Preliminary draft – comments welcome

THE INTERBANK MARKET AFTER AUGUST 2007: WHAT HAS CHANGED, AND WHY?

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Abstract

The paper analyzes the determinants of the sharp increase of interbank interest rates, and of the corresponding spread between unsecured and secured rates, observed since the outbreak of the tensions in worldwide financial markets, in the summer of 2007. According to our estimates, the factors accounting for the widening of the spread, in order of importance, are: a generalized increase in risk aversion; heightened reactivity of the rates to borrowers' characteristics (creditworthiness, but also size); heightened quarter-end and year-end seasonal patterns due to window dressing and/or accounting practices. We find no evidence that lower funding liquidity played an important role. In addition, evidence that the special longer term refinancing operations launched by the ECB since August 2007 had a dampening effect on longer term rates, although they most likely contributed to maintain orderly conditions in the market. We argue that after August 2007 banks may have become more discerning in their lending. At the same time, the increase in the discount granted to borrowers based purely on their size is likely to be a consequence of the recent bailouts of institutions that were considered "too big to fail". Therefore, moral hazard considerations should also remain a concern for central banks.

Contents

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1.Introduction

Since the summer of 2007 the world macroeconomic scenario has been dominated by the US sub-prime mortgage crisis and its repercussions on global financial markets and economic growth. The crisis resulted in higher risk premia worldwide and a large fall in share and bond prices. In money markets, interbank interest rates (the rates at which banks lend to each other) rose sharply for all the major currencies. In particular, spreads between interest rates on unsecured and secured deposits, which had been low and stable for several years, recorded an unprecedented rise (figure 1). A further, strong increase took place in mid September, when the default of Lehman brothers hit the markets.

Interbank rates are important from a macroeconomic viewpoint essentially because they represent the marginal cost of funding for banks. Thus, their variations are rapidly transmitted to the entire term structure, affecting borrowing conditions for households and firms. Furthermore, they underlie many important derivatives markets (e.g. the futures on 3-month rates on the main currencies). The fact that in normal circumstances interbank rates are determined almost one-to-one by changes in the monetary policy stance helps explain why central banks worldwide are so concerned about the latest developments. In the attempt to restore orderly conditions in money markets, they have strived to provide adequate liquidity to the intermediaries, employing traditional instruments as well as new ones. Government interventions have become widespread too since the onset of the crisis. Most commentators agree that these attempts have been broadly successful and have prevented knock-on effects to other financial markets and operators. However, interbank spreads still remain well above the levels that were prevalent prior to the outbreak of the crisis.

The main driver of the increase in the spread is by now well-understood to be that banks require a large premium to lend funds, because of an increased perception of default risk and/or because the market price of taking on such risk has risen (Taylor and Williams, 2008). In this paper we corroborate this initial diagnosis and provide additional evidence on the phenomenon, thanks to a dataset containing information on individual transactions and on the characteristics of the sellers and buyers of funds. Is the increase in the spread affecting all banks alike, or is it related to banks' individual characteristics, e.g. creditworthiness, or size? What share of the soaring spread is due to

increased default risk, and what to increased risk aversion (the price of risk)? What is the role of accounting practices?

Taylor and Williams (2008) mention that spreads may have been influenced by an increased reluctance by lenders to have interbank exposures show up in reporting, especially at year-end. However, they do not quantify this effect. What has been the role of the reduction in market and/or funding liquidity? Furthermore, our sample period extends to December 31, 2008, three months after the default of Lehman brothers brought drastically aggravated the malfunctioning of the money market. Finally, our dataset allows us to explore the relevance of lender-related factors. For instance, Dudley (2008) suggests that banks with tight capital must refrain to lend on the interbank market in order to avoid overshooting their desired leverage. According to this view, a widespread reduction of capitalization, driven by the recent surge of marked-to-market losses, may have shifted upwards the interbank supply schedule, contributing to the rise in the spread. If this were the case, well-capitalized lenders should be lending at lower rates. At the opposite extreme, it has been suggested that banks with free capital might be tempted to adopt a "predatory behaviour", refraining from lending to banks which need the funds to overcome a liquidity crisis, in the hope to acquire them later at bargain prices stage once the liquidity crisis has evolved into a full fledged insolvency. This hypothesis predicts a nonnegative relationship between lender's capitalization and the rate it charges its counterparties.[2]

Our analysis allows us gauge – or to make indirect inference on – the importance of these factors. Following Taylor and Williams (2008), we focus on the spreads between uncollateralized and collateralized rates to eliminate direct effects of central bank interventions – expected or actual changes in official rates, or in the supply of central bank money – as these factors should in principle affect both types of rates.[3]

Our empirical approach is extremely simple. Spreads (derived from individual transactions) are regressed on a set of bank-specific and market-wide explanatory variables. We allow for the possibility of a structural break in the estimated relationships after the breakout of the strains, as banks may have suddenly realized that the lending practices heretofore prevailing in the market were no longer adequate – indeed, our results strongly support the hypothesis of a radical change in the reactivity of the spreads to their

[2] Giavazzi (2008) attributes this hypothesis to Ricardo Caballero.

[3] Indeed, the behavior of the spreads in figure 1 is very similar for both dollar and euro rates, in spite of the fact that between August 2007 and the end of our sample period (May 2008) the Federal Reserve has lowered its target rate from 5.25 to 2.0, whereas the European Central Bank has left it unchanged.

determinants. Our main focus is on longer maturities namely the ones ranking from one week to twelve months.

Our main data source is the *e*-MID, a screen-based trading facility used by Italian and other European banks to exchange interbank funds. *e*-MID data comprise information on individual interbank contracts in euro, at various maturities. Merging these data with key characteristics of the borrower taken form the Bank of Italy supervisory report allows us to control for market-wide effects as well as borrower-specific features. To our knowledge, a dataset with similar features has been built and used by Furfine (1990, 2000) for the US federal funds market, and by several other authors who have followed his methodology, but only for the overnight segment. By contrast, we are able to do a similar matching for longer term maturities, those at the center of the current policy debate. Another important advantage of *e*-MID data is that interest rates reflect actual transactions, and therefore they do not suffer from the potential distortions affecting offered rates, such as Libor or Euribor rates - another issue that has stirred some debate recently (see e.g. Dolan (2008)). At the same time, *e*-MID rates track closely their aggregate counterparts, as banks can arbitrage between the *e*-MID and the over-the-counter market. This allows us to make inference on the euro area interbank market by and large.

Only few papers have focused on the recent widening of interbank spreads and its determinants, due to the novelty of the phenomenon. Taylor and Williams (2008) argue that the phenomenon is driven by increased counterparty risk and that the new term auction facility introduced by the Federal Reserve has not significantly reduced the spread. However, they work with market-wide data. Michaud and Upper (2008), Gyntelberg and Wooldridge (2008) suggest that both credit risk and liquidity factors have played a significant role. Cassola et al. (2008) present a rich analysis of the impact of the crisis on the overnight market, documenting an increase in the cross-sectional dispersion of the interest and a decline in cross-border trades. Overall, they interpret their findings as reflecting increased asymmetric information problems. Our paper is also related to recent empirical microstructure studies of the money market (Hendry and Kamhi (2007), Farinha and Gaspar (2007), although they do not focus on the recent crisis), and to the rapidly growing literature on the impact of the crisis on the functioning of financial markets (e.g. Frank, González-Hermosillo and Hesse (2008)) and on central banks reaction to the crisis (e.g. Chailloux et al. (2008)).

The rest of the paper is structured as follows. Section 3 describes the data sources and some choices made for the construction of the dataset. Section 4 illustrates some key features of the data using tables and figures. The main regression results are in section 5, a series of related robustness checks in section 6. The final section summarizes the main results.

