro country, changing composition[b]	European Commission	565	.2934708	.099115
Δ Cross-border claims[b]	Difference in cross-border bank loans and deposits between source and host, in natural log	BIS LBS	271	2.309588	-1.363213
Δ Bilateral trade[a]	Difference in trade volume (X + M) from source's perspective, normalised for GDP, in natural log	IMF DOTS, CEPII	271	.3765287	-.0355355
Initial trade level, 2008	Pre-crisis bilateral trade level (averaged for 2005-2008), in natural log	IMF DOTS, CEPII	565	2.075084	3.88784
Initial cross-border position, 2008	Pre-crisis bilateral cross-border position (average of bank claims for 2005-2008), in natural log	BIS LBS, CEPII	565	3.778548	21.16601
Source-country-specific variables					
Δ NPL[b]	Pre-post crisis difference in NPL ratio	IMF FSI	271	8.636709	5.09409
Δ ROE[b]	Pre-post crisis difference in ROE, percentage	World Bank	271	10.89589	-6.696564
Δ WGI average[b]	Pre-post crisis difference in average WGI-score	World Bank	271	.1250692	-.0638958
Δ Long-term interest rate[a]	Pre-post crisis difference in LT interest rate	ECB IRS	271	1.869001	-1.92143
Δ Short-term interest rate[b]	Pre-post crisis difference in ST interest rate	Eurostat	271	.5279332	-3.604045
Δ Real GDP growth rate[b]	Pre-post crisis difference in RGDP growth rate	IMF IFS	271	3.301013	-.078754
Δ Inflation rate[b]	Pre-post crisis difference in inflation rate	Eurostat	271	.9853917	-1.848862
Δ GDP per capita[b]	Pre-post crisis difference in GDP per capita, in natural log	CEPII	271	.1019253	.0189513
Host-country-specific variables					
Δ NPL[b]	Pre-post crisis difference in NPL ratio	IMF FSI	270	9.573249	.129117
Δ ROE[b]	Pre-post crisis difference in ROE, percentage	World Bank	271	11.57879	-11.0515
Δ WGI average[b]	Pre-post crisis difference in average WGI-score	World Bank	271	.1444145	-.0385004
Δ Long-term interest rate[a]	Pre-post crisis difference in LT interest rate	ECB IRS	262	1.586558	-1.731466
Δ Short-term interest rate[b]	Pre-post crisis difference in ST interest rate	Eurostat	271	.9569341	-3.873809
Δ Real GDP growth rate[b]	Pre-post crisis difference in RGDP growth rate	IMF IFS	271	3.113286	-1.418054
Δ Inflation rate[b]	Pre-post crisis difference in inflation rate	Eurostat	271	2.351785	-3.185763
Δ GDP per capita[b]	Pre-post crisis difference in GDP per capita, in natural log	CEPII	271	.1518424	.0841096

[a] Measured in US dollars, $.
[b] All time-varying variables are on the year-level.
[c] Composition of EA-host countries changes in: 2007 (when Slovenia joins the euro zone), in 2008 (when Malta and Cyprus join), 2009 (Slovakia joins), and in 2011 (Estonia joins).

6 Results

In this chapter I present visual evidence for the proposed mechanisms of the euro effect and discuss the results of the regression models applied to estimate and decompose the effect of (common) EA membership on bilateral cross-border credit positions and credit contractions within the EU during the euro crisis.

Figure 6.1 displays the average logs of total cross-border claims between 2008-2015, decomposed by means of the four different country pair indicators, based on the EA membership of the respecting parties within the pair. It presents a simplified visualisation of the discussed pairwise, creditor and debtor channels of the euro effect on cross-border bank lending. Overall, average bilateral cross-border credit positions in the EU seem to have decreased during the total studied period of 2008-2015 across all types of country pairs. However, when considering individual slopes of the different country pairs more carefully over time, heterogeneous movements across euro-pair types can be observed. Pairs consisting of countries with common EA membership (EA pair) or at least the host country being an EA member (EA host), show the strongest relative year-on-year credit decline between 2010 and 2012, the peak of the euro crisis. Not surprisingly, the curtailment of cross-border claims between country pairs of which both banks are located in EA countries seems to be the most sharp and persistent. In addition, but to a lesser extent, starting 2011, the decrease seems led by country pairs of which the debtor (host) country is an EA member. This could point to the evaporation of trust in lending to EA debtor countries. Even though this figure only provides an incomplete picture of the effects, as no other control variables are included, it does give reason to suspect a pairwise euro effect that is most strongly present during the euro crisis period.

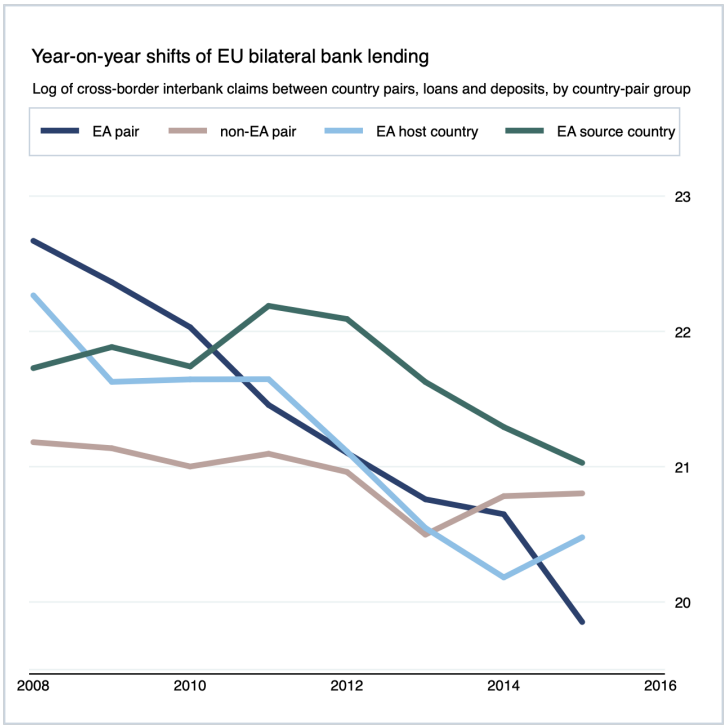


Figure 6.1: Time series plot of bilateral cross-border claims for each 'euro effect'-channel over the 2008-2015 period. *Note:* Log of average yearly bilateral cross-border claims (*Y-axis)*) between EU banks over time (*X-axis*). Various types of country pairs are sorted by the EA membership of the corresponding source and host country: EA_{ijt}^{pair} (both countries within EA) $non\text{-}EA_{ijt}^{pair}$ (neither country in the EA) EA_{ijt}^{source} (creditor is EA country) and EA_{ijt}^{host} (borrowing country is a EA member.

6.1 Panel estimation: Euro-pairs and bilateral cross-border claims in loans and deposits

Table6.1 represents the results from the full panel analyses, as described in equation 4.1 and 4.2. Column (1) represents the initial pairwise (non-) euro effect of interest, depicted by variables EA_{ijt}^{pair} and *non-*EA_{ijt}^{pair}. As can be seen, the coefficient for the the pairwise effect, EA_{ijt}^{pair}, enters with the expected negative sign at a statistically significant level. The point estimate of -1.684 predicts a decrease of C_{ijt}, i.e. the log of total cross-border bank claims in loans and deposits, by a factor of exp(-1.684) when borrowing occurs between two euro countries, compared to all other country pairs (Table 6.1, column 1). This can be transformed to an average decrease of approximately 81% in cross-border claims if both countries are EA countries. In my sample, the average dollar value of cross-border claims between 2008 and 2015, is estimated to be 21.36 in natural log levels (Table 5.1). Hence, the point estimate of -1.684 corresponds to a decrease in the level of outstanding bank claims of approximately $1.55 billion. On the contrary, the positive point estimate of 1.125 for non-EA pairs would imply an average increase in cross-border claims when neither country is part of the EA, compared to all other country pairs (Table 6.1, column 1). This would suggest that, when comparing country pairs where at least one counterparty is an EA member, cross-border bank lending between banks located outside of the euro zone increased. Even though this points to a notable difference in cross-border lending related to EA membership, this effect is not statistically significant. Columns (2) and (3) introduce the creditor and debtor effect variables EA_{ijt}^{source} and EA_{ijt}^{host}, respectively, one by one into the model. Of these two effects, the negative point estimate of -1.520 for the debtor effect is the only significant coefficient and would point to an estimated decrease in cross-border bank claims of 78%, or $1.49 billion if the borrowing bank is located within the EA (Table 6.1, column 3). As the estimated debtor effect is almost as large as the pairwise effect this could indicate that the decrease in cross-border bank lending actually travels through the debtor channel. As explained in Chapter 3, in this setting it is still uncertain whether the perceived pairwise and debtor effects in column (1) and (3) are not driven by the omitted euro channels. In column (4) of Table 6.1, I control for the separate euro channels. All of the euro effect variables enter the model simultaneously with non-EA country pairs as the base group. As expected, in this setting all of the coefficients lose their independent significance, pointing towards the earlier addressed concern of multicollinearity between the separate euro channel variables 6.1. Hence, in order to determine whether the separate creditor and debtor effects truly exist and, if so, how they might affect the outcome variable, an isolated specification as proposed in equation 4.3 and 4.4 is required. The results of these models will be discussed in section 6.2.

In almost all models, high NPL ratios are significantly associated with a decrease in cross-border bank lending for both source and countries. This is in line with the findings of Emter et al. (2019) and can be explained by the idea that, when faced with decreasing asset quality, banks cut on their cross-border exposures to compensate the losses (McGuire & von Peter, 2016). In column (4), however, both of the NPL coefficients decrease and lose significance. Thus, the explanatory power of NPL ratios is partly consumed by differences between a country pair's EA characteristics. This phenomenon also occurs with the conditioning variables for RGDP growth and short-term interest rates for host countries and common language. When all of the euro effect variables are

added, little variance in credit positions between the groups is left to be explained by these variables.

Throughout the full panel model, ROE is modestly negative, but robustly significantly correlated with cross-border bilateral credit claims (Table 6.1). This also corresponds with previous literature, even though I find a slightly stronger effect, and implies that on both the creditor and the debtor side cross-border bank lending is demotivated when a country's banking system becomes more profitable and thus less dependent of foreign capital. Leverage ratios, however, do not seem to be associated with cross-border lending.

