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Cross-border banking in the EU since the crisis: what is driving the great retrenchment?

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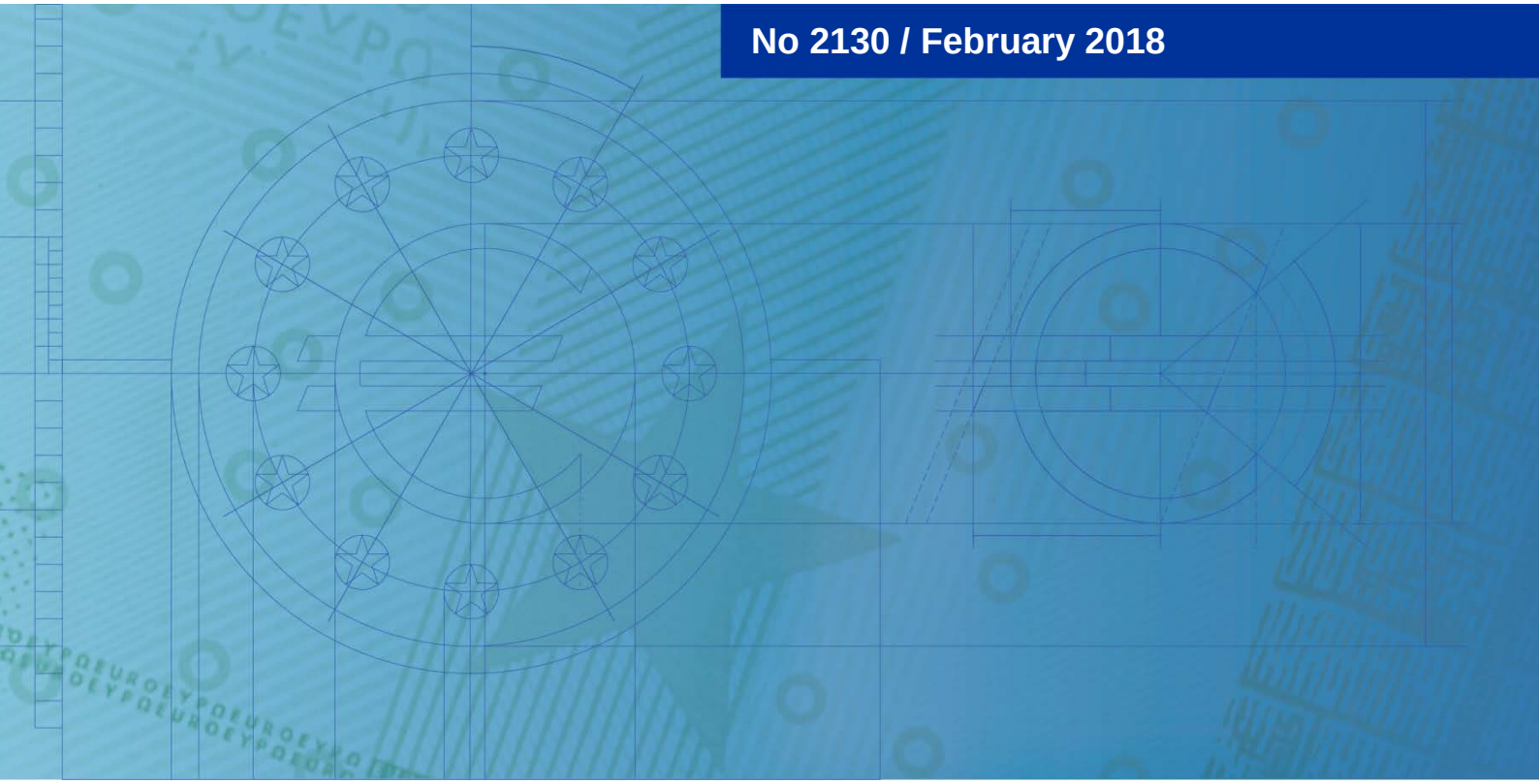

Abstract

This paper examines the drivers of the retrenchment in cross-border banking in the European Union (EU) since the global financial crisis, which stands out in international comparison as banks located in the euro area and in the rest of the EU reduced their cross-border claims by around 25%. Particularly striking is the sharp and sustained reduction in intra-EU claims, especially in the form of deleveraging from cross-border interbank loans. Examining a wide range of possible determinants, we identify high non-performing loans as an important impediment to cross-border lending after the crisis, highlighting the spillovers from national banking sector conditions across the EU. We also find evidence that prudential policies can entail spillovers via cross-border banking in the EU, albeit with heterogeneity across instruments in terms of direction, magnitude and significance. Our results do not point to a major role of newly introduced bank levies in explaining cross-border banking developments.

Keywords: cross-border banking, international capital flows, deleveraging, financial integration, prudential policies, regulation, bank levy

JEL Classification numbers: F21, F30, F42, G15, G28

Non-technical summary

The EU's banking sector is not only the largest in the world, but also accounts for the bulk of the "financial de-globalisation" observed in cross-border banking since the global financial crisis. In this paper we provide an anatomy of the great cross-border banking retrenchment in the EU and investigate a wide range of possible drivers of this phenomenon, including indicators of banking sector performance and stability, prudential policies and bank levies. Using a granular breakdown of cross-border bank lending by instrument and counterparty sector, we are able to identify the most affected components of cross-border lending and shed light on the underlying causes.

Banks located in the euro area and in the rest of the EU reduced their cross-border bank claims by around 25% since the global financial crisis, driven by a sharp and sustained reduction in intra-EU claims, which make up 60% of total EU cross-border claims. Within the EU, banks have cut their cross-border loans by around 40% which particularly affected cross-border interbank lending. Our empirical analysis shows a significant link between deteriorating asset quality and the great retrenchment in cross-border banking, highlighting the spillovers from national banking sector conditions across the EU. We also find evidence that prudential policies can entail spillovers via cross-border banking in the EU, albeit with heterogeneity across instruments in terms of direction, magnitude and significance. In particular, our results suggest that regulatory arbitrage might be possible via the use of foreign branches, while stricter policies at home may preclude banks from direct lending activities abroad, even though this does not apply within the euro area. For newly introduced bank levies, we do not find a discernible link to the great retrenchment, but they may have affected the composition of cross-border banking by incentivising lending to the non-bank sector.

Our analysis suggests that tackling the persistent asset quality problems in the EU is pivotal in order to reap the potential benefits of cross-border banking which relate for instance to risk diversification and risk-sharing. Hence, the findings of this paper make a case for completing the banking union. For instance, the rulebook for financial actors in the EU needs to be amended by adding a chapter on a harmonised approach to the resolution of non-performing loans (NPLs), complemented by country-specific elements in each high-NPL constituency, as stressed by Constâncio (2017).

1. Introduction

The European union (EU) banking sector is not only the largest in the world, but also accounts for the bulk of the "financial de-globalisation" observed in cross-border banking since the global financial crisis (Forbes, 2014; Cerutti and Claessens, 2016; McGuire and von Peter, 2016). In this paper we provide an anatomy of the great cross-border banking retrenchment in the EU and investigate a wide range of possible drivers of this phenomenon, including indicators of banking sector performance and stability, prudential policies and bank levies. Using a granular breakdown of cross-border bank lending by instrument and counterparty sector, we are able to identify the most affected components of cross-border lending and shed light on the underlying causes.

There are important financial stability benefits that may results from financial integration via cross-border banking. These include risk diversification and risk-sharing. For instance, a geographically diversified loan book and deposit base make banks less susceptible to domestic shocks and thus reduce the volatility of their lending and income streams. Further benefits may stem from enhanced competition and greater stability of banking systems, as foreign banks entering less mature markets tend to introduce more sophisticated risk management practices, accelerate the process of privatisation of state-owned banks and contribute to faster resolution of non-performing loans. However, cross-border banking may also entail financial stability costs. The presence of foreign banks, which are associated with greater mobility of capital than domestic banks, may weigh on financial stability in the host economy, owing to spillovers from external shocks (Giannetti and Laeven, 2012). Indeed, the "pecking order" in the post-crisis deleveraging by European banks – shedding cross-border assets initially while sheltering domestic assets – is a case in point. Nevertheless, the view that financial integration via cross-border banking is beneficial overall, except in situations where cross-border exposures are excessive, prevails in the literature (Allen et al., 2011; Beck et al., 2016).[1]

The global financial crisis triggered a rapid decline in international capital flows intermediated by banks, which prior to the crisis had been increasing dynamically (Forbes et al., 2016).[2] In Europe, the precipitous decline in cross-border exposures, especially between banks, partly reflected some excesses prior to the crisis, which may have reflected to some extent distorted incentives for banks to expand their balance sheets (Hale and Obstfeld, 2016). Therefore, part of the reduction in cross-border banking positions may be seen as a welcome development. This notwithstanding, cross-border banking integration in the EU remains desirable, given the still relatively limited cross-border penetration of the banking industry. As well as further enhancing risk-sharing, cross-border banking integration via, for example, cross-border mergers and acquisitions could also help to tackle the "over-banking" problem in some EU countries (Hartmann et al., 2017).

A number of studies suggest that several factors, such as banking sector vulnerabilities, regulatory tightening and government interventions lay behind the cross-border banking retrenchment. While the available literature tends to focus on the impact of one of these factors, our paper investigates them in a comprehensive and integrated framework. This is motivated by the fact that European banks during the post-crisis period faced tighter prudential regulation and higher taxation amid worsening asset quality (Figure 1).

Banking sector performance and vulnerabilities have significant implications for cross-border exposures. McGuire and von Peter (2016) stress their importance as banks affected by larger credit losses at home spread credit contractions across countries. Cerutti and Claessens (2016) suggest that cross-border deleveraging during the height of the global financial crisis varied across countries

[1] For evidence of the significant impact of cross-border banking flows on real economic activity see, for example, Peek and Rosengreen (2000).

[2] The retrenchment in cross-border banking flows after the financial crisis was the most pronounced driver of a broad-based decline in international capital flows, which was followed by an asymmetric recovery in global capital flows across regions and instruments (Milesi-Ferretti and Tille, 2011; Lane, 2013; McQuade and Schmitz, 2017).

and was in line with markets' prior assessments of banks' vulnerabilities. Temesvary and Banai (2017) find at the bank level that lower capital ratios and higher non-performing loans (NPL) – at either the subsidiary or the parent bank-level – significantly weighed on subsidiary lending growth in Central and Eastern Europe before and during the crisis. We contribute to this literature by considering the role of banking sector performance indicators at the country level in the 'advanced' post-crisis period, by investigating, for instance, the presence of cross-border spillovers from deteriorating asset quality, as also noted by the European Commission (2017). Our empirical analysis establishes a significant link between deteriorating asset quality and the great retrenchment in cross-border banking in the EU, highlighting the spillovers from national banking sector conditions across the EU.

