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Abstract

This paper investigates the cyclicality of bank liquidity creation. Since liquidity creation is a major economic function of banks, their liquidity creation behavior may amplify business cycle fluctuations. Using the methodology of Berger and Bouwman (2009) to compute liquidity creation measures, we analyze the relation between GDP growth and liquidity creation of Russian banks from 2004 to 2015. Detailed quarterly data on a very large sample of banks and coexistence of different bank ownership types (state-owned, domestic private and foreign banks), makes Russia an ideal natural laboratory for study of cyclicality of liquidity creation for banks. We find that liquidity creation of banks is procyclical. We show that the liquidity creation behavior of state-owned banks and foreign banks is similar to that of domestic private banks in terms of procyclicality. We further find that the magnitude of procyclicality is higher for liquidity creation than for lending. Thus, while ownership of banks does not influence the liquidity creation behavior of banks, such behavior can amplify business cycle fluctuations.

JEL codes: G21.

Keywords: bank, liquidity creation, business cycles, state ownership.

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1 Introduction

Liquidity creation is a major function of banks in the economy. Banks create liquidity by financing relatively illiquid assets with relatively liquid liabilities and thus contribute to financing the economy and facilitating transactions between economic agents. It is generally accepted that liquidity creation favors economic growth (e.g. Berger and Sedunov, 2015; Fidrmuc, Fungáčová and Weill, 2015).

The literature on bank liquidity creation saw a recent boost with the novel approach proposed by Berger and Bouwman (2009) to measure liquidity created by banks. Several works build on this approach in examining the determinants of liquidity creation (e.g. Berger, Bouwman, Kick, and Schaeck, 2016; Fungáčová, Weill, and Zhou, 2017), as well as the consequences of liquidity creation for financial stability (Berger and Bouwman, 2012; Fungáčová, Turk, and Weill, 2015).

The aim of this paper is to investigate cyclicality of bank liquidity creation. Berger and Bouwman (2015) point out that bank lending alone is not an optimal measure of bank output. In order to account for differences in loan categories and composition on the liability side, one should rather look at the bank liquidity creation. Even as cyclicality of bank lending has received attention (e.g. Micco and Panizza, 2006; Bertay, Demirgüç-Kunt, and Huizinga, 2015), no studies to the best of our knowledge consider how bank core output in the form of liquidity creation reacts to business cycle fluctuations. Given the key function of banks as liquidity creators, cyclicality of bank liquidity creation might generate undesirable effects in the economy by amplifying recessions.

This study also considers whether liquidity creation by state-owned banks might be less procyclical than liquidity creation of domestic private banks and foreign banks. Such a finding would imply that state-owned banks play a greater role in economic stabilization than domestic private banks or foreign banks. Bertay, Demirgüc-Kunt and Huizinga (2015) show that lending of state-owned banks tends to be less procyclical than lending of private banks. Thus, we ask if this finding holds for the broader notion of liquidity creation as well.

To investigate these issues, we follow the methodology of Berger and Bouwman (2009) in measuring bank liquidity creation. We classify all bank assets and liabilities based on their degree of liquidity, then assign weights to each item and compute the amount of liquidity created by each bank. We consider the Russian banking system for our analysis and use comprehensive quarterly data from financial reports of the Russian banks covering the period 2004–2015. The availability of a rich panel dataset on all Russian banks in terms of level of detail and frequency allows for the measurement of liquidity creation and for the investigation of business cycle fluctuations. The co-existence of state-owned, domestic private and foreign banks – especially with each type of bank

controlling significant market shares – makes Russia an ideal natural laboratory for analyzing how ownership influences cyclicality of bank liquidity creation.

This paper contributes to the literature on bank liquidity creation by providing evidence on its cyclical nature and potential amplifying role in economic recessions. It also relates to the discussion on the economic impact of state ownership of banks. This is particularly relevant to emerging economies, where banks typically play a major financing role and the state may be heavily involved in the banking industry.

The rest of the article is structured as follows. Section 2 reviews the related literature. Section 3 presents data and methodology. Section 4 displays the main estimations. Section 5 provides additional estimations on cyclicality of bank lending. Section 6 concludes.

2 Related literature

Our paper relates to two strands of literature. The first deals with bank ownership and lending behavior, the second with bank liquidity creation.

Regarding the first strand, many studies note the strong association between bank ownership and lending behavior. Consistent with the political view of state ownership, some of these studies show that state-owned banks can be exploited by politicians in ways that drive bank lending to suboptimal levels, especially around electoral periods (Sapienza, 2004; Dinç, 2005; Khwaja and Mian, 2005; Carvalho, 2014; Infante and Piazza, 2014).

On the other hand, some researchers find, especially after the credit crunch of 2008, that state ownership of banks can be quite valuable in providing a semblance of economic stability in times of financial turmoil. State-owned banks can increase their lending during crises even as foreign banks pull back sharply (Brei and Schclarek, 2013; Fungáčová, Herrala, and Weill, 2013; Albetrazzi and Bottero, 2014; De Haas et al., 2015).

Many studies tackle state ownership of banks and its impact on lending (Cull and Martinez Peria, 2013; Davydov, 2016).

