Bank of Russia Financial Stability Department

INTER-DEALER REPO MARKET REPORT, I QUARTER 2012

Moscow 2012

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FOREWORD

Dear readers,

The Bank of Russia has launched a new regular report to cover developments in the inter-dealer repo market. The Report will share results of analysis conducted by the Financial Stability Department of the Bank of Russia as regards money market conditions, improved functioning of the monetary policy transmission mechanism, enhanced efficiency of the central bank interest rate policy, macroprudential policies and systemic risk minimisation.

The Bank of Russia's special focus on the inter-dealer repo market is driven by the nature of its liquidity management framework and set of tools: the primary tool to manage current liquidity in the banking sector is via repo transactions. Moreover, as the autumn of 2008 showed, the repo market can create instability resulting in squeezed liquidity in the banking sector. These and other reasons clarified in the Report explain the Bank of Russia's thinking behind its decision to disclose in more detail the structure and risks of the repo market. Looking ahead, we plan to inform the public on the state of affairs in other money market segments as well.

This publication has been designed to address several objectives. First, as we disclose information about market conditions, we help market participants to assess their financial risks, particularly, stock market and interest rate risks, and also liquidity risks. Second, by showing market structure dynamics, we seek to facilitate a more balanced evolvement of the various market segments. And, third, each issue of the Report will look at the Bank of Russia's liquidity management policies of the banking sector. Therefore, we see the Report as a means to enhance the efficiency of the Bank of Russia's public communication policy.

We hope that the new Report on the situation in the inter-dealer repo market will be seen as a valuable source of information for market participants, and will be useful not only for domestic, but also for foreign investors considering coming to Russia.

S.A. Shvetsov,

Deputy Chairman of the Bank of Russia

SUMMARY CONCLUSIONS

- The size of the inter-dealer repo market in the first quarter of 2012 (about 500 billion roubles) was not big enough to provide adequate liquidity to its participants. Therefore, to support financial stability, the Bank of Russia had to maintain its active presence in the market.

- Market participants extensively borrowed from the Bank of Russia at month-ends, during tax periods and periods of other payments, with total borrowings soaring from 200-300 billion roubles to 500-700 billion roubles.

- Money market interest rates were driven by the liquidity conditions, following similar patterns (fluctuated in the range of 4.1 percent – 6.1 percent). Inter-dealer repo market rates were higher than interbank lending rates.

- The inter-dealer repo market was largely an overnight market (overnight transactions ranged between 69.2 percent and 83.6 percent of the market). Repo transactions with maturities in the range between two and seven days also accounted for a substantial (albeit incommensurate) share of the market (from 11.3 percent to 24.9 percent). Longer-term transactions with maturities beyond seven days had a thin market share.

- The inter-dealer repo market is basically an interbank market, with bank-to-bank lending constituting 26.1 percent of the total market, and bank-to-client lending (clients being both banks and non-banks) – 38.7 percent.

- A substantial share of client transactions in the inter-dealer repo market was taken by non-residents, with non-resident borrowings accounting for 53.1 percent of the total dealer-to-client borrowings market, and non-resident lending amounting to 63 percent of the total dealer-to-client lending transactions.

- The lender side of the inter-dealer repo market was concentrated, with the top 20 lenders accounting for 56.6 – 67.1 percent of the market. On the borrower side of the market, the concentration was moderate, with the top 20 borrowers' share ranging between 34.3 and 45.1 percent.

- Inter-dealer repo trade was secured by top-grade assets: shares and corporate bonds issued by leading Russian companies, and government bonds. Government securities or securities issued by companies with state holding in their capital, i.e., Ministry of Finance bonds, Moscow Government bonds, Gazprom and Sberbank equities and bonds, accounted for approximately 50 percent.

- Inter-dealer repos on equities take an important share in the total market positions of banks. This is one of the reasons why the inter-dealer repo market may be exposed to higher potential market risk in times of turbulence, requiring closer monitoring. A further source of potential systemic risk may come from the concentration of banks in equity portfolios of the repo market, both on the lending and on the borrowing side. However, actual market risks in the inter-dealer equity repo market are not so high given that the equities used are mostly issued by corporate top-notches (the so-called blue-chips).

- A stable and smoothly functioning inter-dealer repo market is essential for monetary policy implementation. Apart from that, the Bank of Russia's involvement in the inter-dealer repo market is important for containing systemic risks: during stress episodes, the Bank of Russia

operates in the inter-dealer repo market to dampen shocks, prevent them from spreading and insure the market's resilience and sustainable operation, with a view to minimising systemic losses of the financial sector.

- An analysis of liquidity transmission in the inter-dealer repo market suggests that under normal conditions the transmission chain may be as long as four consecutive links of liquidity transmission from one participant to another, while in times of financial stress it is compressed to mere two links. The bulk of liquidity is allocated among banks emerging as net lenders in the repo market and among the largest banks with access to Bank of Russia refinancing mechanism (Sberbank of Russia and others). Such trade accounts for 55.71 percent of the overnight market. The multipliers calculated for the purposes of inter-dealer repo liquidity transmission analysis reflect improved liquidity conditions in the overnight market in the first quarter of 2012.

- Systemic risk in the inter-dealer repo market measured by the Shapley Value method more than halved during the period under review. The systemic risk reduction has been driven by higher fragmentation of the repo market. Inter-coalitional linkages strengthened, while extra-coalitional linkages weakened, leading to lower potential losses incurred as a result of a default by a group of market participants holding homogeneous equity portfolios.

- Stress testing of the inter-dealer repo market has revealed that the total value of defaulted transactions may be as high as 114 billion roubles, with the number of such transactions running at 3,898 and the shortage of collateral – at 8.2 billion roubles. Overall, the stress test showed moderate resilience of the market to the stock market risk.

INTRODUCTION

The money market is an important segment of the financial market serving to reallocate short-term liquidity. The money market brings together market participants with both either a surplus or a shortage of short-term liquidity (i.e., liquidity with overnight to one year maturity). The Bank of Russia is especially concerned about the money market in the context of the on-going changes in its intermediate and operational targets. The Guidelines of the Single State Monetary Policy in 2012 and for 2013 and 2014 outline that the Bank of Russia will complete its transition to inflation targeting in the next three-year period. A consistent unwinding of the Bank of Russia's intervention in exchange rate formation in the foreign exchange market will be accompanied by the shift of focus towards the money market. Against this background, interest rate management becomes a key element in monetary policies. The Bank of Russia plans to use short-term money market rates as the operational target of its interest rate policy. At this point, the indicative weighted rouble deposit rate RUONIA (Rouble OverNight Index Average) is supposed to play this role. However, it is not excluded that the inter-dealer repo rate may be used instead, provided there is an appropriate methodological backing.

At the operational level, inflation targeting is underpinned by operational procedures, i.e., an operational framework of the central bank aimed at achieving operational targets, including the interest rate target (i.e., the operational benchmark of the interest rate policy), and the instruments and conditions for providing liquidity to the banking sector. For the operational procedure to be efficient, the Bank of Russia needs to have appropriate analytical tools to assess interest rate policy transmission in the money market. This toolkit includes analysis of interest rate and volume measures of the money market, and a system of daily monitoring and dynamic analysis of the efficiency of transmission mechanism.

As the Bank of Russia pursues its liquidity management policy, it pays special attention to the inter-dealer repo market. The following factors contribute to its special importance:

- the repo market is a mechanism for liquidity reallocation in the financial system, with its quantitative measures reflecting the state of monetary transmission;
- as evidenced by the autumn of 2008, the repo market may be a source of instability, deteriorating into a banking liquidity crisis;
- volumes in the short-term segment of the inter-dealer repo market (overnight) are comparable with volumes in the short-term segment of the interbank market, adjusted for intragroup trade;
- interest rates and haircuts of repo transactions are macroprudential indicators, i.e., they reflect linkages between the market of corporate and government bonds, the equity market and the interbank lending market;
- the repo market concentrates financial sector systemic risks, as its players include non-banking professional participants of the stock market, in addition to major banks;
- the repo market is used by the Bank of Russia for its liquidity supply operations.

Sustainable money market development includes the following objectives:

1) liquidity reallocation on stable terms, i.e., with acceptable volatility of short-term interest rates and smoothed changes in trade volumes;

2) minimisation of counterparty default risks with the help of quality collateral and adequate haircuts;

3) well-balanced development of various segments of the market, including a full-fledged segment for longer than overnight maturities.

With regard to the growing significance of the inter-dealer repo market, the Bank of Russia commences launching quarterly reports of this market. Similar reports are published by other central banks, from a brief weekly Money Market Report by the Central Bank of Malta to the ECB's statistical yearbook Euro Money Market Survey.

The ultimate aim of this publication is to promote financial stability by enhancing money market transparency. If participants are more aware of the market structure and trends, they would better understand and more appropriately assess their own risks. Moreover, the Bank of Russia seeks to inform market participants about potential collective consequences of their individual investment decisions in case of a bandwagon effects and misjudgment of market risks. Finally, we use this Report to reach out to the investment and banking communities, hoping that it may start a dialogue with market participants about systemic risks.

The Report is not an official Bank of Russia document; it is more of an analytical and information paper. Since 2010, the Russian Repo Council and the National Securities Market Association have been producing biannual inter-dealer repo market surveys in line with ICMA (International Capital Market Association) methodologies. However, given that the Bank of Russia Report makes use of the actual trade statistics of the MICEX-RTS, while ICMA methodologies involve surveying of market participants on a voluntary basis, there is a mismatch between the samples of the two studies, implying a divergence in aggregate market estimates. But indeed, they in no way contradict each other. Quite the opposite, both studies give a comprehensive idea of both the exchange-traded and the OTC market segments. In its Report, the Bank of Russia is planning to focus more on prudential measures and monetary policy implementation.

This Report provides an insight into the inter-dealer repo market conditions in the first quarter of 2012. The latest reporting data are provided for 30 March 2012, with any possible material events following the reporting date excluded from the analysis.

A data source for the study was the MICEX-RTS repo trade data. All the indicators were calculated on the basis of outstanding (rather than executed) transactions as of a date, unless otherwise specified. The analysis excludes the first ten days of January, because the repo market operated in a special mode at that time.

KEY FEATURES OF THE INTER-DEALER REPO MARKET

The total value of outstanding inter-dealer repo contracts was 495 billion roubles on average in the first quarter of 2012 (varying in the range of 400 to 600 billion roubles throughout the quarter), while the value of outstanding contracts with the Bank of Russia varied from 200 to 700 billion roubles (Chart 1), showing a rising trend by the end of the quarter. The volumes of both outstanding inter-dealer repo contracts and of closed transactions as of a date (Chart 1 and Chart 2) stayed largely steady (hereinafter the first 10 days of January are excluded from the analysis), while the value of transactions with the Bank of Russia varied widely, increasing by month-ends, during tax periods and periods of other payments, when banks (the key participants of the market, see below) needed additional liquidity to cover these needs. This trend was especially noticeable at the end of the quarter due to the quarterly tax period, e.g., for VAT. Increase in the value of transactions with the Bank of Russia was accompanied by a decline in inter-dealer repo transactions, because:

- some participants switched from inter-dealer market borrowings to borrowings from the Bank of Russia (replacement effect);

- some participants cut their lending in the inter-dealer repo market amid tight liquidity conditions.

Chart 1. Accumulated positions in the repo market, billion roubles

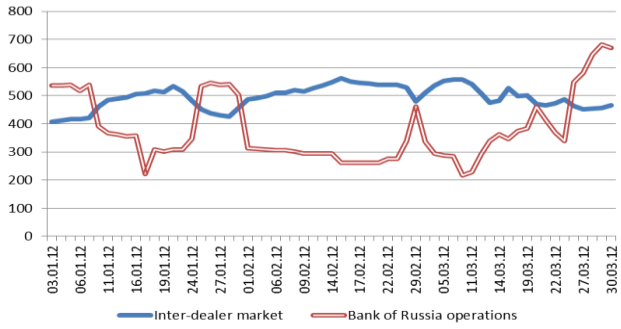
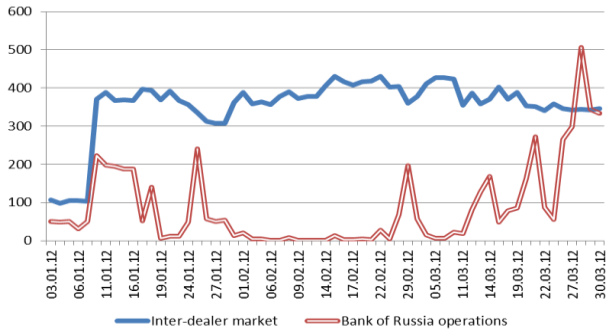


Chart 2. REPO market turnover, billion roubles



The size of the inter-dealer repo market was not big enough to fully supply its participants with liquidity. Therefore, the Bank of Russia had to maintain its active presence in the market. As a result, the situation in the market was largely driven by the activities of the central bank.

The number of non-banks remained roughly unchanged during the quarter (with an equal number of lenders and borrowers) (Chart 3). This is because non-banks mostly played the role of intermediaries, engaging in transactions on behalf and on account of their clients, as the latter showed rather a monotonous pattern of demand and supply, weakly related to banking sector liquidity conditions. On the contrary, the number of banks changed with a clearly defined tendency. At the start of the quarter, when liquidity was excessive[1], lenders markedly outnumbered borrowers, while further on, as the liquidity conditions deteriorated, the number of lenders started declining, while the number of borrowers rose. As a result, borrower banks exceeded lender banks by the end of the quarter (a decline in inter-dealer repo borrowers in the last week of March was caused by their switching to Bank of Russia loans).

[1] A temporary excess of liquidity in the banking system was evidenced by the low RUONIA level, with its values close to 4 percent – the Bank of Russia overnight deposit rate.

A similar pattern was observable in the number of transactions. Client transactions were stable, showing a rise in numbers in the first half of the quarter and staying virtually unchanged in the second half (Chart 4). The number of dealer-to-dealer (mostly banks) transactions largely followed a similar pattern; however, it strongly depended on the Bank of Russia's actions, as the market participants tended to replace their inter-dealer repo market transactions with Bank of Russia transactions.