The literature on international spillovers from prudential policies has remained inconclusive: some studies highlight the role of regulatory arbitrage (or "leakage"), which could increase cross-border banking positions, while others stress that adhering to more stringent rules is costly for banks, which in turn cut cross-border positions. For instance, Houston et al. (2012) provide evidence of regulatory arbitrage for the period before the global financial crisis, concluding that banks exploiting differences in regulation focused more on markets with less stringent regulation. Ongena et al. (2013) show that tighter regulation at home is associated with looser lending standards in banks' foreign operations. Similarly, Bremus and Fratzscher (2015) find that increasing independence and power for supervisory authorities at home diverts credit abroad, except in the euro area, where more stringent capital requirements reduced cross-border banking activity. Forbes et al. (2016) conclude that the interaction between prudential regulation and unconventional monetary policy explain roughly a third of the contraction of the UK's cross-border bank lending, while Ichiue and Lambert (2016) suggest that tighter regulatory standards explain a sizeable portion of the decline in cross-border bank lending globally since the global financial crisis.[3] It has also been established in the literature that international spillovers from prudential policies can vary significantly across various instruments (Fahr and Zochowski, 2015; Buch and Goldberg, 2016). For example, Reinhardt and Sowerbutts (2015) observe that more stringent capital requirements for domestic banks lead to a higher demand by the non-bank sector for cross-border funding. We find evidence that prudential policies can entail spillovers via cross-border banking in the EU, albeit with heterogeneity across instruments in terms of direction, magnitude and significance. In particular, our results suggest that regulatory arbitrage might be possible via the use of foreign branches, while stricter policies at home may preclude banks from direct lending activities abroad, albeit this is not found for the euro area sample.

The final policy measure we investigate in this paper relates to the impact of newly introduced bank levies on cross-border banking. We treat banking sector taxes separately from prudential policy measures and measure them using data on actual revenues from those taxes. This in our view better captures the additional tax burden on banks compared with using binary variables as in Cerutti et al. (2016), given different definitions of the underlying tax base for bank levies across EU countries.[4] We find that the introduction of bank levies after the financial crisis did not have an overall adverse impact on cross-border banking in the EU, but may have affected its composition by incentivising cross-border lending to the non-bank sector.

The remainder of this paper is organised as follows. Section 2 provides stylised facts on the retrenchment in cross-border banking in the EU. Section 3 presents our empirical strategy and discusses the explanatory variables. Section 4 provides the main empirical results, while Section 5 presents several robustness checks and Section 6 concludes.

[3] There are several studies monitoring the implementation of prudential policies and estimating their impact on the local economy. See, among others, Cerutti et al. (2015).

[4] Huizinga et al. (2014) find that banks almost fully pass on double taxation cost through higher interest margins abroad, while they also show that double taxation reduces banking-sector foreign direct investment.

2. "The great retrenchment" – stylised facts

We use data on bilateral cross-border bank positions gathered from the Bank for International Settlements' (BIS) databank on the residence-based locational banking statistics (LBS), which are consistent with the other macro-financial variables used in this paper. The LBS detail at the country level the geographical composition of banks' balance sheets and capture outstanding claims and liabilities of banking offices located in the BIS reporting countries, including intragroup positions, and exclude local claims of foreign branches and subsidiaries.[5] The original data reported by the BIS have been corrected for valuation effects due to exchange rate variations following Cerutti (2015), which are particularly relevant as large exchange rate movements tend to coincide with contractions in cross-border lending (Avdjiev and Takats, 2014).[6] Therefore changes in the bilateral cross-border positions approximate well capital flows intermediated by banks between source and host countries and closely match banking sector financial flows recorded in "other investment" of the balance of payments (Kleimeier et al., 2013). We use annual data on all 28 EU countries, out of which 15 countries are reporting to the BIS and constitute our set of "source countries", while all EU countries feature as "host countries".[7]

The strong growth in global and EU cross-border banking up to the global financial crisis as well as the subsequent precipitous retrenchment in its aftermath, further amplified by the euro area sovereign debt crisis, is well documented in the literature. Taking into account more recent data we note that global cross-border banking positions have contracted by around 15% by the end of 2016, compared with their peak in 2008, and this retrenchment was predominantly driven by European banks. Banks located in the euro area and in the non-euro area EU countries reduced their cross-border bank claims by around 25% over this period, while banks located elsewhere (e.g. in the US and Japan), following an early retrenchment, had re-built their cross-border positions to surpass their pre-crisis peaks in 2015 (Figure 2). Our focus on the EU in this paper is warranted not only because of the severity in the cross-border retrenchment by European banks, but also given their important role in global banking. Prior to the crisis banks located in the EU accounted for 57% of global cross-border bank claims, which, following the great retrenchment, declined to around 48% at the end of 2016. Particularly striking is the sharp and sustained reduction in intra-EU claims, which account for 60% of total cross-border claims, whereas European banks' exposures to counterparties located outside the EU have partly recovered since 2012 (Figure 3).[8] Zooming in on intra-EU cross-border claims by instruments and counterparty sector, we note that the great cross-border banking retrenchment was driven predominantly by deleveraging from cross-border loans (Figure 4) to other banks (Figure 5). As domestic loans in the EU have remained above their pre-crisis level over the same period, this points to an increasing home bias (Figure 6) which supports the evidence of a "pecking order" in banks' deleveraging in the EU as banks cut significantly their cross-border assets, while largely sheltered domestic assets (ECB, 2012).

While informative, the aggregate developments described above mask significant heterogeneity at the country-pair level. When comparing cross-border loans in the post-crisis period with the pre-crisis levels, we observe a significant retrenchment for some country pairs, while for others cross-border positions actually increased (Figure 7). This bilateral perspective, which we further exploit in the

[5] The BIS also collects data on banks' country risk exposures and reports them as the consolidated banking statistics. They include the cross-border consolidated positions of banks headquartered in the BIS reporting countries, including positions of their foreign affiliates net of intragroup positions. For a recent analysis using consolidated data see, for example, McCauley et al. (2017). See Figure A.1 for an illustration of the BIS locational banking data.

[6] For further details see Annex A.1.

[7] The euro area sample among the BIS reporting countries consists of the 11 original euro area countries and Greece, while the non-euro area EU reporting countries are Denmark, Sweden and the United Kingdom.

[8] Intra-euro area exposures of banks located in the euro area accounted for around 45% of total exposures in 2016, while exposures vis-à-vis the rest of the EU and vis-à-vis third countries accounted for around 24% and 31%, respectively.

empirical analysis of the paper, provides several interesting observations. First, there is no single source country that reduced its cross-border exposures against all host countries. Second, an increase of cross-border positions between the two periods was not so rare, as one may have expected.[9] Third, many countries heavily reduced their exposures not only vis-à-vis stressed countries, including Greece, Ireland, Italy and Portugal, but also vis-à-vis Austria and Belgium.

3. Empirical strategy

3.1 Empirical specifications

As a first step, we employ a gravity model approach using the full panel dimension of the dataset at annual frequency, focusing on the period between 2008 and 2015.

$$C_{ijt} = \beta_0 + \beta_1 NPL_{it} + \beta_2 NPL_{jt} + \beta_3 PPI_{it} + \beta_4 PPI_{jt} + \beta_5 TAX_{it} + \beta_6 TAX_{jt} + \alpha' X_{ij} + \mu_i + \theta_j + \gamma_t + \epsilon_{ijt} \quad \text{(eq. 1)}$$

We estimate the determinants of bilateral cross-border banking loans and deposits between two EU countries by OLS, sequentially using the log of positions vis-à-vis banks and the non-bank sector as the dependent variable. We focus on cross-border loans and deposits, which are not only the most direct channel of international bank lending, but were also most affected by the retrenchment after the crisis, as previously discussed. By separately analysing cross-border loans to banks and non-banks, we account for the fact that developments in these two sectors and their determinants might differ.

Our main explanatory variables – further discussed below – are the non-performing loans ratio (*NPL*), an index of prudential policy stringency (*PPI),* and a measure of the tax burden arising from levies on banks (*TAX*). We further include in the matrix X_{ij}, a set of standard gravity-type variables used in the international finance literature such as bilateral distance, bilateral trade as well as common language and legal origin indicators (Hellmanzik and Schmitz, 2017), and macroeconomic controls (Herrmann and Mihaljek, 2010).[10] We also control for changes in the institutional and regulatory environment by including the average score of the World Bank's Worldwide Governance Indicators.[11] Institutional quality in the host country is known to be a pull factor for capital inflows (Papaioannou, 2009; Schmitz, 2011; and Bremus and Fratzscher, 2015). The role of institutional quality for source countries is less clear *a priori* as banks facing improvements in their domestic institutional framework may focus more on their home market, but may also be better equipped to establish cross-border activities.

We further control for banking sector performance by employing measures of banking sector profitability and the leverage ratio. Since a large portion of the cross-border banking retrenchment relates to interbank lending, the volume of central bank liquidity provided to each national banking system is also controlled for.[12] Furthermore, we include a dummy indicating euro area entry for those host countries that joined the euro area after 2008. All variables enter the econometric model both for source and host countries, along with a comprehensive set of fixed effects to control for unobserved heterogeneity across countries and over time ($\mu_i, \theta_j,$ and γ_t).

[9] Financial centres, through which banking flows from other jurisdictions are often intermediated, present a special case. For example, cross-border claims of EU countries on Luxembourg remained mostly unaffected by the crisis and increased overall.

[10] The gravity model was first introduced by Tinbergen (1962) to explain bilateral trade flows by the size of and distance between two countries. Okawa and van Wincoop (2012) provide a formal theoretical framework to justify the use of gravity models in international finance by linking bilateral investment patterns to differences in transaction costs.

[11] This composite index includes the following indicators: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption.

[12] The macroeconomic variables are obtained from the ECB's Statistical Data Warehouse (SDW) as well as the IMF's International Financial Statistics (IFS) and World Economic Outlook databases and the gravity controls are taken from the CEPII database and Mayer and Zignago (2011). Data on return on equity are from the IMF's FSIs, the leverage ratio is from the ECB's CBS and central bank liquidity provision is from the ECB's BSI database. Data on central bank liquidity provision for the United Kingdom are obtained from the Bank of England.

