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Market microstructure, banks' behaviour, and interbank spreads

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Abstract

We present an empirical analysis of the European electronic interbank market of overnight lending (e-MID) during the years 1999–2009. The main goal of the paper is to explain the observed changes of the cross-sectional dispersion of lending/borrowing conditions before, during and after the 2007–2008 subprime crisis. Unlike previous contributions, that focused on banks' dependent and macro information as explanatory variables, we address the role of banks' behaviour and market microstructure as determinants of the credit spreads. We show that all banks experienced significant variations in their liquidity costs due to the sensitivity of borrowing and lending rates to the timing and side (quoter versus aggressor) of trades. We argue that while larger banks did experience better funding condition during the crisis this was not just a consequence of the "too large to fail" perception of the market. Larger banks have been able to play more strategically when managing their liquidity, by taking advantage of the changing market microstructure.

Keywords: Interbank lending, market microstructure, subprime crisis, liquidity management

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1. Introduction

Interbank markets play a key role in banks liquidity management and the transmission of monetary policy. Well-functioning interbank markets effectively channel liquidity from financial intermediaries with a surplus of funds to those in need, allowing for more efficient financial intermediation. Variations in interbank rates are transmitted to the entire term structure, affecting borrowing conditions for households and firms. Interbank rates provide benchmarks (e.g. the Libor, Euribor and Eonia) for the pricing of fixed-income securities and underlie derivatives contracts such as short term interest rate futures and interest rate swaps, used by banks to hedge their short-term interest rate risks. Thus, policymakers have an interest in having a financial system with an efficient interbank market, that is, one in which the central bank can achieve its desired rate of interest and one that allows institutions to trade liquidity minimizing transaction costs and information asymmetries.

In normal times, interbank markets are among the most liquid in the financial sector and the financial literature has historically devoted a relatively low consideration to the interbank market due to the short-term nature of the exchanged deposits. Banks have accepted non-collateralized loans as counterparties were considered safe and sound enough and liquidity risk has been perceived as marginal due to the central bank role as lender of last resort. However, during the 2007–2008 financial crisis liquidity in the interbank market has considerably dried up, even at short maturities, and an increasing dispersion in the credit conditions of different banks has emerged. These events have triggered a new interest in interbank markets. The dramatic change of volumes and active banks following the subprime crisis can be hardly explained as a real reduction of liquidity need by banks. A number of papers in the literature have addressed the causes of this "market freeze" and in particular compared the two hypotheses of liquidity hoarding versus credit monitoring (Heider et al., 2009; Acharya and Merrouche, 2010; Gale and Yorulmazer, 2011). On the demand side, a possible explanation for the crunch suggested by Cassola et al. (2010) was adverse selection, with banks preferring not to reveal their needs for liquidity, which could lead to credit rationing, and switching from a highly transparent electronic market to more opaque over-the-counter trades.

On the empirical side, a number of investigations of the interbank market microstructure before the crisis has been carried out. The US Federal Funds market was studied by Hamilton (1996) and Furfine (2000, 2001, 2002). Beaupain and Durré (2008) presented a comprehensive analysis of the dynamics of the Euro overnight money market using data until April 2007. They uncovered regular seasonal patterns of market activity and liquidity, as well as patterns determined by the Eurosystems operational framework. Iori et al. (2008) studied the evolution of the network topology of the e-MID within maintenance periods in the years 1999–2002, by applying methods of statistical mechanics. They showed that a large number of small/medium size banks tend to be liquidity providers, and lend to a small number of large banks; strategic behaviour, in terms of preferential and speculative lending, tends to be rather limited in e-MID. Baglioni and Monticini (2008a,b) showed the presence of an intraday term structure of interest rates, as the overnight rate displays a clear downward pattern throughout the trading session, with banks borrowing at a premium early in

the morning and at a discount at the end of the day.

An increasing number of studies has analysed how the financial crisis has affected the credit conditions of banks in the interbank market. Angelini et al. (2011) analysed the spreads between uncollateralized e-MID rates and collateralized Eurepo rates on maturities from one week to 12 months. They observe that the mean spread increases and the distribution becomes more disperse during the crisis. The question they address is what share of the soaring spread is due to an increased bank-specific default risk and what to a generalized surge in risk aversion measured from the equity market. They find that before the crisis bank size is the only important borrower caracteristic to determine spreads, and large banks get better rates. During the crisis the effect of borrower creditworthiness, measured by rating and capitalization, becomes significant and sizeable, with larger banks still experiencing better borrowing conditions both before and after the Lehman collapse. Nonetheless the main determinant of the increasing spreads (two thirds of the effect) appears to be the overall increase in risk aversion. A similar effect of size on spread is found by Gabrieli (2011), who focuses on the overnight determinant of credit spreads, defined as the difference between the volume-weighted average daily interbank rate and the ECB policy rate. Her results corroborate the existence of a too-big-to-fail guarantee implicitly granted by the market to the banks with the highest volumes of business. In fact, the price benefit enjoyed by relatively bigger banks becomes much stronger after 29 September 2008, i.e. when European governments were forced to make explicit the promise that no other systemically important financial institution would be allowed to fail.

Our analysis shows that during the crisis, while some banks did better or worse than others, they all experienced a large variability of their rates over time. Such variability is not easy to explain in terms of bank-specific characteristics or idiosyncratic risks. Therefore we focus on the impact on spreads of banks behaviour, given the micro-structural features we describe in the first part of the paper. We address the question of how the changes of the cross-sectional dispersion of lending/borrowing conditions within the interbank market before, during and after the 2007–2008 subprime crisis have been affected by banks' behaviour and market microstructure as determinants of the credit spreads. While previous researches focus the role of banks' dependent and macro information as explanatory variables, the market microstructure approach allows us to show the following results. We find that the higher the volume traded by a bank in the morning, the higher are the spreads (that is borrowing conditions deteriorate in the morning for borrowers and improve for lenders) and the higher the volume traded as quoters, the better are the rates obtained, both for lenders and borrowers.

The paper is organised as follows. Section 2 describes the mechanism of the electronic interbank market and Section 3 describes the database. Section 4 describe the composition of the market. Section 5 analyses rates and cross-sectional credit spreads. In Section 6 we analyse changes in selected microstructure variables and in Section 7 we test the hypothesis that interest rates spreads may be driven by bank trading behaviour. Section 8 concludes.

2. Market mechanism

Interbank markets can be organized in different ways: physically on trading floors, by telephone calls, or on electronic platforms. In Europe, interbank trades are executed in all these ways. The only electronic market for interbank deposits in the Euro area and the USA is the e-MID (Mercato Interbancario dei Depositi). It was founded in Italy in 1990 for Italian Lira transactions and denominated in Euros in 1999. Three currencies are currently being traded: Euro, US Dollar, and GB Pound. Credit institutions (i.e. banks and electronic currency institutions) and investment companies can participate in the market if their net capital is respectively at least 10 million US Dollars (or its equivalent in another currency) and 300 million Euros (or its equivalent in another currency). When the financial crisis started, there were 246 market members from 29 EU countries and the US, of which 30 central banks and 2 Ministries of Finance acting as market observers, and 108 domestic banks and 106 international banks acting as market players. The nationalities of banks active in the e-MID are 16: Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, and Portugal[1].

The number of transactions and the trading volume increased systematically until the beginning of the financial crisis, with an average of 450 transactions each day and an exposure for each transaction of about 5.5 million Euros. According to Baglioni and Monticini (2008a), this evolution is due to the trend toward real-time settlement for payments, securities, and foreign exchange transactions that took place in recent years. This trend has increased the value of intraday liquidity. As shown by Iazzetta and Manna (2009), interbank deposits as a percentage of total assets of the banking system doubled from 8% in 1993 to approximately 16% in 2007. According to the European Central Bank (2011a), the e-MID accounted, before the crisis, for 17% of the total turnover in the unsecured money market in the Euro area. Its last report on money markets (European Central Bank, 2011a) recorded around 10% of the total overnight turnovers.

Contracts of different maturities, from one day to one year, can be traded, but the overnight segment represents more than 90% of the transactions in the e-MID. Our analysis has focused on the overnight segment (the analysis of longer maturities is in progress). Trading in e-MID starts at 8 a.m. and ends at 6 p.m. The large majority of volumes are traded in the Euro section of the market, and, more specifically, on the overnight contracts, defined as the trade for a transfer of funds effected on the day of the trade and returned at 9 a.m. of the subsequent business day.

The main difference with respect to the security market is that market participants can choose their counterparties. An operator willing to trade can pick a quote and manifest his wish to close the trade. Trades are public in terms of maturity, rate, volume, and time. While the identity of the quoting bank is normally public too (the quoter may choose to post a trade anonymously, but this option is rarely used), the identity of the aggressor can

[1]The E-Mid market, on January 2014, recorded 127 banks trading liquidity from 28 countries (92 Italian banks and 35 foreign banks). 29 Central Banks participate the market to monitor the interbank deposit size and rates. The e-Mid company is participated by 31 banks.

only be disclosed by a quoter during the negotiation phase. A quoter willing to lend capital has the option to reject an aggression, and similarly an aggressor has the additional option of not closing a trade after knowing the counterparty, if this was not public. An aggressor can also subordinate his wish of closing a trade to some specific requests, such as a larger or smaller volume or a different rate.

The e-MID thus provides a transparent platform where all parties can monitor in real time the evolution of traded rates, while benchmarks like the Libor and Euribor, as seen by the recent Libor fixing scandal, can be easily manipulated.

3. Data set

The data base is composed by the records of all transactions registered in the period 01/1999–12/2009. Each line contains a code labeling the quoting bank, i.e. the bank that proposes a transaction, and the aggressor bank, i.e. the bank that accepts a proposed transaction. The rate that the lending bank will receive is expressed per year; the volume of the transaction, i.e. the amount of lent money, is expressed in millions of Euros. A label indicates the side of the aggressing bank, i.e. whether the latter is lending/selling ("Sell") or borrowing/buying ("Buy") capitals to or from the quoting bank. Other labels indicate the dates and the exact time of the transaction. Moreover, the records specify the type of contract the two banks are trading. The main difference between contracts is the length of the lending period. We consider only the overnight ("ON") and the overnight long ("ONL") contracts. The latter is the version of the ON when more than one night/day is present between two consecutive business days, e.g. on weekends. While we do not know the identity of the banks, each bank is identified by a unique code, so we can follow banks activity over time. We additionally know the banks country of origin and, for Italian banks, their size (measured as total assets). The acronyms of the data provider are "MA" for major, "LA" for large, "ME" for medium, "SM" for small, "MI" for minor, "FB" for a foreign bank. Italian legal entities belonging to foreign banking groups appear in the database as domestic. We checked that the size classification was stable over time with the exception of a few banks that were removed form the sample.

The database does not provide information on the state of the book, its dynamics and how the banks use this information when acting on the market. A dataset similar to ours was the object of a number of past studies (Masi et al., 2006; Gaspar et al., 2007; Iori et al., 2007; Iori and Precup, 2007; Iori et al., 2008; Baglioni and Monticini, 2008a,b; Angelini et al., 2011; Brunetti et al., 2011; Delpini et al., 2013; Beaupain and Durré, 2013; Fricke et al., 2014), while Brousseau and Manzanares (2005) performed a study using the full book information.

4. E-MID market composition

In this section we describe how participation in the e-Mid market has evolved since its start, in 1999, till the end of 2009.

Table 1: Banks active as borrowers per group per year.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
MA	6	7	7	6	6	6	6	6	6	4	4
LA	12	12	8	7	9	7	7	9	9	6	5
ME	26	26	26	23	17	14	13	13	12	12	10
SM	68	64	74	61	57	52	53	58	54	53	51
MI	76	59	33	31	28	26	26	14	16	20	19
FB	2	13	20	31	48	54	60	59	62	58	39

Table 2: Banks active as lenders per group per year.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
MA	6	7	7	6	6	6	6	6	6	4	4
LA	12	12	8	7	9	7	7	9	9	6	4
ME	26	26	26	23	18	14	13	13	11	11	10
SM	75	65	76	66	60	58	55	62	58	54	55
MI	91	70	44	39	34	35	33	17	20	22	22
FB	3	11	21	32	48	57	61	66	70	70	45

The composition of the market in terms of active banks belonging to different groups is summarised in Tables 2 and 3, separately for lenders and borrowers. In Fig. 1, we plot the average daily lending and borrowing volume per group and in Fig. 2 the net trading volume per group. Figure 1 shows that the five Italian groups, while composed of very different numbers of banks, have a similar market share. Participation of foreign banks has fast increased since the opening of the market and just before the crisis the foreign banks shared, almost equally, the market with the Italian banks. Since 1999 the positions of some of the groups changed from being net borrowers to net lenders and vice versa (Fig. 2). In particular during the crisis the minor (MI) banks acted as the main net lenders to the system, while the large (LA) and medium (ME) banks were the main net borrowers. Small (SM) banks had a more balanced position, but predominantly acted as net lender before and during the crisis. Major (MA) banks acted as net borrowers during the first part of the crisis, but their net position became erratic after the Lehman default. Foreign banks (FB) acted as net borrowers until 2005, but took a more balanced position during the crisis, acting predominantly as net lenders.