When turning to the control variables for macroeconomic conditions, real GDP growth for source countries only enters the specification significantly in model (4) and suggests that economic growth stimulates banks to spread their lending activities abroad (Table 6.1). Similarly, inflation rates in host countries only become significant in model (4). For source countries, the coefficient flips sign and increase in significance in model (4). The positive inflation coefficients for both source and host countries imply that an already 'overheating' economy further encourages cross-border lending and borrowing. The latter contradicts most literature as increasing prices (decreasing cost of domestic money) in the recipient country would be expected to limit the demand for (extra) cross-border funding (Cerutti et al., 2014; Derviz & Podpiera, 2007). A reason for the positive coefficient could be that the funds obtained from increased post-crisis bank lending are used to stimulate the economy, driving up inflation. Another explanation could be the fact that inflation in host countries reduces the domestic value of borrowed money, possibly stimulating the need for funds and credit demand.

The gravity control variables enter all models with the expected coefficients, except for common language[1]. In accordance with economic literature, increased bilateral distance, which is generally associated with an increase in information asymmetry between countries, significantly depresses cross-border lending activity. Whereas an increase in bilateral trade is significantly positively related to bilateral banking, confirming the underlying links between the sectors (Lane & Milesi-Ferretti, 2008) (Mishra, 2007). Common legal origin enters the model at a positively significant level, but only when all types of country pairs are incorporated, pointing to a possible trumping effect of the coinciding legal frameworks in the omitted groups when individual country pairs are not independently considered. Finally, in source countries, good institutional quality (i.e. a high WGI-score) is significantly negatively related to cross-border credit supply, which corresponds the findings of Emter et al. (2019). It could be the case that when a bank is faced with improved institutions in its home country, it might focus on the domestic market and the incentive to engage in international activities decreases.

Table 6.1: Results of full panel estimation on cross-border bank positions

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
EA-country-pair	-1.684**			-0.634
	(0.668)			(0.563)

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[1] As it is quite rare to have a common language within the EU, apart from French (France and parts of Belgium) or German (Germany and Austria), this coefficient probably reflects the specific lending patterns between those countries

Table 6.1 (continued)

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
Non-EA-country pair	1.125			
	(0.721)			
Source EA-country		-0.852		0.304
		(0.578)		(0.419)
Host EA-country			-1.520**	-0.0151
			(0.638)	(0.507)
NPL (source)	-0.0841***	-0.0839***	-0.0839***	-0.0401*
	(0.0248)	(0.0248)	(0.0248)	(0.0235)
NPL (host)	-0.0658***	-0.0644***	-0.0656***	-0.0265
	(0.0162)	(0.0164)	(0.0163)	(0.0205)
ROE (source)	-0.00753**	-0.00762**	-0.00761**	-0.0197**
	(0.00356)	(0.00365)	(0.00357)	(0.00794)
ROE (host)	-0.0118**	-0.0114**	-0.0117**	-0.0170**
	(0.00463)	(0.00462)	(0.00464)	(0.00806)
Leverage ratio (source)	0.0176	0.0179	0.0179	-0.0390
	(0.0255)	(0.0256)	(0.0256)	(0.0327)
Leverage ratio (host)	-0.0222	-0.0225	-0.0224	-0.0394
	(0.0246)	(0.0247)	(0.0246)	(0.0292)
WGI average (source)	1.766**	1.790**	1.775**	-2.643***
	(0.816)	(0.817)	(0.815)	(0.563)
WGI average (host)	-1.185	-0.896	-1.179	0.409
	(0.890)	(0.914)	(0.889)	(0.561)
Long-term interest rate (source)	0.0242	0.0248	0.0243	0.0102
	(0.0311)	(0.0312)	(0.0311)	(0.0363)
Long-term interest rate (host)	-0.0131	-0.00618	-0.0136	0.0421
	(0.0317)	(0.0319)	(0.0317)	(0.0590)
Short-term interest rate (source)	-0.134	-0.134	-0.135	-0.441***
	(0.142)	(0.142)	(0.142)	(0.162)
Short-term interest rate (host)	0.0726**	0.0667*	0.0737**	0.0686
	(0.0358)	(0.0365)	(0.0358)	(0.0704)
Real GDP growth (source)	-0.0201	-0.0196	-0.0199	-0.0452*
	(0.0197)	(0.0198)	(0.0197)	(0.0265)
Real GDP growth (host)	-0.0418***	-0.0352**	-0.0416**	0.0167
	(0.0161)	(0.0166)	(0.0161)	(0.0242)
Inflation rate (source)	-0.110*	-0.110*	-0.110*	0.232**
	(0.0590)	(0.0591)	(0.0590)	(0.101)
Inflation rate (host)	0.0502	0.0482	0.0500	0.132***
	(0.0329)	(0.0329)	(0.0329)	(0.0396)
Common language	-1.162***	-1.184***	-1.187***	-0.403
	(0.400)	(0.400)	(0.400)	(0.469)
Common legal origin	0.355	0.308	0.308	0.779***
	(0.312)	(0.309)	(0.309)	(0.297)
Bilateral trade, ln	1.433***	1.429***	1.438***	1.115***

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Table 6.1 (continued)

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
	(0.236)	(0.234)	(0.235)	(0.0948)
Bilateral distance, ln	-1.204***	-1.228***	-1.215***	-0.748**
	(0.446)	(0.442)	(0.443)	(0.322)
Observations	1896	1896	1896	1896
R-squared	0.7393	0.7376	0.7384	0.6162
Source country fixed effects	Yes	Yes	Yes	No
Host country fixed effects	Yes	Yes	Yes	No
Time fixed effects	Yes	Yes	Yes	Yes
GDP controls	Yes	Yes	Yes	Yes

Notes: Table reports regression coefficients. Robust standard errors in parentheses (clustered at the country-pair level). The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between all source and non-EA host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for source and host) include: NPL, ROE, and leverage ratios of the respective banking sectors, average WGI-scores, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form). Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

6.2 Panel estimation: Isolated creditor and debtor effects on cross-border bank lending

When turning to the panel results portrayed in Table 6.2 and 6.3 for the respective isolated "pure" creditor and debtor effects, the gravity control variables and additional controls are gradually included to carefully examine the behavior of the two isolated coefficients.

In Table 6.2 the sample consists of country pairs consisting of all creditor countries lending to a fixed sample of solely non-EA host countries. The variable capturing the "pure creditor" effect is positive and becomes statistically significant when gravity controls are added (Table 6.2, column 2). However, when moving from model (2) to (3), after including the full set of control variables the value of the point estimator decreases dramatically and loses all significance. This suggests that the former positive relationship between a creditor's EA membership and bank credit provision was likely driven by underlying country pair characteristics, absorbed by the coefficient of EA_{ijt}^{source}. Indeed, moving from model (2) to (3), the large and highly significant negative coefficient for the estimated effect of a source country's WGI-score on cross-border banking is especially notable and reflects how the effect of EA-membership in column (2) was probably positively biased by the omission of controls for institutional quality. In addition, bilateral trade, common legal origin and inflation in host countries seem to be the factors that positively influence cross-border banking rather than a source country's EA membership. In other words, there is insufficient prove to support the theory of a separate creditor channel driving the euro effect.

Table 6.2: Panel results for isolated creditor effect

	Log of total cross-border claims		
VARIABLES	(1)	(2)	(3)
Source EA-country	0.472	1.075**	0.237
	(0.613)	(0.431)	(0.365)
NPL (source)			0.0153
			(0.0291)
NPL (host)			-0.0112
			(0.0460)
ROE (source)			-0.0147
			(0.00898)
ROE (host)			-0.0671***
			(0.0169)
Leverage ratio (source)			-0.0374
			(0.0450)
Leverage ratio (host)			-0.0936
			(0.0816)
WGI average (source)			-3.107***
			(0.713)
WGI average (host)			0.108
			(1.421)
Long-term interest rate (source)			0.0857
			(0.0584)
Long-term interest rate (host)			-0.339
			(0.236)
Short-term interest rate (source)			-0.503**
			(0.234)
Short-term interest rate (host)			0.111
			(0.142)
Real GDP growth (source)			-0.124***
			(0.0280)
Real GDP growth (host)			-0.0752*
			(0.0420)
Inflation rate (source)			0.254*
			(0.136)
Inflation rate (host)			0.201***
			(0.0492)
Common language		-0.773	-0.0543
		(0.553)	(1.010)
Common legal origin		1.293**	1.485**
		(0.540)	(0.628)
Bilateral trade, ln		1.202***	1.712***
		(0.117)	(0.125)
Bilateral distance, ln		-0.267	0.685
		(0.540)	(0.516)

Continued on next page

Table 6.2 (continued)

	Log of total cross-border claims		
VARIABLES	(1)	(2)	(3)
Observations	736	736	646
R-squared	0.2325	0.6224	0.7373
Time period	'08-'15	'08-'15	'08-'15
Time fixed effects	Yes	Yes	Yes
GDP controls	Yes	Yes	Yes

Notes: Table reports regression coefficients. Robust standard errors in parentheses (clustered at the country-pair level).
The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for source and host) include: NPL, ROE, and leverage ratios of the respective banking sectors , average WGI-scores , long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

Next, the results of the OLS panel regression to estimate the "pure" debtor effect are presented in Table 6.3. To isolate the effect EA membership of the debtor (host) country has on bilateral bank lending, the studied sample includes country pairs consisting of all borrowing host countries and only non-EA source countries. When turning to the estimated regression coefficients, however, it becomes clear that the "pure" debtor effect of EA membership only holds in absence of all conditioning variables other than GDP controls (Table 6.3, column 1). The point estimate becomes less negative and loses all significance when gravity control variables are included (Table 6.3, column 2). The highly significant values for bilateral trade and distance, show that the effect in column (1) was most likely driven by these gravity effects. It is worth noting that the relatively small sample size of non-EA source countries (Denmark, Sweden and the UK) could be problematic in the sense that the results could be driven by dominant country-specific dynamics. Especially when regarding the UK's dominant creditor position within the EU, this could indeed be the case (Figure 2.2a). However, the regression results do not significantly change when either one of these three source countries is removed from the sample and the absence of a separate debtor effect remains intact.[2]

Overall, the discussed results suggest that when both countries are located within the euro area, this shared EA membership is negatively associated with outstanding credit claims, i.e. in the period of 2008-2015 the euro had a negative effect on bilateral cross-border bank lending. However, this relationship does not seem to travel through separate debtor and creditor channels, which leaves the initial pairwise effect to be the determining driver of the euro effect on cross-border banking.