Using bilateral data at the country-pair level allows for separating demand factors from supply factors, since banking systems in various countries face similar demand from a given host country (Claessens, 2016). Hence, relative differences in bilateral lending patterns likely reflect supply-side (i.e. source country) characteristics, except for specific bilateral lender–borrower factors, which we also control for using alternative specification of fixed effects in our robustness tests. As we also include source and host country fixed effects in our baseline specifications and simultaneously control for economic activity, we further alleviate concerns that shifts in cross-border lending reflect demand factors.[13]

In a second step, we compare the post-crisis (2013-2015) to the pre-crisis period (2005-2007) in order to identify the structural drivers of the great retrenchment in cross-border banking in the EU. To this end we follow the approaches presented by Galstyan and Lane (2013) and Bremus and Fratzscher (2015) and estimate a cross-sectional specification in which most variables are averaged for the respective periods and then expressed as differences. The time-invariant gravity variables and variables capturing initial conditions enter in log-levels.

$$\Delta C_{ij} = \beta_0 + \beta_1 \ln(C_{ij}^{pre}) + \beta_2 \Delta NPL_i + \beta_3 \Delta NPL_j + \beta_4 \Delta PPI_i + \beta_5 \Delta PPI_j + \beta_6 \Delta TAX_i + \beta_7 \Delta TAX_j + \alpha' X_{ij} + \epsilon_{ij} \quad \text{(eq. 2)}$$

In equation (2) $\Delta C_{ij} = \ln(C_{ij}^{post-crisis}) - \ln(C_{ij}^{pre-crisis})$ denotes the change in claims of country *i* (source) on country *j* (host) between the pre- and post-crisis periods. Furthermore, we also control for the pre-crisis levels bilateral cross-border banking positions $\ln(C_{ij}^{pre})$ and bilateral trade, following Galstyan and Lane (2013) who find a "reversion to the mean" effect in bilateral portfolio investment patterns, as cross-border positions were cut most where pre-crisis bilateral holdings were the largest. As in the panel set-up above, the matrix X_{ij} includes a set of standard gravity-type variables and macroeconomic controls.

3.2 Main explanatory variables

We include the ratio of non-performing loans to total gross loans (NPL) as a general measure of banking sector health that may signal asset quality problems. A high NPL ratio can be interpreted as an indicator of unresolved financial sector problems, legacy issues and legal framework problems. Elevated NPL ratios may give rise to cross-border spillovers if banks, in an effort to shore up their balance sheets, cut their cross-border exposures (European Commission, 2017). A high NPL ratio can create deleveraging pressures, for instance as a result of higher risk weights. Similarly, weakened bank profitability leads to slower capital accumulation, thereby impeding banks' capacity to leverage, which – coupled with tighter regulation – may reduce banks' willingness to engage in risk-taking across borders. Since 2008 banks in the EU have experienced, on average, an increase in NPL ratios amid gradually declining leverage and relatively subdued profitability. Developments in NPL ratios have however been heterogeneous across countries in recent years. While NPL ratios in, for example, Greece, Ireland, and Cyprus reached high double-digit values during the period considered, they remained low or even decreased in countries such as Germany or the United Kingdom (Figure 8). Notably, changes in the NPL ratios were driven by developments in non-performing loans (numerator) rather than total gross loans (denominator).

Prudential policies (PPI) were tightened across the EU and globally in the aftermath of the crisis. This applies especially to capital requirements (the Basel requirements and their transposition into EU law in the Capital Requirements Directive (CRD IV) and Capital Requirements Regulation (CRR)), but also to other prudential instruments. To track the evolution of prudential policies at the country level, we construct an index of prudential policy stringency using a database compiled by Cerutti et al.

[13] As a robustness check we run the regressions including time-varying host and source country fixed effects in a first step and subsequently regress the fixed effects estimates on our variables of interest (see Section 5 for further details).

(2016) and information provided by the European Systemic Risk Board (ESRB, 2016). The database records the changes in a policy instrument with a value of "1", "-1" or "0" in a given quarter if the prudential tool was tightened, loosened, or remained unchanged, respectively. An annual index of prudential policy stringency is constructed by summing the quarterly changes in five types of commonly implemented prudential instruments (i.e. capital requirements, sector-specific capital buffers, interbank exposure limits, concentration limits and loan-to-value ratio limits) for each instrument in any given year and subsequently for all instruments.[14] Hence, our annual prudential policy stringency index (PPI) is the cumulative sum of prudential policy changes since the first quarter of 2000 and captures the level of "tightness" of prudential policy across EU countries over time (Figure 9). We alleviate concerns about cross-country comparability due to, for example, differences in the level of an instrument in 2000, by using country fixed effects and differencing in our econometric models, respectively.[15] As the international spillovers of prudential policies can vary significantly across types of instrument (Fahr and Zochowski, 2015; Buch and Goldberg, 2016), we distinguish between prudential policies aimed at banks, or "lenders", (i.e. capital requirements, capital buffers, interbank exposure limits and concentration limits) and those aimed at borrowers (i.e. loan-to-value ratio limits).

Finally, we include bank levies (TAX) – special taxes on banks – which were widely introduced in the EU after the financial crisis, possibly with the objective of recouping some of the fiscal costs incurred during the crisis in order to support the domestic banking sector. Using the National Tax Lists from Eurostat, we construct our measure of bank levies by scaling the associated tax revenues by gross income of the banking sector.[16] In the post-crisis period 13 EU countries had introduced bank levies (Figure 10), while the relative tax burden on the banking sector ranges from 0.7% of gross income in Germany to 9.4% in the Netherlands in the post-crisis period (Figure 11). The extent of cross-border potential spillovers from such bank levies depends on, among other factors, the underlying tax base and corresponding incentives for banks to adjust their lending activity. On the one hand, an additional tax burden at home might constrain banks and hence lead to reduced cross-border lending. On the other hand, banks might have an incentive to increase their exposure to the foreign non-bank sector rather than increase cross-border interbank lending, since the latter is in some cases classified as a risk factor that directly leads to higher taxes paid.

4. Empirical results

4.1 Panel estimation results

Table 1 reports results from the panel model (eq. 1) for cross-border claims in loans and deposits for the EU sample (columns 1 and 2) and for the euro area sample (columns 3 and 4).[17]

We find that elevated NPL ratios are significantly associated with a retrenchment in cross-border banking in both samples. For source countries, the estimated impact is somewhat larger for interbank lending (columns 1 and 3) than for lending to the other sectors (columns 2 and 4).[18] This may reflect

[14] Cerutti et al. (2016) provide no information on Cyprus, which we exclude from the further analysis.

[15] A potential caveat of this approach is that changes in the instruments may have different qualitative implications in terms of intensity across countries and over time.

[16] The National Tax List contains a detailed list of budget revenues from taxes and social contributions using national classification. In the cases of Belgium and Portugal this also includes mandatory contributions to the bank resolution funds. Gross income equals net interest income plus non-interest income. For details, see Appendix Table A1 and IMF (2006).

[17] The EU sample includes 15 EU source countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom) and all EU host countries. The euro area sample includes the 11 original euro area Member States and Greece as source countries and all current euro area Member States as host countries. Due to prudential policy measures data availability we exclude Cyprus from both samples.

[18] Any differences in the number of observations are due to missing values in the dependent variables. Restricting the sample to cases to be exactly the same across both dependent variables does not change the results.

the shorter maturity of interbank lending and therefore the greater flexibility in adjusting these exposures. In addition, banks might be less keen on reducing their positions vis-à-vis the real economy, as these are often subject to higher build-up costs. Worsening asset quality and the need to shore up banks' balance sheets are thus found to be important impediments to cross-border banking integration within the EU in line with McGuire and von Peter (2016). This is consistent with the idea that high NPLs can create deleveraging pressures, thereby impeding banks' capacity to provide financing to the economy (Constâncio, 2017). It is also in line with the notion that "financial de-globalisation" in Europe is a reflection of banks responding to credit losses by shedding assets abroad (McCauley et al., 2017). Moreover, the result for host countries suggests that higher NPL ratios are associated with less cross-border funding to the domestic banking sector, which could potentially aggravate credit supply constraints. This is further amplified by reduced cross-border borrowing by non-banks in high NPL host countries.

Compared with asset quality, other bank performance indicators – such as the leverage ratio and return on equity – are more loosely associated with developments in cross-border lending. Profitability is significant only for interbank lending, as more profitable banks exhibit reduced exposures across borders. This could reflect the post-crisis macroeconomic environment, in which low interest rates and central bank liquidity provision – which the model controls for – give profitable banks less incentives to engage in interbank cross-border lending. The post-crisis decline in bank leverage across the EU, which, on average, has been rather gradual, does not appear to be significantly associated with the decline in cross-border exposures.

Our analysis shows that prudential policies can entail spillovers via cross-border banking in the EU, albeit with heterogeneity across instruments in terms of direction, magnitude and significance. In particular, we find a significant negative correlation between tighter prudential policies aimed at lenders in source countries and cross-border lending to the non-bank sector for the EU sample (Table 1, column 2). This may be driven by higher costs banks face from stricter prudential policies at home, enticing them to cut direct cross-border lending activities. Within the euro area however, banks increase their cross-border interbank positions when confronted with more stringent prudential policies domestically (Table 1, column 3), suggesting the possibility of intra-euro area spillovers through leakages from tighter prudential policies aimed at the banking sector. Exploiting the instrument dimensions of the PPI, there is evidence that these are to some extent driven by stricter concentration and interbank exposure limits in source countries, which may incentivise diversification, including cross-border diversification (Table 2). Such lending behaviour may be transmitted across borders by intra-group transactions to subsidiaries and branches in the rest of the EU, which, in contrast to lending to unrelated banks, has remained relatively resilient in the post-crisis period.

Turning to host country prudential policies, more stringent policies aimed at banks in host countries are associated with increased cross-border lending vis-à-vis both counterparty sectors for the EU sample (Table 1, columns 1 and 2).[19] This hints towards possible regulatory arbitrage since foreign banks might channel more funds directly to borrowers and their branches as these may not be subject to the tighter regulation affecting domestic banks in the host countries.[20] Direct cross-border lending to non-banks however, is reduced by stricter lending standards aimed at borrowers in host countries, which indicates that these measures are also binding for cross-border lending activity. By contrast, stricter prudential measures aimed at borrowers in source countries are not significant.

[19] A statistically significant positive impact of tighter prudential policies aimed at lenders in host countries is also found for cross-border interbank lending within the euro area.
[20] Note that the BIS LBS data on interbank lending include both lending to related offices (branches and subsidiaries) and unrelated banks.

Overall, our results suggest that regulatory arbitrage might be possible via the use of foreign branches, while stricter policies at home may preclude banks from direct lending activities abroad, albeit this is not found for the euro area sample. [21]

The introduction of bank levies – special taxes on banks – in several EU countries does not appear to be significantly connected to cross-border banking. Among the other control variables, banks reduce cross-border lending to the foreign non-bank sector when institutional quality improves in the home country, which corresponds to the findings by Bremus and Fratzscher (2015). Conversely, this implies that a deteriorating institutional framework at home prompts banks to rebalance towards lending across the border. Interestingly, institutional quality of the host countries is a significant pull factor for cross-border interbank lending in the euro area (Table 1, column 3) since the crisis. We also control for monetary policy – using short term interest rates – in our analysis. A tighter monetary policy stance in host countries is significant with a positive sign for lending to non-banks (Table 1, column 2) in the EU sample, suggesting tighter monetary policy in host countries to be a pull factor for cross-border lending to the non-bank sector. For the euro area sample, the coefficients on short-term interest rates are not significant, reflecting the common monetary policy in the euro area being picked up by the year fixed effects. Higher long-term interest rates in source countries are significantly associated with less cross-border lending to the non-bank sector in both samples. This may reflect spillovers from higher funding costs of governments to banks in stressed countries since 2008, leading to a more pronounced retrenchment from direct cross-border lending by banks located in these countries. Moreover, we include the central bank liquidity provision to national banking systems in the estimations. Higher liquidity provision to host countries is significantly associated with lower cross-border interbank funding. This likely reflects a combination of demand and supply factors affecting banks in stressed euro area countries, which amid challenging funding conditions had to rely heavily on central bank liquidity as foreign banks chose not to rollover their cross-border interbank positions.

