Are risky banks rationed by corporate depositors?

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Abstract

We analyze auctions of unsecured money market deposits of firms to banks via a FinTech intermediary. In each auction, only the firm observes the banks and their interest rate bids and decides where to deposit its funds. We observe that deposit interest rate bids increase monotonically with banks' risk and that firms in general prefer higher deposit interest rates. However, our results show that the selection of firms of where to deposit is concave in bid interest rate in line with the notion of credit rationing in Stiglitz and Weiss (1981). We find this confirmed on the intensive as well as on the extensive margin. Risky banks eventually exit the market, and re-enter when their risk decreases again in the long-term. Relatedly, we observe that risky banks exit when the interest rate they have to offer increases above the interest rate charged by the central bank. This has important implications for banks' access to unsecured corporate funding, central bank liquidity provision and the understanding of deposit markets as well as Fintech in general.

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1. Introduction

The seminal work of Stiglitz and Weiss (1981) suggests that lenders might ration borrowers and that rationing can occur in equilibrium even though borrowers offer to pay a higher interest rate. Interest rates serve as a screening device for lenders and a higher offer signals potentially higher borrower risk. If information is imperfect and costly, an optimal interest rate exists that maximizes a lender's expected return, and offers beyond this rate are rejected even though there is a higher demand for loans. Interestingly, despite the large and still growing theoretical literature on credit rationing, only little empirical evidence exists linking a borrower's interest rate offers to lending decisions. An important reason might be data availability. Even if information on loan applications and rejections is available, uncertainty about "true" borrower risk remains. Ideally, as empirical researchers, we would like to investigate loan applications where borrowers signal their risk via the interest rate they are willing to pay [conditional on their (observable) characteristics]. In a competitive market, this interest rate might then allow lenders to screen borrowers, which in turn would allow researchers to test hypotheses related to credit rationing.

In this paper, we empirically investigate credit rationing as modeled in Stiglitz and Weiss (1981) using unique data of a FinTech intermediary. However, and in contrast to their perspective that banks lend to firms, we investigate firms that are lending to banks in the corporate deposit market and examine whether risky banks are rationed by depositing firms. Specifically, we use data of auctions of deposits from a multi-dealer trading platform over the 2005 to 2015 period. On this platform, firms are able to offer funds at a maturity of their choice.[1] The usual offer period is 2 minutes for an overnight deposit. Firms' selection of banks follows a two-step process. In a first step, firms decide which banks to invite to an auction. These banks

[1] We provide a detailed explanation of the auction format on the platform in the next section.

are then able to bid for the offered deposit amount and, in a second step, the firm has the choice to select a bank bid or to select no bid at all. It might also select several banks and divide the offered amount according to its preferences. In all auctions, only the firm observes the bidding information during the auction, i.e. banks do not observe the other banks' bids in the auction. We observe all offers and the corresponding bids together with the outcome. We know the identities of banks and observe the timestamp and information of each of their bids. We also have a numerical identifier for each of the firms available and are thereby able to track these and their matching with banks over time.[2]

This market is important for both firms and banks. Today's liquidity management of firms implies that many firms deposit high amounts of their daily liquidity with different banks to earn interest income and let it not just sit idle (Duchin et al., 2016). The average deposit amount in this market is €81.4 million. Difficulties in accessing this liquidity only for a few days due to, for example, financial difficulties of a bank could already cause substantial problems to some firms. Banks often rely on obtaining short-term funding via corporate deposit markets. The daily unsecured funds from firms' liquidity management are interesting for banks because these are often cheaper than funds obtained in the interbank market.[3] The average total deposited amount in a quarter via the platform is €181 billion. These funds might especially be useful in times when the interbank or secured (repurchase) funding markets are stressed (e.g.; Afonso, Kovner, and Schoar, 2011; Ashcraft, McAndrews, and Skeie, 2011; Gorton and Metrick, 2012; Krishnamurthy, Nagel, and Orlov, 2014; Heider, Hoerova, and Holthausen, 2015).

[2] Note that the setup of a multi-dealer trading platform implies high transparency and allows us to investigate the selection of banks by firms with sufficient statistical power. Furthermore, it ensures that quotes are competitive irrespective of client sophistication (Hau et al., 2017).

[3] In the following section, we provide more institutional details, which show that in case of bank default the (uninsured) deposits in our study are treated equally to claims of bondholders, while they have the same seniority as long-term but lower seniority than short-term unsecured interbank transactions. Note that this is in contrast to the US, where uninsured depositors have first claim over other non-deposit claim holders in the event of bank failure, as regulated in the 1993 Depositor Preference Act.

In our main analysis, we test whether the probability that a deposit interest rate bid is selected by a firm is concave in the interest rate. According to our theoretical framework, a higher interest rate bid implies a higher probability to be selected. However, the increase in probability should reduce the larger the interest rate bid. The idea is illustrated in Figure 1. As shown in Figure 1A, a bank's interest rate bid increases monotonically in the bank's risk.[4] However, given market imperfections some uncertainty about bank risk remains. This suggests that rationing might especially be observable when uncertainty is higher, that is, for riskier banks. It is important to keep in mind that Stiglitz and Weiss (1981) determine an *equilibrium* optimal interest rate suggesting a discrete interest rate threshold of borrower rationing. In contrast, given the empirical nature of our study we use the notion of a continuous threshold. That is, for a given level of observable bank risk a higher interest rate signals higher "true" risk. However, we expect that if banks were rationed, this might especially be observable when bank characteristics already indicate a high level of uncertainty via banks' risk.[5] Accordingly, rationing should especially be observable empirically for high interest rate bids such that the probability of a bank to be selected increases at a slower rate the higher the bid. This is depicted in Figure 1B.

[Insert Figure 1 here]

Hau et al. (2017) show for the foreign exchange market that on multi-dealer request-for-

[4] Note that banks cannot bid any random interest rate given that some of their characteristics are readily observable to firms via e.g. accounting data or CDS spreads.

[5] We acknowledge that other factors such as a firm-bank relationship or future business in other areas might have an impact on deposit interest rate bids. However, we examine the bids of very large banks where it is not obvious that repeatedly interacting with one of these substantially reduces information asymmetries relative to other banks. Furthermore, it is not clear why one bank would have a higher interest than other banks to obtain future business from the firm. This especially applies given that we investigate in general overnight deposits on a trading platform which might only have very little if any influence on obtaining future business from the firm in other areas.

quote (RFQ) platforms dealers price competitively.[6] In a first step, we perform several checks to obtain further confidence regarding competitiveness and efficiency also when analyzing deposits in this environment. In our main tests, our preferred measure for risk is a bank's interest rate bid (as shown in Figure 1B). We thus first investigate if bank characteristics are monotonically related to bank deposit interest rate bids (as shown in Figure 1A). We find that banks with higher CDS spreads monotonically bid higher interest rates. This applies on a given day as well as within an auction. On average, a one percent higher CDS spread implies a 2.8 basis points (bps) higher deposit interest rate bid within an auction. We also find that smaller banks, banks with higher leverage, and banks with lower return on equity bid higher rates.

We then examine firms' management of deposits more broadly. As expected, we observe that firms prefer higher to lower interest rates. On average, a 1bps higher interest rate bid in an auction increases the likelihood that a bid is selected by 0.6%; consistently, submitting the highest bid in an auction implies a 55% probability to win the auction. However, we also document that firms actively manage risks and do not only select the highest yielding deposit bid. Conditional on bidding the same interest rate, firms select less risky banks. They also diversify more when bank risk increases: holding the total monthly deposit amount constant, firms allocate smaller amounts per bank to a larger number of banks.

In the main part of our analyses, we test the model of Stiglitz and Weiss (1981) empirically and investigate whether a bank's likelihood to be selected is concave in its deposit interest rate bid. Our results show that risky banks are rationed by depositing firms. We observe that the probability to be selected is increasing in deposit interest rate bid but with a decreasing

[6] We also use data from a multi-dealer RFQ platform which follows the same setup for deposits as it is described in Hau et al. (2017) for FX. Interestingly, the authors also show that dealers do not price discriminate even when a client always requests quotes only from the same dealer. The reason is that dealers do not know how many other dealers, if any, were also asked to bid.

slope. This is also confirmed when scaling interest rate bids by banks' risk, comparable to a piecewise linear estimation. Consistent with our theoretical framework, credit rationing is more pronounced when uncertainty about bank risk is higher. These results are confirmed in non-crisis as well as in severe crisis periods, splitting deposits into amounts above and below €100 million per auction, including only overnight deposits, or specifically controlling for the preference of firms for the highest bid in an auction.

We also investigate rationing using data aggregated to the bank-month level. For this purpose, we examine the percent of auctions in which a bank is not selected (which we call "failure rate"). If firms ration banks, the relationship between this failure rate and a bank's deposit interest rate bid should be convex. This is also borne in the data. A bank's failure rate is decreasing in deposit interest rate bid, which is, again, attenuated the higher the bid. We observe the same pattern when we replace the deposit interest rate bid with the fraction of auctions in which a bank has the highest bid within a month. In further tests, we condition on a bank's auction success probability and investigate the monthly failure rate of banks in auctions for banks that are selected by at least some of the firms and those, which are not selected by any of the firms despite bidding for their deposits. Also in these cases, we observe a convex relationship between auction failure rate and bid deposit interest rates. These results provide further empirical evidence that risky banks are rationed by depositing firms.

Our results provide especially strong support for a rationing of risky banks given the two-step selection process for firms described above. If banks are too risky, firms might not even invite them to bid for their deposits. We therefore also investigate the extensive margin and examine whether banks exit the market when they become too risky, similar to funding dry-ups as in, for example, Perignon et al. (2018). Our analyses show that banks are more likely to exit

the market when their observable risk is higher. Additionally, we observe that high bank risk is a predictor of bank exit. However, the same is true in the opposite direction for bank re-entry. When bank risk decreases, banks are more likely to return to the deposit platform. Moreover, lower bank risk is also a predictor of bank re-entry. Interestingly, a return seems to be related to a longer-term decrease in bank risk, that is, banks re-enter the market after having stabilized with respect to risk again. This is in line with Perignon et al. (2018), who show that performance is decreasing in the long-run after a bank's exit from wholesale funding markets and adds to their findings showing that re-entry is related to long-run improvements in bank risk.[7]

Finally, we investigate the mechanism of a bank's exit from the corporate deposit market in more detail. Given that a bank's funding rate is monotonically related to its risk, an explanation might be that other funding markets become more attractive. We therefore investigate if banks are more likely to exit unsecured corporate deposit markets when they (have to) bid more often above the interest rate required to obtain funding in alternative markets. For the latter, we use the interbank market and funding via the central bank. Importantly, the interest rate in the interbank market is sensitive to banks' risk while the European Central Bank (ECB) follows a fixed interest rate full allotment procedure since October 2008. That is, the main refinancing rate is largely risk-insensitive.[8] Our results show that banks are more likely to exit the unsecured corporate deposit market after months in which they bid more often above the interest rate charged by the ECB. We do not observe this pattern for the percentage of bids above

[7] Perignon et al. (2018) observe that banks almost never re-enter the market and conclude that these are not perceived as safe anymore. While this is true for stressed banks which eventually have to restructure or even default, some could only have difficulties in the short-term. We observe in our data that some are able to re-gain confidence from investors over time and continue regular business again despite the difficulties in the past. However, given the confidentiality of our data we are not able to list these as in Perignon et al.

[8] While the fixed interest rate full allotment procedure implies that each bank obtains funds from the ECB at the same interest rate irrespective of its risk, the ECB states in its guidelines that "the Eurosystem may also suspend, limit or exclude counterparties' access to open market operations .. on the grounds of prudence" (guideline (EU) 2015/510 of the ECB of 19 December 2014). The same applies to provided collateral.

the interbank market interest rate. This suggests that a largely risk-insensitive refinancing rate, as it is the case for the ECB since 2008, constitutes a ceiling for short-term bank funding rates. Note that our result on rationing of banks by firms is confirmed also when we remove the cases where banks bid above the ECB main refinancing rate. In sum, both effects seem to be in place at the same time. Risky banks are rationed by corporate depositors as well as have a higher likelihood to obtain funding in markets where interest rates are largely risk-insensitive.