2.Data

Our main data source is the *e*-MID, a multilateral screen-based trading facility on which Italian and other European banks exchange electronically interbank deposits with maturities ranging from overnight (one day) to twelve months. The data, collected by the Bank of Italy for supervisory reasons, consists of all the euro-denominated transactions executed on the *e*-MID during the period between January 25, 2005 and December 31, 2008. However, most of the analysis for the crisis period is conducted over the subperiod August 9, 2007 - September 13, 2008, to eliminate the effect of the failure of Lehman brothers from the estimates. Market participant initiate a trade by posting on the system a proposal (a quantity and a rate) for any available maturity. Proposals can be either bid or on the ask side: a bid proposal is a request of funds by a borrower, an ask one is an offer of funds by a lender. The displayed quote, which shows the proponents' identity, can be accepted by a counterparty for the entire quantity posted or for part of it.[4] Bid contracts represent about 80 per cent of the traded volumes on the platform for the overnight trades and about 60 per cent for those at longer maturities.

While most of the activity on the e-MID is at short maturities, we focus on longer-term contracts, because it is on these maturities that the spread has significantly increased since August 2007. Contracts are traded on the *e*-MID for maturities of 1, 2 and 3 weeks, 1, 2, 3 .. 12 months. We compute the interest rate spread as the difference between each individual rate and the Eurepo rate of the corresponding maturity.[5] Table 1 shows that a daily average of 24 participants has been active in the markets for maturities of 1-week or beyond,

[4] See Beaupain and Durrè (2008) for a detailed microanalysis of the *e*-MID and a description of its features. The proponent-lender has to confirm each incoming application of its quotation and can reject them for exceeding bilateral credit limits towards the participant asking for funds. Since these limits can be set by the lender on a totally discretionary basis, at a daily frequency, the proponent-lender can de facto choose the borrower. This explains why in the empirical analysis that follows we fail to detect significant differences in the behavior of bid- and ask- generated rates.

[5] Eurepos are repurchase agreements on high quality government or government-guaranteed paper. Since Eurepo rates at intermediate maturities (four, five, seven, eight, ten and eleven months) are not available, we compute a linear interpolation. This procedure has no relevant effect on our results, also because it concerns only 1 per cent of the total number of longer-term contracts.

accounting for 21 contracts, altogether worth 0.7 billion euro. The small decline recorded by these indicators during the crisis does not seem to have drastically changed this situation.

For data concerning banks' individual characteristics we rely on several sources. Balance sheet data, at a quarterly frequency, are taken from the Bank of Italy supervisory reports.[6] Our baseline results, presented below, are derived using individual institutions balance sheets. To account for the delayed publication, balance sheet data were merged with the daily dataset with a one-quarter lag. For instance, daily market data for 2006.Q1 are merged with 2005.Q4 balance sheet data. Rating variables by leading rating agencies (Fitch, Moody's and Standard & Poor's) are taken from Bloomberg. The ratings relate to the overall soundness, to specific debt securities as well as to default risk at short and long-term horizons. Table A1 in the Appendix reports details for the available rating types and the numerical coding that we used to construct the related regressors. In short, we assign a 1 to the best rating class, and increasing integer values to the lower classes, so that lower rating correspond to higher values of our rating measures. No rating of any type is available for 60 of the 197 market participants in our sample. Of these, 13 belong to a group in which the controlling company is rated, so we assign them the rating of the latter. The treatment of the remaining operators without rating is illustrated in section 4. Over our sample period, 7 bank mergers and acquisitions were recorded, involving 14 *e*-MID participants. The two banks involved in each operation were considered as separate entities until the effective date of the operation, and as a new, single one afterwards, even if in 6 cases the two treasury desks continued to operate on the *e*-MID separately for a short period after the merger. Also, contracts signed by branches of institutions are considered as done by the home company.

3.A preliminary look at the data

Figure 2 shows the time series behavior of *e*-MID - Eurepo spreads at key maturities, in comparison with those computed using Euribor rates. Although at times divergences appear, overall the *e*-MID rates closely track their Euribor counterparts. A marked widening of the spreads since August 2007 is clearly visible for all the series, roughly proportional to the maturity.[7] The dispersion of the rates in the cross-section of banks has significantly increased since the onset of the crisis. This is documented by the kernel probability densities in figure 3, estimated separately for the pre-crisis and crisis periods. The standard deviation jumps

[6] Since lack of quarterly data for foreign e-MID participants forces us to omit them from the regressions, we also worked with annual balance sheet data taken from Bankscope; we describe the results in the section documenting the robustness checks.

from 2 to 23 basis points for 1-month contracts, from 2 to 16 for 3-month contracts. On average across maturities, the standard deviation increased six-fold, with a peak of 12 for the 3-weeks contracts.

What explains these patterns across pre-crisis and crisis periods? Table 1 provides some preliminary evidence that a deterioration in observable measures of creditworthiness cannot be the main explanation, which reports statistics for the longer term segments of the market during the pre-crisis and crisis sub-periods, and for the banks active in those market segments. The daily average number of participants is broadly stable: it was 25 before August 2007, and 22 afterwards. Likewise, no major changes take place in the key characteristics of borrowers. Their average size (proxied by the logarithm of total assets) increases. Given the relationships between size and rates, which we document in the next section, this should have determined a reduction – not an increase – of the spreads. The total capital ratio records only a slight deterioration. The Fitch long-term issuer default rating, used to derive our baseline results in the next sub-sections, remains broadly stable; the evidence is similar across different rating types and rating agencies.

4.Regression analysis

4.1Basic specification and methodological issues

In this section we regress the interest rates spreads illustrated in the previous section on a series of market-wide and bank-specific explanatory variables, allowing for possible changes in the relationships after August 2007. The empirical counterpart of equation (4) is the following:

$$r_{it} = c + \beta_1 \bar{x}_{it} + \beta_2 (\bar{x}_{it} D_{turm,t}) + \beta_3 \bar{z}_t + \beta_4 \bar{z}_t D_{turm,t} + \varepsilon_{it}, \quad (5)$$

where r_{it} is the interest rate spread, $\bar{x}_{it}$ is a vector of bank-specific variables, whereas $\bar{z}_t$ controls for a series of market-wide effects, influencing interbank rates at various frequencies and maturities, which we discuss below. $D_{turm,t}$ is a dummy variable taking value 1 for the period after the 9th of August 2008 and zero otherwise, reflecting the assumption that the breakout of the strains coincided with the first massive liquidity injection

[7] The overnight spread (the differential between the overnight and the minimum rate on the main refinancing operations of the EBC, not reported in the figure) is an exception: the average during the crisis is zero, as opposed to 7 basis points prior to August 2007. The decline is due to the massive liquidity injections performed by the ECB with the aim to keep the tensions under control.

of the ECB.[8] The coefficients vectors β_2 and β_4 allow us to test whether there has been a general change in money market patterns during the strains ($\beta_2 = \beta_4 = 0$ would be consistent with no structural change in the estimated relationships). Our a priori is that a structural break did indeed take place, and that bank-specific characteristics, such as creditworthiness, became more important after August 2007.[9] The dependent variable is constructed by stacking all the *e*-MID contracts with maturity equal to or longer than one week, in deviation from the Eurepo rate of the corresponding maturity.[10] This choice is dictated by the thinness of the market for longer maturities, documented in section 2. One consequence is that the key coefficients – rating, size, etc, – must be interpreted as the effect of the regressors on an "intermediate" maturity, and not on any specific maturity. On the other hand, on average over the crisis period (excluding the months following the Lehman default) our dependent variable has a maturity of about 35 days and a value of 37 basis points (averages weighted by the number of contracts). The latter value closely matches those computed using Euribor-Eurepo spreads at the 1- and 2-month maturities (32 and 50 points, in the order), and is not too distant from the 3-month spread, a key gauge of the tensions (66 points). Thus, we argue that our results carry over to longer maturities.

One key explanatory variable is the credit rating, available at a daily frequency for individual banks. The regression results reported below are derived using Fitch long-term issuer default rating, coded so as to take values from 3 to 12, corresponding to the best and worst observed rating classes, in the order (see table A1). Since a large number of banks in our sample has no rating, we set the rating variable equal to 13 for these banks; at the same time, we introduce in the regressions a dummy variable taking value 1 for banks with no rating and 0 otherwise. This procedure amounts to constraining the coefficients of all other variables – bank-specific and deterministic ones – to be the same across banks with and without a rating. It allows us make inference about banks without a rating, and significantly increases the number of observations available for the analysis of longer term rates. For the same reason, we pool bid- and ask-originated contracts. In section 5 we assess the robustness

[8] This choice for the beginning of the crisis period, which follows Taylor ands Williams (2008), appears the natural one based on the behavior of the relevant time series. However, we also experimented with alternative dates, such as the 10th of July, when S&P announced the possible downgrading of 612 residential mortgage-backed securities backed by US sub-prime loans and a revision of the rating methodology of CDOs. Our result are robust to this alternative choice.