The gravity control variables have the expected signs across specifications, except for the common language index. Bilateral trade has a positive, significant impact on bilateral cross-border banking, in particular in the EU sample, highlighting the strong interlinkages between trade and finance. Geographic distance, which tends to proxy information asymmetries, has a dampening effect, as usually found in the gravity literature on international finance. Finally, a common legal origin is associated with increased cross-border interbank lending, highlighting the greater ease of conducting cross-border banking when the legal framework of two countries is more similar.

4.2 Cross-sectional difference estimation results

Turning to analysis of structural factors that explain changes in EU cross-border banking between the pre-crisis period (2005-2007) and the post-crisis period (2013-2015), Table 3 reports the results for specification (eq. 2).

Overall, we find strong evidence that the retrenchment was driven by source country factors highlighting the important role of idiosyncratic supply shocks as stressed by Amiti et al. (2017). More specifically, we observe that larger increases in NPL ratios in source countries are significantly associated with the retrenchment in cross-border banking since the global financial crisis. Turning to other banking sector characteristics, we find for the EU sample that larger increases in banking sector capitalisation in source countries are associated with increasing cross-border lending to both the bank and non-bank sector.

[21] Notably, our results may not fully capture the overall impact of prudential policies on cross-border banking within the EU as those measures that were common across countries, for instance reflecting the Basel requirements and their transposition into EU law in the CRD IV/CRR package, are absorbed econometrically by using time fixed effects to the extent that these were introduced in the same year. Results from estimations excluding time fixed effects, which are available upon request, do, however, not point in this direction.

Our results do not point to a major role for the prudential policy stance in explaining the cross-country variation in cross-border banking within the EU since the crisis. In line with the panel results, we find that banks in the euro area increased their cross-border interbank positions (or retrenched less) when confronted with more stringent prudential policies domestically (Table 3, column 3). Moreover, the results show that a larger tightening in policies aimed at non-bank borrowers (i.e. loan-to-value ratios) in host countries was associated with a larger retrenchment in foreign interbank funding, possibly via reduced lending to affiliated banks. Moreover, the results show that a tightening in borrowing policies in source countries is associated with a larger retrenchment in direct lending to the non-bank sector.

Turning to the role of bank levies, we find evidence that a higher tax burden in source countries increases cross-border lending to the non-bank sector in the EU (Table 3, column 2). This indicates that the introduction of bank levies after the financial crisis did not have an overall adverse impact on cross-border banking in the EU, but may have affected its composition. Although the tax base for bank levies is quite heterogeneous across countries, in a number of countries bank levies increase proportionally to the share of (foreign) interbank loans. This may have incentivised banks to engage in direct cross-border lending to the non-bank sector at the expense of interbank lending.

Consistent with the results in the previous sub-section, we find that improving institutional quality in source countries is associated with reduced cross-border lending to the non-bank sector, albeit only for the euro area sample (Table 3, column 4). Geographic distance has a significant negative impact on the change in cross-border interbank lending, suggesting that banks cut their positions especially vis-à-vis those banks located farther away. The extent of pre-crisis bilateral trade linkages for the EU sample softens significantly the cross-border banking retrenchment. We also find a "reversion to the mean" effect in line with Galstyan and Lane (2013), as banks reduced their cross-border positions more vis-à-vis countries with whom they had larger initial positions.

5. Robustness analysis

We conduct several robustness and sensitivity analyses of our baseline specification, which are overall supportive to our main findings. First, we extend the horizon of our panel analysis to the period 2001-2015 (Table A.2) and find our main results on the NPL ratios and prudential policies to hold. This is likely due to the fact that most of the movements in these two sets of indicators took place since the global financial crisis.

Second, we run the panel analysis for the period 2008 to 2015 for EU source countries, but include only host countries located outside the EU. In this, we use time-varying host country fixed effects (in addition to source country fixed effects) that allow to include as many non-EU countries as possible to investigate whether the supply side factors that matter for intra-EU cross-border banking (Table 1) also apply to cross-border exposures of EU banks vis-à-vis the rest of the world. Our results (Table A.3) show that elevated NPL ratios are also significantly associated with a retrenchment in cross-border banking vis-à-vis non-EU countries, with the impact being higher for cross-border interbank lending, similar to the results from our baseline specification. This shows that the asset quality problems observed in some EU countries also had repercussions on countries outside the EU. On prudential policies, we find that banks increase their cross-border interbank positions when confronted with more stringent prudential policies domestically. This result – which is consistent with the one obtained for the euro area in our baseline specification – suggests that EU countries increased their interbank lending to non-EU countries in response to tighter prudential policies at home, likely following risk diversification motives.

Third, we directly control for developments in domestic lending to ensure that patterns in cross-border banking are not fully driven by the same factors that drive domestic lending patterns. This approach leaves most of our results intact (Table A.4). Specifically, the strong negative relationship between the NPL ratios and cross-border interbank lending remains virtually unchanged. The NPL ratio coefficients for source countries on cross-border lending to non-banks turn insignificant, suggesting

that the reaction of direct cross-border lending to deteriorating asset quality follows a similar pattern as observed for domestic lending. On prudential policies, our previous results remain unchanged for policies implemented in sources countries, while the coefficients on prudential policies targeting banks in host countries turn insignificant throughout. Although our baseline specification indicated an increased interbank lending from foreign banks to their branches – which are not subject to tighter regulation – controlling explicitly for domestic lending patterns in host countries may soak up this result econometrically due to increased lending in host countries by these branches. Furthermore, we find that a higher tax burden on banks in their country of residence increases cross-border lending to the non-bank sector in the EU.

Fourth, as a robustness check of our baseline econometric approach we change our panel estimation as presented in equation (1). In a first step we regress cross-border lending to banks and non-banks, respectively, on a full set of country-pair and time-varying source and host country fixed effects, thereby completely isolating the source and host country specific factors driving bilateral cross-border positions (Amiti et al., 2017). This approach enables us to control, for instance, for all host country-year specific demand factors which might affect cross-border loans. In a second step, we regress the estimates of time-varying source and host fixed effects obtained in the first step on our set of source or host country-specific variables used in our main analysis.[22] Our main results – most notably for NPL – remain robust to this alternative estimation procedure (Table A.5).

Fifth, we include a measure of the immediate "peak-of-the-crisis" deleveraging as an additional explanatory variable in our cross-sectional specification (eq. 2).[23] This approach is motivated by the fact that the extent to which countries introduced prudential policies and bank levies might have been determined by the depth of the immediate crisis. Hence, these policy variables might suffer from a reverse causality bias, if those countries that were particularly affected by the cross-border deleveraging might have been prompted to introduce harsher policy responses. While such concerns should be alleviated by using bilateral data, we still explore this possibility. The initial crisis deleveraging variable shows a positive and significant coefficient in all specifications – except for interbank lending in the euro area – indicating that banks further reduced cross-border lending to those countries towards which they had already cut their exposures during the immediate crisis period (Table A.6). Moreover, many of the other variables – and in particular the prudential policy index – remain significant, showing that the reverse causality problem is not very pronounced and that the changes in bilateral cross-border banking positions since the crisis are not perfectly correlated with the deleveraging patterns observed during the peak of the crisis.

In further (unreported) robustness tests, we exclude potential outliers – in particular in terms of NPL ratios – from the regression analysis.[24] Additionally, we re-estimate the models excluding the financial centre countries Luxembourg and the United Kingdom.[25] Since these countries intermediate cross-border banking flows from many countries, also from outside the EU, they might be more sensitive to global forces rendering domestic factors less significant in our estimations. The results remain largely unchanged in this exercise, but the coefficient on NPL in the source country loses significance for cross-border positions vis-à-vis the non-bank sector in the difference estimations. Finally, the panel estimation results are also robust to using lagged – rather than contemporaneous – explanatory variables.

[22] This approach also tackles potential clustering issues in the standard errors of the policy variables (see, among others, Angrist and Pischke, 2009)
[23] We calculate this variable as the difference in bilateral cross-border claims between 2009Q2 and 2008Q1.
[24] NPL ratios were exceptionally high in Greece, reaching above 36% in 2015. Re-estimating our models excluding Greece leaves the results qualitatively unchanged compared to our baseline specification, while the coefficients on source country NPL slightly increase in size.
[25] The full results of these regressions are available upon request.

6. Conclusions

In this paper we examine the potential drivers of the great retrenchment in cross-border banking within the European Union (EU), which stands out in international comparison. We investigate whether tightening of regulatory policies, an increasing relative tax burden on banks, and the remnants of the global financial crisis manifested in persistently high shares of non-performing loans on banks' balance sheets contributed to the great retrenchment. Taking a granular view on cross-border bank claims in the EU, we observe that cross-border interbank loans were most affected by the deleveraging since the global financial crisis.

Employing both a panel data approach for the period 2008-2015 as well as a cross-sectional difference approach comparing the pre-crisis (2005-07) and post-crisis (2013-2015) periods, we find a significant link between deteriorating asset quality and the great retrenchment in cross-border banking in the EU. This link is particularly strong for source countries and cross-border interbank lending and highlights the spillovers from national banking sector conditions across the EU. We also find evidence that prudential policies can entail spillovers via cross-border banking in the EU, albeit with heterogeneity across instruments in terms of direction, magnitude and significance. In particular, our results suggest that regulatory arbitrage might be possible via the use of foreign branches, while stricter policies at home may preclude banks from direct lending activities abroad, albeit this is not found for the euro area sample. For newly introduced bank levies, we do not find a discernible link to the great retrenchment, but they may have affected the composition of cross-border banking by incentivising lending to the non-bank sector. Overall, the EU cross-border banking retrenchment was driven to a greater extent by source country factors, which is in line with the existing literature stressing that, during crisis times, cross-border bank flows are mainly affected by idiosyncratic shocks to creditor banks.

Our analysis suggests that tackling the persistent asset quality problems in the EU is pivotal in order to reap the potential benefits of cross-border banking which relate for instance to risk diversification and risk-sharing. Hence, the findings of this paper make a case for completing the banking union. For instance, the rulebook for financial actors in the EU needs to be amended by adding a chapter on a harmonised approach to NPL resolution, complemented by country-specific elements in each high-NPL constituency, as stressed by Constâncio (2017).