Credit rationing is important for the transmission of monetary policy as well as long-term growth (Calomiris and Longhofer, 2009). It is also broadly related to bank runs (e.g.; Diamond and Dybvig, 1983; Calomiris and Kahn, 1991). Empirical evidence on rationing is limited. Berger and Udell (1992) show that loans under commitment do not increase in tight markets and conclude that rationing is not a significant macroeconomic phenomenon. Some studies analyze survey data.[9] The challenge with these data is that self-reported rejections do not necessarily relate to credit rationing (Calomiris and Longhofer, 2009). Finally, Berger et al. (2011a, 2011b) and Cerqueiro et al. (2016) investigate the aspects of rationing with respect to collateral.

The paper proceeds as follows. In section 2, we describe the trading platform and the deposit auction format in more detail and provide institutional details on claim priority in European banks. In section 3, we describe the data and provide descriptive statistics. In section 4, we investigate market efficiency. Section 5 presents the findings on rationing of banks. Section 6 concludes.

2. Institutional Details

In this section we describe the format of the auctions which we investigate in our analyses. Thereafter, we explain the claim priority of the deposits we include in our study in case

[9] Examples are Cox and Jappelli (1990), Jappelli (1990), or Chakravarty and Scott (1999).

of default to put results into perspective.

2.1 AUCTION FORMAT

We use data from a European multi-dealer request-for-quote trading platform, comparable to Hau et al. (2017) for the foreign exchange market, which ranks among the three largest platforms in Europe by volume. It was founded in the early 2000's as a multi-product platform and grew substantially over time. Prior to trading, banks and firms agree on a framework agreement. This agreement applies to all of their future trades on the platform.

Firms are able to offer any deposit amount with any maturity on the platform. All banks that have entered a framework agreement with the firm can be invited by the firm to bid.[10] The maximum bidding time in general is two minutes but can be adjusted by the firm prior to the start of the auction. Until the end of this period and briefly afterwards, the firm can select a bid based on its preferences. Banks do not observe other banks' bids but can adjust their offer during the bidding period. This implies that banks adjust their bid during the bidding process only idiosyncratically due to e.g. changes in the market interest rate but not in response to other banks' bids. Important to note is that the platform uses so-called "nice quotation". This implies that for every €1 million that a bank bids for, it has to wait one third of a second. Accordingly, if a bank bids for €30 million it has to wait for 10 seconds (30 * $^1/_3$) before it is allowed to adjust its previous bid. In our analyses, we only include the last bid of a bank in an auction because this is the latest information available to a firm when accepting (or rejecting) an offer.

Appendix A1. shows an example of a deposit auction. This auction is executed on November 14, 2005 at 12:35:58 p.m. The maturity is one day, the notional is €76,200,000 and

[10] The choice to enter a framework agreement with a bank actually constitutes the first step of firms on the selection of banks. However, we refrain from analyzing this in more detail due to insufficient data. For example, we do not have data on the differences in general availability of banks to firms or the differences in contract complexity available. That is, several other factors besides bank risk might have an influence on firms' decision to enter a framework agreement, for which we are not able to control.

six banks bid in this auction. The executed bid is the bank bid where "Status" and "Status of bank bid" both indicate "EXEC", that is, the bid of 2.08% of Bank2 which is provided on November 14, 2005 at 12:35:34 p.m. is the actual deposit transaction. The bids of the other five banks are not selected by the firm what is indicated by "LCAN" (list cancel) in the column "Status of Bank Bid". Interest rates on the platform are quoted using an actual/360 day count convention and transactions are settled on the same day. This implies that the amount of €76,200,000 in the example is transferred on November 14, 2005 to Bank2 and repaid to the firm on November 15, 2005. Note that the numerical firm identifier, which is of course the same for all observations in this auction, is removed from the example.

2.2 CLAIM PRIORITY

For the interpretation of our results, it is important to understand the priority of the deposits, which we include in our analyses, in case of default. We exclude all deposit transactions below a notional value of €100,000. Accordingly, we only include *uninsured* deposits, which are not covered by deposit insurance. Furthermore, these deposits are also *not collateralized* by specific assets of the bank. In case of default the assets of a bank will be liquidated and distributed to creditors according to a given priority structure. If and how the deposits are *secured* consequently depends on their claim priority in case of default.

In the US, the 1993 Depositor Preference Act (called "Omnibus Budget Reconciliation Act") gives uninsured domestic depositors first claim on the assets of a failed bank over other bank claim holders in the event of bank failure. Thus, these depositors have priority over foreign deposits (that is, deposits payable outside the US), bondholders and interbank funds. In short, uninsured depositors hold "more secured" funds than other claim holders do.

The regulation in Europe regarding claim priority is becoming consistent among countries only since 2015, when the Bank Recovery and Resolution Directive (2014/59/EU) was initiated to secure a minimum harmonization of rules and powers for the recovery and resolution of financial institutions. For an illustration of claim priority in the period 2005 to 2015, which we include in our analyses, we use the case of Germany as an example. For a German bank, the cascade of losses, and therefore the "inverted claim priority", is as follows:

i. shares and other instruments of Common Equity Tier 1

ii. additional Tier 1 instruments, such as unsecured unlimited subordinated bonds or silent participations with a conversion clause

iii. instruments of Tier 2, such as subordinated loans or participation rights

iv. unsecured subordinated liabilities that do not meet the requirements of additional Tier 1 and Tier 2 instruments

v. unsecured senior liabilities, such as loans from other banks, bonds, and corporate deposits greater than €100,000

vi. preferential deposits, such as deposits of private individuals as well as small and medium sized enterprises (SME) greater than €100,000

Accordingly, the deposits analyzed in our study are included in v. While i. to iii. are considered to be regulatory capital, the remainder is used for bail-in in case of default of a bank following the ranking above. Accordingly, the corporate deposits that are analyzed in this paper are junior to deposits of SME firms[11] while they have the same seniority as bank loans. It is important to note that the latter only applies to bank loans with a maturity of at least one week because refinancing interbank loans, that is, interbank liabilities with an initial maturity of less

[11] Note that we are not able to exactly classify the deposits in our study without restriction because we do not have the firms' identities. The average notional amount of €81.4 million per actual transaction, however, provides us with confidence that the firms in our sample are rather large.

than 7 days, are excluded from this loss cascade. Accordingly, the uninsured and uncollateralized deposits we investigate in our analyses have the same priority as bondholders and longer-term interbank deposits but are junior to short-term interbank deposits and deposits of SMEs and retail customers.

The claim priority of the relevant corporate deposits is rather comparable among countries in the European Union during the respective timeframe. Briefly investigating also the creditor hierarchy in the UK we observe that losses are incurred first by shareholders, then by any interest incurred post insolvency, followed by unsecured subordinated creditors, such as subordinated bondholders, and finally by unsecured senior creditors, such as bondholders and corporate deposits greater than £85,000. Accordingly, the rank of corporate deposits is rather similar across European countries.

3. Data

We investigate data from a European multi-dealer request-for-quote trading platform from January 3, 2005 until December 31, 2015. We include only Euro-denominated deposits with a notional amount of more than €100,000. Table 1 reports in Panel A descriptive statistics and in Panel B descriptions of variables. It shows that the data include 446,173 observations of 486 firms depositing with 87 banks.[12] We define an auction as an offer where at least two different banks bid. The data include 64,280 auctions where at least one bank is selected. In these, on average 4.55 banks are bidding. This reduces to 3.38 banks when including all observations because several deposit offers, specifically 10% of all observations, only include one bidding bank. Accordingly, firms also access the platform when they would like to have an

[12] Note that the actual number of observations is much higher in our initial data set but we only include the last bid of each bank for a deposit offer, as explained earlier.

offer from a specific bank what argues for the convenience and ease of using it.[13]

[Insert Table 1 here]

The average maturity of offered deposits is 9 days, with a median maturity of 1 day. That is, a large part of our sample is overnight deposits. 79% of all observations and 85.6% of all transactions have a maturity of one week or shorter. The median notional amount offered is €35 million, with a median in auctions with at least one transaction of €39 million. Figure 2 shows in Panel A that the quarterly total deposit amount is rather constant. Panels B and C depict, however, that banks allocate lower amounts per bank in more auctions during severe crisis periods as was the case in e.g. 2008 and 2011. Panel D additionally shows that the percent of auctions in which no bank is selected increases in later periods, which include crises as well as negative interest rate offers.

[Insert Figure 2 here]

In our data, we know the bidding banks' names and collect annual bank-specific accounting variables from Bankscope and match these (with a one year lag) to each deposit transaction. The average bank in our sample has €874 billion of total assets in 2005 real terms, with a leverage of 95%, and a non-performing loan (NPL) ratio of 4%. The return on equity (ROE) is 2% and asset growth is zero on average, where the spread between loan and deposit interest rates of a bank is 1.19%, and its exposure to off-balance sheet items is 19%. Note that several of these measures such as NPL, ROE, or asset growth exhibit substantial variation. This is to be expected given our sample period, which includes the financial as well as the sovereign debt crisis. We measure bank risk via a bank's five-year credit default swap (CDS) spread obtained from Markit. The average 5-year bank CDS spread is 117bps over our sample period

[13] Another reason might be favorable interest rates in line with competitive pricing on these platforms (Hau et al., 2017). As described before, dealers do not know how many other dealers, if any, are also asked to bid.

and the average deposit interest rate bid is 112bps. Figure 3 compares the weekly average interest rate bid on the platform for overnight deposits to the interbank market using the EONIA interest rate (Panel A), and the Markit iTraxx Europe Senior Financials Index to the CDS spread of banks included in our sample (Panel B). Note that the latter only starts in the 24th week of 2006 due to data availability for the iTraxx index.[14] The figure indicates that both interest rate bids on the platform as well as banks' risk are representative. Deposit interest rates strongly decrease since end of 2008, when the ECB started to substantially reduce interest rates, and become negative from mid-2014 on, in line with the ECB's introduction of a negative deposit facility interest rate in June 2014. In general, overnight deposit interest rates on the platform are slightly lower than the interbank interest rate. Bank risk increases substantially since mid-2007 when the financial crisis started and peaks in 2011 with the sovereign debt crisis.

[Insert Figure 3 here]

The data also include a unique numerical identifier for each depositing firm that allows us to distinguish between depositors and track these over time. In Figure 4 Panel A we depict on the left the fraction of auctions in which the highest bid is selected, the second highest bid is selected, etc. On the right, we show the difference in interest rates between selected and non-selected bid(s) within an auction. The figure provides empirical evidence that firms in general prefer higher interest rates. However, it also illustrates descriptively that this preference is lower in severe crisis. For example, in 2011, the number of auctions in which the highest bid is selected reduces substantially and the interest rate of a selected bid is in some periods lower than non-selected bids, even when calculating the weekly average. Panel B of Figure 4 shows on the left the fraction of auctions in which the bank with the lowest risk in terms of CDS spread is

[14] Adding the average CDS spread of only our sample banks in the period before does not add much value as only a flat line can be observed as is the case in the current figure until week 29 in 2007. The standard deviation of the spreads shown in the figure until this point in time is only about 2bps for both the index and banks in our sample.

selected, the second lowest risk, etc. On the right, we depict the CDS spread difference between selected and non-selected banks within an auction. The patterns are much less clear-cut than in Panel A. While the left side of Panel B shows some indication of a preference for lower bank risk, the right side suggests that the risk of selected banks in terms of CDS spread is higher. An obvious explanation for the latter is that riskier banks bid higher rates, which firms in general prefer, as shown in Panel A of Figure 4. However, two things are important to note. First, despite firms' general preference for higher interest rates, the picture with respect to banks' risk is much more scattered. And second, the difference in CDS spread of selected and non-selected banks is never extreme. We observe only 2 (7) weeks with a CDS spread difference of more than 50bps (40bps). It indicates an upper boundary for banks' risk in this market. We investigate these aspects in more detail in multivariate analyses in the following.

