

# International Financial Integration, Crises, and Monetary Policy: Evidence from the Euro Area Interbank Crises

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## Abstract

We analyze how financial crises affect international financial integration, exploiting euro area proprietary interbank data, crisis and monetary policy shocks, and variation in loan terms to the same borrower on the same day by domestic versus foreign lenders. Crisis shocks reduce the supply of cross-border liquidity, with stronger volume effects than pricing effects, thereby impairing international financial integration. On the extensive margin, there is flight to home—but this is independent of quality. On the intensive margin, however, GIPS-headquartered debtor banks suffer in the Lehman crisis, but effects are stronger in the sovereign-debt crisis, especially for riskier banks. Nonstandard monetary policy improves interbank liquidity, but without fostering strong cross-border financial reintegration.

**Keywords:** financial integration, financial crises, cross-border lending, monetary policy, euro area sovereign crisis, liquidity

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## 1. INTRODUCTION

In stark contrast to historical systemic crises that were mainly plagued by retail bank runs, the global financial crisis—that started with the Lehman Brothers’ failure on September 15, 2008, and intensified in the euro area after April 2010 with the sovereign debt crisis—was largely characterized by a reduction in wholesale funding liquidity (Freixas, Laeven, and Peydró 2015). However, the most recent global crisis is similar in key respects to historical crises. Jordá, Schularick, and Taylor (2011) and Gourinchas and Obstfeld (2012) show that financial crises tend to follow periods of strong private credit growth financed partly with foreign liquidity. One important outcome of the recent global financial crisis has been a geographic fragmentation of liquidity in world financial markets, partially unwinding the trend in cross-border financial integration that occurred since the mid-1980s (IMF 2013). To combat this recent crisis, central banks have mainly responded by using nonstandard monetary policies (Draghi 2013; Stein 2014).

In this paper, we offer an in-depth analysis of how financial crises affect international financial integration, including whether the new, expansionary nonstandard monetary policy actions may help to repair disrupted financial markets. Despite the utmost importance of this question for scholars and policymakers, empirical analysis is scarce, mainly due to the lack of comprehensive micro-datasets—especially on the cross-border lending channels needed to analyze international financial integration—since wholesale credit transactions are mostly over-the-counter trades. Comprehensive micro-credit datasets, however, are necessary both to control for borrower fundamentals and to examine heterogeneity in cross-border versus domestic loan terms. In this paper, we use new lender-borrower transaction-level data from the euro area interbank market derived from its interbank payment system, Target2.

The strengths of these data are numerous. First, different from other loan data, we can compare, for otherwise *identical* loans to the same borrower on the same day, the volume and spread of a foreign versus a domestic lender. In other credit markets, loans from different lenders to the same borrower are not granted on the same day (thus the borrower’s risk may be different) and can have different maturities, currencies, or collateral; however, in interbank markets, if one exploits the data on overnight loans in the central bank payment system, one can avoid this problem. Hence, not only is analyzing the interbank wholesale market key for studying the recent

financial crises, but it is also key for identifying the effects of crises on cross-border financial integration.

Second, as compared to the global financial market, the euro area is a single currency union, with a bank-dominated system and strong financial integration with respect to its wholesale financial market. In contrast to the U.S. interbank data, we can study the cross-border dimension—which is the question that we address in this paper—and our database also provides us with identifiers for interbank credit transactions and the ultimate borrower and lender banks involved in the loan, all of which are crucial for identification. Moreover, the euro area had risks associated with various countries' sovereign debt, which gives our data larger cross-sectional and time variation in crisis shocks. Finally, before the Eurosystem's announcement of quantitative easing in January 2015, the Eurosystem pursued several new and nonstandard monetary policies whose main effects were felt in its banking system, given the importance of banks in the European financial and economic system (Praet 2016).

To identify the impact of financial crises on lending terms across borders as compared to domestic terms (thereby affecting international financial integration), we restrict the Target2 dataset to euro-denominated interbank overnight loans. We analyze loans granted to the same borrower on the same day, thus controlling for time-varying unobserved borrower fundamentals, thereby isolating differential bank-to-bank loan conditions (access, volume, and spread) by domestic versus foreign lenders (abstracting from other loan differences, such as maturity and currency). This empirical strategy implies—at the intensive and extensive margins of lending—analyzing the data at the *borrower-lender-day* level and adding *borrower\*day* fixed effects. To further control for time-varying creditor bank conditions (e.g., liquidity hoarding) and for time-invariant lender-borrower bank characteristics (e.g., similar business models), we can add *lender\*day* and *lender\*borrower* fixed effects. Moreover, in conjunction with the euro area interbank data, we exploit both the Lehman failure and the sovereign debt shocks, since we have access to data going from June 1, 2008, until December 31, 2014. We analyze separately the Lehman collapse and the sovereign debt crisis, as the former is more bank-related and the latter is more dependent on sovereign risk, especially in countries rescued by the Troika (an ECB-EU-IMF bailout to Greece, Ireland, Portugal, and to Spain's banking sector, the *GIPS* countries).

For both shocks, we not only identify the impact of the financial crisis events on cross-border loan conditions, but we also examine the drivers behind the reduction in cross-border

liquidity during crises. In particular, a crucial question that arises is whether the identified differential effect (domestic versus cross-border) is stronger depending on borrower or borrower-country risk characteristics (a flight to quality), or if the potential reduction in cross-border liquidity might be due to a general flight home effect, where lenders in general favor domestic over foreign borrowers, independently of borrower risk characteristics. We collect several variables to measure the risk characteristics of the borrower bank. In our baseline regressions, we use an identifier for GIPS-headquartered borrower banks, as these countries were at the core of the European sovereign debt crisis. Also, given the relationship between a country's public finances and its banking sector, we collect data on each borrower-country's level of public debt as a fraction of its GDP. In addition, we follow Djankov, McLiesh, and Shleifer (2007) and use the index of the borrower-country's protection of creditor rights. Moreover, we obtain information on bank balance sheet characteristics for each borrowing bank: that is, asset size and leverage.<sup>1</sup> Finally, we analyze the role of nonstandard monetary policy in affecting the interbank liquidity supply, especially to the cross-border segment.

Our findings are robust. Financial crisis shocks reduce the supply of interbank liquidity on both the extensive and intensive margins, exerting a substantially stronger negative effect for cross-border loans, thereby impairing international financial integration. Specifically, when comparing the same bank borrower on the same day, as the crisis intensifies, a foreign lender is less likely to grant an interbank loan than a domestic lender. Conditional on granting the overnight loan, a foreign lender reduces the loan amount and increases the loan spread. During the worst part of each crisis event, compared to a domestic lender, a foreign lender reduces access to the same borrower on the same day by 29 percent during the Lehman crisis and by 24 percent during the sovereign debt crisis, and reduces volume by 12 percent and by 10 percent, respectively. Moreover, the impairment of cross-border liquidity is substantially stronger for the volume of loans compared with their price. Cross-border spreads increase by 7 basis points during the Lehman shock; during the sovereign crisis, cross-border spreads increase only for borrower banks headquartered in the GIPS countries.

At the extensive margin (access to interbank liquidity), we find in both crisis periods that the reduction of the supply of cross-border liquidity is independent of borrower-bank risk

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<sup>1</sup> Apart from these variables, we have collected multiple other borrower- and country-level variables commonly used in the literature, which we will discuss further in the results section.

characteristics, including risk at the country-level where the borrower bank is headquartered. These results suggest a strong general flight home effect during crisis times at the extensive margin, which is independent of borrower bank risk and quality.

Conversely, once a cross-border loan is granted, the borrower risk characteristics matter for the volume and spread (intensive margin). In particular, there is a flight to quality, but this is dependent on the risk of the borrower banks. During the Lehman crisis, compared with other cross-border borrower banks, GIPS-headquartered borrower banks pay spreads that are up to 17 basis points higher for cross-border (as opposed to domestic) liquidity. Moreover, the cross-border liquidity crunch for GIPS-borrowers intensified during the sovereign debt crisis, when GIPS-headquartered borrower banks also obtained substantially smaller cross-border loan amounts (reductions of up to 52 percent), in addition to paying higher spreads on these international loans (up to 14 basis points). Moreover, during the sovereign crisis, the reduced amounts of cross-border loans to GIPS-headquartered banks were stronger for highly leveraged GIPS-headquartered borrower banks.

Finally, we find that expansionary nonstandard monetary policies partly mitigate interbank liquidity restrictions during crisis periods, but these public policies are limited in their ability to foster strong cross-border financial reintegration. For identification, we use a short time window (+/- one week) to measure the effects around the three main expansionary monetary policy measures enacted over the two crisis periods: (i) the fixed-rate full allotment (FRFA) policy in October 2008 (the Lehman period); (ii) the first and second three-year long-term refinancing operation (LTROs) during the sovereign debt period in December 2011 and in February 2012, respectively; and (iii) Draghi's "whatever-it-takes" speech in July 2012, with the related announcement of the outright monetary transaction (OMT) policy by the Eurosystem in August 2012 (ECB 2008; Draghi 2012a). Exploiting the impact of these monetary policy changes on cross-border versus domestic loans, we find that all three measures resulted in greater improvements in the supply of cross-border loans, compared with domestic lending, at the extensive margin but not at the intensive margin. For example, all three expansionary monetary policies reduce the interbank rates for all loans, but have a similar effect on domestic and cross-border loans (despite the fact that the crisis shocks were more negative on the cross-border segment). In addition, the effects are similar for riskier banks (e.g., highly leveraged GIPS-borrowers). Moreover, the OMT policy—both the Draghi speech and the announcement by the

Eurosystem—has positive effects on (private) interbank liquidity despite there having been no actual injection of public liquidity, just the suggested possibility that this policy tool might be used.<sup>2</sup>

#### **CONTRIBUTION TO THE LITERATURE**

Our main contribution to the literature is identifying how financial crises impact cross-border lending, thereby affecting international financial integration. We offer an in-depth analysis of the factors explaining the reduction in cross-border lending and the role that monetary policy can play in promoting international financial reintegration.

It is well known that during financial crises, activity in international markets often declines. For example, the 2008–2009 financial crisis was accompanied by a reduction both in global trade (Levchenko, Lewis, and Tesar 2010) and in gross capital flows (Broner et al. 2013), including a decline in international bank lending (Cetorelli and Goldberg 2011). Micro studies, such as Giannetti and Laeven (2012), have shown that the collapse of the global market for syndicated loans during financial crises can partly be explained by a reduction in cross-border lending. We contribute to this literature by studying euro area interbank data in conjunction with the Lehman and sovereign debt shocks to identify the cross-border effects, and also analyze the factors explaining the reduction in cross-border lending and the role that monetary policy plays in these effects.

Importantly, we find that for otherwise identical loan contracts, cross-border loans are penalized more substantially, and even more so on volume than on interest rate spreads. Analyzing the interbank wholesale market is an important question in itself, as the series of global financial crises that began with the Lehman failure were mainly concentrated in the wholesale funding market. However, it is key to note that identifying the supply of cross-border loans is also important. We isolate the loan volume and spread by foreign versus domestic lenders to the same borrower in otherwise identical loan contracts, since borrowers that also have foreign lenders are different from those banks that mainly borrow domestically. Note also that in a global financial crisis, international banks can be more negatively affected, and as these banks

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<sup>2</sup> Given that we analyze the overnight interbank market, it is crucial to emphasize that the main quantitative effects we find regarding cross-border versus domestic liquidity supply may be thought of as a lower bound, as with longer maturities the effects should be larger, given the higher risk involved. However, given the nature of monetary policy, unconventional or not, the effects should be stronger for shorter rather than longer maturities. Hence, our results on the limited effects of monetary policy in delivering strong international financial reintegration should also hold beyond the overnight lending market considered in this paper.

have more cross-border loans than do local banks, this fact will in turn mechanically reduce cross-border loan volumes even if the supply of cross-border loans does not change.<sup>3</sup>

There is also a large and growing literature on the euro area sovereign debt crisis that started in 2010 (see, e.g., Sinn 2013; Acharya, Drechsler, and Schnabl 2014; Farhi and Tirole 2016; Uhlig 2014). The euro area sovereign debt crisis is generally perceived as having been caused by increased concern about sovereign debt defaults, which could result in the euro area's financial system becoming increasingly fragmented (IMF 2013). Our results show that—even for the highly integrated interbank market—the financial integration achieved within the euro area prior to 2008 was not crisis-proof. More importantly, our results show that the geographic segmentation during the euro area crisis was not only due to the elevated risk of sovereign defaults, as we find that the Lehman shock particularly affected cross-border lending in the eurozone. However, unlike the Lehman crisis shock, the sovereign debt shocks differentially affected GIPS-headquartered borrower banks, especially those with higher leverage.