[9] Frank, González-Hermosillo and Hesse (2008) provide evidence in line with this a priori, although not specific to the interbank market.

[10] OIS (Overnight Indexed Swap) rates have often been used in the recent months as a baseline against which to measure movements in the uncollateralized rates (see e.g. Taylor and Williams (2008)). Replacing Eurepo with OIS rates does not affect our results.

of our key results to these choices, as well as to several other features of the baseline specifications presented in this section.

Finally, we also include a proxy for risk aversion computed using the methodology outlined in Jackwerth (2000).[11] In short, it is obtained as the ratio between the density estimated using historical data from the S&P/MIB index (the benchmark index for the Borsa Italiana, tracking the 40 most-traded stocks), and the risk-neutral density derived from the options on the index. This variable should capture risk aversion of participants in the Italian stock market.

4.2Regression results

The regressions results are in table 2. We mostly base our comment on the OLS estimates in the first column, discussing the rest of the table at the end of the section. The coefficients for the pre-crisis period (first column, upper part of the table) suggest that in normal times the premium paid by borrowers increases as their rating deteriorates (we use Fitch long-term issuer default rating, coded so that low values correspond to good ratings). The coefficients of the zero-one dummy for banks with no rating is significant, suggesting that the borrowing costs faced by banks without rating are slightly higher (1-2 basis points) than those of the best banks, in line with those of banks with an average rating, and lower than those with poor ratings.[12] The negative and significant coefficients for borrower size (proxied by total assets) and capital ratio indicate that large, highly capitalized banks borrow at relatively good rates. However, as we shall see in the next sub-section, from a quantitative viewpoint these effects are negligible. The regression also shows that better capitalized lenders manage to lend at lower rates (we experimented with several other lender characteristics, but generally found them to be irrelevant). Finally, the effect of risk aversion is highly significant. As we shall see, this is the single largest determinant of the increase in the longer term spread.

The picture emerging from the coefficients estimated over the crisis period (lower panel of table 3) is quite different. All the coefficients are now much larger in absolute value. Note that they are additional effects, so to obtain the post-crisis effect of each variable

[11] This variable was kindly provided to us by Marcello Pericoli.

[12] Recalling that the rating variable is set to 13 for non rated banks, the estimated effect of the lack of rating during the pre-crisis period is 1.6 basis points (obtained as 0.26*13 – 1.76). This compares to 1.8 points for banks with an average rating (the mean rating for rated banks is 6.8, yielding 0.26*6.8=1.8), and 3.1 for banks with the worst rating (0.26*12=3.1).

the coefficients in the upper and lower parts of the table must be added. The increased discount based on borrower size seems particularly interesting. In the light of the recent wave of bailouts, it suggests that moral hazard risks may have increased. Altogether, these results lend some support to the hypothesis set forth by Taylor and Williams (2008) to explain increased overnight funds volatility in the US market: if traders are more suspicious about some borrowers than others, this will show up in increased dispersion of rates in the cross-section. This will yield increased volatility of the effective daily federal funds rate, which is estimated from these trades. However, as we shall see in the next subsection, bank characteristics explain a relatively modest portion of the large increase in cross-sectional variability documented in figure 3.

Postponing to the next subsection the economic interpretation of these coefficients, we now discuss the controls for market-wide effects (not reported in the table): dummies for each maturity traded; for bid vs. ask transactions; for window dressing/accounting effects. All these variables are also interacted with the post-crisis dummy.

The estimates reveal that the dummies controlling for window dressing/accounting effects are important. The use of these dummies, which we limit to maturities up to 3 months, is prompted by the observation that interbank rates of the various maturities tend to record an upward jump as soon as the period spanned by related contract includes the key day – the final day of the quarter, or of the year.[13] This reflects the sharp increases typically recorded by the overnight rate on these days. In turn, this appears to be due to window dressing and/or accounting practices.[14] The related coefficients for the pre-crisis and the crisis periods are reported in figure 4. With all due caveats, made necessary by the limited number of observations available, the impact of the crisis is self-evident. Consider the end-of-year effects first. On December 15, 2007 the 2 week rate soared by 60 basis points; a

[13] The dummies are constructed as follows. For the 1 week maturity, we set the end-of-quarter (end-of-year) dummy equal to 1 during the week to quarter end (year-end), and to zero otherwise. That is, the dummy is turned on as soon as the contract incorporates the final day of the quarter (year). Likewise, for the 2-week contract the dummy is set equal to 1 on the 2 weeks to quarter-end (year-end), and so forth. For the 3 month contract only year-end dummies are used. As we have seen in the regressions for the overnight, an increase is clearly documented at month-end as well.

[14] Specifically, end-of-quarter data are used to compute capital requirements. In the case of listed companies, they are also incorporated in quarterly statistical releases to the market. In practice, these data determine "capital absorption", i.e. a cost to the banks. Hence at quarter-end banks' attempts to minimize on interbank exposures drive interest rates up. The effect is magnified at year-end because annual balance sheet data mostly rely on the situation on the final day of the year. The overnight rate also displays end-of-month patterns, generated by banks' effort at minimizing their end-of-month debt exposure. In turn, this may be due to the practice of tracking the capital requirements and reporting to the bank's top management on a monthly basis for internal strategic purposes.

similar increase was recorded on the 7th by the 3-week rate, on November 30 by the 1-month rate. The increases at the 2 and 3 month maturity are much smaller, 17 and 9 basis points, respectively, but still economically significant, considering that since August 2007 the 3 month spread has averaged 66 basis points. In the pre-crisis period these effects present a similar pattern, and are clearly identified, but are smaller roughly by a factor of 10. Figure 4 also shows that end-of-quarter tensions, barely visible before August 2007, become significant on shorter maturities; the "jump" in the 1-month rate is as large as 15 basis points. This suggests that since the onset of the crisis banks have become more reluctant to *report* their interbank exposures. That is, the increased premium signals aversion not so much to interbank exposure per se, but to making such exposures public – either internally or externally.

Finally, we attempted to gauge the importance of funding liquidity as a determinant of the long term spread. First, we included in the regressions dummies equal to one on the day of the announcement of exceptional long-term refinancing operations (3 and 6 month maturity) launched by the European central bank since August 2007. Also, we include The coefficients of the policy dummies suggest that the ECB interventions did not have an important effect on the spread. The coefficient for the 3 month refinancing operations is insignificant, whereas the announcement of the 6 month operation had a significant but positive impact on the long-term rate – most likely a spurious effect.[15] This result is in line with the evidence in Taylor and Williams (2008) concerning the lack of effect of the Fed's term auction facility on US interbank rates. Clearly, this need not imply that these refinancing operations were useless: by providing liquidity to specific institutions, they most likely contributed to maintain orderly conditions in the market. As a second way to gauge the impact of liquidity on the spread, we introduces measures of bank liquidity (the ratio between liquid and total assets, and the ratio between interbank assets and liabilities) among the regressors. If funding liquidity were an important factor behind the increase in the spread, we should expect relatively low spreads for highly liquid banks. However, we find that the coefficients of our liquidity proxies generally take the wrong sign in the regressions or are insignificant, both before and after August 2007. Therefore, we omit them from our baseline specification. With all due caveats, due to the difficulty of coming up with reliable proxies, this evidence suggests that funding liquidity does not seem an important determinant of the widening of the spreads.

[15] Similar results were obtained using alternative dummies for the interventions (based on the auction date or the settlement date).