[Insert Figure 4 here]

3. Deposit Market Efficiency

Hau et al. (2017) show for the foreign exchange market that on multi-dealer request-for-quote (RFQ) platforms dealers price competitively. In this section, we perform several tests to obtain further confidence regarding competitiveness and efficiency also when analyzing deposits in this environment. The first part investigates the relation between bank risk and bid deposit interest rate. This is followed by an analysis of firms' preference for higher interest rates in general as well as the management of risk by firms when depositing.

3.1. BANK RISK AND BID DEPOSIT INTEREST RATE

As illustrated in Panel A of Figure 1, we first would like to establish that interest rates monotonically increase with bank risk. For this purpose, we investigate deposit offers where at

least two different banks bid and at least one bid is selected by the firm. That is, we only include auctions which result in an actual transaction. We regress the bid deposit interest rate of a bank on the bank's risk measured via its CDS spread and further bank characteristics. We also include an indicator for the first bid in an auction to control for potential bid time preferences of firms. In all regressions, we use heteroscedasticity-robust standard errors clustered at the bank and month level. The results are shown in Table 2.

[Insert Table 2 here]

Columns (1) to (4) include fixed effects for each day, columns (5) to (8) fixed effects for each auction. That is, we measure the relation of explanatory variables and bid deposit interest rates on a given day as well as within a specific auction. We observe that banks with a higher CDS spread bid higher deposit interest rates. Including a squared term to account for any non-linearity between bank risk and bid interest rate, we find that the increase in bid interest rate is linearly related to increases in bank risk as the squared term is insignificant in all cases. We also find that smaller banks, banks with higher leverage, and banks with lower return on equity bid higher rates. These results confirm that bid deposit interest rates monotonically increase with banks' risk.

In another test, we regress in Panel B an indicator variable which is one for the highest bid in an auction on the same control variables as in Panel A. It supports our previous finding. Riskier banks are more likely to bid highest in an auction. This effect is monotonically increasing in banks' risk.

Table 2 confirms the idea illustrated in Figure 1A. Riskier banks (have to) bid higher deposit interest rates. This is in line with the literature on depositor discipline, which argues that depositors discipline banks by requiring higher interest rates for deposits (e.g.; Park and

Peristiani, 1998; Jagtiani and Lemieux, 2000; Martinez Peria and Schmukler, 2001; Goldberg and Hudgins, 2002; Maechler and McDill, 2003; Acharya and Mora, 2015; Bennett, Hwa, and Kwast, 2015; Lamers, 2015).

3.2. BANK SELECTION AND FIRM RISK MANAGEMENT

As an additional test of market competitiveness and efficiency, we investigate general firm behavior in more detail. In simple words, we want to ensure that firms behave rationally when depositing via the trading platform. We test two hypotheses. The first one is that firms prefer higher interest rates in general. We regress an indicator variable which is one for a bid which is selected by a firm and zero otherwise on bid deposit interest rate and control variables. In the regressions, we use heteroscedasticity-robust standard errors clustered at the bank and month level. The results are shown in Panel A of Table 3.

[Insert Table 3 here]

Columns (1) and (2) depict that a higher interest rate bid within an auction implies a higher probability that this bid is selected by the firm. We re-run the regressions including an indicator for the highest bid instead of the bid deposit interest rate. Columns (3) and (4) show that a bid is more likely to be selected when it is the highest bid in an auction. On average, a 1bps higher interest rate bid in an auction increases a bank's likelihood to be selected by 0.6% while bidding highest in an auction implies a 55% success probability.

The second hypothesis we test is that firms actively manage risk. As described earlier, the median notional amount offered is €35 million with an average of €74.4 million. It is rather unlikely that firms do not manage risks when depositing these amounts, despite the short maturity. However, we have to account for our findings that riskier banks bid higher interest rates, while firms in general prefer higher rates. If we were to regress our indicator variable for

bid selection on bank risk we would observe the joint effect, that is, that riskier banks are more likely to be selected which is driven by their higher interest rate bids. We therefore investigate bank selection within an auction including only bids with the same interest rate. Additionally, we account for our results in Figure 4A, and columns (3) and (4) of Table 3A that banks have a strong preference for the highest bid in an auction and perform the same analysis including only bids with the same interest rate, which is the highest in this auction. The results are shown in Panel B of Table 3. We find that conditional on bid deposit interest rate riskier banks are less likely to be selected. We also observe that this effect becomes stronger the higher banks' risk. Including indicator variables for bank CDS level intervals ranging from 100 to 200bps, 200 to 300bps, and 400bps and above, both column (2) and column (4) show that firms do not (statistically significantly) differentiate between banks when their CDS spread is below 200bps. However, banks' bid selection probability substantially decreases above this threshold, conditional on bid interest rate. Importantly, the effect is non-linear and stronger for higher levels of bank risk.

In Panel C of Table 3 we perform the same analysis as in Panel B but match bank bids on the interest rate as well as additionally also on the relationship of the firm to the bank. Bharath et al. (2011) for example show for the loan market that repeated borrowing from the same lender implies better loan terms such that the interest rate spread is lower.[15] We also know that banks charge lower rates for relationship borrowers which (often) further decrease for the following loan(s) (Bodenhorn, 2003; Ioannidou and Ongena, 2010; López-Espinosa, Mayordomo, and Moreno, 2017).[16] These patterns might also apply to the deposit market such that interest rates are different between banks with different relationship levels and potentially bias our results. We

[15] Elyasiani and Goldberg (2005) and Degryse, Kim, and Ongena (2009) provide nice overviews on the effects of relationship on loan contract characteristics and credit availability.
[16] Ioannidou and Ongena (2010) show that banks eventually increase these loan rates again which relates to hold-up.

calculate the relationship between a firm and a bank on the trading platform-level via the deposited amount between the firm and the bank over the last year divided by the firm's total deposited amount over the last year, following for example Bharath et al. (2007, 2011) and Adam and Streitz (2016). We again compare bids with the same interest rate and out of these additionally only include bids where the relationship level between a firm and a bank is the same. Relationship level is divided into intervals using steps of ten percentage points, that is, banks with a relationship to the firm between zero and less than 10% are considered as having the same relationship level, etc. Furthermore, we include only bids with the same highest interest rate bid in an auction and the same firm-bank relationship level. Panel C shows the results. It confirms that conditional on bid deposit interest rate as well as on relationship level, firms select less risky banks. Again, columns (2) and (4) show that selection probability is non-linear and more negative for higher levels of bank risk.

In another test of firms' active management of bank risk, we investigate deposit amounts in more detail. Figure 2 already suggests descriptively that banks diversify to a larger extent in crisis periods. We investigate diversification via the total deposited amount in a period, the average amount deposited per auction, and the number of banks with which the firms deposits on the platform in a given period. Regarding the period, we aggregate data to the weekly, monthly, as well as the quarterly level. In these regressions, we use bank characteristics together with firm fixed effects as controls and heteroscedasticity-robust standard errors clustered at the time level. Panel D of Table 2 shows our results. Irrespective of how we aggregate the data, we observe that firms deposit lower amounts per auction (columns (1) to (3)) with more banks (columns (4) to (6)) after periods of higher bank risk. Importantly, as shown in columns (7) to (9), the total deposited amount does not change due to banks' risk in the previous period. This confirms that

firms diversify deposits to a larger extent after periods of high bank risk.

The results in this sub-section strongly argue in favor of market competitiveness and efficiency. In line with general expectations, we observe that firms in general prefer higher interest rates. However, we also observe strong empirical evidence that firms actively manage risk and do not only reach for yield. Conditional on bidding the same interest rate, firms select less risky banks. They also diversify more when bank risk increases. These tests suggest that interest rate bids of banks might serve as a screening device for firms. We test this in the next section.

4. Rationing of Banks

In this section, we investigate if risky banks are rationed by corporate depositors. We first investigate the relationship between bank selection and bid deposit interest rate. Thereafter, we examine bank auction failure. This is followed by an analysis of bank market exit and re-entry. The section concludes with robustness tests.

4.1. BANK SELECTION AND BID DEPOSIT INTEREST RATE

Figure 1B depicts the idea of how to empirically test the model of Stiglitz and Weiss (1981). Importantly, given the empirical setup, we cannot use their notion of a discrete interest rate threshold at which banks are rationed but use the concept of a continuous threshold. That is, for a given level of observable bank risk, a higher interest rate signals higher "true" risk. If firms rationed banks we would expect that the probability of a deposit interest rate bid to be selected by a firm is concave in bid interest rate. To test this, we regress an indicator variable which is one for a selected bank bid on banks' bid deposit interest rates. Additionally, we include a squared term of the bid deposit interest rate to test for the concavity of selection probability in

bid deposit interest rate as depicted in Figure 1B. If banks were rationed by firms, we would expect the coefficient of the bid interest rate to be positive and the coefficient of the squared term to be negative. For an exhaustive analysis, we examine various sub-samples. As a first set, we include all deposit interest rate bids. That is, we also include deposit offers in which only one bank offers an interest rate. We do so for two reasons. First, the results in Hau et al. (2017) show that offers are competitive on trading platforms also when asking for quotes only from a single dealer. And second, firms are able to discard all bank bids for a deposit offer and initiate another auction on the same day. Accordingly, firms are able to select banks over a given day. We therefore include day fixed effects instead of auction fixed effects which would be too rigid and eliminate large parts of firms' actual scope of selection.[17] The second set consists of all bank bids in auctions, that is, deposit offers where at least two different banks bid. This implies that firms are able to select banks also within an auction. However, a concern might be that some auctions include only bank bids which are not competitive and therefore no bid is selected. We therefore include a third set which includes only auctions which result in at least one transaction. In the regressions, we use heteroscedasticity-robust standard errors clustered at the bank and month level. The results are shown in Table 4.

[Insert Table 4 here]

Columns (1), (3) and (5) show the regression results for the three sub-samples including day fixed effects. Column (7) additionally includes firm fixed effects to account for constant firm-specific characteristics such as general size, industry, or corporate governance and general

[17] As a simplifying example, imagine a firm which offers the same deposit amount in two auctions on a given day. Bank A bids a interest rate for the first offer and the auction is discarded by the firm. Bank B bids for the second time offer and is selected. Auction fixed effects would eliminate both offers from our analysis due to insufficient variation of the dependent variable, however, day fixed effects allow to investigate firm selection on this specific day. Note that results continue to hold when we include firm-day fixed effects.

selection behavior.[18] The results confirm that risky banks are rationed by corporate depositors. The coefficient of the bid interest rate is positive and the coefficient of the squared term is negative in all cases. However, the statistical significance of the squared term decreases the stricter we are in our definition of the included sample and fixed effects. We hypothesize that rationing is especially observable when uncertainty about banks' risk is higher. In these cases, the interest rate offer by the bank provides a more important signal of the bank's "true" risk and reduces information asymmetry to a larger extent. Accordingly, for higher levels of bank risk rationing should especially be observable empirically such that the probability of a bank to be selected increases at a slower rate the higher the bid. We therefore divide interest rate bids into CDS spread intervals of the bidding banks, comparable to a piecewise linear estimation.[19] We use 4 intervals in steps of 100bps, i.e. [0; 100bps), [100; 200bps), [200; 300bps), and 300bps or larger. The results are shown in the even columns of Table 4. They strongly confirm rationing of risky banks by corporate depositors. In all specifications, the selection probability of banks' interest rate bid is concave when uncertainty about banks' risk is high. Both the linear as well as the squared term are statistically significant for interest rate bids of banks with a CDS spread of 200bps or more. Note that this is in line with our results on firms' risk management in Panel B of Table 3. It provides empirical evidence of rationing as suggested by the model of Stiglitz and Weiss (1981).

4.2. BANK AUCTION FAILURE AND BID DEPOSIT INTEREST RATE

In this sub-section, we test rationing of banks by firms from another angle. We

[18] As mentioned earlier, we only have a numerical identifier available for each firm but we know that these are non-financial firms.