Our paper also adds to the banking literature by contributing to the studies investigating interbank liquidity. During financial crises, there may be a reduction in interbank lending (Acharya, Gale, and Yorulmazer 2011) due to borrowers' counterparty risk (Flannery 1996; Furfine 2001; Freixas and Jorge 2008) or because of lenders' liquidity hoarding (Allen, Carletti, and Gale 2009; Caballero and Krishnamurthy 2008; Diamond and Rajan 2011). In a seminal paper, Afonso, Kovner, and Schoar (2011) analyze conditions in the U.S. unsecured interbank market around the time of the Lehman Brothers' bankruptcy, show that counterparty credit risk

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<sup>3</sup> In a global financial crisis, global (international) banks are in general more affected than are local banks. Global banks have more cross-border loans, and therefore, the volume of cross-border loans will be reduced because the typical borrower of these loans is more negatively affected by the crisis. In consequence, the reduction of cross-border loans is not due to reduced financial integration, but just that the typical borrower bank of these loans is riskier during the global crisis. As we explained above, in contrast to the literature using macro-, bank- or firm-level data, or even the literature using loan-level data, we can isolate differential bank-to-bank loan terms (volume and spread) for overnight-euro-denominated-uncollateralized loans granted to the same borrower on the same day for the same maturity by distinguishing between domestic and foreign lenders. Therefore, we also contribute to the literature on the credit channel by identifying the supply of credit. Khwaja and Mian (2008) show that—in order to identify the credit supply—loan-level (lender-borrower level) data are required; see also Paravisini (2008). They compare different business loans to the same borrower in the same quarter or year and argue that variations in lending from different banks must be associated with bank-related shocks. A critique of this line of research is that business loans from different banks are different for the same firm; for example, the purpose of the loan, its maturity, currency, and the moment when the contract is granted, and thus the borrower fundamentals differ. Since we exploit *identical* loan contracts granted to the same borrower from different lenders on the same day using a standard overnight loan in the central bank payment system (with potentially different loan volume and spread by foreign versus domestic lenders), we can identify a better measure of credit-supply restrictions (in this case, those related to the cross-border dimension in the interbank market).

plays a larger role than liquidity hoarding in tightening interbank loan terms, and do not find an interbank market freeze. Pérignon, Thesmar, and Vuillemeys (forthcoming), analyzing bank-level unsecured certificates of deposits in the European market, do not find any market-wide freeze during the 2008–2014 period. We contribute to this literature by empirically identifying the supply of cross-border interbank liquidity. Freixas and Holthausen (2005) theoretically analyze the impairment of cross-border interbank lending. We empirically show a reduction in the supply of cross-border interbank liquidity—a freeze in cross-border bank-to-bank liquidity—and its determinants: a flight to home—but not to better borrower quality—at the extensive margin; however, a flight to home and borrower quality is present at the intensive margin, with stronger effects on volume than on pricing.<sup>4</sup>

Finally, we contribute to the literature on monetary policy. The interbank market is a key channel for transmitting monetary policy to the real economy, but in a financial crisis, this transmission mechanism may be impaired (Draghi 2012b). On the theoretical front, Gertler and Kiyotaki (2010) show how problems in the interbank market can generate aggregate real effects in the macroeconomy and how nonstandard monetary policy can alleviate these problems (see also Gertler and Karadi 2011, 2013; Kiyotaki and Moore 2012); at the micro level, Bolton and Freixas (2006), Diamond and Rajan (2006) and Stein (2012) highlight the importance of monetary policy for banking, while Freixas, Martin, and Skeie (2011) and Allen, Carletti, and Gale (2014) argue that monetary policy can directly improve liquidity conditions in the interbank market (Bolton, Santos, and Scheinkman (2011) show the limits of private liquidity in crises). Despite the importance of these questions for theory and policy, as far as we are aware, there is no other paper using bank-to-bank micro-level data to identify the effects of monetary policy on interbank liquidity supply during crises. Our evidence shows the positive role that monetary policy can play in improving interbank liquidity, yet it also suggests the limitations of monetary policy in promoting cross-border financial reintegration.

The remainder of this paper is as follows. Section 2 describes our dataset. Section 3 discusses our identification strategy and results. Section 4 concludes with a concise summary of the paper.

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<sup>4</sup> Furfine (2003), Iyer and Peydró (2011), and Acharya and Merrouche (2013), respectively, analyze the U.S., Indian, and U.K. interbank markets during a financial crisis. Moreover, some policy papers have analyzed cross-border loans (Bindseil, Cour-Thimann, and König 2012; Garcia-de-Andoain, Hoffmann, and Manganelli 2014), but unlike these papers, we identify the effects at the lender-borrower-day level. As we explain in this paper, this empirical strategy is crucial for identifying the cross-border effects.



## 2. DATA

We have access to transaction-level data on interbank loans with information on the price, volume, maturity, day of the loan, and the identity of the ultimate borrower and lender, for all loans settled via Target2 by euro area banks from June 1, 2008, to December 31, 2014. Target2 is the Eurosystem's main payment and settlement system and carries out more than 90 percent of all fund flows between pairs of credit institutions in the euro area. Ninety-one percent of the aggregate Target2 turnover refers primarily to interbank payments as the system settles payments on a continuous basis in central bank money.<sup>5</sup> From the Target2 payment data, as we detail below, we obtain wholesale interbank funding information at the bank-to-bank level, data that are otherwise not observable due to the bilateral nature of over-the-counter trades.

There are three main advantages of using Target2 interbank transaction data compared with the U.S. Fedwire or any other major payment system. First, in Target2 the payment legs of interbank money market transactions are classified as interbank credit payments, which are crucial for identifying interbank loans. Given that we only focus on these interbank transactions, we match the two payment legs of an interbank loan (that is, the initial payment of the principal amount and the repayment of the principal plus an additional amount that acts as interest) and obtain further details on the transactions (prices and maturities) in addition to the volume by employing a refined version of Furfine (1999)'s algorithm, as developed by Arciero et al. (2016).<sup>6</sup>

Second, for each loan, Target2 interbank credit payments reflect the information on the ultimate lender and borrower. This information is crucial for the identification of the lender's and borrower's country of origin that in turn is essential to identify cross-border versus domestic loans (the key question of this paper, along with other related questions such as borrower banks

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<sup>5</sup> The value of all interbank payments executed in Target2 in a four-day period corresponds to the total annual GDP of the euro area. Money market transactions may also be settled via EURO1, the second, yet much smaller, large-value payment system with a daily turnover of less than 8.3 percent of Target2 (Arciero et al. 2016).

<sup>6</sup> The algorithm matches payment legs such that the implied loans have a minimum amount of 1 million EUR (a volume-dependent minimum incremental amount), an interest rate that lies in a corridor depending on the average European money market interbank rate, EONIA, and interest rates in multiples of 0.005 percentage points. For an explanation and validation of the algorithm, please refer to Arciero et al. (2016). To ensure robustness, we try several parameter combinations and find that our results are not driven by the choice of the algorithm. In particular, we run the algorithm for various symmetric and asymmetric corridor widths around EONIA. Furthermore, we employ a corridor-free approach on overnight loan payments. Our main results remain unaffected by these changes to the algorithm-based identification technique.

headquartered in crisis countries—Greece, Ireland, Portugal, and Spain—to which we hereafter refer to as the GIPS countries). In comparison, Fedwire data have information only on the settling institutions.<sup>7</sup>

Third, the algorithm’s estimation accuracy is checked against actual loans from some euro area countries using transaction-level information from supervisory datasets (Bank of Spain) or from private datasets (Italy’s e-MID). Arciero et al. (2016) and De Frutos et al. (2016) validate the Target2 interbank loan data using the Italian uncollateralized e-MID trading platform and the Spanish unsecured post-trading platform MID, respectively. The quality checks reveal that the Target2 interbank loan-level data match very well the actual Italian and Spanish unsecured money market data (incorrectly identifying less than 1 percent of payment legs as interbank loans), which also verifies the unsecured nature of the loans in our data. The quality of the interbank data for the United States and the United Kingdom is not easy to validate due to the lack of actual transaction-level data (Armantier and Copeland 2012).<sup>8</sup>

We supplement our database on interbank loans with information on the borrowing institution, both at the borrower-country and borrower-bank level, to investigate if the supply of cross-border liquidity depends on borrower characteristics. More precisely, we compute an identifier for GIPS-headquartered borrower banks, i.e., those banks headquartered in Greece, Ireland, Portugal, or Spain, as these countries were at the core of the European sovereign debt crisis. Also, we follow Djankov, McLiesh, and Shleifer (2007) and use the index on the borrower-country’s protection of creditor rights. Moreover, given the relationship between a country’s public finances and its banking sector, we collect data from Eurostat on each borrower-country’s level of public debt as a fraction of its GDP. Further, we obtain standard information

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<sup>7</sup> In our analysis, we exclude intra-group transactions since the risk of a loan between two banks of the same banking group is not as risky as a loan granted to an external bank. For cross-border trades, this ensures that loans between banks belonging to the same holding group are excluded. Target2 has an indicator variable that identifies interbank payments within the same banking group. We have left these cross-border transactions within a bank holding group for future research. Moreover, we also use the unique bank identifier code (BIC) and consolidate banks on their first six digits (from the initial eleven digits) to account for the different branches and subsidiaries in the domestic market.

<sup>8</sup> Kovner and Skeie (2013) assess the U.S. data using banks’ fed funds borrowing as reported in the quarterly FR Y-9C filings. They show that flows of overnight loans extracted from Fedwire payments data explain 78 percent of these outstanding overnight loans at quarter ends reported by big U.S. bank holding companies.

on bank balance sheet characteristics for each borrowing bank, that is, asset size and equity, which we collect from Bureau van Dyk’s Bankscope.<sup>9</sup>

### 3. EMPIRICAL STRATEGY AND RESULTS

This section starts with a thorough discussion of the general empirical strategy that we use to identify how financial crises impact cross-border lending, and provides some summary statistics. We present and discuss the results for the crisis periods surrounding the Lehman failure and the sovereign debt shocks. First, we examine the overall effects of both financial crises on cross-border versus domestic lending. Second, we examine the drivers behind the reduction in cross-border (versus domestic) interbank liquidity during crises. Third, we show the results on monetary policy.

#### 3.1. IDENTIFICATION STRATEGY

To identify the impact of the global financial crisis on cross-border lending, we examine the differential cross-border lending behavior of euro area banks relative to domestic lending using the data at the lender-borrower-time level. First, this allows us to control for unobserved and observed heterogeneity in time-varying fundamentals for borrowers and lenders, and also for unobserved and observed heterogeneity in time-invariant fundamentals for borrower-lender pairs. Second, loan-level data allow us to isolate the heterogeneous effects across bank-pairs in providing credit; specifically, whether the cross-border versus domestic loan terms to the *same* borrower on the *same* day are different.

We focus only on overnight interbank loans.<sup>10</sup> Unlike other credit markets, the overnight segment of the interbank market is very active—even during crisis periods—and thus allows comparing truly identical loans—overnight-uncollateralized-euro-denominated loans to the same

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<sup>9</sup> While these variables enter our benchmark specifications, we have collected multiple other borrower- and country-level variables that did not turn out to be relevant factors in our analysis. We discuss these other variables and the robustness checks in the results section.

<sup>10</sup> In 2008, the turnover in the overnight interbank credit market was about 5.2 times the size of the GDP of the entire euro area. Relative to the market capitalization of all euro area banks, the size of the overnight interbank market is 12.4 percent. The overnight interbank market is less risky than the longer-term segment, implying that our economic effects can be considered as a lower bound. After Lehman’s failure, the interbank term lending activity dropped by more than 80 percent, and did not recover in the period thereafter. The remaining term lending is not sufficient for the application of the identification strategy that we introduce in this section, as we do not have enough multiple loans with the same maturity granted by a foreign and a domestic lender to the same borrower on the same day.

borrower on the same day—with characteristics differing only in the volume and spread of the associated loan, depending on whether the lender is a domestic or a foreign bank. To identify this differential effect, it is crucial to control for time-varying observed and unobserved borrower-bank-specific fundamentals, such as higher counterparty risk with borrower\*day fixed effects (Khwaja and Mian 2008).<sup>11</sup> Hence, on the same day for the same borrower, we compare the loan conditions among foreign versus domestic lenders for otherwise identical loans.

To further isolate the supply of cross-border (versus domestic) loans, where the variation is at the bank-to-bank level, we control for lenders' time-varying unobserved and observed fundamentals by adding lender\*day fixed effects (Jiménez et al. 2014). By adding these effects, we control for whether the lender has, for instance, more or less liquidity (volume and cost) to lend on a given day (thus controlling, e.g., for lender's liquidity hoarding). Finally, we add lender\*borrower fixed effects to account for the time-invariant effects of persistent lender-borrower characteristics, such as the overall amount of cross-border versus domestic loans or similar business models. Hence, we identify the pure effects of time-varying crisis shocks on cross-border versus domestic loan conditions (i.e., we employ a difference-in-difference analysis).