The average number of active banks in each day is reported in Fig. 3 separately for quoters (left) and aggressors (right). Three long-term trends are apparent. First, from 1999 to 2004, the number of active banks decreases for two reasons: the market was basically domestic, and that period was characterised by a lower number of medium and large banks, due to mergers and acquisitions; From 2004 to mid 2007, the markets become more internationally oriented,

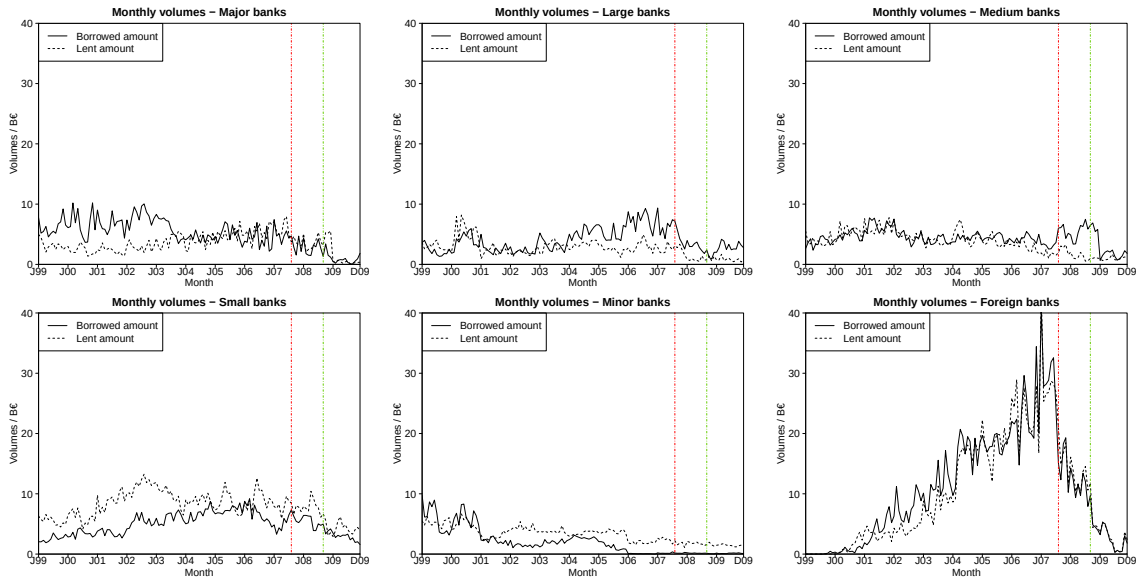

Figure 1: Average daily volume per maintenance period per group as lender (dashed line) and borrower (continuous line).

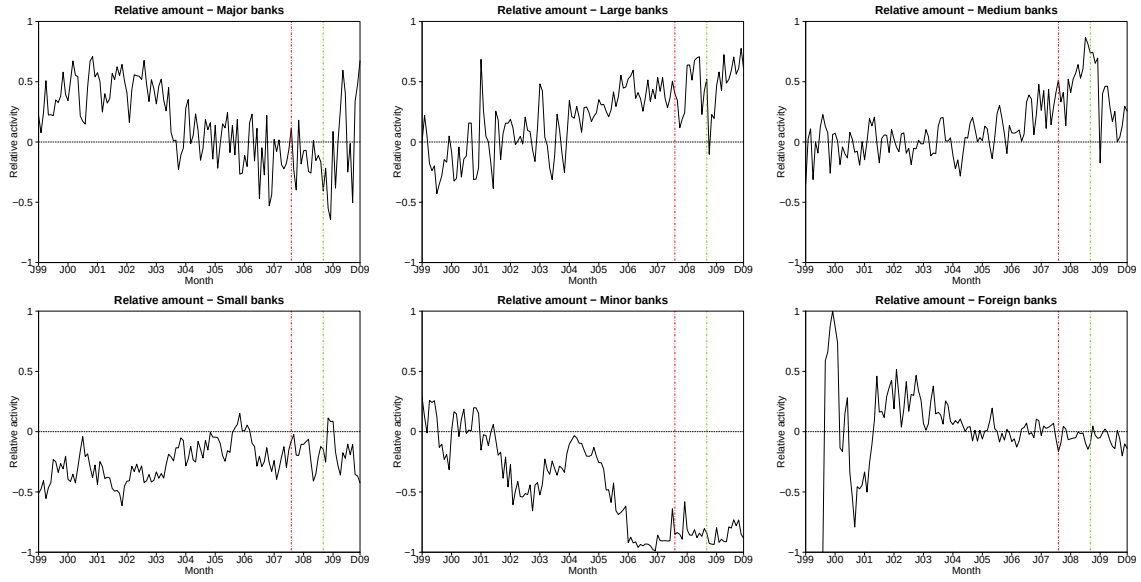

Figure 2: Net percentage traded volume per group as lender and borrower.

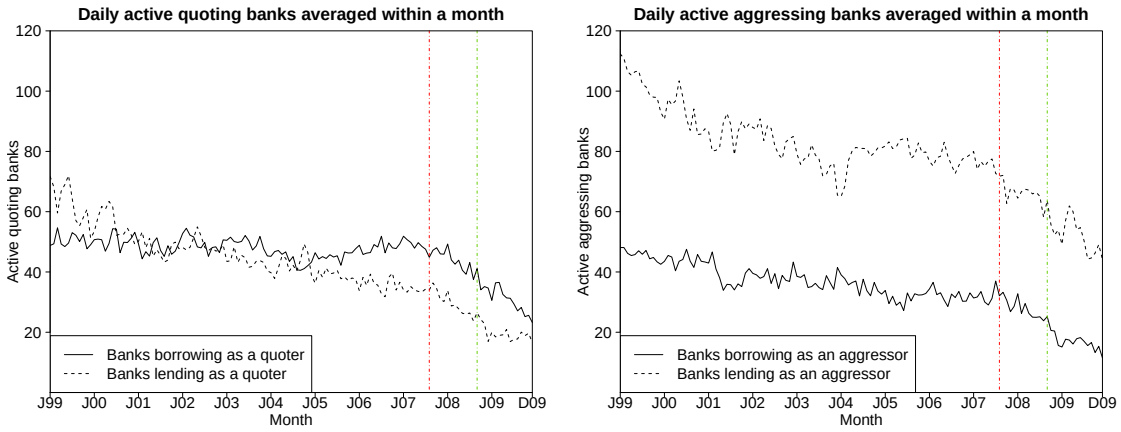

Figure 3: Left: average of the daily number of quoter banks in a maintenance period. Right: average of the daily number of aggressor banks in a maintenance period. In both cases transactions have been separated into lending and borrowing.

and the number of foreign banks equalsled the number of domestic ones. This period is characterized by a constant number of daily active banks, around a monthly average of 130 agents. After the beginning of the crisis, the number of active banks dropped below 80. On the quoter side we observe that the number of lending banks declined steadily between 1999 and 2009, while the number of borrowing banks surged between 2005 and 2007 but declined faster after the summer of 2007. The majority of banks act as aggressor when lending (see Figure 3 (right)). This asymmetry is confirmed at the intraday scale. More than 70% of the quotes are to borrow (in terms of number (left) and volume (right) of transactions), a proportion that increases on average with the time of the day, as shown in Fig. 4, for three different periods (defined in Table 2).

The decline in market turnover during the crisis can potentially generate endogeneity problems due to self-selection issues. During periods of financial distress in fact banks with funding constraints may prefer to trade over the counter to avoid signalling their liquidity shortages. Our estimates are conditional on banks trading in the e-MID market, and thus our panel does not correspond to an unconditional i.i.d. sample of the entire spectrum of banks in the European interbank money market but to an i.i.d. sample of the banks trading in the e-MID electronic platform. Given the purpose of the paper, that is is to uncover banks responses to microstructure factors, the electronic segment of the interbank market is the best candidate for our analysis thanks to its homogeneous microstructure features.

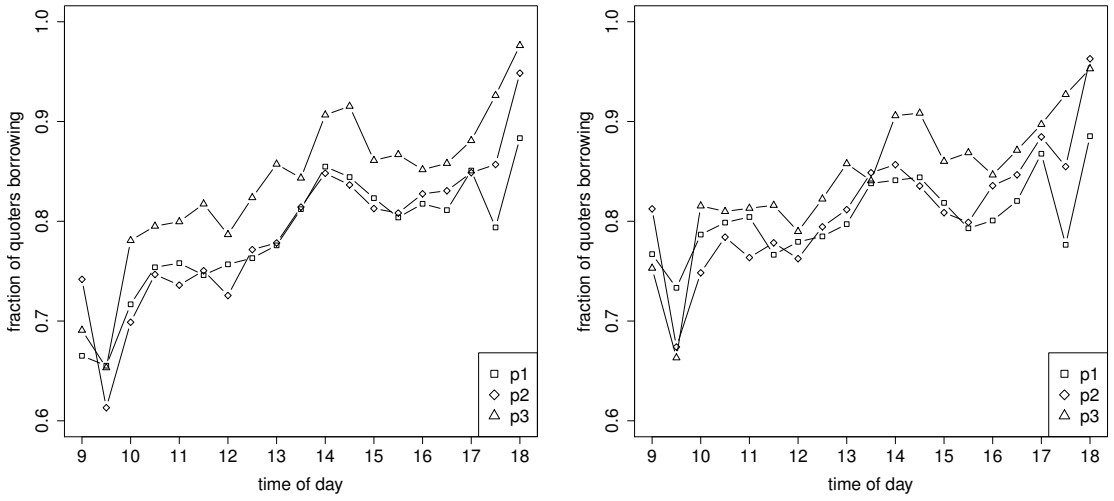

Figure 4: Left: intraday average fraction $N^{\mathrm{b}}/(N^{\mathrm{b}}+N^{\mathrm{l}})$ of number of borrower quotes over all quotes. Right: intraday average fraction $V^{\mathrm{b}}/(V^{\mathrm{b}}+V^{\mathrm{l}})$ of volume of borrower quotes over all quotes. The three curves correspond to the 3 periods p1, p2, p3 defined in Table 2.

5. Rates and spreads

In this section we focus on market rates, cross-sectional spreads and their volatility. We compute the volume-weighted mean rate as

$$r_d = \frac{1}{V_d} \sum_{j=1}^{N_d} \sum_{i=1}^{N_{j,d}} V_{i,j,d}\, r_{i,j,d}, \tag{1}$$

where $V_{i,j,d}$ and $r_{i,j,d}$ are the volume and rate of transaction i of bank j in day d, $N_{j,d}$ is the number of transactions of bank j in day d, and $V_d = \sum_{j=1}^{N_d} \sum_{i=1}^{N_{j,d}} V_{i,j,d}$ is the total trading volume of all N_d banks active in day d.

The volume-weighted mean rate, together with the ECB key rates for the considered period[2] are plotted in Fig. 5 (left panel). The extreme uncertainty of interest rate levels during the crisis is highlighted by the daily volatility shown in Fig. 5 (right panel). Volatility

[2]ECB rates are defined as follows (European Central Bank, 2011b): **Marginal lending facility rate (EuroMLR):** the rate fixed by the ECB for operations where counterparties can use the marginal lending facility to obtain overnight liquidity from the National Central Banks (NCBs) against eligible assets. The interest rate on the marginal lending facility normally provides a ceiling for the overnight market interest rate. **Main refinancing facility operations (EuroRPS):** rate of regular liquidity-providing reverse transactions with a frequency and maturity of one week. They are executed by the NCBs on the basis of standard tenders and according to a pre-specified calendar. The main refinancing operations play a pivotal role in fulfilling the aims of the Eurosystem's open market operations and normally provide the bulk of refinancing to the financial sector. **Deposit facility rate (EuroDEP):** counterparties can use the deposit

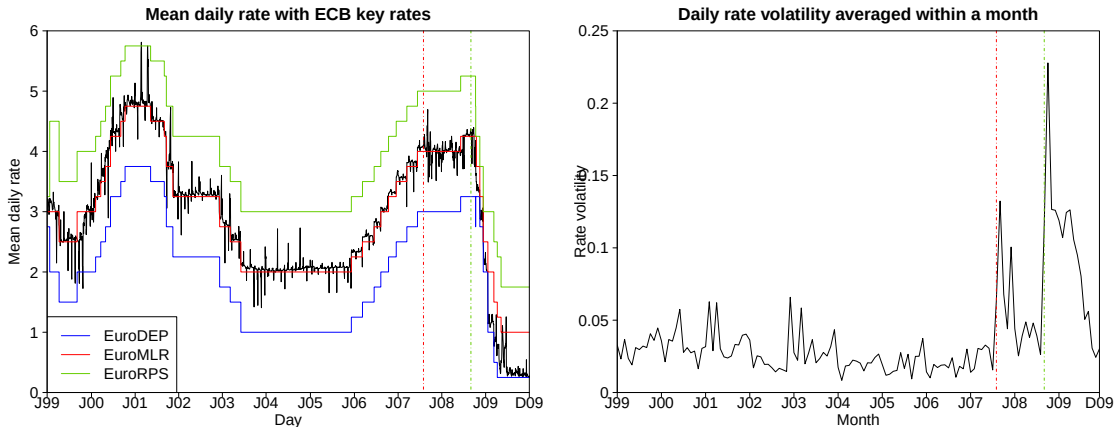

Figure 5: Left: mean daily rate, in each analysed trading day, and ECB key rates. Right: Daily rate volatility averaged within a maintenance period. The vertical lines indicate the Central Banks coordinate intervention to increase liquidity (August 2007) and the collapse of Lehman Brothers (September 2008).