[19] A piecewise linear estimation would generally imply that we divide interest rate bids into intervals and investigate these separately. However, given our sample period which includes substantial changes in bid interest rate level as well as standard deviation we rather use bank CDS spreads which we show to be strongly related to interest rate bids and which have the same economic interpretation irrespective of economic conditions and time periods.

investigate if bid deposit interest rates are non-linearly related to banks' failure in auctions. Failure is defined as a bank not being selected by a firm. Additionally, we aggregate data to the bank-month level. This allows us to not only investigate the opposite view to the previous section at the aggregate level but also to examine the extreme case of auction failure, that is, no selection of any bid of a bank in a given month. Therefore, in this sub-section, we are able to investigate the intensive as well as the extensive margin.

We calculate a bank's failure rate as the number of auctions in which a bank bids in a month and is not selected over the total number of auctions in which it bids in this month. We regress this variable on the bank's average bid deposit interest rate in this month. In these regressions, we include month fixed effects and use heteroscedasticity-robust standard errors clustered at the bank level. The results are shown in Table 5.

[Insert Table 5 here]

Table 5 confirms that a bank's bid selection probability is negatively related to its interest rate bid. Irrespective of including bank accounting variables, columns (1) and (2) of Panel A show that higher deposit interest rate offers imply that a bank is less likely to not being selected in auctions. However, including the squared term of its average bid interest rate in columns (3) and (4) shows that this relation is convex. This provides further empirical evidence of rationing of banks by firms. In another test, we replace a bank's monthly bid deposit interest rate with the fraction of auctions in which the bank bids highest in a month. The results are shown in columns (5) to (8). They depict the same pattern as for a bank's bid interest rate. Banks which bid more often highest in auctions are less likely to not being selected, however, the effect attenuates the higher this fraction.

Additionally, we are interested if results are different between banks which are successful

in at least some of the auctions in which they bid and those which are invited by firms to bid but are never selected in a month. Note that the latter is a variation of the extensive margin as it implies that despite banks bid they are excluded from the market by firms. In Panel B of Table 5 we show in columns (1) to (4) regression results of a bank's failure rate on its interest rate when at least one of the bank's bids in a month is selected by a firm. Columns (5) to (8) show regressions of an indicator variable which is one when the bank bids and none of its bids is selected in a month and zero when at least one of its bids is selected. We find our previous results confirmed. A higher bid interest rate implies that banks are less likely to fail in auctions. However, the effect attenuates the higher the rate. This is also confirmed when investigating the probability to be excluded from the market. It is another empirical confirmation of rationing of risky banks by corporate depositors.

4.3. BANK MARKET EXIT AND RE-ENTRY

The results in the previous sub-sections on the non-linearity between deposit bid interest rates and bank selection provide strong support for rationing of risky banks. In general, we would expect that firms do not invite banks to bid for their deposits if they appear to be too risky to them. In this sub-section, we therefore investigate the extensive margin in more detail. Specifically, we analyze the relation between banks' risk and their participation in the deposit market. We are interested if bank risk is related to bank exit and re-entry, comparable to Perignon et al. (2018) who show that banks' participation in wholesale markets is related to future bank performance.[20] These tests are related to the notion of "redlining" in Stiglitz and Weiss (1981), that is, observationally distinguishable borrowers are excluded from the market because of their high risk.

[20] We do not investigate the first time entry of banks to the platform as this might be related to self-selection of banks and accordingly a substantial degree of endogeneity.

In a first sub-sample, we aggregate data to the bank-month level and define an indicator variable for bank exit, which is one in months when a bank does not participate on the platform but has participated in earlier periods, and zero when it bids for deposits on the platform. In a second sub-sample, we do the same on the firm-bank-month level. Note that in the latter case banks might not be bidding to some firms but still bid to others.[21] We regress this variable on banks' risk. In all regressions, we include month fixed effects and use heteroscedasticity-robust standard errors clustered at the bank level. The results are shown in Table 6.

[Insert Table 6 here]

Columns (1) to (4) of Table 6 show results using data aggregated to the bank-month level, columns (5) to (8) incorporate data at the firm-bank-month level. In odd columns, we regress bank exit on average bank risk in the same month, in even columns on average bank risk in the previous month. We are interested if bank market exit is related to bank risk as well as if bank risk predicts exit. Table 6 confirms both. Banks are more likely to exit competitive corporate deposit markets when their risk is higher. Columns (3) and (4) additionally include bank fixed effects and show that this applies also for within bank changes in risk. Following this notion, we additionally incorporate firm-bank fixed effects in columns (7) and (8). Note that in addition to constant bank- and firm-specific factors, it also controls for constant factors between a firm and a bank, such as the firm and bank headquarters being close to each other, or executives in the bank and the firm having close relationships.[22] We also observe that bank risk predicts bank market exit. This suggests that bank exit is related to longer-term changes in banks' risk.

[21] We do so to obtain a full and realistic picture. While some banks might suddenly exit the market, it might be the case that others exit gradually across firms.

[22] Khan et al. (2018) provide empirical evidence for the loan market that relations between individual managers affect lending relationships. Furthermore, Degryse and Ongena (2005) show that loan rates decrease with the distance between the firm and the bank and Giannetti and Laeven (2012) confirm a home bias of lenders especially in crises.

We also examine if this applies for bank re-entry. We define an indicator variable of re-entry which is one in a month when a bank bids on the platform but did not bid in the previous month and zero in months in which a bank does not bid, while having bid in the past. Column (1) of Panel B in Table 6 shows that a bank is more likely to re-enter the deposit market when its risk is lower. Bank risk is also predicts bank re-entry, as shown in column (2). To investigate the long-term relation of re-entry and bank risk, in columns (3) to (6) we regress bank risk one to four quarters ahead on bank re-entry in the current quarter. We observe that the return of a bank to competitive corporate deposit markets is related to a longer-term decrease in its risk. Bank re-entry predicts lower bank risk up to three quarters into the future.

Our results show that bank risk and bank deposit market participation are related. In further tests, we try to shed more light on the mechanism of banks' exit from competitive corporate deposit markets. Our earlier findings show that riskier banks (have to) bid higher deposit interest rates. It is reasonable to assume that banks have access to several other funding markets and are likely to prefer these when the interest rate they have to pay there is lower. We therefore compare a bank's bid deposit interest rates on the platform to the interbank market as well as to the central bank interest rate. For the interbank market, we use the EONIA and calculate the percentage of bids in a month, in which the bank bids an interest rate higher than the EONIA interest rate on this day. Note that the interbank market interest rate is sensitive to banks' risk. For a comparison of bid deposit interest rates on the platform to the central bank interest rate, we only investigate data starting in October 2008. Since this time, the ECB follows a fixed interest rate policy in its main refinancing operations and fully allots all liquidity demanded by banks, provided they have sufficient collateral. This implies that the main

refinancing rate is largely risk-insensitive.[23] We calculate the percentage of bids in a month which are higher than the main refinancing operations' interest rate. In addition to the fraction of bids above the main refinancing and the interbank market interest rate, we include a banks' auction failure rate as a proxy for rationing of banks by firms. In sum, we test if banks exit the market because they are rationed by firms or because alternative markets' interest rates are more favorable, or both. We use data aggregated to the firm-bank-month level and regress our indicator variable for bank exit on these three measures lagged by one month and fixed effects. In all regressions, we include month fixed effects and use heteroscedasticity-robust standard errors clustered at the bank level. The results are shown in Table 7.

[Insert Table 7 here]

Columns (1) to (3) show the results for each measure individually, including firm-bank fixed effects. Accordingly, we investigate bank exit controlling for constant bank-specific, firm-specific, and also firm-bank specific factors. In columns (4) to (6), we incorporate all measures and use month (column (4)), bank and month (column (5)), and firm-bank and month (column (6)) fixed effects. Including the percentage of bids higher than the central bank's interest rate naturally reduces the number of observations in columns (2) and (4) to (6) due to the shorter period used for its calculation. Table 7 shows that banks are more likely to exit the corporate deposit market when the have a higher percentage of auctions in which they bid and are not selected by firms. They are also more likely to exit when the percentage of bids with an interest rate higher than the refinancing rate is larger. However, we do not observe any effect on bank exit for the percentage of bids higher than the interbank market interest rate.

The results in Table 7 suggest that two factors are important drivers of banks' exit from

[23] The ECB substantially eased collateral requirements during the financial crisis to "reduce asset-side constraints" (ECB monthly bulletin, October 2010) what argues in favor of the risk insensitivity of ECB funding.

competitive corporate deposit markets. These are rationing of banks by firms as well as the interest rate charged by the central bank when it is a rather risk-insensitive. Regarding the latter, our findings indicate that the main refinancing rate constitutes a ceiling for short-term interest rates when the central bank follows a fixed interest rate policy. It also suggests that liquidity in competitive funding markets is reduced, at least in the tail of high bank risk, due to central bank policy. In sum, both effects seem to be in place at the same time. Risky banks are rationed by corporate depositors as well as have a higher likelihood to obtain funding in markets where interest rates are largely risk-insensitive.

4.4. ROBUSTNESS

In this sub-section, we perform several tests to ensure the robustness of our results. As our benchmark, we use the sample of all bank bids in auctions, that is, columns (3) and (4) of Table 4. In a first test, we split our sample into the sovereign debt crisis, ranging from 2010 until 2012, and the remaining period.[24] As shown in Figure 3B, bank's CDS spreads were at substantially higher levels during the sovereign debt crisis. We thereby investigate if firms ration banks only in periods of severe crisis and substantially higher bank risk or if this applies to all periods. In a second test, we analyze if rationing only occurs for large deposit amounts. A potential concern might be that banks are more lenient for smaller amounts and ration banks only when amounts are large. We therefore split our sample using a threshold of €100 million per auction. Note that this implicitly also addresses a potential higher level of financial literacy in larger firms. In a third test, we only include overnight deposits. Firms might be more lenient when depositing overnight and not ration in these cases. In a fourth test, we exclude all bank bids above the ECB main refinancing rate. As shown in the previous section, banks are more likely to

[24] In a further test, not shown for brevity, we also investigate only the pre-crisis period, that is, the start of our sample period until August 2007. All results hold.

exit the market when they (have to) bid more often above the central bank interest rate. We therefore would like to test if our results on rationing continue to hold when we remove these cases. The results for these robustness tests are shown in Panel A of Table 8.

[Insert Table 8 here]

Our finding of firms rationing riskier banks is confirmed in all cases. Irrespective of how we split the sample, we observe that both the linear as well as the squared term of the bid deposit interest rate are statistically significant for bids of banks with a CDS spread of 200bps or more.

In another robustness test, we specifically account for firms' preference for the highest bid in an auction. We hypothesize that bidding highest in an auction implies a higher probability of a bid to be selected, as already shown descriptively in Figure 4A. However, if banks were rationed by firms we would expect that conditional on bidding highest, a higher interest rate signals higher bank risk to the firm. Accordingly, we expect a negative effect on the interaction term between highest bid and bid deposit interest rate, especially when uncertainty about banks' risk is higher, i.e. for riskier banks. Panel B of Table 8 shows the results.

It confirms a rationing of risky banks by corporate depositors, also when controlling for firm's preference for the highest bid in an auction. We observe a statistically significant coefficient for the interaction term between bid deposit interest rate and our indicator variable for the highest bid in an auction when bank risk is elevated. Interestingly, this effect is confirmed not only for the interaction but also for the interest rate bid interest itself. Panel B also shows the strong preference of firms for the highest bid in an auction reflected in t-values of the coefficient of more than 24. Accordingly, firms strongly prefer the highest bid in auction but also ration banks based on their interest rate bid when uncertainty about "true" bank risk is elevated.

5. Conclusion

In this paper, we investigate depositing of firms with banks using data from a FinTech intermediary. Our results provide empirical evidence that firms ration risky banks in line with the model of Stiglitz and Weiss (1981). This is important for our understanding of short-term bank funding, the transmission of monetary policy, as well as FinTech in general.