[2] When the UK is removed, the point estimate does not show any notable difference in size. The standard error becomes slightly bigger, which is probably a consequence of the shrunk sample size.

Table 6.3: Panel results for isolated debtor effect

	Log of total cross-border claims		
VARIABLES	(1)	(2)	(3)
Host EA-country	-1.876**	-0.310	-0.198
	(0.715)	(0.550)	(0.619)
NPL (source)			0.0527
			(0.212)
NPL (host)			-0.0420
			(0.0354)
ROE (source)			0.00609
			(0.0432)
ROE (host)			-0.00918
			(0.0131)
Leverage ratio (source)			-0.366
			(0.284)
Leverage ratio (host)			0.0698*
			(0.0377)
WGI average (source)			-2.201
			(1.893)
WGI average (host)			-0.264
			(0.881)
Long-term interest rate (source)			0.721
			(0.450)
Long-term interest rate (host)			0.0743
			(0.0982)
Short-term interest rate (source)			0.733
			(0.514)
Short-term interest rate (host)			0.0580
			(0.125)
Real GDP growth (source)			0.0476
			(0.127)
Real GDP growth (host)			0.0153
			(0.0387)
Inflation rate (source)			-0.122
			(0.166)
Inflation rate (host)			0.138**
			(0.0691)
Common language		0.427	0.808
		(1.349)	(1.209)
Common legal origin		0.885	1.185*
		(0.752)	(0.658)
Bilateral trade, ln		1.050***	0.947***
		(0.158)	(0.179)
Bilateral distance, ln		-1.751***	-1.502*
Observations	619	619	570

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Table 6.3 (continued)

	Log of total cross-border claims		
VARIABLES	(1)	(2)	(3)
R-squared	0.4769	0.7190	0.7608
Time period	'08-'15	'08-'15	'08-'15
Time fixed effects	Yes	Yes	Yes
GDP controls	Yes	Yes	Yes

Notes: Table reports regression coefficients. Robust standard errors in parentheses. The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for source and host) include: NPL, ROE, and leverage ratios of the respective banking sectors , average WGI-scores , long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

6.3 Cross-sectional difference estimation: Euro-pairs and the growth of cross-border claims in the euro-crisis

In this section, I turn to the cross-sectional analysis on changes in cross-border claims between the pre-euro crisis period (2005-2008) and the post-euro crisis period (2013-2015) to determine whether shared euro area membership also affected the intra-EU credit contractions of the euro crisis.

Table 5.2 summarizes the descriptive statistics of the cross-sectional model and shows how the average change in pre- and post-euro crisis credit levels is estimated to be -1.363 in log levels. The negatives value of the average differences, reflect the credit retrenchments during the euro crisis.

Table 6.4 represents the results of the cross-sectional difference model as expressed in equations 4.5 (column 1) and 4.6 (column 2-4). Overall, it seems that shared euro area membership is weakly significantly associated with cross-border credit retrenchments. Column (1) displays a significantly negative point estimate of -0.547 for the pairwise effect of EA membership on cross-border credit curtailment during the euro crisis. In other words, when comparing pre- and post crisis credit levels, EA pairs curtailed bank lending by a factor of exp(-0.547), or approximately 42%, more, respectively, than other country pairs. I do not find clear differences in credit retrenchments for non-EA country pairs. These results are in line with the results from the panel estimation and indicate a negative pairwise euro effect on bank lending between the pre- and post euro crisis period.

Columns (2) and (3) present the estimators of the indicator dummies EA_i^{source} and EA_j^{host} that capture the respective creditor and debtor channels of the euro effect. The estimator for the debtor effect obtains a significantly negative coefficient of -0.555 (Table 6.4, column 3). As the coefficient is almost equal to the pairwise point estimate in column (1), the results suggest that the earlier noted negative pairwise effect could

actually travel through the debtor channel (Table 6.4, column 3). This would be the case when all EU banks, regardless of their euro adoption, disproportionately curtail credit from banks located in euro countries. As discussed in Chapter 2 at the peak of the credit boom, 'core' creditor EA countries were lending especially large amounts to periphery EA member states (Baldwin & Giavazzi, 2015). As these countries had very large current account imbalances, their economies became troubled when credit inflows were halted. Non-EA creditor's fear of further contagion from the euro zone could have caused economies to disproportionately pull back credit from borrowing EA countries. In fact, after the credit stop of mid-2008, many banks considerably contracted their lending vis-á-vis Greek banks (Hellwig, 2018). To verify whether the coefficients in column (1) and (3) can be interpreted as the "pure" debtor or pairwise effects of EA membership on credit curtailment, isolation of the three euro channels is needed. In column (4) of Table 6.4 all of the euro effect variables are included in the specification to control for the individual effects. However, as before in the panel setup, in this setting all of the coefficients enter the model insignificantly and the coefficient of EA_j^{host} flips sign. This confirms the earlier addressed difficulty of completely separating and correctly interpreting the individual euro channels when using the full sample as they are highly collinear with each other (See Appendix A, Table A.3)[3]. As explained in Chapter 4 the sample is too small to form subsamples to isolate the effects further. Therefore, even though there seems to be a suggestion of a pairwise effect, there is insufficient evidence to conclude if this effect is indeed purely driven by debtor countries.

Turning to the control variables, some changes can be observed compared to the panel setup in the previous sub-section. In the cross-sectional analysis, the only variables that show robust significance are the leverage ratios and long-term interest rates for host countries. A reason for this could be that during the euro crisis most EA countries were subject to comparable circumstances and there was little difference in macroeconomic conditions across member states. Similarly, bank performance indicators do not prove to have a major role in explaining variation across different types of country pairs. Surprisingly, the gravity variables all turn insignificant as well and do not seem to be driving the euro crisis' credit changes. The insignificant estimators for initial credit positions point to absence of the "reversion of the mean" effect as stated by Galystane and Lane (2013). However, the highly significant positive estimator for initial bilateral trade levels points to a opposite effect. During the euro crisis, banks seem to have increased their lending more vis-á-vis countries where initial (trade) levels were higher. This would point to a "progression towards" rather than a "reversion from" the mean trade levels with initial trade partners, suggesting that established trade links make a difference in stressed banking dynamics.

Table 6.4: Cross-sectional estimation results for euro crisis period

	Log change of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
EA-country-pair	-0.547*			-0.767
	(0.310)			(0.565)
Non-EA-country pair	-0.336			

Continued on next page

[3] There is an especially high correlation between the variables EA_j^{host} and EA_{ij}^{pair} of 0.7015.

Table 6.4 (continued)

VARIABLES	Log change of total cross-border claims (1)	(2)	(3)	(4)
	(0.460)			
Source EA-country		0.293		0.658
		(0.380)		(0.514)
Host EA-country			-0.555*	0.0262
			(0.299)	(0.511)
NPL (source)	-0.0112	-0.0662	-0.0322	-0.0528
	(0.0968)	(0.101)	(0.0922)	(0.101)
NPL (host)	0.00688	0.0154	0.00284	0.00366
	(0.0235)	(0.0228)	(0.0234)	(0.0235)
ROE (source)	-0.0414	-0.0624	-0.0487	-0.0574
	(0.0433)	(0.0449)	(0.0417)	(0.0447)
ROE (host)	-0.0153	-0.0169	-0.0131	-0.0128
	(0.0157)	(0.0157)	(0.0158)	(0.0158)
Leverage ratio (source)	-0.0534	-0.0489	-0.0495	-0.0497
	(0.0461)	(0.0464)	(0.0460)	(0.0461)
Leverage ratio (host)	0.0624*	0.0725**	0.0591*	0.0579*
	(0.0326)	(0.0320)	(0.0326)	(0.0326)
WGI average (source)	1.488	1.990	1.806	1.830
	(2.670)	(2.691)	(2.659)	(2.676)
WGI average (host)	0.505	0.301	0.599	0.521
	(1.224)	(1.221)	(1.218)	(1.222)
Long-term interest rate (source)	-0.102	-0.0222	-0.0588	-0.00683
	(0.394)	(0.401)	(0.390)	(0.399)
Long-term interest rate (host)	-0.384**	-0.378**	-0.335**	-0.323*
	(0.166)	(0.169)	(0.169)	(0.171)
Short-term interest rate (source)	-0.305	-0.203	-0.236	-0.277
	(0.630)	(0.632)	(0.628)	(0.629)
Short-term interest rate (host)	0.298	0.284	0.289	0.271
	(0.190)	(0.192)	(0.189)	(0.191)
Real GDP growth (source)	-0.221	-0.176	-0.200	-0.181
	(0.141)	(0.144)	(0.139)	(0.143)
Real GDP growth (host)	0.0593	0.0668	0.0629	0.0653
	(0.0537)	(0.0541)	(0.0535)	(0.0538)
Inflation rate (source)	-0.286	-0.292	-0.273	-0.261
	(0.323)	(0.325)	(0.323)	(0.323)
Inflation rate (host)	-0.0466	-0.0200	-0.0574	-0.0468
	(0.0911)	(0.0898)	(0.0899)	(0.0910)
Bilateral trade, ln	-0.114	-0.0453	-0.189	-0.121
	(0.424)	(0.419)	(0.419)	(0.423)
Common language	-0.662	-0.868*	-0.700	-0.702
	(0.500)	(0.497)	(0.492)	(0.500)
Common legal origin	0.397	0.230	0.327	0.375
	(0.322)	(0.317)	(0.315)	(0.322)

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Table 6.4 (continued)