Despite this wide-ranging body of literature, there has been little discussion on how various types of banks react to business cycle fluctuations. Linking credit and GDP growth, Micco and Panizza (2006) find that lending by state-owned banks is less cyclical than lending by privately owned banks. Using an extensive dataset from 111 countries during 1999–2010, Bertay, Demirgüc-Kunt and Huizinga (2015) show that state-owned banks lend countercyclically regardless of financial crises. While these results are especially strong for developed countries with good governance,

their general conclusion is that state involvement through government ownership of banks serves as a stabilizing force throughout the business cycle.

Duprey (2015) confirms these findings with bank data from 83 countries over the period 1990–2010. He documents that privatized banks are associated with increased lending cyclicality by combining state ownership with individual privatization/nationalization events.

Behr, Foos, and Norden (2017) examine the effect of government involvement in banks on cyclicality of lending to small and medium-sized enterprises. Using Germany's unique institutional setting, they show that state involvement in a bank reduces the sensitivity of bank lending to GDP growth. On average, lending by banks with state involvement is 25% less cyclical than for other types of local banks.

The second strand of literature involves the emerging topic of bank liquidity creation. A key motivation for the focus on the function of banks as liquidity creators is the argument from Berger and Bouwman (2015) that bank lending alone is not an optimal measure of bank output. In order to account for differences in loan categories and composition on the liability side, one should rather look at the bank liquidity creation measure suggested by Berger and Bouwman (2009).

Existing empirical literature in the emerging research area of bank liquidity creation focuses on determinants of bank liquidity creation. Several studies suggest, for example, that while bank capital tends to be negatively related to liquidity creation, it may depend on bank size and presence of deposit insurance system (Lei and Song, 2013; Fungáčová, Weill, and Zhou, 2017). This relationship can even be reversed, implying that greater liquidity creation increases the probability of bank failure (Fungáčová, Turk, and Weill, 2015). At the same time, liquidity creation by banks may be sensitive to regulatory interventions and bailouts (Berger et al., 2016) or to monetary policy (Rauch et al., 2011). For the latter category, the sensitivity may depend on bank size and general economic conditions (Berger and Bouwman, 2012).

The existing literature suggests that bank ownership may be a major determinant of bank liquidity creation. Fungáčová and Weill (2012) document that large state-owned banks have the greatest impact on liquidity creation in Russia. Moreover, while on average liquidity creation by private domestic and foreign banks contracted during the recent financial crisis, state-owned banks did not reduce their liquidity creation. These results could also indicate potential countercyclical behavior in liquidity creation by state-controlled banks.

Lei and Song (2013) argue that general negative relation between bank capital and liquidity creation is irrelevant for foreign banks operating in China. Their findings underline the importance of type of bank ownership and its impact on liquidity creation.

Several recent studies show that liquidity creation by banks positively affects economic growth. Berger and Sedunov (2015) argue that higher levels of bank liquidity creation are associated with significantly higher GDP in individual US states. Fidrmuc, Fungáčová, and Weill (2015) document that liquidity creation by banks is positively related to economic growth in Russian regions (a relationship that held even during the recent financial crisis).

Overall, these results imply that development of the financial sector may significantly contribute to economic growth through the bank liquidity creation channel.

3 Data and methodology

3.1 Data description

We employ quarterly bank-level financial statement data for Russian banks from the Central Bank of Russia (CBR). The period covered is 2004–2015. The dataset contains detailed information that is necessary for calculation of the bank liquidity creation measures. We distinguish among corporate, household, and government loans, as well as types of deposits. Our data also contains detailed information on maturity of various balance sheet items. Since the data cover all Russian banks, there is no selection bias.

We augment our original dataset with additional data on state ownership of banks from Vernikov (2016) and define a bank as state-owned if the majority stake in the bank is held by the federal government, central bank, state-owned enterprises, regional government, or municipality. We define foreign banks as those where foreign owners hold more than 50% of the bank's equity. The data on foreign ownership are obtained from the CBR, www.allbanks.ru webpage and the banks' own websites. We also consider macro-level variables provided by Russia's Federal State Statistics Service (Rosstat).

By excluding non-bank organizations from our sample, we ensure that the data only include commercial banks. We trim our dependent variables at the 2.5% and 97.5% to avoid extreme outliers. The final sample consists of unbalanced panel observations on 1,180 individual banks. Depending on the model specification, the number of observations varies between 33,099 and 35,349 bank-quarter observations. Descriptive statistics of the variables used in our analysis are provided in Table 1.

3.2 Liquidity creation measures

Taking Russia-specific factors into account, we construct our bank liquidity creation measures using the three-step procedure developed by Berger and Bouwman (2009). In the first step, we classify all

bank balance sheet items as *liquid*, *semi-liquid*, or *illiquid*. This classification is based on the ease, cost, and time necessary for banks (customers) to turn their obligations into liquid funds (withdraw funds).