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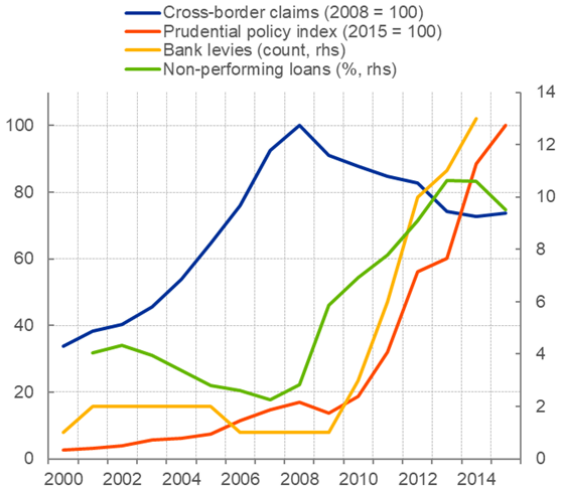
Figure 1: Intra-EU cross-border bank claims, policy measures and asset quality

(index: 2008 = 100; percentage, count, four-quarter moving averages)

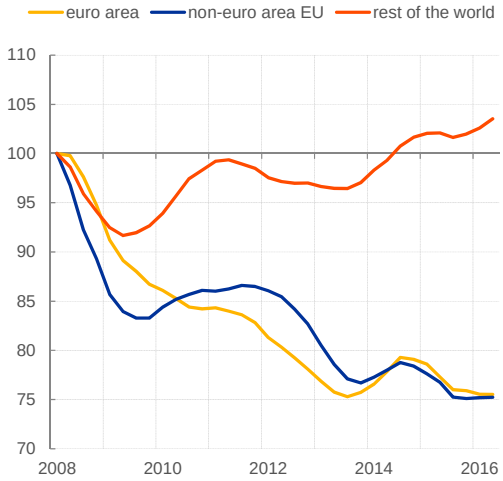


Sources: BIS, Eurostat, Cerutti et al. (2016), World Bank, authors' calculations.

Note: Intra-EU cross-border claims is the sum of bilateral cross border intra-EU claims. Bank levies refer to the number of EU countries that implemented them. Prudential policy index is the average index across EU countries. Non-performing loans as percentage of total gross loans (un-weighted country average).

Figure 2: Cross-border bank claims by location of reporting bank

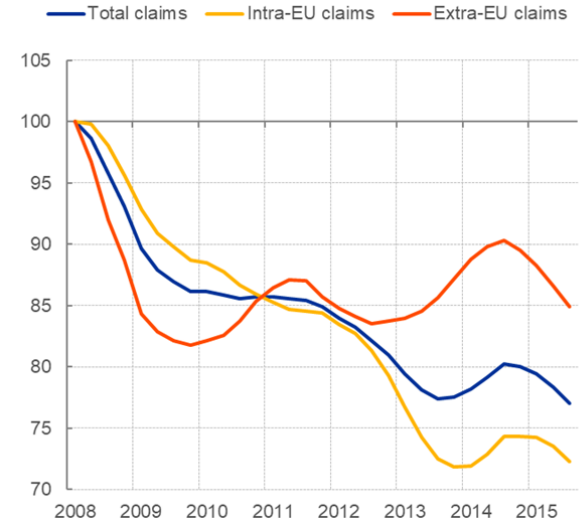
(index: Q3 2008 = 100; four-quarter moving averages)



Sources: BIS and authors' calculations.

Figure 3: EU reporting banks' cross-border claims by destination country

(index: Q3 2008 = 100; four-quarter moving averages)

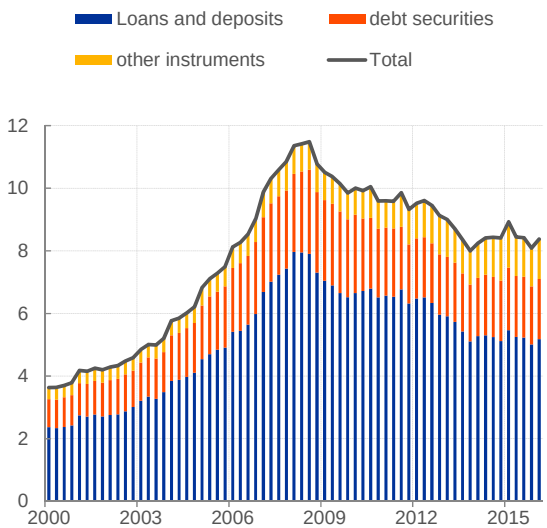


Source: BIS and authors' calculations.

Note: Cross-border claims of banks based in all BIS reporting countries in the EU on all countries, other EU countries (intra-EU) and non-EU countries (extra-EU).

Figure 4: Intra-EU cross-border bank claims by instrument

(€ trillions, adjusted for exchange rate changes, four-quarter moving averages)

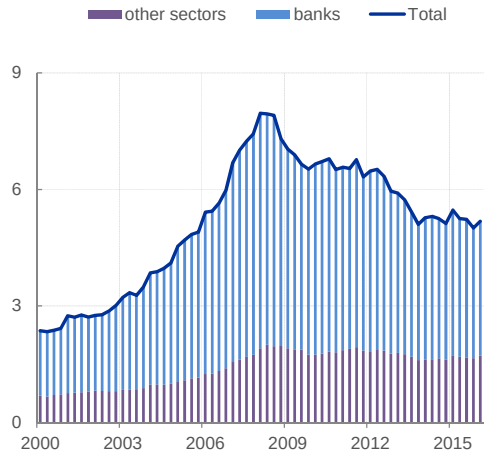


Source: BIS and authors' calculations.

Note: Cross-border intra-EU claims of banks based in EU countries.

Figure 5: Cross-border intra-EU bank claims in loans and deposits by counterparty sector

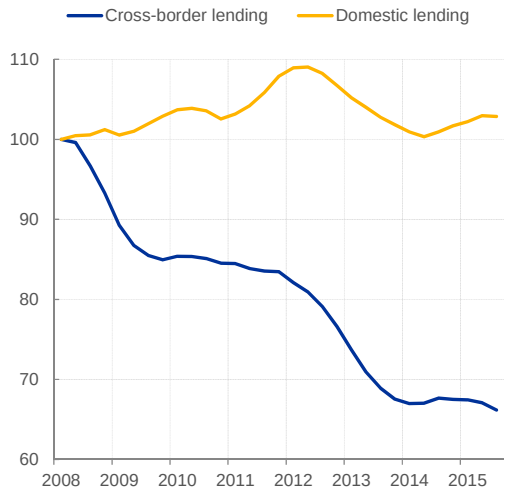
(€ trillions, adjusted for exchange rate changes, four-quarter moving averages)



Source: BIS and authors' calculations.
Note: Cross-border intra-EU claims of banks based in EU countries.

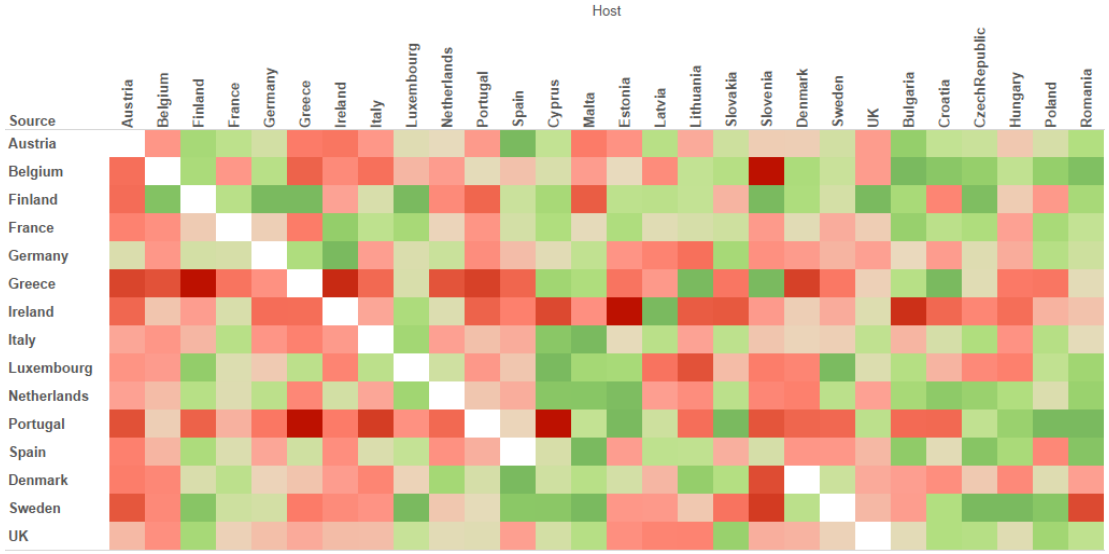
Figure 6: Cross-border and domestic lending in the EU

(index: Q3 2008 = 100; four-quarter moving averages)



Source: BIS, ECB and authors' calculations.

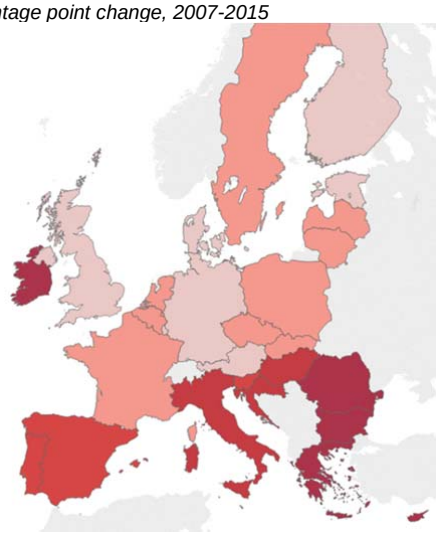
Figure 7: Heterogeneity in retrenchment across country pairs within the EU



Source: BIS and authors' calculations.
Note: Change in average bilateral cross-border claims in loans and deposits on all sectors between the pre-crisis (2005-07) and the post-crisis (2013-2015) period. Dark red indicates high negative values (i.e. retrenchment) and dark green indicates high positive values.

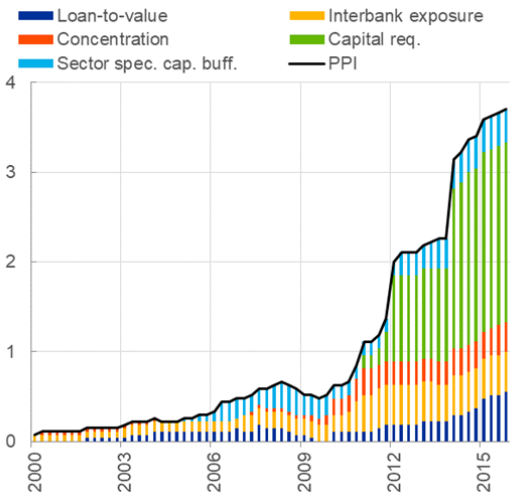
Figure 8. Change in NPL ratios

Percentage point change, 2007-2015



Source: World Bank, IMF IFS, authors' calculations.
Note: Dark red indicates high increases in NPL ratios, light red indicates low increases or decreases.