Columns (a) and (b) of table 3 present random effect regressions. Specification (a) includes random effects for the borrower and fixed effects for the lender; in specification (b) we eliminate the proxy for aggregate risk aversion and add daily dummies. The results broadly confirm the OLS results which we have discussed thus far, except that the coefficient of the lender's capital ratio becomes insignificant, both before and during the crisis, if daily dummies are included (specification (b)). This casts some doubts on the robustness of this result.

In the right-hand side of the table the same regressions are replicated over an extended crisis period, which includes the months following the Lehman default, when the spread soared to record heights. In these regressions the Lehman default was partly treated as a second structural break. That is, we introduced a "Lehman" dummy, equal to one between September 15 and December 31, 2008, and added additional maturity dummies, interacted with this Lehman dummy. However, the other regressors were left unchanged, as three months of additional data were deemed insufficient to support a full set of additional parameter estimates.

Once we let the additional dummies capture the bulk of the large increase in the average spread, the estimated coefficients appear to confirm the ability of our regression to capture part of the increased cross-sectional variability in the data. The coefficients of the borrower rating and of the risk aversion proxy increase, suggesting that these determinants have become more important after the Lehman default, whereas the coefficient of borrower's capitalization declines somewhat.

The coefficient of borrower's size is particularly interesting, in the light of the increased discount based on borrower size documented in the regressions on the left of table 3. A priori, one could have expected a significant drop in this coefficient after the Federal reserve decided to let Lehman fail. On the other hand, in the light of the acceleration recorded by the financial crisis after this event, it is equally plausible that lenders may have been reinforced in their belief that no (other) large bank would be allowed to fail. The estimates are somewhat ambiguous: according to the first two specifications , the coefficient of size estimated over the full crisis period is smaller than before, but it is practically unchanged in specification (c).

4.3Accounting for the soaring spread

In this section we obtain a quantitative assessment of the contribution given by the various regressors in Table 2 to the increase in the long-term interbank spread. To this end, we use the estimated OLS coefficients from the first column of the table to compute fitted values for banks with the best, or the worst, rating in the sample, for large or for small banks (those in the top or bottom decile of the size distribution), etc. Also, to simulate the absence of window dressing/accounting effects, or of risk aversion, fitted values without these effects are computed (i.e. the related coefficients are set to zero). Simple averages of these fitted values are then computed over the pre- and crisis subperiods.

The resulting values are in Table 3. Over the crisis period our dependent variable averages 37 basis points, as opposed to 5 before August 2007.[16] In the absence of window-dressing at the quarterly and annual frequency, the average spread would have been 32 points on average during the crisis (vs. 4 points over the pre-crisis period). The estimated effect of risk aversion is the largest: in its absence the spread would have been 3 basis points before the crisis and only 12 points afterwards.

Coming to the effect of borrower's characteristics, table 3 shows that until August 2007 the spread was in a range of plus or minus 2 basis point around the average, regardless of borrower characteristics. Afterwards this situation changes: the spread increases to 40 basis points for banks with the worst rating, vs. 34 points for those with the best rating; for small banks it grows to 40 points, but only to 34 for large banks. Overall, for poorly rated, small, poorly capitalized banks the estimated spread increases to 44 basis points, whereas for top rated, large, well-capitalized banks it increases to only 27 points, only 22 points higher than before August 2007.

Summing up, during the crisis our composite spread records an increase of 32 basis points (from 5 to 37). Of this increase, we reckon that 8 points (about 25 percent) are due increased reactivity to borrower characteristics;[17] using the same reckoning yields that 4 points (above 10 percent) of the increase reflects window-dressing/accounting procedures, whereas 23 points (70 percent) are due to increased risk aversion.

[16] The average values of the fitted and actual series coincide. As we have seen above, they also closely match those computed from Euribor rates.

[17] This figure is computed as the difference between the average spread and the estimated spread paid by the "best" banks after August 2007 (37-27 points), minus the same difference computed over the pre-crisis period (5-3 points).

5.Robustness checks

In this section we summarize the results of a series of robustness checks conducted on the regressions presented in the previous section. Some are documented in the appendix. First, we check the sensitivity of our results to our treatment of observations pertaining to banks without rating, described in section 5.1. To this end, the regressions were estimated separately over two subsamples of banks: those that do not have a rating, and those that have it. For the first subsample the estimated coefficients are broadly of the same sign and magnitude as those in the baseline regressions in Table 2. The same holds true for the second group, although OLS estimates (the Hausman test rejects the random effects model) yield a smaller absolute value of coefficients for both the size and the capital ratio. All in all, constraining the bank-specific variables to have the same effect for both rated and not rated banks does not seem to significantly affect our conclusions regarding banks' characteristics, in particular on the differences between the pre- crisis and crisis sub-periods.

Second, we assess the sensitivity of our results in Table 2 to our choice of pooling the various contracts on maturities longer than or equal to 1-week into a single dependent variable. To this end, we augmented the baseline specification with interactions between each bank-specific variable and the maturity of the contract, allowing each corresponding coefficient to change linearly as the maturity lengthens. The estimated coefficients for the interaction terms in size and capital ratio are negative and significant during the crisis. Precisely, the discount for better capitalized banks increases by about 1.0 basis points as the maturity lengthens by one week; the corresponding discount for larger banks is just 0.2 basis points. Interestingly, the spread elasticity to the rating variable appears to be instead roughly constant across maturities. This picture is common to both the OLS and fixed-effect regressions. We also run separate regressions for the main maturities, those for which a sufficient number of contracts was available. In spite of the small number of observations for some maturities, the related results, in table A2, confirm the increase in the reactivity of rates to size and to capitalization in the post-crisis period. Furthermore, they suggests that the effects are proportional to the maturity of the contract.

Since the 3-month maturity has been the gauge of the tensions preferred by most commentators, we used the related regression results to replicate the exercise reported in Table 3. Across the pre- and crisis periods, the 3-month spread increases on average by 59 basis points (from 7 to 66). For large, highly capitalized banks the cost of funds increases by

45 points (from 7 to 52), implying that heightened reaction to individual bank characteristics explain 18 basis points of the increase. Window dressing effects account for an increase of 2 points (although this figure is likely an underestimate, because the 3-month rate is also partly influenced by the tensions for the shorter maturities, documented in section 4, that are not captured by the end-of-year dummy). Risk aversion explains 53 points of the increase; as a proportion of the total increase this is larger than documented in the previous subsection. Overall, this suggest that the relative importance of risk aversion grows as the maturity of the interbank contract lengthens, whereas that of window dressing/accounting effects declines. Overall, these results are broadly coherent with those in section 5.3.

Third, we worked with annual balance sheet data, to keep foreign banks (for which quarterly data were unavailable to us) into the estimation sample. The results were very similar to those reported in Table 2. In this case, we also experimented with alternative balance sheet variables, in addition (and instead of) the total capital ratio. We considered the cost-income ratio and the return on average equity (ROAE), which should proxy for banks' efficiency and profitability. The estimated coefficients for the ROAE are generally positive but not significant, both before and during the crisis. The coefficient for the cost-income ratio tends to take the wrong sign during the pre-crisis period (less efficient banks would borrow at a discount); after the breakout of the strains the coefficient is positive but not significant. These balance sheet variables were also constructed using data consolidated at the group level. This choice yields a slight deterioration of the regressions and a slightly lower absolute value for estimated coefficients, although by and large the latter still maintain the sign and significance patterns of the baseline specification.

Fourth, we considered ask- and bid-originated contracts separately. As mentioned in section 3, in ask-originated contracts the lender posts a quote on the dedicated *e*-MID screen without knowing the identity of the applicant borrower. This warrants the premium on ask-originated rates documented in section 4. To make sure that pooling bid and ask originated contracts does not significantly affect our main results, we ran separate regressions for each contract type. The results confirm that the estimated coefficients are broadly similar across the two contract types.

Finally, we experimented with different rating measures. In principle, ratings pertaining to the short-term outlook should be best suited for the interbank market. However, we experimented with all the ratings in Table A1. Our choice of Fitch long-term issuer

default rating for the baseline regressions was based on availability (it was among the most commonly available for our sample of banks) and good regression fit. However, most other ratings yielded very similar results, except those provided by Standard & Poor's. For these, the sign of the coefficient is negative and non significant for the crisis period (long-term issuer default rating) or for both the pre-crisis and crisis periods (short-term issuer default rating). We also experimented with squared and log alternatives to the rating variable used in the baseline regressions. Overall, the linear form seemed the more robust, although in some unreported specifications the other versions also worked well. The interpretation of the regression results in Table 2 was little affected.