Our results show that firms' management of deposits is in line with depositors disciplining banks. Risky banks are rationed by firms and eventually exit competitive funding markets but also return to these when their risk decreases again in the long-term.

We also observe that banks are more likely to access funding from the central bank when the competitive market interest rate exceeds the central bank interest rate, when the latter is rather risk-insensitive. The intention of the central bank might be to ensure funding for risky banks; however, by using a fixed refinancing rate it simultaneously introduces a ceiling on corporate deposit interest rates. This implies lower returns for firms' deposits what might involve negative real effects. Our results empirically confirm that a fixed interest rate refinancing policy represents a subsidy (especially) for risky banks.

Finally, we observe that deposits traded via a FinTech intermediary are not only large in quantity and size but also that the market is highly competitive and efficient. Given the pace of technological change, future research will be able to investigate several exciting new aspects for various classes of financial assets.

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Figure 1

Bank Risk, Interest Rate, and Bank Selection

The figure illustrates in Panel A the relation between bank risk and bank bid deposit interest rate. Panel B shows the relation between bank bid deposit interest rate and the selection probability of deposit bid.

Fig. 1A: Bank risk and bank interest rate bid

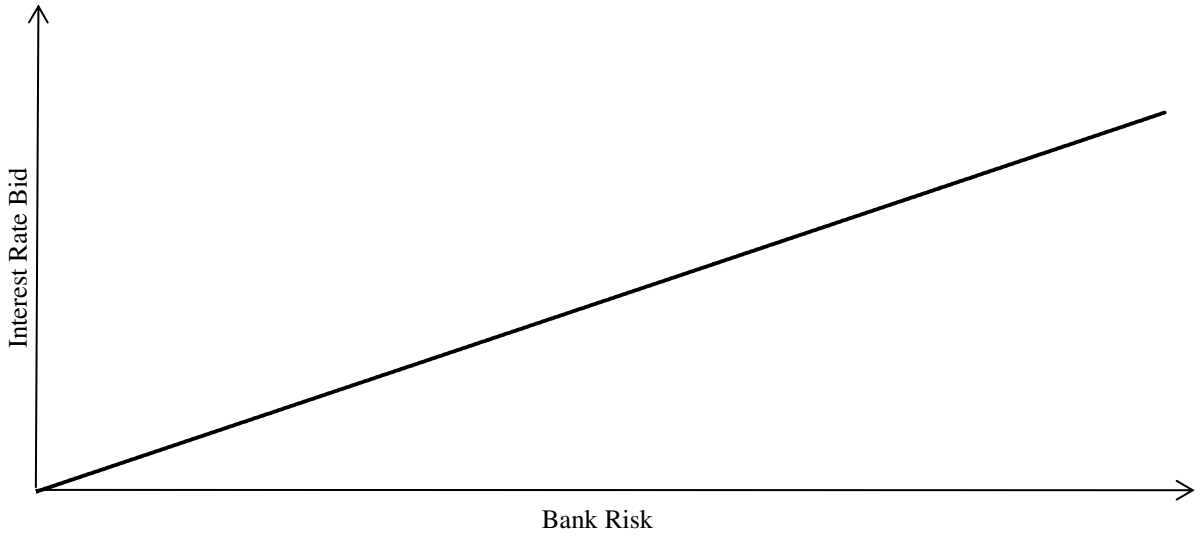

Fig. 1B: Bank interest rate bid and banks' probability to be selected

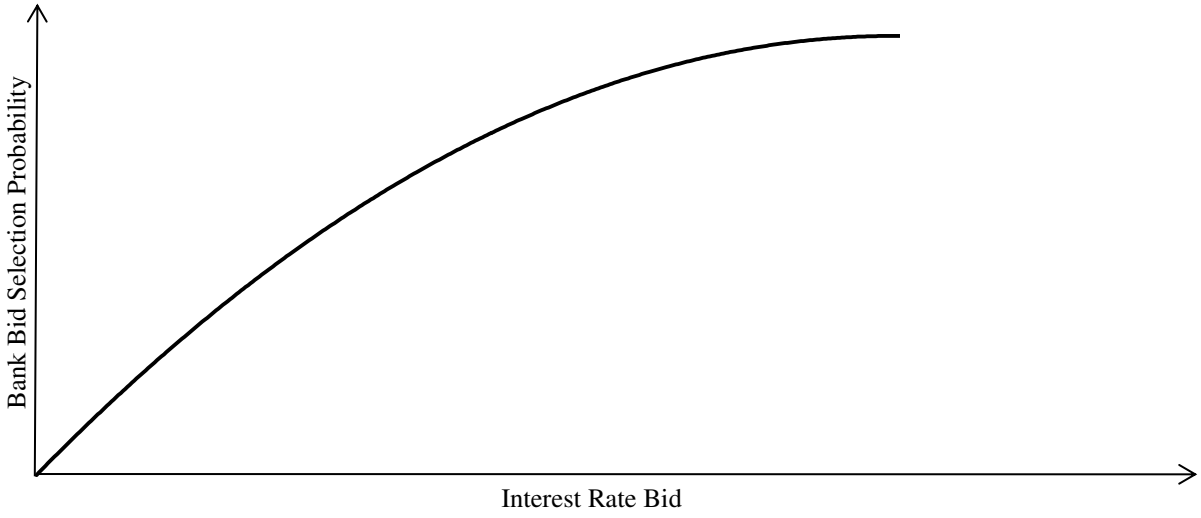

Figure 2

Deposit Volume and Auctions

The figure shows the volume of traded €-deposits on the platform from January 2005 to December 2015. Figure 2A depicts the total deposited amount in each quarter. Figure 2B shows the average notional deposit amount per auction. Figure 2C shows the number of auctions in each quarter, and Figure 2D shows the numbers of auctions in which no bank is selected as a fraction of all auctions in each quarter.

Fig. 2A: Notional deposit amount per quarter (€ bn.)

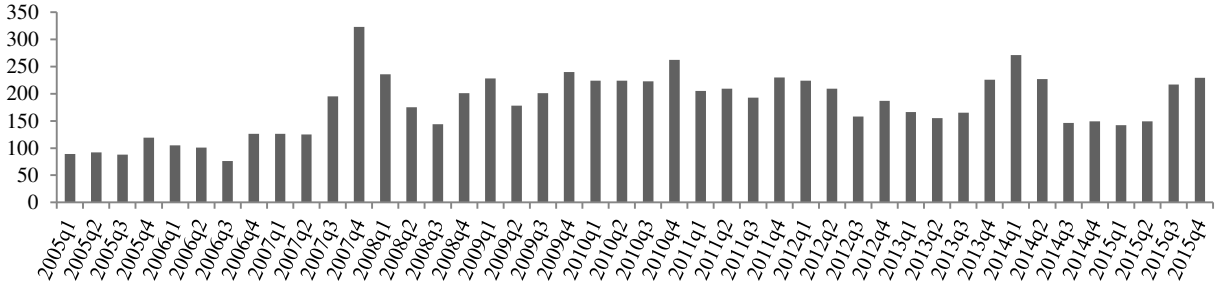

Fig. 2B: Notional deposit amount per auction (€ mn.)

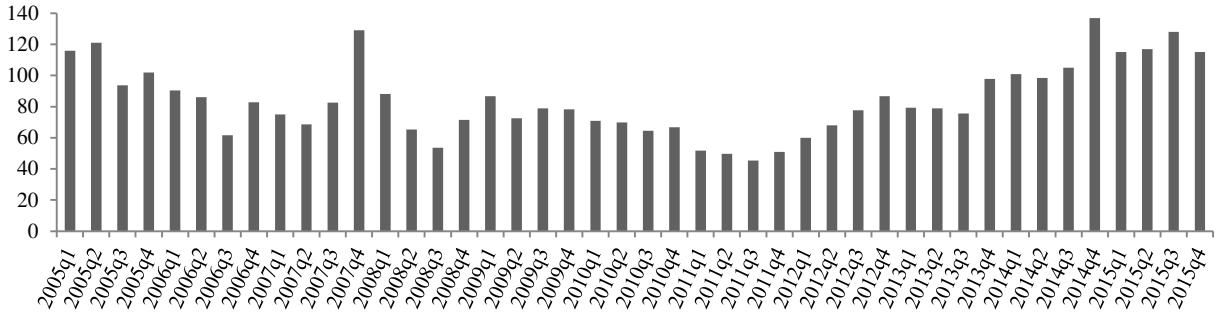

Fig. 2C: Number of auctions

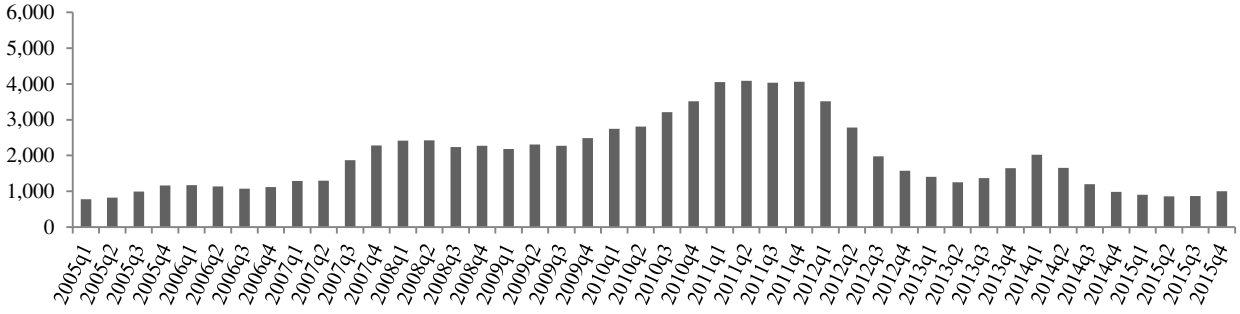

Fig. 2D: Percent of auctions where no bank is selected

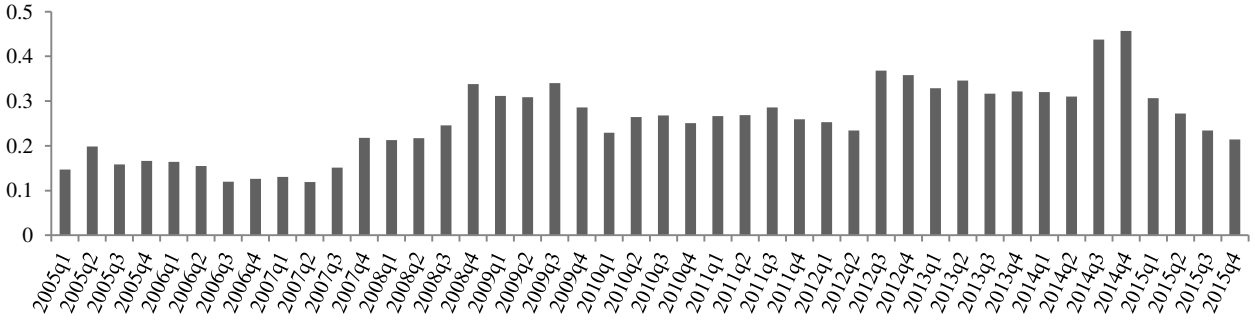

Figure 3

Deposit Rate and Bank Risk

The figure shows in Figure 3A the average interest rate of overnight €-deposit auctions on the platform and the EONIA interest rate in basis points both aggregated to the weekly level from January 2005 to December 2015. Figure 3B shows in basis points the Markit™ iTraxx Europe Senior Financials Index starting from week 24 in 2006 due to data availability together with the average CDS spread of banks on the platform weighted by their number of bids in each week.