Chart 3. Number of inter-dealer repo market participants, legal entities

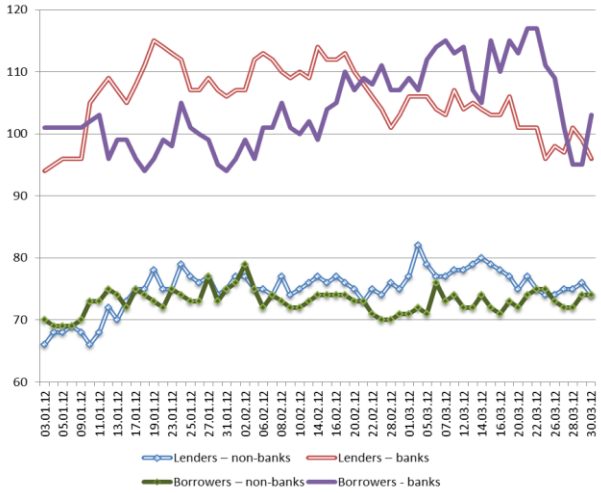
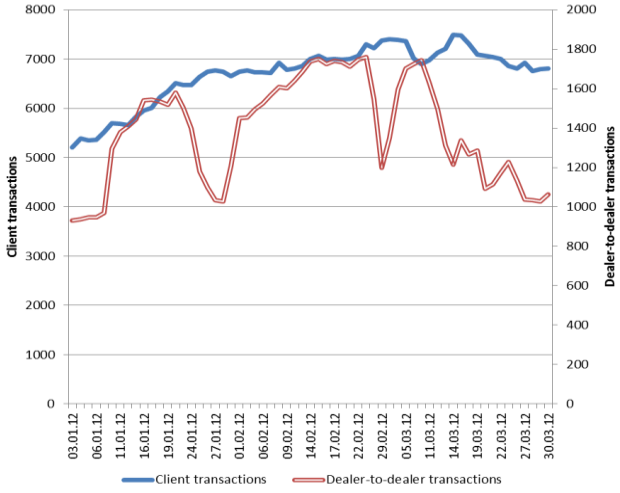


Chart 4. Number of inter-dealer repo market transactions, per day



Money market interest rates, as well as values of transactions, were largely driven by liquidity conditions in the first quarter of 2012. When liquidity was in shortage, rates were rising, and when it was in surplus, they were falling (Chart 5). Inter-dealer repo and interbank lending rates behaved similarly, however interbank lending rates were lower. In some measure, this difference may be explained by lower counterparty risks in the interbank lending market, given that market players are well informed about their counterparties, and a short counterparty list (interbank lending market transactions were mostly conducted between banks with roughly equal standing in terms of asset size). Repo market transactions were more heterogeneous, as they involved a wider community of counterparties, with a fairly large share of client transactions (see below). Therefore, counterparty risks in the inter-dealer repo market were significantly higher.

The gap (spread) between the rates increased in times of excessive liquidity, because interbank lending market players were willing to lend at rates just marginally higher than Bank of Russia deposit rates (reflecting their low counterparty risk assessment). Meanwhile, the inter-dealer repo market showed a significantly higher counterparty risk assessment, as reflected in higher rates. On the other hand, when money market liquidity was in shortage, interbank lending rates were driven by excessive demand for cash, while counterparty risks came secondary in importance. As a result, the spreads narrowed.

However, while there were players engaging in money market arbitrage (borrowing at lower rates in interbank lending market and lending at higher rates in inter-dealer repo market), the gap between the rates remained substantial throughout the quarter.

The lower limit of inter-dealer repo rates was represented by the Bank of Russia's overnight deposit rate (4 percent), while the upper limit – by the Bank of Russia's fixed repo rate (6.25 percent) (Chart 5). The Bank of Russia's repo auction rate (5.25 percent) served as a market stress

indicator: when liquidity was excessive, the inter-dealer repo rate fell below the auction rate, while climbing above it in times of liquidity shortages.

Rates for transactions with different types of collateral followed a similar pattern during the first quarter, with rates for federal bond transactions lower than rates for transactions backed up by corporate, regional and municipal bonds, given the lower credit and market risks associated with the former collateral (Chart 6). Equity rates were lower than bond rates (during most of the period under review) due to a large (about one third) share of securities lending in transactions secured by equities.

Chart 5. Money market rates, %

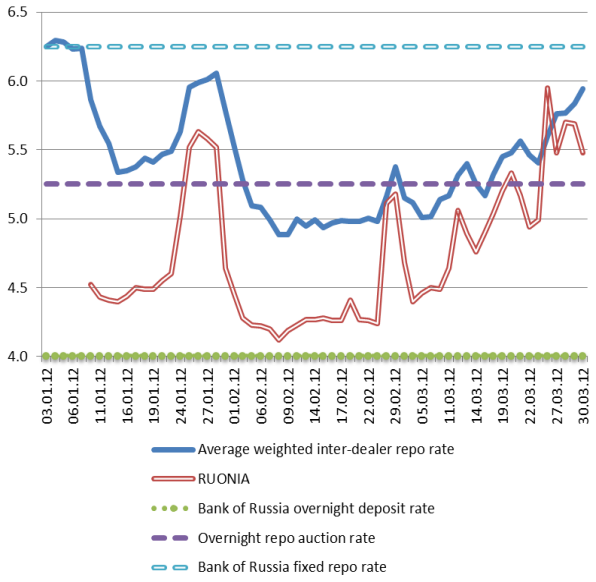
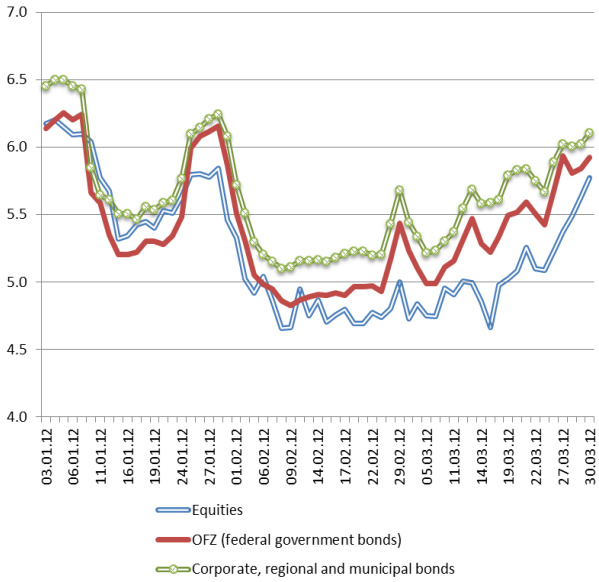


Chart 6. Average weighted rates by collateral, %



Transactions collateralised by equities accounted for 34.4 percent in the first quarter on average, while transactions secured by corporate, regional and municipal bonds accounted for 36.6 percent, and by federal bonds – for 29 percent (Chart 7). The volatile volumes of transactions collateralised by bonds were conditioned by changing positions of banks in the inter-dealer repo market (their collateral portfolios were mostly composed of bonds).

Haircuts on equities varied between 12 percent and 17 percent (this trade featured a significant share of inter-broker and securities lending transactions) (Chart 8), haircuts on corporate, regional and municipal government bonds – between 10 and 12 percent, while on federal bonds – between 6 and 8 percent (for haircut adequacy assessment see the section on the inter-dealer repo market stress-testing below).

Chart 7. Open positions in the inter-dealer repo market by collateral, billion roubles

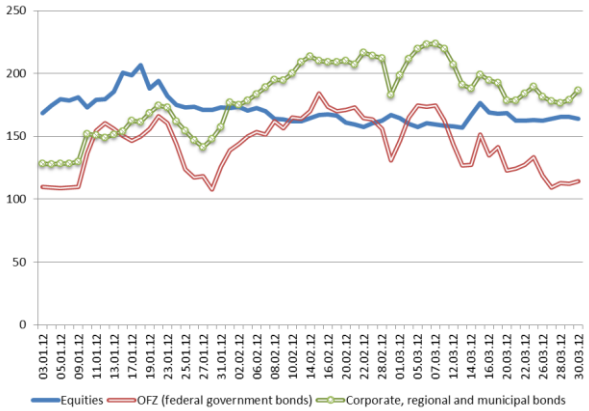
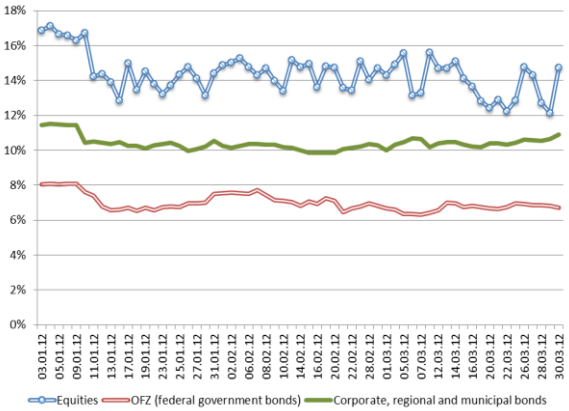


Chart 8. Haircuts in the inter-dealer repo market by collateral, billion roubles



The inter-dealer repo market was predominantly an overnight market in the first quarter of 2012. Any major swings in the volumes of outstanding repo contracts were caused by changes in overnight transaction volumes. The share of overnight transactions was in the range between 69.2 percent and 83.6 percent. Transactions with maturities of up to one week (inclusively) also accounted for a significant (albeit incommensurable) share of the market, fluctuating from 11.3 percent to 24.9 percent. The share of transactions with maturities beyond one week was sufficiently small.

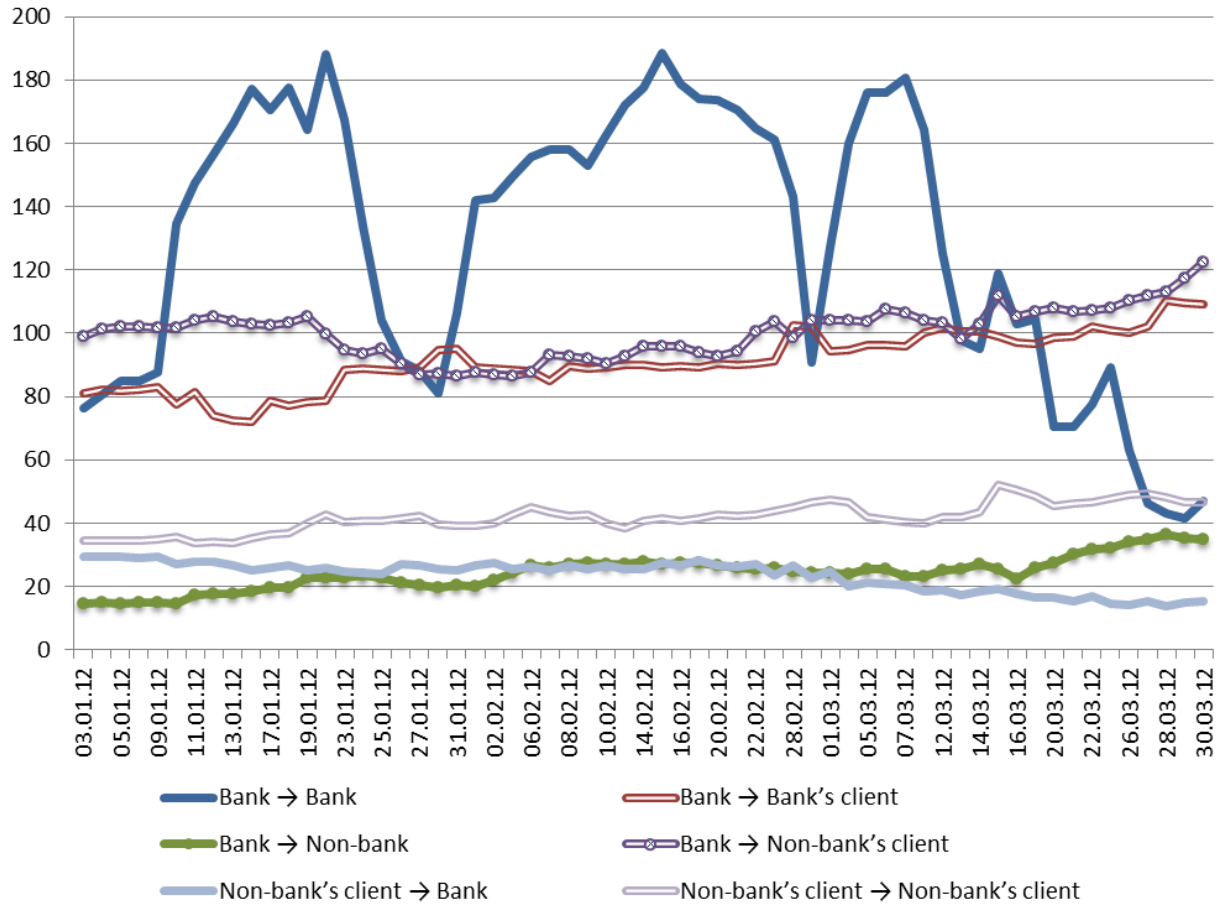
INTER-DEALER REPO MARKET PARTICIPANTS

The biggest share of trade in the inter-dealer repo market fell on bank-to-bank lending (quarterly average at 26.1 percent). Further on, a large share accounted for bank lending to their clients (quarterly average at 20.3 percent), and to clients of non-banks (quarterly average at 18.4 percent) (Chart 9 and Chart 10). These transactions accounted for about two thirds of the market size. Bank-to-bank transactions demonstrated heightened volatility, driven by the overall liquidity conditions in the banking system underlying the volumes of interbank repos.

Borrowers in the inter-dealer repo market were distributed more evenly, with 33.3 percent of total borrowings falling on clients of non-banks, 33 percent – on banks, 27 percent – on clients of banks and 6.8 percent – on non-banks.[2]

Non-banks acted as brokers for lenders in 23.6 percent of transactions, while serving as brokers for borrowers in 40.1 percent of transactions. However, they conducted only a small fraction of the above transactions on their own behalf and on their own account. Non-bank lending on their own account amounted to 7.8 percent (quarterly average) of the total inter-dealer repo market size and their borrowings stood at 6.8 percent.

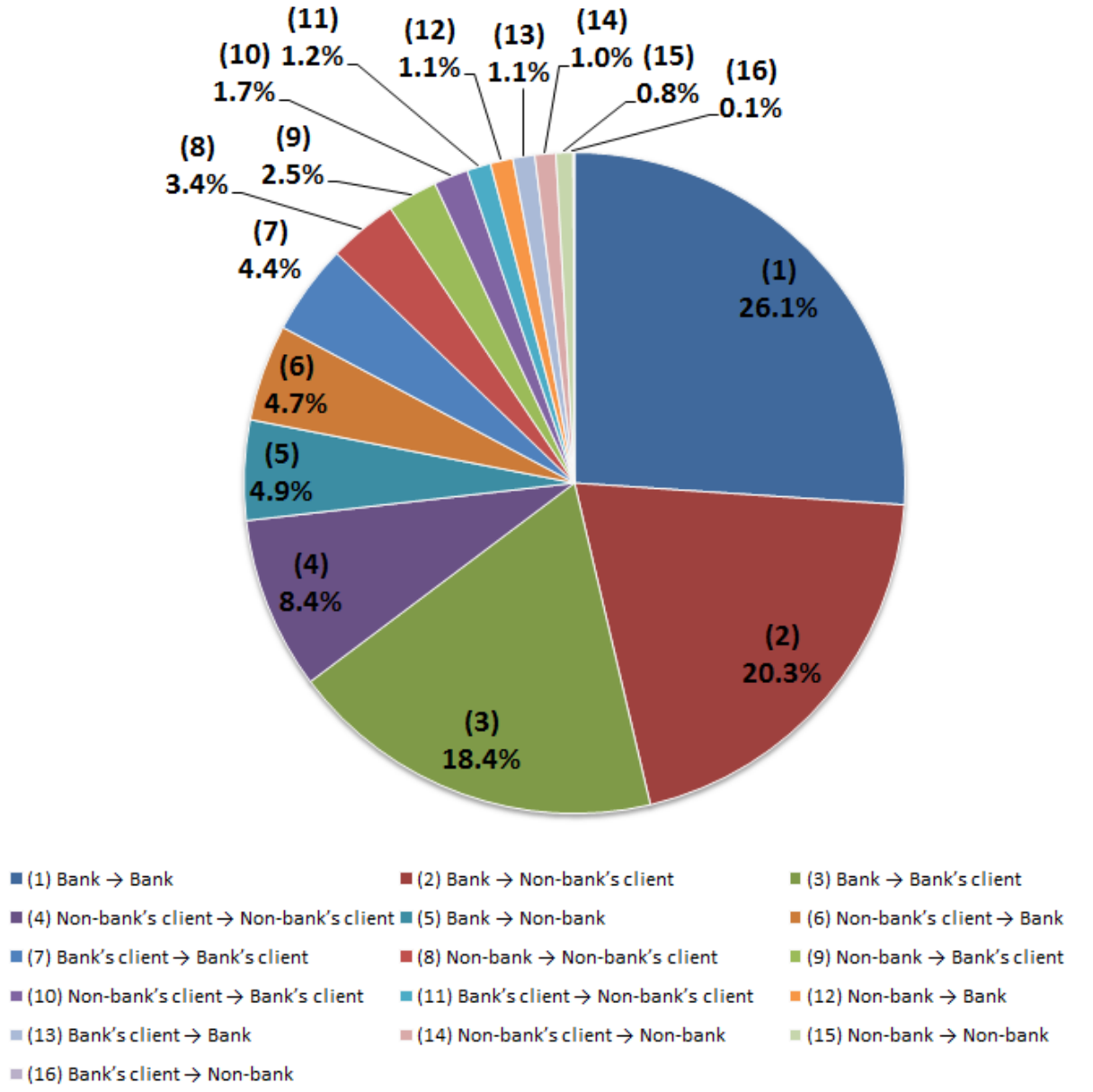
Chart 9. Counterparties to outstanding contracts in the inter-dealer repo market, billion roubles



[2] The sum total of the above measures is 100.1 percent due to a rounding error.

The aggregate share of all the borrowing transactions by clients of banks and non-banks takes 60.3 percent, while the share of client lending transactions stands at 22.6 percent.

Chart 10. Shares of outstanding contracts in the inter-dealer repo market by counterparties (quarterly average), %



A sizeable share in client transactions is taken by non-residents, with non-resident borrowings (quarterly average) at 53.1 percent, and non-resident lending at 63 percent (Chart 12). Borrowings were largely made via non-bank institutions (64.8 percent on average for the quarter), with counterparties mostly represented by banks (64.6 percent on average for the quarter). Lending was also largely conducted via non-bank institutions (68.1 percent on average for the quarter), however showing a more even distribution of counterparties amount bank clients (35.2 percent on average for the quarter), banks (33 percent on average for the quarter), and clients of non-banks (25.8 percent on average for the quarter).

Chart 11. Outstanding inter-dealer repo contracts by maturities, billion roubles

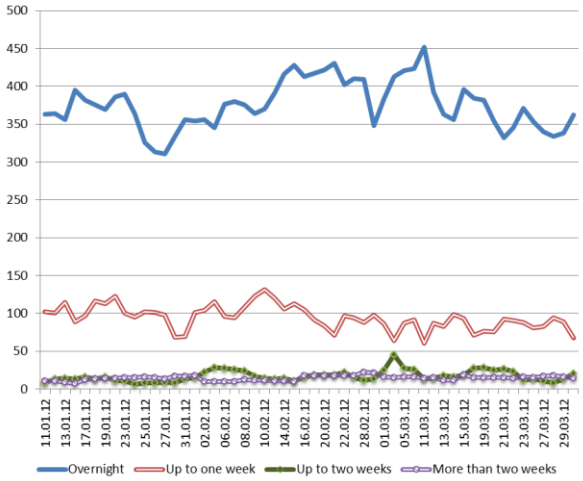
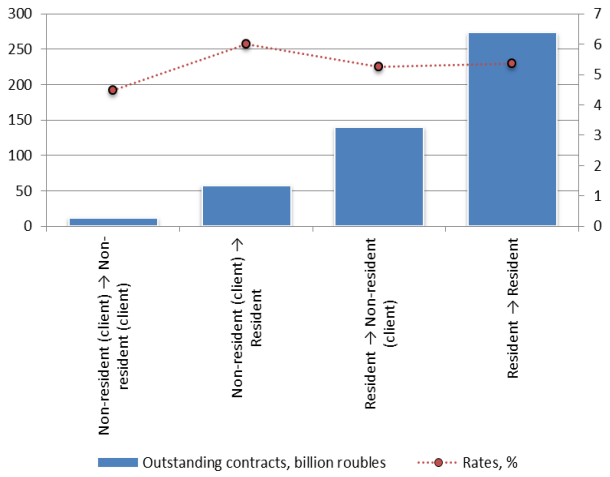


Chart 12. Inter-dealer repo market by counterparties



Transactions brokered by one agent for both the lender and the borrower

A sizeable share in the inter-dealer repo market falls on transactions between clients of one broker. The value of such transactions stood at 62.8 billion roubles as of 30 March 2012 (13.5 percent of the total market), and their number was 3,281 (41.7 percent of the total number of transactions in the market).

Chart 13. Chart of open repo positions (value and rates, as of 30 March 2012)

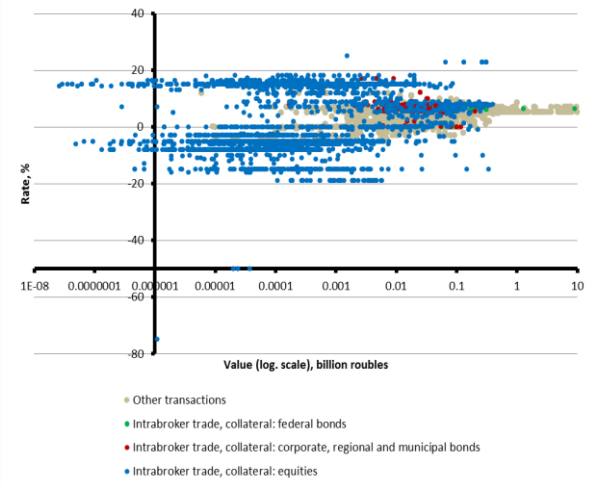
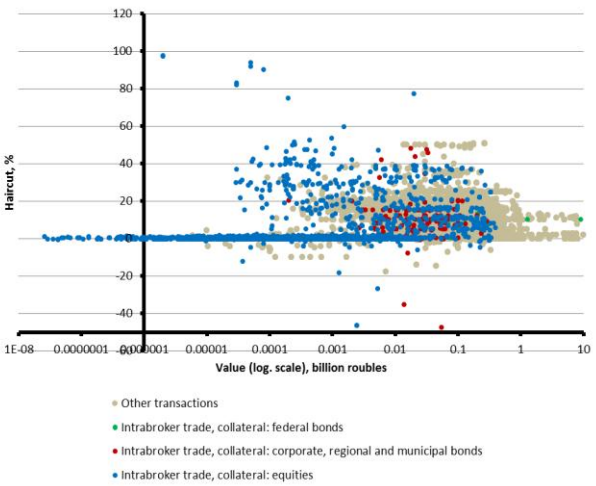


Chart 14. Chart of open repo positions (value and haircuts, as of 30 March 2012)



Most transactions between clients of one broker were secured by equities (64.8 percent). Such transactions featured extreme values of rates (extremely high or low) and zero haircuts. Therefore, the bulk of such transactions were non-market based or were guided by the broker's pricing policy. Transactions secured by equities showed 24.9 percent of intrabroker trade, which, in its turn, could bias the measures estimated for equities.

The inter-dealer repo market was quite concentrated on the lender side throughout the first quarter, with the top 20 lenders fluctuating in the range of 56.6 to 67.1 percent (Chart15). The top 20 lenders included 15 banks, 2 non-banks, 1 bank's client and 1 non-bank's client. On the borrower side, the concentration was moderate, with the top 20 share fluctuating between 34.3

percent and 45.1 percent (Chart 16). Moreover, unlike lenders, the top 20 borrowers showed a largely different pattern of trade from the pattern of outstanding repo trade in the inter-dealer market. The top 20 borrowers were dominated by clients, with 5 bank clients, 7 non-bank clients, 6 banks and 2 non-banks.

Chart 15. Lending in inter-dealer repo market (outstanding contracts) by largest participants, billion roubles.

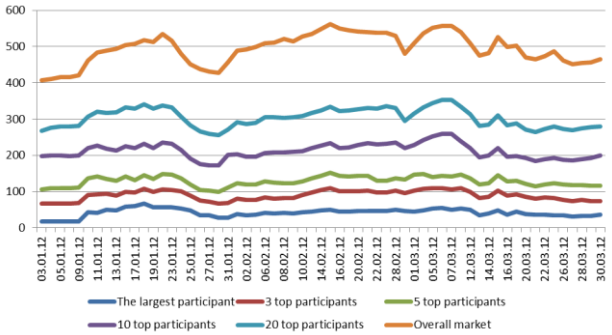
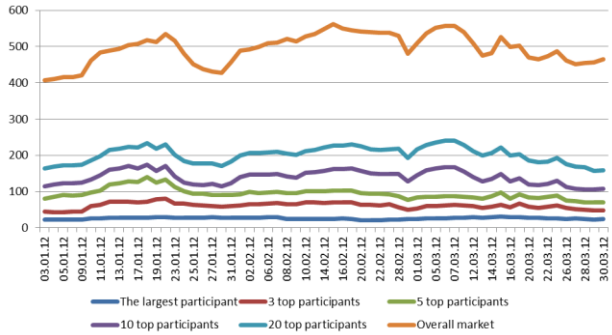


Chart 16. Borrowings in inter-dealer repo market (outstanding contracts) by largest participants, billion roubles



The largest issuer of collateral utilised to secure transactions in the inter-dealer repo market was the Ministry of Finance (OFZ – federal government bonds) (Chart 17 and Chart 18). Volumes of OFZ-secured transactions were highly volatile, following the interbank repo trade dynamics. Volumes of transactions collateralised by securities of other major issuers were relatively stable. Gazprom, Sberbank, LUKOIL, Rosneft, Rostelecom, Uralkali, Tatneft, Nornikel, and Surgutneftegaz mostly supplied equities, while VTB and Transneft were represented (on a large scale) by both equities and bonds. The Government of Moscow, Russian Railways, FGC UES, Russian Agricultural Bank (Rosselkhozbank), Agency for Housing Mortgage Lending (AHML), Mechel, Gazprom Neft and MTS came through as predominantly bond-issuers.

Chart 17. Changes in outstanding inter-dealer repo values by collateral issuers, billion roubles.

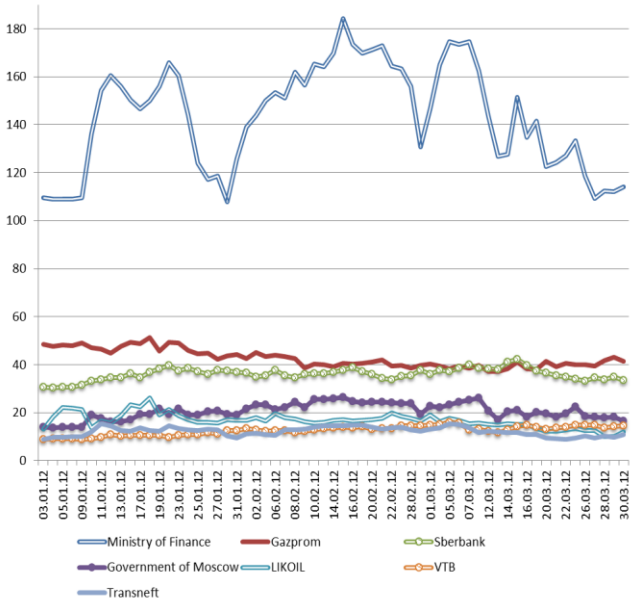
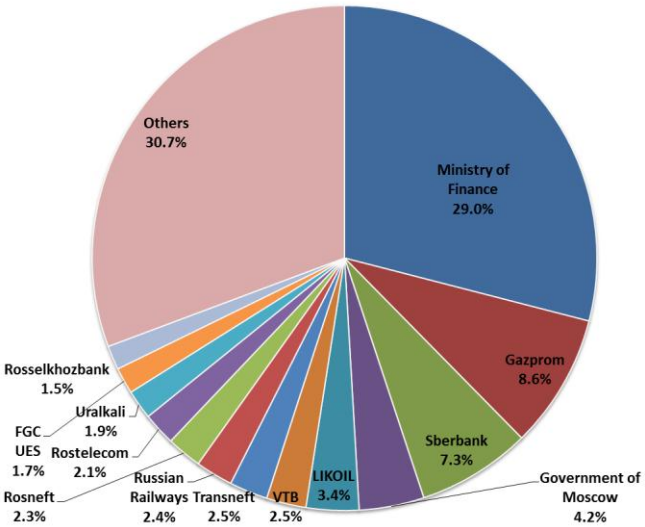


Chart 18. Outstanding inter-dealer repo values by collateral issuers (quarterly average), billion roubles.

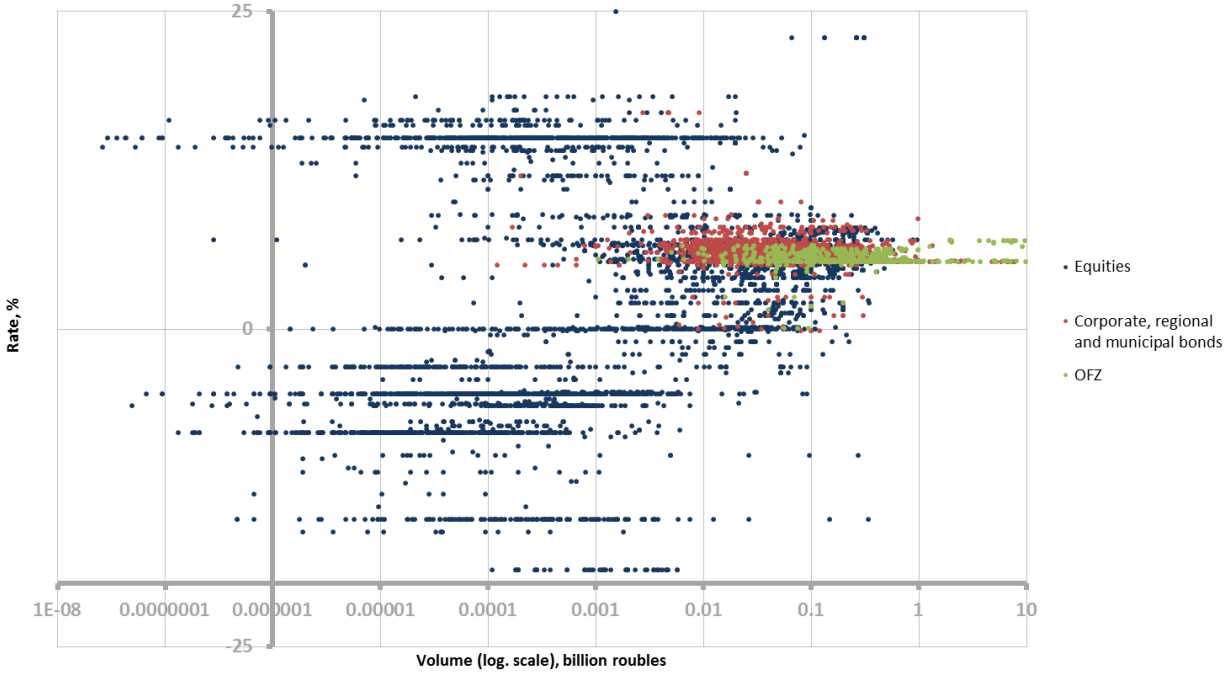


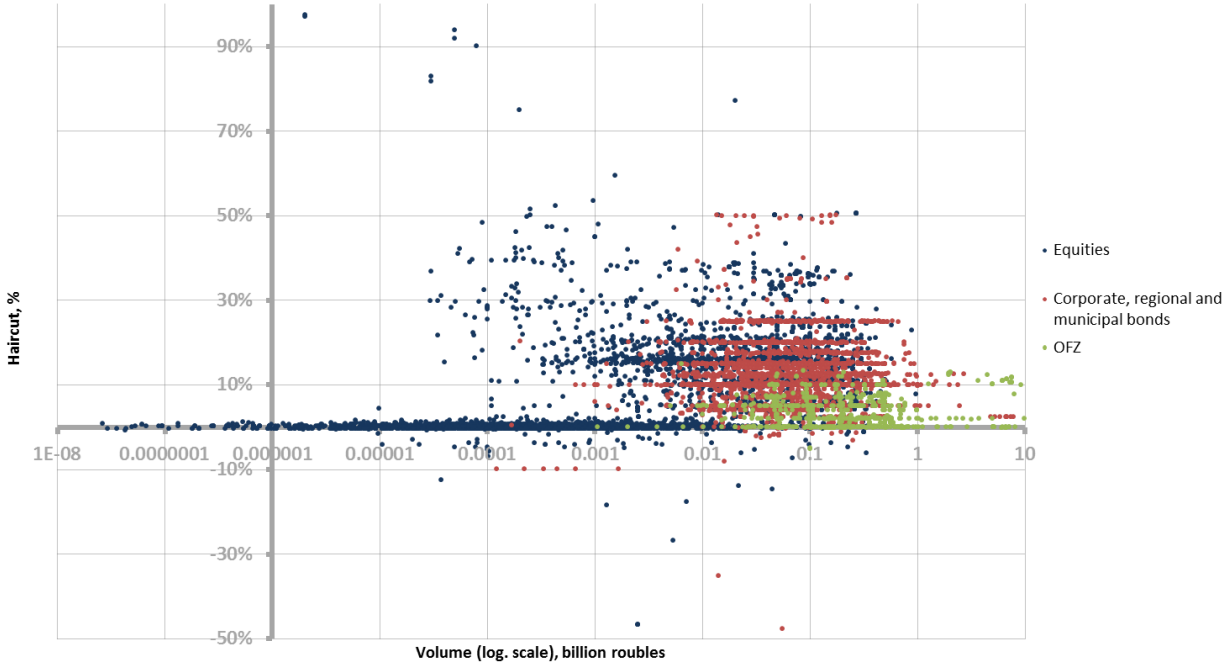
The least risky segment in the repo market was the segment secured by federal bonds. These transactions were large in volumes, had low rates and small haircuts, with a minimal variance in the above parameters. Transactions collateralised with corporate, regional and municipal bonds were perceived as somewhat more risky. Overall, the bond-secured repo market segment was quite homogeneous. By contrast, the equity-secured market segment was heterogeneous, with a wide variation in parameters: rates, haircuts and volumes (Chart 19). A large portion of these transactions fell on inter-broker trade and securities lending, impeding their risk assessment (see section Use of Equity in the Inter-Dealer Repo Market).

In the dealer-to-client lending segment, with market participants lending on their own behalf, a significant share of transactions featured quite high interest rates. However, most extreme rates (both negative and positive) fell on client trade (Chart 20). The bulk of such transactions were executed within one broker, therefore, it can be reasonably assumed that one of the parties would be a broker-affiliated entity. Both banks and non-banks were engaged in such trade. The economic significance of many such transactions looks quite dubious (given that counterparties to such transactions have no proper control and reporting). In contrast, repo transactions executed by market participants on their own behalf and account featured large volumes and moderate rates.

Participants' accumulated positions in the inter-dealer repo market were highly steady. The market was largely an interbank market, with moderate turnovers of speculative trading (the maximum length of the chain from the initial lender to the final borrower did not exceed 4 institutions on average) (Chart 21).

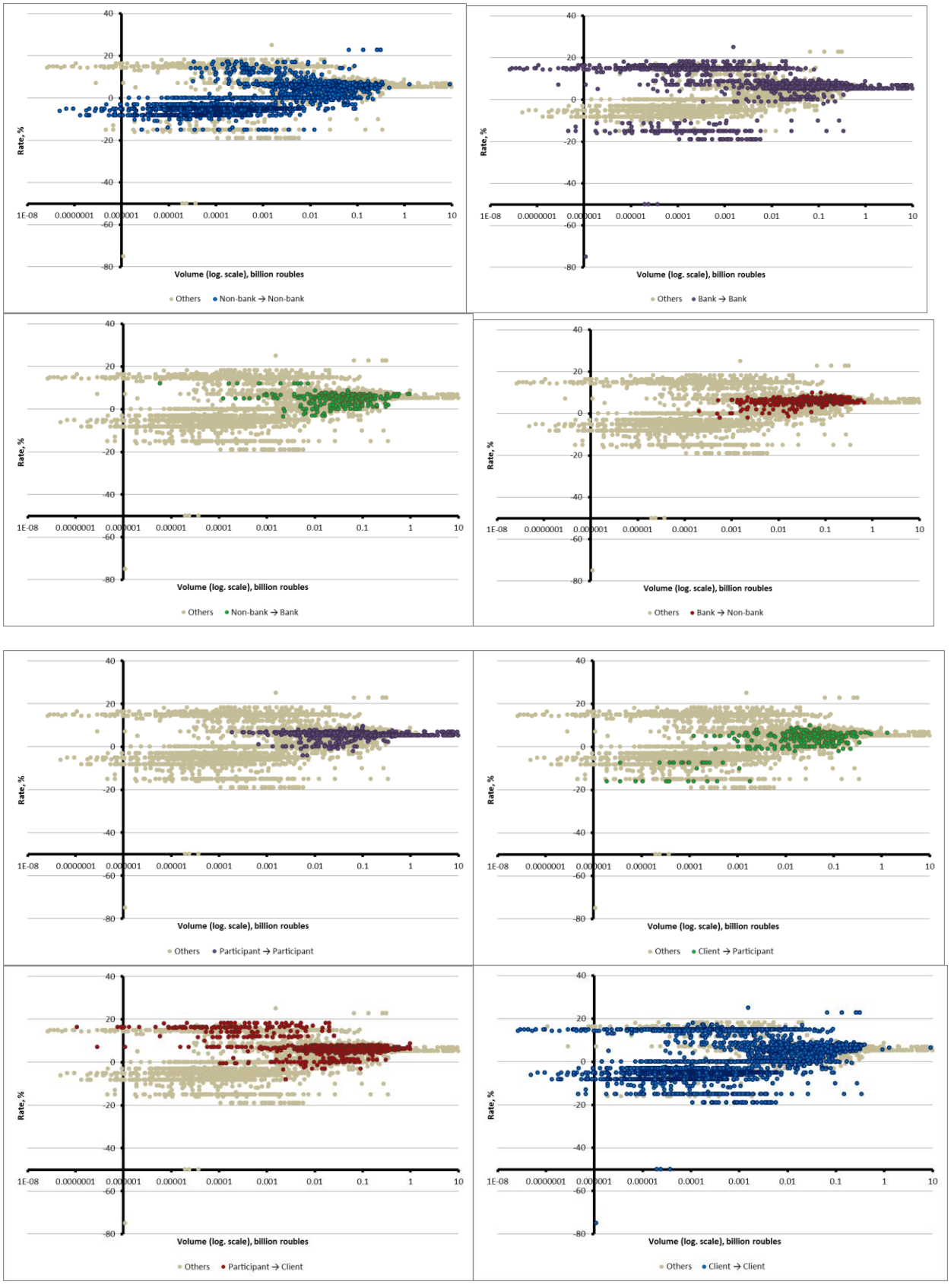
Chart 19. Charts of open positions (volumes, rates and haircuts) in the repo market by types of collateral as of 30 March 2012





Note: the chart shows all the transactions (open positions) as of the date.

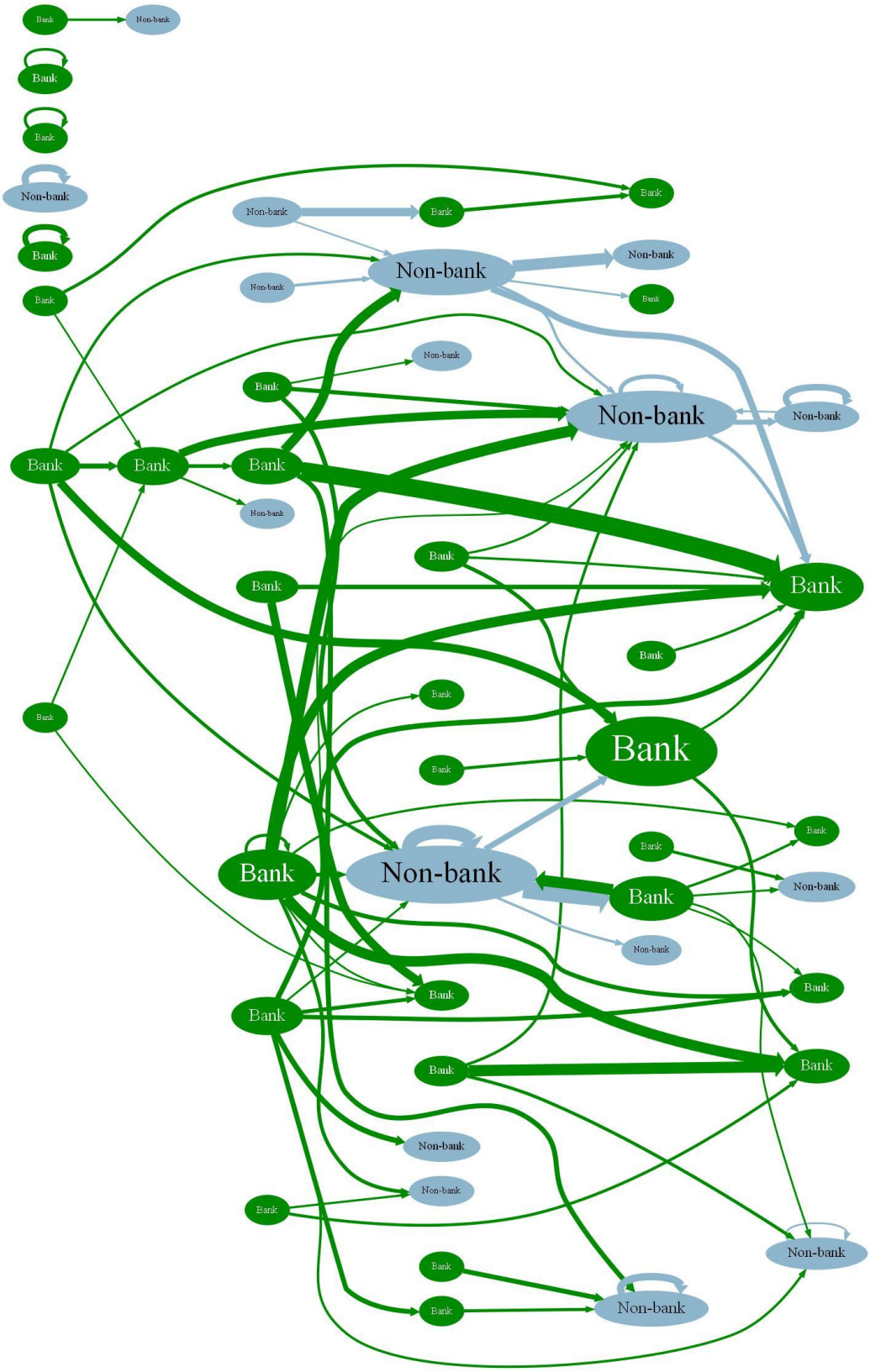
Chart 20. Charts of open positions (volumes, rates) in the repo market by types of dealers (bank, non-bank), on whose behalf transactions were made (on own behalf, on behalf of a client), as of 30 March 2012



Note: the chart shows all the transactions (open positions) as of the date.

Caption xxx -> yyy means that xxx was the lender and yyy was the borrower in the transaction.

Chart 21. Chart of accumulated positions between participants in the repo market (quarterly average)



Note: the chart shows accumulated positions between participants, exceeding 1 billion roubles as a quarterly average. The arrows show the movement of funds from lenders to borrowers.

USE OF EQUITIES IN THE INTER-DEALER REPO MARKET

Equities stand apart among inter-dealer repo securities, excluded from the list of eligible securities accepted as collateral for Bank of Russia repo transactions. There are several reasons for treating equities as a separate inter-dealer repo market group of securities. First, equities are a capital market instrument and, as such, they are much more volatile in value than other securities used in the inter-dealer repo market, resulting in higher levels of market risk associated with trading in shares. Second, the use of equities to secure repo transactions impacts heavily their features, resulting in their sizeable deviations from average market values, with respective effects on systemic risk.

Given high importance of equities to support the inter-dealer repo market operations and funding of credit institutions during the peak of the 2008 crisis, some blue-chip issues were included on the Lombard list of the Bank of Russia and were allowed to be used as security for repos with the Bank of Russia. Despite relatively low credit institutions' demand for equity-secured refinancing, this measure helped to stabilise the inter-dealer repo market. Stock holdings in credit institutions' portfolios are particularly important for the Bank of Russia, because in case of a further liquidity stress episode they may become a source of higher demand for repo transactions collateralised by equities.

Chart 22. Share of equities in banks' open positions in the inter-dealer repo market

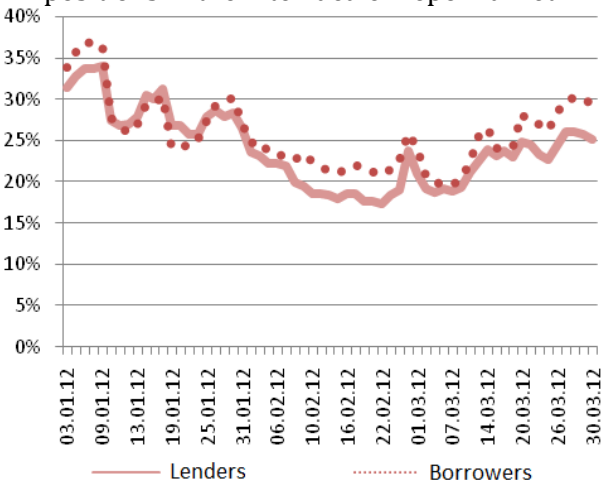
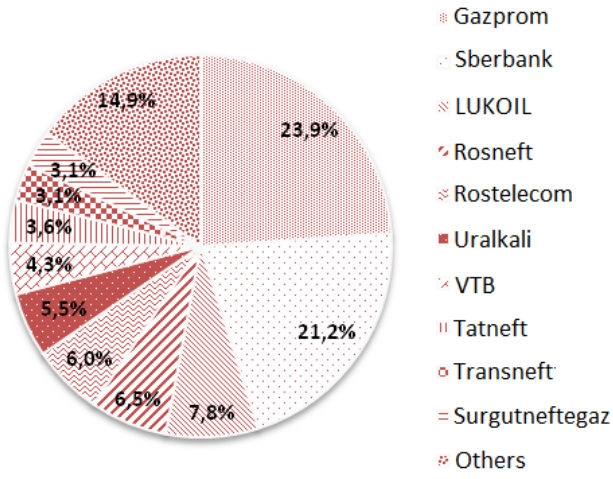


Chart 23. Equity portfolio in the inter-dealer repo market, by issuer



Inter-dealer repos secured by equities account for a considerable share in market positions of banks. In the first quarter of 2012, the share of equities used to collateralise repo transactions varied between 17 to 34 percent for lender banks, and between 20 to 37 percent for borrower banks (Chart 22). The overall dynamics of the share of equities used for securing repos are similar for lenders and borrowers, showing a rising trend in times of higher stress due to market shrinking followed by substitution of some market counterparties by the Bank of Russia. Therefore, banks' funding of some of their market obligations through the increased demand for the Bank of Russia's repo instruments results in enhanced role of equities in the inter-dealer repo market segment. This is one of the reasons why the inter-dealer repo market is a source of higher potential market risk in times of stress, requiring closer monitoring.

Chart 24. Concentration of lender banks in the portfolio of equities used as collateral for inter-dealer repo transactions (shares of one, three and five largest participants)

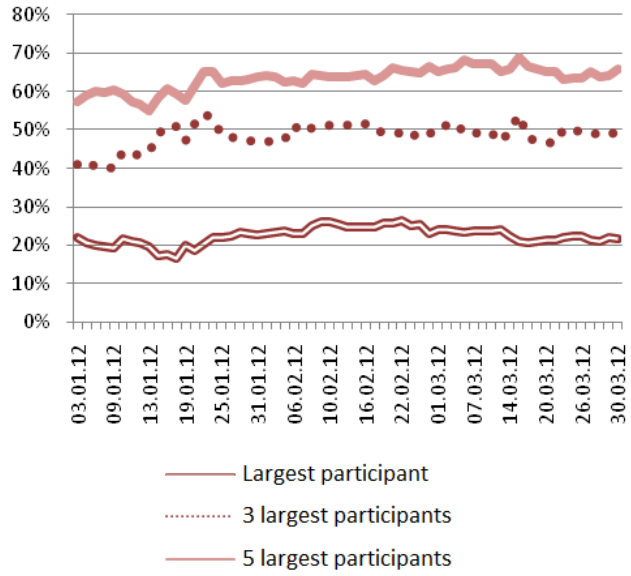
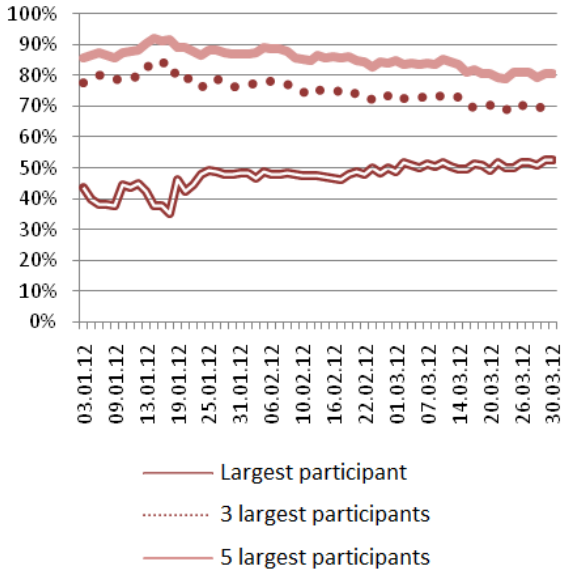


Chart 25. Concentration of borrower banks in the portfolio of equities used as collateral for inter-dealer repo transactions (shares of one, three and five largest participants)



A further source of potential systemic risk may come from banks' concentration in the equity portfolio of the repo market, both on the lending and on the borrowing side. The largest holder of equity portfolio in the group of repo market lender banks accounts for about 20 percent of the total, the top three holders take 50 percent, while the top five – 65 percent. These shares were relatively steady throughout the quarter (Chart 23). Meanwhile, borrower banks show a higher level of equity portfolio concentration risks. Thus, the largest borrower had more than 50 percent in the total portfolio at the end of the first quarter (Chart 24), motivating the Bank of Russia to strengthen its risk monitoring associated with transactions secured by equities of certain participants in the repo market.

However, the actual market risks in the inter-dealer equity repo market are not so high given that participants have mostly securities of largest issuers (the so-called blue chips) in their portfolios. Specifically, over a half of the total equity portfolio in the inter-dealer repo market falls on three largest issuers: Gazprom, Sberbank and LUKOIL (Chart 25). Securities of other issuers are also highly liquid and will be in demand in the market even in times of stress. As the market turbulence and systemic risks escalate, the Bank of Russia may consider resuming repo transactions backed by blue chips.

BANK OF RUSSIA'S PARTICIPATION IN THE INTER-DEALER REPO MARKET

A sound and smoothly operating inter-dealer repo market is essential for monetary policy implementation. Open market operations through repo transactions allow the Bank of Russia to regulate liquidity in the banking sector and to manage interest rates, i.e., to modify quantitative monetary parameters in line with the operational targets of the economic policy. As banks increase their demand for liquidity and lenders contract their net positions in the repo market, market interest rates will rise (Chart 26). Responding to short-term liquidity deficit, the Bank of Russia will step up buying securities accepted as collateral for its transactions, thereby facilitating a balance between money demand and supply by replacing supply from the market net lenders (Chart 27). Alternatively, when liquidity supply expands and credit institutions decrease their demand for refinancing, the Bank of Russia will be withdrawing from the market.

Chart 26. Net position of net lenders in the inter-dealer repo market, and interest rates

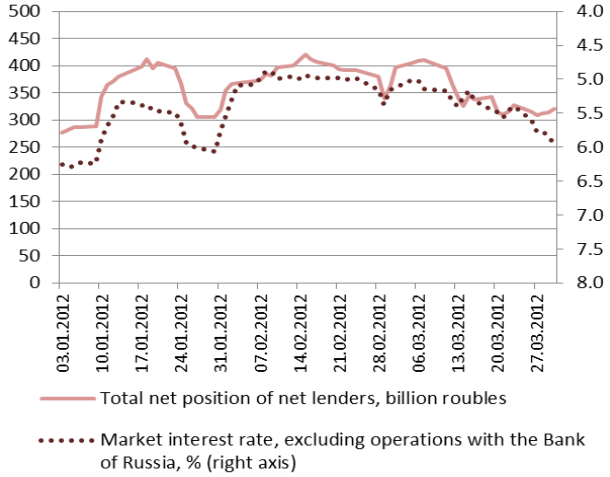
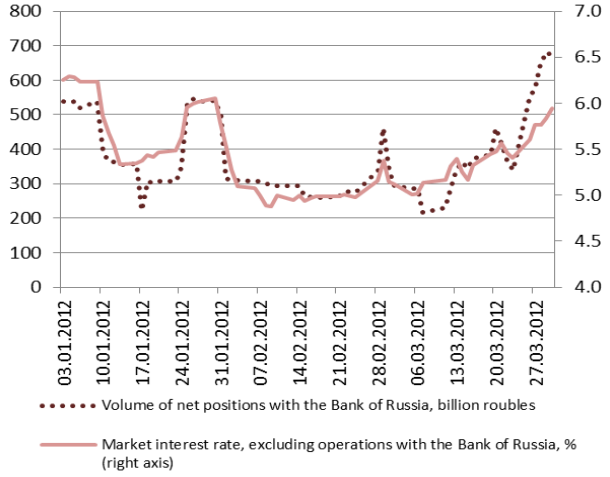


Chart 27. Bank of Russia's open positions in the inter-dealer repo market and interest rates



In addition to monetary policy implementation, the Bank of Russia's involvement in the inter-dealer repo market is important for containing systemic risk. Unlike the unsecured interbank lending market, where participants' exposures and positions are determined by prevailing credit risks and bilateral credit limits, the inter-dealer repo market is much exposed to securities market volatility, as securities are used to collateralise repo transactions. When the value of collateral falls, repo market participants face market risk, which can deteriorate into liquidity risk and require systemic borrowings via the Bank of Russia refinancing facilities. Therefore, during liquidity stress episodes, the Bank of Russia operations in the inter-dealer repo market are aimed at containing shocks and ensuring market stability, seeking to minimise systemic losses of the financial sector (see Section on Inter-Dealer Repo Market Stress-Testing).

That said, it should be noted that market players have limited space for reducing their liquidity risks via repo transactions with the Bank of Russia. First, to be able to conduct repo transactions with the Bank of Russia, a market participant should have a status of a credit institution and meet certain requirements as regards its economic position.[3] This implies that a fairly large group of market participants, including non-banks and less sound banks, cannot refinance their obligations

[3] For more detail see: http://www.cbr.ru/dkp/standart_system/print.aspx

via repo transactions with the Bank of Russia. Second, repo transactions with the Bank of Russia are subject to quantitative limits on credit exposures of certain participants, related to the size of their own capital. If a participant has an exceedingly high degree of leverage (ratio of inter-dealer repo debt to equity), it would be impossible to fully refinance this debt via repo transactions with the Bank of Russia.

Third, the list of securities, accepted as eligible collateral for repo transactions, is limited. As of March 2012, the market value of the total securities issues accepted by the Bank of Russia as collateral was estimated at about 9 trillion roubles, with about 2.3 trillion roubles held by banks. Moreover, these holdings are not evenly distributed by their credit ratings: banks mostly hold federal government securities (rated BBB+), while significant stocks of securities rated BBB and BB+ (by S&P) are held by non-banks (Chart 28 and Chart 29).

Chart 28. Distribution of securities accepted by the Bank of Russia to collateralise its repo transactions, by credit ratings of issues (issuers)

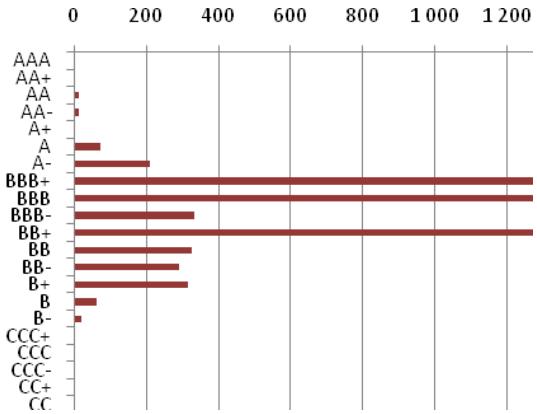
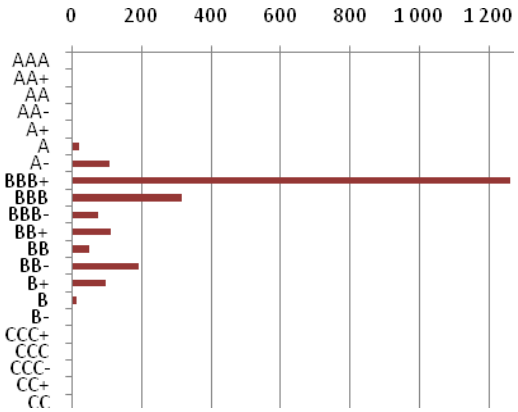


Chart 29. Distribution of securities accepted by the Bank of Russia to collateralise its repo transactions in banks' portfolios, by credit ratings of issues (issuers)



It may be noteworthy that one function of the inter-dealer repo market is to reallocate not only cash, but also securities used to collateralise repo transactions. Buy/sell-back agreements allow participants who need specific securities issues to buy those, use them in their transactions, and then sell them back to the initial holder. Consequently, the inter-dealer repo market allows reallocation of collateral between the banking and the non-banking sectors of the financial system, modifying banks' potential capacity to get refinancing from the Bank of Russia secured by their market assets.

In the total stock of securities used to collateralise inter-dealer repo trade by banks, the share of securities accepted by the Bank of Russia as eligible collateral for its repo transactions went to as high as 75 percent in the first quarter of 2012 (Chart 30), only to revert back to its level at the beginning of the year, at just above 60 percent.

Therefore, banks participating in inter-dealer repo market trade have quite ample possibilities for replacing market financing (should it dry up) with Bank of Russia repo loans to refinance their existing debt.

Chart 30. Share of securities, accepted as collateral for repo trading by the Bank of Russia, in transactions of bank participants

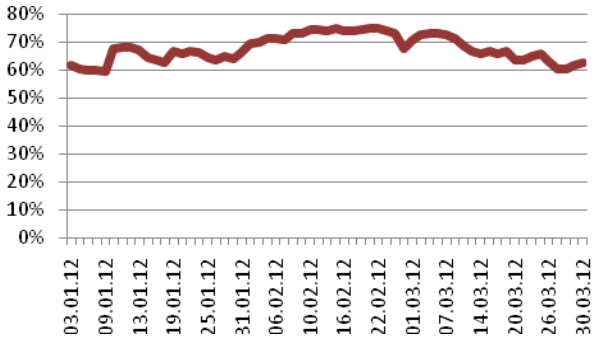
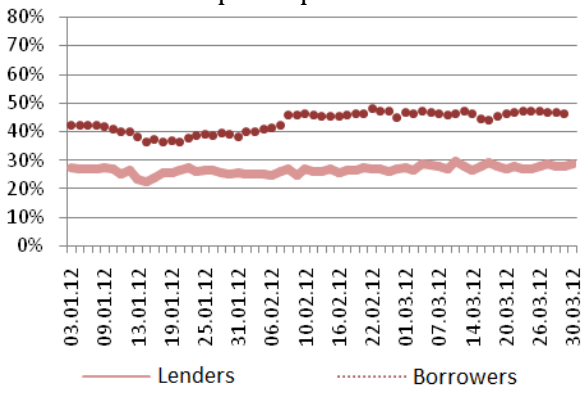


Chart 31. Share of securities, accepted as collateral for repo trading by the Bank of Russia, in transactions of non-bank participants



At the same time, it may be of note that the share of securities accepted by the Bank of Russia for its repo transactions, varies widely across bank participants, with significant deviations from the average market value shown by some players. An extremely low value of this indicator shown by some active players may be a sign of their potential susceptibility to systemic shocks, and should draw enhanced attention from the regulator.

The sustainability of the inter-dealer repo market is also impacted by the composition of non-banks' security portfolios. In the first quarter of 2012, the share of securities accepted as collateral for repo transactions with the Bank of Russia accounted for about 45 percent on average of trade of non-bank borrowers, while for non-bank lenders it was somewhat below 30 percent (Chart 31). A positive development observable in the first quarter of 2012, was an emerging rising trend for non-bank borrowers: this share increased from 42 to 47 percent during the period. These trends imply wider possibilities for banks, who act as counterparties to non-banking participants in inter-dealer repo market, to use in times of stress (should the need arise) their securities accepted as collateral in repo transactions with the Bank of Russia.

LIQUIDITY TRANSMISSION IN THE OVERNIGHT SEGMENT OF THE INTER-DEALER REPO MARKET

This section presents the results of the transmission mechanism analysis (see Conceptual Framework for Liquidity Transmission Analysis), as applied to the repo market in the first quarter of 2012. The period of observation spans from *3 January to 30 March 2012* (62 trading days). The key focus was on bond-secured transactions, as they are a key instrument to support banking liquidity. During the period under review, daily bond repo market turnover, including Bank of Russia operations, averaged 713.8 billion roubles (737.3 billion roubles in March 2012). Regular market participants included 201 dealers, both banks and non-banks. In January-February 2012, the bulk of trade was concentrated in the overnight segment[4] (291.6 billion roubles or 43.9 percent of the total market) and in the segment beyond 30 days (34.7 percent of the total market). Interest rates by maturities are given in Table 1.

Table 1. Average weighted interest rates by trade maturities, %

Period	Overnight	2-6 days	7 days	8-29 days	30 days	Over 30 days
January 2012.	5.64%	5.66%	5.75%	6.10%	6.65%	6.86%
February 2012.	4.89%	5.11%	5.42%	6.20%	6.95%	6.88%
March 2012	5.37%	5.52%	5.44%	6.18%	6.66%	6.90%

Conceptual framework for liquidity transmission analysis

To provide information and analytical support for the banking liquidity policies as regards setting quantitative parameters for repo transactions, the Bank of Russia has developed an analytical system for daily monitoring and dynamic analysis of the efficiency of the money market transmission mechanism. This system addresses the following related tasks:

- Monitoring of current inter-dealer repo market conditions: response of money market indicators to changes in Bank of Russia policy rates, liquidity parameters and liquidity management procedures;
- Measuring of liquidity allocation patterns in the inter-dealer repo market, by groups of participants;
- Quantitative assessment of the inter-dealer repo market's financial stress.

To facilitate practical application of the algorithm, the Financial Stability Department has designed a special framework of concepts and categories. This framework is based on a tiering approach to markets. The repo market is structured as a **multi-tier system** representing a sequential allocation of liquidity among groups of market participants.

The market tiers are lined up sequentially depending on participants' ease of access to the Bank of Russia's refinancing facilities. The zero tier includes the Bank of Russia and market lenders (buyers of securities) who never act as borrowers (sellers of securities). If one broker acts on behalf of the lender and the borrower in one transaction, this broker will be classified in tier zero.

[4] Excluding Fridays, week-ends, holidays and days before holidays.

The first tier includes borrowers (sellers) engaged in repos with zero-tier players, including the Bank of Russia. Market participants' affiliation to further tiers is determined by iteration: any successive tier will accommodate borrowers engaging in repo transactions with lenders from the preceding tier. If a borrower engages in repo trade with lenders from various tiers, this borrower will be classified into the tier of the lowest possible number. Therefore, the population of market players shows a "tree" of linkages across various tiers.

To analyze the liquidity transmission mechanism in the repo market we use a system of multipliers:

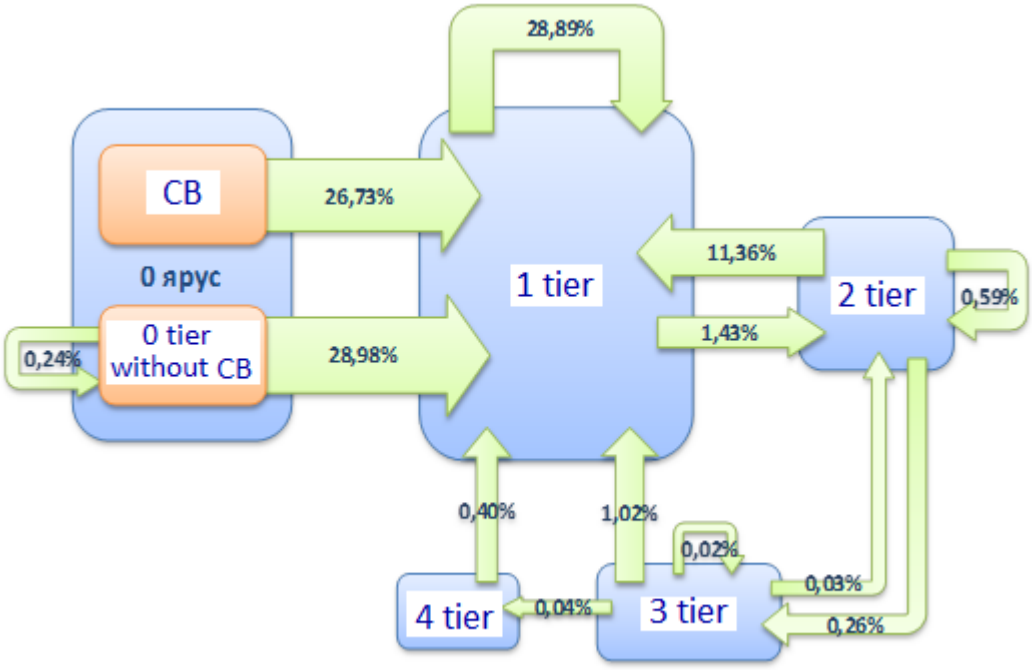
- *Multiplier No.1 (the market/tier 0)* – a ratio of overnight positions to total liquidity provided by tire zero of liquidity allocation;
- *Repo market multiplier No.2 (the market/the Bank of Russia)* – a ratio of overnight positions to total liquidity borrowed from the Bank of Russia;
- *Repo market multiplier No.3 (the market excluding the Bank of Russia/tier 0 excluding the Bank of Russia)* – ratio of overnight positions excluding borrowings from the Bank of Russia, to total liquidity provided by tier zero, excluding borrowings from the Bank of Russia.

From the perspective of liquidity transmission analysis, a break-down of the market into the tiers will seem most interesting. All overnight transactions secured by bonds are calculated for each of the trading days. The average number of such open positions (number of linkages among various dealers) is estimated at 460 per day for 166 dealers. Over a half of overnight trade (55.71 percent in value terms) is conducted between tier zero (includes the Bank of Russia and primary lenders) and tier one, incorporating Sberbank of Russia and other largest banks with easy access to the refinancing system. An overall distribution among the tiers[5] is given in Chart 32, showing shares of tier-to-tier trading volumes of the total overnight market turnover. The average number of tier zero participants is 51 (including 38 banks), of tier one – 93 (including 72 banks), and of tier two – 19 (including 11 banks).

The chart suggests that almost all the liquidity is concentrated in tier one. This tier captures most cash from tier zero, as well as funds from the other tiers. In the first quarter of 2012, the Bank of Russia was much less present in the repo market compared to the fourth quarter of 2011. Specifically, its market share contracted from 58.5 percent to 26.7 percent. During the span of absent central bank interventions in the overnight market, lending from tier zero banks expanded, as well as lending from dealers belonging to the other tiers. Moreover, liquidity reallocation within one single tier intensified, with such tier 1 transactions amounting to 28.9 percent (the so-called "loops" in linkages within one tier).

[5] Estimated by average values of trade between the tiers over the period under review.

Chart 32. Liquidity allocation in the overnight repo segment in the first quarter of 2012

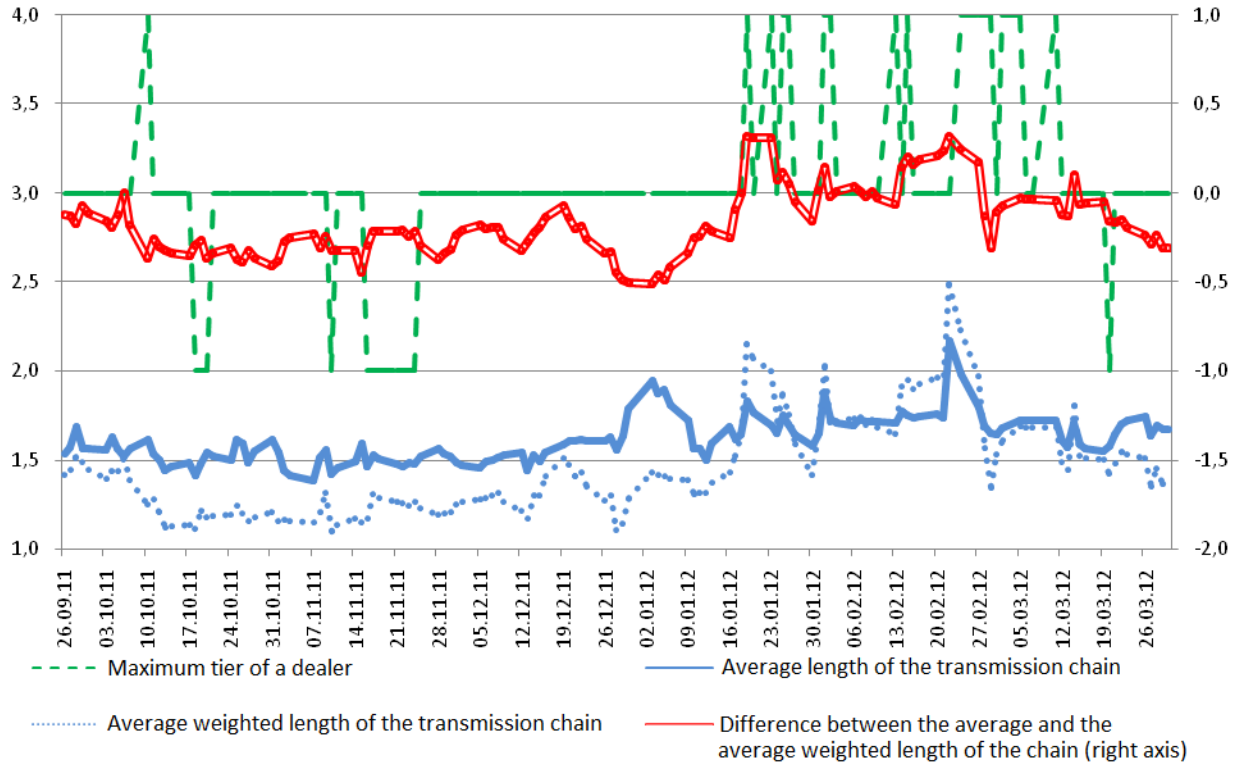


Note. The scheme presents a directed graph illustrating cash flows in the repo market. The pointed arrows (graphs) show liquidity provision operations (i.e. repo transactions), while the blocks stand for tiers of market participants. The directed graph shows cash flows in the overnight bond segment, totaling about 291.6 billion roubles. The percentage values reflect shares of these cash flows in the total bond segment of the overnight market. The closed graph means that the trade is transacted between dealers (clients) from the same tier.

The maximum length of the transmission chain reached 4 links in the first quarter, as liquidity went from tier zero to tier four. To identify the number of the tier for a transaction, the lender's tier is relevant. This points to the capacity of this specific tier to provide available funds to the market. In most cases, the chain was three links long, which was also a minimal transmission length. During financial stress episodes, for example, on certain days in October – November 2011, the market shrank to three tiers (from tier zero through tier 2), while under normal conditions the market operated across five tiers (February 2012).

The average and the average weighted length of the transmission chain showed a growing trend in November 2011 – February 2012, suggesting enhanced efficiency of liquidity allocation throughout the overall financial system. In late February, and in March 2012, the average weighted length of the chain contracted, i.e., lower tier trade started to dominate the market. For example, on 22 February 2012 (on Wednesday), the funds provided by tier zero were allocated further than tier 2 on average (a historic maximum). While in October-December 2011, and in March 2012, the difference (Chart 33, right axis) between the average and the average weighted length of the chain was in the negative area (i.e., the share of tier zero trade was high), in January-February 2012, the share of the average weighted chain length was equal or higher than the average length of the links. Therefore, shares of higher tier trade increased, with positive implications for liquidity allocation.

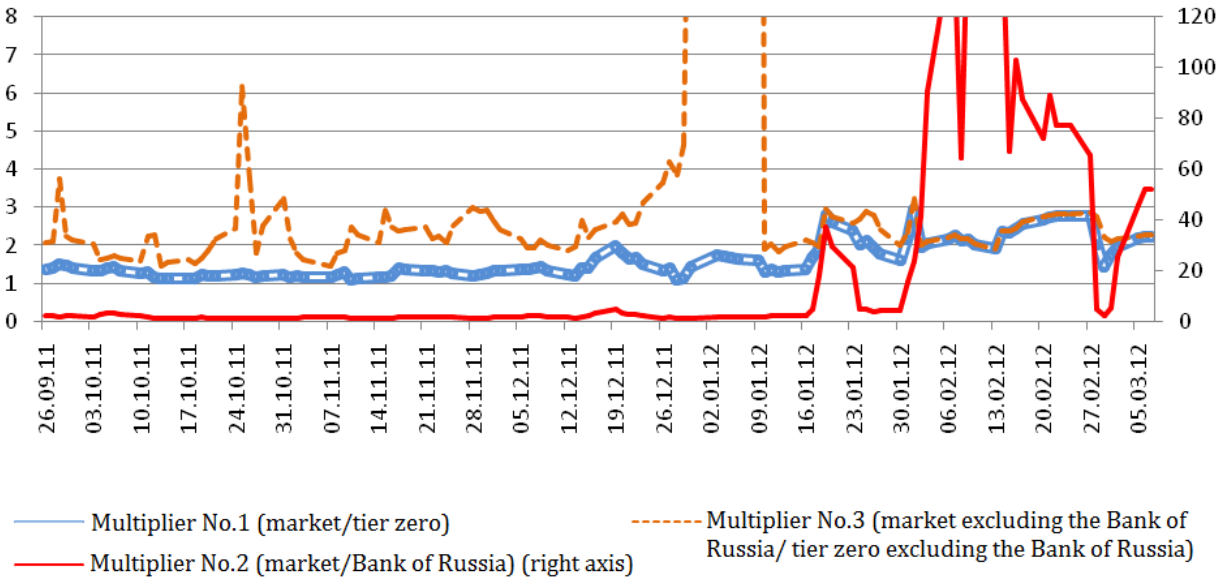
Chart 33. Transmission chain length in the overnight bond repo segment



Average weighted interest rates at each tier of liquidity allocation show the average rate of cash borrowing for this tier. In February 2012, as the liquidity pressures eased, the rates edged down at every tier.

Bank of Russia liquidity provision via overnight repos shrank significantly in February 2012. Against this backdrop, the values of multipliers No.2 (ratio of the total market size to tier zero trade) and No.3 (ratio of the total market size excluding the Bank of Russia to tier zero size excluding the Bank of Russia) virtually merged. In the fourth quarter of 2011, in early January and in late March 2012, multiplier No.2 was significantly higher than multiplier No.3, especially on the days when demand for liquidity was high in the market, including during the New Year holidays. Similarly, the value of multiplier No.1 (ratio of the total market size to liquidity provided by the Bank of Russia) increased in the second half of January and in February 2012, as evidenced by lower funding provided by the Bank of Russia and the overall liquidity restoration in the repo market (Chart 34).

Chart 34. Multipliers for the overnight bond repo segment



The intermediation ratio (net liquidity borrowings by a liquidity tier to its total trade) – running high in October-November 2011 (over 0.8) - indicates that tier one accumulates significant volumes of liquidity. In February 2012, tier one banks decreased their average weighted intermediation ratio to 0.62, suggesting improved liquidity transmission. Sberbank drastically cut its borrowings in February 2012 to become a net lender with the intermediation ratio at -0.81. Tier two banks generally showed a net outflow of funds, except for periods of short liquidity.

Table 2. Average weighted intermediation ratio for tiers one and two

Period	**Tier 1**			**Tier 2**	
	banks	Sberbank	Non-banks	banks	Non-banks
October 2011	0.86	0.19	0.77	-0.39	0.29
November 2011	0.83	0.27	0.76	0.02	0.41
December 2011	0.75	0.23	0.68	-0.17	0.16
January 2012	0.73	0.62	0.65	-0.66	0.52
February 2012	0.62	-0.81	0.73	-0.86	-0.06
March 2012	0.62	-0.26	0.79	-0.88	0.10

Overall, the analysis of the transmission mechanism in the inter-dealer overnight repo market suggests the following regularities:

- An important indicator of money market conditions may be the share of the overnight repo segment secured by bonds. In period of stress, for example, in October 2011, the share of the overnight segment in bond-secured trade was above 73.2 percent, while in favorable periods, like in February 2012, their share retreated to 40.1 percent, largely on the back of contracted Bank of Russia operations.

- The maximum length of the liquidity transmission chain may be four links, i.e., the market structure normally does not exceed 5 tiers. During financial stress episodes the market will shrink to three tiers, while under normal conditions it will be operating across four tiers.

- The average weighted length of the transmission chain extends in good times. While in October 2011 it was 1.25 on average, in February 2012 it was extended to 1.84. The difference between the average and the average weighted length of the chain increased from -0.29 to 0.08, reflecting expanded volume of trade at higher tiers.

- The bulk of liquidity is allocated between tier zero (including the Bank of Russia) and tier one (including Sberbank and other major banks), accounting for 55.71 percent of the overnight market segment.

- First tier banks are normally borrowers, accumulating almost all liquidity, while banks from tier two are usually lenders. Non-banking financial institutions will normally absorb liquidity rather than provide it.

- The average intermediation ratio for tier one banks decreased from 0.86 in October 2011 to 0.62 in February 2012, reflecting a contraction in funds accumulated at this tier. In contrast, tier two saw an expansion in available liquidity, with the ratio decreasing from -0.39 to -0.86.

- The values of the multipliers show improved liquidity in the overnight market.

- Under normal conditions, the weighted price of funding for tier one exceeds that for the other tiers. This may be explained by a number of factors, specifically, by intragroup transactions, reverse repos outside tier one, non-marketable transactions, and trade of non-banking professional participants of the securities market (they normally have to pay more for money market funding);

- Overall, the fact that market players at the junior tiers (three and four) not only receive whatever liquidity they need from the senior tiers, but also act as lenders to tier one and two players, may suggest the presence of adequate liquidity in the system.

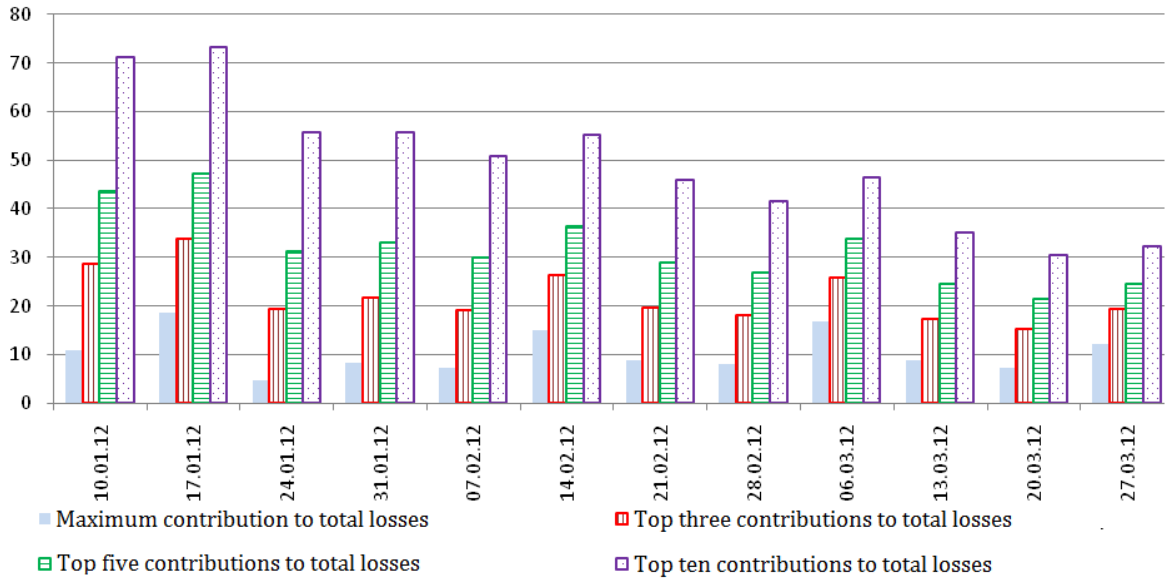
SYSTEMIC RISK AND SYSTEMIC IMPORTANCE OF THE INTER-DEALER REPO MARKET PARTICIPANTS

The Bank of Russia utilises the Shapley value method (see Shapley Value inset below) as an analytical instrument to assess systemic importance of inter-dealer repo market participants. This method allows to measure the systemic importance of each market participant for the overall financial system from the perspective of financial losses that counterparties may incur in case of this participant's default on its repo contract. The Shapley value concept was adapted and applied by the Financial Stability Department in 2011, with appropriate methodological and software work performed by its staff. Actual calculations using the Shapley value methodology are carried out weekly via specially tailored software written in the object-oriented programming language C Sharp (C#).

The maximum contribution to total losses of the financing system (including both banks and non-banks) from the leading systemically important market participant is estimated in the range of 4.5 to 12.1 billion roubles in the first quarter of 2012. As of the end of the first quarter of 2012, it stood at 12.07 billion roubles. Thus, the total loss of the financial system caused by a default of its leading systemically important participant may amount to about 12.07 billion roubles within one month. The value of indicator 'top three contributions to the total loss of the financial system' was in the range between 15.3 and 33.8 billion roubles, reaching 19.34 billion roubles as of the end of the first quarter. The value of indicator 'top ten contributions to the total loss of the financial system' was on a declining trend throughout the first quarter of 2012, decreasing from 73.2 billion roubles to 32.36 billion roubles.

As a result, the systemic risk in the inter-dealer repo market more than halved (Chart 35). The systemic risk reduction has been driven by higher fragmentation of the repo market. Inter-coalitional linkages strengthened, while extra-coalitional relationships weakened, suggesting lower potential losses incurred as a result of a default of a group of market participants holding homogeneous portfolios of securities.

Chart 35. Shapley Value weekly dynamics in the first quarter of 2012 (potential contributions of market participants to total losses of the financial system if counterparties holding homogeneous portfolios default on their repo contracts), billion roubles



Shapley Value

The Shapley value approach was first introduced by US economist from Princeton University Lloyd Shapley in 1953. The method is a solution concept for optimal allocation of the overall gain among the individual players in the context of cooperative games. The Shapley value is a distribution where the payoff of each player is equal to his mean contribution to the well-being of the total coalition, under a certain pattern of its creation. The concept behind the methodology is that the contribution of a single player is measured as a difference between what the coalition can gain with and without the specific individual. In 2009, BIS economists N.Tarashev, C.Borio and K.Tsatsaronis proposed adapting the Shapley value for identification of systemically important financial institutions.

The Financial Stability Department has adapted the Shapley value for analysing systemic importance of repo market participants. The calculation includes more than one step. The first step is to calculate the total loss of the financial system as a result of the coalition's default, with this financial institution included. The coalition of financial institutions is put together in such a way as to have its members' portfolios close to this financial institution in terms of portfolio homogeneity. The second step is to calculate the total loss of the system caused by the default of the coalition excluding this financial institution. The difference between the losses estimated at the first and at the second step is the Shapley value. The Shapley value reflects the contribution by this financial institution to the overall loss of the financial system in case a negative scenario materialises. Similarly, the Shapley value is calculated for each member of the financial system. There will be further steps of the calculation in case of multiple relationships among the members.

Ultimately, the Shapley value describes the degree of an individual institution's systemic importance for the overall financial system. The value is calculated for each institution, to be further used as a basis for the institution's ranking. Systemic importance of a financial institution is a function of the number of its interconnections in the market (number of counterparties), the total value of its market position, the structure and price volatility of its portfolio, and the number of participants in its coalition.

For more detail please see:

- *Моисеев С.Р., Снегова Е.А. Системная значимость участников денежного рынка (Moiseev S.R., Snegova E.A. Systemic Importance of Money Market Participants) // Банковское дело (Banking), 2012. – No.3. – pp. 24-29.*
- *Shapley L.S. A Value for n-Person Games // Annals of Math Studies, 1953. - №28. – pp. 307-312.*
- *Tarashev N., Borio C., Tsatsaronis K. The systemic importance of financial institutions //BIS Quarterly Review, September 2009. – pp. 75-87.*

STRESS TESTING OF THE INTER-DEALER REPO MARKET

Stress testing of the inter-dealer repo market is a methodology to assess how sensitive repo participants' portfolios are to an unlikely and extraordinary but still plausible change in stock market risks. The purpose of stress-testing the repo market is to measure the impact of potential stock market turbulence (shocks) on the overall stability of the financial sector and on the financial strength of its participants. The size of the shock is assumed in such a way as to quantify an extreme but probable risk. The inter-dealer repo market model is designed to reflect the structure of the financial sector, including both banks and non-bank professional participants of the securities market. The inter-dealer repo market stress-testing is a form of scenario analysis to assess the sensitivity of the financial sector to simulated shocks. Therefore, a stress test is a forward-looking analytical instrument, aimed at measuring implications of potential events of uncertain probability.

Repo market stress testing is an aggregated stress test involving assessments of implications of the shock for each market player. Then, the results are further aggregated to get a measurement of a summary impact of the financial turbulence on the whole financial sector. The stress test results in an assessment of changes in financial intermediaries' equity, the size of liquidity deficit that may prevent dealers from meeting their mutual obligations, and overall market losses caused by the stock market shock.

The market shock is assumed as a collapse of prices for financial assets used as collateral to back inter-dealer repo transactions. Declining collateral value leads to increased probability of default under the second leg of the repo transaction (repurchase of securities and repayment of cash). If the price of the collateral is lower than the cash liability as a result of the price shock, the borrower will find it wasteful to meet his obligations and he would opt for a default. Should the stock market collapse be really bad, and the securities plummet in value lower than the haircuts, we may face mass defaults in the inter-dealer repo market.

To simulate the behavior of each market participant, we assess their portfolio sensitivity to price shocks. We calculate a marginal "crisis" price for each security used to collateralise repo trade. It is assumed that the closing leg of the transaction will not be executed if the value of the collateral (calculated on the basis of the "crisis" price) is lower than the present value of the outstanding liability under the close leg of the repo transaction, as of the date of the stress test. In quantitative terms, the size of the shock is simulated by applying the 1 percent historical CVAR (conditional Value at Risk) to the asset price daily variance (in percent). The historical horizon of price behavior observation covers daily stock quotes from 2004 through 2011, which allows considering several periods of financial stress. From each asset's price series, one percent of least values is selected to be used as a basis to calculate their mean value (i.e., conditional VAR). The result is a measure of a potential extreme fall in the asset price within one trading day. The difference between the current price adjusted for the haircut and the "crisis" price is an indication of potential losses of the lender in case the loan portfolio is revalued. This approach helps to measure potential market losses under each repo transaction of each participant. The above stress testing algorithm is used for the inter-dealer exchange-traded repo market. As regards transactions secured by illiquid assets, it is impossible to come up with any satisfactory estimate of the "crisis" price, therefore, such transactions are excluded from our analysis.

The stress test was methodologically elaborated and computer generated by the Bank of Russia in 2011. Actual calculations have been made on the basis of a problem-oriented algorithm integrating the MS Access data base and MS Excel spreadsheets, supported by VBA subprograms.

The market stress test helped to assess:

- Total value and number of transactions at risk of default;
- Share of overdue transactions (both in terms of value and number);
- Total shortage of collateral (i.e., "margin call" or need for liquidity to meet obligations);
- Negative revaluation of equity instruments in case of default and transfer of securities into the lender's ownership;
- Revaluation of own capital and capital adequacy ratio following the stock market shock (for non-bank professional participants – only own capital).

Chart 36. Repo market stress-test chart

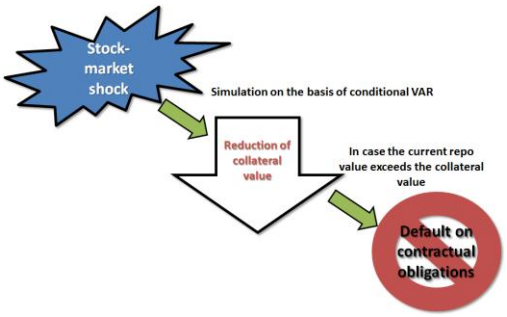
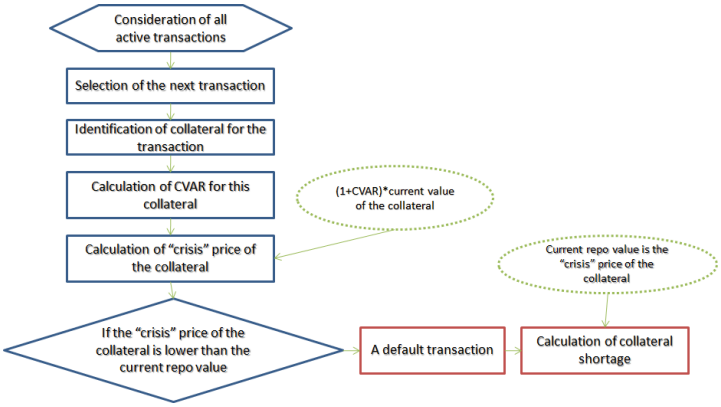


Chart 37. Repo market stress-test algorithm



The inter-dealer repo market stress test used data as of 11 April 2012. The stress test covered 6,561 transactions (of 8,106) for a total value of 361.5 billion roubles (of 519.1 billion roubles). The total value of defaulted transactions (when the value of the collateral fell below the size of the debt as a result of the shock, as of the date of stress testing) amounted to 114 billion roubles, with the number of such transactions at 3,898 and the shortage of collateral (difference between the value of the collateral and the debt, total for all defaulted transactions) at 8.2 billion roubles. The large value and number of defaulted transactions reflects the strength of the simulated shock (looking ahead, shock simulation algorithms will be further elaborated and enhanced[6]); while the relatively small shortage of collateral suggests that market haircuts are basically adequate.

[6] Further elaboration of the stress testing methodology is planned to better account market and credit risk contributors that may potentially increase hypothetical losses of repo market participants.

GLOSSARY

GENERAL CONCEPTS

Basic terms - framework conditions to conclude and execute repo transactions.

Intraday repo – repo transactions with both legs executed within one trading day. Repo maturity is assumed as one day.

Volatility – a quantitative measure of variation in economic variables.

Outstanding repo transaction – a repo transaction with the start leg of the transaction executed and the close leg unexecuted because the term for the close leg has not expired yet.

Dealer – a party (counterparty) to a repo transaction acting either on its own behalf and account or on behalf and account of clients.

Haircut - a percentage variable reflecting the correlation between the value of the collateral and the liability discounted by the repo rate.

Duration – the weighted average time until the redemption of a financial asset (asset portfolio); calculated as a weighted sum total of the asset (asset portfolio) maturities, where the weights are the present values of the shares of the respective cash flows in the total present value of the asset (asset portfolio).

Margin call – a cash payment required by the counterparty (buyer) from the seller as a partial prepayment under the closing leg of the repo transaction if the market value of the collateral drops below the required level.

Credit rating – an expert assessment by a rating agency of the borrower's (issuer's) ability and willingness to meet their obligations fully and in time.

Yield curve (term structure of interest rates) – a graphic interpretation of the relationship between the yield and the term to maturity of a debt obligation.

Accumulated income under repo transactions – an estimated value in roubles used to calculate the liability under a repo transaction.

Collateral – a financial asset traded under a repo transaction. Collateral may include bonds, equities, depositary receipts or a basket of assets.

Residual liability – liabilities of repo counterparts incurred as a result of a non-executed or unduly executed close leg of the repo transaction. Residual liabilities shall be settled with regard to the basic terms.

Buyer (lender) – a party (counterparty) who is selling a financial asset under the second leg of a repo transaction.

Seller (borrower) – a party (counterparty) who is buying a financial asset under the second leg of a repo transaction.

Bank of Russia's interest rate band – a framework of short-term borrowing and lending interest rates of the central bank aimed at limiting the volatility in money market rates.

Repo - is a two-way transaction to sell (buy) a financial asset (the opening leg of the repo) with a commitment to buy (sell) back the same issue and the same amount of the asset (the closing leg of the repo) at such price and at such date in the future, which price and date shall be specified by the conditions of such transaction.

Repo maturity – time period in calendar days between the dates of execution of the start and of the close legs of the repo transaction. The maturity is calculated starting from the date following the date of execution of the start leg through the date of execution of the close leg.

Repurchase price - is a cash amount the seller has to pay to the buyer under the close leg of the repo transaction.

Refund under a repo transaction – a cash amount payable by the seller to the buyer as of the date of the reverse purchase (sale) of the financial asset under the close leg of the repo transaction.

GENERAL MARKET CHARACTERISTICS

Number of participants – number of counterparties (dealers and brokers) in the repo market, includes all the counterparties with open repo positions as of the reporting date. All counterparties engaged in repo and reverse repo transactions, secured by any type of collateral, are included.

Number of open positions – number of open positions between counterparties as of the reporting date. All the one-way transactions of the same maturity made by two participants are aggregated into one position. Then, the number of such positions in the system is derived.

Cash provided by the Bank of Russia – aggregate accumulated positions of market participants under their repo transactions with the Bank of Russia as of the reporting date.

REPO TRADE STRUCTURE BY COLLATERAL

Repo market size, total – total accumulated positions of the repo market participants (repo amount outstanding) as of the reporting date. The amount is calculated as a sum total of all the open positions as of the reporting date across all the instruments and all the maturities. The calculation includes short-sale transactions (securities lending).

Debt repo market size – total accumulated positions of the repo market participants (repo amount outstanding) as of the reporting date. The amount is calculated as a sum total of all the open positions as of the reporting date for repo transactions secured by bonds, of any maturity. The calculation excludes short-sale transactions (securities lending).

Equity repo market size and *other securities (*depositary receipts*) repo market size* – are calculated in a similar way.

Debt repo market share – a percentage ratio of the debt (bonds) repo market size to the total market.

Equity repo market share and *other securities (depositary receipts) repo market share* – are calculated in a similar way

Overnight segment size – total accumulated positions of the repo market participants (repo amount outstanding) as of the reporting date. The amount is calculated as a sum total of all the open overnight (1 day) positions as of the reporting date. The calculation excludes securities lending trade (reverse repo) and repos secured by equities and depositary receipts.

Sizes of 2- to 6-day, one-week, 8- to 29-day, 1-month and over 30 days repo segments are calculated in a similar way.

Overnight repo segment share in total market size, % – ratio of the overnight bond repo market size to the total market size, in %.

Sizes of 2- to 6-day, one-week, 8- to 29-day, 1-month and over 30 days segments are calculated in a similar way.

TRANSMISSION MECHANISM CHARACTERISTICS

These indicators shall be derived for bond-secured transactions. The calculation excludes short-selling trade (securities lending). The overnight segment is estimated separately.

Maximum length of transmission chain – the maximum number of consecutive liquidity provision transactions from the zero to the last tier of the liquidity allocation. It is identified as the highest number of liquidity allocation tiers.

Average length of transmission chain – an average number of consecutive liquidity provision transactions (liquidity transmission), including client transactions of one single broker. It is determined as an average value of the tier number weighted by the number of open positions by this tier's participants.

Average weighted length of transmission chain – an average number of consecutive liquidity provision transactions (liquidity transmission) with regard to trade amounts. It is determined as an average value of the tier's number weighted by the outstanding volume of open positions by this tier's participants.

Repo market multiplier No.1 (the market/tier zero) – a ratio of overnight positions to the total liquidity provided by tire zero of liquidity allocation; calculated for the "repo amount outstanding" field.

Repo market multiplier No.2 (the market/the Bank of Russia) – a ratio of overnight positions to total liquidity borrowed from the Bank of Russia; calculated for the "repo amount outstanding" field.

Repo market multiplier No.3 (the market excluding the Bank of Russia/tier zero excluding the Bank of Russia) – a ratio of overnight positions excluding borrowings from the Bank of Russia to total liquidity provided by tier zero, excluding borrowings from the Bank of Russia; calculated for the "repo amount outstanding" field.

AVERAGE WEIGHTED INTEREST RATES

Average weighted interest rate for tier i – a ratio of the product of the repo amount outstanding and the interest rate to the repo amount outstanding, for lending transactions of tier i of liquidity allocation.

Average weighted interest rate for tier zero (Bank of Russia operations separately) – a ratio of the product of the repo amount outstanding and the interest rate to the repo amount outstanding, for Bank of Russia lending operations.

Average weighted interest rate for tier zero (excluding Bank of Russia operations) – a ratio of the product of the repo amount outstanding and the interest rate to the repo amount outstanding, for lending transactions by other than the Bank of Russia participants.

Average weighted interest rate, total for the market – a ratio of the product of the repo amount outstanding and the interest rate to the repo amount outstanding, for all overnight transactions.

BORROWING AND LENDING VOLUMES ACROSS ALL THE LIQUIDITY ALLOCATION TIERS

Number of tier i participants (banks) – the number of credit institutions (dealers and brokers) active in the repo market, who belong to tier i.

Number of tier i participants (non-banks) – number of tier i counterparties (dealers and brokers), who are not credit institutions.

Tier i borrowings (banks) – amount of cash borrowed under repo transactions by tier i credit institutions; determined for the "repo value outstanding" field.

Tier i borrowings (non-banks) – amount of cash borrowed under repo transactions by tier i financial institutions, who are not credit institutions (banks); determined for the "repo value outstanding" field.

Lending by tier i (banks) – amount of cash granted under repo transactions by tier i credit institutions; determined for the "repo value outstanding" field.

Lending by tier i (non-banks) – amount of cash granted under repo transactions by tier i financial institutions, who are non-banks; determined for the "repo value outstanding" field.

Share of cash lingering at tier i (banks) – a ratio of the difference between borrowed and granted funds to total borrowings by tier i credit institutions.

Share of cash lingering at tier i (non-banks) – a ratio of the difference between borrowed and granted funds to total borrowings by tier i non-bank financial institutions.

Intermediation ratio (banks) – the absolute value of the ratio of the net position (difference between borrowings and loans) of the participants (credit institutions) to the total trade of credit institutions.

Intermediation ratio (non-banks) – the absolute value of the ratio of the net position (difference between borrowings and loans) of the participants (non-credit institutions) to the total trade of non-bank participants.

FORWARD TRANSACTIONS

Number of forward transactions – number of "future" transactions to settle the open leg after the reporting date.

Forward market size, billion roubles – a sum total of accumulated forward positions of repo market participants.

Average weighted maturity of forward transactions, billion roubles – average weighted by initial values maturity for all forward transactions.