6.Conclusions

This paper investigates the behavior of interbank interest rates during the period January 2005 – December 2008, in the attempt to gain insights on the sharp increase recorded by these rates and by the spreads vis-à-vis the corresponding collateralized rates since August 2007 – the "crisis period". To this end, we use data on individual interbank transactions from the *e*-MID, an electronic trading platform used by a pool of European banks.

Preliminarly, we document that the rise in interest rate spreads (computed using *e*-MID average rates, in deviation from their Eurepo counterparts) during the crisis is clearly visible starting from maturities as short as 1 week, and is roughly proportional to the maturity. Our composite long-term spread, which we use in the regression analysis to overcome market thinness problems, and has an average duration of about 37 days, increases by 32 basis points, from an average of 5 to 37 points. Also, a sharp rise in the cross-sectional dispersion of the spreads takes place, with a six-fold increase of the standard deviation, on average across maturities. The paper then explores the determinants of the spreads and possible changes occurred since August 2007. Our main results can be summarized as follows.

First, changes in the composition of the group of active market participants, or a deterioration in *observable* measures of creditworthiness or profitability, such as ratings or capital ratios, do not seem to be important determinants of the widening in interbank spreads observed since August 2007. The only notable change in the characteristic of the average participant is an increase in size, which should have brought about a decline in the spreads.

Second, an increase in aggregate risk aversion seems to have been the most important determinant of the widening spread: about 70 percent of the total increase can be traced to the effect of a proxy of risk aversion computed using option data on the stock market.

Third, borrower characteristics were not an important determinant of the cost of debt during the pre-crisis period. After August 2007, more creditworthy, larger banks obtain a sizeable discount, whereas riskier or smaller institutions pay a correspondingly large premium. Our estimates suggest that about 25 percent of the increase in our composite long term spread are due to heightened reactivity of rates to borrower characteristics.

Fourth, after August 2007 the effect of window dressing/accounting procedures on interest rates at year-end and quarter-end become magnified. In particular, we document that interbank spreads record a sudden upward jump as soon as the contract spans year-end (e.g., 1-week rates increase on December 24, 2-week rates on December 15, and so on). While this pattern is well-identified throughout our entire sample, after August 2007 it accounts for huge jumps. A similar pattern, although less pronounced, is found at quarter-end, suggesting that banks have become more worried about their quarterly statistical releases as well. Overall, our estimates imply that window dressing/accounting practices explain over 10 percent of the increase in our composite long-term spread.

Fifth, we find no evidence that the special longer term refinancing operations launched by the ECB since August 2007 had a dampening effect on longer term rates, although they most likely contributed to maintain orderly conditions in the market. Likewise, no evidence is found that high levels of liquidity injected by the central bank induced lenders to lower rates. By contrast, better capitalized lenders did charge lower rates. However, the effect is statistically significant but quantitatively negligible.

Summing up, our results suggest that after August 2007 banks may have become more discerning in their lending. At the same time, the increase in the discount granted to borrowers based purely on their size is likely to be a consequence of the recent bailouts of institutions that were considered "too big to fail". It suggests that moral hazard considerations should also remain a concern for central banks. The analysis of the period following the failure of Lehman brothers, although limited to only three months after the event, does not seem to affect this conclusion.

References

Cassola, N., C. Holthausen and M. Lo Duca (2008). The 2007/2008 turmoil: a challenge for the integration of the euro area money market?, mimeo, European Central bank.

Chailloux, A. S. Gray,U. Klüh, S. Shimizu, and P. Stella,(2008). Central Bank Response to the 2007–08 Financial Market Turbulence: Experiences and Lessons Drawn. IMF working paper no. 210.

Beaupain, R and A. Durrè (2008). The interday and intraday patterns of the overnight market: Evidence from an electronic platform. ECB working paper no. …

Borio, C. (2008). The financial turmoil of 2007-?: a preliminary assessment and some policy considerations. BIS Working Papers. n. 251.

Dolan, M. (2008). London benchmark rate under suspicion. International Herald Tribune, April 24. (http://www.iht.com/articles/2008/04/24/business/libor.php)

Dudley, W. (2008). May You Live in Interesting Times: The Sequel. Remarks at the Federal Reserve Bank of Chicago's 44th Annual Conference on Bank Structure and Competition, Chicago. (http://www.newyorkfed.org/newsevents/speeches/ 2008/ dud080515.html).

Farinha, L. and V. Gaspar (2007). Portuguese banks in the euro area market for daily funds. Banco de Portugal. mimeo.

Frank, N, B. González-Hermosillo and H. Hesse (2008). Transmission of Liquidity Shocks: Evidence from the 2007 Subprime Crisis. IMF working paper no. 200.

Furfine, C. (1999). The microstructure of the federal funds market. Financial Markets. Institutions and Instruments. Vol. 8. pp. 24-44.

Furfine, C. (2000). Interbank Payments and the Daily Federal Funds Rate. Journal of Monetary Economics, 2000, vol. 46 no. 2. pp. 535-553.

Giavazzi, F. (2008). Why does the spread between LIBOR and expected future policy rates persist, and should central banks do something about it? Available on Vox. (http://www.voxeu.org/index.php?q=node/1188)

Gyntelberg, J. and P. Wooldridge (2008). Interbank rate fixings during the recent turmoil. BIS Quarterly Review. March. pp. 59-72.

Jackwerth, J.C., (2000). Recovering Risk Aversion from Option Prices and Realized Returns. Review of Financial Studies, 13, pp. 433-451.

Hartmann, P., M. Manna and A. Manzanares (2001). The microstructure of the euro money market. Journal of International Money and Finance. Vol. 20. N. 6. pp. 895-948.

Hendry, S. and N. Kamhi (2008). Uncollateralized Overnight Loans Settled in LVTS. Bank of Canada. mimeo.

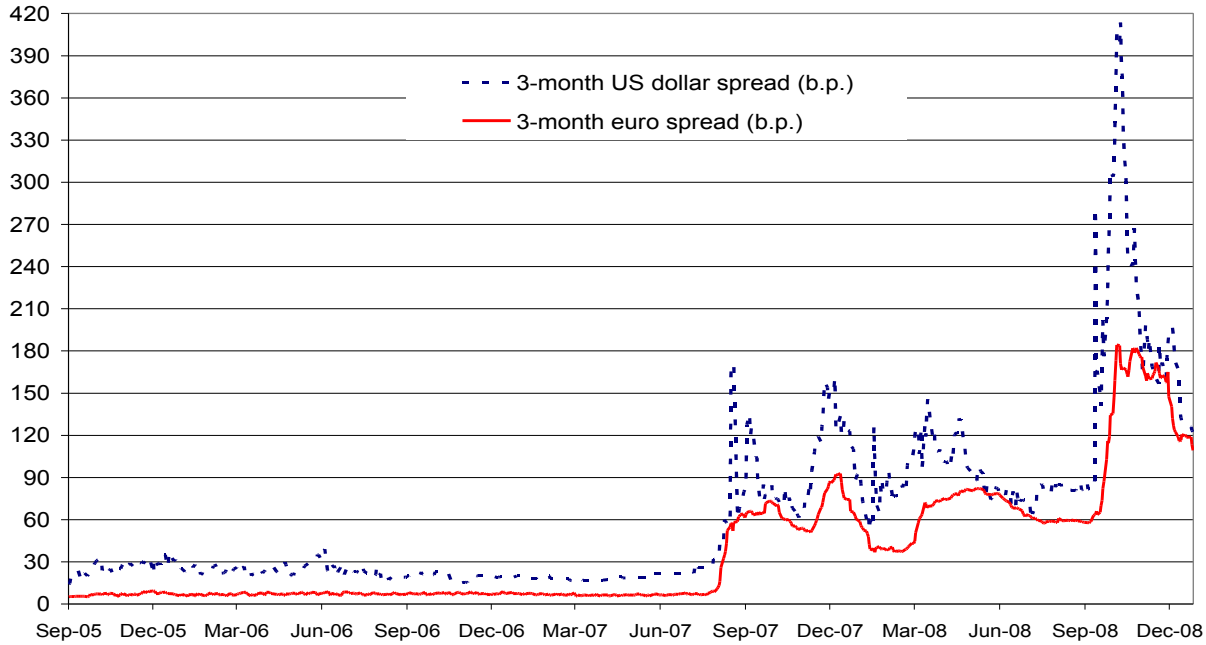
Michaud, F. and C. Upper (2008). What drives interbank rates? Evidence from the Libor panel. BIS Quarterly Review. March. pp. 47-58.