Fig. 3A: EONIA and corporate overnight deposit interest rate

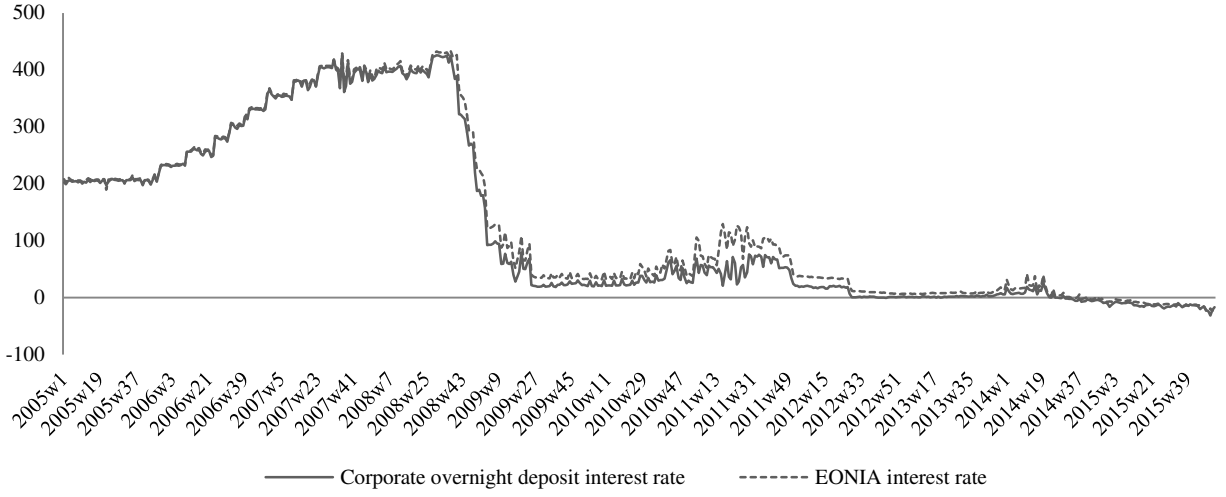

Fig. 3B: iTraxx and average CDS spread of sample banks

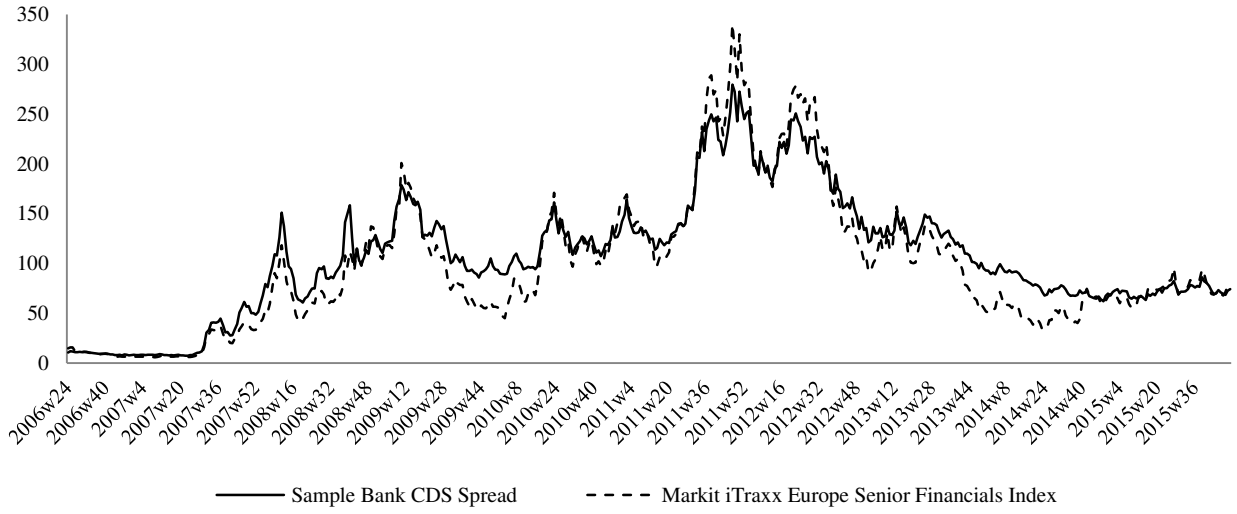

Figure 4

Bid Selection

Figure 4A depicts on the left hand side the percentage of firms selecting the highest, second highest, third highest, fourth highest and fifth highest or lower bid in a transaction and on the right hand side the difference in the average deposit interest rate bid between selected and non-selected bids in auctions with at least one selected bid and two bidding banks, aggregated on the week level. Figure 4B correspondingly depicts bid selection by increasing bank risk using banks' CDS spreads at the time of an auction and bank CDS spread difference between selected and non-selected banks.

Fig. 4A: x-th highest bid selected by firm & bid deposit rate difference between selected and non-selected banks

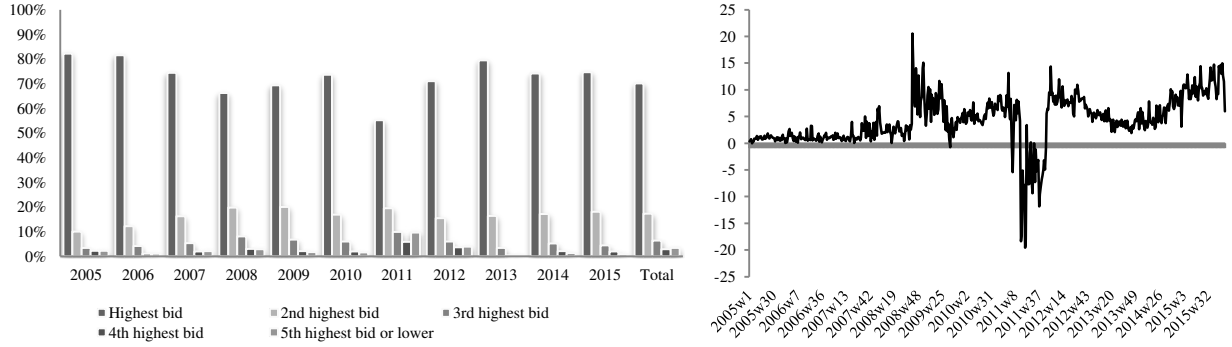

Fig. 4B: x-th lowest risk bank selected by firm & CDS spread difference between selected and non-selected banks

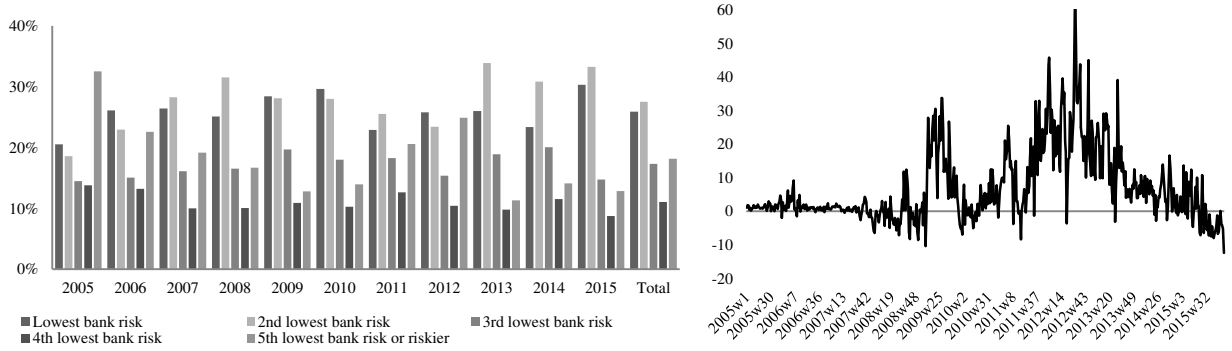

Table 1

Descriptive Statistics

The table shows descriptive statistics using data from January 2005 to December 2015. Bank total assets are measured in real terms with 2005 as base year using the Consumer Price Index (CPI) as published by the OECD. An *auction* is defined as a deposit offer where at least two different banks bid. Variables are defined in Panel B.

Panel A: Descriptive Statistics

Variable Name	Obs.	Mean	St. Dev.	p(1)	p(50)	p(99)
DEPOSIT AUCTION VARIABLES						
Bid deposit interest rate	446,173	112	144	-19	35	430
Bank Risk (bps)	444,126	117	83	6	103	372
BANK ACCOUNTING VARIABLES						
Total Assets (in 2005 € mn.)	445,847	874,682	618,761	1,573	747,571	2,264,468
Leverage	445,847	0.95	0.03	0.86	0.96	0.99
NPL / Total Loans	428,328	0.04	0.03	0.01	0.03	0.11
ROE	445,681	0.02	0.42	-0.48	0.04	0.24
Asset growth	444,954	0.00	0.09	-0.32	0.00	0.27
Net Interest Margin	444,995	1.19	0.69	0.09	0.98	3.37
OBS exposure	430,707	0.19	0.13	0.03	0.16	0.61
DEPOSIT OFFERS						
Notional amount (€)	131,932	74,700,000	112,000,000	480,000	35,000,000	500,000,000
Deposit duration (days)	131,932	10.57	28.97	1	1	152
AUCTIONS WITH TRANSACTION(S)						
Notional amount (€)	64,280	81,400,000	128,000,000	700,000	39,000,000	600,000,000
Deposit duration (days)	64,280	9.01	23.81	1	1	115

# Banks	# Firms	# Auctions	Auctions with transaction & min. 2 banks bidding	# Banks bidding	# Banks bidding | min. 2 banks bidding & min. 1 transaction	# Banks selected in auction | min. 1 bank selected
87	486	131,932	64,280	3.38	4.55	1.09

Panel B: Description of variables

Variable Name	Unit	Description
DEPOSIT AUCTION VARIABLES		
Bid deposit interest rate	bps	The deposit interest rate offered by a bank.
Highest bid in auction	0/1	Indicator variable which is one for the highest bid within an auction.
1 = Selected Bid	0/1	Indicator variable which is one for a selected bid.
Bank Auction Failure Rate	%	Number of auctions in which a bank bids and is not selected over the total number of auctions in which a bank bids in a given period.
Bank Risk	%	A bank's 5 year CDS spread on senior unsecured debt as reported in Markit.
First Bid in Auction	0/1	Indicator variable which is one for the first bid within an auction.
BANK ACCOUNTING VARIABLES		
log(Total Assets)	ln(€ mn.)	Natural logarithm of a bank's total assets in €-million as recorded in Bankscope.
Leverage	%	Ratio of total liabilities to total assets as recorded in Bankscope.
NPL / Total Loans	%	Ratio of non-performing loans to gross total loans as recorded in Bankscope.
ROE	%	Return on equity calculated as net income over equity as recorded in Bankscope.
Asset growth	%	Annual asset growth as recorded in Bankscope.
Net Interest Margin	%	Net interest margin as recorded in Bankscope.
OBS exposure	%	Ratio of off-balance-sheet items divided by the sum of total assets and off-balance-sheet items, both as recorded in Bankscope.

Table 2

Pricing, Bank Risk, and Selection of Banks

The table reports in Panel A regression results of the offered deposit interest rate and in Panel B an indicator variable, which is one for the highest bid in an auction, on control variables. The data range from 2005 to 2015 and include all bank bids of auctions with at least two bids from different banks, which result in at least one transaction. *Bank Risk* is measured via banks' CDS spread. Bank accounting variables are used with their end of previous year value. All variables are defined in Panel B of Table 1. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank and month level. t-statistics are shown in parentheses below coefficient estimates.