Next, we assign weights to all balance sheet items. Following the theory of financial intermediation, banks are seen to create liquidity by transforming illiquid assets to liquid liabilities. We thus apply positive weights to these two balance sheet categories. One unit face value of liquidity is *created* when a unit of liquid liabilities (e.g. current account deposits, weighted 0.5) is used to finance a unit of illiquid assets (e.g. corporate loans, weighted 0.5). We assign negative weights to liquid assets, illiquid liabilities and capital. One unit of liquidity is *destroyed* when one unit of illiquid liabilities or equity is used to finance a unit of liquid assets (e.g. government securities).

Equation (1) presents the functional form used to construct the bank liquidity creation measures in the third step.

$$\textit{Liquidity Creation} = \{\tfrac{1}{2} \times \textit{Illiquid Assets} + 0 \times \textit{Semi-Liquid Assets} - \tfrac{1}{2} \times \textit{Liquid Assets}\} + \{\tfrac{1}{2} \times \textit{Liquid Liabilities} + 0 \times \textit{Semi-Liquid Liabilities} - \tfrac{1}{2} \times \textit{Illiquid Liabilities}\} - \tfrac{1}{2} \times \textit{Capital} \quad (1)$$

In line with Berger and Bouwman (2009), we construct two measures of liquidity creation from Equation (1) using two definitions for each of the right-hand-side terms. The classification of balance sheet items is based on category for the first measure and on maturity of the individual balance sheet items for the second measure. Table 2 provides a detailed description of balance sheet items used to calculate these two liquidity creation measures and the weights assigned to each group.

Our benchmark liquidity creation measure is based on the classification of balance sheet items by category. *Liquid assets* include cash, accounts with banks, and total securities (stocks, debt securities, and promissory notes). Customer loans are divided into corporate loans, loans to individuals, and loans to government. Since banks generally lack the option of selling corporate loans to meet their liquidity needs, such loans are considered *illiquid assets*. Other categories of loans, including loans to individuals, loans to the government and interbank loans, are classified as *semi-liquid assets*. As mortgage lending is a recent phenomenon in Russia, most loans to individuals are short-term loans for buying consumer goods. We treat these loans as semi-liquid, because items with shorter maturity tend to be more liquid than longer-term items, notwithstanding rare loan securitization in Russia. The illiquid assets category includes other assets containing e.g. tangible and intangible assets.

On the liability side, we distinguish between three broad categories: claims of banks, claims of the non-banking sector, and debt securities issued by banks. Claims of banks are readily available for withdrawal and fall into the *liquid liabilities* category. In contrast, there are two types of claims

of the non-banking sector. The first category includes the settlement accounts of clients (domestic and foreign firms, government, and households). These are classified as liquid liabilities. Customers can easily withdraw these funds without penalty. The second category of claims of non-banking sector contains term deposits classified as *semi-liquid liabilities*. These may be difficult or costly to withdraw immediately. The debt securities issued by banks belong either to the liquid category (promissory notes and bonds) or the semi-liquid category (deposit and saving certificates). This categorization is based on the liquidity of these instruments in Russia. The *illiquid liabilities* category consists of other liabilities that we calculate as the difference between total liabilities and the sum of all the above-mentioned claims. We include bank capital here.

The alternative liquidity creation measure that we use in our analysis is based on the classification of balance sheet items by maturity. To calculate this measure, we redefine the subgroups of balance sheet items. *Liquid assets* are defined in the same way as it was the case for classification by category. *Semi-liquid* assets consist of various types of loans with maturity of less than one year. The *illiquid assets* category contains loans with maturity over a year, loans of unknown maturity and other assets (e.g. tangible and intangible assets). *Liquid liabilities* include settlement accounts, claims of banks and debt securities issued (bonds and promissory notes). *Semi-liquid liabilities* contain all deposits with maturity less than one year and debt securities issued (deposit and saving certificates). *Illiquid liabilities* consist of deposits with maturity of more than a year, undefined maturity, and other liabilities. As with our benchmark measure of liquidity creation based on category classification, we treat bank capital as an illiquid balance sheet item.

In line with Berger and Bouwman (2009), our category-based liquidity creation measure is the benchmark indicator. While these authors developed the methodologies for computing both measures, they themselves prefer the category-based measure. In their view: “What matters to liquidity creation on the asset side is the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds. The ability to securitize loans is closer to this concept than the time until self-liquidation.” (Berger and Bouwman, 2009, p. 3797).

We present statistics for the variation in our two main variables - the category-based liquidity creation measure and credit growth by bank type in Panel B of Table 1. While the variation in liquidity creation is higher for foreign banks than for domestic private banks and for state-owned banks, we find that the differences are not statistically significant. However, credit growth is significantly higher for foreign banks than for the other two bank types. It is also significantly higher for domestic private banks than for state-owned banks.

3.3 Methodology

We begin our empirical analysis of cyclicality of liquidity creation with two-way fixed effects estimations. We estimate different specifications of the following model:

$$\Delta LIQ_{i,t} = \alpha_i + \beta_1 \Delta M_i + \beta_2 OWN_{i,t} + \beta_3 \Delta M_i * OWN_{i,t} + \beta_z X_{i,t-1} + BANK_i + TIME_t + \varepsilon_{i,t}\,, \quad (2)$$

where, $\Delta LIQ_{i,t}$ is the change in liquidity creation by bank *i* in quarter *t* and ΔM_i is the change in the macroeconomic indicator for business cycle. We utilize alternatively two indicators for business cycles. *GDP per capita growth* is used in the main estimations in line with earlier papers (e.g., Bertay et al. 2015). We adopt real investment growth in the robustness check as an alternative indicator. To avoid seasonal fluctuations in the quarterly liquidity creation and macroeconomic variables, we calculate the change by dividing quarterly observations in year *t* by the same quarter in year *t-1*.