(averaged within a maintenance period[3]) has reached two peaks (respectively 3 and 6 times the previous volatility average) in July 2007 and after the Lehman Brothers bankruptcy.

In the remaining of the paper we concentrate our analysis around the subprime crisis and the three equal periods, of 440 days each, defined in Table 3: p1preceding the crisis, p2 coinciding with the first outburst of the crisis up to the Lehman default.[4]

To assess whether some banks are able to borrow or lend money at a better rate than others, we define the average daily credit spread $c_{j,d}$ for each bank j in day d, as

$$c_{j,d} = \frac{1}{V_{j,d}} \sum_{i=1}^{N_{j,d}} V_{i,j,d}(r_{i,j,d} - r_d), \tag{2}$$

facility to make overnight deposits with the NCBs. The interest rate on the deposit facility normally provides a floor for the overnight market interest rate.

[3]Credit institutions in the Euro area are required to hold minimum reserve balances with NCBs that have to be fulfilled only on average over a one-month maintenance period. Until the beginning of 2004 the maintenance period used to run from the 24th of a month to the 23rd of the following month. This has changed and now the exact dates are announced by ECB every month in advance.

[4]We choose mid June as the flare up of the crisis period, as this coincides with Bear Stearns & Co informing investors in two of its CDO hedge funds, the High-Grade Structured Credit Strategies Enhanced Leverage Fund and the High-Grade Structured Credit Fund, that it was halting redemptions. This event was followed in mid July by Moody's downgrading 131 ABS emissions backed by subprime residential mortgages, followed on July 30 by Germany's IKB reporting substantial losses and revealing that its main shareholder, KfW, had assumed its financial obligations; on August 9 by French investment bank BNP Paribas suspending three investment funds that invested in subprime mortgage debt, and on August 10 by central banks coordinate efforts to increase liquidity for the first time after September 11. The crisis period p2 also includes the Northern Rock run occurred in mid September 2007 and the Bear Sterns default in mid March 2008 (European Central Bank, 2011b), and p3 following the Lehman default.

Table 3: The three periods in yyyy-mm-dd format.

	Start	End
Pre-crisis (p1)	2006-06-15	2007-06-12
Subprime (p2)	2007-06-13	2008-10-07
Lehman (p3)	2008-10-08	2009-12-07

where $V_{j,d} = \sum_{j=1}^{N_d} V_{i,j,d}$ is the total volume traded by bank j in day d, and the other variables have been introduced in Eq. (1). If a bank participates, in a given day, in both borrowing and lending transactions, two separate credit spread coefficients $c^{\mathrm{b}}_{j,d}$ and $c^{\mathrm{l}}_{j,d}$ can be defined. The credit spreads so defined provide a measure of the ability of a bank to borrow or lend at competitive rates relatively to the mean rate observed in that day in the same market. Thus the spread does not depend on specific features of the interbank market with respect to other markets, such as when the spread in the uncollateralized market is defined by using a collateralized market as reference. Fig. 6 (top panels) shows the quantile plots of the cross-sectional daily borrowing and lending spreads. The figure clearly indicates that while, before the crisis, banks were experiencing similar credit conditions with respect to each other, during the crisis much more variation was observed among borrowers and lenders, with a peak in correspondence of the Lehman default. In fact the cross-sectional mean spreads become negative in p3 indicating that several banks were experiencing better than average borrowing conditions (and worse than average lending conditions), but for a few banks in the tails trading happened on much worse terms. As mentioned before, there has been a considerable effort in the literature to explain this variation, and size has been identified as the main bank-specific factor to drive banks' spreads (Angelini et al., 2011; Gabrieli, 2011). Nonetheless during the financial turmoil all banks have experienced a high variability in their borrowing and lending rates. Indeed the first contribution of our analysis is to show that not only the volatility of the average e-MID rate increased during the crisis, as already seen in Fig. 5, but that the borrowing and lending spreads of individual banks experienced a large variability too.

We calculate the volume-weighted variance of each bank as

$$\mathrm{Var}(c_{j,m}) = \frac{1}{V_{j,m}} \sum_{d=1}^{N_m} \sum_{i=1}^{N_{j,d}} V_{i,j,d}(r_{i,j,d} - r_d)^2 - \left[\frac{1}{V_{j,m}} \sum_{d=1}^{N_m} \sum_{i=1}^{N_{j,d}} V_{i,j,d}(r_{i,j,d} - r_d) \right]^2 , \qquad (3)$$

where $V_{j,m} = \sum_{d=1}^{N_m} \sum_{i=1}^{N_{j,d}} V_{i,j,d}$ is the number of transactions of bank j in a maintenance period m of N_m days. The quantile plot of the variance of the cross-sectional spreads of individual banks, separately for borrowing and lending transactions is shown in Fig. **??**. The figure shows how the cross-sectional mean (and variance) of spreads variances considerably increased during the crisis, in particular after the Lehman default. Notably, while the spreads themselves do not show significative changes ahead of the summer 2007, the cross-sectional

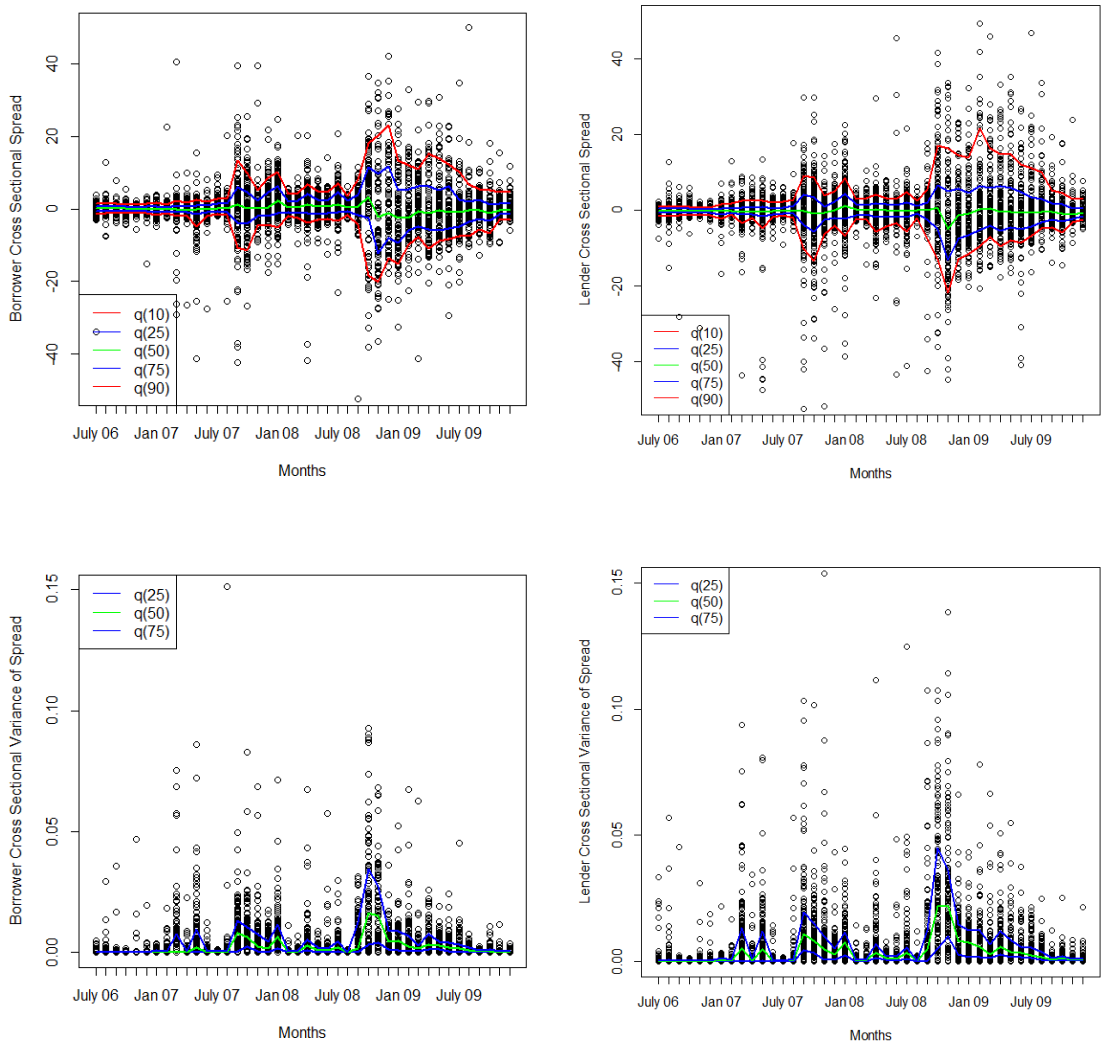

Figure 6: (Top) Cross-sectional spreads for borrowers (left) and lenders (right). (Bottom) Cross-sectional variance of spread variance for borrowers (left) and lenders (right).

variance presents a significant pick in the early months of 2007, providing in this way the first early warning signal of the forthcoming crisis. In Fig. 6 (bottom panels) we show the box plots of spreads for the different groups in the 3 periods. It appears that the Major banks obtained the lowest borrowing spreads and the Large banks the highest lending spreads (in p1 and p2) on average. Nonetheless these two groups experienced a variability comparable, if not larger, to that of the other groups.

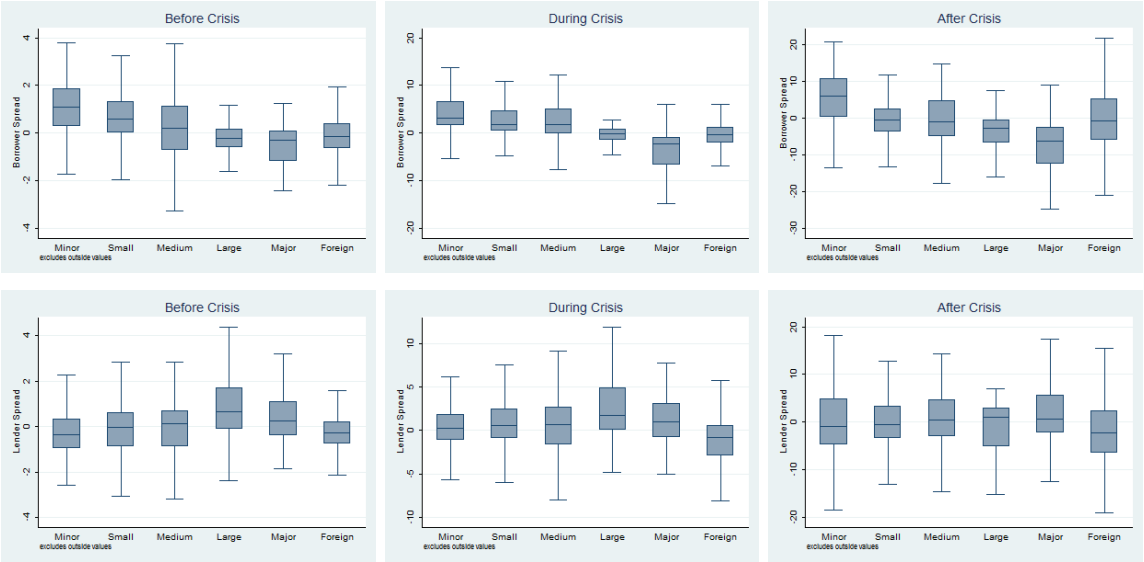

Figure 7: Borrowers (top panels) and lenders (bottom panels) spread for different groups of banks in p1, p2, p3.

Moreover, banks' good and bad performances were not consistent over time. As a measure of consistency of bank performance we measure the autocorrelation of lending and borrowing credit spreads in trading time units (banks differ substantially in term of size and frequency of trades, with some banks settling only a few trades in a year and others trading several times a day). We estimate the cut-off lag as the first time lag at which the autocorrelation becomes statistically not significant (at significance level 5%). The meaning of this measure is to identify the continuity of banks' behaviour either as a borrower or as a lender. We then compare the cut-off point to the bank trading frequency, that is the average number of days a bank is active (as a borrower or as a lender) in a maintenance period.