Given these sets of fixed effects that we use for our empirical identification, we consider only loans where both the lender and the borrower have at least two counterparties per day and where at the same time the lender-borrower pair has traded at least twice in our sample. Moreover, to analyze the cross-border versus domestic funding effects, in all our regressions we exclude loans from borrowers and lenders that have not borrowed or lent at least once both domestically and across borders in the period prior to August 2008 (i.e., before the sample we use for the Lehman period). Hence, our analysis focuses precisely on those banks that had cross-border loans before the Lehman failure. Given these identification restrictions, our final sample consists of interbank loans between 141 borrower banks and 196 lender banks, making a total of 3,136 distinct bank pairs, which corresponds to the approximately 200 largest banks operating in the euro area.

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<sup>11</sup> We apply the borrower fixed-effects estimator as in Khwaja and Mian (2008). This estimator has been used extensively in the literature to analyze granted loans by controlling for borrower unobserved heterogeneity as a proxy for demand. Jiménez et al. (2012) analyze loan applications, but these data are not available for interbank liquidity.

As an empirically proxy for the access to overnight credit, we create a binary variable at the borrower-lender-day level as follows. Given our final sample of 3,136 bank pairs (after applying all restrictions as discussed above), we set the binary variable to the value one on any day on which we observe a loan between the given bank pair (a given borrower and a given lender) in our sample, and to zero on any other day on which there is not an interbank loan for the same bank pair in our sample. We refer to this binary variable as the extensive margin of credit (access).

The intensive margin of credit denotes the loan terms—volume and spread—for all the granted loans (i.e., when access equals a value of one). We measure the volume as the logarithm of the respective loan amount (in EUR millions), and the interest rate spread as the difference between the interest rate paid on the loan and the deposit facility rate; that is, the interest rate paid on excess reserves (IOER).<sup>12</sup> We refer to these variables as volume and spread. In the case of multiple loans for the same bank pair during one day, we aggregate volumes and compute the quantity-weighted interest rate; that is, all the different loans between a lender and a borrower on a given day are aggregated. Thus, in our paper, we use the expression “at the loan-day level” to denote the lender-borrower-day level.

In conjunction with the euro area interbank data, we exploit the Lehman and sovereign debt shocks to identify the effects that financial crises have on the supply of cross-border lending, which in turn affects the level of international financial integration. We analyze the Lehman failure and the sovereign debt crisis as separate events, as the former is more bank-related and the latter depends on GIPS sovereign risk. Consistent with the different nature of the two crisis periods, our proxy for the crisis intensity in the euro area—our variable crisis—in the Lehman period is the three-month Euribor-OIS spread (in percentage points), and in the sovereign debt crisis period by the mean of the logarithm of the five-year periphery country credit default swap spreads (in basis points). For the sake of presentation, we rescale the range of both crisis variables in our regressions to [0,1], such that the value of one represents the highest crisis intensity in each period and zero the lowest intensity.<sup>13</sup> We use the 60-day period from

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<sup>12</sup> During the crisis, the Eurosystem’s expansionary monetary policy via the fixed-rate full-allotment procedure pushed overnight interest rates far below the main refinancing rate (the pre-crisis instrument to steer interbank interest rates), and toward the deposit facility rate; that is, the rate paid on excess reserves (e.g., ECB 2013). Therefore, we use the deposit facility rate to measure the interest rate spread.

<sup>13</sup> We rescale each variable  $X$  in the following way:  $(X - X_{\min}) / (X_{\max} - X_{\min})$ , where the index “min” and “max” denote the minimum and maximum value of  $X$  in either the Lehman or sovereign sample.

August 18, 2008, to November 9, 2008, to analyze the Lehman crisis (with four weeks preceding and eight weeks following Lehman’s failure). We study the sovereign debt crisis over the period from July 1, 2009, to December 31, 2014 (1,356 days).<sup>14</sup> We analyze the impact of financial crisis shocks on cross-border loan conditions using the following linear regression model:

$$Loan_{i,j,t} = \beta \cdot Crisis_t \cdot Cross-border_{i,j} + \alpha_{j,t} + \alpha_{i,t} + \alpha_{i,j} + \varepsilon_{i,j,t}, \quad (1)$$

where loan refers to the loan conditions (access, volume, and spread) that borrower  $j$  receives from lender  $i$  on day  $t$ . Cross-border is a dummy variable that equals the value of one if borrower and lender banks are headquartered in different countries, and equals zero otherwise. Equation (1) represents our benchmark regression that includes the strongest set of fixed effects: borrower\*day, lender\*day, and borrower\*lender fixed effects.

We start our regression with borrower fixed effects, then saturate the regressions with different fixed effects progressively, and then move to equation (1) that refers to the specification with the strongest set of fixed effects (and thus with our strongest identification).<sup>15</sup> We estimate equation (1) with least squares (due to the presence of a large set of fixed effects) and compute heteroskedasticity-robust standard errors clustered at the bank-pair level given that the main variable we are interested in is the cross-border dummy, which varies at the bank-pair level.<sup>16</sup> Finally, we slightly vary the main specification when we analyze the results on the factors explaining the cross-border results and on the monetary policy part. We explain these variations to our main specification when we introduce those results.

Table 1 presents the summary statistics of the interbank overnight loans covering our two financial crisis periods. Out of the 7,348 overnight loans made during the Lehman period (August 18, 2008, to November 9, 2008), 49.13 percent are lent out to foreign borrowers as

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<sup>14</sup> We choose the estimation sample for the Lehman period to start four weeks before Lehman’s failure on September 15, instead of eight weeks before, because our data start only in June 2008, but we need some pre-sample loans to identify banks that are active in the cross-border segment (see previous pages). We extend the sample to eight weeks after Lehman, as a decline in overnight credit was only observed two weeks after Lehman’s failure (see the initial version of this paper where we have documented that, immediately after the Lehman failure, term credit dropped dramatically while overnight volumes increased and fell only after term volumes stabilized at virtually zero). For the sovereign debt sample, we choose mid-2009 as the start to have sufficient pre-crisis interbank loans before the sovereign debt problems of Greece began in April–May 2010. Note that money market tensions relaxed and returned to their pre-Lehman means around mid-2009, as, e.g., indicated by the three-month Euribor-OIS spread.

<sup>15</sup> In a previous version of the paper, we had many more specifications with all the different sets of fixed effects, but for the sake of brevity (both in terms of pages and tables), in the current draft we do not show those robustness tests.

<sup>16</sup> See, for example, Moulton (1986, 1990) and Wooldridge (2002). Our results, however, are all robust to multi-way clustering at the bank-pair and time level.

cross-border loans. In the sovereign debt period from July 1, 2009, to December 31, 2014, the fraction of cross-border loans amounts to 38.20 percent (out of a total of 38,294 overnight loans). Note that the number of interbank loans refers to the dataset after we have imposed all the identifying restrictions, in particular those related to the fixed effects (i.e., borrower\*day, lender\*day, and borrower\*lender fixed effects) that we explained above.

For the granted loans, the median loan amount is twice as large for cross-border loans as for domestic loans (see Table A2 in the appendix). During the Lehman period, the mean amount of cross-border loans amounts to 198 million EUR (median: 100 million EUR) as compared to 109 million EUR (median: 50 million EUR) for domestic loans; in the sovereign period, the mean amount of cross-border loans is 268 million EUR (median: 150 million EUR) as compared to 132 million EUR (median: 50 million EUR) for domestic loans.<sup>17</sup> For the same borrower on the same day, the median loan in our Lehman sample (sovereign debt period) amounts to 123 (140) million EUR from cross-border loans and 75 (53) million EUR for domestic loans; for the same borrower on the same day, the total amount borrowed from cross-border lenders on average is 468 EUR million (median: 655 EUR million) during the Lehman period, while the daily total amount borrowed from domestic lenders is on average 287 EUR million (median: 137 million EUR); during the sovereign period, the total cross-border borrowing amount is on average 416 million EUR (median: 200 million EUR), while the total domestic borrowing volume equals 211 million EUR on average (median: 94 million EUR).<sup>18</sup>

Borrowers with more cross-border loans are substantially larger (in total assets) than borrower banks with more domestic loans. Also, for the same borrower on the same day, cross-border lenders are on average 2.5 times larger in size (total assets) and twice as leveraged as the domestic lenders.<sup>19</sup> Moreover, the average interbank spread paid for cross-border trades corresponds to 88.19 basis points in the Lehman period (and 22.06 basis points in the sovereign debt sample period), with a standard deviation of 32.06 basis points (21.61 basis points during the sovereign debt crisis). In the domestic segment, the spread amounts to 80.17 basis points during the Lehman period and 22.65 basis points during the sovereign debt sample, with a standard deviation of 39.11 basis points and 23.94 basis points, respectively.

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<sup>17</sup> In the raw dataset, the average weekly total borrowing volume before the Lehman failure in the cross-border segment is 146.8 billion EUR, and 128.85 billion EUR in the domestic segment.

<sup>18</sup> The results referred to in the last sentence are not reported in the tables for the sake of conserving space.

<sup>19</sup> If we control for loan size in interactions and in levels, our results are robust.

These summary statistics again highlight the importance of examining the interbank credit supply at the lender-borrower level, since using aggregate data at the bank or country level on interbank lending would mask these differences and could therefore be misleading. For example, in a global financial crisis, global (international) banks are generally more affected. These banks have more cross-border loans, and therefore the volume of cross-border loans will be reduced because the typical borrower for these loans is more negatively affected by the crisis. Then the reduction of cross-border loans would not be due to a reduction in financial integration, but just because of the fact that the typical borrower bank for these loans is riskier during the global crisis. Therefore, bank-level data—as compared to bank-to-bank (loan) level data—are not adequate for identification. Moreover, apart from the loan-level data, borrower\*day fixed effects are crucial to control for unobservable time-varying borrower risk.

Figure 1 shows our crisis measure for both samples. The spread between the three-month Euribor and the correspondingly dated OIS rate (Figure 1.A) substantially increases after the Lehman failure on September 15, 2008, to a maximum of 207 basis points. The crisis measure was stable in our pre-Lehman sample, despite there being significant turbulence during the summer of 2007. In Figure 1.B, we plot the average of the five-year periphery country CDS spreads over the sovereign debt crisis period, which increases from 89 basis points at the beginning of our sample on July 1, 2009, to 296 basis points when Greece experienced its first difficulties in April 2010, and reaches 772 basis points at the height of the sovereign debt crisis. Both figures show that our crisis measures are well suited to measure the crisis shocks and their corresponding intensification in each of our two crisis shock periods.

### *3.2 IMPACT OF FINANCIAL CRISES ON CROSS-BORDER LENDING*

In this section, we analyze the impact of the two financial crisis shocks on credit supply, and particularly on the cross-border lending segment. We analyze the results on the extensive lending margin in Table 2 and then the intensive lending margin in Table 3. The results presented in this section provide the paper's basic findings.

Before we move to the lender-borrower-level data, we start by examining whether the two crisis shocks reduce borrower banks' overall access to interbank credit. In Table 2, columns 1 and 5, we examine the impact of the financial crisis shocks on the daily access to interbank credit at the borrower-bank level during the Lehman and sovereign debt period, respectively. Our



results suggest that, during both crisis periods, the crisis shocks imply a reduction in access to interbank borrowing, which is binding at the borrower-bank level. During the Lehman period, this decline amounts to a maximum of 2.89 percentage points at the worst moment of the crisis, which—compared with the pre-Lehman average borrowing probability of 12.93 percentage points—translates into a relative credit reduction of about 22.35 percent ( $2.89/12.93$ ). For the sovereign debt period, the absolute decrease of 1.34 percentage points corresponds—when compared with the pre-sovereign-debt-crisis average borrowing probability of 10.64 percentage points—to a relative reduction in access by about 12.59 percent at the worst moment of the crisis. Therefore, conditioning on the same borrower, the results suggest that banks experience a strong decline in interbank overnight funding access during the crisis.

We next analyze the supply of interbank credit at the loan level. Controlling for borrower, lender, and time (day) fixed effects, in Table 2, columns 2 and 6, we find that for cross-border loans, the overall credit access is lower than for domestic loans (3.86 percentage points less during the Lehman shock and 1.92 percentage points less during the sovereign debt period). More importantly, in columns 3 and 7, we add the variable *crisis\*cross-border* to examine whether there is an additional time-varying differential cross-border effect related to the crisis. In both crisis periods, we find that the estimated coefficient on the interaction between cross-border lending and the crisis variable is negative and significant. At the worst moment of the Lehman crisis, we find that the access to cross-border loans is reduced by up to an additional 37.22 percent. During the sovereign debt period, we estimate that cross-border lending declines by up to an additional 35.08 percent.<sup>20</sup> Thus, the negative impact of the crisis shocks is substantially stronger for cross-border loans.