To examine the effect of bank ownership characteristics, we include $OWN_{i,t}$, a vector of dummy variables for state, foreign, and private domestic ownership. We also include interaction terms of macro variables and ownership dummies to examine the differential effect of macroeconomic fluctuations on liquidity creation between state-owned, foreign, and private banks. $X_{i,t-1}$ is a matrix of bank-specific control variables. Following the literature, we include lagged values of bank size (log of total assets), the equity-to-assets ratio, the nonperforming-loans-to-total-loans ratio, and the total-loans-to-total-assets ratio as control variables. $BANK_i$ and $TIME_t$ are the bank and time fixed effects. $\varepsilon_{i,t}$ is an error term.

Our baseline regression model with fixed effects is potentially a subject to endogeneity problem. To tackle this problem and account for the dynamic properties of our panel, we include a lagged dependent variable to the right-hand-side of the equation and apply a dynamic two-step system GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) using differenced variables as instruments. We assume that our macroeconomic and ownership variables together with interaction terms are predetermined, implying that they are not correlated with future error terms. All other bank-specific controls are considered as endogenous and instrumented with their lags.

This approach leads to a relatively high number of instruments. To avoid an over-identification problem, we use the collapse option suggested by Roodman (2009) for bank-specific control variables and limit the number of lags used as other instruments accordingly. We apply the Wind-

meijer (2005) correction for standard errors and test for the autocorrelation in residuals with Arellano-Bond test. We report Hansen test for over-identifying restrictions where the null hypothesis is that the instruments used are appropriate.

4 Results

This section presents the results on cyclicality of bank liquidity creation in Russia. We report the main estimations before testing the sensitivity of the results with robustness checks.

4.1 Main estimations

Table 3 presents the main estimations. In columns 1 and 2, we report results without ownership variables. These variables are included in columns 3 and 4. In each case, we perform estimations alternatively with panel fixed effects and system GMM estimators to check the sensitivity of our results. Several conclusions emerge.

First, GDP per capita growth enters with positive and significant coefficients in all regressions. Based on regression specification 1, we infer that an increase of 1 percentage point in GDP per capita growth contributes to a 0.711-point increase in bank liquidity creation. Liquidity creation behavior of banks is thus procyclical, i.e. banks create liquidity in boom times and reduce liquidity creation during bust times. This finding is important as liquidity creation ostensibly exerts beneficial effects on economic activity (Fidrmuc, Fungáčová, and Weill, 2015; Berger and Sedunov, 2015). In other words, the liquidity creation behavior of banks can amplify the business cycle.

Second, the interactions of GDP growth with ownership dummies are not significant. These results imply the absence of difference in cyclicality of liquidity creation by bank ownership. In other words, the liquidity creation behavior of state-owned banks and foreign banks is not different from domestic private banks in terms of procyclicality. The ownership dummies are also not significant, suggesting no difference in liquidity creation behavior over the period between different types of ownership.

Our results differ from those observed on cyclicality of bank lending in Bertay Demirgüc-Kunt and Huizinga (2015). First, our results concern liquidity creation, a broader concept than bank lending. Second, our observations are exclusive to Russia, while the analysis of Bertay, Demirgüc-Kunt and Huizinga (2015) is based on a cross-country sample of 111 countries. Third, we depart from the conclusion of Fungáčová, Herrala, and Weill (2013) that foreign banks tend to reduce their credit supply more and state-owned banks less than domestic private banks in Russia. But again,

their findings consider credit supply in isolation, not liquidity creation – and their study is limited to a period of financial crisis.

Overall, our findings on the cyclicality of liquidity creation and the role of bank ownership show a pattern unlike that observed for bank lending alone. They support the thesis that examining liquidity creation provides additional information for assessing how bank behavior may amplify business cycles.

A natural question emerges if cyclicality of liquidity creation is symmetric for ownership types. Namely, the findings on cyclicality of liquidity creation by ownership type can be asymmetric. The average result can be driven by different liquidity creation behaviors at different stages of the business cycle. For instance, if state-owned banks create more liquidity in both bust and boom times than domestic private banks, the average would be that state-owned banks are no more or less procyclical in their behavior than domestic private banks, i.e. they are more procyclical in boom times and less procyclical in bust times. Yet there is no doubt that their behavior differs from that of the domestic private banks with respect to business cycle fluctuations.

To investigate this question, we replace *GDP growth* by two variables: *High GDP growth* and *Low GDP growth*. Following the approach of Behr et al. (2017), we use the value of average GDP per capita growth during the sample period to distinguish periods of high and low growth. In periods of high growth, the *High GDP growth* variable is equal to the actual GDP per capita growth if the value is above average, and zero otherwise. Correspondingly, in periods of low growth, *Low GDP Growth* is equal to the actual GDP per capita growth if the value is below average, and zero otherwise. This approach enables us to investigate if cyclicality in bank liquidity creation is symmetric through the whole business cycle or asymmetric by only occurring in certain stages of the business cycle. Table 4 reports the estimations.

We observe that estimated coefficient for *High GDP growth* is significantly positive, while the coefficient for *Low GDP growth* is significantly negative. Not tabulated F-tests indicate that coefficients on *High GDP growth* and *Low GDP growth* are statistically different from zero (F-stat = 24.47) and reject the hypothesis on equality of these coefficients at the 1% level (F-stat = 43.32). This finding confirms that the conclusion on procyclical liquidity creation for all banks is observed in both bust and boom times. Hence, procyclicality of liquidity creation is not driven by a particular stage of the business cycle. The magnitude of the coefficients for *High GDP growth* and *Low GDP growth* indicates, however, that economic downturns may have a marginally stronger impact on the change in liquidity creation than upturns. One standard deviation change in *Low GDP growth* causes a change in liquidity creation of 0.04, while a similar change in *High GDP growth* leads to 0.03-point change.

Interaction terms between ownership dummies and *GDP growth* are not significant. Therefore, there is no asymmetry in the cyclicality of liquidity creation for state-owned banks or foreign banks. These banks do not react any differently to booms or busts than domestic private banks.

4.2 Robustness checks

While the two estimation approaches (fixed effects and system GMM) applied in the main estimations already provide a robustness check of our results, we nevertheless check the robustness of our findings with three additional estimations. First, we use an alternative measure for liquidity creation. We have used the category-based liquidity creation measure in our main estimations. We can, however, see if our main findings remain valid when liquidity creation is measured through classification of balance sheet items based on maturity rather than category. We repeat our regressions with the maturity-based liquidity creation measure and report the findings in Table 5.

Our results with the maturity-based liquidity creation measure corroborate the main findings obtained with the category-based liquidity creation measure. We again observe a positive coefficient for *GDP growth* in all regressions. It is significant in three of the four specifications supporting our conclusion that liquidity creation is procyclical. We still find no significance for interaction terms between ownership dummies and *GDP growth*. This finding confirms that cyclicality of liquidity creation does not differ across types of banks. To sum up, the estimations with the maturity-based liquidity creation measure confirm main findings obtained with the category-based liquidity creation measure.

A different result emerges when it comes to ownership dummy variables. While they were not significant when the category-based liquidity creation measure was considered, we now see positive and significant coefficients for *State-owned* and *Foreign* dummy variables in the system GMM regression. These results support the view that state-owned banks and foreign banks increased liquidity creation more over the period than domestic private banks. They are, however, only observed in the system GMM regression and not confirmed by the panel regression with fixed effects.

Second, we use an alternative indicator for the business cycle. One could argue that GDP per capita growth does not fully reflect the state of the Russian economy. We redo our estimations by utilizing real investment growth as the indicator of the business cycle. Table 6 displays these estimations.

The coefficient for real investment growth is significantly positive, supporting the finding of procyclical liquidity creation behavior. We again find no difference when considering the behavior of state-owned and foreign banks. Interaction variables between ownership dummies and real investment growth are not significant.

Thus, the estimations with the alternative business cycle indicator confirm our findings on procyclicality of liquidity creation for all banks, and no differences across bank ownership types.

Third, we investigate whether the cyclicality of liquidity creation differs with size of banks. Studies on liquidity creation show significant differences in liquidity creation of banks depending on size (Berger and Bouwman, 2009). It is therefore of interest to check if size matters for our main finding of procyclicality of liquidity creation.

We consider three size classes of banks based on their ranking by total assets. Large banks are the top 50 banks by total assets, medium banks the next 150 banks, and small banks all others[1]. Table 7 reports the estimations for each size class. As our previous estimations have shown that regressions with fixed effects and with system GMM provide very similar results, we only display the estimations with fixed effects for the sake of brevity. We find that *GDP growth* is significantly positive for all size classes, while interaction terms between *GDP growth* and ownership dummies are not significant. Hence, these results corroborate our main findings on procyclicality of liquidity creation for all banks, and on the absence of differences in cyclicality for ownership types of banks.

5 Cyclicality of liquidity creation vs. cyclicality of lending

Our investigation on cyclicality of liquidity creation in the case of Russian banks so far has established two key findings: 1) the existence of procyclicality of liquidity creation, and 2) a lack of significant differences among the three bank ownership types with respect to procyclicality of liquidity creation.

We now ask if these findings are valid for bank lending. Bank liquidity creation is a broad measure of bank output that includes bank lending, but also other types of assets. It also takes the liability structure into consideration. Thus, liquidity creation and bank lending may not necessarily exhibit the same cyclical behavior. Moreover, cyclicality of ownership types may even differ between bank liquidity creation and bank lending, i.e. different types of banks may have different behaviors for items other than loans.