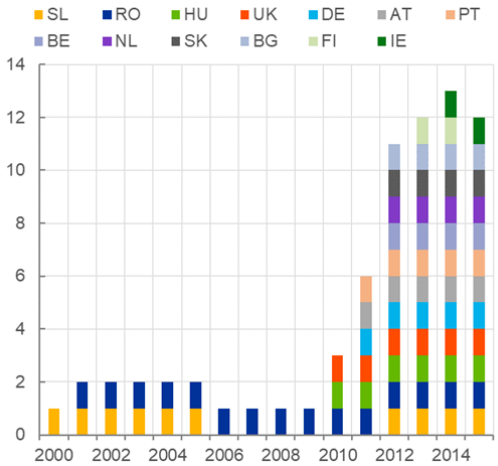
Figure 9. Prudential policy index in the EU



Source: Cerutti et al. (2016), ESRB (2016), authors' calculations.
Note: Cumulative indices as of 2000Q1. The index equals one in the respective quarter if the respective prudential instrument was tightened, zero if no change occurred, and -1 if the instrument was loosened. Sector-specific capital buffer instruments include instruments regulating real estate credit, consumer credit, and other credit.

Figure 10. Incidence of bank levies

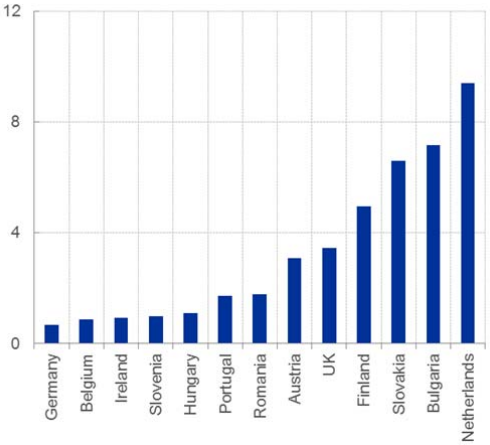
count



Source: Eurostat, IMF and authors' calculations

Figure 11. Tax burden from bank levies

% of banks' gross income, 2013-15 average



Source: Eurostat, IMF and authors' calculations

Table 1: Panel Model Results

	(1)	(2)	(3)	(4)
	Log of all claims in loans and deposits on			
VARIABLES	banks	non-banks	banks	non-banks
NPLs (source)	-0.084***	-0.050***	-0.098**	-0.070**
	(0.026)	(0.019)	(0.039)	(0.029)
NPLs (host)	-0.031*	-0.029***	-0.066**	-0.030*
	(0.018)	(0.011)	(0.028)	(0.018)
Return on equity (source)	-0.011**	-0.003	-0.012*	-0.002
	(0.005)	(0.004)	(0.007)	(0.006)
Return on equity (host)	-0.000	-0.002	-0.003	-0.001
	(0.004)	(0.002)	(0.004)	(0.002)
Leverage ratio (source)	-0.027	0.002	-0.043	-0.008
	(0.025)	(0.020)	(0.034)	(0.027)
Leverage ratio (host)	-0.021	-0.010	-0.007	0.013
	(0.018)	(0.013)	(0.025)	(0.019)
PPI lender (source)	0.120	-0.173***	0.462***	-0.060
	(0.079)	(0.056)	(0.104)	(0.063)
PPI lender (host)	0.118**	0.077*	0.201*	0.057
	(0.058)	(0.043)	(0.109)	(0.080)
PPI borrower (source)	0.019	0.025	-0.045	0.082
	(0.104)	(0.065)	(0.152)	(0.093)
PPI borrower (host)	-0.061	-0.123*	-0.097	-0.110
	(0.091)	(0.066)	(0.130)	(0.101)
BANKTAX (source)	-0.029	0.022	-0.028	-0.000
	(0.027)	(0.015)	(0.041)	(0.022)
BANKTAX (host)	0.021	-0.013	0.004	0.009
	(0.031)	(0.018)	(0.048)	(0.022)
WGI (source)	-0.061	-0.214**	-0.188	-0.472***
	(0.111)	(0.102)	(0.151)	(0.159)
WGI (host)	0.161	-0.133	0.254**	-0.189
	(0.106)	(0.119)	(0.129)	(0.184)
Short-term interest rate (source)	0.030	0.051	0.091	0.091
	(0.062)	(0.066)	(0.088)	(0.094)
Short-term interest rate (host)	0.013	0.070**	0.047	0.049
	(0.039)	(0.027)	(0.079)	(0.045)
Long-term interest rate (source)	-0.012	-0.027*	-0.040	-0.052**
	(0.023)	(0.015)	(0.027)	(0.022)
Long-term interest rate (host)	-0.002	-0.013	-0.017	-0.035
	(0.032)	(0.020)	(0.040)	(0.030)
Central Bank liquidity (source)	0.045	0.056*	-0.063	0.044
	(0.038)	(0.029)	(0.075)	(0.063)
Central Bank liquidity (host)	-0.019	-0.021	-0.138***	-0.034
	(0.018)	(0.014)	(0.045)	(0.038)
Log bilateral trade	1.083***	0.842***	0.333	0.465**
	(0.215)	(0.170)	(0.317)	(0.219)
Log bilateral distance	-1.087***	-0.925***	-1.639***	-1.172***
	(0.293)	(0.213)	(0.453)	(0.284)
Common language	-1.178***	-0.730***	-1.444***	-0.475
	(0.384)	(0.261)	(0.425)	(0.310)
Common legal origin	0.887***	0.055	0.760**	0.191
	(0.310)	(0.221)	(0.379)	(0.307)
Euro area entry (host)	-0.853***	-0.220	-0.214	-0.158
	(0.269)	(0.161)	(0.282)	(0.171)
Observations	2,653	2,693	1,482	1,493
R-squared	0.72	0.79	0.72	0.79
Time period	'08-'15	'08-'15	'08-'15	'08-'15
Sample	EU27	EU27	EA18	EA18
GDP controls	yes	yes	yes	yes
Source country fixed effects	yes	yes	yes	yes
Host country fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes

Robust standard errors (clustered at the country-pair level) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2: PPI Full Split Results

	(1)	(2)	(3)	(4)
	Log of all claims in loans and deposits on			
VARIABLES	banks	non-banks	banks	non-banks
Sector spec. cap. buff. (source)	0.089	-0.148	1.948***	0.549*
	(0.192)	(0.116)	(0.465)	(0.280)
Capital req. (source)	0.036	0.104	0.239	0.064
	(0.117)	(0.070)	(0.169)	(0.090)
Concentration limit (source)	0.165	-0.323***	0.421**	-0.348**
	(0.123)	(0.112)	(0.170)	(0.152)
Interbank exposure limit (source)	0.233*	-0.114	0.631***	0.182
	(0.122)	(0.089)	(0.205)	(0.147)
Loan-to-value limit (source)	-0.009	0.085	-0.046	0.169
	(0.084)	(0.068)	(0.153)	(0.114)
Sector spec. cap. buff. (host)	-0.024	0.141***	-0.224	0.408*
	(0.079)	(0.055)	(0.253)	(0.231)
Capital req. (host)	0.089	0.009	0.242	-0.159
	(0.117)	(0.070)	(0.173)	(0.097)
Concentration limit (host)	0.267*	0.173**	0.269	0.173*
	(0.140)	(0.077)	(0.185)	(0.101)
Interbank exposure limit (host)	0.188*	0.049	0.306	-0.207
	(0.097)	(0.090)	(0.199)	(0.179)
Loan-to-value limit (host)	-0.101	-0.139**	-0.095	-0.178
	(0.083)	(0.061)	(0.141)	(0.112)
Observations	2,795	2,838	1,507	1,517
R-squared	0.72	0.79	0.72	0.79
Time period	'08-'15	'08-'15	'08-'15	'08-'15
Sample	EU27	EU27	EA18	EA18
GDP controls	yes	yes	yes	yes
Source country fixed effects	yes	yes	yes	yes
Host country fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes

Note: The underlying regressions include all explanatory variables also included in table 1. Robust standard errors (clustered at the country-pair level) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Difference Estimation Results

	(1)	(2)	(3)	(4)
	Log of all claims in loans and deposits on			
VARIABLES	banks	non-banks	banks	non-banks
NPLs (source)	-0.180***	-0.060*	-0.193*	-0.122*
	(0.053)	(0.035)	(0.099)	(0.065)
NPLs (host)	-0.012	-0.005	-0.013	0.037
	(0.025)	(0.019)	(0.056)	(0.036)
ROE (source)	-0.042*	0.016	-0.065	-0.028
	(0.023)	(0.016)	(0.054)	(0.032)
ROE (host)	0.005	-0.010	0.023	-0.019
	(0.017)	(0.011)	(0.030)	(0.018)
Regulatory capital (source)	0.174*	0.151*	0.015	0.063
	(0.106)	(0.079)	(0.206)	(0.144)
Regulatory capital (host)	-0.044	-0.048*	-0.131	-0.057
	(0.035)	(0.028)	(0.082)	(0.071)
PPI lender (source)	-0.003	-0.052	0.455*	0.263
	(0.145)	(0.113)	(0.270)	(0.209)
PPI lender (host)	-0.028	0.041	0.105	0.049
	(0.105)	(0.073)	(0.224)	(0.139)
PPI borrower (source)	-0.295	-0.539***	0.311	-0.288
	(0.266)	(0.191)	(0.531)	(0.375)
PPI borrower (host)	-0.264*	-0.131	-0.178	0.063
	(0.153)	(0.095)	(0.367)	(0.253)
BANKTAX (source)	0.209	0.307***	-0.088	0.163
	(0.136)	(0.101)	(0.275)	(0.196)
BANKTAX (host)	-0.002	-0.003	-0.167	-0.055
	(0.054)	(0.036)	(0.177)	(0.128)
WGI (source)	-0.476	-0.308	-1.405	-1.443**
	(0.427)	(0.303)	(1.041)	(0.624)
WGI (host)	0.254	-0.045	0.693	-0.390
	(0.162)	(0.115)	(0.491)	(0.331)
Long-term interest rate (source)	0.532**	0.256*	0.476	-0.068
	(0.216)	(0.143)	(0.500)	(0.292)
Long-term interest rate (host)	-0.149	-0.035	-0.111	-0.210*
	(0.107)	(0.075)	(0.179)	(0.123)
Central Bank liquidity (source)	0.204	0.217*	-0.283	-0.403
	(0.155)	(0.112)	(0.438)	(0.249)
Central Bank liquidity (host)	0.039	0.007	-0.023	0.049
	(0.029)	(0.018)	(0.106)	(0.070)
Initial stock	-0.155**	-0.294***	-0.210*	-0.446***
	(0.064)	(0.044)	(0.114)	(0.061)
Initial bilateral trade	0.406***	0.349***	0.335	0.200
	(0.115)	(0.071)	(0.236)	(0.127)
Log bilateral distance	-0.711***	-0.275*	-1.035***	-0.682***
	(0.205)	(0.148)	(0.383)	(0.210)
Common legal origin	0.263	0.163	0.197	0.099
	(0.271)	(0.183)	(0.404)	(0.243)
Common official language	-0.962**	0.203	-1.954***	-0.393
	(0.401)	(0.265)	(0.472)	(0.316)
EA Entry (host)	-1.424**	0.001	-0.918	-1.874**
	(0.594)	(0.402)	(1.294)	(0.788)
Observations	370	353	198	179
R-squared	0.38	0.32	0.43	0.49
Sample	EU27	EU27	EA18	EA18
GDP controls	yes	yes	yes	yes