We also find that the crisis shocks lead to a reduction in the supply of cross-border loans when we control for *borrower\*time*, *lender\*time*, and *borrower\*lender* fixed effects (Table 2, columns 4 and 8, which report our benchmark regressions). Notice that all these regressions are based on the sample that complies with the restrictions needed to identify the full set of fixed effects, and only includes loans between banks that actively traded both across borders and domestically before the onset of the financial crisis (as explained above in the section on

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<sup>20</sup> The absolute additional reduction during the Lehman crisis is up to 3.16 percentage points relative to the pre-Lehman average loan probability of 8.49 percentage points. The absolute additional change is 1.20 percentage points during the sovereign debt crisis relative to the average pre-crisis loan probability of 3.42 percentage points.

empirical identification).<sup>21</sup> The estimated coefficients are statistically not different than those of the previous model despite a large increase in the R-squared (thus suggesting strong exogeneity to unobservable variables, following Altonji, Elder, and Taber 2005), and they remain economically significant and large (an additional relative reduction for cross-border loans in access to interbank credit by 29.21 percent during Lehman and by 24.38 percent during the sovereign debt sample). All in all, the results suggest that the financial crisis shocks reduce the supply of interbank liquidity at the extensive margin of lending, with substantially stronger negative effects for cross-border loans, thereby impairing international financial integration.

In Table 3, we analyze the intensive margin of credit; that is, the volume and spread for the granted loans. From columns 1 and 6, we find that the crisis shock implies a reduction of credit volume for banks that borrow in the interbank market, which is binding at the (borrower) bank level. During the height of each crisis, there is an overall 33.92 percent decrease in interbank borrowing during the Lehman period and a 28.84 percent decline during the sovereign debt crisis.

Columns 2 and 7 report the coefficients for the loan-level analysis tracing the crises' impact on cross-border versus domestic loan volumes. We find that the crisis shocks imply a stronger reduction of the credit volume supplied for the cross-border segment as compared with the domestic segment (for the same borrower on the same day, also adding lender\*day and borrower\*lender fixed effects). When considering the worst moments of the respective crisis periods, we find an additional reduction in cross-border versus domestic loan volumes by up to 12.45 percent during the Lehman crisis and by 10.04 percent during the sovereign debt period.

In columns 3–5 and 8–10 of Table 3, we show the same results for the spreads of granted loans. In columns 3 and 8, controlling for borrower fixed effects, we find that the sovereign debt crisis shock increases the cost of borrowing by 32.01 basis points at the borrower-bank level (see column 8). However, in column 3 we find that during the Lehman crisis banks pay significantly lower spreads for overnight credit (i.e., interest rates are closer to the rate paid on excess reserves). This finding is in line with other studies that, for the period after the Lehman failure, document a decrease of the overnight rate while the LIBOR-OIS spread increased (e.g., Taylor and Williams 2009; ECB 2013). This is partly due to the decrease of the OIS rate in the second

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<sup>21</sup> We keep the same number of observations in all the columns of the loan-level analysis to facilitate the comparison of the results depending on the different set of controls.

week after the Lehman's failure, suggesting that the market was expecting monetary policy to reduce interest rates (Taylor and Williams 2009). So, in column 4, we restrict our analysis of the financial crisis on spreads to the first week after the Lehman failure (i.e., with four weeks before and one week after Lehman Brothers' failure) and find a positive and significant impact of the crisis on spreads at the bank level immediately after the Lehman shock.

Interestingly, our results for the loan-level analysis with the full set of fixed effects show that, during the Lehman sample, on the same day lenders charge the same borrower significantly higher spreads for cross-border loans as compared with domestic loans during the crisis. Economically, this differential effect in the interest rate spread amounts to 6.97 basis points (column 5) at the worst moment of the crisis (or 6.92 percent when compared to the average spread of 1.01 percentage points before the Lehman failure). During the sovereign debt crisis, we find no significant *average* cross-border differential effect during the crisis (see column 9). While in Section 3.3 we will discuss whether a borrower bank's location and public debt exposure have a different impact on cross-border borrowing during the two crisis periods (see Table 6 Panel B), here we note that once we allow for heterogeneous effects depending on borrower location, we find an additional increase of 13.61 basis points for cross-border loans to borrower banks headquartered in GIPS countries (see column 1 of Table 6 Panel B).

Overall, the results suggest that the financial crisis shocks reduce the supply of interbank liquidity (credit supply) at the extensive and intensive margins of lending (access, volume, and spreads), with substantially stronger adverse effects on cross-border loans, thereby impairing international financial integration. Moreover, the effects are binding at the (borrower) bank level and are significant both for the Lehman and the sovereign debt crises. Importantly, despite only analyzing the less risky segment of overnight loans (as compared with loans with longer-term maturities), the results are quantitatively strong, especially on access and volume.

### 3.3. *FLIGHT TO HOME OR FLIGHT TO QUALITY?*

The previous results indicate that crisis shocks have a strong negative impact on the supply of cross-border liquidity, thereby negatively impacting international financial integration. This result holds after controlling for any unobserved time-varying borrower (and lender) heterogeneity through borrower\*time (and lender\*time) fixed effects, where time is daily fixed effects. Hence, unlike with aggregate or even bank-level data, we can control for any time-

varying compositional differences in the sample of domestic versus foreign borrowers; moreover, as compared with other loan-level data, our loans are identical standardized overnight deposits.

However, a crucial question that arises is whether the tightly identified differential effect (domestic versus cross-border) is stronger depending on borrower or borrower-country risk characteristics (a flight to quality), or if the reduction in cross-border liquidity might be due to a general flight home effect, where lenders favor domestic over foreign borrowers, independent of their risk characteristics. Note that while we identify the average cross-border differential effect by comparing loan conditions for the same borrower on the same day by a foreign versus domestic lender (borrower\*time fixed effects), this differential effect might still be more or less pronounced depending on borrower characteristics.

To estimate the sensitivity of the cross-border differential effect during the crisis periods depending on debtor-bank characteristics, we interact crisis\*cross-border with several borrower-specific variables, including borrower-country level characteristics. In column 1 of Table 4 Panels A and B, we interact crisis\*cross-border with a binary variable that equals the value of one whenever the borrowing bank is headquartered in one of the GIPS countries. This binary variable is a natural candidate, given that the sovereign debt crisis was centered on these countries, but for analytical consistency we also use this variable in the Lehman period. In Table 4, we analyze the extensive margin (access). We find that for the Lehman crisis (Panel A) the cross-border credit crunch is unaffected by GIPS-headquartered borrowing banks. Interestingly, however, during the sovereign debt crisis, the cross-border differential effect is not stronger for GIPS-headquartered borrowers (Panel B).

In column 2, we introduce an interaction term with the creditor rights index from La Porta et al. (1998) and Djankov, McLiesh, and Shleifer (2007) that measures the protection of creditor rights in the borrower country. Our estimates show that both during the Lehman (Panel A) and sovereign debt periods (Panel B), the cross-border differential is not affected by the strength of creditor rights in the borrower country. In column 3, we interact our crisis\*cross-border variable with the borrower-country's public debt as a fraction of the country's GDP. Once again, during both crisis periods, lenders distinguish only between domestic and foreign borrowers; foreign borrowers are granted less credit independently from their country's level of public debt.

In column 4 and 5, we follow Houston, Lin, and Ma (2012) and consider the interaction of our crisis\*cross-border variable with bank balance sheet characteristics. We collect the borrowing bank's total assets and its leverage ratio (equity-to-total-assets). Based on these data we construct the dummy variable, high leverage bank, that equals one if the borrower has a leverage ratio above the median, and zero otherwise. Similarly, we compute the dummy variable, large bank, that equals one for banks with a total asset size above the median value, and zero otherwise. Consistent with our previous country-level variables, we also find that these bank-level variables do not influence the flight home effect in cross-border funding. These results remain qualitatively similar when we include all variables together (see column 6). Therefore, our results for the extensive margin (access to interbank loans) suggest that the reduction of the supply of cross-border loans is independent of debtor bank characteristics, including country-level ones.

While there are many different factors that potentially might relate to the strength of the cross-border differential effect, in our baseline specifications we present only a combination of variables that the literature generally finds important. However, in robustness regressions, we also check the results against the inclusion of multiple other variables used in the literature, such as the borrower-country's bank capital regulations, common language between the lender and borrower country (Rose 2004), bilateral trust, geographic distance, and differences in economic conditions (per capita GDP) between the lender and borrower country (Guiso, Sapienza, and Zingales 2006, 2009), the degree of government bank ownership, and trade flows between the two countries (Giannetti and Laeven 2012; Houston, Lin, and Ma 2012). But in all cases, we do not find that the reduction of cross-border funding access is dependent on any of these borrower-specific variables during the Lehman crisis or the sovereign debt crisis. Therefore, the dry-up of cross-border liquidity on the extensive margin is independent of debtor bank fundamentals; that is, there is a pure flight to home effects but not a flight to quality effect.

In Tables 5 and 6, we replicate the estimation shown in Table 4 for the intensive margin of credit, that is, volume and spread, respectively. Table 5 Panel A shows that during the Lehman crisis the cross-border differential in loan amounts are not affected by GIPS-headquartered banks, by the borrower-country's creditor rights, the ratio of public debt/GDP, or asset size (columns 1 to 4). In column 5, however, we find that the cross-border differential effect in loan amounts during the Lehman crisis is more pronounced for highly leveraged foreign borrower

banks. During the worst moment of the crisis, highly levered borrowers experience an additional reduction in cross-border loan volumes by 18.6 percent (column 6).

From Table 5 Panel B, we find that during the sovereign debt crisis, the reduction in cross-border loan amounts was stronger for smaller foreign banks, and stronger for banks headquartered in countries with a high public debt/GDP ratio, but it was especially stronger for GIPS-headquartered banks. For example, during the worst moment of the crisis, GIPS-headquartered borrower banks experienced an additional 51.6 percent contraction in loan volumes compared with the general cross-border loan volume contraction. Creditor rights and high leveraged foreign borrower banks, however, leave the cross-border differential effect unaffected.

Overall, the results shown in Panels A and B suggest that, unlike the extensive margin of credit (access to interbank loans), the reduction in the amount of cross-border loan supply is affected by debtor bank characteristics, including the risks associated with the country where the borrower-bank is headquartered.

In Table 6 Panels A and B, we examine whether the increase in the spreads of cross-border loans is also affected by borrower-bank and borrower-country characteristics. In column 1 of Table 6 (Panels A and B), we find that during both the Lehman crisis and the sovereign debt crisis, the cross-border differential effect in spreads is stronger for GIPS-headquartered debtor banks. The estimates indicate an additional increase in spreads for cross-border loans by up to 16.9 and 13.6 basis points during the Lehman failure and sovereign crisis, respectively. Note that this is the additional increase in spreads for GIPS-headquartered borrowers compared with the general increase in cross-border loan spreads during the crisis. In column 2 of Panel A, we show that during the Lehman period, lenders asked for a higher interest rate on cross-border loans to borrowers from countries with stronger creditor rights. In column 3, we find that the cross-border differential is unaffected by the public debt/GDP ratio. In columns 4 and 5, we interact crisis\*cross-border with the borrower bank's size and leverage. While both variables appear to affect the cross-border differential effect, in column 6, when we include all the interaction terms simultaneously, we find that lenders charge higher rates on cross-border loans to larger banks. In Panel B, we replicate this analysis for the sovereign debt crisis and find—consistent with the Lehman period—that lenders charge higher rates to large foreign borrower banks and to foreign borrower banks headquartered in the GIPS countries. The borrower-country's creditor protection,

its public debt/GDP ratio, and the borrowing-bank's leverage do not affect the cross-border differential.

In robustness regressions, we find that the results for the intensive margin—both volume and spreads—are robust to the inclusion of other variables used in the literature (as previously discussed). In fact, the impact of GIPS-headquartered borrower banks is the most important variable affecting the cross-border differential in both loan amount and spreads during the sovereign period and in spreads during the Lehman period.

Therefore, in the next step, we examine if the significantly stronger cross-border differential effect for GIPS-headquartered borrowers depends further on bank-level characteristics of GIPS borrowers for the intensive margin. For that purpose, we allow the effect of crisis\*cross-border\*GIPS-bank on loan volumes and spreads to be different for large GIPS-headquartered borrowers and for highly leveraged GIPS-headquartered borrowers. As shown in Table 7, we find that the differential effect on the cross-border loan amount to GIPS-headquartered debtor banks is only affected by higher leveraged borrowers during the sovereign debt crisis. Our estimate suggests that, relative to the general contraction in cross-border loan volumes to GIPS-headquartered borrowers, highly levered GIPS-headquartered borrowers face an additional decline in cross-border volumes of up to 65.7 percent during the worst moment of the sovereign crisis (column 4). However, these effects are statistically significant only at the 10 percent level, and we do not observe an additional differential effect for spreads. Similarly, during the Lehman crisis, the increase in cross-border spreads for GIPS-headquartered debtor banks is unaffected by further bank-level characteristics.