We now perform our estimations by considering a new dependent variable: the growth rate of total loans. This is the same variable that Bertay, Demirgüc-Kunt and Huizinga (2015) and Behr, Foos and Norden (2017) consider in their analysis of the cyclicality of bank lending.

[1] This division reflects the structure of the Russian banking sector. Despite a high number of banks, most are small and only operate at the local or regional level. We get the same results with alternative groupings that consist of Russia's top 25 banks, the 100 next-largest banks, and all other banks.

Table 8 reports the estimations for cyclicality of bank lending. Again, since regressions with fixed effects and system GMM provide similar results in the main estimations, we only display the estimations with fixed effects for the sake of brevity. In column 1, we consider GDP per capita growth. In column 2, we include the interaction terms between GDP per capita growth and ownership dummies. In column 3, we consider the possible asymmetric lending behavior of different types of banks.

First, we observe that bank lending is procyclical with a significantly positive coefficient for *GDP growth* in the first two columns. Hence, bank lending is also procyclical. To assess the magnitude of this procyclicality we compare regressions 1 in Table 3 (for liquidity creation) and Table 8 (for lending) and observe that one standard deviation increase in GDP per capita growth causes a 0.08-point increase in bank liquidity creation but only a 0.05-point increase in lending. In other words, liquidity creation is more procyclical than lending. Furthermore, *High GDP growth* is significantly positive and *Low GDP growth* is significantly negative in column 3. These results show the positive relation between GDP growth and bank lending observed in booms and busts.

Second, we find evidence for a different pattern for state-owned and foreign banks compared to domestic private banks. In column 2, the interaction of *GDP growth* with *Foreign* is significantly positive, suggesting that foreign banks have a greater cyclicality of bank lending than domestic private banks. In column 3, we observe that *Foreign×High GDP growth* is significantly positive, while *Foreign×Low GDP growth* is not significant. In booms, foreign banks amplify the expansion by increasing bank lending more than domestic private banks. However they reduce their lending similarly when the business cycle turns to bust.

Finally, for state-owned banks, we observe no significant coefficient for the interaction of *GDP growth* with *State-owned* in column 2. However, when we examine the possibility of asymmetric lending behavior in column 3, we find a significantly positive coefficient for *State-owned×Low GDP growth* but no significant coefficient for *State-owned×High GDP growth.* This suggests that state-owned banks increase their lending more than domestic private banks during busts, and comports with the view that the lending behavior of state-owned banks is less procyclical. It also corroborates the observations of Bertay, Demirgüc-Kunt and Huizinga (2015) at the world level and Fungáčová, Herrala and Weill (2013) for Russia.

Overall, the estimations for cyclicality of lending show similarities and differences with those for cyclicality of liquidity creation. We find evidence of procyclicality for all banks in both sets of estimations, with some differences by ownership type. For lending only, we find evidence that foreign banks are more procyclical and state-owned banks less procyclical than domestic private banks.

6 Conclusions

This study examined cyclicality of bank liquidity creation. While liquidity creation is a major function of banks in the economy, no paper to date has posed the question of whether liquidity creation is procyclical and thereby might amplify business cycle fluctuations. We analyze this question on the Russian banking system by taking into account potential differences across various bank types. As the literature contains evidence that lending of state-owned banks may be less cyclical than other banks, we also check to see if a similar result is observed for liquidity creation.

Our findings can be summarized as follows. First, we observe that liquidity creation of banks is procyclical, i.e. business cycle fluctuations are positively associated with bank liquidity creation. The magnitude of procyclicality is higher for liquidity creation than for lending. Second, we show that state-owned banks and foreign banks do not have a more or less procyclical liquidity creation behavior than domestic private banks.

These findings have several implications. Liquidity creation behavior of banks can contribute to amplify business cycle fluctuations since liquidity creation has been shown to exert beneficial effects on economic activity. Normatively, the evidence is neutral as to the effects of state ownership of banks. From a research perspective, however, we see liquidity creation broadens the concept of bank output beyond lending and offers tantalizing new avenues for further research.

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Tables

Table 1 Descriptive statistics of the main variables

Panel A of this table provides the descriptive statistics for the main variables included in the estimations. Panel B presents the difference in averages of key variables across bank types. The difference is tested with t-tests, which are provided in parenthesis. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. All variables follow the Table A1 definitions.

Panel A

	N	Mean	Median	SD	Min	Max
Δ Liquidity creation (cat)	36 121	0.25	0.13	1.29	-5.08	7.28
Δ Liquidity creation (mat)	34 219	-0.15	-0.03	1.48	-6.06	4.35
GDP growth	44 227	0.17	0.20	0.11	-0.10	0.36
High GDP growth	44 227	0.15	0.20	0.12	0	0.36
Low GDP growth	44 227	0.01	0.00	0.04	-0.10	0.16
Credit growth	35 152	0.28	0.19	0.47	-0.60	2.63
Real investments growth (RIG)	44 227	0.18	0.18	0.16	-0.14	0.51
Lagged Log(assets)	41 760	14.61	14.49	2.00	6.78	23.84
Lagged Equity/Assets	41 760	0.22	0.17	0.17	-0.68	1.00
Lagged Overdue loans/Loans	40 796	0.03	0.01	0.06	0.00	1.00
Lagged Loans/Assets	41 760	0.57	0.62	0.21	0.00	0.98
State-owned	44 222	0.05	0.00	0.21	0.00	1.00
Foreign	44 222	0.09	0.00	0.29	0.00	1.00