Tarashev, N., Tsatsaronis, K., Karampatos, D. (2003). Investors' attitude towards risk: what can we learn from options?. BIS Quarterly Review. June. pp. 57-65.

Taylor, J. B. and C. Williams (2008). A Black Swan in the Money Market. NBER Working Paper Series. No. 139.

Figure 1 - Interbank rate spreads

(basis points: daily data)

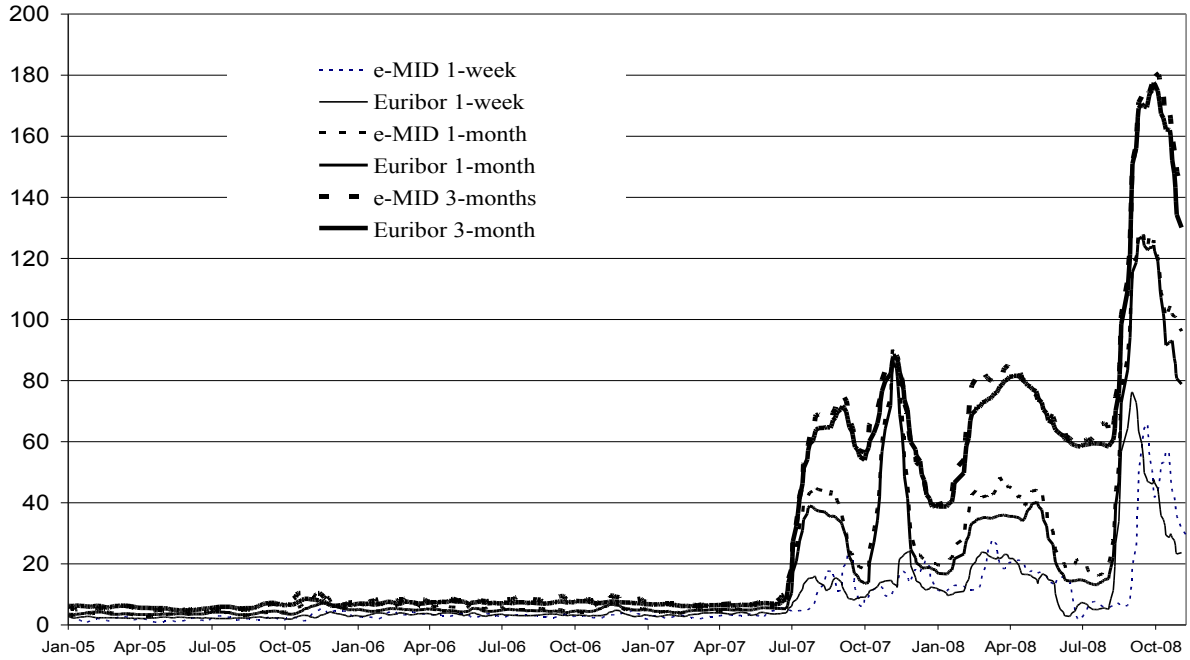


Source: Reuters, Datastream.

Note: The dollar spread is computed as the differential between the LIBOR USD 3-month rate and a composite index of contributors on the bid side for repo 3-month with Treasuries as collateral. The euro spread is computed as the difference between the Euribor and the Eurepo rate of the same maturity.

Figure 2 - Interbank spreads: Euribor vs. *e*-MID

(basis points; 2-week moving averages of daily data)

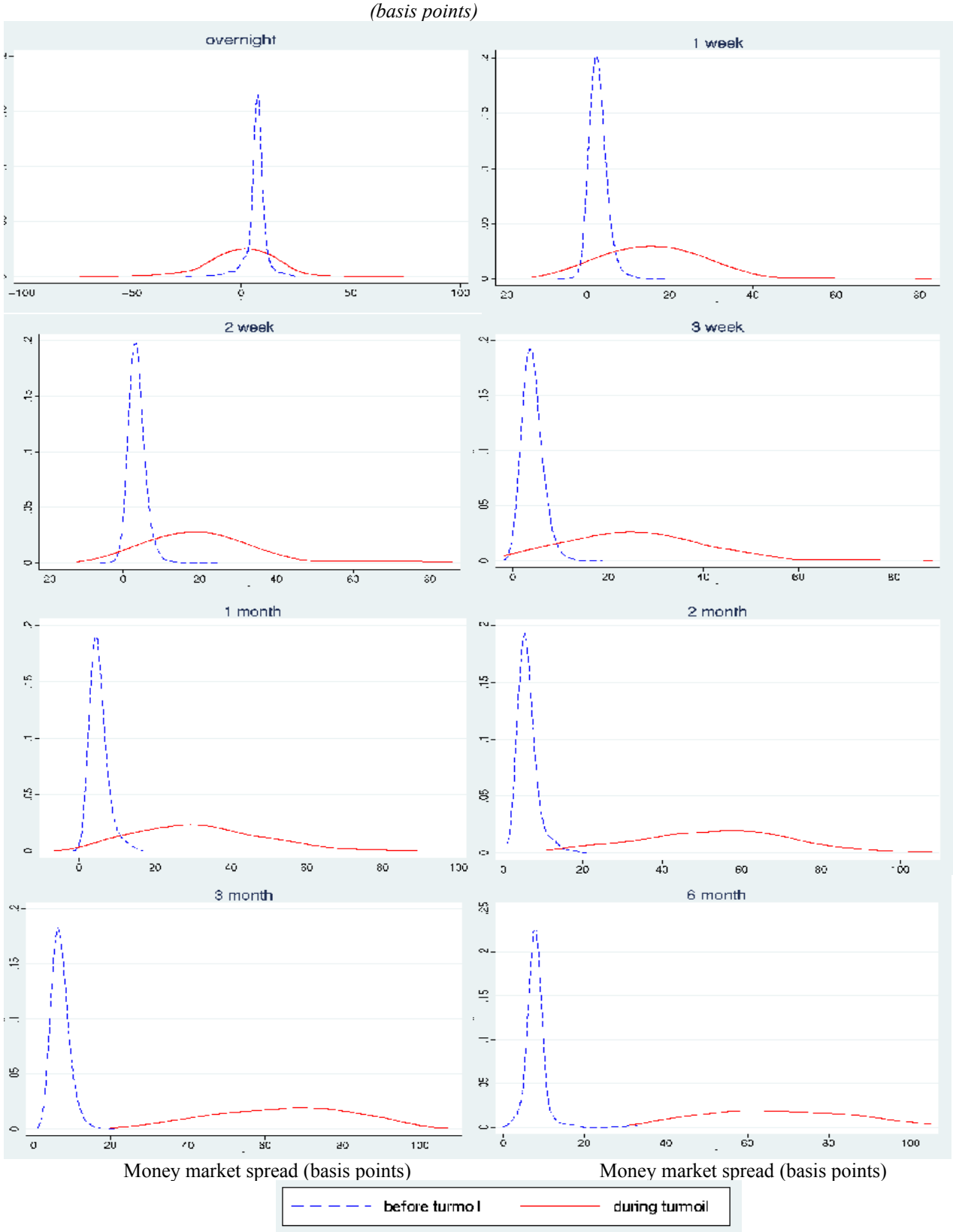


Source: *e*-MID; Reuters for Euribor rates.

Note: Differentials between the series in the legend and the Eurepo rate of the corresponding maturity. The *e*-MID series are computed as simple averages of the individual transactions recorded during the day.