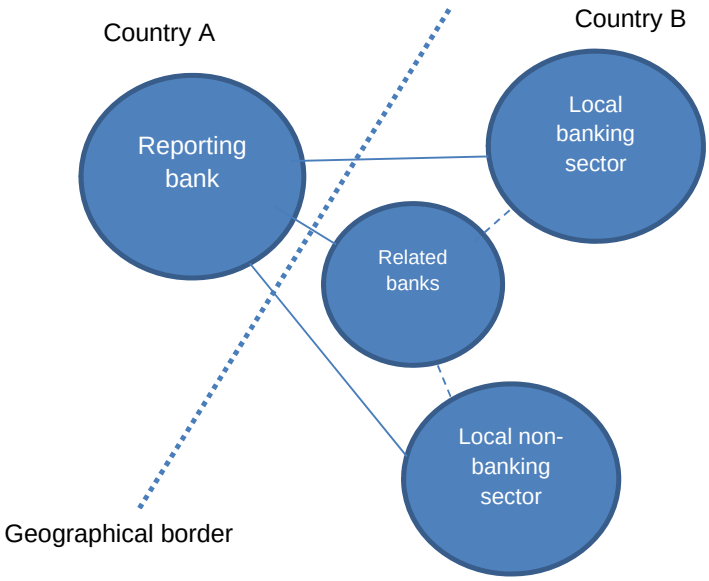
Note: All variables are expressed in differences betwenn the pre- ('05-'07) and post-crisis ('13-'15) period, except for the time invariant variables. Initial stock and trade refer to the pre-crisis levels of bilateral cross border banking positions and bilateral trade. EA entry is a dummy indicating euro area entry for those host countries that joined the EA after 2005. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Annex

A.1 Adjustment of BIS data

We use data on bilateral cross-border bank positions gathered from the Bank for International Settlements' (BIS) databank on locational banking statistics (LBS). In a first step, we fill gaps in the time series by using all available data provided by the BIS. If, for example, there is a missing observation in the time series for claims on banks for a country pair, while the claims on non-banks and total claims are available, we fill the gap by subtracting the non-bank claims from the total claims series. Subsequently, we adjust respective stock (i.e. positions) variables for exchange rate-induced valuation effects using backward adjustment based on flow variables (i.e. starting from the latest data point of a stock variable we subtract the corresponding FX-adjusted flow reported by the BIS and iterate this procedure for the whole time series). In order to get a complete time series the stock and flow series are corrected for the remaining gaps/breaks as follows: [26] missing FX-adjusted flows are replaced with the change in non-adjusted stocks. If a bilateral stock data point is missing it is derived by multiplying the latest existing value with the growth rate of stocks vis-à-vis the world.

Figure A.1 Illustration of BIS Locational Banking Statistics



Cross border claims of country A based banks on country B are indicated by solid lines. They can occur vis-à-vis the local banking sector, including branches and subsidiaries of country A banks, or vis-à-vis the local non-banking sector.

Local claims of branches and subsidiaries on the banking and non-banking sector as indicated by the dashed lines are not included in the locational banking statistics.

[26] For a summary of breaks in the BIS dataset see: http://www.bis.org/statistics/breakstables17.pdf

Table A.1 Sectoral taxes on banks

	2014 value		2015 value		
	% gross income	% of tax revenue	% gross income	% of tax revenue	Tax(es) considered
BE	0.56%	0.11%	1.49%	0.30%	Contribution for Financial Stability to the Resolution Funds
BG	6.76%	1.53%	8.11%	1.82%	Banks contributions to DGF and NRF
DE	0.42%	0.08%	1.23%	0.22%	Bank levy (Bankenabgabe)
IE	1.38%	0.33%	1.38%	0.30%	Bank Levy on DIRT accounts
HU	0.41%	0.36%	0.97%	0.23%	Financial institutions special tax, bank tax
NL	14.18%	0.97%	8.61%	0.59%	Bank Levies
AT	2.60%	0.62%	3.68%	0.76%	Financial Institutions Stability Fee
PT	1.74%	0.45%	1.76%	0.47%	Contribution on banking industry, contributions for the Resolution Fund
RO	1.73%	0.26%	3.52%	0.45%	Tax on profits from commercial banks
SI	1.59%	0.32%	0.13%	0.02%	Tax on balance wealth paid by banks
SK	6.48%	1.14%	4.56%	0.76%	Special levy on selected financial institutions
FI	7.37%	0.22%	n/a	n/a	Bank tax
SE	1.82%	0.20%	1.82%	0.21%	Stability fee
UK	3.37%	0.55%	4.04%	0.66%	Bank Payroll Tax, Bank Levy

Note: the table depicts revenues from the respective taxes on banks divided by gross income of deposit takers in the IMF's FSIs and by total tax revenues in 2014 and 2015. EU countries not mentioned in the table did not introduce such taxes. CZ is excluded because the tax revenue for the resolution scheme is also sourced from non-banks. FI abolished the tax in 2015.

Source: Eurostat, IMF FSIs, authors' calculations.

Table A.2 Panel regression for 2001 – 2015 period

	(1)	(2)	(3)	(4)
	Log of all claims in loans and deposits on			
VARIABLES	banks	non-banks	banks	non-banks
NPLs (source)	-0.103***	-0.054***	-0.109***	-0.077***
	(0.023)	(0.017)	(0.033)	(0.026)
NPLs (host)	-0.042***	-0.008	-0.063***	-0.008
	(0.012)	(0.008)	(0.019)	(0.010)
PPI lender (source)	0.088	-0.145***	0.294***	-0.095
	(0.064)	(0.054)	(0.095)	(0.070)
PPI lender (host)	0.084*	0.028	0.128*	0.029
	(0.047)	(0.043)	(0.077)	(0.070)
PPI borrower (source)	-0.088	-0.047	-0.105	-0.069
	(0.058)	(0.043)	(0.089)	(0.055)
PPI borrower (host)	-0.116	-0.213***	-0.172	-0.206***
	(0.076)	(0.052)	(0.110)	(0.073)
WGI (source)	-0.006	-0.134*	-0.051	-0.288***
	(0.079)	(0.069)	(0.108)	(0.104)
WGI (host)	0.137**	-0.018	0.023	0.014
	(0.067)	(0.065)	(0.095)	(0.111)
Short-term interest rate (source)	-0.033	0.011	-0.026	-0.023
	(0.045)	(0.043)	(0.072)	(0.074)
Short-term interest rate (host)	-0.064**	0.043*	-0.091	0.030
	(0.030)	(0.024)	(0.057)	(0.047)
Long-term interest rate (source)	0.011	-0.003	-0.010	-0.026
	(0.024)	(0.015)	(0.028)	(0.020)
Long-term interest rate (host)	-0.011	-0.016	-0.006	-0.031
	(0.024)	(0.018)	(0.034)	(0.026)
Log bilateral trade	0.872***	0.747***	0.324	0.478**
	(0.169)	(0.137)	(0.231)	(0.193)
Log bilateral distance	-1.054***	-1.012***	-1.346***	-1.077***
	(0.235)	(0.195)	(0.340)	(0.270)
Common language	-0.952***	-0.804***	-1.008***	-0.361
	(0.345)	(0.245)	(0.355)	(0.293)
Common legal origin	0.938***	0.183	0.828***	0.481*
	(0.266)	(0.192)	(0.310)	(0.264)
Euro area entry (host)	-1.105***	-0.324	-0.864***	-0.229
	(0.214)	(0.212)	(0.258)	(0.242)
Observations	4,899	4,850	2,591	2,491
R-squared	0.73	0.78	0.73	0.77
Time period	'01-'15	'01-'15	'01-'15	'01-'15
Sample	EU27	EU27	EA18	EA18
GDP controls	yes	yes	yes	yes
Source country fixed effects	yes	yes	yes	yes
Host country fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes

Robust standard errors (clustered at the country-pair level) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A.3 Extra EU Host Sample

	(1)	(2)
	Log of all claims in loans and deposits on	
VARIABLES	banks	non-banks
NPLs (source)	-0.133***	-0.097***
	(0.016)	(0.015)
Return on equity (source)	-0.001	-0.002
	(0.003)	(0.002)
Leverage ratio (source)	-0.010	-0.063***
	(0.012)	(0.014)
PPI lender (source)	0.100***	0.023
	(0.037)	(0.036)
PPI borrower (source)	-0.074	-0.053
	(0.047)	(0.047)
BANKTAX (source)	0.017	0.004
	(0.011)	(0.013)
WGI (source)	-0.036	0.060
	(0.070)	(0.061)
Short-term interest rate (source)	0.045	0.191***
	(0.044)	(0.035)
Long-term interest rate (source)	0.060***	-0.016
	(0.021)	(0.014)
Central bank liquidity (source)	0.085***	0.050**
	(0.023)	(0.022)
Log bilateral trade	0.137**	0.156***
	(0.057)	(0.049)
Log bilateral distance	-1.288***	-1.023***
	(0.336)	(0.278)
Common language	0.735***	0.842***
	(0.190)	(0.171)
Common legal origin	0.095	-0.020
	(0.137)	(0.124)
Observations	9,818	11,852
R-squared	0.67	0.65
Time period	'08-'15	'08-'15
Sample	EU (source), World excl. EU (host)	
GDP control	yes	yes
Source country FE	yes	yes
Host country-time FE	yes	yes
Year FE	no	no

Robust standard errors (clustered at the country-pair level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4 Controlling for domestic lending

	(1)	(2)	(3)	(4)
	Log of all claims in loans and deposits on			
VARIABLES	banks	non-banks	banks	non-banks
NPLs (source)	-0.085***	-0.015	-0.118***	-0.020
	(0.022)	(0.015)	(0.034)	(0.021)
NPLs (host)	-0.024	-0.027**	-0.056*	-0.026
	(0.020)	(0.012)	(0.032)	(0.021)
Return on equity (source)	-0.011**	-0.002	-0.013*	-0.001
	(0.005)	(0.004)	(0.007)	(0.006)
Return on equity (host)	0.001	-0.002	-0.003	-0.001
	(0.004)	(0.002)	(0.004)	(0.002)
Leverage ratio (source)	-0.027	-0.006	-0.041	-0.011
	(0.025)	(0.020)	(0.033)	(0.027)
Leverage ratio	-0.031*	-0.014	-0.013	0.010
	(0.018)	(0.013)	(0.025)	(0.019)
PPI lender (source)	0.121	-0.269***	0.476***	-0.101
	(0.079)	(0.058)	(0.105)	(0.068)
PPI lender (host)	0.080	0.065	0.183*	0.049
	(0.060)	(0.043)	(0.108)	(0.079)
PPI borrower (source)	0.018	-0.001	-0.017	0.017
	(0.104)	(0.064)	(0.154)	(0.090)
PPI borrower (host)	-0.078	-0.130*	-0.126	-0.127
	(0.091)	(0.066)	(0.133)	(0.106)
BANKTAX (source)	-0.029	0.025*	-0.033	0.010
	(0.027)	(0.015)	(0.042)	(0.022)
BANKTAX (host)	0.018	-0.014	0.005	0.011
	(0.031)	(0.017)	(0.048)	(0.021)
WGI (source)	-0.063	-0.184*	-0.214	-0.412***
	(0.111)	(0.098)	(0.154)	(0.146)
WGI (host)	0.144	-0.140	0.263**	-0.182
	(0.106)	(0.115)	(0.128)	(0.181)
Domestic claims (source)	0.011	1.470***	-0.674	1.777***
	(0.464)	(0.383)	(0.642)	(0.531)
Domestic claims (host)	0.757**	0.216	0.612	0.256
	(0.378)	(0.258)	(0.510)	(0.354)
Short-term interest rate (source)	0.030	0.054	0.088	0.096
	(0.062)	(0.064)	(0.085)	(0.092)
Short-term interest rate (host)	0.013	0.072**	0.048	0.053
	(0.040)	(0.028)	(0.078)	(0.046)
Long-term interest rate (source)	-0.012	-0.028*	-0.044	-0.044**
	(0.022)	(0.015)	(0.027)	(0.021)
Long-term interest rate (host)	-0.007	-0.015	-0.021	-0.037
	(0.032)	(0.020)	(0.041)	(0.028)
Central Bank liquidity (source)	0.045	0.074**	-0.051	0.008
	(0.037)	(0.029)	(0.075)	(0.061)
Central Bank liquidity (host)	-0.018	-0.021	-0.140***	-0.035
	(0.018)	(0.014)	(0.046)	(0.037)
Log bilateral trade	1.081***	0.838***	0.336	0.469**
	(0.214)	(0.170)	(0.317)	(0.219)
Log bilateral distance	-1.090***	-0.934***	-1.635***	-1.174***
	(0.292)	(0.213)	(0.453)	(0.285)
Common language	-1.177***	-0.730***	-1.440***	-0.474
	(0.384)	(0.258)	(0.425)	(0.307)
Common legal origin	0.886***	0.050	0.760**	0.189
	(0.311)	(0.219)	(0.379)	(0.306)
Euro area entry (host)	-0.826***	-0.216	-0.204	-0.160
	(0.271)	(0.161)	(0.284)	(0.170)
Observations	2,653	2,693	1,482	1,493
R-squared	0.72	0.79	0.72	0.79
Time period	'08-'15	'08-'15	'08-'15	'08-'15
Sample	EU27	EU27	EA18	EA18
GDP controls	yes	yes	yes	yes
Source country fixed effects	yes	yes	yes	yes
Host country fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes

Robust standard errors (clustered at the country-pair level) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A.5 Fixed Effects Estimation

VARIABLES	(1) Interbank lending	(2) Interbank lending	(3) Lending to non-banks	(4) Lending to non-banks	(5) Interbank lending	(6) Interbank lending	(7) Lending to non-banks	(8) Lending to non-banks
NPLs (source)	-0.102***		-0.038**		-0.108***		-0.048**	
	(0.020)		(0.016)		(0.023)		(0.020)	
PPI lender (source)	-0.122***		-0.078***		-0.195**		-0.063	
	(0.046)		(0.026)		(0.074)		(0.042)	
PPI borrower (source)	0.000		0.000		0.016		0.052	
	(0.133)		(0.067)		(0.210)		(0.111)	
BANKTAX (source)	-0.038		0.024		-0.064		0.001	
	(0.044)		(0.019)		(0.067)		(0.029)	
WGI (source)	-0.073		-0.233*		-0.062		-0.413**	
	(0.139)		(0.128)		(0.226)		(0.189)	
Long-term interest rate (source)	0.018		-0.021		-0.014		-0.033	
	(0.027)		(0.018)		(0.033)		(0.022)	
Central bank liquidity (source)	0.041		0.038		0.096		0.078	
	(0.041)		(0.028)		(0.124)		(0.080)	
Log GDP (source)	-0.720		-0.931*		-1.016		-1.127	
	(0.966)		(0.524)		(1.264)		(0.677)	
NPLs (host)		-0.046***		-0.018***		-0.075***		-0.024**
		(0.014)		(0.006)		(0.019)		(0.011)
PPI lender (host)		0.060*		0.073***		0.205***		0.039
		(0.036)		(0.021)		(0.050)		(0.036)
PPI borrower (host)		-0.089		-0.090**		-0.097		-0.090
		(0.091)		(0.045)		(0.109)		(0.091)
BANKTAX (host)		0.013		-0.003		-0.014		0.014
		(0.024)		(0.011)		(0.032)		(0.018)
WGI (host)		0.115		-0.167*		0.214*		-0.257*
		(0.106)		(0.087)		(0.129)		(0.147)
Long-term interest rate (host)		-0.004		-0.008		0.003		-0.027*
		(0.028)		(0.012)		(0.027)		(0.014)
Central bank liquidity (host)		-0.062***		-0.024*		-0.147***		-0.030
		(0.017)		(0.012)		(0.030)		(0.025)
Log GDP (host)		0.308		-0.466		-0.285		-0.665
		(0.539)		(0.326)		(0.625)		(0.573)
Observations	120	206	120	206	96	142	96	142
R-squared	0.66	0.28	0.35	0.19	0.62	0.42	0.27	0.17
Time period	'08-'15	'08-'15	'08-'15	'08-'15	'08-'15	'08-'15	'08-'15	'08-'15
Sample	EU27	EU27	EU27	EU27	EA18	EA18	EA18	EA18

Note: Robust standard errors in parentheses. The dependent variables are fixed effects estimates for source and host country from a first stage regression of bilateral cross-border claims on bilateral trade, country-pair fixed fixed effects and time-varying source and host country fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table A.6 Difference estimation including initial crisis impact

	(1)	(2)	(3)	(4)
	Log of all claims in loans and deposits on			
VARIABLES	banks	non-banks	banks	non-banks
NPLs (source)	-0.166***	-0.048	-0.145	-0.120*
	(0.056)	(0.035)	(0.101)	(0.066)
NPLs (host)	-0.021	0.002	-0.033	0.049
	(0.025)	(0.018)	(0.060)	(0.033)
ROE (source)	-0.037	0.020	-0.021	-0.041
	(0.023)	(0.016)	(0.057)	(0.032)
ROE (host)	-0.006	-0.007	0.014	-0.011
	(0.017)	(0.010)	(0.032)	(0.016)
Regulatory capital (source)	0.176	0.136*	0.076	-0.023
	(0.117)	(0.077)	(0.236)	(0.144)
Regulatory capital (host)	-0.023	-0.045	-0.096	-0.063
	(0.036)	(0.028)	(0.087)	(0.070)
PPI lender (source)	0.091	-0.009	0.645**	0.159
	(0.140)	(0.118)	(0.269)	(0.197)
PPI lender (host)	-0.018	0.035	0.136	0.074
	(0.108)	(0.066)	(0.235)	(0.133)
PPI borrower (source)	-0.447*	-0.524***	-0.172	-0.112
	(0.260)	(0.193)	(0.604)	(0.376)
PPI borrower (host)	-0.245	-0.154*	-0.175	-0.062
	(0.157)	(0.084)	(0.408)	(0.238)
BANKTAX (source)	0.264*	0.284***	0.122	0.072
	(0.138)	(0.101)	(0.308)	(0.196)
BANKTAX (host)	0.001	0.014	-0.161	-0.004
	(0.055)	(0.033)	(0.192)	(0.124)
WGI (source)	-0.485	-0.244	-0.646	-1.677**
	(0.410)	(0.292)	(1.124)	(0.643)
WGI (host)	0.248	-0.014	0.696	-0.121
	(0.164)	(0.115)	(0.522)	(0.303)
Long-term interest rate (source)	0.529**	0.243*	0.663	-0.224
	(0.231)	(0.135)	(0.540)	(0.296)
Long-term interest rate (host)	-0.161	-0.032	-0.162	-0.185
	(0.110)	(0.078)	(0.188)	(0.125)
Central Bank liquidity (source)	0.135	0.145	-0.041	-0.582**
	(0.152)	(0.108)	(0.457)	(0.251)
Central Bank liquidity (host)	0.046	0.010	0.001	0.071
	(0.031)	(0.019)	(0.107)	(0.069)
Initial stock	-0.146**	-0.227***	-0.175	-0.345***
	(0.064)	(0.046)	(0.119)	(0.059)
Initial bilateral trade	0.396***	0.304***	0.271	0.170
	(0.119)	(0.072)	(0.246)	(0.120)
Log bilateral distance	-0.515***	-0.234*	-0.906**	-0.597***
	(0.197)	(0.142)	(0.376)	(0.200)
Common legal origin	0.193	0.090	0.075	0.094
	(0.254)	(0.181)	(0.399)	(0.241)
Common official language	-0.744*	0.089	-1.627***	-0.235
	(0.382)	(0.220)	(0.474)	(0.308)
EA Entry (host)	-1.457**	-0.171	-0.924	-1.947***
	(0.610)	(0.392)	(1.292)	(0.730)
Initial crisis impact	0.419***	0.321***	0.240	0.283***
	(0.133)	(0.071)	(0.229)	(0.081)
Observations	346	326	184	162
R-squared	0.41	0.35	0.44	0.54
Sample	EU27	EU27	EA18	EA18
GDP controls	yes	yes	yes	yes

Note: All variables are expressed as differences between pre- ('05-'07) and post-crisis ('13-'15) period, except for the time invariant variables. Initial stock and trade refer to the pre-crisis levels of bilateral cross-border banking positions and bilateral trade. EA entry is a dummy indicating euro area entry for those host countries that joined the EA after 2005. Initial crisis impact is the difference in bilateral cross-border claims between 2009Q2 and 2008Q1. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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