Panel B

				Difference in means		
	State-owned	Foreign	Private	State vs. Private	Foreign vs. Private	State vs. Foreign
Δ Liquidity creation (cat)	0.23	0.28	0.25	-0.01	0.03	-0.05
				(0.45)	(1.32)	(1.21)
Credit growth	0.25	0.29	0.28	-0.03**	0.01*	-0.04***
				(2.03)	(1.40)	(2.42)

Table 2 Liquidity creation measures

This table classifies all balance sheet items in terms of their liquidity. The weight of each category is given in parentheses and it is used to calculate two liquidity creation measures following Equation (1). *Category Measure* denotes a category-based liquidity creation measure, whereby bank activities are classified based on various categories. *Maturity Measure* is a maturity-based liquidity creation measure that is based on category, maturity classification for interbank loans, and total liabilities.

Category measure	**Illiquid assets (1/2)**	**Semi-liquid assets (0)**	**Liquid assets (-1/2)**
	Corporate loans	Interbank loans	Cash
	Other assets	Loans to government	Correspondent accounts with other banks
		Loans to individuals	Total securities (stocks, debt securities, promissory notes)
	Liquid liabilities (1/2)	**Semi-liquid liabilities (0)**	**Illiquid liabilities and capital (-1/2)**
	Debt securities issued (bonds and promissory notes)	Debt securities issued (deposit and saving certificates)	Other liabilities
	Claims of non-bank sector: settlement accounts (firms, households, government)	Claims of non-bank sector: term and other deposits (firms, households, government)	Capital
	Claims of banks		
Maturity measure	**Illiquid assets (1/2)**	**Semi-liquid assets (0)**	**Liquid assets (-1/2)**
	Corporate loans (maturity over 1 year)	Corporate loans (maturity less than 1 year)	Cash
	Loans to government (maturity over 1 year)	Loans to government (maturity less than 1 year)	Correspondent accounts with other banks
	Loans to individuals (maturity over 1 year)	Loans to individuals (maturity less than 1 year)	Total securities (stocks, debt securities, promissory notes)
	Loans to banks (maturity over 1 year)	Loans to banks (maturity less than 1 year)	
	Other loans		
	Other assets		
	Liquid liabilities (1/2)	**Semi-liquid liabilities (0)**	**Illiquid liabilities and capital (-1/2)**
	Debt securities issued (bonds and promissory notes)	Debt securities issued (deposit and saving certificates)	Deposits (maturity over 1 year and uncertain term to maturity)
	Claims of non-bank sector: settlement accounts (firms, households, government)	Deposits (maturity less than 1 year)	Other liabilities
	Claims of banks		Capital

Table 3 Main estimations

The dependent variable is the growth in liquidity creation based on category. Regression type (OLS with fixed effects or System GMM) indicated at the top of each column. All variables are defined as in Table 1. Robust standard errors in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Δ liquidity creation (CAT)			
	(1)	(2)	(3)	(4)
Regression type	OLS with FE	Sys. GMM	OLS with FE	Sys. GMM
GDP growth	0.711***	0.571***	0.719***	0.505***
	(0.16)	(0.13)	(0.16)	(0.15)
Lagged Δ Liquidity creation (cat)		0.430***		0.430***
		(0.02)		(0.02)***
State-owned			-0.018	-0.056
			(0.13)	(0.07)
State-owned x GDP growth			0.230	0.142
			(0.28)	(0.19)
Foreign			-0.066	0.053
			(0.15)	(0.10)
Foreign x GDP growth			-0.253	-0.327
			(0.43)	(0.29)
Lagged Log(assets)	-0.003	-0.089***	-0.002	-0.041
	(0.03)	(0.03)	(0.03)	(0.04)
Lagged Equity/Assets	-0.904***	-1.501***	-0.902***	-1.675***
	(0.15)	(0.32)	(0.15)***	(0.32)
Lagged Overdue Loans/Loans	-1.468***	-1.732***	-1.469***	-1.355***
	(0.31)	(0.43)	(0.31)	(0.41)
Lagged Loans/Assets	1.154***	1.441***	1.157***	1.503***
	(0.11)	(0.18)	(0.11)	(0.19)
Constant	-0.045	0.796	-0.059	0.158
	(0.45)	(0.51)	(0.45)	(0.58)
No. of obs.	35 349	33 099	35 347	33 097
Adjusted R-squared	0.044		0.044	
Number of banks	1 180	1 167	1 180	1 167
Number of instruments		720		740
AR(2) test p-value		0.195		0.206
Hansen OIR test p-value		0.118		0.298