In sum, our previous results show that the crisis shocks reduce the supply of interbank liquidity, but especially the cross-border liquidity, thereby impairing international financial integration. Importantly, at the extensive margin (access to interbank loans), unlike the intensive margin (volume and price), the reduced supply of cross-border loans is independent of debtor bank characteristics, including the country-level characteristics based on where the debtor bank is headquartered, thereby suggesting a strong general flight home effect during crisis times independent of debtor bank risk and quality.

Interestingly, during the Lehman crisis, GIPS-headquartered debtor banks were paying higher spreads for cross-border liquidity. The cross-border liquidity crunch for GIPS-borrowers intensified during the sovereign debt crisis, when GIPS-headquartered debtor banks also

obtained substantially smaller cross-border loan amounts besides paying higher spreads on these international loans. We also find that the reduction of cross-border loan amounts to GIPS-headquartered banks was particularly strong for highly leveraged GIPS-headquartered borrowers.

### 3.4. IMPACT OF EXPANSIONARY MONETARY POLICY

Overall, our basic results suggest that the crisis shocks imply a reduction of the supply of credit, with a stronger negative differential effect on the supply of cross-border loans compared with domestic loans. Expansionary monetary policy via the credit channel (e.g., Bernanke and Gertler 1995; Bernanke 2007) may relax financial constraints by reducing the general severity of the crisis and also by relaxing the financial constraints of riskier loans (e.g., a cross-border loan in crisis times).<sup>22</sup> Moreover, nonstandard monetary policy has been the most important policy for combating illiquidity in the euro area. Therefore, a crucial question that arises is whether nonstandard, expansionary monetary policy helps to mitigate credit supply restrictions, notably cross-border frictions, thereby helping to promote international financial reintegration in crisis times.

To identify the effect of expansionary monetary policy, we continue exploiting the data at the lender-borrower-day level, but now with a short window of one week before and after the main monetary policy measures undertaken in each crisis period: (i) the fixed-rate full allotment (FRFA) policy in October 2008 (the Lehman period); (ii) the first and second three-year long-term refinancing operation (LTROs) during the sovereign debt period in December 2011 and in February 2012, respectively; and (iii) Draghi’s “whatever-it-takes” speech in July 2012, with the related announcement of the outright monetary transaction (OMT) policy by the Eurosystem in August 2012.<sup>23</sup> We use a difference-in-difference approach for the analysis of the impact of the different monetary policy changes:

$$Loan_{i,j,t} = \beta \cdot Monetary\ Policy_t \cdot Cross\ border_{i,j} + \alpha_{j,t} + \alpha_{i,t} + \alpha_{i,j} + \varepsilon_{i,j,t}, \quad (2)$$

where the dependent variable is the interbank overnight loan condition granted to borrower  $j$  by lender  $i$  at day  $t$ . Monetary policy is a binary variable that equals a value of one on any day in the week after the key public policy change, and equals zero in the week before. That is, for the

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<sup>22</sup> As we have seen, there are frictions between foreign and local lenders that make cross-border lending riskier than domestic lending.

<sup>23</sup> The outright monetary transaction is a Eurosystem program under which the euro area central banks make secondary market purchases of bonds issued by Eurozone member-states under strong conditionality.



Lehman period, during the +/- one week window, the monetary policy dummy equals the value of one in the week after the implementation of the FRFA policy on October 15, 2008, and equals zero on the days prior to that date. For the sovereign debt crisis period, we independently study the effect of the two LTROs using the monetary policy dummy that takes the value of one in the week after December 21, 2011, for the first LTRO, and the week after February 29, 2012, for the second LTRO, and zero for the week before, respectively. To study the effect of Draghi's "whatever-it-takes" speech, we define the dummy variable such that it takes the value of one in the week after July 26, 2012, and zero in the week before. Moreover, because in the week after Draghi's speech, the Eurosystem announced its outright monetary transaction (OMT) program on August 2, 2012, we also consider another regression where we take the week before Draghi's speech and the week after the OMT announcement (thus leaving out the week from July 28 through August 2).<sup>24</sup>

For empirical identification, we use borrower\*time fixed effects, lender\*time fixed effects, and borrower\*lender fixed effects, where time is daily, thus mimicking the strong identification from our benchmark equation (1). However, this identification strategy can be employed only for the extensive margin (access) as, within a very short window of time (as in this case for the identification of monetary policy changes), the requirements needed for the identification of the fixed effects cannot be met for the intensive margin of credit (volume and spread) due to the lack of statistical power. We therefore study the intensive margin with a specification including only borrower and lender fixed effects (note, however, that in Table 2 we find that the estimated cross-border effects do not change if we add the strongest set of fixed effects).

In Table 8, Panel A, we investigate the effect of expansionary monetary policy on the access to cross-border credit. In column 1, we find that the FRFA policy improves the cross-border funding access during the crisis. The effect of the improvement amounts to 1.59 percentage points, thus suggesting a relative improvement for cross-border loans of 29.18 percent when compared with the average loan probability of 5.43 percentage points in the week

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<sup>24</sup> For the FRFA and LTRO measures, we use the actual implementation day, because those monetary policy measures were directly impacting the interbank market through central bank liquidity allocation. We use the announcement day of the OMT instead, because the OMT was primarily focused on sovereign yields, thus only affected banks indirectly, and, in addition, the OMT program was never actually used (that is, there was no actual liquidity provision as compared to the FRFA and LTROs).

before the policy intervention. Our results for the effect of the first LTRO in December 2011 suggest no effect on the differential access in cross-border lending; however, the implementation of the second LTRO in February 2012 significantly improves the supply of cross-border loans by 1.93 percentage points, (59.19 percent when compared with the average loan probability of 3.27 in the week before the LTRO).<sup>25</sup>

Moreover, the Draghi speech to do “whatever-it-takes” to save the euro improves the supply of access to cross-border loans by 2.34 percentage points. When compared to the average loan probability of 3.61 percentage points in the week before the speech, this amounts to a relative improvement of 64.84 percent. In the alternative specification, when we look at the change during the week after the OMT announcement on August 2, 2012, compared with the week before the Draghi speech, we find an even stronger improvement of cross-border access of 3.40 percentage points, or 94.17 percent, compared with the week before the speech. In sum, the overall results for access suggest that monetary policy has a strong impact on the cross-border segment. However, the effects are similar for riskier banks (e.g., highly-leveraged GIPS-borrowers); see Appendix Table A3.

In Table 8, Panels B and C, we present findings that monetary policy affects the intensive margin (loan terms) of credit overall, but does not affect the volume and spread differentially for cross-border loans, thus showing that monetary policy has a limited effect in ameliorating the financial integration problems during crises.<sup>26</sup> In particular, within the intensive margin, the effects are stronger for reducing spreads than for increasing volume. We find that the FRFA policy decreases spreads by 15.29 basis points, which implies an improvement of spreads by 34.53 percent when compared with the average spread before the FRFA policy. However, there is *no* differential effect depending on cross-border versus domestic loans (despite that the crisis shocks implied that worse effects would be felt on cross-border loans). In addition, we find that the first LTRO increases the overall borrowing amount by 14.77 percent and reduces spreads by 13.20 basis points. Economically, the improvement of interbank spreads corresponds to a relative decline in spreads of 34.73 percent (when compared with the average spread in the week before

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<sup>25</sup> The first LTRO took place on December 21, 2011, and provided 489.2 billion EUR. The second operation took place on February 29, 2012, and provided 529.5 billion EUR.

<sup>26</sup> Both at the extensive and intensive margins, we do not find a further differential effect for the cross-border segment during the crisis depending on borrower-bank risk or location; that is, GIPS- versus non-GIPS-headquartered banks (not reported).

the first LTRO). Yet there is *no* differential effect on cross-border loan volumes (the first and second coefficients add up to zero), while for loan spreads, we find a small improvement for domestic compared with cross-border loans. All in all, unlike our results for the extensive margin (access to liquidity), at the intensive margin we do not find that expansionary monetary policy has a greater effect on improving the cross-border (relative to the domestic) segment, despite the cross-border margin being more negatively affected by the sovereign debt crisis.

We do not find that the Draghi speech had a significant effect on volumes or spreads (differently than for access). However, after the related OMT announcement, we find an improvement on overall spreads by 10.04 percent (when compared with the average spread before the Draghi speech). It is interesting to note that the OMT policy—both the Draghi speech as well as the announcement by the Eurosystem—improved (private) interbank liquidity despite there being no actual injection of public liquidity, just the promise to use this policy tool.

In sum, all these results highlight the positive role that monetary policy can have to improve interbank liquidity during crisis times. Yet our findings also suggest that there are significant limitations to the effectiveness of monetary policy, especially on the cross-border segment, to deliver strong international financial reintegration.

#### **4. CONCLUSION**

In a seminal paper, Afonso, Kovner, and Schoar (2011) do not find a freeze occurring in the U.S. unsecured interbank market around the time of the Lehman Brothers' bankruptcy. More recently, Pérignon, Thesmar, and Vuillemeys (forthcoming) do not find any market-wide freeze in the European market of unsecured certificates of deposits during the 2008–2014 period. In this paper, we study whether there is a freeze in the cross-border unsecured interbank lending market. In particular, we analyze whether (and how) financial crises affect international financial integration, and also the role of nonstandard monetary policy in promoting international financial integration in crisis times.

As we argue in the paper, the euro area interbank market is an excellent platform for identification and for economic analysis. In particular, we exploit the euro area interbank market data in conjunction with the Lehman and sovereign debt shocks and the main, new nonstandard monetary policy measures enacted by the Eurosystem. Moreover, our empirical strategy relies on analyzing interbank loan terms for (identical) overnight loans in the central bank payment system

made to the same borrower on the same day, but differentiated by domestic versus foreign lenders.

We find that the financial crisis shocks strongly reduce the supply of interbank liquidity, at both the extensive and intensive margins, with substantially stronger negative effects for cross-border loans (a maximum of 29 percent), thereby impairing international financial integration. When comparing the same borrower on the same day, the foreign (as compared with the domestic) lender grants less interbank loans as the crisis intensified; and conditional on granting the overnight loan, the foreign lender reduced the loan amount and increased the loan spread. Moreover, the impairment of cross-border liquidity is quantitatively stronger on volumes than on pricing.

Importantly, at the extensive margin, we find that the dry-up of cross-border liquidity is independent of debtor-bank fundamentals—that is, there is a flight to home, but not to quality (the dry-up is similar for riskier compared with safer foreign borrower banks). In contrast, at the intensive margin, there is a flight to quality, but this is dependent on the risk level associated with borrower banks. Interestingly, GIPS-headquartered debtor banks had already suffered in the Lehman crisis, but the effects were stronger during the sovereign debt crisis, especially for riskier GIPS banks (with a reduction of 66 percent in loan volumes). Therefore, the geographic market segmentation is different for the extensive versus the intensive margins of lending. Finally, we find that expansionary nonstandard monetary policy (FRFA, LTROs, and Draghi's OMT “whatever-it-takes”) partly mitigates some of the private interbank liquidity supply restrictions during the sovereign debt crisis, but this policy that provides public debt liquidity has encountered significant limitations on delivering strong cross-border financial reintegration in the market for private liquidity.