Panel A: Bid deposit interest rate and bank risk

Dependent Variable	*Bid deposit interest rate*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank Risk	3.634***	3.531*	2.645**	2.476	3.078**	2.831**	2.429*	2.325*
	(2.850)	(1.922)	(2.127)	(1.442)	(2.591)	(2.160)	(1.949)	(1.851)
Bank Risk²		0.022		0.035		0.053		0.022
		(0.080)		(0.136)		(0.221)		(0.091)
Other Transaction Variables								
First Bid in Auction			-0.388	-0.388			-0.137	-0.137
			(-1.004)	(-1.004)			(-0.523)	(-0.523)
Bank Accounting Variables								
log(Total Assets)			-0.751**	-0.751**			-0.478**	-0.478**
			(-2.626)	(-2.627)			(-2.570)	(-2.570)
Leverage			23.869**	23.949*			11.889*	11.947*
			(2.008)	(1.998)			(1.694)	(1.699)
NPL / Total Loans			25.963	26.150			14.663	14.765
			(1.334)	(1.350)			(0.897)	(0.913)
ROE			-0.428	-0.424			-0.813**	-0.810**
			(-0.851)	(-0.841)			(-2.242)	(-2.243)
Asset Growth			-4.483	-4.502			-2.761	-2.771
			(-1.240)	(-1.244)			(-0.969)	(-0.971)
Net Interest Margin			1.146	1.148			1.279	1.280
			(1.054)	(1.054)			(1.520)	(1.520)
OBS Exposure			-3.826	-3.834			-4.086	-4.089
			(-1.057)	(-1.055)			(-1.363)	(-1.362)
Day Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Auction Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	291,328	291,328	267,006	267,006	291,159	291,159	264,711	264,711
R-squared	0.989	0.989	0.988	0.988	0.995	0.995	0.994	0.994

Panel B: Highest bid in auction and bank risk

Dependent Variable	*1 = Highest bid in auction*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank Risk	0.115***	0.146**	0.105***	0.129**	0.169***	0.219***	0.150***	0.190***
	(3.282)	(2.260)	(3.341)	(2.252)	(4.235)	(3.241)	(4.399)	(3.289)
Bank Risk²		-0.007		-0.005		-0.011		-0.008
		(-0.917)		(-0.740)		(-1.455)		(-1.228)
Other Transaction Variables	No	No	Yes	Yes	No	No	Yes	Yes
Bank Accounting Variables	No	No	Yes	Yes	No	No	Yes	Yes
Day Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Auction Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	291,328	291,328	267,006	267,006	291,159	291,159	264,711	264,711
R-squared	0.032	0.032	0.040	0.040	0.173	0.174	0.195	0.196

Table 3

Selection of Banks, Deposit Amount, and Bank Risk

The table reports in Panel A regressions of an indicator variable for the selected bid(s) in an auction on *bid deposit interest rate* in percent (columns (1) and (2)) and an indicator variable for the highest bid in an auction (columns (3) and (4)), and control variables. In Panel B, it shows regressions of an indicator variable for the selected bid(s) in an auction on control variables comparing bids with the same interest rate (columns (1) and (2)) and the same interest rate, which is the highest in the auction (columns (3) and (4)). *Bank Risk* is measured via banks' CDS spread. In columns (2) and (4) bank risk is split via indicator variables for the level of the respective CDS spread of banks. The data range from 2005 to 2015 and include all bank bids of auctions with at least two bids from different banks, which result in at least one transaction. Bank accounting variables are used with their end of previous year value. Panel C follows the setup in Panel B and compares bids with the same interest rate and relationship level (columns (1) and (2)) and the same interest rate, which is the highest in the auction, and relationship level (columns (3) and (4)). Relationship is defined as the amount the firm deposited with a bank on the platform over the last year over the total amount deposited on the platform by this firm. Relationship level is then defined in steps of ten percentage points, that is, banks with a relationship between zero and less than 10% are considered to have the same relationship level, etc. Panel D shows regressions of the average offered deposit amount per transaction in columns (1) to (3), the number of banks with which a firm deposits in columns (4) to (6), and the total deposited notional of a firm in € million in columns (7) to (9), all in a given period specified at the top of each column. *Bank Risk* and control variables are used as the average in the previous period using all deposit transactions of the firm. All variables are defined in Panel B of Table 1. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank and month level in Panels A to C and at the time period level in Panel D. t-statistics are shown in parentheses below coefficient estimates.

Panel A: Selection and price

Dependent Variable	*1 = Selected bid*			
	(1)	(2)	(3)	(4)
Bid deposit interest rate	0.625***	0.553***		
	(3.692)	(3.419)		
Highest bid in auction			0.556***	0.555***
			(30.731)	(27.850)
Other Transaction Variables	No	Yes	Yes	Yes
Bank Accounting Variables	No	Yes	Yes	Yes
Auction Fixed Effects	Yes	Yes	Yes	Yes
Observations	292,663	266,093	292,663	266,093
R-squared	0.180	0.205	0.428	0.444

Panel B: Selection of banks and bank risk conditional on interest rate bid

Dependent Variable	*1 = Selected bid | Same bid deposit interest rate*		*1 = Selected bid | Same highest bid deposit interest rate*	
	(1)	(2)	(3)	(4)
Bank Risk	-0.032***		-0.092***	
	(-3.605)		(-2.707)	
$1_{Bank\ Risk\ (CDS < 100bps)}$		base case		base case
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		-0.007		-0.018
		(-0.768)		(-0.642)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		-0.045***		-0.114*
		(-2.758)		(-1.727)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		-0.077***		-0.215*
		(-3.355)		(-1.916)
Other Transaction Variables	Yes	Yes	Yes	Yes
Bank Accounting Variables	Yes	Yes	Yes	Yes
Auction-deposit bid rate FE	Yes	Yes	Yes	Yes
Observations	78,098	78,098	19,619	19,619
R-squared	0.521	0.521	0.269	0.269

Panel C: Selection of banks and bank risk conditional on interest rate bid and relationship level

Dependent Variable	*1 = Selected Bid | Same bid deposit interest rate & same relationship level*		*1 = Selected Bid | Same highest bid deposit interest rate & same relationship level*	
	(1)	(2)	(3)	(4)
Bank Risk	-0.023***		-0.148***	
	(-3.317)		(-4.345)	
$1_{Bank\ Risk\ (CDS < 100bps)}$		base case		base case
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		-0.018**		-0.053
		(-2.478)		(-1.378)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		-0.037***		-0.212***
		(-3.288)		(-2.832)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		-0.057***		-0.365***
		(-3.572)		(-3.926)
Other Transaction Variables	Yes	Yes	Yes	Yes
Bank Accounting Variables	Yes	Yes	Yes	Yes
Auction-deposit bid rate-relationship level FE	Yes	Yes	Yes	Yes
Observations	40,848	40,848	6,919	6,919
R-squared	0.605	0.605	0.406	0.405

Panel D: Total amount, number of banks, and amount per auction

Dependent Variable	*Average amount per auction$_t$*			*Number of banks$_t$*			*Total amount$_t$*		
Time	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bank Risk$_{t-1}$	-0.053***	-0.047***	-0.058***	0.187***	0.266***	0.228*	0.050	0.123	0.912
	(-11.813)	(-7.559)	(-5.411)	(10.247)	(5.361)	(1.794)	(0.780)	(0.309)	(0.573)
Control Variables$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,648	5,466	2,135	15,648	5,466	2,135	15,648	5,466	2,135
Adjusted R-squared	0.711	0.769	0.828	0.415	0.509	0.606	0.538	0.554	0.572

Table 4

Rationing of Banks – Bank Selection

The table reports regressions of an indicator variable for the selected bid(s) in an auction on control variables. The data range from 2005 to 2015. Column (1) and (2) include all €-deposit bids on the trading platform, columns (3) and (4) include all bids where at least two banks bid for an offered deposit amount, and columns (5) to (8) include all bank bids of auctions with at least two bids from different banks, which result in at least one transaction. In even columns, the deposit interest rate bid of a bank is interacted with indicator variables for the level of the respective CDS spread of banks. Bank accounting variables are used with their end of previous year value. *Bid deposit interest rate* is included in percent. All variables are defined in Panel B of Table 1. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank and month level. t-statistics are shown in parentheses below coefficient estimates.

Dependent Variable	*1 = Selected bid*							
	All bids		*All bids in auctions*		*All bids in auctions with min. 1 transaction*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid deposit interest rate	0.262***		0.207***		0.322***		0.319***	
	(3.809)		(3.384)		(3.143)		(2.854)	
*Bid deposit interest rate **								
$1_{Bank\ Risk\ (CDS < 100bps)}$		0.233***		0.171**		0.259**		0.239*
		(2.757)		(2.372)		(2.228)		(1.941)
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		0.243***		0.195***		0.312***		0.313***
		(3.648)		(3.263)		(3.057)		(2.840)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		0.321***		0.264***		0.401***		0.402***
		(4.358)		(3.696)		(3.559)		(3.244)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		0.361***		0.300***		0.449***		0.468***
		(3.181)		(3.029)		(3.179)		(3.350)
Bid deposit interest rate^2	-0.048***		-0.026***		-0.028*		-0.017	
	(-4.068)		(-2.728)		(-1.767)		(-1.011)	
Bid deposit interest rate^2 ***								
$1_{Bank\ Risk\ (CDS < 100bps)}$		-0.044***		-0.021*		-0.018		-0.004
		(-3.034)		(-1.742)		(-0.968)		(-0.190)
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		-0.046***		-0.027***		-0.030*		-0.021
		(-3.932)		(-2.750)		(-1.835)		(-1.234)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		-0.067***		-0.046***		-0.054**		-0.048*
		(-4.062)		(-2.992)		(-2.435)		(-1.948)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		-0.082***		-0.063**		-0.085**		-0.078**
		(-2.688)		(-2.411)		(-2.184)		(-2.121)
Other Transaction Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Accounting Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No	No	Yes	Yes
Observations	413,670	411,871	371,384	369,740	268,216	267,006	268,214	267,004
R-squared	0.088	0.088	0.021	0.022	0.030	0.031	0.098	0.100

Table 5

Rationing of Banks – Bank Auction Failure

The table reports regressions of the auction failure rate on control variables using data aggregated to the bank-month level using all auctions with at least two bids from different banks, which result in at least one transaction. *Bank auction failure rate* is defined as number of auctions in which a bank bids and is not selected over the total number of auctions in which a bank bids in a given month. In Panel B, columns (1) to (4) include only observations where auction failure rate is not equal to 100% in a month, and columns (5) to (8) uses an indicator variable as dependent variable which is one if a bank's auction failure rate is equal to 100% in a month and zero otherwise. *Bid deposit interest rate* is the average monthly interest rate the bank is bidding in percent and *Highest bid ratio* is the number of auctions in which a bank bids highest over the total number of auctions in which a bank bids in a given month. Bank accounting variables are used with their end of previous year value. All variables are defined in Panel B of Table 1. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. t-statistics are shown in parentheses below coefficient estimates.

Panel A: Auction failure rate

Dependent Variable	*Bank auction failure rate*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid deposit interest rate	-0.797***	-0.733***	-1.040***	-0.995***				
	(-7.972)	(-7.150)	(-9.430)	(-9.532)				
Bid deposit interest rate²			0.091***	0.118***				
			(2.936)	(5.760)				
Highest bid ratio					-0.713***	-0.729***	-0.871***	-0.879***
					(-20.394)	(-23.155)	(-14.423)	(-15.571)
Highest bid ratio²							0.180**	0.176**
							(2.198)	(2.293)
Bank Accounting Variables	No	Yes	No	Yes	No	Yes	No	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,653	4,187	4,653	4,187	4,653	4,187	4,653	4,187
R-squared	0.208	0.246	0.229	0.271	0.635	0.658	0.638	0.661

Panel B: Auction failure rate conditional on auction success

Dependent Variable	*Bank auction failure rate | min. 1 bid selected in month*				*1 = No bid selected in month*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid deposit interest rate	-0.885***	-0.808***	-1.135***	-1.083***	-0.602***	-0.626***	-0.846***	-0.872***
	(-9.728)	(-8.490)	(-9.873)	(-8.998)	(-4.723)	(-4.617)	(-5.725)	(-6.184)
Bid deposit interest rate²			0.091**	0.136***			0.091***	0.111***
			(2.526)	(4.590)			(3.256)	(3.094)
Bank Accounting Variables	No	Yes	No	Yes	No	Yes	No	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,729	3,338	3,729	3,338	4,653	4,187	4,653	4,187
R-squared	0.247	0.304	0.264	0.324	0.119	0.143	0.128	0.152

Table 6

Rationing of Banks – Bank Market Exit and Re-Entry

The table reports regressions of an indicator variable for bank exit in Panel A and bank re-entry in columns (1) and (2) of Panel B on control variables. Columns (3) to (6) in Panel B use bank risk as dependent variable measured via banks' CDS spread. The data range from 2005 to 2015 and use information on all €-deposit bids on the platform. *Bank Exit* is defined in Panel A columns (1) to (4) on the bank-month level (Panel A columns (5) to (8) on the firm-bank-month level) and one if a bank is not bidding in a month on the platform (to a firm) while having bid (to the firm) on the platform before and zero when bidding (to the firm) on the platform. *Bank Re-Entry* is an indicator defined on the bank-month level which is one when a bank bids in a month on the platform but does not bid in the previous month while having bid on the platform before. It is zero in all months when a bank does not bid while having bid on the platform before. All variables are defined in Panel B of Table 1. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. t-statistics are shown in parentheses below coefficient estimates.

