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Numerical and Empirical Analysis of Interbank Lending and Systemic Risks

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e-MID

Dataset

Objectives

Cross-sectional Spreads

Strategic Behaviour?

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Numerical and empirical analysis of interbank lending and systemic risks

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Talk given at: ICTP



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Interbank markets play a key role in banks' liquidity management and the transmission of monetary policy.

- First and foremost, it is in such markets that central banks actively intervene to guide their policy interest rates.
- Well functioning interbank markets effectively channel liquidity from institutions with a surplus of funds to those in need, allowing for more efficient financial intermediation.
- Variations in interbank rates are rapidly transmitted to the entire term structure, affecting borrowing conditions for households and firms.
- Interbank rates provide benchmark (e.g. LIBOR) for the pricing of fixed-income securities and underlie derivatives contracts such as the eonia-swaps and futures on 3-month rates, used by banks to hedge their short term interest rate risks.



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Thus, policymakers have an interest in having a financial system with a well functioning and robust interbank market, that is, one in which the central bank can achieve its desired rate of interest and one that allows institutions to efficiently trade liquidity.

One of the mandate of Central Banks is to manage the liquidity in the banking system.

- weekly auctions
- the marginal lending facility in order to obtain overnight liquidity from the central bank, against the presentation of sufficient eligible assets
- the deposit facility in order to make overnight deposits with the central bank.



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The ECB key rates are:

- Marginal lending facility rate (EuroMLR): the rate 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) are executed by the NCBs on the basis of standard tenders and according to a pre-specified calendar. The main refinancing operations provide the bulk of refinancing to the financial sector.
- **Deposit facility rate (EuroDEP):** counterparties can use the deposit 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.



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Credit institutions in the euro area are required to hold minimum reserve balances with NCBs.

- These reserves are remunerated at the main refinancing rate.
- They have to be fulfilled only on average over a one-month maintenance period that runs from the 24th of a month to the 23rd of the following month.
- Banks can exchange reserves on the interbank market with the objective to minimize the reserve implicit costs.
- The overnight rate is bounded above and below by the official rates corridor fixed by the ECB: banks may borrow against collateral at the rate on the marginal lending facility (the ceiling) or deposit funds at the rate on the overnight deposit facility (the floor).



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The electronic Market for Interbank Deposits, e-MID, covers the entire existing domestic overnight deposit market in Italy.

- This market is unique in the Euro area in being a screen based fully electronic interbank market. Outside Italy interbank trades are largely bilateral or undertaken via voice brokers.
- The central system is located in the office of the SIA and the peripherals on the premises of the member participants.
- The names of quoting banks are visible next to their quotes to facilitate credit line checking. A transaction is finalized if the ordering bank accepts a listed bid/offer.



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Both italian banks and foreign banks can exchange funds. Market players are 246 members from 29 EU countries and the US, of which:

- 30 central banks acting as market observers
- 2 Ministries of Finance
- 108 domestic banks
- 106 international banks



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Types of trade:

- Overnight (O/N): Trades for a transfer of funds to be effected on the day of the trade and to return on the subsequent Business Day;
- Tomorrow next (T/N): Trades for a transfer of funds on the first Business Day following the day of the trade and to return on the second Business Day following that of the trade;
- Spot next (S/N): Trades for a transfer of funds on the second Business Day following the day of the trade and to return on the third Business Day following that of the trade;



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- Time Deposits: Trades for an initial transfer of funds and to return at a predetermined maturity (from 1 week to 12 months);
- Broken Date Deposit: Trades with freely agreed Initial Value Date and Final Value Date between parties without standardization obligations provided that both dates do not coincide with the previous ones and that the two days are not separated by a period superior to a calendar year



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Daily transactions by contract



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Daily volumes by contract Pre and post sub prime



Numerical and empirical analysis of interbank lending



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- Trading in e-MID starts at 8 a.m. and ends at 6 p.m.
- Deals between Italian banks mature at 9 a.m. (next day).
 Deals involving (at least) a foreign bank mature by noon (next day).
- Previous day trades are settled in real-time, as the borrowing bank has to repay the amount due through a Target payment.



Trading mechanism

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- As in a security market, participants post their quotes.
- Aggressors can pick a quote and manifest their willing to close the trade. This choice is completely done by the operator itself; he can choose the quantity, rate and counterpart he prefers, regardless of the book status.
- A quoter willing to lend capital, has the options to reject an aggression. This major difference from the security market gives the participant the opportunity to choose their counterpart. An aggressor can subordinate her willing to close a trade to some specific requests, such as a larger or smaller volume or a different rate.
- The operator posting anonymously a quote is disclosed only by another operator aggressing the pending quote. In this case the aggressing operator has the additional option of not closing a trade after knowing the counter party.