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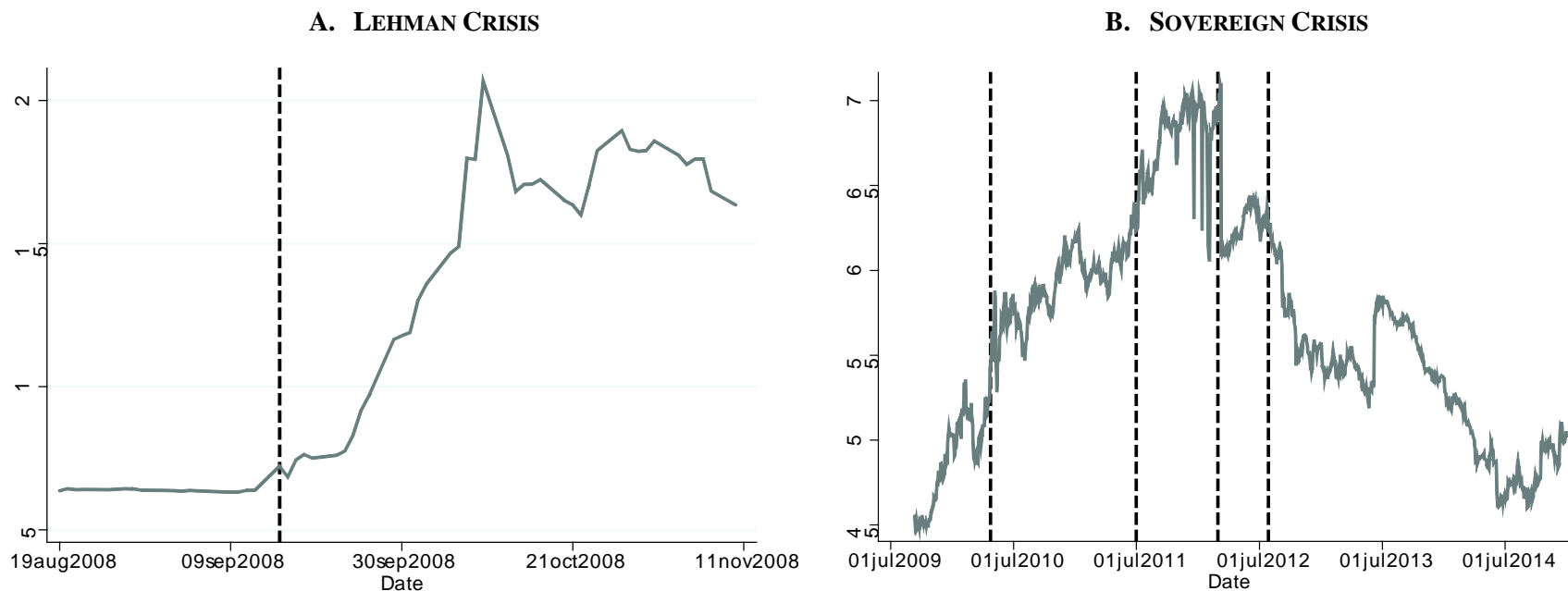
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**FIGURE 1: THREE-MONTH EURIBOR-OIS SPREAD AND MEAN PERIPHERY CDS DURING THE CRISES**



Source: Authors' calculations.

Notes: This figure shows our crisis measures for the Lehman crisis and sovereign debt crisis period, respectively. We define "Lehman Crisis" as August 18, 2008, to November 9, 2008, daily frequency, and "Sovereign Crisis" as July 1, 2009, to December 31, 2014, daily frequency. Subfigure (a) shows the difference (in percentage points) between the three-month Euribor rate and the correspondingly-dated overnight index swap (OIS) rate during the Lehman crisis sample. The dashed vertical line refers to September 15, 2008, the day on which Lehman Brothers filed for bankruptcy. Subfigure (b) plots the average of the logarithm of the five-year periphery country CDS spreads (in basis points). The first dashed vertical line denotes April 23, 2010, the day the Greek government activated the financial support mechanism. The second dashed vertical line refers to June 30, 2011, when market analysts became increasingly worried that Spain could keep refinancing its debt burden. The third dashed vertical line represents the second three-year LTRO on February 29, 2012, while the last dashed vertical line denotes the Draghi's "whatever-it-takes" speech on July 26, 2012.

**TABLE 1: SUMMARY STATISTICS**

<b>Dependent Variable:</b>	<b>Lehman Crisis</b>					<b>Sovereign Crisis</b>				
	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>
Access	6.557	0.000	24.752	0.000	0.000	2.170	0.000	14.569	0.000	0.000
Loan Amount	152.960	90.000	241.722	15.000	400.000	183.812	75.000	317.623	34.000	500.000
Amount	4.328	4.500	1.219	2.708	5.992	4.347	4.318	1.320	2.708	6.215
Spread	0.841	1.000	0.360	0.200	1.110	0.224	0.130	0.231	0.020	0.550

<b>Independent Variable:</b>	<b>Lehman Crisis</b>					<b>Sovereign Crisis</b>				
	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>
Euribor-OIS (3M)	0.250	0.080	0.320	0.000	0.810					
Mean Periphery CDS (log)						0.490	0.520	0.240	0.140	0.800
Cross-border	0.491	0.000	0.500	0.000	1.000	0.382	0.000	0.486	0.000	1.000
GIPS Bank	0.162	0.000	0.369	0.000	1.000	0.071	0.000	0.258	0.000	0.000
Creditor Rights	2.110	2.000	0.837	1.000	3.000	2.253	2.000	0.880	1.000	3.000
Public Debt	72.929	64.400	24.891	35.500	99.800	88.070	79.000	20.427	72.400	112.500
Large Bank	0.660	1.000	0.474	0.000	1.000	0.618	1.000	48.590	0.000	1.000
High Leverage Bank	0.364	0.000	0.481	0.000	1.000	0.496	0.000	0.500	0.000	1.000

This table reports descriptive statistics of the main variables used in the paper, across two sub-periods. We define “Lehman Crisis” (August 18, 2008, to November 9, 2008, daily frequency), and “Sovereign Crisis” (July 1, 2009, to December 31, 2014, daily frequency). “Access” denotes the extensive margin of credit. “Loan Amount” reflects the loan volume in EUR million, “Amount” refers to the logarithm of “Loan Amount”. “Spread” reflects the difference (in percentage points) between the interest rate of a loan and the interest rate paid on excess reserves (IOER). For the extensive and intensive margin, we have 188,160 and 7,348 observations during the Lehman crisis, and 4,252,416 and 38,294 observations during the sovereign debt crisis, respectively. Summary statistics for independent variables refer to sample for intensive margin. “Cross-border” is a dummy variable that equals one if lender bank and borrower bank are headquartered in different countries, and zero otherwise. “Euribor-OIS (3M)” refers to the spread between the three-month Euribor rate and the correspondingly-dated overnight index swap (OIS) rate (in percentage points). “Mean Periphery CDS” is the average of the logarithm of the five-year credit default swap (CDS) spread of the periphery countries (in basis points). The definition of “GIPS Bank”, “Creditor Rights”, “Public Debt”, “Large Bank”, and “High Leverage Bank” can be found in the Appendix Table A1. We scaled our crisis variables (Euribor-OIS spread, and mean (log) periphery CDS) such that the lowest value in each subsample equals zero, and the highest value equals one. The summary statistics for cross-border versus domestic are reported separately in the appendix.

**TABLE 2: CROSS-BORDER DIFFERENTIAL IN ACCESS DURING THE CRISIS**

	Lehman Crisis				Sovereign Crisis			
	Dependent Variable: Access							
	Bank Level	Loan Level			Bank Level	Loan Level		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis	2.8978*** (0.69)				-1.3402** (0.67)			
Cross-Border		-3.8619*** (0.45)	-2.1072*** (0.60)			-1.9204*** (0.19)	-1.8213*** (0.19)	
Crisis * Cross-Border			-3.1626*** (0.74)	-2.4846*** (0.83)			-1.2007*** (0.34)	-0.7925** (0.40)
Time FE	No	Yes	Yes	-	No	Yes	Yes	-
Borrower FE	Yes	Yes	Yes	-	Yes	Yes	Yes	-
Lender FE	No	Yes	Yes	-	No	Yes	Yes	-
Borrower * Time FE	No	No	No	Yes	No	No	No	Yes
Lender * Time FE	No	No	No	Yes	No	No	No	Yes
Pair FE	No	No	No	Yes	No	No	No	Yes
Observations	60,180	188,160	188,160	188,160	1,360,068	4,252,416	4,252,416	4,252,416
R-Squared	0.659	0.096	0.096	0.360	0.384	0.078	0.078	0.306

This table shows the impact of the financial crisis on the extensive margin of credit, by domestic versus foreign lenders, across two sub-periods. We define “Lehman Crisis” (August 18, 2008, to November 9, 2008, daily frequency), and “Sovereign Crisis” (July 1, 2009, to December 31, 2014, daily frequency). The dependent variable in columns 1 and 5 is at the borrower bank-time level and equals one if borrower bank *j* obtained an overnight loan on day *t*, and zero otherwise. The dependent variable in columns 2–4 and 6–8 is at the borrower-lender-time level and equals one if lender bank *i* grants an overnight loan to borrower bank *j* on day *t*, and zero if no loan is granted. For a thorough description of our dependent variable, refer to Section 3. “Cross-border” is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. “Crisis” refers to the Euribor-OIS spread (3M) for the Lehman crisis and to the mean (log) periphery CDS spread for sovereign debt crisis. For the sake of representation, we have multiplied the estimated coefficients by 100. We scaled our crisis variables (Euribor-OIS spread, and mean (log) periphery CDS) such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of our main variables can be found in the Appendix Table A1. Fixed effects are included (“Yes”), are not included (“No”), or are spanned by another set of fixed effects (“-”). Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**TABLE 3: CROSS-BORDER DIFFERENTIAL IN AMOUNT AND SPREAD DURING THE CRISES**

	Lehman Crisis					Sovereign Crisis				
	Dependent Variable:									
	Amount		Spread			Amount		Spread		
	Bank Level	Loan Level	Bank Level	Loan Level	Loan Level	Bank Level	Loan Level	Bank Level	Loan Level	Loan Level
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Crisis	-0.3392*** (0.11)		-0.7989*** (0.04)	0.8532*** (0.13)		-0.2884* (0.16)		0.3201*** (0.03)		
Crisis * Cross-Border		-0.1245** (0.06)			0.0697*** (0.02)		-0.1004** (0.05)		0.0062 (0.01)	0.1361*** (0.04)
Time FE	No	-	No	No	-	No	-	No	-	-
Borrower FE	Yes	-	Yes	Yes	-	Yes	-	Yes	-	-
Lender FE	No	-	No	No	-	No	-	No	-	-
Borrower * Time FE	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes
Lender * Time FE	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes
Pair FE	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes
Observations	1,941	7,348	1,941	901	7,348	13,368	38,294	13,368	38,294	38,294
R-Squared	0.650	0.919	0.578	0.216	0.630	0.631	0.862	0.200	0.947	0.947

This table shows the impact of the financial crisis on the intensive margin of credit, by domestic versus foreign lenders, across two sub-periods. We define “Lehman Crisis” (August 18, 2008, to November 9, 2008, daily frequency), and “Sovereign Crisis” (July 1, 2009, to December 31, 2014, daily frequency). The dependent variable in columns 1 and 6 is at the borrower bank-time level and equals the (log) total amount borrowed by bank  $j$  on day  $t$ . The dependent variable in columns 2 and 7 is at the borrower-lender-time level and equals the (log) amount of the loan lender bank  $i$  grants to borrower bank  $j$  on day  $t$ . The dependent variable in column 3-4, and 8 is at the borrower bank-time level and equals the difference (in percentage points) between the volume-weighted interest rate of the amount borrowed by bank  $j$  on day  $t$  and the interest rate paid on excess reserves (IOER) on day  $t$ . In column 4, we restrict the sample to one week after Lehman’s failure to account for market expectations on monetary policy interest rate cuts (sample runs from August 18, 2008 to September 19, 2008, daily frequency). The dependent variable in columns 5, 9, and 10 is at the borrower-lender-time level and equals the spread between the interest rate of the loan lender bank  $i$  grants to borrower bank  $j$  on day  $t$  and the interest rate paid on excess reserves (IOER) on day  $t$ . For a thorough description of the dependent variables, refer to Section 3. In column 10, the coefficient for “Crisis \* Cross-border” is the estimated effect for GIPS banks from column 1 of Table 6 Panel B, where we include the additional term “Crisis \* Cross-border \* GIPS Bank”. “Cross-border” is a dummy variable that equals one if lender bank  $i$  and borrower bank  $j$  are headquartered in different countries, and zero otherwise. “Crisis” refers to the Euribor-OIS spread (3M) for the Lehman crisis and to the mean (log) periphery CDS spread for sovereign debt crisis. We scaled our crisis variables (Euribor-OIS spread, and mean (log) periphery CDS) such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of our main variables can be found in the Appendix Table A1. Fixed effects are included (“Yes”), are not included (“No”), or are spanned by another set of fixed effects (“-”). Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**TABLE 4 PANEL A: HETEROGENEITY IN CROSS-BORDER DIFFERENTIAL IN ACCESS  
DURING THE LEHMAN CRISIS**

	Dependent Variable: Access					
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis * Cross-Border	-2.4133*** (-2.97)	-2.5029*** (-3.03)	-2.6170*** (-3.14)	-1.8860 (-1.55)	-2.7486*** (-3.07)	-3.9849** (-2.23)
Crisis * Cross-Border * GIPS	-1.0665 (-0.41)					-0.4988 (-0.15)
Crisis * Cross-Border * Creditor Rights		1.3082 (1.44)				1.2343 (1.30)
Crisis * Cross-Border * Public Debt			-0.0607 (-1.37)			-0.0561 (-1.05)
Crisis * Cross-Border * Large Bank				-0.9388 (-0.60)		0.6150 (0.33)
Crisis * Cross-Border * High Leverage Bank					1.2742 (0.70)	2.3448 (1.39)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	188,160	188,160	188,160	188,160	188,160	188,160
R-Squared	0.360	0.360	0.360	0.360	0.360	0.360

This table shows the heterogeneity in the cross-border differential in the extensive margin of credit during the Lehman crisis (August 18, 2008, to November 9, 2008, daily frequency). The dependent variable is at the borrower-lender-time level and equals one if lender bank *i* grants an overnight loan to borrower bank *j* on day *t*, and zero if no loan is granted. “Cross-border” is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. “Crisis” refers to the Euribor-OIS spread (3M) for the Lehman crisis, which we scaled such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of “GIPS Bank”, “Creditor Rights”, “Public Debt”, “Large Bank”, and “High Leverage Bank” can be found in the Appendix Table A1. Fixed effects are included (“Yes”) as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\* p<.01, \*\* p<0.05, \* p<0.1.