Panel A: Bank Exit

Dependent Variable	*Bank level*				*Firm-Bank level*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank Risk$_t$	0.030***		0.040***		0.028***		0.028***	
	(2.782)		(7.039)		(3.172)		(3.063)	
Bank Risk$_{t-1}$		0.031***		0.042***		0.030***		0.028***
		(2.786)		(7.257)		(3.287)		(3.299)
Bank FE	No	No	Yes	Yes	No	No	No	No
Firm-Bank FE	No	No	No	No	No	No	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,339	5,277	5,339	5,277	68,242	65,158	67,590	65,043
R-squared	0.031	0.031	0.464	0.473	0.042	0.036	0.360	0.373

Panel B: Bank Re-Entry

Dependent Variable	*Bank Re-Entry$_t$*		*Bank Risk$_{t+1}$*	*Bank Risk$_{t+2}$*	*Bank Risk$_{t+3}$*	*Bank Risk$_{t+4}$*
	(1)	(2)	(3)	(4)	(5)	(6)
Bank Risk$_t$	-0.013**					
	(-2.089)					
Bank Risk$_{t-1}$		-0.019**				
		(-2.300)				
Bank Re-Entry$_t$			-0.224*	-0.231**	-0.192*	-0.117
			(-1.703)	(-2.102)	(-1.776)	(-1.415)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	857	857	847	829	813	797
R-squared	0.233	0.234	0.771	0.766	0.752	0.746

Table 7

The Mechanism of Bank Market Exit

The table reports regressions of an indicator variable for bank exit on control variables. The data range from 2005 to 2015 and use information on all €-deposit bids on the platform, aggregated to the monthly level. *Bank Exit* is defined on the firm-bank level and one if a bank is not bidding in a month on the platform to a firm while having bid to the firm on the platform before and zero when bidding to the firm on the platform. *Bank auction failure rate* is defined as number of auctions in which a bank bids and is not selected over the total number of auctions in which a bank bids in a given month. *% bids > ECB rate*$_t$ is the number of auctions in which the bank bids above the main refinancing rate over the total number of auctions in which a bank bids in a given month using only the fixed interest rate regime of the ECB since October 15, 2008. *% bids > Interbank rate*$_t$ is the number of auctions in which the bank bids above the EONIA interest rate over the total number of auctions in which a bank bids in a given month. All variables are defined in Panel B of Table 1. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. t-statistics are shown in parentheses below coefficient estimates.

Dependent Variable	*Bank Exit*					
	(1)	(2)	(3)	(4)	(5)	(6)
Bank auction failure rate$_{t-1}$	0.051***			0.058***	0.055***	0.055***
	(5.268)			(5.163)	(4.922)	(5.169)
(% bids > ECB rate)$_{t-1}$		0.071***		0.096***	0.071***	0.082***
		(3.636)		(4.385)	(3.357)	(4.205)
(% bids > Interbank rate)$_{t-1}$			-0.003	-0.002	-0.001	-0.002
			(-0.083)	(-0.064)	(-0.032)	(-0.062)
Bank FE	No	No	No	No	Yes	No
Firm-Bank FE	Yes	Yes	Yes	No	No	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,171	30,614	40,171	30,897	30,892	30,614
R-squared	0.241	0.245	0.240	0.022	0.039	0.246

Table 8

Robustness

The table reports regressions of an indicator variable for the selected bid(s) in an auction on control variables. The data range from 2005 to 2015. It includes all bids where at least two banks bid for an offered deposit amount. In even columns, the deposit interest rate bid of a bank is interacted with indicator variables for the level of the respective CDS spread of banks. Bank accounting variables are used with their end of previous year value. *Bid deposit interest rate* is included in percent. All variables are defined in Panel B of Table 1. *Sovereign Debt Crisis* is defined as the period 2010 to 2012. *ECB rate* is defined as the interest rate in the ECB's main refinancing operations since the introduction of a fixed interest rate on October 15, 2008. The statistical significance of results is indicated by * = 10% level, ** = 5% level and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank and month level. t-statistics are shown in parentheses below coefficient estimates.

Dependent Variable	*1 = Selected bid*													
	Main		*Time*				*Amount*				*Maturity*		*Alternative Interest Rate*	
			No Sovereign Debt Crisis		*Sovereign Debt Crisis*		≤ €100mn.		> €100mn.		*Only Overnight*		*Exclude all bids > ECB rate*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Bid deposit interest rate	0.207***		0.599***		0.223***		0.169***		0.521***		0.461***		0.236***	
	(3.384)		(5.704)		(3.028)		(3.170)		(4.186)		(3.001)		(2.977)	
Bid deposit interest rate *														
$1_{Bank\ Risk\ (CDS < 100bps)}$		0.171**		0.603***		0.116		0.131**		0.477***		0.409**		0.187**
		(2.372)		(5.564)		(0.793)		(2.021)		(3.664)		(2.421)		(2.075)
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		0.195***		0.574***		0.202***		0.154***		0.532***		0.458***		0.230***
		(3.263)		(5.187)		(2.765)		(2.954)		(4.127)		(2.931)		(2.859)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		0.264***		0.667***		0.335**		0.232***		0.563***		0.530***		0.311***
		(3.696)		(5.361)		(2.438)		(3.546)		(3.989)		(3.454)		(3.377)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		0.300***		0.700***		0.328***		0.260***		0.598***		0.509***		0.376***
		(3.029)		(5.170)		(2.808)		(2.864)		(3.089)		(3.287)		(3.041)
Bid deposit interest rate^2	-0.026***		-0.077***		-0.146***		-0.022**		-0.044*		-0.037		-0.061	
	(-2.728)		(-5.248)		(-3.125)		(-2.512)		(-1.908)		(-1.406)		(-1.351)	
Bid deposit interest rate^2 *														
$1_{Bank\ Risk\ (CDS < 100bps)}$		-0.021*		-0.078***		-0.100		-0.016		-0.034		-0.026		-0.049
		(-1.742)		(-5.169)		(-0.687)		(-1.434)		(-1.512)		(-0.918)		(-1.043)
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		-0.027***		-0.071***		-0.133**		-0.022**		-0.048*		-0.038		-0.067
		(-2.750)		(-4.485)		(-2.593)		(-2.460)		(-1.883)		(-1.424)		(-1.371)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		-0.046***		-0.096***		-0.233*		-0.043***		-0.061*		-0.059**		-0.097*
		(-2.992)		(-3.982)		(-1.838)		(-2.846)		(-1.908)		(-2.036)		(-1.842)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		-0.063**		-0.112***		-0.165**		-0.054**		-0.096*		-0.068**		-0.152**
		(-2.411)		(-4.011)		(-2.698)		(-2.160)		(-1.854)		(-2.013)		(-2.255)
Other Transaction Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Accounting Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	371,384	369,740	183,893	183,106	187,491	186,634	290,012	288,578	81,367	81,157	191,621	191,071	289,762	288,644
R-squared	0.021	0.022	0.034	0.034	0.024	0.027	0.020	0.021	0.089	0.090	0.036	0.037	0.021	0.022

Table 8
Robustness cont.

Dependent Variable	*1 = Selected bid*			
	(1)	(2)	(3)	(4)
Highest bid in auction	0.441***	0.449***	0.436***	0.446***
	(24.547)	(25.262)	(27.684)	(28.331)
Bid deposit interest rate	-0.127***		-0.241***	
	(-4.629)		(-3.570)	
*Bid deposit interest rate **				
$1_{Bank\ Risk\ (CDS < 100bps)}$		-0.122***		-0.229***
		(-4.287)		(-3.247)
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		-0.115***		-0.218***
		(-4.152)		(-3.088)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		-0.109***		-0.203***
		(-4.029)		(-2.995)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		-0.115***		-0.200***
		(-3.866)		(-3.041)
*Highest bid in auction **	-0.012*		-0.002	
Bid deposit interest rate	(-1.668)		(-0.391)	
*Highest bid in auction **				
*Bid deposit interest rate **				
$1_{Bank\ Risk\ (CDS < 100bps)}$		-0.010		0.000
		(-1.410)		(0.026)
$1_{Bank\ Risk\ (100bps \leq CDS < 200bps)}$		-0.032***		-0.027**
		(-2.962)		(-2.373)
$1_{Bank\ Risk\ (200bps \leq CDS < 300bps)}$		-0.069***		-0.075***
		(-2.708)		(-3.161)
$1_{Bank\ Risk\ (CDS \geq 300bps)}$		-0.086**		-0.119**
		(-2.092)		(-2.528)
Other Transaction Variables	Yes	Yes	Yes	Yes
Bank Accounting Variables	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	No	No
Auction FE	No	No	Yes	Yes
Observations	371,384	369,740	368,827	366,977
R-squared	0.233	0.234	0.428	0.430

Appendix A1.

Exemplary Deposit Auction

The table shows an exemplary deposit transaction for illustrative purposes.

Time of trade	Firm ID	Bank Name	Maturity date	Transaction start date	Time of Bank Bid	Product	Currency	Status	Status of Bank Bid	Notional amount	Quote value
14-11-2005 12:35:58	xxxxxxxx	Bank1	15-11-2005	14-11-2005	14-11-2005 12:35:43	Deposit	EUR	EXEC	LCAN	76,200,000	2.06
14-11-2005 12:35:58	xxxxxxxx	Bank2	15-11-2005	14-11-2005	14-11-2005 12:35:34	Deposit	EUR	EXEC	EXEC	76,200,000	2.08
14-11-2005 12:35:58	xxxxxxxx	Bank3	15-11-2005	14-11-2005	14-11-2005 12:35:33	Deposit	EUR	EXEC	LCAN	76,200,000	2.07
14-11-2005 12:35:58	xxxxxxxx	Bank4	15-11-2005	14-11-2005	14-11-2005 12:35:35	Deposit	EUR	EXEC	LCAN	76,200,000	2.05
14-11-2005 12:35:58	xxxxxxxx	Bank5	15-11-2005	14-11-2005	14-11-2005 12:35:39	Deposit	EUR	EXEC	LCAN	76,200,000	2.06
14-11-2005 12:35:58	xxxxxxxx	Bank6	15-11-2005	14-11-2005	14-11-2005 12:35:26	Deposit	EUR	EXEC	LCAN	76,200,000	2.07

Trade Number	Identifying number for a specific trade.
Time of trade	Time when the auction is closed. It shows the date and the exact time in seconds. All transactions are executed on the same day.
Firm ID	Numerical identifier for each firm, anonymized for confidentiality reasons.
Bank Name	Bank names available but changed for confidentiality reasons.
Maturity date	The maturity of the trade.
Transaction start date	The start date of the trade.
Time of Bank Bid	The exact time a bank is bidding for a deposit amount. If a bank provides several bids in a transaction we use the last bid of this bank.
Product	The product which is traded.
Currency	The currency of the product.
Status	The status of the entire auction. EXEC means that the trade is executed.
Status of Bank Bid	The status of each bank's bid in the auction. LCAN means ListCancel, that is, another bank bid was selected by the firm. EXEC depicts the executed trade.
Notional amount	The notional amount banks bid for.
Quote value	The deposit interest rate banks are bidding in the auction. Banks bid an annual interest rate in percent using an actual/360 day count convention.