In Fig. 8 we plot, for each bank, the ratio of the bank cut-off point to its trading frequency versus its average credit spread. The horizontal line at 0 and the vertical line at 1 separate the phase space into four regions. The left quadrants Q1 and Q4 contain banks whose performance autocorrelation is shorter than a maintenance period, while the right quadrants Q2 and Q3 identify banks with a performance autocorrelation longer than a maintenance period. The figure shows that, as the crisis progressed from p1 to p3, banks' performances became more diversified and banks were locked for longer in their patterns of over- or under-performance. Nonetheless, only very few borrowers and lenders experienced

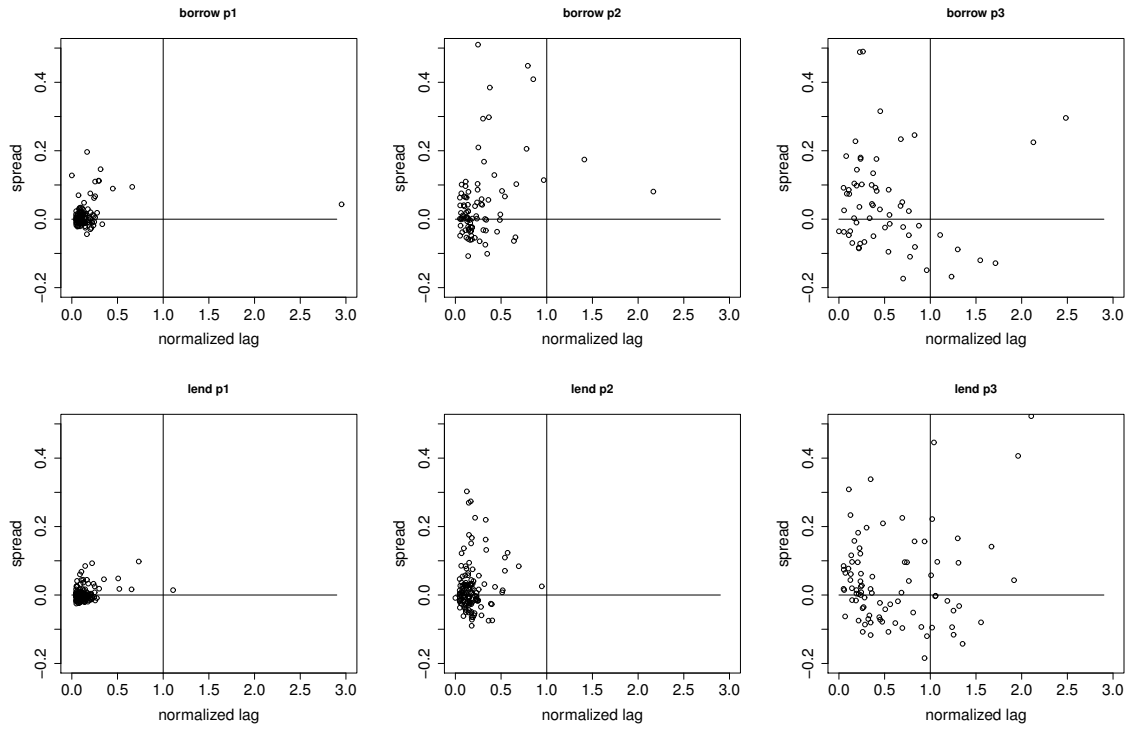

Figure 8: Cut-off lag (normalised by mean participation in maintenance period) versus bank borrowing (top) and lending (bottom) spreads (y-axis) for p1, p2, p3.

autocorrelations beyond a single maintenance period. If spreads were determined by bank-specific characteristics, such as credit rating or size, or by a consistent strategic behaviour, we would expect to find a long-term autocorrelation in their performance, that is not observable here. Thus our analysis questions whether banks' spreads may have been affected not only by idiosyncratic factors, in particular credit ones, but also by factors such as the market conditions at the time banks execute their trades.

6. Market microstructure features

In this section we identify some microstructure features that can potentially affect interbank rates. As shown in the following subsections, four features of the market changed considerably after the beginning of the crisis: the slope of the intraday rate term structure, the market bid-ask spread, the reserve requirement maintenance effect and the price impact effect.

6.1. Term structure of intraday spreads

As initially reported by Baglioni and Monticini (2008a), trading in the interbank market is more expensive the morning than in the afternoon. This is due to the implicit intraday maturity of overnight deposits, which are not expected to be reimbursed after 24 hours, but at 9 am of the day following the trade (foreign banks were allowed to settle their operations at 12 am, but only one did so). Therefore, overnight deposits traded earlier in the morning have a longer maturity and higher expected yields. In a more recent paper, Baglioni and Monticini (2008b) study the evolution of the intraday term structure during the crisis. The authors report a considerable increase in the slope of the yield curve after the default of Lehman that may create a risk-free profit opportunity (lend in the morning and borrow in the afternoon). The authors suggest that this opportunity is not arbitraged away after the crisis for two main reasons, uncertainty about availability of liquidity late in the afternoon and an increase in the implicit cost of collaterals. We calculate the intraday interest rate spread $s_d(t)$ as the difference between the instantaneous rates within a window of one hour centered around time t of day d (i.e., considering the trades performed in the 30 minutes before and after t) and the average rate of that day[5]. Fig. 9 shows the average intraday interest rate spread in p1, p2 and p3, which is in line with the results of Baglioni and Monticini (2008b).

The observation of such a slope in the term structure of overnight rates suggests the possibility of an opportunistic behaviour for banks with liquidity surplus: lend in the morning, borrow in the afternoon. Nonetheless such a strategy would entail some risk. In fact a negative slope of the rates was not observed every single day and while the average spread is lower in the afternoon, it is also more volatile as shown by the higher variance bars in

[5]Baglioni and Monticini (2008b) use the main refinancing rate as reference. We choose to estimate the spread with respect to the average market rate so that the spread is not directily affected by official rates and monetary policy decisions.

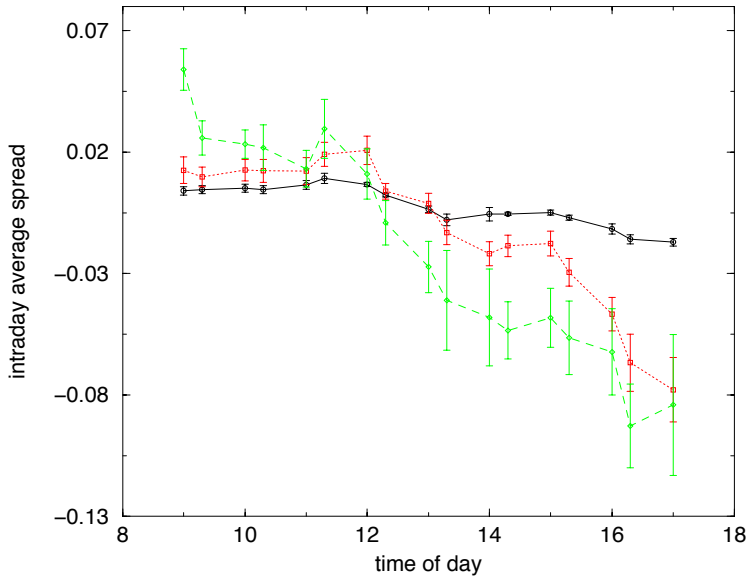

Figure 9: Intraday spread averaged over p1 (black), p2 (red) and p3 (green).

Fig. 9. Our findings suggest that while the slope of the intraday yield curve did not guarantee arbitrage opportunities it did nonetheless create opportunities for risk oriented banks to profit from the pattern of intraday rates. This raises the interesting question "Are interbank spreads affected by the banks' decisions to trade either in the morning or in the afternoon?".

6.2. Market bid-ask spread

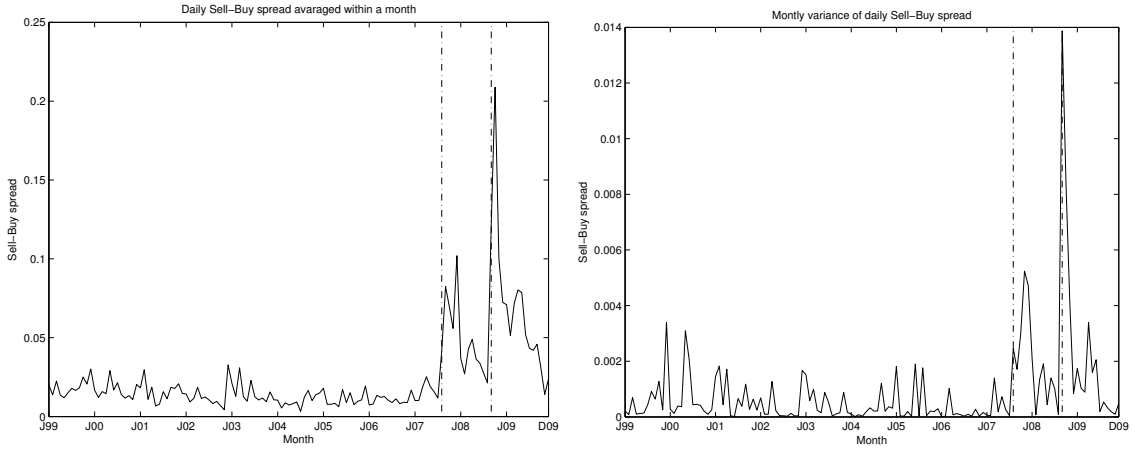

Figure 10: Monthly average of the daily sell-buy spread and its variance.

While we cannot measure the real bid-ask spread in the market because our data do not provide information on posted quotes, we construct a proxy in the following way. In each

day we calculate the volume-weighted average rates at which buy-initiated transactions and sell-initiated transactions are settled. We take the difference between these two rates as a proxy of the bid-ask spread. The daily mean values r_d^{b} and r_d^{s} are defined similarly to Eq. (1) as

$$r_d^{\mathrm{b}} = \frac{1}{V_d^{\mathrm{b}}} \sum_{j=1}^{N_d} \sum_{i=1}^{N_{j,d}^{\mathrm{b}}} V_{i,j,d}^{\mathrm{b}} r_{i,j,d}^{\mathrm{b}} \tag{4}$$

$$r_d^{\mathrm{s}} = \frac{1}{V_d^{\mathrm{s}}} \sum_{j=1}^{N_d} \sum_{i=1}^{N_{j,d}^{\mathrm{s}}} V_{i,j,d}^{\mathrm{s}} r_{i,j,d}^{\mathrm{s}}, \tag{5}$$

where the superscripts b and s distinguish among the buy and sell transactions.

The *bid-ask spread* (or *sell-buy spread*) can now be easily computed as $s_d = r_d^{\mathrm{b}} - r_d^{\mathrm{s}}$. Fig. 10 shows the evolution of its monthly average (left) and of its monthly variance (right). Two very well defined peaks are clearly present after the crisis milestones. The first non-trivial conclusion we can extrapolate from the figure is the presence of such a spread; in fact the market is not a typical limit-order book market. Moreover, the spread has dramatically increased during the crisis and two very well-defined peaks are clearly present in concomitance with the beginning of the crisis and the Lehman collapse. During the crisis, bid-ask spreads experience values higher than 200 basis points, when the usual pre-crisis level was around 3 basis points. Paradoxically, the liquidity stress seems to be absorbed just before the Lehman collapse, when the bid-ask spread drops below 5 basis points, the resistance level empirically observed before the sub-prime shock. In fact in both the landmark events, the spread trend appears to be absorbed in a few weeks, with a strong correlation with the rate volatility pattern. This is certainly due to the massive liquidity intervention of the European Central Bank, that from June 2007 to June 2010 increased its assets by about 600 billions Euros (+65%), using standing facilities, marginal lending facilities and open market operations, and easing the procedures and the eligible assets required to borrow money. The bid-ask spread effect raises the question: "Can banks can trade at a more profitable rate if they submit their orders as quoters rather than as aggressors?"

6.3. Reserve maintenance period effect

A number of authors have shown that liquidity trading is affected by the reserve maintenance period announced by the ECB rather than by calendar months. Barucci et al. (2004) and Iori et al. (2008) have provided evidence that interest rate exhibits predictable patterns at the end of the reserve maintenance period, with a consistent decrease reported at the end of the period before 2001, and a consistent increase after 2001. Beaupain and Durré (2008) shows that market activity intensifies over the reserve maintenance period with the number of trades and the realised volatility of the overnight interest rate reaching a peak on the last day of the period; the imbalance between buy and sell orders decreases markedly over the last days; the market spread follows a similar path with a decrease towards the end of the period. It is also during the last days that the deviation of e-MID transaction prices

from the actual EONIA increases. Such empirical patterns are consistent with theoretical predictions and remain valid across subsamples.

While we do not observe, for the period analysed, a consistent increase (or decrease) of interbank rates at the end of the maintenance periods, we do ask the question "Are interbank spreads affected by banks' trades executed at the end of the maintenance period?"

6.4. Price impact effect

Our sample of banks is highly heterogeneous with larger (domestic and foreign) banks trading orders of larger sizes, while smaller banks exchanging smaller volumes, as shown in Fig. 11.

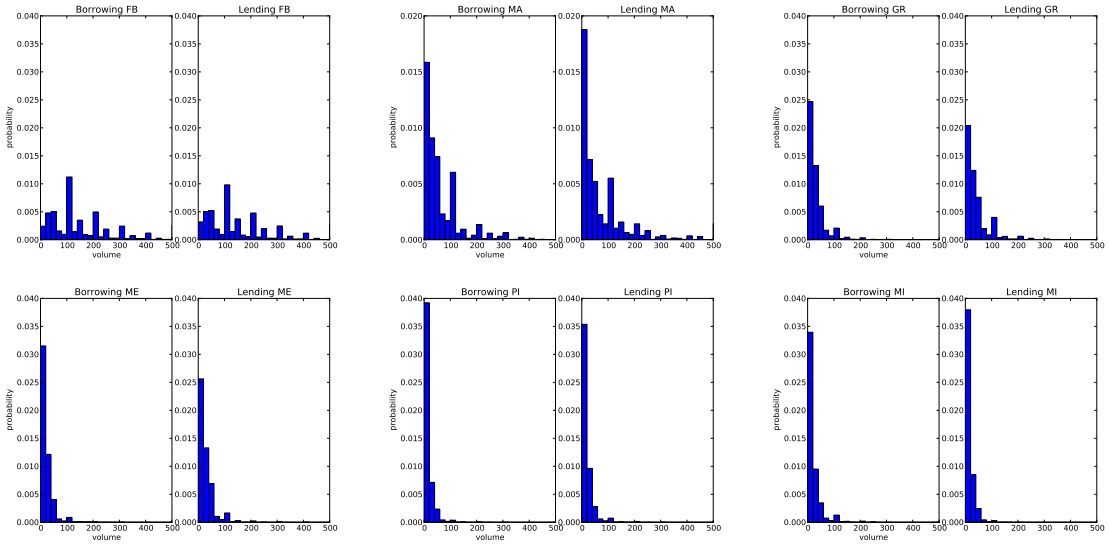

Figure 11: Distribution of order sizes for different groups of banks as borrower (left panel) and lenders (right panel).