**TABLE 4 PANEL B: HETEROGENEITY IN CROSS-BORDER DIFFERENTIAL IN ACCESS  
DURING THE SOVEREIGN CRISIS**

	Dependent Variable: Access					
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis * Cross-Border	-0.7586** (-2.04)	-0.7927** (-2.01)	-0.7778** (-2.03)	-0.5220 (-0.86)	-0.7468* (-1.78)	0.1262 (0.15)
Crisis * Cross-Border * GIPS	-0.5100 (-0.38)					-1.0730 (-0.80)
Crisis * Cross-Border * Creditor Rights		0.0219 (0.06)				-0.0806 (-0.21)
Crisis * Cross-Border * Public Debt			0.0088 (0.45)			-0.0023 (-0.12)
Crisis * Cross-Border * Large Bank				-0.4424 (-0.63)		-0.5147 (-0.58)
Crisis * Cross-Border * High Leverage Bank					-0.2264 (-0.24)	-1.1415 (-1.54)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,252,416	4,252,416	4,252,416	4,252,416	4,252,416	4,252,416
R-Squared	0.306	0.306	0.306	0.306	0.306	0.306

This table shows the heterogeneity in the cross-border differential in the extensive margin of credit during the Sovereign crisis (July 1, 2009, to December 31, 2014, daily frequency). The dependent variable is at the borrower-lender-time level and equals one if lender bank *i* grants an overnight loan to borrower bank *j* on day *t*, and zero if no loan is granted. “Cross-border” is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. “Crisis” refers to the mean (log) periphery CDS spread for sovereign debt crisis, which we scaled such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of “GIPS Bank”, “Creditor Rights”, “Public Debt”, “Large Bank”, and “High Leverage Bank” can be found in the Appendix Table A1. Fixed effects are included (“Yes”) as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\* p<.01, \*\* p<0.05, \* p<0.1.

**TABLE 5 PANEL A: HETEROGENEITY IN CROSS-BORDER DIFFERENTIAL IN AMOUNT  
DURING THE LEHMAN CRISIS**

	Dependent Variable: Volume					
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis * Cross-Border	-0.1531*** (-2.89)	-0.1542*** (-2.93)	-0.1530*** (-2.89)	-0.1513** (-2.35)	-0.0833 (-1.37)	0.0059 (0.06)
Crisis * Cross-Border * GIPS	-0.0422 (-0.39)					-0.1324 (-0.95)
Crisis * Cross-Border * Creditor Rights		0.0063 (0.15)				0.0073 (0.16)
Crisis * Cross-Border * Public Debt			0.0007 (0.38)			-0.0004 (-0.25)
Crisis * Cross-Border * Large Bank				-0.0082 (-0.10)		-0.0824 (-0.83)
Crisis * Cross-Border * High Leverage Bank					-0.2225** (-2.34)	-0.1860* (-1.89)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,348	7,348	7,348	7,348	7,348	7,348
R-Squared	0.915	0.915	0.915	0.915	0.916	0.916

This table shows the heterogeneity in the cross-border differential in the intensive margin of credit during the Lehman crisis (August 18, 2008, to November 9, 2008, daily frequency). The dependent variable is at the borrower-lender-time level and equals the (log) amount of the loan lender bank *i* grants to borrower bank *j* on day *t*. “Cross-border” is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. “Crisis” refers to the Euribor-OIS spread (3M) for the Lehman crisis, which we scaled such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of “GIPS Bank”, “Creditor Rights”, “Public Debt”, “Large Bank”, and “High Leverage Bank” can be found in the Appendix Table A1. Fixed effects are included (“Yes”) as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < .01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .



**TABLE 5 PANEL B: HETEROGENEITY IN CROSS-BORDER DIFFERENTIAL IN AMOUNT  
DURING THE SOVEREIGN CRISIS**

	Dependent Variable: Volume					
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis * Cross-Border	-0.0944** (-1.97)	-0.0939** (-1.98)	-0.0962** (-2.03)	-0.1120** (-2.02)	-0.1017* (-1.74)	-0.3178*** (-3.45)
Crisis * Cross-Border * GIPS	-0.3826** (-2.03)					-0.5155** (-2.35)
Crisis * Cross-Border * Creditor Rights		0.0119 (0.33)				-0.0266 (-0.69)
Crisis * Cross-Border * Public Debt			-0.0064** (-2.29)			-0.0057* (-1.82)
Crisis * Cross-Border * Large Bank				-0.0038 (-0.04)		0.1891* (1.82)
Crisis * Cross-Border * High Leverage Bank					0.0953 (1.05)	0.1277 (1.34)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	38,294	38,294	38,294	38,294	38,294	38,294
R-Squared	0.861	0.861	0.861	0.861	0.861	0.862

This table shows the heterogeneity in the cross-border differential in the intensive margin of credit during the Sovereign crisis (July 1, 2009, to December 31, 2014, daily frequency). The dependent variable is at the borrower-lender-time level and equals the (log) amount of the loan lender bank *i* grants to borrower bank *j* on day *t*. “Cross-border” is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. “Crisis” refers to the mean (log) periphery CDS spread for sovereign debt crisis, which we scaled such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of “GIPS Bank”, “Creditor Rights”, “Public Debt”, “Large Bank”, and “High Leverage Bank” can be found in the Appendix Table A1. Fixed effects are included (“Yes”) as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**TABLE 6 PANEL A: HETEROGENEITY IN CROSS-BORDER DIFFERENTIAL IN SPREAD  
DURING THE LEHMAN CRISIS**

	Dependent Variable: Spread					
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis * Cross-Border	0.0665*** (3.42)	0.0707*** (3.64)	0.0752*** (3.81)	0.0402* (1.72)	0.0999*** (4.22)	-0.0088 (-0.29)
Crisis * Cross-Border * GIPS Bank	0.1692*** (3.46)					0.1651*** (2.93)
Crisis * Cross-Border * Creditor Rights		-0.0304** (-2.27)				-0.0117 (-0.90)
Crisis * Cross-Border * Public Debt			0.0006 (0.74)			0.0013 (1.62)
Crisis * Cross-Border * Large Bank				0.0769** (2.35)		0.0935*** (2.65)
Crisis * Cross-Border * High Leverage Bank					-0.0815** (-2.24)	0.0178 (0.46)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,348	7,348	7,348	7,348	7,348	7,348
R-Squared	0.585	0.584	0.583	0.584	0.584	0.586

This table shows the heterogeneity in the cross-border differential in the intensive margin of credit during the Lehman crisis (August 18, 2008, to November 9, 2008, daily frequency). The dependent variable is at the borrower-lender-time level and equals the spread between the interest rate of the loan lender bank  $i$  grants to borrower bank  $j$  on day  $t$  and the interest rate paid on excess reserves (IOER) on day  $t$ . “Cross-border” is a dummy variable that equals one if lender bank  $i$  and borrower bank  $j$  are headquartered in different countries, and zero otherwise. “Crisis” refers to the Euribor-OIS spread (3M) for the Lehman crisis, which we scaled such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of “GIPS Bank”, “Creditor Rights”, “Public Debt”, “Large Bank”, and “High Leverage Bank” can be found in the Appendix Table A1. Fixed effects are included (“Yes”) as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**TABLE 6 PANEL B: HETEROGENEITY IN CROSS-BORDER DIFFERENTIAL IN SPREAD  
DURING THE SOVEREIGN CRISIS**

	Dependent Variable: Spread					
	(1)	(2)	(3)	(4)	(5)	(7)
Crisis * Cross-Border	0.0030 (0.43)	0.0081 (1.06)	0.0027 (0.33)	-0.0095 (-1.00)	0.0102 (1.12)	-0.0013 (-0.09)
Crisis * Cross-Border * GIPS Bank	0.1361*** (3.28)					0.0908* (1.66)
Crisis * Cross-Border * Creditor Rights		-0.0090 (-1.11)				-0.0004 (-0.05)
Crisis * Cross-Border * Public Debt			-0.0012 (-1.35)			-0.0009 (-0.68)
Crisis * Cross-Border * Large Bank				0.0388** (2.40)		0.0342** (2.47)
Crisis * Cross-Border * High Leverage Bank					0.0158 (1.14)	-0.0339 (-1.38)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	38,294	38,294	38,294	38,294	38,294	38,294
R-Squared	0.947	0.947	0.947	0.947	0.947	0.947

This table shows the heterogeneity in the cross-border differential in the intensive margin of credit during the Sovereign crisis (July 1, 2009, to December 31, 2014, daily frequency). The dependent variable is at the borrower-lender-time level and equals the spread between the interest rate of the loan lender bank  $i$  grants to borrower bank  $j$  on day  $t$  and the interest rate paid on excess reserves (IOER) on day  $t$ . "Cross-border" is a dummy variable that equals one if lender bank  $i$  and borrower bank  $j$  are headquartered in different countries, and zero otherwise. "Crisis" refers to the mean (log) periphery CDS spread for sovereign debt crisis, which we scaled such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of "GIPS Bank", "Creditor Rights", "Public Debt", "Large Bank", and "High Leverage Bank" can be found in the Appendix Table A1. Fixed effects are included ("Yes") as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**TABLE 7: HETEROGENEITY IN GIPS CROSS-BORDER DIFFERENTIAL DURING THE CRISIS**

VARIABLES	Dependent Variable: Volume				Dependent Variable: Spread			
	Lehman Crisis		Sovereign Crisis		Lehman Crisis		Sovereign Crisis	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis * Cross-Border	-0.1577*** (-2.93)	-0.1547*** (-2.85)	-0.0967** (-2.02)	-0.1040** (-2.15)	0.0609*** (3.08)	0.0622*** (3.15)	0.0031 (0.44)	0.0042 (0.57)
Crisis * Cross-Border * GIPS Bank	-0.1283 (-0.62)	-0.0357 (-0.28)	-0.5053* (-1.85)	-0.1364 (-0.63)	0.0649 (0.61)	0.1869*** (3.22)	0.1414** (2.20)	0.1233*** (3.06)
Crisis * Cross-Border * GIPS Bank * Large GIPS Bank	0.1067 (0.43)		0.2297 (0.64)		0.1291 (1.04)		-0.0088 (-0.12)	
Crisis * Cross-Border * GIPS Bank * High Leverage GIPS Bank		-0.0323 (-0.13)		-0.6568* (-1.76)		-0.0889 (-0.74)		0.0629 (0.67)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,348	7,348	38,294	38,294	7,348	7,348	38,294	38,294
R-Squared	0.915	0.915	0.861	0.861	0.585	0.585	0.947	0.947

This table shows the heterogeneity in the cross-border differential for GIPS-headquartered banks in the intensive margin of credit, across two sub-periods. We define “Lehman Crisis” (August 18, 2008, to November 9, 2008, daily frequency), and “Sovereign Crisis” (July 1, 2009, to December 31, 2014, daily frequency). The dependent variable in columns 1-4 is at the borrower-lender-time level and equals the (log) amount of the loan lender bank *i* grants to borrower bank *j* on day *t*. The dependent variable in columns 5-8 is at the borrower-lender-time level and equals the spread between the interest rate of the loan lender bank *i* grants to borrower bank *j* on day *t* and the interest rate paid on excess reserves (IOER) on day *t*. “Cross-border” is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. “Crisis” refers to the Euribor-OIS spread (3M) for the Lehman crisis and to the mean (log) periphery CDS spread for sovereign debt crisis. We scaled our crisis variables (Euribor-OIS spread, and mean (log) periphery CDS) such that the lowest value in each subsample equals zero, and the highest value equals one. The definition of our main variables and “GIPS Bank”, “Large GIPS Bank” and “High Leverage GIPS Bank” can be found in the Appendix Table A1. Fixed effects are included (“Yes”) as indicated. Where possible, a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**TABLE 8: MONETARY POLICY AND CROSS-BORDER LENDING**