	Log change of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
Bilateral distance, ln	-0.225	-0.350	-0.227	-0.233
	(0.340)	(0.336)	(0.335)	(0.339)
Initial bilateral trade level, ln	0.531***	0.580***	0.552***	0.583***
	(0.122)	(0.128)	(0.118)	(0.128)
Initial cross-border bank position, ln	-0.0271	-0.0452	-0.0208	-0.0484
	(0.0789)	(0.0797)	(0.0753)	(0.0802)
Observations	261	261	261	261
R-squared	0.4079	0.4003	0.4075	0.4128
Crisis period	'09-'12	'09-'12	'09-'12	'09-'12
GDP controls	Yes	Yes	Yes	Yes

Notes: Table reports regression coefficients. Robust standard errors in parentheses (clustered at the country-pair level).
The dependent variable is the pre- and post-crisis change in outstanding bilateral cross-border claims (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls, expressed in differences, (source and host) include: NPL, ROE, WGI-score, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, bilateral trade levels (natural log denominated at GDP level). Time-invariant dummy variables for common language and common legal origin, bilateral distance between capitals (natural log form).
[a] [b] Initial levels refer to averaged levels over the pre-euro crisis period of 2005-2008
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

Overall, the discussed results suggest that within the period 2008-2015, euro area membership seems to be a determining factor in explaining adverse cross-border bank lending patterns within the EU. When both countries in a lending pair are euro countries, this negatively affects their bilateral bank lending and results in lower credit positions compared with pairs that consist of only one or no euro country. Moreover, a euro effect is also visible during the credit contractions of the eponymous euro crisis as (common) euro membership is negatively related to cross-border credit changes. When comparing the changes in pre- and post-crisis credit levels, I find that EA country pairs contract their lending more than other country pairs within the EU, pointing to a 'pairwise' effect on credit retrenchment. This aligns with the idea that the EMU intensified financial links and made member states more susceptible to intra-area credit contractions, or "sudden stops". Shared euro membership could propagate movements of distrust and cause shock symmetry and form a channel for intra-area crisis contagion (De Grauwe & Ji, 2013). Weak evidence for a additional debtor effect implies that credit curtailments directed at EA debtor countries is a possible driver for the pairwise effect. However, there is insufficient evidence to derive a 'pure' debtor effect and thus the true underlying mechanisms of the pairwise effect remain undecided.

7 Robustness checks and extensions

In this chapter, I carry out some robustness analyses to examine whether my results hold in alternative specifications and extensions. I conclude the chapter with considering some possible threats to the model and suggestions for further research.

7.1 Euro effects on different crisis periods

To determine whether the found euro effect on credit contractions is relevant for the eponymous crisis only, I extend the baseline model of the cross-sectional difference analysis (equation 4.5) to two additional crisis periods. First of all, I examine the euro effect during the preceding global financial crisis of 2008/2009, for which the respective pre- and post-crisis periods are (2005-2007) and (2009). Secondly, I evaluate the total crisis period and compare the euro effect on credit changes between the pre-crisis (2005-2007) and post-crisis period (2013-2015) to determine whether EA membership is also the driver of credit curtailment during this overall 'great retrenchment' period [1].

Table 7.1 reports the results of the cross-sectional difference analysis examined during the global crisis of 2008/2009[2]. The results are in line with the EU trends in cross-border banking outlined in Chapter 2. As can be seen in column (1), (2) and (3), the euro effect coefficients of EA_{ijt}^{pair}, EA_{ijt}^{source} and EA_{ijt}^{host}, respectively, have positive signs, indicating a positive credit change, or lending increase, for all euro-related country pairs during the 2008/2009 period. This makes sense as during the majority of this global crisis period, intra-EA bank lending was actually still increasing. Recalling Figure 2.1, the amount of outstanding credit claims from euro area reporting countries increased until its peak level in 2008Q2, after which it took a steep dive. As the coefficients enter with insignificant levels, these two contradicting effects seem to eliminate each other in the data. In addition, the point estimate of non-EA pairs is significantly negative, indicating that credit contractions did occur between banks located outside of the euro area. In contrary to the results found in Table 6.4, during the global crisis there seems to be no significant relation between EA membership and credit contractions where non-EA countries are negatively associated with credit contractions.

Table 7.1: Cross-sectional estimation results for global financial crisis period, 2008/2009

	Log change of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
EA-country-pair	0.129			-0.365
	(0.261)			(0.379)
Non-EA-country pair	-0.517*			
	(0.303)			

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[1] Because its later the EU entry, Croatia is only present in the post-crisis sample of the 2008-2015 period and therefore excluded from both the analyses

[2] As the demoted by the forward slash, this period represents one financial year 2008-2009, which is 12 consecutive months. Rather than a hyphened period, e.g. 2014-2015, which means 2 years

Table 7.1 (continued)

	Log change of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
Source EA-country		2.446		2.404
		(2.202)		(2.183)
Host EA-country			0.250	0.463
			(0.207)	(0.302)
NPL (source)	0.424**	0.438**	0.416**	0.453**
	(0.194)	(0.204)	(0.195)	(0.204)
NPL (host)	-0.0997	-0.111*	-0.101	-0.0981
	(0.0631)	(0.0615)	(0.0630)	(0.0634)
ROE (source)	0.0283	0.00421	0.0310	0.00988
	(0.0217)	(0.0287)	(0.0221)	(0.0287)
ROE (host)	0.00369	0.00112	0.00502	0.00123
	(0.0112)	(0.0111)	(0.0113)	(0.0112)
WGI average (source)	3.450**	1.747	3.730**	2.035
	(1.590)	(1.939)	(1.599)	(1.912)
WGI average (host)	1.683	1.517	1.647	1.625
	(1.210)	(1.209)	(1.206)	(1.214)
Long-term interest rate (source)	0.169	0.590	0.143	0.504
	(0.420)	(0.519)	(0.423)	(0.513)
Long-term interest rate (host)	0.330*	0.391**	0.344**	0.323*
	(0.172)	(0.162)	(0.173)	(0.174)
Short-term interest rate (source)	-0.460	0.929	-0.660**	0.732
	(0.321)	(1.377)	(0.315)	(1.367)
Short-term interest rate (host)	0.0750	0.0240	0.0739	0.0624
	(0.0849)	(0.0737)	(0.0843)	(0.0846)
Real GDP growth (source)	-0.0377	-0.0605	-0.0323	-0.0460
	(0.0791)	(0.0783)	(0.0792)	(0.0798)
Real GDP growth (host)	0.0365	0.0298	0.0390	0.0323
	(0.0342)	(0.0338)	(0.0343)	(0.0342)
Inflation rate (source)	-0.100	-0.0377	-0.0945	-0.0420
	(0.228)	(0.234)	(0.227)	(0.234)
Inflation rate (host)	-0.0132	-0.0205	-0.0159	-0.00345
	(0.0710)	(0.0710)	(0.0711)	(0.0728)
Bilateral trade, ln	-0.0328	-0.178	-0.0603	-0.0744
	(0.423)	(0.440)	(0.431)	(0.435)
Common language	-0.320	-0.284	-0.397	-0.290
	(0.265)	(0.261)	(0.257)	(0.267)
Common legal origin	-0.00906	-0.0478	-0.0467	-0.0238
	(0.222)	(0.231)	(0.227)	(0.224)
Bilateral distance, ln	0.110	0.276	0.0722	0.199
	(0.233)	(0.232)	(0.236)	(0.247)
Initial bilateral trade level, ln	0.235*	0.284**	0.232*	0.248**
	(0.120)	(0.111)	(0.120)	(0.119)
Initial cross-border bank position, ln	-0.0859	-0.0553	-0.0801	-0.0714

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Table 7.1 (continued)

VARIABLES	Log change of total cross-border claims (1)	(2)	(3)	(4)
	(0.0598)	(0.0638)	(0.0606)	(0.0639)
Observations	193	193	193	193
R-squared	0.1888	0.1846	0.1832	0.1919
Crisis period	'08 -'09	'08 -'09	'08 -'09	'08 -'09
GDP controls	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses (clustered at the country-pair level).
The dependent variable is change in bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for source and host) include: NPL, ROE, WGI-score, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, initial levels of bilateral trade and cross-border lending, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).
[a] [b] Initial levels refer to averages over the pre-crisis period of 2005-2007
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

In Table 7.2 the pre- and post-crisis time frame is extended to the include both the global and euro crisis periods. This setup explores if the euro effect can explain the credit changes between the pre-crisis period (2005-2007) and the post-crisis period (2013-2015). Overall, I observe that common EA membership between countries is significantly associated with the cross-border credit retrenchment during the total crisis period in the EU. Similar to the euro crisis period, Table 7.2 shows significantly negative coefficients for both EA_{ijt}^{pair} and EA_{ijt}^{host}, suggesting a pairwise euro effect and a possible debtor effect (Table 7.2, column 1 and 3). However, different than before, when all of the country pair variables are included in the model, the point estimate for EA_{ijt}^{pair} remains significant on the 10% level. The coefficient obtains a substantial negative value of -1.067 which would predict a decrease in cross-border bank lending of approximately 66%. (7.2, column 4). This points to robust evidence of a pairwise euro effect on cross-border credit contractions since the global financial crisis, with the shared euro adoption as a shock propagator.