Figure 3 - Estimated densities of money market spreads

(basis points)



Source: *e*-MID

Note: The densities are estimated from data on individual transactions over the pre-crisis (January 24, 2005 - August 8, 2007) and crisis (August 9, 2007 – Sep 15, 2008) periods. A normal kernel is used, with bandwith 1 and 10 for the two periods, in the order.

Table 1: Main data

		e-MID transactions			
		overall sample	before crisis	during crisis: excluding Lehman failure	during crisis: including Lehman failure
		Main money market variables			
Daily volumes exchanged (millions of euros)	mean	646	686	580	572
	st dev	416	405	418	425
	min	3	3	20	10
	max	3,067	2,495	3,067	3,067
Spread (basis points)	mean	16.5	4	33.7	43.3
	st dev	28	3	25.5	38.1
	min	-12	-6	-12	-12
	max	226	32	128.3	225.9
Daily average number of active participants	mean	24	25	23	22
	st dev	8	8	8	8
	min	2	2	2	2
	max	49	49	44	44
Duration (days)	mean	36.6	35.6	38.9	39.0
	weighted avg	32.4	32.4	33.2	32.6
Number of contracts		20,750	14,279	5,314	6,480
		Main bank variables			
Rating (Fitch long-term issuer default rating)	mean	6.9	7.0	7.0	6.9
	st dev	1.9	1.8	2.1	2.1
	min	3	3	3	3
	max	12	12	12	12
Bank size (ln of total assets in billions of euro)	mean	9.14	9.12	9.10	9.18
	st dev	1.38	1.35	1.34	1.43
	min	4.88	4.88	5.82	5.41
	max	12.99	12.96	12.98	12.99
Capital ratio (percentage points)	mean	15.0	14.7	15.9	15.7
	st dev	13.9	12.9	16.7	15.8
	min	5.6	5.6	6.3	6.2
	max	251.6	251.6	143.8	143.8

Source: *e*-MID; Bank of Italy supervisory reports for balance sheet data; Bloomberg for rating.

Note: In the table we report summary statistics of data for pooled contracts with maturities of 1, 2 and 3 weeks, 1 to 12 months. The spread is computed as a simple average of the difference between *e*-MID rates on individual transactions of a given maturity and the Eurepo rate of the corresponding maturity. The rating (Fitch long-term issuer default rating) is expressed in numerical form, with larger values corresponding to worse ratings. See table A1 for the coding.

Table 2 - Dependent variable: long-term interbank spread

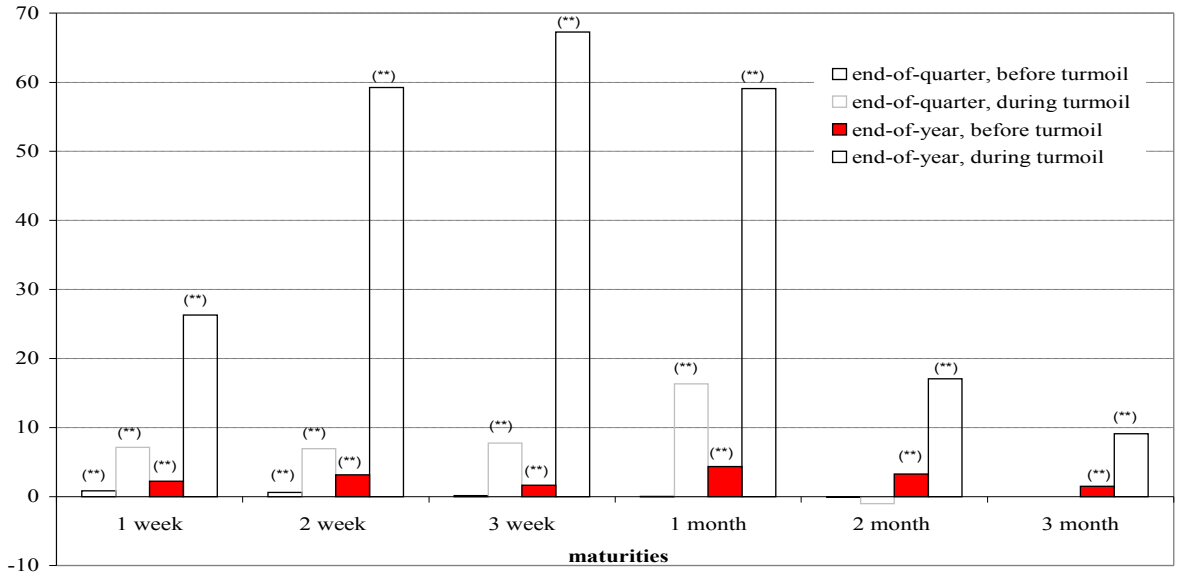
(in basis points)

	OLS	random effects		OLS	effects	
		(a)	(b)		(a)	(b)
		Before turmoil				
		(Jan 24, 2005- Aug 8, 2007)				
Bank-specific characteristics						
Rating	0.26**	0.30**	0.37**	0.26**	0.32**	0.37**
Bank has no rating (0-1)	-1.76**	-1.95**	-2.44**	-1.76**	-2.00**	-2.39**
Ln(total assets)	-0.38**	-0.24**	-0.20**	-0.38**	-0.21**	-0.18**
Capital ratio	-0.45*	-0.59*	-0.89**	-0.45*	-0.78**	-0.88**
Capital ratio seller	-2.51**	-6.86**	2.33	-2.51**	-7.32**	1.86
Risk aversion	3.05**	3.08**	-	3.05**	3.11**	-
		Additional effect during turmoil				
	excluding Lehman failure			Including Lehman failure		
	(Aug. 9, 2007 – Sept 15, 2008)			(Aug. 9, 2007 – Dec 31, 2008)		
Bank-specific characteristics						
Rating	0.42**	0.39**	0.15	0.74**	0.72**	0.41**
Bank has no rating (0-1)	-3.44**	-3.28**	-1.92**	-5.15**	-5.03**	-3.28**
Ln(total assets)	-1.06**	-0.97**	-1.26**	-0.84**	-0.63**	-1.32**
Capital ratio	-23.63**	-22.40**	-16.95**	-18.37**	-18.13**	-14.15**
Capital ratio seller	-3.62**	-14.68**	-3.73	6.37	-11.81**	-2.09
Risk aversion	27.07**	26.03**	-	30.40**	29.33**	-
# obs.	15179	15179	15179	16015	16015	16015
R-squared	0.92	0.91	0.91	0.92	0.91	0.91
Fixed effects for lender	no	yes	yes	no	yes	yes
Daily fixed effects	no	no	yes	no	no	yes
# buyer banks	97	97	97	98	98	98
# rated buyer banks	26	26	26	26	26	26
# seller banks	103	103	103	104	104	104
# rated seller banks	28	28	28	28	28	28

Note: The dependent variable is the spread between *e*-MID rates on individual transactions of various maturities, and their Eurepo daily average counterparts. See section 4.3 in the text for the construction of the dependent variable, and section 4.1 for the description of the treatment of banks without rating. Maturities considered are 1, 2, and 3 weeks, 1 to 12 months. The regressions also include two sets of zero-one dummies, for the pre-crisis and crisis periods (coefficients not reported), each controlling for: maturity (1, 2, and 3 weeks; 1 to 12 months); market side of transaction (bid or ask); window dressing/accounting effects at year-end (for 1, 2 and 3 week, 1, 2 and 3 month maturities) and quarter-end (for all but the 3-month maturity); dummies for the announcement of several exceptional long-term refinancing operations (3 and 6 month maturity) launched by the European central bank since August 2007. Heteroskedasticity robust t statistics are reported. One or two asterisks denote significance at the 5 and 1 percent confidence level, respectively. The adjusted R-squared is reported for the OLS regression, the within R-squared for the random effects regression.