While the price-volume hypothesis and market concentration hypothesis have been the subject of many empirical studies in securities markets (Morse, 1980; Karpoff, 1987; Campbell et al., 1993; Rosu, 2009), the effect of volume on prices has been underestimated in money markets. By investigating the role of market concentration on spreads we can test if some results that apply to equity and futures market may also be valid for credit markets. More precisely, we want to detect whether the corollary of the efficient market hypothesis, according to which large blocks of assets are traded at close to the market price, applies to the interbank market. The empirical evidence is mixed: in particular Lamont and Frazzini (2007) suggest that companies with high trading volume concentration perform better in equity market, while Bushman et al. (2011) find that volume concentration is negatively correlated to abnormal spread. During the financial crisis, the role of order size on credit rates could have changed because of the liquidity pressure on banks and the low depth of

the interbank market. Including a concentration variable allows us to address the question "Are interbank spreads affected by the size of orders relative to the overall market volume?"

7. Cross-sectional regressions

The empirical analysis presented in this section assesses the impact of the market microstructure on interbank spreads. While previous researches have focused on credit risk and monetary policy factors to explain the dynamics of interest rate spreads paid by borrowers, relatively little attention has been paid to banks intra-day and intra-maintenance period behaviour, their decision to play either as quoter or as aggressor and the concentration of their trades out of the total volume traded in the market. To assess the impact of these microstructure features we regress the average monthly credit spread (separately for borrowing and lending spreads) versus the following four variables (defined separately for borrowing and lending transactions):

1. AM/PM VOLUME (x_1), defined, for each bank, as (monthly volume traded in the morning - monthly volume traded in afternoon) / total monthly volume. This is a measure of banks' decision either to borrow or to lend money when, on average, the rate is respectively higher or lower.

2. QUOTER/AGGRESSOR VOLUME (x_2), defined as (daily volume traded as quoter - daily volume traded as aggressor) / total daily volume, is a measure of banks' decision either to borrow or to lend money as an aggressor or a quoter.

3. CONCENTRATION RATIO (x_3), defined as volume traded by a bank in a month / total monthly volume traded in the market, aims at testing the impact of order size on spread.

4. RESERVE PERIOD RATIO (x_4), defined, for each bank, as volume traded in the last three days of maintenance period/ total monthly volume. Indicates whether banks are constrained by the end of the maintenance period deadline.

Table. 4 in the Appendix reports descriptive statistics for spread and market microstructure variables for borrowers and lenders. Borrowing spread lies between -110 and 50 with an average value of 0.48 with the highest average spread observed during crisis. Lending spread lies between -118 and 81 with an average value of -0.23. On the borrowing side, while the mean value of x_1 is positive, we observe its smallest value in p2, indicating that overall banks postponed some of their borrowing activity to the afternoon, at the beginning of the crisis, in the attempt to achieve lower rates. After the Lehman default nonetheless borrowing is concentrated in the morning, probably in response to increasing liquidity pressure on banks. **On the lending side, x_1 becomes negative in p2 suggesting liquidity hoarding in the morning, in response to banks' increased uncertainty about their own liquidity needs. In p3, however, x_1 reverts to positive and reaches its highest value, indicating lenders are willing to satisfy the high demand from borrowers, that**

pushes the morning rates to very high values after the Lehman default. This behaviour may appear surprising as in the post-crisis, the European Central Bank offered unlimited amounts of liquidity at fixed rate. Nonetheless Central Bank borrowing is collateralized and, as reported by Baglioni and Monticini (2008b) the implicit cost of collaterals increased considerably during and after the crisis. The dynamics of x_1 suggests that banks found more attractive to borrow in the uncollateralized inter bank market after the crisis, and were ready to pay a premium to secure liquidity early in the trading day, rather than provide collaterals to secure Central Bank financing.

As the crisis progresses we also note a tendency for borrowers to act more often as quoters. Lastly, we observe an increase in the concentration variable (x_3) over time on both sides of the market. Variation of x_4 across the three periods are negligible.

In order to analyze the relation between spread and market microstructure variables, we performed the following pooled OLS regressions, with robust standard errors, separately for borrowing and lending banks:

$$c_{j,t} = \beta_0 + \beta_1 x_{1,jt} + \beta_2 x_{2,jt} + \beta_3 x_{3,jt} + \beta_4 x_{4,jt} + \beta_5 SM_j + \beta_6 ME_j + \beta_7 LA_j + \beta_8 MA_j + \beta_9 FB_j + u_{j,t} \tag{6}$$

where $c_{j,t}$ is the average monthly spread of bank j in time t, and x_1, x_2, x_3, x_4 represent volume,quoter/aggressor, concentration and period respectively and $u_{j,t}$ is the residual. Bank specific variables are defined as dummies with six levels (Minor, Small, Medium, Large, Major and Foreign) and the Minor group is chosen as the reference. The asset size information of the foreign banks is not available for us. The model is estimated for the three subperiods p1, p2, p3 separately.

Tables with the regression results can be found in the Appendix. Results for the baseline regressions are reported for the borrowing banks in Table. 5 and the lending banks in Table. 10.

The analysis shows that time of trading is significative and positively correlated with spreads both on the lending and the borrowing side (trading preferentially in the morning improves lender performance and reduces borrower performance) in all three periods. The coefficient of x_1 increases over time for both borrowers and lenders indicating that the effect of timing on trade becomes more determinant with the progression of the crisis.

Trading preferentially as a quoter improves the performance of both lenders and borrowers. The coefficient of x_2 increases (in absolute value) as the crisis progresses. These findings suggest that quoters have an advantage in determining interbank rates compared to aggressors. The significativeness of this variable may be due, in addition to the spread affect, to the information content of order flows. Before the crisis, the purchase of liquidity from an aggressor could have been a signal, with noise, that the aggressor believed the rate was undervalued (Rime, 2003). After the crisis, the information content may have changed and simply reveal how bank treasuries have to balance inflows and outflows.

Volume concentration is significant, and more important in p1 and p3 for borrowers, and in p2 and p3 for lenders. The sign of the coefficient of x_3, positive for borrowers and negative for lenders, indicates that volume concentration has an unfavourable price impact

effect, reducing both borrowers and lenders performances. This result is consistent with the imperfect substitutes hypothesis, which assumes that assets are not close substitute for each other. In case of large banks, the small number of counterparts and the disclosure of higher risks could have affected the rate of interbank deposits. Therefore, equilibrium rates change when demand curves shift to eliminate excess demand.

The end of maintenance period variable is significative for borrowers only after the crisis and has a positive sign thus supporting the hypothesis that banks were constrained by the reserve requirement after the crisis (in $p3$). The coefficient of x_4 is significative for lenders before and during the crisis. The negative sign indicates that hoarding liquidity, and postponing lending till the end of the maintenance period, was not a profitable strategy for lenders, at least before the Lehman default.

We confirm that size is an important variable in the determination of the interbank rate with borrowing rates decreasing, on average, and lending rates increasing, with banks size. The size effect is particularly strong for borrowers in p3. Nonetheless, size is not significative in p2, except for the Major banks. This result indicates that when market microstructure variables are controlled for, size is not as determinant as previously reported in the literature (Angelini et al., 2011; Gabrieli, 2011).

Foreign banks (that are typically large), pay higher spreads than the larger Italian banks as borrowers, and receive lower spreads as lenders, a result suggesting poor market integration in the European interbank market.

The F-test statistics reported at the bottom of in Table. 5 and Table. 10 check whether the coefficients of the market microstructure variables are jointly equal to zero or not. The statistics indicate that microstructure variables are jointly significant and enhance the explanatory power of the model.

Overall, our analysis demonstrates that spreads incorporate a liquidity risk premium (the widening bid-ask spreads and the increasing intraday slope of interest rates are indicators of liquidity shortages) in addition to a credit risk premium (that previous studies have associated with bank sizes). This corroborates the analyses of Michaud and Upper (2008) and Eisenschmidt and Tapking (2009), which both point out that after August 2007 rates reached levels that cannot be explained alone by a higher credit risk.

7.1. Robustness checks

As a robustness check, we estimate the same model as above for three different sub samples of banks. Firstly, we consider only banks which have traded at least 25 times in each of the three periods, secondly we consider the banks which have traded at least 50 times in each of the three period and lastly, we consider all banks in the sample but control for the ones that dropped out after the collapse of Lehman Brothers with a dummy variable ($p3$). This robustness check allows us to control for potential self-selection problem due to the drop in the number of banks trading in the e-MID market after the collapse of Lehman Brothers. The findings, reported in Table. 5 for borrower and Table. 10 for lenders indicate that the baseline regression results remain virtually unchanged and robust to the different samples of the dataset. Moreover, banks that drop in p3 do not appear to borrow at significantly different rates compared to the banks that remain active, suggesting that the

self-selection problem is not an issue for our analysis. On the lending side nonetheless the banks that dropped in p3 received consistently lower rates than the ones which remained. The underperformance of these banks may have provided them with an incentive to stop trading in this market.

As an additional robustness check, we also use the following panel data model with time and bank fixed effects with robust standard errors:

$$c_{j,t} = \beta_0 + \beta_1 x_{1,jt} + \beta_2 x_{2,jt} + \beta_3 x_{3,jt} + \beta_4 x_{4,jt} + u_{j,t} \tag{7}$$

$$u_{j,t} = u_j + \delta_t + e_{j,t} \tag{8}$$

The bank-fixed effect captures bank characteristics such as ownership and credit risk. The time-fixed effect captures the evolution of the market across time and common shocks that can affect all banks. While fixed effect models do not allow to estimate the coefficients for dummy variables (such as size), they provide the opportunity to check whether pooled OLS analysis gives similar results to the fixed effect model when only market microstructure variables are considered.

The results reported in Table. 6 for borrowers and in Table. 11 for lenders show that, even when controlling for bank heterogeneity, the relation between spreads and market microstructure variables remain unchanged respect to the baseline regression model.[6]

7.2. Individual groups analysis

In this section, we capture the role of the microstructure variables separately for each group, in terms of their asset size and nationality. To reduce the number of tables we report results only for the 3 periods p1, p2 and p3 combined together. Also in this case we estimate the baseline regression for all transactions and perform robustness checks with different samples of banks. The results are reported in Table. 7 for borrowers and Table 12 for lenders.

On the demand side, the time of trading is significant and positive for all groups of banks, indicating that all banks benefit from borrowing later in the day. Acting as a quoter is again significative for all groups. Banks achieve lower borrowing rates when trading on this side of the market. However, the coefficient of x_2 is negative but insignificant for major borrowers. This is possibly due to the fact that the major banks consistently execute more than 75% of their trades as quoters, thus x_2 has little variability for this group.

On the supply side, lending in the morning and lending as a quoter leads to higher lending rates for all groups of banks. Noneheless x_2 is not significative for foreign banks. The fact foreign banks do not achieve better rates when trading as quoters again suggests poor market integration.

When controlling for banks that drop in p3 we find that this variable is not significant as a determinant of the lending rates. On the borrowing side instead our analysis interestingly

[6]Temiszoy et al. (2014), performing link level rather than bank-level regressions, and show that the effect of the microstructure variable is qualitatively the same also when controlling for the identity of the counterparty to a trade as well as when including indices of preferential lending and borrowing among the regressing variables.

suggests that the smaller banks (MI and PI group) that dropped, while still in the market significatively outperformed the ones that remained active after the Lehman default. On the contrary, the large banks that dropped significatively underperformed, in p1 and p2, the ones that kept trading in p3. Thus, if there was a self selection issue, the reasons for leaving the e-MID market may have been different for banks belonging to groups of different size: adverse selection for the small ones (as suggested by Heider, Hoerova, and Holthausen (2009)), and a stigma effect associated with signalling financial distress for the larger ones.

7.3. Strategic behaviour

The aim of this session is to establish whether some banks were able of profit more than others from the changing microstructure conditions by trading more strategically. In particular we focus on the variables x_1 and x_2, that we treat here as the dependent variables, and test if their values changed significantly across groups and in which direction.

We estimate the following pooled OLS model with robust standard errors, for borrowers and lenders separately:

$$x_{1,jt} = \beta_0 + \beta_1 SM_j + \beta_2 ME_j + \beta_3 LA_j + \beta_4 MA_j + \beta_5 FB_j + u_{j,t} \quad (9)$$

$$x_{2,jt} = \beta_0 + \beta_1 SM_j + \beta_2 ME_j + \beta_3 LA_j + \beta_4 MA_j + \beta_5 FB_j + u_{j,t} \quad (10)$$

The regression outputs reported in Table 8 for borrowers indicate that only Major and Foreign borrowers performed the majority of their trades in the afternoon. While both groups increased the proportion of afternoon trades in p2, only the Major banks to increase it even further in p3. Foreign banks did not manage to do so and reverted to the pre crisis level of afternoon trading in p3. The positive and significant coefficients for the Minor banks reveal on the contrary that they mainly borrowed in the morning, thus paying higher rates. On the lending side, as reported in Table 13, Minor banks lend preferentially in the morning, achieving higher rates, and Foreign banks in the afternoon, achieving lower rates. Overall there is a tendendency to hoard liquidity the morning in p2.

The sign of the coefficients of the variable x_2 reported in Table 9 for borrowers and in Table 14 for lenders reveals that, a part from the minor banks, borrowers prefer trading as quoters and lenders all prefer trading as aggressors. On the lending side the effect becomes even more clear with the progressing of the crisis. The larger Italian banks and Foreign banks achieved the largest proportion of borrowing trades as quoters thus achieving better rates. On the lending side the Major baks achieved the largest proportion of trades as quoters in p1 and p2 but in p3 it is the Minor and Small banks trading more often as aggressor.

Our findings indicates that, in addition to the too-big-to-fail argument, the favourable borrowing and lending conditions of larger banks have partly been the result of a more strategic liquidity management. On the lending side we observe that foreign banks have not been able to optimise their strategies (small or negative x_1 and x_2 indicate too much lending in the afternoon and as aggressors, which is less profitable). As mentioned by Cassola et al. (2010), this observation confirms a poor market integration on this side of the market, with foreign banks lending mostly to other foreign and large Italian banks that, as seen before, tend to borrow later in the afternoon.

8. Conclusions

In this paper we have investigated the impact of the 2007–2009 financial crisis on the behaviour of banks within the interbank market and, in turn, on their lending and borrowing spreads. Running econometric analyses we have highlighted the role of the changing intraday term structure of interest rate and of the market bid-ask spread as explanatory variables for the variability in credit conditions. In particular our results show that the higher the volume traded by a bank in the morning, the higher are the spreads (that is borrowing conditions deteriorate in the morning for borrowers and improve for lenders) and the higher the volume traded as quoters, the better are the rates obtained, both for lenders and borrowers.

While our analysis confirms that larger banks did perform better during the crisis, we identify the reasons for their success. The larger banks are the ones who better responded to the changing market microstructure condition and optimised their trades so to reduce the liquidity costs. Their better performance was actively achieved by a sophisticated liquidity management and not the result of the market participants perceiving them as too big to fail.

The policy implications of our findings are as follows. To reduce the volatility of interbank market rates, central banks should provide liquidity by calibrating their interventions according to the intraday term structure slope. Since the slope depends on expected short rates, central banks can fine-tune how they provide liquidity playing as market makers continuously during the trading day, coherently with the real-time gross settlement of the payment system.

The interest rate volatility stabilization and spread normalization could be pursued introducing overnight deposits expiring after 24 hours. This way the liquidity settlement would be distributed along the day, avoiding the concentration of all the interbank trades early in the morning. This innovation could go along with the introduction of intraday deposits, completing the Arrow-Debreu market structure.

Finally, the evidence about the dependence of interest-rate spreads on banks' behavior supports a revision of their liquidity-management practice. Banks' treasuries should try to manage and net their financial balances by optimizing costs and returns according to the features of the market microstructure, such as timing their trades, adjusting the concentrations of volumes, possibly via pooling operations, and choosing strategically the quoter/aggressor side to lend and borrow money.

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Appendix: Regression results

Table 4: Descriptive Statistics

		Borrower				Lender			
		All Periods	**Period 1**	**Period 2**	**Period 3**	**All Periods**	**Period 1**	**Period 2**	**Period 3**
Spread	Mean	0.48	0.05	1.04	0.15	-0.23	-0.40	-0.49	0.37
	St Dev	7.19	3.12	7.65	9.78	8.17	4.50	9.11	9.95
	Min	-110.1	-41.3	-110.1	-84.4	-118.4	-97	-118.4	-44.7
	Max	50.1	40.6	39.6	50.1	81.9	13.4	45.3	81.9
	Median	0.25	0.18	0.83	-0.49	-0.12	-0.12	0.007	-0.78
x_1	Mean	0.16	0.15	0.12	0.25	0.06	0.04	-0.015	0.22
	St Dev	0.67	0.64	0.68	0.69	0.65	0.63	0.65	0.66
	Min	-1	-1	-1	-1	1	-1	-1	-1
	Max	1	1	1	1	1	1	1	1
	Median	0.32	0.29	0.25	0.43	0.19	0.14	0.08	0.40
x_2	Mean	0.31	0.28	0.28	0.42	-0.62	-0.59	-0.63	-0.66
	St Dev	0.69	0.68	0.70	0.67	0.50	0.51	0.49	0.51
	Min	-1	-1	-1	-1	-1	-1	-1	-1
	Max	1	1	1	1	1	1	1	1
	Median	0.57	0.54	0.52	0.69	-0.89	-0.84	-0.87	-0.96
x_3	Mean	0.0098	0.0083	0.0091	0.0128	0.0075	0.0066	0.0069	0.0096
	St Dev	0.0187	0.0154	0.0157	0.0256	0.0129	0.0112	0.0111	0.0169
	Min	7e-07	88e-06	7e-06	2e-06	6e-06	6e-07	1e-06	4e-06
	Max	0.2177	01877	0.1374	0.2177	0.2239	0.0997	0.1046	0.2239
	Median	0.0025	0.0020	0.0027	0.0033	0.0028	0.0022	0.0026	0.0040
x_4	Mean	0.17	0.16	0.16	0.17	0.19	0.19	0.20	0.18
	St Dev	0.24	0.22	0.23	0.26	0.24	0.23	0.24	0.25
	Min	0	0	0	0	0	0	0	0
	Max	1	1	1	1	1	1	1	1
	Median	0.09	0.10	0.10	0.07	0.12	0.13	0.13	0.10

Table 5: Pooled OLS Results for Borrowers

	Baseline Regressions								Robustness Check							
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
x_1	3.29***	1.18***	3.65***	5.07***	3.70***	1.42***	4.18***	4.95***	4.59***	1.73***	5.80***	5.58***	3.30***	1.19***	3.65***	5.07***
	(0.22)	(0.16)	(0.41)	(0.46)	(0.30)	(0.22)	(0.65)	(0.44)	(0.39)	(0.31)	(0.95)	(0.50)	(0.22)	(0.17)	(0.41)	(0.46)
x_2	-2.73***	-1.04***	-2.56***	-5.14***	-3.14***	-1.01***	-3.20***	-5.40***	-2.84***	-0.81***	-2.54***	-5.32***	-2.76***	-1.05***	-2.58***	-5.14***
	(0.18)	(0.12)	(0.32)	(0.44)	(0.21)	(0.14)	(0.44)	(0.48)	(0.27)	(0.22)	(0.60)	(0.60)	(0.18)	(0.12)	(0.33)	(0.44)
x_3	0.12***	0.15***	0.03	0.22**	0.15***	0.12**	0.08	0.25***	0.16***	0.14*	0.21**	0.21**	0.12***	0.15***	0.03	0.22**
	(0.04)	(0.04)	(0.07)	(0.09)	(0.05)	(0.06)	(0.08)	(0.09)	(0.05)	(0.08)	(0.10)	(0.09)	(0.04)	(0.04)	(0.07)	(0.09)
x_4	0.34	-0.78	-0.11	2.23**	1.54**	-1.04	2.93*	2.66**	1.27	-1.45	3.86*	1.44	0.32	-0.82	-0.11	2.23**
	(0.65)	(0.88)	(1.24)	(1.11)	(0.75)	(0.83)	(1.53)	(1.20)	(0.90)	(1.02)	(1.98)	(1.34)	(0.65)	(0.89)	(1.24)	(1.11)
Small	-1.44***	-1.01*	-0.24	-2.24**	-1.43***	-0.48*	-1.14	-2.43**	-0.22	-0.75***	-1.70	0.22	-1.46***	-1.06*	-0.25	-2.24**
	(0.52)	(0.55)	(0.84)	(1.05)	(0.55)	(0.25)	(0.77)	(1.15)	(0.72)	(0.26)	(1.47)	(1.40)	(0.52)	(0.55)	(0.84)	(1.05)
Medium	-1.32**	-1.35**	0.81	-3.23***	-1.08*	-0.44	-0.14	-3.14**	-0.63	-1.06***	-2.19	-0.59	-1.31**	-1.35**	0.81	-3.23***
	(0.57)	(0.61)	(0.95)	(1.16)	(0.59)	(0.28)	(0.83)	(1.29)	(0.74)	(0.29)	(1.47)	(1.49)	(0.57)	(0.61)	(0.95)	(1.16)
Large	-3.06***	-2.03***	-1.56	-6.39***	-3.45***	-1.80***	-2.37***	-6.40***	-2.20***	-1.95***	-2.85**	-3.63**	-2.96***	-1.95***	-1.49	-6.39***
	(0.61)	(0.64)	(0.97)	(1.37)	(0.67)	(0.57)	(0.91)	(1.47)	(0.79)	(0.62)	(1.32)	(1.64)	(0.62)	(0.65)	(0.98)	(1.37)
Major	-3.86***	-2.00***	-3.28**	-5.78***	-3.73***	-0.88***	-3.87***	-5.83***	-2.05**	-1.05***	-3.84***	-2.58	-3.80***	-1.94***	-3.24**	-5.78***
	(0.76)	(0.63)	(1.41)	(1.68)	(0.81)	(0.32)	(1.30)	(1.75)	(0.87)	(0.39)	(1.43)	(1.88)	(0.77)	(0.62)	(1.42)	(1.68)
Foreign	-0.83	-1.05**	-0.27	-0.85	-0.15	-0.22	-0.08	-0.42	1.28*	-0.47	-0.35	2.67*	-0.77	-1.02**	-0.22	-0.85
	(0.57)	(0.52)	(0.99)	(1.18)	(0.61)	(0.30)	(0.87)	(1.33)	(0.75)	(0.47)	(1.25)	(1.59)	(0.57)	(0.52)	(0.99)	(1.18)
Dropped Banks													-0.44	-0.35	-0.30	
													(0.29)	(0.26)	(0.58)	
Observations	4,268	1,438	1,742	1,088	2,766	825	1,110	831	2,296	673	910	713	4,268	1,438	1,742	1,088
R-squared	0.199	0.156	0.209	0.311	0.235	0.225	0.254	0.325	0.247	0.228	0.275	0.331	0.200	0.158	0.209	0.311
F statistics	100.05	24.78	30.03	70.83	92	26.88	28.41	67.47	71.70	18.16	22.94	55.59	100.16	23.68	29.73	70.83

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
The null hypothesis of F statistics is the coefficient of x_1,x_2,x_3 and x_4 are jointly equal to 0.

Table 6: Fixed Effect Model for Borrowers

	Baseline Regressions				Robustness Check											
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
x_1	2.87***	1.45***	3.42***	2.37***	3.27***	1.63***	4.39***	2.33***	3.97***	1.96***	6.32***	1.98***	2.87***	1.45***	3.42***	2.37***
	(0.29)	(0.28)	(0.61)	(0.56)	(0.45)	(0.40)	(1.14)	(0.62)	(0.57)	(0.55)	(1.65)	(0.63)	(0.29)	(0.28)	(0.61)	(0.56)
x_2	-1.68***	-0.65**	-1.64***	-2.78***	-1.74***	-0.16	-2.03**	-2.67***	-1.44**	0.23	-1.92*	-2.23***	-1.68***	-0.65**	-1.64***	-2.78***
	(0.32)	(0.29)	(0.53)	(0.46)	(0.49)	(0.51)	(0.86)	(0.62)	(0.60)	(0.67)	(1.01)	(0.67)	(0.32)	(0.29)	(0.53)	(0.46)
x_3	0.27***	0.03	0.27**	0.60***	0.25**	-0.00	0.20	0.56***	0.27**	-0.04	0.21	0.54**	0.27***	0.03	0.27**	0.60***
	(0.09)	(0.05)	(0.11)	(0.20)	(0.10)	(0.09)	(0.15)	(0.20)	(0.11)	(0.12)	(0.16)	(0.21)	(0.09)	(0.05)	(0.11)	(0.20)
x_4	0.64	-1.08	-0.07	3.43***	1.80***	-0.47	3.07*	3.82***	1.44**	-1.04	4.58**	2.52***	0.64	-1.08	-0.07	3.43***
	(0.63)	(0.81)	(1.36)	(1.17)	(0.56)	(0.64)	(1.59)	(1.04)	(0.61)	(0.73)	(2.21)	(0.94)	(0.63)	(0.81)	(1.36)	(1.17)
Observations	4,268	1,438	1,742	1,088	2,766	825	1,110	831	2,296	673	910	713	4,268	1,438	1,742	1,088
R-squared	0.106	0.083	0.091	0.160	0.141	0.107	0.129	0.167	0.149	0.124	0.166	0.144	0.106	0.083	0.091	0.160
Number of borrower	182	163	166	136	74	74	74	74	59	59	59	59	182	163	166	136

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 7: Pooled OLS results for Different Groups of Borrowers

	Baseline Regressions						Robustness Check																	
	All Transactions						Min Transaction 25						Min Transaction 50						Dropped Banks Controlled					
VARIABLES	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks
x_1	0.47	4.62***	6.48***	5.36***	4.32***	3.68***	2.88***	3.83***	3.25***	3.78***	4.13***	2.92***	0.47	4.62***	6.48***	5.36***	4.32***	3.68***	2.88***	3.83***	3.25***	3.78***	4.13***	2.92***
	(2.13)	(0.63)	(0.70)	(1.16)	(1.06)	(0.56)	(0.82)	(0.46)	(0.48)	(0.90)	(0.95)	(0.28)	(2.13)	(0.63)	(0.70)	(1.16)	(1.06)	(0.56)	(0.82)	(0.46)	(0.48)	(0.90)	(0.95)	(0.28)
x_2	-23.07***	-2.78***	-2.08***	-4.66***	-1.85	-3.19***	-3.05***	-2.99***	-4.36***	-3.94***	-1.89	-2.21***	-23.07***	-2.78***	-2.08***	-4.66***	-1.85	-3.19***	-3.05***	-2.99***	-4.36***	-3.94***	-1.89	-2.21***
	(6.24)	(0.33)	(0.67)	(0.81)	(1.91)	(0.55)	(0.80)	(0.30)	(0.43)	(0.59)	(1.71)	(0.27)	(6.24)	(0.33)	(0.67)	(0.81)	(1.91)	(0.55)	(0.80)	(0.30)	(0.43)	(0.59)	(1.71)	(0.27)
x_3	10.68	0.58***	0.05	0.13**	0.20	0.15	12.17*	0.49***	-0.10	0.13**	0.19	0.09	10.68	0.58***	0.05	0.13**	0.20	0.15	12.17*	0.49***	-0.10	0.13**	0.19	0.09
	(9.43)	(0.17)	(0.10)	(0.06)	(0.28)	(0.11)	(6.80)	(0.17)	(0.09)	(0.06)	(0.26)	(0.07)	(9.43)	(0.17)	(0.10)	(0.06)	(0.28)	(0.11)	(6.80)	(0.17)	(0.09)	(0.06)	(0.26)	(0.07)
x_4	2.78	1.84	2.24	-2.01	2.40	0.24	0.07	0.57	2.26	-2.80	1.80	0.24	2.78	1.84	2.24	-2.01	2.40	0.24	0.07	0.57	2.26	-2.80	1.80	0.24
	(1.92)	(1.40)	(1.63)	(2.32)	(2.90)	(1.48)	(2.45)	(1.12)	(2.06)	(2.10)	(2.83)	(0.96)	(1.92)	(1.40)	(1.63)	(2.32)	(2.90)	(1.48)	(2.45)	(1.12)	(2.06)	(2.10)	(2.83)	(0.96)
Dropped Banks																			-2.69***	-1.27*	-0.74	2.03***	0.81	-0.59
																			(0.78)	(0.65)	(1.39)	(0.55)	(1.07)	(0.42)
Observations	321	1,678	432	278	187	1,372	83	1,374	360	207	155	587	32	1,281	278	207	155	343	321	1,678	432	278	187	1,372
R-squared	0.135	0.190	0.266	0.211	0.106	0.146	0.507	0.216	0.294	0.244	0.100	0.180	0.492	0.216	0.417	0.244	0.100	0.219	0.143	0.191	0.267	0.236	0.108	0.147

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 8: Pooled OLS Results for x_1 for Borrowers

	Baseline Regressions								Robustness Check							
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
Small	0.34	0.37	0.38	0.28**	0.36	0.40	0.39	0.32	0.37***	0.39	0.39***	0.32**	0.35	0.36	0.38	0.28**
	(0.05)	(0.09)	(0.07)	(0.08)	(0.07)	(0.12)	(0.12)	(0.12)	(0.10)	(0.07)	(0.16)	(0.16)	(0.05)	(0.09)	(0.07)	(0.08)
Medium	0.26**	0.24	0.22	0.34	0.26**	0.26	0.24	0.33	0.46***	0.49*	0.49***	0.40**	0.26**	0.22	0.22	0.34
	(0.05)	(0.10)	(0.08)	(0.09)	(0.08)	(0.13)	(0.13)	(0.13)	(0.10)	(0.08)	(0.16)	(0.17)	(0.05)	(0.10)	(0.08)	(0.09)
Large	0.26**	0.18	0.23	0.42	0.26**	0.16*	0.20*	0.42	0.27***	0.16*	0.21***	0.43***	0.25**	0.14*	0.23	0.42
	(0.05)	(0.10)	(0.08)	(0.09)	(0.07)	(0.14)	(0.12)	(0.12)	(0.10)	(0.10)	(0.16)	(0.17)	(0.05)	(0.10)	(0.08)	(0.09)
Major	-0.16***	0.04***	-0.23***	-0.35***	-0.20***	0.08**	-0.28***	-0.35***	-0.19	0.07**	-0.27	-0.35*	-0.16***	0.01***	-0.23***	-0.35***
	(0.06)	(0.11)	(0.09)	(0.11)	(0.08)	(0.15)	(0.13)	(0.14)	(0.11)	(0.11)	(0.17)	(0.18)	(0.06)	(0.11)	(0.09)	(0.11)
Foreign	-0.10***	-0.10***	-0.20***	0.14***	-0.01***	-0.04***	-0.08***	0.16***	0.08	0.03***	0.00***	0.23	-0.10***	-0.12***	-0.21***	0.14***
	(0.05)	(0.09)	(0.07)	(0.09)	(0.07)	(0.13)	(0.12)	(0.13)	(0.10)	(0.09)	(0.16)	(0.18)	(0.05)	(0.09)	(0.07)	(0.09)
Dropped Banks													0.03	0.10**	0.03	
													(0.04)	(0.04)	(0.06)	
Minor (Reference)	0.37***	0.33***	0.34***	0.44***	0.45***	0.43***	0.44***	0.50***	-0.06	0.33***	-0.44***	-0.04	0.37***	0.31***	0.34***	0.44***
	(0.04)	(0.09)	(0.07)	(0.07)	(0.07)	(0.12)	(0.11)	(0.12)	(0.10)	(0.07)	(0.16)	(0.16)	(0.04)	(0.09)	(0.07)	(0.07)
Observations	4,268	1,438	1,742	1,088	2,766	825	1,110	831	2,296	673	910	713	4,268	1,438	1,742	1,088
R-squared	0.098	0.101	0.153	0.052	0.091	0.095	0.142	0.071	0.100	0.087	0.180	0.087	0.098	0.105	0.153	0.052

The coefficients of Small, Medium, Large, Major and Foreign groups are presented as the sum of reference group and the coefficient of related group to compare the coefficients easily.
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 9: Pooled OLS Results for x_2 for Borrowers

	Baseline Regressions								Robustness Check							
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
Small	0.23***	0.13***	0.19***	0.40***	0.32*	0.23	0.26	0.47	0.37***	0.30***	0.33***	0.50***	0.24***	0.14***	0.18***	0.40***
	(0.05)	(0.10)	(0.07)	(0.08)	(0.09)	(0.18)	(0.12)	(0.15)	(0.02)	(0.03)	(0.04)	(0.03)	(0.05)	(0.10)	(0.07)	(0.08)
Medium	0.37***	0.35***	0.28***	0.53***	0.34*	0.31*	0.23	0.52	0.54***	0.51***	0.52***	0.61***	0.40**	0.36***	0.30***	0.53***
	(0.05)	(0.11)	(0.09)	(0.10)	(0.09)	(0.19)	(0.13)	(0.16)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)	(0.11)	(0.08)	(0.10)
Large	0.52***	0.45***	0.51***	0.64***	0.51***	0.28	0.57***	0.63**	0.50***	0.27***	0.57***	0.63***	0.59***	0.49***	0.63***	0.64***
	(0.05)	(0.10)	(0.08)	(0.09)	(0.09)	(0.20)	(0.13)	(0.15)	(0.04)	(0.08)	(0.05)	(0.04)	(0.05)	(0.11)	(0.08)	(0.09)
Major	0.54***	0.45***	0.62***	0.56***	0.55***	0.39**	0.67***	0.56	0.55***	0.38***	0.67***	0.56***	0.59***	0.49***	0.67***	0.56***
	(0.06)	(0.11)	(0.09)	(0.12)	(0.09)	(0.20)	(0.13)	(0.17)	(0.05)	(0.07)	(0.07)	(0.09)	(0.06)	(0.11)	(0.09)	(0.12)
Foreign	0.48***	0.46***	0.47***	0.56***	0.59***	0.48***	0.60***	0.68**	0.56***	0.40***	0.60***	0.68***	0.54***	0.49***	0.56***	0.56***
	(0.05)	(0.10)	(0.07)	(0.09)	(0.09)	(0.19)	(0.12)	(0.15)	(0.04)	(0.07)	(0.06)	(0.06)	(0.05)	(0.10)	(0.07)	(0.09)
Dropped Banks													-0.29***	-0.11**	-0.48***	
													(0.04)	(0.05)	(0.06)	
Minor (Reference)	-0.26***	-0.41***	-0.29***	-0.10	0.17**	-0.03	0.18	0.31**	0.91***	0.83***	0.91***	0.99***	-0.23***	-0.39***	-0.25***	-0.10
	(0.04)	(0.09)	(0.07)	(0.08)	(0.08)	(0.18)	(0.12)	(0.14)	(0.02)	(0.01)	(0.04)	(0.01)	(0.04)	(0.09)	(0.07)	(0.08)
Observations	4,268	1,438	1,742	1,088	2,766	825	1,110	831	2,296	673	910	713	4,268	1,438	1,742	1,088
R-squared	0.086	0.104	0.099	0.077	0.040	0.032	0.079	0.026	0.034	0.027	0.069	0.029	0.101	0.107	0.139	0.077

The coefficients of Small, Medium, Large, Major and Foreign groups are presented as the sum of reference group and the coefficient of related group to facilitate comparison.
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 10: Pooled OLS Results for Lenders

	Baseline Regressions				Robustness Check											
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
x_1	1.28***	4.29***	4.45***	3.86***	1.01***	5.00***	5.01***	3.66***	0.99***	4.22***	5.28***	3.44***	1.31***	4.33***	4.45***	
	(0.20)	(0.23)	(0.36)	(0.41)	(0.24)	(0.19)	(0.44)	(0.46)	(0.26)	(0.19)	(0.45)	(0.51)	(0.20)	(0.25)	(0.35)	(0.41)
x_2	2.56***	0.80*	2.78***	4.73***	3.01***	1.64***	2.86***	5.18***	3.21***	1.50***	2.99***	5.59***	2.58***	0.79*	2.82***	4.73***
	(0.28)	(0.45)	(0.47)	(0.56)	(0.25)	(0.25)	(0.32)	(0.66)	(0.27)	(0.18)	(0.31)	(0.72)	(0.28)	(0.46)	(0.47)	(0.56)
x_3	-0.36***	-0.04	-0.29***	-0.66***	-0.47***	-0.01	-0.44***	-0.74***	-0.48***	-0.04	-0.40***	-0.74***	-0.39***	-0.06	-0.34***	-0.66***
	(0.06)	(0.05)	(0.11)	(0.13)	(0.07)	(0.04)	(0.11)	(0.14)	(0.08)	(0.03)	(0.11)	(0.14)	(0.06)	(0.04)	(0.11)	(0.13)
x_4	-3.57***	-2.69**	-5.44***	-1.37	-4.10***	-4.25***	-6.89***	-0.90	-2.80**	-3.43**	-4.74*	-0.19	-3.59***	-2.68**	-5.52***	-1.37
	(0.83)	(1.15)	(1.61)	(1.05)	(1.07)	(1.61)	(2.29)	(1.14)	(1.19)	(1.74)	(2.46)	(1.22)	(0.83)	(1.15)	(1.61)	(1.05)
Small	0.31	0.09	-0.10	1.41**	0.97***	0.01	0.36	2.69***	1.07***	0.08	0.45	2.71***	0.28	0.03	-0.12	1.41**
	(0.29)	(0.18)	(0.40)	(0.69)	(0.27)	(0.14)	(0.33)	(0.65)	(0.27)	(0.13)	(0.32)	(0.65)	(0.29)	(0.16)	(0.40)	(0.69)
Medium	0.32	-0.06	0.08	1.35	1.30***	0.40*	1.05*	2.20**	0.80**	0.38**	0.17	1.40	0.36	-0.04	0.15	1.35
	(0.44)	(0.46)	(0.75)	(0.90)	(0.37)	(0.21)	(0.58)	(0.90)	(0.36)	(0.16)	(0.51)	(0.88)	(0.44)	(0.46)	(0.76)	(0.90)
Large	1.32***	1.29***	2.59***	1.54	2.75***	1.28***	3.90***	4.64***	2.68***	1.31***	3.60***	4.71***	1.61***	1.49***	2.94***	1.54
	(0.41)	(0.27)	(0.62)	(1.25)	(0.47)	(0.43)	(0.71)	(1.04)	(0.47)	(0.42)	(0.66)	(1.04)	(0.42)	(0.36)	(0.64)	(1.25)
Major	2.15***	1.36***	0.83	5.36***	3.21***	0.83***	1.92*	6.93***	3.10***	0.88***	1.48	6.99***	2.32***	1.50***	1.07	5.36***
	(0.57)	(0.33)	(1.03)	(1.40)	(0.64)	(0.32)	(1.13)	(1.37)	(0.65)	(0.30)	(1.14)	(1.38)	(0.58)	(0.40)	(1.03)	(1.40)
Foreign	0.76**	0.40**	0.69	1.33	1.94***	0.16	2.00***	3.67***	2.03***	0.14	1.85***	4.10***	0.90***	0.45**	0.97**	1.33
	(0.33)	(0.20)	(0.50)	(0.92)	(0.37)	(0.26)	(0.54)	(1.02)	(0.46)	(0.17)	(0.64)	(1.27)	(0.33)	(0.20)	(0.49)	(0.92)
Dropped Banks													-1.11***	-0.57	-1.53**	
													(0.38)	(0.48)	(0.66)	
Observations	5,568	1,816	2,300	1,452	4,038	1,203	1,598	1,237	3,503	1,020	1,372	1,111	5,568	1,816	2,300	1,452
R-squared	0.128	0.079	0.164	0.164	0.156	0.155	0.203	0.191	0.150	0.181	0.179	0.201	0.129	0.081	0.166	0.164
Fstatistics	91.63	26.02	42.21	42.06	92.63	24.04	48.67	38.68	81.85	36.59	43.94	36.32	93.06	26.36	42.21	42.3

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
The null hypothesis of F statistics is the coefficient of x_1,x_2,x_3 and x_4 are jointly equal to 0.

Table 11: Fixed Effect Model Results for Lenders

	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
x_1	3.30***	1.09***	4.00***	3.48***	3.95***	1.05***	5.37***	3.93***	3.90***	0.79*	4.94***	4.13***	3.30***	1.09***	4.00***	3.48***
	(0.34)	(0.25)	(0.64)	(0.54)	(0.40)	(0.36)	(0.79)	(0.56)	(0.47)	(0.42)	(0.90)	(0.59)	(0.34)	(0.25)	(0.64)	(0.54)
x_2	2.31***	1.71**	3.43***	2.82**	2.55***	2.41***	3.39***	3.55***	2.16***	1.83**	2.39***	4.20***	2.31***	1.71**	3.43***	2.82**
	(0.46)	(0.68)	(0.70)	(1.13)	(0.60)	(0.89)	(0.86)	(1.33)	(0.59)	(0.72)	(0.60)	(1.53)	(0.46)	(0.68)	(0.70)	(1.13)
x_3	-0.43***	-0.02	-0.42**	-0.51***	-0.52***	-0.00	-0.41**	-0.54***	-0.55***	-0.03	-0.45**	-0.55***	-0.43***	-0.02	-0.42**	-0.51***
	(0.09)	(0.08)	(0.17)	(0.13)	(0.11)	(0.06)	(0.20)	(0.13)	(0.13)	(0.05)	(0.20)	(0.13)	(0.09)	(0.08)	(0.17)	(0.13)
x_4	-3.55***	-2.44***	-4.72***	-2.12	-3.71***	-3.44***	-4.63**	-2.26	-3.83***	-3.36***	-4.26**	-2.64	-3.55***	-2.44***	-4.72***	-2.12
	(0.81)	(0.88)	(1.44)	(1.32)	(0.98)	(1.05)	(1.78)	(1.49)	(1.10)	(1.15)	(1.98)	(1.68)	(0.81)	(0.88)	(1.44)	(1.32)
Observations	5,568	1,816	2,300	1,452	4,038	1,203	1,598	1,237	3,503	1,020	1,372	1,111	5,568	1,816	2,300	1,452
R-squared	0.115	0.101	0.129	0.137	0.140	0.138	0.163	0.165	0.147	0.150	0.152	0.191	0.115	0.101	0.129	0.137
Number of lender	195	178	181	151	104	104	104	104	88	88	88	88	195	178	181	151

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 12: Pooled OLS Results for Different Group of Lenders

	Baseline Regressions						Robustness Check																	
	All Transactions						Min Transaction 25						Min Transaction 50						Dropped Banks Controlled					
VARIABLES	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks	All-Minor Banks	All-Small Banks	All-Medium Banks	All-Large Banks	All-Major Banks	All-Foreign Banks
x_1	2.87***	4.46***	5.00***	3.87***	3.55***	2.19***	3.22***	4.35***	4.19***	3.78***	3.59***	2.72***	3.22***	3.99***	4.22***	3.78***	3.59***	2.84***	2.88***	4.46***	4.93***	3.87***	3.55***	2.24***
	(0.42)	(0.34)	(0.78)	(0.69)	(0.97)	(0.33)	(0.47)	(0.36)	(0.67)	(0.85)	(1.01)	(0.46)	(0.47)	(0.37)	(0.72)	(0.85)	(1.01)	(0.61)	(0.42)	(0.34)	(0.77)	(0.69)	(0.96)	(0.34)
x_2	3.94***	3.34***	2.14***	1.05**	2.54***	1.17	3.68***	3.32***	1.87***	1.84*	2.56***	2.08**	3.68***	3.42***	1.99***	1.84*	2.56***	2.80	3.93***	3.35***	2.17***	1.38***	2.53***	1.19
	(0.45)	(0.34)	(0.78)	(0.50)	(0.82)	(0.75)	(0.36)	(0.35)	(0.58)	(0.93)	(0.91)	(0.90)	(0.36)	(0.34)	(0.61)	(0.93)	(0.91)	(1.72)	(0.47)	(0.34)	(0.75)	(0.53)	(0.81)	(0.74)
x_3	-1.90***	-0.76***	-0.66***	-0.16	-0.34*	0.05	-1.72***	-0.73***	-0.77***	-0.10	-0.31	-0.06	-1.72***	-0.71***	-0.60**	-0.10	-0.31	-0.10	-1.91***	-0.76***	-0.67***	-0.16	-0.33*	0.02
	(0.35)	(0.09)	(0.22)	(0.15)	(0.19)	(0.10)	(0.30)	(0.09)	(0.25)	(0.16)	(0.21)	(0.12)	(0.30)	(0.09)	(0.23)	(0.16)	(0.21)	(0.14)	(0.37)	(0.09)	(0.23)	(0.15)	(0.19)	(0.10)
x_4	-4.56**	-6.51***	-6.29**	-0.80	-3.37	0.55	-2.12	-6.53***	-1.26	5.03***	-2.02	1.17	-2.12	-4.30***	-3.38**	5.03***	-2.02	1.43	-4.59**	-6.50***	-6.23*	-0.76	-3.33	0.51
	(2.18)	(1.41)	(3.15)	(1.67)	(6.00)	(1.16)	(2.09)	(1.46)	(1.42)	(1.58)	(6.62)	(2.30)	(2.09)	(1.60)	(1.47)	(1.58)	(6.62)	(3.38)	(2.21)	(1.41)	(3.18)	(1.68)	(6.00)	(1.16)
Dropped Control																			-0.18	0.10	-0.72	-0.81	-1.01	-0.73
																			(0.67)	(0.56)	(1.90)	(0.54)	(0.92)	(0.59)
Observations	711	2,226	440	256	197	1,738	524	2,104	344	126	165	775	524	1,961	288	126	165	439	711	2,226	440	256	197	1,738
R-squared	0.182	0.188	0.206	0.204	0.117	0.047	0.227	0.182	0.235	0.267	0.102	0.081	0.227	0.160	0.264	0.267	0.102	0.077	0.182	0.188	0.206	0.208	0.120	0.048

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 13: Pooled OLS Results for x_1 for Lenders

	Baseline Regressions				Robustness Check											
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
Small	0.19*	0.12*	0.13	0.30	0.18***	0.12***	0.14***	0.31	0.21**	0.16**	0.16***	0.35	0.19	0.12*	0.13	0.30
	(0.03)	(0.05)	(0.04)	(0.04)	(0.03)	(0.05)	(0.04)	(0.05)	(0.03)	(0.05)	(0.04)	(0.05)	(0.03)	(0.05)	(0.04)	(0.04)
Medium	0.05***	-0.04***	-0.05***	0.28	0.11***	0.04***	0.03***	0.31	0.18***	0.08**	0.10***	0.37	0.05***	-0.06***	-0.05***	0.28
	(0.04)	(0.07)	(0.06)	(0.07)	(0.04)	(0.07)	(0.06)	(0.07)	(0.04)	(0.08)	(0.06)	(0.07)	(0.04)	(0.07)	(0.06)	(0.07)
Large	0.20	0.34*	0.13	0.01***	0.29	0.60***	0.19	0.16	0.29	0.60***	0.19	0.16	0.18	0.28	0.11	0.01***
	(0.04)	(0.07)	(0.07)	(0.10)	(0.05)	(0.06)	(0.08)	(0.10)	(0.05)	(0.06)	(0.08)	(0.10)	(0.05)	(0.07)	(0.07)	(0.10)
Major	0.07***	-0.03***	-0.01**	0.28	0.06***	-0.08***	0.00***	0.28	0.06***	-0.08***	0.00***	0.28	0.06***	-0.07***	-0.02**	0.28
	(0.05)	(0.07)	(0.07)	(0.10)	(0.05)	(0.08)	(0.07)	(0.11)	(0.05)	(0.08)	(0.07)	(0.11)	(0.05)	(0.07)	(0.07)	(0.10)
Foreign	-0.17***	-0.14***	-0.24***	-0.04***	-0.12***	-0.07***	-0.21***	-0.02***	0.04***	0.09***	-0.06***	0.16*	-0.18***	-0.16***	-0.26***	-0.04***
	(0.03)	(0.05)	(0.04)	(0.06)	(0.03)	(0.05)	(0.05)	(0.07)	(0.04)	(0.06)	(0.06)	(0.08)	(0.03)	(0.05)	(0.04)	(0.06)
Dropped Banks													0.08**	0.12***	0.09	
													(0.03)	(0.04)	(0.06)	
Minor (Reference)	0.23***	0.22***	0.16***	0.31***	0.28***	0.28***	0.28***	0.30***	0.28***	0.28***	0.28***	0.30***	0.23***	0.20***	0.16***	0.31***
	(0.02)	(0.04)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.04)
Observations	5,568	1,816	2,300	1,452	4,038	1,203	1,598	1,237	3,503	1,020	1,372	1,111	5,568	1,816	2,300	1,452
R-squared	0.063	0.056	0.074	0.045	0.047	0.053	0.073	0.035	0.017	0.038	0.031	0.014	0.064	0.061	0.075	0.045

The coefficients of Small, Medium, Large, Major and Foreign groups are presented as the sum of reference group and the coefficient of related group to facilitate comparison.
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 14: Pooled OLS Results for x_2 for Lenders

	Baseline Regressions								Robustness Check							
	All Transactions				Min Transaction 25				Min Transaction 50				Dropped Banks Controlled			
VARIABLES	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis	All	Before Crisis	During Crisis	After Crisis
Small	-0.59***	-0.54***	-0.57**	-0.66**	-0.59**	-0.53***	-0.56***	-0.67	-0.60***	-0.57***	-0.57***	-0.66	-0.58***	-0.54***	-0.56**	-0.66**
	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.05)	(0.04)	(0.04)	(0.02)	(0.05)	(0.04)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
Medium	-0.50***	-0.46***	-0.48***	-0.56	-0.55***	-0.51***	-0.53***	-0.59	-0.54***	-0.53**	-0.54**	-0.55*	-0.50***	-0.46***	-0.49***	-0.56
	(0.03)	(0.06)	(0.05)	(0.06)	(0.04)	(0.07)	(0.06)	(0.07)	(0.04)	(0.08)	(0.06)	(0.07)	(0.03)	(0.06)	(0.05)	(0.06)
Large	-0.54***	-0.36***	-0.62	-0.78***	-0.65	-0.52**	-0.62	-0.79*	-0.65	-0.52**	-0.62	- 0.79*	-0.55***	-0.35***	-0.64	-0.78***
	(0.04)	(0.06)	(0.06)	(0.06)	(0.04)	(0.09)	(0.07)	(0.06)	(0.04)	(0.09)	(0.07)	(0.06)	(0.04)	(0.06)	(0.05)	(0.06)
Major	-0.48***	-0.36***	-0.39***	- 0.76**	-0.48***	-0.35***	-0.33***	- 0.75	-0.48***	-0.35***	-0.33***	-0.75	-0.48**	-0.36***	-0.39***	-0.76**
	(0.04)	(0.06)	(0.06)	(0.08)	(0.05)	(0.07)	(0.07)	(0.08)	(0.05)	(0.08)	(0.07)	(0.08)	(0.04)	(0.06)	(0.06)	(0.08)
Foreign	- 0.74***	-0.70	-0.76***	-0.76***	- 0.72	-0.61*	-0.75	-0.80**	-0.74*	-0.66	-0.76	- 0.79**	-0.74***	-0.70	-0.77***	-0.76***
	(0.02)	(0.04)	(0.03)	(0.05)	(0.03)	(0.05)	(0.04)	(0.05)	(0.03)	(0.06)	(0.04)	(0.06)	(0.02)	(0.04)	(0.03)	(0.05)
Dropped Control													0.04*	-0.03	0.08*	
													(0.03)	(0.03)	(0.04)	
Minor (Reference)	-0.65***	-0.75***	-0.65***	-0.57***	-0.69***	-0.70***	-0.69***	-0.67***	-0.69***	-0.70***	-0.69***	-0.67***	-0.65***	-0.75***	-0.65***	-0.57***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Observations	5,568	1,816	2,300	1,452	4,038	1,203	1,598	1,237	3,503	1,020	1,372	1,111	5,568	1,816	2,300	1,452
R-squared	0.027	0.054	0.044	0.019	0.019	0.021	0.044	0.015	0.019	0.026	0.040	0.016	0.028	0.054	0.046	0.019

The coefficients of Small, Medium, Large, Major and Foreign groups are presented as the sum of reference group and the coefficient of related group to compare the coefficients easily.
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)