Sample: +/- 1 Week Around Monetary Policy Event					
Monetary Policy Event:	Full Allotment	First 3-Yr LTRO	Second 3-Yr LTRO	Draghi's Whatever- It-Takes-speech	OMT Announcement
	(October 15, 2008)	(December 21, 2011)	(February 29, 2012)	(July 26, 2012)	(August 2, 2012)
<b>PANEL A - Dependent Variable: Access</b>	(1)	(2)	(3)	(4)	(5)
Monetary Policy * Cross-Border	1.5854** (0.79)	-0.5002 (0.66)	1.9334* (1.05)	2.3385** (1.12)	3.3960*** (1.31)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	27,760	22,280	15,642	14,443	11,910
R-squared	0.551	0.550	0.509	0.619	0.631
<b>PANEL B - Dependent Variable: Amount</b>	(1)	(2)	(3)	(4)	(5)
Monetary Policy * Cross-Border	-0.0706 (0.07)	-0.1498** (0.07)	-0.0002 (0.18)	0.0260 (0.10)	0.0860 (0.18)
Monetary Policy	0.0445 (0.04)	0.1477*** (0.06)	-0.0884 (0.11)	-0.0194 (0.06)	0.0139 (0.08)
Cross-Border	-0.3580*** (0.12)	-0.0676 (0.11)	0.3459 (0.28)	0.1705 (0.41)	1.1554** (0.45)
Borrower FE	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes
Observations	1,221	685	338	470	410
R-squared	0.855	0.884	0.885	0.890	0.876
<b>PANEL C - Dependent Variable: Spread</b>	(1)	(2)	(3)	(4)	(5)
Monetary Policy * Cross-Border	-0.0341 (0.03)	0.0795*** (0.03)	-0.0012 (0.02)	0.0122 (0.01)	-0.0001 (0.01)
Monetary Policy	-0.1529*** (0.02)	-0.1320*** (0.03)	-0.0325*** (0.01)	-0.0082 (0.01)	-0.0114** (0.01)
Cross-Border	-0.0605* (0.03)	-0.0725*** (0.03)	-0.0148 (0.01)	0.1776 (0.14)	0.2486* (0.15)
Borrower FE	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes
Observations	1,221	685	338	470	410
R-squared	0.760	0.764	0.720	0.884	0.929

This table shows the impact of the Eurosystem's main monetary policy measures on the cross-border differential in the extensive and intensive margin of credit. For identification, we use a window of +/- 1 week around the respective monetary policy event. In Panel A, the dependent variable is a dummy variable that equals one if lender bank *i* grants an overnight loan to borrower bank *j* on day *t*, and zero otherwise. The dependent variable in Panel B is the (log) amount of the loan lender bank *i* grants to borrower bank *j* on day *t*. The dependent variable in Panel C is the spread (in percentage points) between the interest rate of the loan lender bank *i* grants to borrower bank *j* on day *t* and the interest rate paid on excess reserves (IOER) on day *t*. For a thorough description of the dependent variables, refer to Section 3. The independent variable "Monetary Policy" is a dummy variable that equals one the week after the date of the respective monetary policy event that is provided in the table, and zero in the week before the given event. "Cross-border" is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. The definition of our main variables can be found in the Appendix Table A1. Fixed effects are included ("Yes"). Where possible a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## APPENDIX

### TABLE A1: DEFINITION OF MAIN VARIABLES

Variable	Definition
Access(i,j,t)	Binary variable that equals the value one if lender bank i engages in at least one overnight interbank transaction with borrower bank j on day t, and zero otherwise.
Amount(i,j,t)	Logarithm of the aggregate overnight interbank lending amount (in EUR million) that lender i provides to borrower j on day t.
Spread(i,j,t)	Difference (in percentage points) between the (volume-weighted) interest rate that borrower j pays to lender i for overnight interbank transactions on day t and the interest rate paid on excess reserves (EOR) on the same day t.
Access(j,t)	Binary variable that equals the value one if borrower j engages in at least one overnight interbank transaction on day t, and zero otherwise.
Amount(j,t)	Logarithm of the aggregate overnight interbank lending amount (in EUR million) that bank j borrows on day t.
Spread(j,t)	Difference (in percentage points) between the (volume-weighted) interest rates that borrower j pays for overnight interbank loans on day t and the interest rate paid on excess reserves on the same day t.
Euribor-OIS(t)	Difference (in percentage points) between the three-month Euribor rate and the correspondingly-dated overnight index swap (OIS) rate on any given day t. We scale the variable such that the lowest value in sample equals zero, and the highest value equals one.
Mean Periphery CDS(t)	Average of the logarithm of the five-year periphery country CDS spread (in basis points) on any given day t. We scale the variable such that the lowest value in sample equals zero, and the highest value equals one.
Cross-border(i,j)	Binary variable that equals the value one if lender i and borrower j are headquartered in different countries, and zero otherwise.
GIPS Bank(j)	Binary variable that equals the value one if the borrowing bank is headquartered in one of the GIPS countries, i.e., Greece, Ireland, Portugal, and Spain, and zero otherwise.
Creditor Rights(j)	Index from La Porta et al. (1998) and Djankov, McLiesh, and Shleifer (2007) that measures the protection of creditor rights in the borrower country.
Public Debt(j)	Borrower-country's public debt as a fraction of the country's GDP as of 2007 for the Lehman crisis period and as of 2009 for the sovereign crisis period.
Large Bank(j)	Binary variable that equals the value one if the borrowing bank has total asset size above the cross-sectional median as at 2007 (2009) for the Lehman crisis period (sovereign crisis period), and zero otherwise.
High Leverage Bank(j)	Binary variable that equals the value one if the borrowing bank has a leverage ratio above the cross-sectional median as at 2007 (2009) for the Lehman crisis period (sovereign crisis period), and zero otherwise.
Large GIPS Bank(j)	Binary variable that equals the value one if the borrowing bank is a GIPS bank and has total asset size above the cross-sectional median as at 2007 (2009) for the Lehman crisis period (sovereign crisis period), and zero otherwise.
High Leverage GIPS Bank(j)	Binary variable that equals the value one if the borrowing bank is a GIPS bank and has a leverage ratio above the cross-sectional median as at 2007 (2009) for the Lehman crisis period (sovereign crisis period), and zero otherwise.
Monetary Policy(t)	Binary variable that equals the value of one on any day after the respective monetary policy change, and zero in the week before. We consider the three main expansionary monetary policy enacted over our two crisis periods: during the Lehman crisis, (i) the fixed-rate full allotment (Full Allotment), and during the sovereign debt crisis, (ii) the two 3-year long-term refinancing operations (First 3-Yr LTRO), (iii) and Draghi's "whatever-it-takes" speech including the related outright monetary transactions (OMT announcement) program.
Full Allotment(t)	Binary variable that equals the value one as of October 15, 2008, when the Eurosystem implemented the fixed-rate full allotment policy and, zero on any other day.
First 3-Yr LTRO(t)	Binary variable that equals the value one as of October 21, 2011, when the Eurosystem implemented the first 3-year LTRO, and zero on any other day.
Second 3-Yr LTRO(t)	Binary variable that equals the value one as of February 29, 2012, when the Eurosystem implemented the second 3-year LTRO, and zero on any other day.
Draghi's Whatever-it-takes-speech(t)	Binary variable that equals the value one as of July 26, 2012, when the Draghi gave his "whatever it takes" speech, and zero on any other day.
OMT announcement(t)	Binary variable that equals the value one as of August 2, 2012, when the ECB announced the outright monetary transactions (OMT) program, and zero on any other day.

**TABLE A2: SUMMARY STATISTICS DEPENDING ON CROSS-BORDER AND DOMESTIC LENDING**

<b>PANEL A: CROSS-BORDER</b>												
<b>Variable</b>	<b>Lehman Crisis</b>						<b>Sovereign Crisis</b>					
	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>	<b>Obs</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>	<b>Obs</b>
Access	5.23	0.00	22.27	0.00	0.00	108,780	1.27	0.00	11.18	0.00	0.00	2,462,496
Loan Amount	198.19	100.00	235.17	24.48	500.00	3,610	268.05	150.00	370.61	45.00	600.00	14,626
Amount	4.72	4.61	1.13	3.20	6.21	3,610	5.00	5.01	1.08	3.81	6.40	14,626
Spread	0.88	1.01	0.32	0.25	1.10	3,611	0.22	0.14	0.22	0.02	0.55	14,626
<b>PANEL B: DOMESTIC</b>												
<b>Variable</b>	<b>Lehman Crisis</b>						<b>Sovereign Crisis</b>					
	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>	<b>Obs</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>	<b>p(10)</b>	<b>p(90)</b>	<b>Obs</b>
Access	8.37	0.00	27.70	0.00	0.00	79,380	3.41	0.00	18.16	0.00	0.00	1,789,920
Loan Amount	109.27	50.00	239.95	10.00	200.00	3,738	131.75	50.00	266.94	10.00	300.00	23,668
Amount	3.95	3.91	1.18	2.30	5.30	3,738	3.94	3.91	1.29	2.30	5.70	23,668
Spread	0.80	1.00	0.39	0.12	1.13	3,738	0.23	0.13	0.24	0.02	0.58	23,668

This table reports summary statistics of our dependent variables used in the paper conditional on cross-border and domestic trades, across two sub-periods. We define “Lehman Crisis” (August 18, 2008, to November 9, 2008, daily frequency), and “Sovereign Crisis” (July 1, 2009, to December 31, 2014, daily frequency). “Access” denotes the extensive margin of credit. “Loan Amount” reflects the loan volume (in EUR million), “Amount” refers to the logarithm of “Loan Amount”. “Spread” reflects the difference (in percentage points) between the interest rate of a loan and the interest rate paid on excess reserves (IOER). For a thorough description of the dependent variables, refer to Section 3.

**TABLE A3: MONETARY POLICY AND HETEROGENEITY IN CROSS-BORDER LENDING**

Sample: +/- 1 Week Around Monetary Policy Event					
Dependent Variable: Access					
Monetary Policy Event:	Full Allotment	First 3-Yr LTRO	Second 3-Yr LTRO	Draghi's Whatever-It-Takes-speech	OMT Announcement
	(October 15, 2008)	(December 21, 2011)	(February 29, 2012)	(July 26, 2012)	(August 2, 2012)
PANEL A - Dependent Variable: Access	(1)	(2)	(3)	(4)	(5)
Monetary Policy * Cross-border	5.2661*** (2.93)	-1.0730 (-0.70)	3.6801* (1.85)	0.0577 (0.01)	4.0547 (0.83)
Monetary Policy * Cross-border * GIPS Bank	0.8742 (0.27)	-5.2566** (-2.30)	7.2238* (1.70)	1.0270 (0.12)	-1.2159 (-0.12)
Monetary Policy * Cross-border * Creditor Rights	-0.9751 (-1.06)	0.3853 (0.50)	0.4858 (0.53)	0.1106 (0.01)	0.2492 (0.03)
Monetary Policy * Cross-border * Public Debt	0.0069 (0.14)	0.0295 (0.88)	0.0630 (1.01)	0.0445 (0.31)	-0.0606 (-0.34)
Monetary Policy * Cross-border * Large Bank	-3.6679** (-2.12)	0.1684 (0.12)	-2.5063 (-1.48)	2.4461* (1.75)	-0.3545 (-0.18)
Monetary Policy * Cross-border * High Leveraged Bank	-1.8049 (-1.03)	1.0652 (0.77)	-0.0255 (-0.01)	0.8226 (0.41)	-0.8898 (-0.35)
Borrower * Time FE	Yes	Yes	Yes	Yes	Yes
Lender * Time FE	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	27,760	22,280	15,642	14,443	11,910
R-squared	0.552	0.551	0.51	0.619	0.631

This table shows the impact of the Eurosystem's main monetary policy measures on the cross-border differential in the extensive depending on borrowing bank heterogeneity. For identification, we use a window of +/- 1 week around the respective monetary policy event. The dependent variable is a dummy variable that equals one if lender bank *i* grants an overnight loan to borrower bank *j* on day *t*, and zero otherwise. The independent variable "Monetary Policy" is a dummy variable that equals one the week after the date of the respective monetary policy event that is provided in the table, and zero in the week before the given event. "Cross-border" is a dummy variable that equals one if lender bank *i* and borrower bank *j* are headquartered in different countries, and zero otherwise. The definition of our main variables and "GIPS", "Creditor Rights", "Public Debt", "Large Bank", and "High Leverage Bank" can be found in the Appendix Table A1. Fixed effects are included ("Yes"). Where possible a constant is included but its estimated value is not shown to avoid cluttering. Robust standard errors are presented in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .