Tracing the Impact of Central Bank Liquidity Infusions on Financially Constrained Banks: Evidence from a Natural Experiment[*]

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Abstract

This paper looks at how central bank-administered liquidity infusions impacted the lending patterns of Russian banks during the recent global financial crisis. Using data on the maturity of foreign loans, I indentify banks that were unable to roll-over foreign debt after the sudden stop of external financing caused by the Lehman Brothers collapse and compare them with banks that were unaffected by this event. Applying the difference-in-difference method, I find that while the assistance provided by the Central Bank through liquidity auctions primarily went to the former group of banks, it had a mixed impact on their lending. While there was no significant difference in corporate lending growth between the two groups of banks after the bailout, lending to individuals and entrepreneurs decreased even more among the banks that received assistance. In addition, the results of my study suggest that the bailout assistance provided by the Central Bank impacted the risk-taking strategies of the banks that benefited from it and made them more risk-averse. These banks used the funds they received not only to pay out foreign debt, but also to accumulate cash deposits in non-resident banks. They also increased their holdings of market securities significantly more than other banks.

JEL classification: G21, E58

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1 Introduction

Banks are central to economic activity and monetary authorities often bail them out in cases of severe liquidity shortages in the banking system. When government-managed capital reallocations benefiting a particular group of banks occur, academics and policy makers often raise concerns about the necessity and consequences of such government interventions. Among others, Dell'Ariccia et al. (2008) and Kroszner et al. (2007) have dealt with this issue. They have demonstrated that industrial sectors that are more financially dependent on banks perform significantly worse than others during banking crises and that the magnitude of the real effect on these sectors caused by financial constraints is non-trivial. This paper seeks to explore this issue further and addresses the following questions: How effective are certain forms of government assistance in terms of distributing funds to distressed banks? Do government interventions help distressed banks to maintain lending to the real sector? How do banks that receive government funds use them?

Diamond and Rajan (2005) identify two types of bailouts: *pure liquidity infusions* into banks and *pure recapitalizations* of banks. They demonstrate that the level of success of these rescue programs largely depends on the root cause of the banking system's problems: an aggregate liquidity shortage or insolvency of a group of banks. There is little empirical literature that looks into the impact of different bailout programs on the real economy. Notable contributions include studies by Calomiris et al. (2004), who examine the outcomes of market-based and government-managed bank rescue programs across countries, and by Giannetti and Simonov (2010), who use the Japanese experience in the late 90s and provide micro evidence on how recapitalizations of banks affected their lending to firms. The Troubled Asset Relief Program (TARP), which the US government implemented to strengthen its financial sector during the recent liquidity crisis, gave rise to a series of papers on the impact of a banks recapitalization on their risk-taking behavior (e.g., Duchin and Sosyura (2011), Black and Hazelwood (2011)).

In this study I investigate the effectiveness of central bank's *liquidity infusions* into the banking system during financial distress. For addressing this matter I use the experience of the Russian banking system during the recent global financial crisis which provides an ideal experimental setting for identification of the banks that were affected by the crisis and participated in a bailout. Prior to the crisis many Russian banks were heavily dependent on

foreign borrowing and were therefore directly affected by the sudden stop of external financing caused by the collapse of the Lehman Brothers in September 2008. In the aftermath of this event, the Central Bank of Russia (CB) allocated substantial financial assistance to domestic banks through the long-term uncollateralized liquidity auctions where banks may bid for the CB funding and could choose the amount of liquidity they needed. In this respect these liquidity auctions resemble the European Central Bank's Long-Term Refinancing Operation (LTRO) launched in December 2010 under which banks can choose to refinance their bond holding for up to three years.

Drawing on insights of Almeida et al. (2009) I use a predetermined variation of foreign debt maturity across a sample of the largest Russian banks in a period after the Lehman Brothers bankruptcy and identify groups of banks that were disproportionately affected by the sudden collapse of external financing due to inability to roll-over their foreign debt. Since decisions on long-term borrowing trough Eurobonds and syndicated loans issuance were made *ex ante* and the crisis came unexpectedly, banks with a large fraction of foreign debt maturing during the shutdown of the capital markets were more constrained than otherwise similar banks whose debt matured outside of the crisis event window.[1]

In a natural experiment setup, I test three hypotheses: 1) I compare affected and unaffected banks' participation in government bailout programs; 2) I compare banks' lending policies to different types of borrowers; 3) I study affected banks' positions at the inter-bank money markets and investment decisions with regard to securities.

The task of empirically identifying the bank lending channel is often complicated by simultaneity problems. For example, banking crises and declines in the bank supply of credit are often triggered by the reduction of credit demand by firms (e.g., Khwaja and Mian (2008), Paravisini (2008), Gan (2007)). In case of the 2008 Russian banking crisis, this problem is mitigated by the exogenous character of the crisis. While developed market economies started to decline from the onset of the global financial crisis in 2007, Russia belonged to a group of emerging market economies that experienced a so called "decoupling" period prior to the

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[1]For a sample of mid-sized banks that did not issue Eurobonds but borrowed abroad through the international interbank money market I use the Duchin et al. (2010) identification strategy which is based on an assumption that year-before decisions made by banks to rely on foreign funding are not positively correlated with unobserved bank-specific demand shocks following the sudden stop. For this sample I allocate banks with high pre-crisis foreign borrowing into a treated group and form a control group for them using the propensity score matching methods.

Lehman Brothers collapse (Kose et al. (2008)). During this time, several major investment banks even issued research reports assigning the status of "investment currency" to the Russian ruble in the global carry-trade.[2] This suggests that the sudden stop of external financing to Russian banks in late 2008 was not caused by domestic fundamentals and can be considered exogenous in character.

Another simultaneity problem is related to a tendency of modern banks to increasingly rely on capital markets on both sides of their balance sheets. For example, Hale and Santos (2009) estimate that for the US banks bond financing on the liability side increased from 3.5% in 1988 to 9% in 2007. Gropp and Heider (2009) demonstrate that between 1991 and 2004 a similar shift in capital structure affected the European banks. During the same period, banks in the US and Europe increased their exposure to housing related securities on the asset side. In an environment of this kind, it is challenging to disentangle negative capital markets shocks, which affected banks' non-deposit liabilities, and securities related assets (e.g., Puri et al. (2011), Rice and Rose (2010)). However, unlike banks in industrialized countries, Russian banks did not invest in mortgage-backed securities originating in the US and their asset operations were domestically oriented. This fact makes Lehman Brothers bankruptcy a negative liability shock for the Russian banking system.

After this identifying event and the subsequent shut down of international capital markets the inability of banks to roll-over foreign debt became a concern for the CB. It responded by heavy quantitative easing in two dimensions. On the one hand, it started selling its international reserves, which decreased from $ 596.6 bln. in August 2008 to $ 384.1 bln. in March 2009[3]. On the other hand, it started ruble liquidity infusions into the banking system through newly established credit facilities. These liquidity infusions were organized as pay-your-bid auctions, in which all banks satisfying certain criteria could bid for CB funding. Thus, banks could independently determine the extent of their participation in these auctions within a limit preset by the CB. Against this background, I test whether Russian banks that were directly affected by the cut in external financing that followed the Lehman Brothers collapse bid more aggressively for CB funding than other banks. The difference-in-difference

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[2]In May 2008, Bloomberg reported that Goldman Sachs, Merrill Lynch, and Deutsche Bank advised their customers that the Russian ruble was becoming one of the most lucrative objects of investment amid the continuing world financial markets instability.

[3]Following China and Japan Russia owns the third largest foreign currency reserves in the world.

(D-in-D) estimates for a sample of large banks that issued Eurobonds and syndicated loans suggests that financially constrained banks obtained significantly more credit from the CB than unconstrained banks. Among the sample banks that were affected by the cut in external funding, the total volume of foreign debt scheduled to mature within one year after the crisis represents, on average, 9.5% of their pre-crisis assets, while the amount of funds received from the CB within the same period represents 12% of their initial assets.

The estimation results on banks' lending to different types of borrowers suggest that, in the one year period following the sudden stop, the amount of lending by banks identified as affected by this event did not significantly differ from lending by unaffected banks. This finding could be interpreted as tentative evidence that CB liquidity infusions helped financially constrained banks to sustain corporate lending. At the same time, I find that despite government assistance, affected large and mid-sized banks cut lending to individuals and entrepreneurs significantly more than unaffected banks. This suggests that borrowers with weaker bank-client relationships were less likely to restructure their previous debt with banks and were more strongly affected during the crisis.

Finally, I pursue an investigation of banks' investment strategies by looking at banks' investments into market securities and holdings of the foreign currency. First I find that affected banks significantly increased holdings of government and non-government securities. The former results confirm the "flight to quality" phenomenon, while the later can be explained by two complementary phenomena. On the one hand, growth of investment in market securities is consistent with the findings by Brunnermeier et al. (2011) and Duchin and Sosyura (2011) on increase in risk-taking behavior by bailed out banks. On the other hand, due to qualitative easing, banks were allowed to use a broad range of corporate securities as collateral for funding granted by the CB under its traditional credit facilities, which would increase their incentives to hold such assets.

The last results concern banks' net position with respect to non-resident banks at the international interbank money market. One year after the sudden stop, the net average position of the banks in my sample with respect to non-resident banks grew positive. The net increase represented 9% of affected banks' pre-crisis assets and 5% of unaffected banks' assets. This means that foreign currency obtained by banks through CB's liquidity infusions were not only used to pay down foreign debt, but were also accumulated on accounts in

non-resident banks. This phenomenon has two explanations: 1) Western banks were viewed as safe havens by Russian banks and they increased their deposits with these banks. This is consistent with the behavior of the investors in the US who run into insured bank deposits during periods of market turmoil as demonstrated by Gatev et al. (2007); 2) after a sudden stop, the Russian ruble depreciated by about 30% against the USD and Euro, which turned foreign currency hoarding into an attractive investment strategy for Russian banks with access to the CB liquidity. Using banks' income statements I find that foreign currency operations were a significant source of profits for Russian banks during the crisis period.

The remainder of the paper is as follows. The next section describes the background of the Russian policy of quantitative easing. Section 3 describe the data set and the methodology used. The main empirical results are reported in Section 4 and Section 5 provides conclusions.

2 Background of Russian Quantitative Easing

2.1 Foreign Borrowing by Russian Banks

Capital account liberalization combined with solid macroeconomic performance of Russia due to favorable terms of trade resulted in high foreign borrowing by the private sector[4]. For example, using the comprehensive data on international syndicated loans, De Haas and van Horen (2008) report that Russian syndicated borrowing represented 33% of the global total in 2005-2008, when the US and the Euro-15 countries are excluded. After the capital account liberalization in July 2006, Russian banks increasingly borrowed in foreign currency from international capital markets by issuing Eurobonds and taking syndicated loans. Wholesale funding from foreign banks was also a significant source of financing.

Table A1 in the Appendix reports summary statistics on total issuance of Eurobonds and syndicated loans by Russian banks during December 2003 - August 2009. The amount borrowed was equivalent to 80 bln. USD. As can be seen from Figure A3 when Lehman Brothers filed for bankruptcy in September 2008 about three quarters of this debt (about 57 bln. USD.) was still due. This figure also displays a spectacular growth of Russian banks' foreign liabilities until the beginning of the global financial crisis in August 2007. These liabilities remained flat in the last quarter of 2007 and the first quarter of 2008 but

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[4]According to the CBR estimates foreign liabilities of the Russian banking sector represented 19% of total liabilities in August 2008, while individual deposits represented 24.5% of bank's liabilities.

started growing again in the second quarter of 2008 as Russian ruble continued strengthening against the USD. However, following the collapse of the Lehman Brothers and shut down of international capital markets Russia experienced a significant sudden stop of external financing. The ruble exchange rate considerably depreciated and foreign liabilities of Russian banks started a continuous decline until leveling out at 38 bln. USD in the end of 2009.

2.2 Lehman Brothers Bankruptcy and the Sudden Stop

When Henry Paulson was asked to define the worst moment of the recent liquidity crisis his reply was: "September 17, 2008 when the capital market froze, when there started to be the run on the money markets, banks stopped to lend to each other." (Wessel (2010)).

Figure A1 displays dynamics of the LIBOR and Overnight Indexed Swap (OIS). One can observe that over the year 2008 prior to Lehman Brothers collapse on September 15th the LIBOR-OIS spread was stable (see Brunnermeier (2009), Taylor and Williams (2009)), which suggests that the Lehman Brothers bankruptcy was unanticipated by financial markets. Figure A2 plots dynamics of the sovereign CDS spreads on Russian and Mexican debt[5]. Firstly, a sharp increase in the risk premium on sovereign debt in the last quarter of 2008 means that the emerging markets were effectively shut down from the international capital markets. Secondly, the period immediately prior to the Lehman's bankruptcy was characterized by very narrow CDS spreads and benign borrowing conditions for emerging markets suggesting that a stop in international capital flows was indeed unanticipated.

2.3 Uncollateralized Liquidity Auctions by the Central Bank of Russia

Following a sudden-stop of international capital flows in September 2008 the CB became concerned with inability of banks to roll-over foreign debt. This resulted in two policy measures. On the one hand, the CB started a massive sale of its currency reserves, which peaked in August 2008 at $ 596.6 bln. and bottomed in March 2009 at $ 384.1 bln., which implies a total transfer of $ 200 bln. to the private sector (see Figure A4). On the other hand, the CB started massive injections of domestic currency liquidity into the banking system.

During the most acute stage of the financial crisis, in October 2008, the CB created a new credit facility - uncollateralized liquidity auctions, where banks may bid for CB funding without putting up any collateral. The only requirement for participation in these auctions

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[5]Mexico had the same credit rating as Russia during the time period relevant for the study.

is that banks have an international credit rating that exceeds a certain level. Initially the minimum credit ratings accepted were B- assigned by Fitch or S&P or B3 by Moody's. An additional feature of the auctions was there long-term nature (most of the auctions provided funds for 3-12 months period). The Figure A5 in the appendix illustrates the total amount that the Russian banks borrowed from the CB under this new credit facility. One can see that at the peak in December 2008 borrowing amounted to about 1.3 trillion RUB which is close to 45 bln. USD.

The auctions are organized in American style and parameters are preset in advance. For example, the CB publicly announces the total amount of funding it will give out, the minimum interest rate it will accept and the length of credit it will grant. Qualified banks may submit bids for funding together with an indication of the interest rate they are willing to pay. The maximum bid amount for each bank is set according to a formula published by the CB in its regulations. Following an auction, the CB ranks bids submitted by banks with respect to the interest rate offered and accepts bids in this order (starting from the bid with the highest interest rate offer) until all bids are satisfied. In case banks overbid, the CB stops the auction at the point when the preannounced amount of liquidity injection has been exhausted. Each bank whose bid was satisfied pays the interest rate it offered.

Several policy steps of qualitative easing were adopted with regard to this facility:

- Initially the maturity of credit under this facility was 5 weeks. However, on November 5, 2008, the CB extended the term of uncollateralized credit to 6 months for banks with a minimum credit rating of BB- assigned by Fitch or S&P or Ba3 by Moody's;

- On November 12, 2008, in addition to banks that were assigned at least B- or B3 credit rating by international credit agencies, the CB allowed banks that were assigned credit ratings by two domestic Russian agencies to participate in uncollateralized credit auctions with a 5 weeks' term. On December 12, 2008, the CB added two other domestic credit agencies to the list of credit agencies whose ratings are acceptable for participation in uncollateralized auctions. Russian banks that have not been granted credit ratings by international agencies are normally smaller and less transparent than those that have been granted such ratings. In view of this, the CB's decision to expand the pool of eligible auction participants to include banks with credit ratings only from domestic agencies resulted in that more risky and less established banks could participate.

The simultaneous injection of rubles and dollars into the banking system allowed banks facing foreign debt roll-over problems to repay their foreign debt. This makes Russia an interesting case to study the impact of liquidity injections by monetary authority on financially constrained banking system.

3   Empirical Design and the Data Description

The data I use include monthly observations on the balance sheets and quarterly income statements of all Russian banks as well as all Eurobond and syndicated loans issued by them in 2004-2010. I have obtained data from three sources. The data on banks' balance sheets and income statements has been compiled by the CB on the basis of reports on monthly transactions submitted to the CB by individual banks. This data covers all accounting variables that banks report to the CB according to the "Accounting Rules for Banks Operating in the Russian Federation"[6].

The two other sources of data are Bloomberg and Cbonds. These information agencies compile data on all Eurobonds and syndicated loans issued by Russian banks. The main variables in both data sets overlap but some details of the bond contracts are better represented in one comparing to the other.

As regards data selection criteria, I first ranked over 1000 Russian banks by their average asset size and picked the top 350 banks. Secondly, using the CB reports, I identified banks that have been licensed to conduct transactions with non-residents and had non-zero liabilities with respect to non-residents during the 1 year preceding the sudden stop. A total of 172 banks remained in the final sample.

Because the difference-in-difference method is valid only if banks in a sample are as similar as possible, I divided my data into two sub-samples. This was done with reference to the existing literature on empirical corporate finance, which holds that companies that have entered foreign capital markets are more transparent and safe than others (see Schmukler and Vesperoni (2006)). Accordingly, the first sub-sample in my study includes banks that issued Eurobonds or took syndicated loans and had them outstanding in August 2008 (36 banks), while the second sub-sample includes banks that only borrowed from foreign banks through the interbank market (136 banks). Summary statistics for some of the main capital

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[6]This date set was recently used by Chernykh and Cole (2011), Juurikkala et al. (2011) and Berger et al. (2010).

ratios is provided in Table B4 in the appendix.

3.1 The "Experiment"

The main idea of my natural experiment setup is to find a variable that exhibited prede-termined variation during the unexpected sudden stop of external financing. As discussed before, the proportion of long-term debt maturing after the crisis is a good candidate since decisions about long-term borrowing were made *ex ante* before the crisis. Since the sudden stop was unexpected, banks with a large fraction of foreign debt maturing during the col-lapse of the capital market were more constrained than otherwise similar banks whose debt matured outside of the crisis event window.

Large Banks

For the first sub-sample of 38 banks that issued Eurobonds or took syndicated loans prior to September 2008, I use Bloomberg and Cbonds data on debt structure. I calculate a *Cumulative maturity flow of Eurobonds & syndicated loans over 1 year/Assets$_{t_0}$* where 1 year covers the period after the sudden stop (Sep. 2008 -Aug. 2009) and *Assets$_{t_0}$* are taken at the beginning of this period (September 2008). Banks with a ratio above the median are allocated to the "treated" group (17 banks), while all other banks are allocated to a "control" group (19 banks).

The upper panel of Table B1 in the appendix reports averages for both groups and the mean-comparison t-tests for the difference between the groups during the year preceding the crisis, the year after the crisis, and for difference-in-difference. As can be seen from the table, the total maturity outflow of Eurobonds and syndicated loans was almost identical for treated and control banks in a pre-crisis period. However, during the year after the sudden stop, the average size of outflow was 9.4% of the initial assets for treated banks, while 2.7% for the control group. The difference-in-difference estimate of outflow, which amounts to 6.5% of assets, can be expected to place a sufficiently binding constraint on the treated group of banks relative to the control group.

One of the possible criticism of using foreign debt maturity as an identification device could be that decisions to borrow at international capital markets may be endogenous to unobserved variation in banks' investment opportunities before the crisis. In order to address this issue, I report estimates for *Cumulative inflow of Eurobonds & syndicated loans/Assets$_{t_0}$*

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in the second row of Table B1. The results show that the two groups of banks were not significantly different from each other in terms of foreign funds inflows neither during the last year nor the last quarter preceding the sudden stop. This suggests that there was no pre-determined difference between banks in terms of their investment opportunities.

Medium Banks

The second sub-sample includes 136 mid-sized banks that borrowed from foreign banks through the interbank money market. In order to identify financially constrained banks from the balance sheet data I pursue a strategy used by Duchin *et al.* (2010) which relies on an assumption that year-before decisions made by banks to rely on foreign funding are not positively correlated with unobserved bank-specific demand shocks following the sudden stop. First, I calculate *Net long-term borrowing from non-resident banks/Assets* ratio for each bank in each month where Net interbank loans from non-resident banks with more than 3 month maturity are used. Next I calculate the average of these ratios for each bank in the sub-sample during the 1-year period *preceding* the sudden stop, rank banks by this ratio and allocate the top 20% to a "treated" group (26 banks). I use a propensity score matching estimator (e.g., Zhao (2004), Roberts and Whited (2011)) and observable characteristics of banks to form a "control" group (26 banks) from the rest of the sub-sample[7].

As can be seen form Table B2 the net long-term liability of treated banks to non-resident banks was 7.4% of their assets on average in a year before the sudden stop, while for the control group this ratio represented only 0.8% of assets. By construction one would expect the treated group of banks to be more financially constrained relative to the control group in case of a sudden stop of external financing.

In order for a natural experiment to be successful it is important that studied subjects are not significantly different before the experiment along characteristics other than those that allocate them into treated and control groups. Table B4 reports various asset and liability ratios for all subgroups of banks during 1 year before the sudden stop. As can be seen from mean-comparison t-test the difference between groups is not significantly different between groups for all cases except one. For mid-sized banks that only borrowed from non-residents

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[7]The logit single nearest-neighbor specification without replacement is used for calculating the propensity score and Deposit/Asset, Credit to non-banks/Assets, Non-performing loans/Assets ratios are used as observable characteristics for matching control groups from a sub-sample of 110 banks that had an exposure to an international interbank money market.

through the interbank market the total lending to private entrepreneurs represented 4.5% of assets for the treated and only 1.1% of assets for the control groups.

3.2 Endogeneity Concerns

One of the main concerns in banking studies is the possibility of a sample-selection bias, which could arise if variation in performance across treated and control groups of banks during the crisis is pre-determined by different managerial decisions between the two groups before the crisis. Acharya *et al.* (2011) outline two main moral hazard problems faced by banks: 1) shirking in the effort to monitor loans; 2) engaging in excessively risky lending policies. In order to test if there was a selection bias across treated and control groups of banks along these dimensions I use two variables: Δ*Non-performing loans over 1 year/Assets*$_{t_0}$ and Δ*Demand deposits over 1 year/Assets*$_{t_0}$. If one group of banks lent more to low-quality firms before the sudden stop it should exhibit a significant growth in non-performing loans during the crisis. On the other hand, if a group of banks is considered risky one would expect a significantly stronger decline in deposits held by individuals in that group during the crisis (Diamond and Dybvig (1983)).

Non-performing loans

Russian bank balance-sheet data reports non-performing loans by borrower type. My total measure of non-performing loans includes credit to private companies, individuals, state-owned enterprises and non-resident companies. I have also added the value of defaulted short-term promissory notes issued by companies and held by banks.

The estimation results reported in Table B3 indicate that, during the year following the crisis, the growth of non-performing loans was positive and varied between 2% to 3% of banks' initial assets. The growth of non-performing loans after the crisis was almost identical for treated and control groups of banks, meaning that there was no pre-determined variation in terms of credit quality of bank's clients across groups.

Total individual deposits

The estimation results for the demand deposits indicate that there was an overall decline in deposits held in banks (ranging from 4 to 7.7% of banks' initial assets), but there was no significant variation across treatment groups during the crisis period and in D-in-D. The fact that a bank-run does not reveal a significant difference between identified groups of banks

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suggests that sample-selection bias is unlikely to be a major problem.

3.3 Methodology

Using the difference-in-difference (D-in-D) estimator, I investigate if banks belonging to the "treated" group behaved differently from those in the "control" group. The specification of the D-in-D method can be found in Bertrand *et al.* (2004).

$$\Delta Y_{i\tau} = \alpha + \beta_1 TREAT + \beta_2 \tau + \beta_3 (\tau \times TREAT) + \beta_4 X_{i\tau} + \varepsilon_{it}$$

where indictor variable TREAT takes value 1 if bank belongs to a "treated" group and zero if "control". This variable captures possible differences between the two groups prior to the sudden stop. The indicator variable τ takes value 1 if observations belong to the 1 year time period *after* the sudden stop (September 2008 to August 2009) and zero if they belong to the 1 year time period *before* the stop (September 2007 to August 2008). This variable captures aggregate factors that would change in Y even in the absence of a sudden stop. The main coefficient of interest is on the interaction term β_3. It captures all variation in outcome variables specific to the treatments (relative to controls) in the period after the sudden stop (relative to the period before).

$\Delta Y_{i\tau}$ - represents four main groups of outcome variables, which were motivated in the introduction: 1) growth of net borrowing from the CB in the period before and after the sudden stop relative to initial assets; 2) growth of volume of credit extended to different types of private borrowers in the period before and after the sudden stop relative to initial assets; 3) growth of net interbank positions and investment in market securities relative to initial assets; 4) net income for different banking activities.

$X_{i\tau}$ - represents a set of control variables standard for banking studies[8] which are: a dummy variables for state-controlled banks, a dummy variable for banks affiliated with state enterprises (e.g., railroads), a size of a banks' assets relative the largest bank, deposits-to-assets ratio, and non-performing loans-to-assets ratio. I calculate monthly values of these ratios and take 1-year averages before and after the crisis for each banks.

The affiliation dummies, bank size and an non-performing loans-to-assets ratio control for unobserved variation in investment opportunities across treated and control groups of

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[8]See for example De Haas et al. (2010), Ivashina and Scharfstein (2010) and Gan (2007).

banks while inclusion of the deposits-to-assets ratio controls for variation in the supply of funds across identified groups of banks. In order to account for the small-sample bias, I report bootstrapped standard errors for all specifications as suggested by Horowitz (2004).

4   Empirical Results

4.1   Net Borrowing from the Central Bank

Table 1 reports D-in-D estimates of net long-term (more than 3 months) borrowing from the CB through its new credit facilities. As can be seen from the top panel, the value of CB credit that large and financially constrained banks received after the sudden stop was 12% of their pre-crisis assets. The D-in-D estimate for this sub-sample is 4.5% and is significant at 10%. The negative sign here indicates an increase in liabilities.

Estimates for mid-sized banks that only borrowed from non-residents at the interbank market indicate that although banks in this category made active use of the CB facility, the treated banks did not receive significantly more funding than banks in the control group.

[Table 1 about here]

These results mean that the CB liquidity infusions organized as pay-your-bid auctions were mostly absorbed by large treated banks that were unable to roll-over foreign debt. In other words, most of the assistance, which was distributed in a way that allowed banks to choose how much funding to ask for, went to banks that were most affected by the crisis.

There is a large body of macro-related literature that investigates the impact of sudden stops of external financing on economies with dollarized banking systems (see Rajan and Tokatlidis (2005) for an overview). In a predominant number of cases, the subsequent dollar shortage is resolved by borrowing from international financial institutions such as the IMF. The Russian experience represents a unique case of massive non-IMF interventions conducted by a domestic central bank in an economy experiencing dollar shortage after a sudden stop. As evident from Table 1, all banks in the sample increased their borrowing from the CB during the crisis period. The drawdown of Russia's international reserves that took place at the same time suggests that ruble liquidity received by banks was used to buy dollars for the purpose of repaying foreign debts.

4.2 Lending to the Private Sector

4.2.1 Lending to non-financial corporate borrowers

I apply the same empirical strategy to another set of outcome variables - lending to different types of private borrowers. First, I consider lending to non-financial corporate borrowers, which accounts for the largest portion of banks' assets. I separate loans granted by banks into three categories: 1) short-term lending (all loans below 1 year maturity); 2) medium-term lending (all loans between 1 and 3 years maturity); 3) long-term lending (all loans with maturity longer than 3 years).

[Table 2 about here]

The estimation results in the first and second column of Table 2 demonstrate that there was a strong credit expansion in short-term lending across all groups of banks during the year preceding the sudden stop. It ranged from 8% to 15% of the assets banks held in September 2007. During the year that followed the sudden stop, growth turned negative. Depending on the group of banks, it ranged between -5.5% and -7.5% of their pre-crisis assets[9]. However, as can be seen from the last row in each panel, the D-in-D estimates are not statistically significant, which suggests that the decline in short-term lending to corporate borrowers was not different across treated and control banks for both sub-samples.

The results on medium-term lending indicate that lending in this maturity grew at the same pace in the pre-crisis and crisis period (3-5% of initial assets). In this context, it should be noted that even if the demand for a new credit declines during a crisis, banks often restructure existing corporate debt, and firms tend to draw down the existing credit lines at banks. As a result, bank balance sheet data may even indicate credit expansion during a crisis. (This phenomenon is investigated in Ivashina and Scharfstein (2010)). Anecdotal evidence suggests that Russian banks also did a lot of restructuring of existing debt during the crisis period. A main concern for my results could be the existence of bias to engage in debt restructuring across treated and control groups due to, for example, different

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[9]Industries that normally borrow on a short-term basis, such as retailers, represented a significant portion of the clients of Russian banks prior to the crisis. According to the July 2008 CBR Bulletin on Banking Statistics, bank lending to corporate borrowers was divided among different industries in the following way: 1) 26% retailers and wholesalers; 2) 20% manufacturing and commodity extraction; 3) 16% construction and real estate; 4) 8% electricity and transport; 5) 6.6% agriculture; 6) 23.4% other industries.

ownership structure. Dummies for state-controlled and state affiliated banks included in all specifications should, however, absorb this effect.

The estimates of long-term lending reported in panel A of Table 2 demonstrate that banking business in this maturity was anemic for all banks in both periods.

Altogether these findings could be interpreted as tentative evidence that the CB's liquidity infusions helped affected banks to sustain lending to corporate borrowers at a level not significantly different from that of unconstrained banks.

4.2.2 Lending to individuals

Another important category of private borrowers is that of private individuals. The balance sheet data on Russian banks that I use does not distinguish between different types of individual loans that were granted by banks. The variable used in my study therefore provides an aggregate measure of consumer, auto loans, mortgages and various other types of credit to individuals. Similarly to corporate borrowers, I distinguish between three maturity categories for individual loans.

The estimates of long-term lending reported in panel B of Table 2 parallel the results for corporate long-term lending, i.e. they show non-significant growth across all banks for all periods. All action with respect to individual lending was concentrated in the medium-term maturity segment. The growth rates in the pre-crisis period reported in Table 2 were of the same magnitude as that of medium-term corporate lending (3 to 5% of initial assets). However, after the sudden stop, medium-term lending to individuals turned negative (-1.5% to -4.5% of assets), while medium-term corporate lending maintained the same pace as before.

The pre-crisis credit expansion to individuals in the medium-term maturity can be explained by the extraordinary boom in auto sales and auto loans issuance that Russia enjoyed at that time. According to PricewaterhouseCoopers (PwC), the volume of car sales in Russia exhibited the following dynamics: 2 million units in 2006, 2.8 million units in 2007 and in 2008, 1.4 million units in 2009. PwC reported that car sales in Russia exceeded sales in Germany in the first half of 2008, making Russia the biggest car market in Europe during that period[10]. According to PwC estimates, 31% of car sales in 2008 were financed by bank loans. In 2009 this figure dropped to 10%. The average price of a car sold in Russia fell from $21.7 thousands in 2008 to $18 thousands in 2009.

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[10]In July 2008, PwC issued a report entitled "Is Russia the Largest Car Market in Europe?"

For the sample of mid-sized banks the D-in-D coefficients for short-term and medium-term lending to individuals are negative and statistically significant at 10% .This suggests that boom and bust cycle of consumer lending was positively associated with foreign borrowing for this group of banks and their business model substantially relied on foreign funding.

4.2.3   Lending to private entrepreneurs

Previous studies have offered many reasons to consider small firms as having weaker bank-client relationships than large corporate borrowers (e.g., Gertler and Gilchrist (1985), Gan (2007)). This implies that small firms are less likely to restructure their previous debt and are more vulnerable to cuts in external financing. In this environment one would expect that total change in lending to entrepreneurs during the crisis largely represents change (decline) in new lending. As expected, the results for total lending to private entrepreneurs that I obtained provide a uniform picture for both sub-samples of banks.

As one can see from the bottom panel of Table 2 the D-in-D estimates for bank lending to private entrepreneurs are negative and highly statistically significant. This finding suggests that, even though financially constrained banks obtained more funding from the CB than non-constrained banks, they still cut their lending to this group of borrowers who were less likely to restructure their previous debt.

4.3   Asset Allocation of Banks: Investment in Market Securities

One of the salient features of the recapitalization of banks in the US through TARP was an increase of risk-taking and growth of banks' non-interest rate income (e.g., Brunnermeier *et al.* (2011), Duchin and Sosyura (2011), Black and Hazelwood (2011)). In order to test the hypothesis on asset allocation of financially constraint banks that were recipients of the CB liquidity infusions I use two variables on the asset side of banks' balance sheets: holdings of government and of non-government market securities.

Government securities

The D-in-D estimates of banks' holdings of government securities, which are reported in Table 3, are positive and statistically significant for both sub-samples (2.1% and 2.7% of banks' initial assets). This increase in holdings of government debt supports the "flight to quality" hypothesis.

[Table 3 about here]

Non-government securities

The increase in holdings of non-government securities is statistically significant only for large banks that relied on Eurobonds and syndicated loan financing. This result is consistent with the finding that treated banks in this sub-sample also significantly increased net borrowing from the CB (as reported in Table 1). Because traditional short-term CB credit facilities require collateral, the growth of investment in non-government securities by this group of banks suggests that they used these securities as collateral for obtaining CB funding. A significant increase in holdings of non-government market securities by banks that received most of the bailout funding is also consistent with the behavior of the US banks, that were recipients of TARP, as documented by Brunnermeier *et al.* (2011).

4.4   Net Position at the International Interbank Money Market

Counter-party risk at the interbank money market was one of the key factors behind the liquidity crunch of 2007-2008 (e.g., Brunnermeier (2009), Taylor and Williams (2009)). The balance-sheet data precludes tracing banks' interbank market exposure with particular counter-parties but the division of banks into large and mid-sized sub-samples and treated and control groups allows me to get an aggregate picture of banks' behavior. Net position in relation to non-resident banks is a variable that tracks foreign currency assets of banks. In order to calculate this variable, I use the deposits of all maturities held by Russian banks in non-resident banks with a positive sign, as well as all liabilities to non-resident banks of all maturities with a negative sign.

[Table 4 about here]

Let me start by interpreting the results for mid-sized banks in Panel A of Table 4. Treated banks in this sub-sample have a higher ratio of long-term liabilities to non-resident banks in the pre-crisis year by construction. The total growth of net liabilities to non-resident banks for these banks was 9% of their initial assets in the pre-crisis year. During the crisis period, the growth rate of deposits in non-resident banks exceeded the growth rate of liabilities for this group of banks (as indicated by the positive sign) during that period.

The net indebtedness of large banks in relation to non-residents grew by 3-4 % of their initial assets in the pre-crisis year. However, after the crisis and the beginning of quantitative

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easing by the CB, both treated and control groups of banks became net lenders to non-resident banks. The net position of treated banks in non-resident accounts grew by 8.8% of their initial assets, while growth for the control group was 4.7%. The D-in-D estimate is positive but not significant, the difference during a crisis year is significant at 10%.

These results demonstrate that banks used CB ruble infusions to obtain foreign currency, which was used not only to repay foreign debt but also was accumulated on deposits at non-resident banks. This behavior is consistent with findings of Gatev *et al.* (2007) who demonstrate, that contrary to the standard notion on liquidity risk, investors in the US view bank deposits as safe havens during periods of market turmoil. Russian banks exhibited a similar behavior with respect to Western banks and increased their deposits in them.[11]

5   Robustness Checks

5.1   Income of Banks

Besides balance sheet data Russian banks report detailed income statements on a quarterly basis. Using these data I calculate four variables for pre-crisis and crisis years: 1) net profits from foreign currency operations; 2) net profits from lending to companies and individuals; 3) net profits from securities trading; 4) total net profit.

The first variable includes profits/losses from foreign currency trading and positive/negative re-evaluation of banks' currency holdings. Net profits from lending to companies and individuals equals interest rate income from loans to companies and individuals minus interest rate cost of deposits held in banks by companies and individuals. Net profit from securities trading includes trading gains/losses for equities, positive/negative re-evaluation of equity holdings as well as coupon income and gains/losses associated with bonds of all types. Total net profit is calculated as total profits minus total losses.

[Table 5 about here]

The results suggest that during a government bailout program banks that were more affected during the crisis and received more government assistance significantly increased their

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[11]Panel B of Table 4 reports the results for banks' exposure at the domestic interbank money market. The insignificant D-in-D estimates for both sub-samples of banks suggest that variation with respect to financial constraints faced by banks as a result of a sudden stop did not result in a variation of their behavior at the domestic interbank money market.

profitability from non-traditional banking activities such as: foreign currency operations and securities trading, while profitability of lending to the private sector remained unchanged. These findings complement my previous results that banks significantly increased their holdings of market securities and built up foreign currency deposits at non-resident banks. The non-significant difference in total net profits suggests that there was no pre-determined variation across banks, which confirms the absence of a sample-selection bias.

Figure A6 plots the dynamics of the domestic money market 3 month Mosibor interest rate, interest rate implied by the Covered Interest Rate (CIP) parity and the average rate at the CB's 3-months uncollateralized liquidity auctions. One can see that until April 2009 it was profitable for banks to borrow from the CB and convert rubles into US dollars as the interest rate implied by the covered carry trade was about 3 times higher than the borrowing rate for the CB liquidity. In April 2009 ruble devaluation expectations waned and uncollateralized borrowing from the CB decreased.

5.2 Early Eurobonds prepayments

In an environment where the ruble devalued by 30% with respect to USD and Euro, one would expect banks to accumulate foreign currency assets and decrease all foreign currency liabilities. Complementary evidence on this behavior can be found from the Bloomberg data on exercise of call options embedded in some of the Eurobonds issues.

[Table 6 about here]

The Table 6 reports the total flow of early prepayments of Eurobonds made by banks. One can see that both groups of banks increased early prepayment of Eurobonds during the crisis and banks belonging to the control group repaid a significant amount of debt ahead of time during the period of Russian quantitative easing. Early prepayments for this group represented 1.2% of their pre-crisis assets and were three times higher than for treated banks.

5.3 Placebo test

The strategy of dividing banks into treated and control is based on the assumption that banks experience constraints when their foreign debt matures at a time when there is a sudden stop in external financing. As emphasized by Almeida *et al.* (2009) and Roberts and

Whited (2011), if this strategy is correct, one would expect not to get statistically significant results for the same experimental groups for periods outside the crisis event.

In order to perform the placebo test, I run specification (1) on the sample covering a period of two years before the sudden stop. The indicator variable τ in this case takes value 1 if observations concern the year that immediately preceded the sudden stop (September 2007-August 2008) and zero if they concern the year that preceded this period (September 2006 to August 2007). The results on estimates of D-in-D coefficients for all outcome variables are reported in Table 7.

<div align="center">[Table 7 about here]</div>

The significance of the total net position with respect to non-resident banks for the sample of mid-sized banks is dictated by the fact that this variable was chosen to separate the two groups of banks during the one year period that preceded the crisis by construction of treatment dummies.

All in all the placebo test results confirm the validity of the strategy chosen for identifying affected and unaffected banks during the crisis.

6   Conclusion

Using data on foreign borrowing by Russian banks, I identify banks that were financially constrained at the onset of the sudden stop caused by the collapse of the Lehman Brothers in September 2008. In a natural experiment set-up, I trace the impact of liquidity infusions made by the CB on banks' funding and lending decisions. Using the difference-in-difference framework, I find that demand for CB funding increased relatively more among banks that were affected by the sudden stop than among those that were not affected during the year following the crisis. This means that the government assistance, which was distributed in a way that allowed banks to choose how much funding to ask for, primarily went to banks that were most affected by the sudden stop.

Secondly, I examine how lending to different types of private borrowers varied among constrained and non-constrained banks. The estimation results for non-financial corporate borrowers suggest that there was strong credit expansion across all banks during the year preceding the sudden stop. In the year following the sudden stop, all banks substantially cut

short-term lending to corporate borrowers, but maintained positive growth in the medium-term maturity segment. The D-in-D estimates suggest that there was no significant variation across banks, which could be interpreted as tentative evidence that the CB liquidity infusions helped financially constrained banks to sustain lending to corporate borrowers at the same level as unconstrained banks. Lending to entities that are expected to have weaker banking relationships, such as individuals and entrepreneurs exhibited a more pronounced boom and bust cycle. The D-in-D estimates for these categories of borrowers suggest that affected banks cut lending significantly more than unaffected banks.

Thirdly, I find that during the year that followed the crisis, when the CB engaged in quantitative easing that involved domestic currency infusions into banks and sale of international reserves, all banks in my sample substantially increased their holdings of foreign currency on accounts in non-resident banks. This suggests that government assistance was used by banks not only for foreign debt repayment but also for foreign currency hoarding. I also look at banks' decisions concerning asset allocation and show that affected banks increased their holdings of market securities significantly more than unaffected banks during the year following the sudden stop. The increase in holdings of government debt supports the "flight to quality" hypothesis. The growth in holdings of non-government securities can be explained by risk-shifting behavior of bailed out banks and by the fact that banks used securities as collateral for obtaining the short-term funding from the CB.

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7 Appendix A. The Sudden Stop and Borrowing by Russian Banks

Table A1. Summary statistics of all Eurobonds issued and all syndicated loans obtained by Russian banks[a] in Dec. 2003 – Aug. 2009

	Banks	Asset rank[b]	Bonds in USD (mln.\$)	Bonds in EUR (mln.€)	Bonds Swiss Frank (mln. CHF)	Synd. loans in USD (mln.\$)	Synd. loans in EUR (mln.€)
1	Sberbank	1	2,750	0	0	4,450	0
2	VTB	2	10,000	2,830	750	2,450	0
3	Gazprombank	3	3,670	0	500	1,600	0
4	Rosselhozbank	4	5,550	0	525	520	0
5	Bank Moskvy	5	1,750	0	250	2,270	0
6	VTB24	6	800	0	0	730	0
7	Alfa bank	7	4,220	375	0	2,520	0
8	Rosbank	10	450	0	0	370	50
9	Uralsib	11	290	0	0	2,480	0
10	Promsvjazbank	12	1,120	0	0	1,840	0
11	Nomos	13	660	0	0	740	0
12	MDM	14	3,625	225	0	2,778	0
13	Transcredit	15	830	0	0	523	0
14	Sankt-Peterburg	16	175	0	0	145	0
15	Ak Bars	17	725	0	0	0	0
16	VTB S-Z	18	700	0	0	310	0
17	Petrocommerz	21	770	0	0	397	0
18	Russkii standart	22	1,400	0	0	250	0
19	Zenit	24	200	0	0	783	93
20	MezhProm bank	25	250	200	0	572	0
21	URSA	26	777	700	0	765	0
22	Vozrozhdenie	28	0	0	0	163	0
23	MBRR	31	310	0	0	50	65
24	KM bank	32	100	0	0	123	0
25	Souz	45	175	0	0	89	0
26	Binbank	46	241	6	0	119	0
27	MosCredit bank	48	100	0	0	471	0
28	Probiznesbank	52	470	24	0	113	0
29	Credit Evropa	54	250	0	0	120	0
30	TransCapital	55	275	0	0	192	1
31	Tatfondbank	60	320	0	0	36	0
32	RosEvroBank	64	230	0	0	227	0
33	Vostochnyi	70	43	0	0	10	0
34	Center-Invest	73	175	0	0	250	0
35	Loko bank	91	100	0	0	150	0
36	Gazbank	97	100	0	0	0	0
	TOTAL		43,601	4,360	2,025	28,606	209

Note: [a] The sample excludes banks with foreign ownership.

[b] The column reports banks' rank by asset size in 2008

Figure A1. Dynamics of 1-month LIBOR and OIS in USD
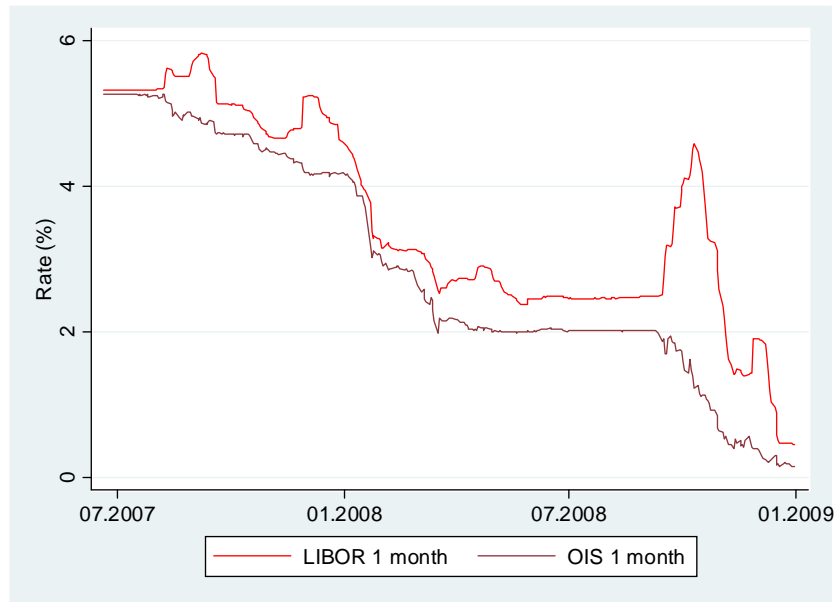
Figure A2. Dynamics of sovereign CDS
spreads for Russia and Mexico
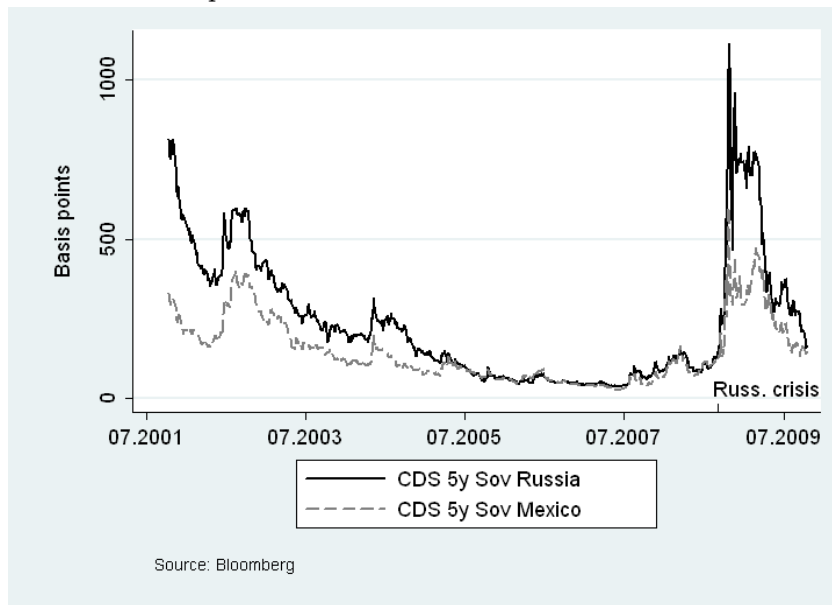
Figure A3. Aggregate value of banks' liabilities from
Eurobonds and syndicated loans

Source: Bloomberg, Cbonds
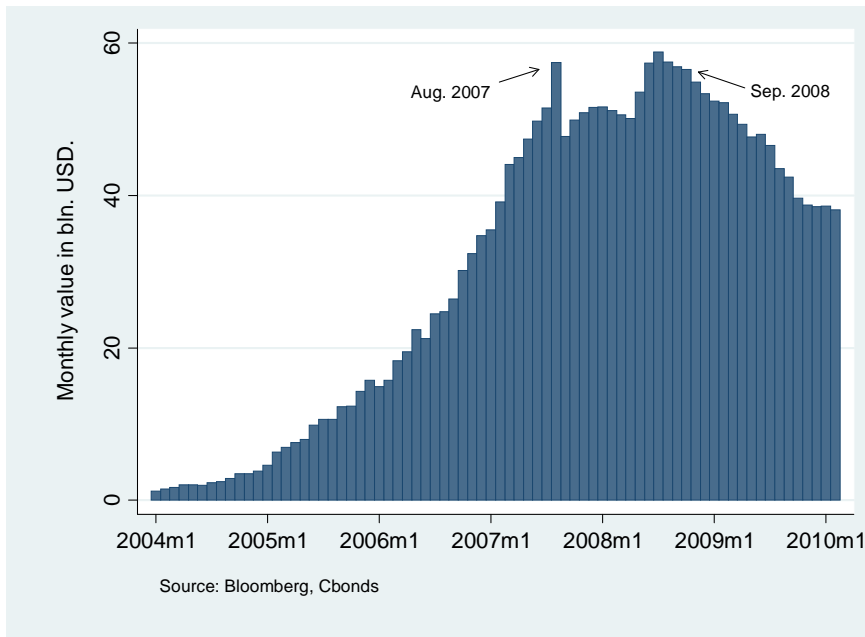
Note: Using Bloomberg data on individual Eurobonds and syndcated loans, I calculate montly net flows and construct total foreign liability of banks in Table A1. For issues in Euro and CHF, I use current month exchange rate and convert values into USD.

Figure A4. Average monthly level of official foreign exchange reserves of the
Central Bank of Russia

Source: Central Bank of Russia
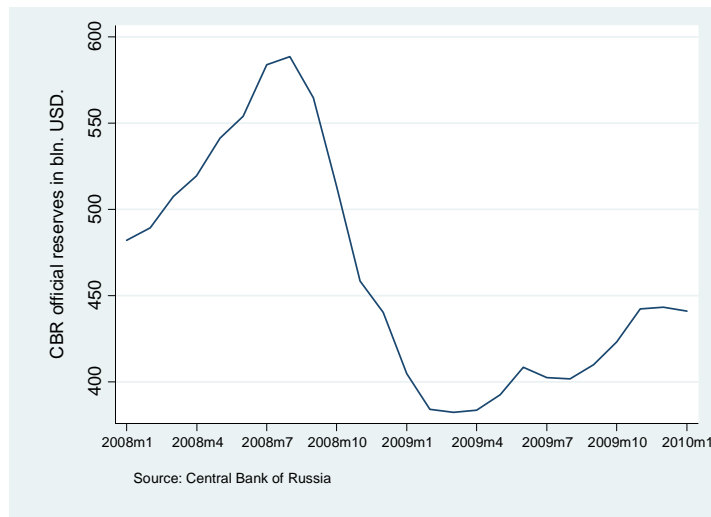
Figure A5. Total amount of funds borrowed by banks through the
CB's uncollateralized liquidity auctions
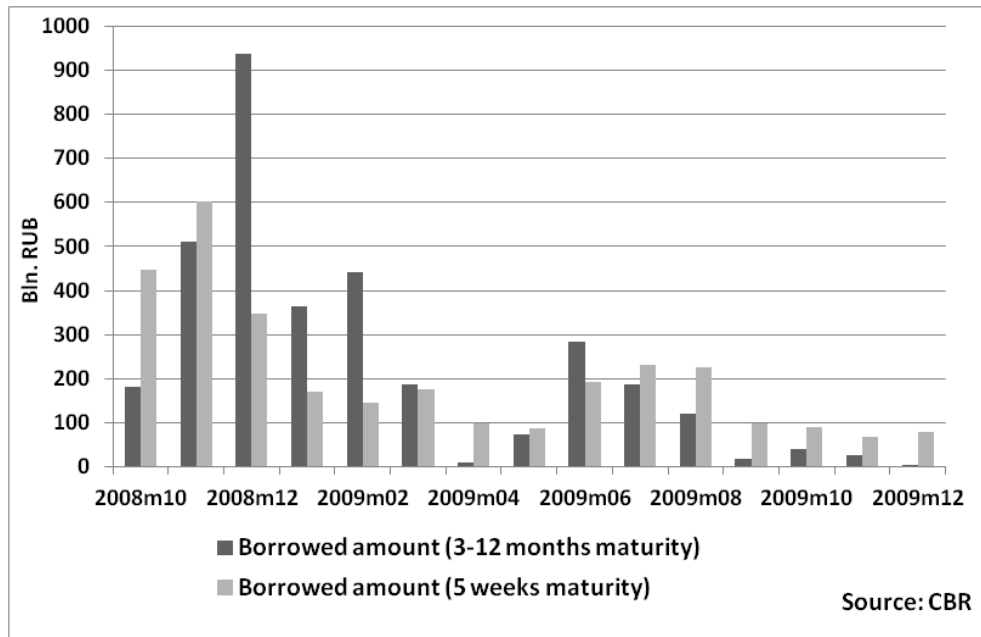
Figure A6. Interest rates dynamics of the domestic interest rates
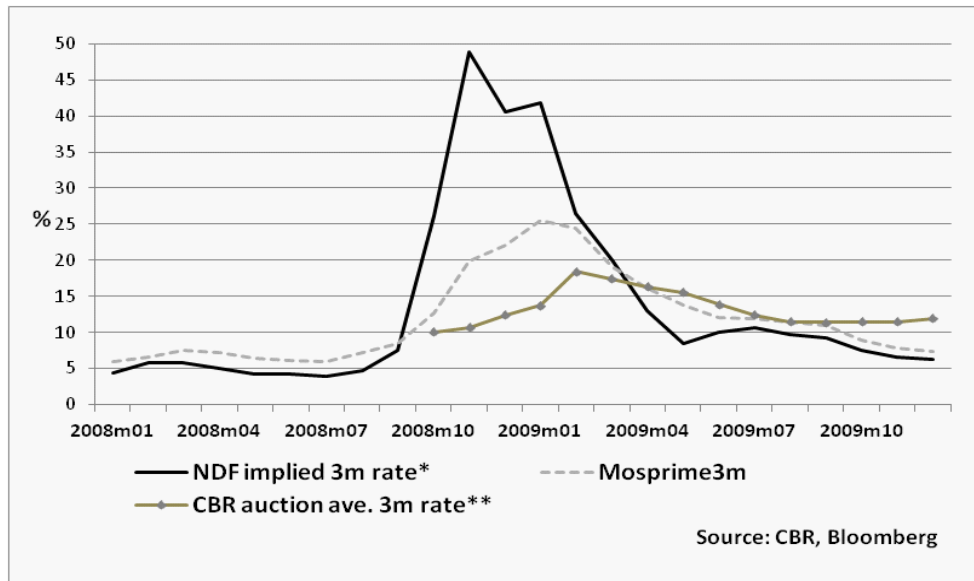
Note: * NDF implied rate is calculated by using Covered Interest Parity formula
with Non-deliverable USD/RUB forward rate, spot USD/RUB exchange rate,
LIBOR3m as inputs (Impl. rate=400*((1+ LIBOR3m/400)*NDF3m/USDRUB-1))

** CB rate is the average rate for a given month for all CB uncollaterized auctions

8 Appendix B. Identification of Treated and Control Banks

Table B1. Identification of Treated and Control Groups among Banks that Issued Eurobonds or Syndicated Loans (Large Banks)

I use a sample of 36 banks that were not subject to foreign-control and that issued Eurobonds or obtained syndicated loans prior to Sep. 2008. I calculate *Cumulative in(out)flow of Eurobonds and syndicated loans over 1 year/Assets$_{t_0}$*, where 1 year refers either to the one-year period preceding the sudden stop (Sep. 2007- Aug. 2008) or the one-year period following this event (Sep. 2008 -Aug. 2009) and *Assets$_{t_0}$* are measured at the beginning of each period (Sep. 2007 and Sep. 2008 respectively). Following the identification strategy of Almeida et al. (2009) I allocate banks with a ratio *Cumulative maturity flow of Eurobonds and syndicated loans over 1 year DURING THE CRISIS/Assets$_{t_0}$* above the median to "treated" group (17 banks), while all other banks are allocated to the "control" group (19 banks). The table reports averages for both groups and the mean-comparison t-tests for difference in a pre-crisis, crisis periods and for difference-in-difference (D-in-D)

|	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
Maturity flow/ Assets$_{t_0}$	-0.034 (0.010)	-0.033 (0.011)	-0.001 (0.015)	-0.094 (0.011)	-0.027 (0.010)	-0.066*** (0.021)	**-0.065*** (0.021)**
Issuance flow/ Assets$_{t_0}$	0.058 (0.007)	0.043 (0.007)	0.014 (0.010)	0.007 (0.007)	0.004 (0.007)	0.003 (0.010)	**-0.011 (0.014)**

As a robustness check I calculate difference in *Cumulative in(out)flow of Eurobonds and syndicated loans over 1 quater/Assets$_{t_0}$*, for the identified "treated" and "control" groups where 1 quater refers to June 2008 - Aug. 2008 and (Sep. 2008 - Nov. 2008) periods.

	Pre-crisis quater			Post-crisis quater			
	Treated banks	Control banks	Difference in pre-crisis quater	Treated banks	Control banks	Difference in crisis quater	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
Maturity flow/ Assets$_{t_0}$	-0.011 (0.005)	-0.009 (0.004)	0.002 (0.007)	-0.023 (0.005)	-0.005 (0.004)	-0.019*** (0.007)	**-0.017* (0.009)**
Issuance flow/ Assets$_{t_0}$	0.017 (0.004)	0.014 (0.004)	0.003 (0.005)	0.011 (0.004)	0.003 (0.004)	0.008 (0.005)	**0.005 (0.008)**

Note: * Denotes significance at 10%;** Denotes significance at 5%;*** Denotes significance at 1%.

Table B2. Identification of Treated and Control Groups among Banks that Borrowed at the International Interbank Market (Medium Banks)

I use a sample of 136 banks that were not subject to foreign-control and that did not issue Eurobonds or obtain syndicated loans, but borrowed from foreign banks through the interbank money market prior to September 2008. Using Duchin et al. (2010) identification strategy I calculate the average *Net long-term (>3 months) borrowing from non-resident banks/Assets* ratio for each bank during the 1 year period preceding the crisis and allocate top 20% of banks to "treated" group (26 banks). Using a propensity score matching estimator (Roberts and Whited (2011)), I form a "control" group (26 banks) from the rest of the population. The following table reports yearly averages of this ration across the identified groups and D-in-D estimates.

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
Net borrowing from non-resid. banks/ Assets	-0.074 (0.013)	-0.008 (0.013)	-0.067*** (0.018)	0.001 (0.014)	0.000 (0.013)	0.001 (0.021)	**0.068*** (0.026)**

Table B3. Endogeneity Concerns for Treated and Control Groups of Banks

I test if variation in performance across treated and control groups of banks during the crisis is pre-determined by diffrences between the two groups before the crisis. If one group of banks lent more to low-quality firms before the sudden stop it should exhibit a significant growth in non-performing loans during the crisis. Also if banks are considered risky, one expects a significant decline in deposits held by individuals in the weaker group of banks.

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
$\Delta Non\text{-}performing\ loans/Assets_{t_0}$							
Large banks	-0.003 (0.007)	-0.012 (0.019)	0.010 (0.013)	0.030 (0.011)	0.026 (0.015)	0.004 (0.011)	**-0.005 (0.015)**
Medium banks	-0.008 (0.007)	-0.003 (0.003)	-0.005 (0.006)	0.018 (0.005)	0.023 (0.007)	-0.004 (0.007)	**0.001 (0.008)**
$\Delta Total\ deposits/Assets_{t_0}$							
Large banks	-0.001 (0.020)	0.004 (0.021)	-0.005 (0.027)	-0.053 (0.021)	-0.077 (0.022)	0.024 (0.020)	**0.029 (0.036)**
Medium banks	0.035 (0.018)	0.008 (0.015)	0.027 (0.020)	-0.050 (0.019)	-0.040 (0.023)	-0.010 (0.028)	**-0.038 (0.033)**

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Table B4. Summary Statistics for Treated and Control Banks during the Pre-crisis Year (September 2007-August 2008

	Large Banks Sample			Medium Banks Sample		
	Treated	Control	t-stat[a]	Treated	Control	t-stat[a]
Log assets	18.792	18.756	0.097	16.391	16.217	-0.766
Assets/ Sberbank assets[b]	0.056	0.038	-0.889	0.003	0.003	-0.793
Capital ratios[c]						
Capital/Assets	-0.049	-0.040	0.602	-0.070	-0.077	-0.381
Liability ratios[c]						
Deposit/Assets	-0.177	-0.232	1.300	-0.239	-0.194	1.004
Eurobonds/Assets	-0.116	-0.116	0.012			
Net non-resident interbank /Assets	-0.097	-0.058	1.628	-0.049	-0.004	3.495***
Net domestic interbank /Assets	-0.001	-0.012	1.087	-0.026	-0.024	0.090
Net CB credit/ Assets	-0.002	-0.001	0.889	-0.001	-0.001	0.163
Asset ratios[c]						
Total credit to private companies/Assets	0.434	0.404	-0.612	0.427	0.499	1.510
Total credit to private entrepreneurs/Assets	0.016	0.016	-0.081	0.045	0.011	-2.369**
Total credit to individuals/Assets	0.140	0.220	1.805*	0.150	0.112	-0.956
Total non-perf. loans/ Assets	0.012	0.023	1.003	0.015	0.016	0.232
Total holdings of govt. securities /Assets	0.014	0.017	0.635	0.028	0.028	-0.068
Total holdings of non-. govt securities /Assets	0.075	0.060	-0.989	0.067	0.071	0.197
N.banks/N. months	17/12	19/12		26/12	26/12	

Note: The tables reports one year averages for all sub-samples used in the study.

[a] Mean-comparison t-tests for differnce between treatd and control groups.

[b] Size of bank's assets relative to the largest state-owned bank whose share of deposits in 2008 was 51.5% (see Cole and Chernykh (2011)). Sberbank itself is excluded from this statistic.

[c] For liabilities and capital all agregates are taken with a negative sign, for assets with a positive sign

9 Appendix C. Empirical Results

Table 1. Difference-in-Difference Test for Net Long-Term Borrowing from the Central Bank Before and After the Sudden Stop

This table presents estimates of the average change in treated and control banks' net long-term borrowing from the CBR during the year that preceded the crisis (Sep. 2007 - Aug. 2008) and the crisis year (Sep.2008 and Aug. 2009). The change is measured in relation to the assets held by each bank at the beginning of each period. CBR deposit/loans with more than 3 month maturity are used. The D-in-D specification includes dummies for state-owned and state-controlled banks and banks' asset size relative to Sberbank, Deposit/Asset and non-performing loans-to-assets ratios. The coefficients for these covariates are not reported in the table. All foreign controlled banks have been excluded from the analysis.

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
ΔNet long-term borrowing from the $CBR/Assets_{t_0}$							
Large banks	-0.015	-0.021	0.006	-0.120	-0.079	-0.039**	**-0.045***
	(0.017^a)	(0.019)	(0.019)	(0.019)	(0.022)	(0.019)	**(0.026)**
Medium banks	-0.001	0.001	-0.002	-0.036	-0.049	0.014	**0.016**
	(0.008)	(0.006)	(0.004)	(0.012)	(0.015)	(0.016)	**(0.016)**

Note: * Denotes significance at 10%; ** Denotes significance at 5%*** Denotes significance at 1%.
[a] All standard errors are bootstrapped with 150 replications

**Table 2. Difference-in-Difference Test for Lending to Different
Types of Borrowers Before and After the Sudden Stop**

This table presents estimates of the average change in total lending to different types of borrowers over the year that preceded/followed the sudden stop, in relation to banks' assets at the beginning of each period. Lending to non-financial private companies and to individuals is used in three maturity ranges. Lending to individual entrepreneurs of all maturities is used. The D-in-D specification includes dummies for state-owned and state-controlled banks, banks' asset size, deposit/asset and non-performing loans-to-assets ratios (not reported).

		Pre-crisis year			Crisis year			
		Treated banks	Control banks	Diff. pre-crisis year	Treated banks	Control banks	Diff. crisis year	D-in-D
		(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
A. Δ *Total lending to non-financial private corporate borrowers*/$Assets_{t_0}$								
Short- term	Large banks	0.087 (0.021)	0.083 (0.020)	0.004 (0.029)	-0.055 (0.028)	-0.057 (0.018)	0.002 (0.032)	**-0.002** **(0.038)**
(<1 year)	Medium banks	0.151 (0.095)	0.077 (0.038)	0.074 (0.094)	-0.073 (0.049)	-0.075 (0.042)	0.001 (0.045)	**-0.072** **(0.103)**
Medium- term	Large banks	0.033 (0.011)	0.037 (0.017)	-0.004 (0.019)	0.031 (0.012)	0.031 (0.014)	-0.001 (0.013)	**0.004** **(0.022)**
(1-3 years)	Medium banks	0.048 (0.028)	0.037 (0.015)	0.011 (0.030)	0.031 (0.023)	0.055 (0.021)	-0.024 (0.024)	**-0.035** **(0.037)**
Long- term	Large banks	0.017 (0.009)	0.015 (0.010)	0.002 (0.007)	0.021 (0.009)	0.007 (0.010)	0.014 (0.013)	**0.012** **(0.014)**
(>3 years)	Medium banks	0.010 (0.018)	-0.003 (0.009)	0.013 (0.013)	-0.009 (0.015)	0.003 (0.008)	-0.012 (0.012)	**-0.024*** **(0.014)**
B. Δ *Total lending to individuals*/$Assets_{t_0}$								
Short- term	Large banks	-0.004 (0.014)	0.008 (0.011)	-0.012 (0.016)	-0.027 (0.014)	-0.037 (0.018)	0.010 (0.012)	**0.022** **(0.022)**
(<1 year)	Medium banks	0.044 (0.015)	0.026 (0.011)	0.018 (0.015)	-0.017 (0.011)	-0.004 (0.008)	-0.013 (0.008)	**-0.031**** **(0.015)**
Medium- term	Large banks	0.031 (0.019)	0.071 (0.033)	-0.040 (0.030)	-0.035 (0.021)	-0.045 (0.030)	0.009 (0.019)	**0.050** **(0.035)**
(1-3 years)	Medium banks	0.057 (0.027)	0.012 (0.016)	0.045* (0.024)	-0.015 (0.021)	-0.013 (0.017)	-0.002 (0.012)	**-0.046*** **(0.025)**
Long- term	Large banks	-0.003 (0.006)	-0.017 (0.016)	0.014 (0.012)	-0.005 (0.006)	-0.012 (0.008)	0.007 (0.005)	**-0.007** **(0.012)**
(>3 years)	Medium banks	0.000 (0.000)	-0.002 (0.002)	0.001 (0.001)	-0.001 (0.000)	-0.001 (0.000)	0.000 (0.000)	**-0.001** **(0.001)**
C. Δ *Total lending to enterpreneurs*/$Assets_{t_0}$								
All	Large banks	0.013 (0.004)	0.005 (0.005)	0.008 (0.005)	-0.007 (0.003)	0.001 (0.004)	-0.008** (0.004)	**-0.015***** **(0.005)**
maturities	Medium banks	0.014 (0.005)	0.005 (0.004)	0.009 (0.006)	-0.009 (0.004)	-0.004 (0.003)	-0.006 (0.004)	**-0.015***** **(0.007)**

Note: * Denotes significance at 10% ;** at 5%; *** at 1%. [a] All standard errors are bootstrapped

Table 3. Difference-in-Difference Test for Total Investment in Market Securities Before and After the Sudden Stop

This table presents estimates of the average change in investment in securities over the year that preceded/followed the sudden stop, in relation to banks' assets measured at the beginning of each period. Panel A reports estimates for government securities holdings; Panel B reports estimates for non-government securities holdings. The D-in-D specification includes dummies for state-owned and state-controlled banks, and banks' asset size relative to Sberbank, Deposit/Asset and non-performing loans-to-assets ratios. The coefficients for these covariates are not reported in the table. All foreign controlled banks have been excluded from the analysis.

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
A. Δ *Total investment into government securities*/$Assets_{t_0}$							
Large banks	-0.011	0.002	-0.013	0.015	0.008	0.007	**0.021***
	(0.008)	(0.006)	(0.011)	(0.007)	(0.005)	(0.007)	**(0.012)**
Medium banks	-0.007	0.006	-0.013	0.006	-0.008	0.015	**0.027****
	(0.005)	(0.011)	(0.012)	(0.009)	(0.006)	(0.010)	**(0.051)**
B. Δ *Total investment into non-government securities*/$Assets_{t_0}$							
Large banks	0.009	0.031	-0.023	0.057	0.029	0.028	**0.050****
	(0.017)	(0.015)	(0.019)	(0.019)	(0.014)	(0.020)	**(0.025)**
Medium banks	0.010	0.014	-0.004	-0.006	0.027	-0.033	**-0.029**
	(0.020)	(0.022)	(0.021)	(0.018)	(0.021)	(0.022)	**(0.029)**

Note: * Denotes significance at 10% ;** Denotes significance at 5%; *** Denotes significance at 1%.
[a] All standard errors are bootstrapped with 150 replications

Table 4. Difference-in-Difference Test for Net Lending(+)/Borrowing(-) at Interbank Market Before and After the Sudden Stop

This table presents estimates of the average change in treated and control banks' net position at interbank market during the year that preceded the crisis (Sep. 2007 - Aug. 2008) and the crisis year (Sep.2008 and Aug. 2009). The change is measured in relation to the assets held by each bank at the beginning of each period. Bank's net interbank position is calculates as bank's deposits in non-resident banks minus bank's liabilities in non-resident banks. Panel B reports banks positions at the domestic interbank market. The D-in-D specification includes dummies for state-owned and state-controlled banks and banks' asset size relative to Sberbank, Deposit/Asset and non-performing loans-to-assets ratios. The coefficients for these covariates are not reported in the table. All foreign controlled banks have been excluded from the analysis.

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
A. $\Delta Net\ total\ non\text{-}resident\ interbank\ money\ market\ position/Assets_{t_0}$							
Large banks	-0.044	-0.037	-0.007	0.080	0.040	0.040*	**0.047**
	(0.030)	(0.028)	(0.033)	(0.034)	(0.025)	(0.024)	**(0.041)**
Medium banks	-0.088	-0.014	-0.074**	0.007	-0.005	0.013	**0.087***
	(0.033)	(0.015)	(0.029)	(0.019)	(0.013)	(0.015)	**(0.033)**
B. $\Delta Net\ total\ domestic\ interbank\ money\ market\ position/Assets_{t_0}$							
Large banks	-0.013	-0.013	-0.000	-0.027	-0.020	-0.007	**-0.007**
	(0.018)	(0.017)	(0.015)	(0.020)	(0.020)	(0.018)	**(0.023)**
Medium banks	-0.019	-0.035	0.016	0.022	0.023	-0.001	**-0.018**
	(0.028)	(0.020)	(0.029)	(0.022)	(0.024)	(0.029)	**(0.044)**

Note: * Denotes significance at 10%; ** Denotes significance at 5%*** Denotes significance at 1%.
[a] All standard errors are bootstrapped with 150 replications

**Table 5. Difference-in-Difference Test for Banks' Net Incomes
Before and After the Sudden Stop**

This table presents estimates of the average net income of banks over the year that preceded/followed the sudden stop, in relation to banks' assets measured at the beginning of each period. Bank's net profit is calculated as bank's income from a specific activity minus bank's cost associated with this activity. For example, net profits from lending to companies and individuals equals interest rate income from loans to companies and individuals minus interest rate costs of deposits held in banks by companies and individuals. The D-in-D specification includes dummies for state-owned and state-controlled banks, and banks' asset size relative to Sberbank, Deposit/Asset and non-performing loans-to-assets ratios. The coefficients for these covariates are not reported in the table. All foreign controlled banks have been excluded from the analysis.

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
A. *Net profit from foreign currency operations (trading and revaluation)/Assets$_{t_0}$*							
Large banks	0.002	0.002	0.000	0.026	0.001	0.026**	**0.026***
	(0.007)	(0.007)	(0.007)	(0.011)	(0.011)	(0.013)	**(0.014)**
Medium banks	0.021	0.017	0.004	0.022	0.038	-0.016	**-0.020**
	(0.012)	(0.007)	(0.008)	(0.013)	(0.020)	(0.016)	**(0.018)**
B. *Net profit from lending to companies and individuals/Assets$_{t_0}$*							
Large banks	0.181	0.226	-0.045	0.193	0.230	-0.037	**0.008**
	(0.021)	(0.033)	(0.026)	(0.024)	(0.027)	(0.023)	**(0.030)**
Medium banks	0.170	0.193	-0.022	0.149	0.187	-0.038	**-0.016**
	(0.030)	(0.029)	(0.037)	(0.033)	(0.027)	(0.038)	**(0.051)**
C. *Net profit from securities trading/Assets$_{t_0}$*							
Large banks	0.015	0.022	-0.007	0.039	0.028	0.011*	**0.018***
	(0.004)	(0.008)	(0.006)	(0.007)	(0.006)	(0.006)	**(0.009)**
Medium banks	-0.001	0.001	-0.011	0.009	0.045	-0.036	**-0.025**
	(0.008)	(0.009)	(0.009)	(0.007)	(0.013)	(0.015)	**(0.017)**
D. *Net Total profit/Assets$_{t_0}$*							
Large banks	0.062	0.083	-0.021	0.022	0.025	-0.004	**0.017**
	(0.009)	(0.009)	(0.013)	(0.009)	(0.009)	(0.013)	**(0.018)**
Medium banks	0.054	0.074	-0.020	0.025	0.045	-0.019	**0.000**
	(0.009)	(0.009)	(0.013)	(0.010)	(0.009)	(0.014)	**(0.019)**

Note: * Denotes significance at 10%;** Denotes significance at 5%
[a] All standard errors are bootstrapped with 150 replications

Table 6. Difference-in-Difference Test for Eurobonds Early Prepayments

	Pre-crisis year			Crisis year			
	Treated banks	Control banks	Difference in pre-crisis year	Treated banks	Control banks	Difference in crisis year	D-in-D
Total Eurobonds early prepayments/Assets$_{t_0}$							
Large banks	0.000	0.000	0.000	-0.004	-0.012	0.008	**0.008**
	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	**(0.007)**

Table 7. The Placebo Test for Two Pre-crisis Periods
Sep. 2006 - Aug 2007 versus. Sep. 2007 -Aug. 2008

	Large banks	Medium banks
	D-in-D	D-in-D
	2 vs. 1 Year Before	2 vs. 1 Year Before
ΔNet long-term borrowing from the CBR/Assets$_{t_0}$	-0.001 (0.003)	0.002 (0.002)
ΔTotal deposits/Assets$_{t_0}$	0.010 (0.038)	0.020 (0.025)
ΔNet total non-resid. interbank position/Assets$_{t_0}$	0.021 (0.040)	-0.062** (0.028)
ΔTotal lending to companies (up to 1 year maturity) /Assets$_{t_0}$	-0.022 (0.041)	0.058 (0.108)
ΔTotal lending to companies (3 year maturity) /Assets$_{t_0}$	-0.027 (0.024)	0.054 (0.036)
ΔTotal lending to companies (more than 3 year maturity)/Assets$_{t_0}$	0.018 (0.018)	0.018 (0.018)
ΔTotal lending to individuals (up to 1 year maturity)/Assets$_{t_0}$	0.014 (0.042)	0.004 (0.020)
ΔTotal lending to individuals (3 year maturity)/Assets$_{t_0}$	0.052 (0.065)	0.024 (0.035)
ΔTotal lending to individuals (more than 3 year maturity)/Assets$_{t_0}$	0.009 (0.010)	0.003 (0.002)
ΔTotal lending to entrepreneurs/Assets$_{t_0}$	0.006 (0.005)	0.005 (0.007)
ΔTotal investment into govt. securities/Assets$_{t_0}$	-0.005 (0.016)	-0.012 (0.012)
ΔTotal investment into non-govt. securities/Assets$_{t_0}$	-0.041* (0.023)	0.003 (0.026)
ΔTotal non-perf. loans/Assets$_{t_0}$	0.019 (0.012)	-0.015* (0.008)

Note: This table reports difference-in-difference tests for all outcome variables on a sample covering a period of two years before the sudden stop.