Table 7.2: Cross-sectional model over total crisis period, between (2005-2007) and (2015-2013)

VARIABLES	Log change of total cross-border claims (1)	(2)	(3)	(4)
EA-country-pair	-1.203***			-1.067*
	(0.368)			(0.596)
Non-EA-country pair	0.134			
	(0.520)			
Source EA-country		-0.286		-0.119
		(0.902)		(0.945)
Host EA-country			-0.854***	-0.137
			(0.326)	(0.535)

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Table 7.2 (continued)

	Log change of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
NPL (source)	0.133	0.0449	-0.0199	0.129
	(0.117)	(0.208)	(0.0995)	(0.206)
NPL (host)	0.0683	0.0588	0.0682	0.0683
	(0.0439)	(0.0447)	(0.0440)	(0.0440)
ROE (source)	0.119	0.0401	-0.0602	0.115
	(0.122)	(0.244)	(0.101)	(0.240)
ROE (host)	0.0233	0.0218	0.0222	0.0233
	(0.0246)	(0.0253)	(0.0248)	(0.0247)
WGI average (source)	-0.334	1.487	3.533	-0.254
	(3.616)	(5.635)	(3.375)	(5.541)
WGI average (host)	1.486	0.854	1.256	1.482
	(1.433)	(1.465)	(1.427)	(1.452)
Long-term interest rate (source)	-0.0212	-0.0839	-0.268	-0.0265
	(0.552)	(0.633)	(0.553)	(0.620)
Long-term interest rate (host)	-0.471**	-0.484**	-0.439**	-0.470**
	(0.188)	(0.198)	(0.189)	(0.194)
Short-term interest rate (source)	-1.508	-0.929	-0.105	-1.478
	(1.009)	(1.868)	(0.905)	(1.836)
Short-term interest rate (host)	0.427**	0.412*	0.431**	0.426**
	(0.215)	(0.220)	(0.216)	(0.216)
Real GDP growth (source)	-0.123	-0.133	-0.213	-0.125
	(0.211)	(0.242)	(0.212)	(0.237)
Real GDP growth (host)	-0.0238	0.0142	-0.0230	-0.0238
	(0.0631)	(0.0628)	(0.0634)	(0.0633)
Inflation rate (source)	-0.988**	-0.789	-0.495	-0.977
	(0.444)	(0.725)	(0.413)	(0.712)
Inflation rate (host)	-0.0924	-0.0830	-0.0772	-0.0921
	(0.141)	(0.145)	(0.141)	(0.142)
Bilateral trade, ln	-0.410	-0.240	-0.460	-0.409
	(0.433)	(0.429)	(0.429)	(0.435)
Common language	-0.393	-0.910	-0.608	-0.395
	(0.570)	(0.568)	(0.560)	(0.579)
Common legal origin	0.637*	0.560	0.562	0.637*
	(0.365)	(0.373)	(0.366)	(0.367)
Bilateral distance, ln	0.158	-0.0995	0.0730	0.158
	(0.400)	(0.402)	(0.401)	(0.401)
Initial bilateral trade level, ln	0.537***	0.534***	0.577***	0.538***
	(0.142)	(0.159)	(0.142)	(0.156)
Initial cross-border bank position, ln	-0.0284	-0.0625	-0.0261	-0.0285
	(0.0910)	(0.0914)	(0.0904)	(0.0915)
Observations	219	219	219	219
R-squared	0.3811	0.3472	0.3691	0.3811
Crisis period	'08-'12	'08-'12	'08-'12	'08-'12

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Table 7.2 (continued)

	Log change of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
GDP controls	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses (clustered at the country-pair level).
The dependent variable is change in bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for source and host) include: NPL, ROE, WGI-score, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, initial levels of bilateral trade and cross-border lending, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).
[a] [b] Initial levels refer to averages over the pre-crisis period of 2005-2007
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

7.2 Additional robustness checks

First of all, to examine whether my main results hold if I extend the time series of the baseline model of the panel analysis to the period 2004-2015. I find that the for the results for all the euro channels, in both the full panel setup as well as the isolated setting, do not significantly change (TablesA.4 and A.5 in Appendix A).

As cross-border claims in and loans and deposits are typically of short-term nature, the use of yearly observations might not properly reflect the high sensitivity of the banking system to fluctuations in credit flows. Therefore, I rerun the panel regression using quarterly data on cross-border claims, obtained through the BIS LBS. As many of the control variables lack data on a quarterly basis, I use Stata's linear interpolation to fill the missing values[3]. The coefficient for the pairwise effects decreases is size, but remains significant (Table A.6, column 1 in Appendix A). However, the debtor effect reduces in significance from the 5% to the 10% level. When the creditor and debtor effects are further isolated the pure effects again enter with insignificant coefficients, weakening the evidence for a separate euro channel to drive the found pairwise effect (Table A.7 in Appendix A). This confirms the suggestion of the euro effect being present in the form of a pairwise effect only. However, these results should be interpreted with caution as the use of linear interpolation is not a very precise method and forces to assume linearity when in reality performance variables such as ROE might not behave linearly form quarter to quarter, especially during stressed periods.

Lastly, additional (unreported) robustness checks include the exclusion of possible outliers, a rerun of the cross-sectional regression excluding country pairs that have less observations than the amount of years observed. The results show that these observations have little leverage over the total sample, keeping the main findings intact.

[3] The linear interpolation was applied to the controls for NPL, ROE, leverage ratios, WGI and all of the gravity variables

7.3 Threats to the identification and future research

The BIS publishes international banking statistics on a quarterly frequency. However, as many of the included control variables only report at a yearly frequency, the use of quarterly data would result in many missing observations. The disadvantage of using annual observations, however, is the loss of variance within a year. As previously mentioned, the short-term loans and deposits used in this analysis might therefore fluctuate to a stronger degree than the annual variance implies, especially during the banking turmoil of the crisis. However, as the pairwise effect remains intact when using quarterly data, this does not seem to be a major issue. As briefly mentioned in Chapter 5, only 11 of all of the 28 EU countries are BIS reporting countries. This means that even though all countries enter in the host (debtor) group, less than 50% of the sample constitute the set of source countries. This could have consequences when the variances between the groups of source and host countries are unequal. When comparing the variances of source and host groups, there does not seem to be a great dissimilarity in terms of variance in cross-border claims (Table A.8). However, among the countries that do report to the BIS only 3 out of 15 are non-EA countries, namely Denmark, Sweden and the UK. Therefore, the panel set is relatively unbalanced in terms of EA membership among source countries. Even though source and host country fixed effects should take these concerns out of the way, it must be noted that the under representation of non-EA creditors substantially decreases the variance across non-EA creditor countries.

As banking data from the Deutsche Bundesbank is not made publicly available through the BIS‘ LBS dataset, my thesis does not include Germany in the sample. However, as noted before, one of the core creditors responsible for the credit build-up of the euro zone was Germany, lending almost $250 billion per year to other EA countries by 2007. Following Baldwin and Giavazzi (2015) it also served as net lender to crisis hit nations (Greece, Ireland, Portugal and Spain). Moreover, after the crisis hit Europe, starting 2008Q3 Germany, as most banks, significantly cut back on their cross-border lending (Düwel, Frey & Lipponer, 2011) (Hellwig, 2018). Given their fact that Germany is a euro country, lacking data on the credit curtailments of this net creditor country could affect my regression results and may cause a underestimation of the pairwise effect as well as the pure creditor effect. Creditor data is also missing from Spain and Portugal, but as these countries were net debtors (especially Spain with $150 billion in capital inflow before the euro crisis (Baldwin & Giavazzi, 2015)), their absence can be viewed as a shortcoming of less explanatory importance.

Compared to the model of Emter et al. (2019) my model lacks control variables for prudential policy stringency indicators (PPI) and Central Bank liquidity provision. As these variables prove to be significant determinants, the omission of these variables in my model could have implications for my estimation results. Within their euro area sample, Central Bank funding in host country has a negative effect on cross-border credit claims. Omission of this control variable could therefore lead to an overestimation of the effect of euro membership international banking dynamics. with regard to PPI, as Emter et al. (2019) showed in their analysis, a tighter (higher) PPI aimed at banks in source countries are positively correlated with credit provision of banks within the euro area. Therefore, omission of PPI could downward bias my result and result in an underestimation of the found euro effect.

Lastly, my explanatory variables, used to distinguish the different country pairs and their corresponding euro effects, are based on a predominantly time-fixed characteristic,

namely membership to the euro zone. This causes the different pair variables to be highly collinear not only with each other but also with additional country-fixed effects. This complicates the use of a time series analysis were fixed effects are integrated to control for unobserved determinants. In my research I tried overcoming this methodological shortcoming by including an elaborate set of control variables when the specification did not allow for the inclusion of country-fixed effects. However, this does leave room for excluded and unobserved factors to bias my results. Therefore, a suggestion for future research might be the use of an instrumental variable that captures EA membership and is independent of any other debtor- and creditor-specific characteristics.

8 Conclusion and discussion

This study investigates the 'euro effect', i.e. a country's membership to the euro area, on the cross-border bank lending dynamics between EU countries around and during the euro crisis. By applying a panel regression analysis I investigate general international bank lending dynamics in the EU over the period 2008-2015. Credit changes between the pre-euro crisis period (2005-2008) and the post-euro crisis period (2013-2015) are estimated using a cross-sectional difference specification. I extend on the existing literature by investigating the credit changes during the euro crisis specifically, but also look into the global crisis and total crisis period. In addition, instead of assuming one uniform transmission channel for the euro effect across country pairs, I explore three separate channels through which the effect may travel: a pairwise, debtor and creditor effect.

I find evidence pointing to a negative pairwise euro effect on bilateral credit provision, as cross-border claims between banks that are *both* situated in euro countries are on average 81% lower than other types of country pairs. In addition, this pairwise effect is also visible during the credit curtailments that took place in times of the euro crisis. More specifically, I find that credit curtailments between EA countries were on average 42% larger than curtailments between other country pairs. In both specifications, my results do not point to a separate creditor or debtor effect facilitating the pairwise euro effect in crisis banking dynamics. Even though there seems to be weak evidence for a disproportionate pullback of credit from borrowing euro countries, due to data shortcomings that restrict further channel isolation, this does not suffice to derive a pure debtor effect and provides an opportunity for further research.

When the time span of the cross-sectional analysis is altered, I find that the pairwise effect is even more strongly related to the great retrenchments of the total crisis period of 2008-2012, but is not associated with the retrenchments during the preceding global financial crisis that emerged after the Lehman Brothers default mid-2008. This indicates that the EA-specific pull-back in cross-border lending developed in a later stadium, but was more persistent.

As the Cetorelli and Golberg (2011) show, apart from cross-border lending, the crisis contagion also spread through two other channels: local lending by foreign banks subsidiaries and domestic banks' access to international financial resources. An extension to my study could therefore be the exploration of the euro effect on these channels and the connection to the real economy.

My results show how membership to the euro zone is not only of importance when studying credit buildups and financial integration, but also with regard to the following break-downs. This in line with the evidence introduced by McCauley (2017), proving that the post-crisis deglobilazation in cross-border banking was not a global phenomenon, nor a European effect, but rather a euro effect that, according to my research, travelled for a large part through pairwise membership. This view confirms concerns regarding the strong financial interdependence of euro countries against the weak overall (macroeconomic) stability of the euro system during the crisis period. Financial shocks can indeed be transferred to the real economy and vice versa, stressing that one policy type cannot be targeted without acknowledging the effects of the others (Ongena

et al., 2015) (2011). After the dense financial integration, the credit retrenchments of the euro crisis seems to have triggered EA countries to once again move towards the pre-euro level of financial fragmentation (Maudos & de Guevara, 2015). What is more, on an macroeconomic and political level, euro countries are also increasingly polarizing, for example in terms of wage diversions, trade imbalances and international investment positions (Gräbner, Heimberger, Kapeller & Schütz, 2017) (Eurostat, 2019a). This stresses the importance of alignment and compatibility between both the overarching monetary policy of the ECB as well as the individual country-level government policies. Recent reforms, such as the creation of a "banking union" in 2012, targeted at greater integration across national banks systems and sovereigns, but are still to be fully formed (ECB, 2018). In the meantime, deep banking integration with real economy still seems to be of modest size as only a tenth of cross-border bank lending is targeted at firms and households. However, as argued by (Hoffmann et al., 2019) it is this form of banking integration with real sector, is necessary to truly make the EA banking system resilient to global financial shocks and important field for further research on the development of the EMU and role of the euro.

A Tables

Table A.1: EU and EA membership of countries in panel

Country	BIS reporting?	Date of EU entry	Euro Area
Austria	Yes	1995	1999
Belgium	Yes	1958	1999
Bulgaria	No	2007	-
Cyprus	Yes	2004	2008
Croatia	No	2013	-
Czechia	No	2004	-
Germany	Yes	1958	1999
Denmark	Yes	1973	-
Estonia	No	2004	2011
Spain	No*	1986	1999
Finland	Yes	1995	1999
France	Yes	1958	1999
United Kingdom	Yes	1973	-
Greece	Yes	1981	2001
Hungary	No	2004	-
Ireland	Yes	1973	1999
Italy	No*	1958	1999
Lithuania	No	2004	2015
Luxembourg	Yes	1958	1999
Latvia	No	2004	2014
Malta	No	2004	2008
Netherlands	Yes	1958	1999
Poland	No	2004	-
Portugal	No*	1986	1999
Romania	No	2007	-
Sweden	Yes	1995	-
Slovenia	No	2004	2007
Slovakia	No	2004	2009

* Officially a BIS reporting country, but excluded from my research sample as such, due to missing data.

Table A.4: Panel regression, baseline model over period 2004-2015

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
EA-country-pair	-1.659***			-0.602
	(0.567)			(0.561)
Non-EA-country pair	1.146*			

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Table A.4 (continued)

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
	(0.653)			
Source EA-country		-0.966		0.282
		(0.593)		(0.417)
Host EA-country			-1.536***	-0.0299
			(0.551)	(0.508)
NPL (source)	-0.0782***	-0.0780***	-0.0779***	-0.0367
	(0.0252)	(0.0252)	(0.0253)	(0.0231)
NPL (host)	-0.0665***	-0.0647***	-0.0665***	-0.0236
	(0.0155)	(0.0157)	(0.0156)	(0.0203)
ROE (source)	-0.00644*	-0.00652*	-0.00650*	-0.0187**
	(0.00363)	(0.00369)	(0.00364)	(0.00789)
ROE (host)	-0.0114**	-0.0111**	-0.0113**	-0.0165**
	(0.00459)	(0.00458)	(0.00459)	(0.00801)
Leverage ratio (source)	0.0123	0.0126	0.0127	-0.0372
	(0.0247)	(0.0246)	(0.0247)	(0.0315)
Leverage ratio (host)	-0.0220	-0.0202	-0.0218	-0.0395
	(0.0240)	(0.0241)	(0.0240)	(0.0296)
WGI average (source)	1.315	1.345	1.326	-2.665***
	(0.866)	(0.865)	(0.865)	(0.564)
WGI average (host)	-1.302	-0.846	-1.300	0.441
	(0.852)	(0.883)	(0.850)	(0.557)
Long-term interest rate (source)	0.0167	0.0173	0.0167	0.00306
	(0.0322)	(0.0323)	(0.0322)	(0.0368)
Long-term interest rate (host)	-0.0220	-0.0158	-0.0226	0.0357
	(0.0313)	(0.0313)	(0.0313)	(0.0577)
Short-term interest rate (source)	-0.132	-0.131	-0.133	-0.425***
	(0.144)	(0.144)	(0.144)	(0.160)
Short-term interest rate (host)	0.0934**	0.0903**	0.0936***	0.0761
	(0.0361)	(0.0364)	(0.0360)	(0.0699)
Real GDP growth (source)	-0.0276	-0.0271	-0.0275	-0.0478*
	(0.0194)	(0.0195)	(0.0194)	(0.0263)
Real GDP growth (host)	-0.0383**	-0.0302*	-0.0381**	0.0146
	(0.0163)	(0.0166)	(0.0163)	(0.0240)
Inflation rate (source)	-0.105*	-0.105*	-0.105*	0.236**
	(0.0594)	(0.0594)	(0.0594)	(0.0996)
Inflation rate (host)	0.0380	0.0332	0.0379	0.122***
	(0.0319)	(0.0319)	(0.0320)	(0.0401)
Common language	-1.161***	-1.190***	-1.184***	-0.401
	(0.401)	(0.401)	(0.401)	(0.461)
Common legal origin	0.342	0.298	0.298	0.776***
	(0.311)	(0.308)	(0.308)	(0.292)
Bilateral trade, ln	1.407***	1.407***	1.414***	1.120***
	(0.235)	(0.234)	(0.234)	(0.0939)

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Table A.4 (continued)

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
Bilateral distance, ln	-1.286***	-1.305***	-1.294***	-0.757**
	(0.446)	(0.442)	(0.443)	(0.326)
GDP per capita, ln (source)	-2.773**	-2.799**	-2.778**	3.688***
	(1.256)	(1.264)	(1.256)	(0.690)
GDP per capita, ln (host)	1.364	1.012	1.331	0.977**
	(1.147)	(1.149)	(1.144)	(0.477)
Observations	1928	1928	1928	1928
R-squared	0.7380	0.7361	0.7372	0.6172
Time period	'04-'15	'04-'15	'04-'15	'04-'15
Source country fixed effects	Yes	Yes	Yes	No
Host country fixed effects	Yes	Yes	Yes	No
Time fixed effects	Yes	Yes	Yes	Yes

Notes: Table reports regression coefficients. Robust standard errors in parentheses (clustered at the country-pair level).
The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for both source and host countries) include: NPL, ROE, and leverage ratios of the respective banking sectors, average WGI-scores, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

Table A.5: Panel results for isolated debtor and creditor effects over period 2004-2015

	Log of total cross-border claims	
VARIABLES	(1)	(2)
Source EA country	0.268	
	(0.334)	
Host EA country		-0.184
		(0.616)
NPL (source)	0.0321	0.0533
	(0.0265)	(0.210)
NPL (host)	0.00953	-0.0427
	(0.0315)	(0.0356)
ROE (source)	-0.0119	0.00440
	(0.00771)	(0.0425)
ROE (host)	-0.00826	-0.00950
	(0.00955)	(0.0130)
Leverage ratio (source)	-0.0402	-0.349
	(0.0438)	(0.281)
Leverage ratio (host)	-0.101*	0.0693*

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Table A.5 (continued)

VARIABLES	Log of total cross-border claims (1)	(2)
	(0.0557)	(0.0371)
WGI average (source)	-3.190***	-2.028
	(0.595)	(1.926)
WGI average (host)	2.203	-0.272
	(1.460)	(0.885)
Long-term interest rate (source)	0.0971	0.714
	(0.0614)	(0.450)
Long-term interest rate (host)	-0.0183	0.0754
	(0.173)	(0.0979)
Short-term interest rate (source)	-0.527***	0.798
	(0.192)	(0.502)
Short-term interest rate (host)	0.0338	0.0561
	(0.104)	(0.124)
Real GDP growth (source)	-0.134***	0.0379
	(0.0259)	(0.125)
Real GDP growth (host)	-0.0106	0.0172
	(0.0268)	(0.0387)
Inflation rate (source)	0.266**	-0.0549
	(0.131)	(0.171)
Inflation rate (host)	0.0194	0.139*
	(0.0661)	(0.0698)
Common language	-0.388	0.831
	(1.355)	(1.235)
Common legal origin	1.455**	1.184*
	(0.666)	(0.665)
Bilateral trade, ln	1.845***	0.949***
	(0.159)	(0.177)
Bilateral distance, ln	0.737	-1.530**
	(0.509)	(0.757)
Observations	663	570
R-squared	0.7695	0.7611
Time period	04-'15	04-'15
Time fixed effects	Yes	Yes
GDP controls	Yes	Yes

Notes: Table reports regression coefficients. Robust standard errors in parentheses (clustered at the country-pair level).

The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Additional controls (for both source and host countries) include: NPL, ROE, and leverage ratios of the respective banking sectors, average WGI-scores, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted), inflation rates, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).

Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

Table A.2: Pearson's correlation matrix for euro effect indicator variables, panel model

Variable	EA_{ijt}^{host}	EA_{ijt}^{source}	EA_{ijt}^{pair}	$non\text{-}EA_{ijt}^{pair}$
EA_{ijt}^{host}	1			
EA_{ijt}^{source}	-0.0365	1		
EA_{ijt}^{pair}	0.6811	0.5608	1	
$non\text{-}EA_{ijt}^{pair}$	-0.4319	-0.5346	-0.2942	1

Table A.3: Pearson's correlation matrix for euro effect indicator variables, cross-sectional model

Variable	EA_{ij}^{pair}	$non\text{-}EA_{ij}^{pair}$	EA_{ij}^{host}	EA_{ij}^{source}
EA_{ij}^{pair}	1			
$non\text{-}EA_{ij}^{pair}$	-0.2964	1		
EA_{ij}^{host}	0.7015	-0.4100	1	
EA_{ij}^{source}	0.5342	-0.5548	-0.0386	1

Table A.6: Panel regression, baseline model with quarterly data

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
EA-country-pair	-1.245**			-0.554
	(0.615)			(0.608)
Non-EA-country pair	0.772			
	(0.675)			
Source EA-country		-0.379		0.476
		(0.559)		(0.455)
Host EA-country			-1.124*	0.0537
			(0.610)	(0.554)
NPL (source)	-0.0978***	-0.0975***	-0.0976***	-0.0488**
	(0.0260)	(0.0261)	(0.0260)	(0.0233)
NPL (host)	-0.0799***	-0.0795***	-0.0802***	-0.0354**
	(0.0172)	(0.0173)	(0.0172)	(0.0176)
ROE (source)	-0.00868**	-0.00878**	-0.00878**	-0.0272***
	(0.00387)	(0.00382)	(0.00387)	(0.00714)
ROE (host)	-0.000156	-0.000197	-0.0000916	-0.0107
	(0.00503)	(0.00503)	(0.00504)	(0.00668)
Leverage ratio (source)	-0.00686	-0.00622	-0.00633	-0.0710**
	(0.0174)	(0.0176)	(0.0175)	(0.0294)
Leverage ratio (host)	-0.0142	-0.0157	-0.0145	-0.0521*
	(0.0191)	(0.0191)	(0.0191)	(0.0279)

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Table A.6 (continued)

	Log of total cross-border claims			
VARIABLES	(1)	(2)	(3)	(4)
WGI average (source)	0.568	0.592	0.593	-1.787***
	(0.801)	(0.800)	(0.803)	(0.667)
WGI average (host)	0.0162	0.146	0.0141	0.218
	(0.973)	(0.975)	(0.971)	(0.640)
Long-term interest rate (source)	0.0314	0.0311	0.0311	0.0559
	(0.0343)	(0.0342)	(0.0343)	(0.0487)
Long-term interest rate (host)	0.0301	0.0335	0.0307	0.0410
	(0.0304)	(0.0305)	(0.0304)	(0.0638)
Short-term interest rate (source)	0.186**	0.190**	0.186**	0.378***
	(0.0893)	(0.0896)	(0.0896)	(0.104)
Short-term interest rate (host)	0.103***	0.0984***	0.103***	0.131*
	(0.0371)	(0.0373)	(0.0370)	(0.0688)
Real GDP growth (source)	-0.00196	-0.00214	-0.00196	-0.0273
	(0.00801)	(0.00793)	(0.00799)	(0.0175)
Real GDP growth (host)	0.00593	0.00749	0.00643	0.0515**
	(0.0143)	(0.0144)	(0.0143)	(0.0248)
Inflation rate (source)	-0.0809**	-0.0819**	-0.0813**	0.0290
	(0.0317)	(0.0318)	(0.0318)	(0.0417)
Inflation rate (host)	0.0251	0.0267	0.0256	0.0260
	(0.0175)	(0.0174)	(0.0174)	(0.0267)
Common language	-1.177***	-1.195***	-1.197***	-0.297
	(0.385)	(0.380)	(0.380)	(0.460)
Common legal origin	0.262	0.223	0.223	0.702**
	(0.282)	(0.279)	(0.279)	(0.301)
Bilateral trade, ln	1.370***	1.363***	1.369***	1.137***
	(0.235)	(0.233)	(0.234)	(0.101)
Bilateral distance, ln	-1.126***	-1.143***	-1.136***	-0.590*
	(0.433)	(0.433)	(0.434)	(0.318)
	(1.237)	(1.240)	(1.239)	(0.518)
Observations	6803	6803	6803	6803
R-squared	0.7109	0.7098	0.7102	0.5718
Time period	'08-'15	'08-'15	'08-'15	'08-'15
Source country fixed effects	Yes	Yes	Yes	No
Host country fixed effects	Yes	Yes	Yes	No
Time fixed effects	Yes	Yes	Yes	Yes
GDP controls	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses (clustered at the country-pair level)
The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Column (1)-(3) also includes source and host country-fixed effects. Additional controls include: NPL, ROE, and leverage ratios of the respective banking sectors (source and host), WGI-score (average of 6 WGI-indicators, source and host), long-term interest rates (10-year-bond yields, source and host), short-term interest rates (money market rates, source and host), real GDP growth (annually, seasonally adjusted, source and host), inflation rates (annual percentage change of HCIP, source and host), dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form).
Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

Table A.7: Panel results for isolated debtor and creditor effects with quarterly data

	Log of total cross-border claims	
VARIABLES	(1)	(2)
Source EA country	0.352	
	(0.419)	
Host EA country		-0.104
		(0.637)
NPL (source)	-0.00176	-0.253*
	(0.0358)	(0.142)
NPL (host)	-0.0372	-0.0175
	(0.0507)	(0.0297)
ROE (source)	-0.0184*	-0.0349*
	(0.0102)	(0.0193)
ROE (host)	-0.0452***	0.00241
	(0.0155)	(0.0113)
Leverage ratio (source)	-0.0854*	-0.289**
	(0.0434)	(0.110)
Leverage ratio (host)	-0.0123	0.0476
	(0.0888)	(0.0440)
WGI average (source)	-2.371**	-4.584***
	(0.958)	(1.361)
WGI average (host)	-0.653	0.0933
	(1.472)	(0.973)
Long-term interest rate (source)	0.169**	0.122
	(0.0797)	(0.133)
Long-term interest rate (host)	-0.0449	0.0132
	(0.155)	(0.0976)
Short-term interest rate (source)	0.151	0.384***
	(0.184)	(0.144)
Short-term interest rate (host)	0.102	0.108
	(0.111)	(0.124)
Real GDP growth (source)	-0.102***	-0.141***
	(0.0258)	(0.0382)
Real GDP growth (host)	-0.00779	0.0713*
	(0.0402)	(0.0375)
Inflation rate (source)	-0.0329	-0.0891*
	(0.0599)	(0.0473)
Inflation rate (host)	0.106**	0.0549
	(0.0447)	(0.0477)
Common language	-0.727	0.436
	(0.988)	(1.480)
Common legal origin	1.050*	0.966
	(0.595)	(0.705)
Bilateral trade, ln	1.668***	0.978***
	(0.145)	(0.201)
Bilateral distance, ln	0.297	-1.528*

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Table A.7 (continued)

VARIABLES	Log of total cross-border claims (1)	(2)	
	(0.541)	(0.769)	
Observations	2338	1978	
R-squared	0.6374	0.7152	
Time fixed effects	Yes	Yes	Yes
GDP controls	Yes	Yes	Yes
Time period	'08-'15	'08-'15	

Notes: Robust standard errors in parentheses (clustered at the country-pair level) The dependent variable is outstanding bilateral cross-border claims measured in dollars (in natural log form) between source and host countries. The explanatory variables include dummy variables denoting EA-membership of both, neither or either host or source country. All specifications include time-fixed effects (annually). Column (1)-(3) also includes source and host country-fixed effects. Additional controls (for both source and host countries) include: NPL, ROE, and leverage ratios of the respective banking sectors, WGI-score, long-term interest rates, short-term interest rates, real GDP growth (annually, seasonally adjusted, source and host), inflation rates, dummy variables for common language and common legal origin, bilateral trade levels (natural log denominated at GDP level), bilateral distance between capitals (natural log form). Statistical significance at the 1%, 5% and 10% level is indicated by $***$, $**$ and $*$, respectively.

Table A.8: Statistics on log of cross-border credit claims, by source and host countries, 2004-2015

	Log of total cross-border claims					
	Obs.	Mean	Min	Max	SD	Var
Source countries						
Austria	237	22.04428	10.19914	25.75833	2.464954	6.075998
Belgium	314	21.70316	8.987197	26.92732	3.525837	12.43153
Denmark	312	19.74867	6.907755	25.90358	3.484589	12.14236
Finland	276	19.09531	7.600903	25.98521	3.802452	14.45864
France	310	22.99862	9.903487	28.26011	2.97232	8.834687
Greece	256	20.31305	11.06664	26.01463	3.135847	9.833535
Ireland	306	20.79915	9.680344	27.39508	3.764874	14.17428
Luxembourg	314	22.04052	10.54534	27.19464	3.058331	9.353388
Netherlands	255	23.45718	14.7302	28.16216	2.132648	4.548187
Sweden	300	19.98354	6.931472	26.42442	3.960061	15.68208
UK	315	23.74585	15.59924	28.3445	2.848198	8.112233
Host countries						
Austria	120	21.11326	13.32447	24.83206	2.689749	7.234752
Belgium	117	23.36282	18.68742	26.861	2.223813	4.945343
Bulgaria	113	18.75644	12.99225	23.65266	2.771304	7.680128
Cyprus	122	18.58877	6.931472	26.01463	4.061776	16.49802
Czech Republic	125	20.06933	13.81050	23.67541	2.712922	7.359944

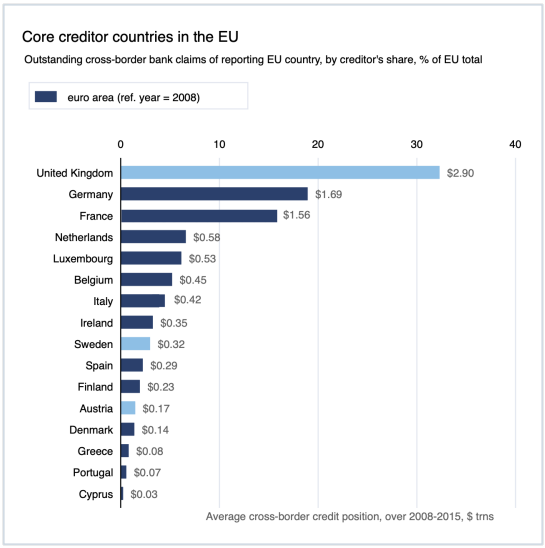
Continued on next page

Table A.8 (continued)