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- The data base is composed by the records of all transactions registered in the period 01/1999–12/2009 for a total of 1.523.510 transactions.
- For each contract we have information about the date and time of the trade, the quantity, the interest rate and the encoded name of the quoting and ordering bank.
- The banks are reported together with a code representing their country and, when the bank is Italian, a final label that indicates the class of capitalization (large, medium, small)
- The set of internal loans and debts has a structure that can be naturally described by means of a network, that is a system consisting of vertices (banks) connected by one or more oriented edges (debts/loans).
- The aggregate characteristics of the entire set of transactions can thus be studied in terms of the statistical and topological properties of this network.



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- analyze the response of the e-Mid to the recent financial crisis
- investigate intraday and intra-maintenance-period patterns in the activities of banks.
 - identify strategic behaviour in banks
- analyze the evolution of structure of the interbank network over time.
- relate finding to interbank market stability





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Figure: Mean daily rate with the ECB key rates. Here we added two vertical lines. The first marks the subprime crisis of August 2007 and the second the collapse of Lehman Brothers of September 2008.





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Figure: Left: Daily rate volatility averaged within a month. Right: Daily normalized volatility averaged within a month.



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Figure: Left: monthly average of daily volumes. Right: monthly average of daily trades. Black line borrower initiated transactions, dashed line lender initiated transactions.



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Figure: Left: daily average $N_b/(N_b + N_l)$. Right: daily average of $V_b/(V_b + V_l)$





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Figure: Monthly average of daily active banks. A bank is considered to be active if engage in at least one trade during a given day, without considering its side (quoter or aggressor).





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Figure: Left: monthly average of the daily active banks acting as quoters. Right: monthly average of daily active banks acting as aggressors. Black line borrowers, dashed line lenders.





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Figure: Intraday rate deviation from mean daily rate.





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P(Max rate)

Numerical and empirical analysis of interbank lending



Bid-Ask spread

We define \bar{r}_s and \bar{r}_b are as

$$\bar{r}_s^d = \frac{\sum_{i=1}^{N_{sd}} r_{si} v_{si}}{\sum_{i=1}^{N_{sd}} v_{si}}$$
$$\bar{r}_b^d = \frac{\sum_{i=1}^{N_{bd}} r_{bi} v_{bi}}{\sum_{i=1}^{N_{sd}} v_{bi}}$$

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where N_{sd} and N_{bd} are the number of the Sell and Buy transactions in the day *d*. The labels Sell or Buy indicate that the quoter bank is borrowing and the aggressor is lending in the first case, and the opposite in the second case. The *bid-ask spread* (or *Sell-Buy*) can now be easily computed as $s_{ba}^{d} = \bar{r}_{b}^{d} - \bar{r}_{s}^{d}$.





Figure: Monthly average of the daily Sell-Buy spread. Two very well defined peaks are clearly present after the crisis milestones



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Figure: Left: bid-ask spreads intraday average. Right: Number of transactions intraday average.



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It is interesting to study whether some banks are able to borrow/lend money at a better rate than other banks. To do so, we considered the spreads defined as

$$c_{ij} = \frac{\sum_{j} (r_{ij} - \bar{r})}{\bar{r}}$$
(1)

where the mean rate \bar{r} is averaged over a day.



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Before crisis

- clustering coefficient smaller than if trades happens at random
- very limited preferential attachment

But before crisis there was little scope for playing strategically! Did things changed after the crisis?



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Figure: Relative clustering coefficient C_a (left); Relative clustering coefficient C_b (rigth) as a function of the distance from the EoM.



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Figure: (Left) Participation ratio $Y_2^c(i)$ as a function of $1/k_i$ for borrowing (black) and lending transactions (red). The continuous black line is the benchmark case of no preferential lending/borrowing. (Right) random network case



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Figure: Medium size italian bank. Larger spreads after ECB rate rate falls



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Figure:



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Figure:



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Information effect early in the morning:

- higher rates
- wider spreads
- less borrowers initiated transactions

see also Cassola, Holthausen and Lo Duca (2008).



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Determinant of credit spreads: cross-sectional spreads broader (even more as ECB rate increases)

- Size effect?
- Credit rating effect?
- Strategic behaviour (daily or monthly)?