Figure 4 - Estimated effect of window dressing on interbank spreads

(basis points; estimation period: January 24th 2005 - September 15th 2008)



Note: The figure reports the coefficients of the zero-one dummies capturing the effect of end-of-quarter and end-of-year window dressing-type practices on interbank rates for the maturities reported on the horizontal axis (for the 3-month maturity end-of-quarter dummies were not estimated). The coefficients are those of the OLS regression in table 3, not reported in the table. The end-of-year effects are obtained by adding the coefficients of the end-of-quarter and end-of-year dummies. One or two asterisks (above each histogram) denote 5 and 1 percent significance levels, respectively.

Table 3 - Simulated longer term spread

(basis points; average values)

	Jan 1,2005- Aug 9, 2007	Aug 9, 2007 Sep 15, 2008
Average cost of funds	5	37
Estimated cost of funds:		
- net of effect of risk aversion	3	12
- net of window dressing/accounting effects	4	32
- for:		
- banks with best rating	4	34
- banks with no rating	5	37
- large banks	4	34
- highly capitalized banks	5	34
- best rated, large, highly capitalized banks (a)	3	27
- banks with worst rating	6	40
- small banks	6	40
- poorly capitalized banks	5	38
- poorly rated, small, undercapitalized banks (b)	7	44
Estimated premium paid by:		
- worst vs. best rated banks	2	6
- small vs. large banks	2	6
- poorly vs. highly capitalized banks	0	4
- "worst" vs. "best" bank (b)-(a)	4	17

Note. Using the estimates in table 3, the table reports fitted values for the banks groups indicated by row, averaged over the pre- and crisis periods. The date for the beginning of the crisis is set to August 9, 2007. Large (small) banks are those in the tenth (first) decile of the distribution of total assets. Highly (poorly) capitalized banks are those in the tenth (first) decile of the distribution of the capital/total assets ratio.

Appendix

Table A1 - Numeric coding of selected rating variables

	individual rating		senior unsecured debt rating		subordinated debt rating	long-term issuer default rating		short-term issuer default rating	
code	Fitch	Moody's	Fitch	Moody's	Fitch	Fitch	S&P's	Fitch	S&P's
1	A	Aaa	AAA	Aaa	AAA	Aaa	AAA	F1+	A-1+
2	A/B	Aa1	AA+	Aa1	AA+	Aa1	AA+	F1	A-1
3	B+	Aa2	AA	Aa2	AA	Aa2	AA	F2	A-2
4	B/C	Aa3	AA-	Aa3	AA-	Aa3	AA-	F3	A-3
5	C	A1	A+	A1	A+	A1	A+	B	B
6	C/D	A2	A	A2	A	A2	A	C	B-1
7	D	A3	A-	A3	A-	A3	A-	D	B-2
8	D/E	Baa1	BBB+	Baa1	BBB+	Baa1	BBB+		B-3
9	E	Baa2	BBB	Baa2	BBB	Baa2	BBB		C
10	F	Baa3	BBB-	Baa3	BBB-	Baa3	BBB-		R
11		Ba1	BB+	Ba1	BB+	Ba1	BB+		SD/D
12		Ba2	BB	Ba2	BB	Ba2	BB		
13		Ba3	BB-	Ba3	BB-	Ba3	BB-		
14		B1	B+	B1	B+	B1	B+		
15		B2	B	B2	B	B2	B		
16		B3	B-	B3	B-	B3	B-		
17		Caa1	CCC+	Caa1	CCC+	Caa1	CCC+		
18		Caa2	CCC	Caa2	CCC	Caa2	CCC		
19		Caa3	CCC-	Caa3	CCC-	Caa3	CCC-		
20		Ca	CC	Ca	CC	Ca	CC		
21		C	C	C	C	C	C		
22			D		D		D		
number of rated banks trading contracts at different maturities									
overnight	77	35	70	78	61	87	87	57	71
long-term	61	21	50	57	46	61	66	39	56

Table A2 - Dependent variable: interest rate spread on individual maturities

(in basis points; OLS; estimation period: January 24th 2005 - Sep 15th 2008)

	1-week		2-week		3-week		1-month		2-month		3-month		6-month	
	coeff	t stat	coeff	t stat	coeff	t stat	coeff	t stat	coeff	t stat	coeff	t stat	coeff	t stat
Bank-specific variables							**Before crisis**							
Rating	0.14	*4.1*	0.18	*4.1*	0.33	*4.6*	0.31	*6.2*	054	*6.0*	0.24	*4.5*	0.56	*3.5*
Bank has no rating	-0.97	*-4.3*	-1.33	*-4.6*	-2.28	*-5.0*	-1.90	*-6.8*	-3.58	*-6.1*	-1.67	*-5.1*	-4.11	*-3.2*
Ln(size)	-0.36	*-12.5*	-0.43	*-10.3*	-0.38	*-5.5*	-0.33	*-8.1*	-0.30	*-3.9*	-0.38	*-8.0*	-0.32	*-2.5*
Capital ratio	-1.03	*-2.2*	-0.37	*-0.6*	-0.35	*-0.3*	0.47	*0.8*	-1.78	*-1.5*	-0.60	*-0.8*	1.30	*0.6*
Market-wide variables (0-1)														
Risk aversion	2.52	*16.6*	2.80	*14.0*	3.14	*9,7*	3.23	*13.7*	3.38	*8.9*	4.22	*15.0*	2.76	*5.4*
Transaction is in bid	-0.68	*-12.9*	-0.69	*-9.9*	-0.42	*-3.7*	-0.85	*-10.6*	-0.83	*-6.3*	-0.71	*-7.6*	0.18	*1.0*
Year-end window dressing	3.42	*11.6*	3.20	*10.4*	3.82	*15.0*	4.75	*22.4*	3.65	*13.7*	1.56	*13.2*	-	-
Quarter-end window dressing	0.31	*3.3*	0.32	*3.1*	-0.17	*-1.3*	-0.22	*-2.6*	-0.26	*-1.8*	-	-	-	-
constant	4.74	*10.7*	5.90	*9.4*	4.62	*4.2*	4.54	*6.9*	4.69	*3.9*	8.13	*10.9*	7.53	*4.8*
							Additional effect during crisis							
Bank-specific variables														
Rating	0.56	*2.2*	0.77	*2.4*	1.05	*1.4*	0.86	*2.3*	1.18	*1.1*	-0.23	*-0.5*	-4.00	*-1.9*
Bank has no rating	-1.88	*-1.3*	-3.38	*-1.8*	-10.11	*-1.9*	-6.2	*-3.1*	-7.76	*-1.2*	-0.27	*-0.1*	13.5	*0.3*
Ln(size)	-0.08	*-0.3*	0.02	*0.03*	-1.38	*-1.5*	-0.86	*-1.8*	-0.83	*-1.0*	-1.83	*-3.8*	-3.20	*-1.3*
Capital ratio	-1.67	*-0.3*	-8.02	*-0.7*	-42.10	*-1.4*	-15.24	*-1.4*	-44.78	*-1.3*	-72.17	*-4.6*	-132.00	*-2.5*
Market-wide variables (0-1)														
Risk aversion	12.80	*7.8*	0.71	*0.2*	23.2	*4.0*	19.67	*5.7*	40.98	*7.8*	61.01	*21.0*	53.82	*4.2*
Transaction is in bid	-1.27	*-2.4*	-0.91	*-1.2*	-0.05	*-0.0*	0.27	*0.3*	-4.54	*-2.6*	-0.72	*-0.8*	0.40	*0.1*
Year-end window dressing	9.28	*1.9*	37.05	*12.7*	61.29	*14.9*	43.76	*24.6*	11.64	*5.2*	11.18	*9.7*	-	-
Quarter-end window dressing	15.76	*14.1*	17.22	*11.1*	6.53	*2.5*	14.42	*16.7*	9.26	*5.6*	-	-	-	-
Maturity (0-1)	-4.31	*-1.0*	7.25	*0.8*	11.41	*0.8*	8.02	*1.1*	12.90	*0.9*	34.81	*4.6*	94.90	*3.3*
No. obs.	4824		2580		897		3106		898		2193		407	
R^2	0.70		0.86		0.93		0.90		0.93		0.95		0.95	

Note: The spread is computed as the *e*-MID rate on individual transactions for the maturity reported in the various columns, minus the daily average of the Eurepo rate of the corresponding maturity.