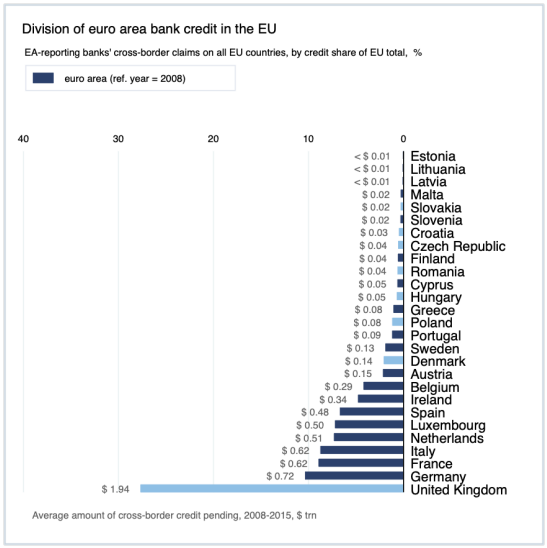
	Log of total cross-border claims					
	Obs.	Mean	Min	Max	SD	Var
Germany	126	25.11191	21.5630	28.1245	1.61846	2.619413
Denmark	117	23.33111	16.01628	25.98521	1.976243	3.905535
Estonia	106	18.62706	8.987197	23.94726	3.306018	10.92976
Spain	129	22.53159	13.52382	27.48754	3.243705	10.52162
Finland	111	22.05488	15.44082	26.42442	1.957362	3.831265
France	117	24.28213	19.59711	28.34450	2.167291	4.697150
Greece	114	19.63469	7.600903	25.66993	4.172717	17.41156
Croatia	30	18.2599	13.72122	24.18622	3.129482	9.793657
Hungary	125	20.47392	13.94566	24.62981	2.888529	8.343598
Irelamd	114	23.16131	14.50565	27.54781	3.170508	10.05212
Italy	128	23.13151	13.12038	27.21111	3.165277	10.01898
Lithuania	101	18.94346	9.680344	23.91777	3.214623	10.3338
Luxembourg	112	23.53595	17.16039	26.41885	1.948898	3.798203
Latvia	112	19.32891	9.903487	24.14486	2.923569	8.547257
Malta	121	19.07973	6.907755	24.23927	3.710918	13.77091
Netherlands	117	23.46234	15.22845	27.67314	2.539369	6.448397
Poland	124	21.91057	15.73727	24.24619	1.885575	3.555393
Portugal	129	20.923	8.006368	25.68073	3.394654	11.52368
Romania	124	20.11857	11.61729	24.80375	3.292507	10.8406
Sweden	116	22.89953	17.25734	25.90358	2.381387	5.671005
Slovenia	99	19.65237	9.392662	24.41036	3.18313	10.13232
Slovakia	109	18.94506	8.853665	23.33814	3.697575	13.67206
UK	117	25.84279	23.10789	28.26011	1.280719	1.64024

B Figures

Figure B.1: Cross-border bank creditors and borrowers within the EU, by share of total claims in the EU, 2008-2015. *Sources:* BIS, Eurostat and author's calculations. *Note:* Total cross-border claims of all EU banks based in BIS reporting countries (a) and decomposition of claims of EA-banks based in BIS reporting countries on all borrowing EU countries (b). Claims are expressed in dollars and as percentages of EU totals, across all instruments.



(a) Cross-border bank claims, by location of reporting bank



(b) Bank claims of EA-countries on all EU counterparties

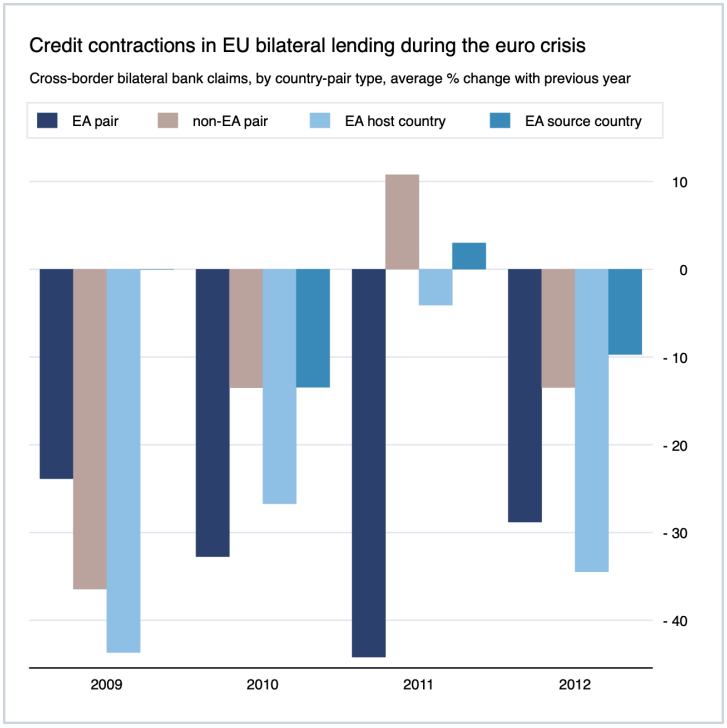
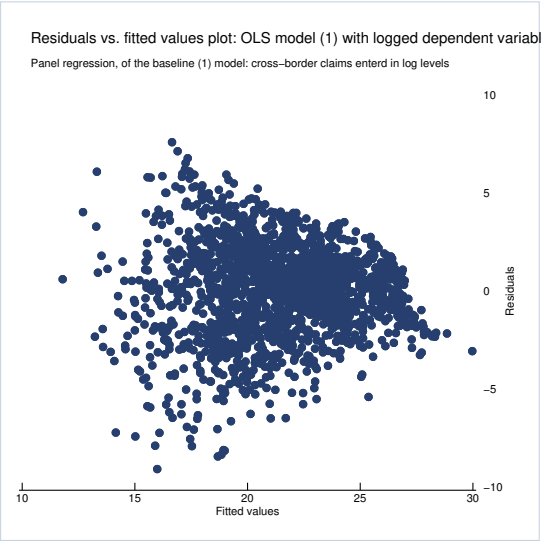
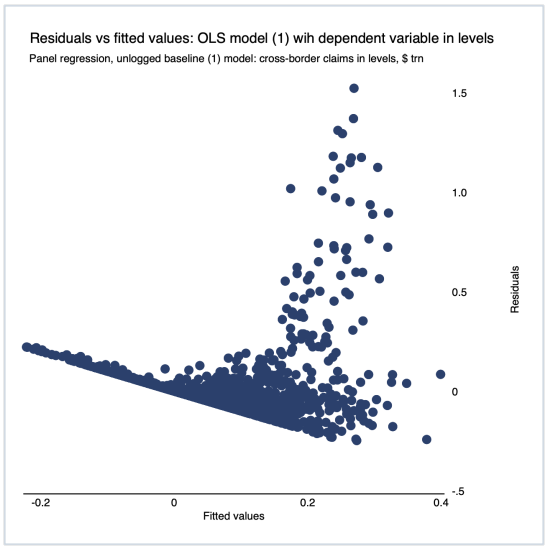


Figure B.2: Per year changes in outstanding cross-border bank claims in the euro crisis period 2009-2012. *Note:* Log change of average yearly bilateral cross-border claims between EU banks, sorted by 'euro category' of the country-pairs: EA_{ijt}^{pair}, $non\text{-}EA_{ijt}^{pair}$ EA_{ijt}^{source} and EA_{ijt}^{host}.

Figure B.3: Residuals plots of baseline regression model: $C_{ijt} = \beta_0 + \beta_1 EAijt^{pair} + \beta_1 non\text{-}EA_{ijt}^{pair} + \delta X_{ijt} + \phi_i + \omega_j + \gamma_t + \varepsilon_{ijt}$ with the dependent variable, C_{ijt} entered in (a) log values and (b) dollar values.

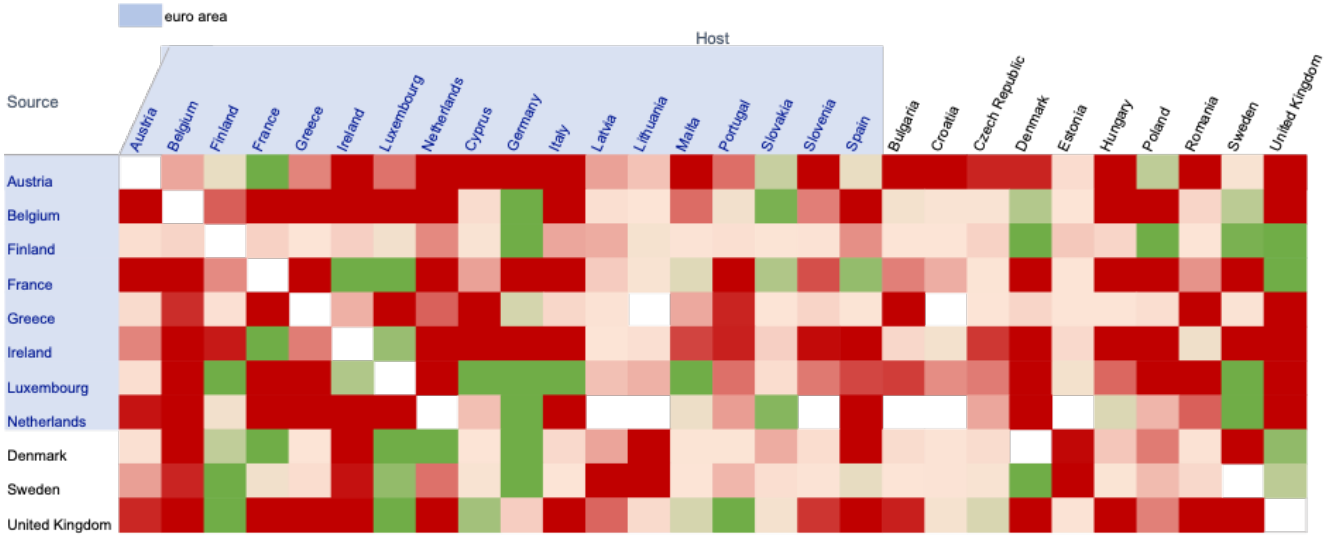


(a) Log-linear OLS regression model



(b) Unlogged OLS regression model

Figure B.4: Euro crisis credit contractions across country pairs within the EU.
Source: BIS and author's calculations. *Note:* Average of quarterly cross-border credit flows (loans and deposits) in all sectors during the euro crisis: from 2009Q1 to 2012Q4. Dark red indicate negative flows (i.e. contractions), whereas dark green indicate positive flows (i.e. expansions). The BIS calculates break- and exchange rate- adjusted changes in amounts outstanding (loans and deposits) between country pairs. These adjusted changes approximate the underlying credit flows during a quarter. Countries highlighted in blue are part of the euro area.



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