Table 4 High and low GDP growth

The dependent variable is the growth in liquidity creation based on category measure. Regression type (OLS with fixed effects or System GMM) indicated at the top of each column. High and Low GDP growth are defined using the value of average GDP per capita growth over the full sample period. High (Low) GDP growth is equal to the actual GDP per capita growth if above (below) the mean, and zero otherwise. Other variables follow the Table 1 definitions. Robust standard errors in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Δ Liquidity creation (CAT)	
	(1)	(2)
Regression type	OLS with FE	Sys. GMM
High GDP growth	0.271**	0.230**
	(0.13)	(0.11)
Low GDP growth	-1.014***	-0.560***
	(0.24)	(0.22)
Lagged Δ Liquidity creation (cat)		0.451***
		(0.02)
State-owned	-0.018	-0.099
	(0.12)	(0.07)
Foreign	-0.080	0.004
	(0.15)	(0.08)
State-owned x High GDP growth	0.281	0.184
	(0.28)	(0.18)
State-owned x Low GDP growth	-0.062	0.074
	(0.69)	(0.44)
Foreign x High GDP growth	-0.141	-0.232
	(0.40)	(0.26)
Foreign x Low GDP growth	-0.498	-0.504
	(0.85)	(0.61)
Lagged Log(assets)	0.001	-0.016
	(0.03)	(0.04)
Lagged Equity/Assets	-0.895***	-1.367***
	(0.15)	(0.33)
Lagged Overdue Loans/Loans	-1.447***	-1.463***
	(0.31)	(0.38)
Lagged Loans/Assets	1.164***	1.249***
	(0.11)	(0.19)
Constant	0.021	-0.028
	(0.45)	(0.55)
No. of obs.	35 347	33 097
Adjusted R-squared	0.045	
Number of banks	1 180	1 167
Number of instruments		821
AR(2) test p-value		0.117
Hansen OIR test p-value		0.852

Table 5 Alternative liquidity creation measure

The dependent variable is the growth in liquidity creation based on maturity. Regression type (OLS with fixed effects or System GMM) indicated at the top of each column. All variables follow the Table 1 definitions. Robust standard errors in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Δ Liquidity creation (MAT)			
	(1)	(2)	(3)	(4)
Regression type	OLS with FE	Sys. GMM	OLS with FE	Sys. GMM
GDP growth	0.356*	0.226	0.393*	0.441**
	(0.20)	(0.18)	(0.20)	(0.20)
Lagged Δ Liquidity creation (mat)		0.271***		0.293***
		(0.03)		(0.03)
State-owned			0.146	0.210*
			(0.14)	(0.11)
State-owned x GDP growth			0.195	0.357
			(0.43)	(0.30)
Foreign			0.080	0.208**
			(0.16)	(0.09)
Foreign x GDP growth			-0.615	-0.450
			(0.53)	(0.41)
Lagged Log(assets)	-0.048	-0.102***	-0.049	-0.111***
	(0.03)	(0.04)	(0.03)	(0.04)
Lagged Equity/Assets	-0.350**	-1.088***	-0.353**	-0.804***
	(0.16)	(0.34)	(0.16)	(0.30)
Lagged Overdue Loans/Loans	0.096	-0.080	0.081	-0.282
	(0.26)	(0.38)	(0.26)	(0.36)
Lagged Loans/Assets	1.281***	1.662***	1.284***	1.578***
	(0.11)	(0.24)	(0.11)	(0.25)
Constant	-0.018	0.662	-0.014	0.711
	(0.50)	(0.54)	(0.49)	(0.62)
No. of obs.	33 442	30 142	33 440	30 140
Adjusted R-squared	0.031		0.031	
Number of banks	1 180	1 167	1 180	1 167
Number of instruments		720		740
AR(2) test p-value		0.162		0.261
Hansen OIR test p-value		0.405		0.789

Table 6 Alternative indicator of the business cycle

The dependent variable is the growth in liquidity creation based on category measure. Regression type (OLS with fixed effects or System GMM) indicated at the top of each column. All variables follow the Table 1 definitions. Robust standard errors in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Δ Liquidity creation (CAT)			
	(1)	(2)	(3)	(4)
Regression type	OLS with FE	Sys. GMM	OLS with FE	Sys. GMM
Real investments growth (RIG)	0.798***	0.570***	0.788***	0.521***
	(0.12)	(0.09)	(0.12)	(0.11)
Lagged Δ Liquidity creation (cat)		0.420***		0.425***
		(0.02)		(0.02)
State-owned			-0.003	-0.057
			(0.13)	(0.08)
State-owned x RIG			0.147	0.117
			(0.21)	(0.15)
Foreign			-0.111	0.012
			(0.15)	(0.09)
Foreign x RIG			0.060	-0.039
			(0.33)	(0.22)
Lagged Log(assets)	-0.007	-0.097***	-0.005	-0.044
	(0.03)	(0.03)	(0.03)	(0.04)
Lagged Equity/Assets	-0.910***	-1.528***	-0.908***	-1.746***
	(0.15)	(0.34)	(0.15)	(0.33)
Lagged Overdue Loans/Loans	-1.474***	-1.785***	-1.473***	-1.494***
	(0.31)	(0.41)	(0.31)	(0.42)
Lagged Loans/Assets	1.158***	1.508	1.161***	1.532***
	(0.11)	(0.13)	(0.11)	(0.20)
Constant	-0.000	0.872*	-0.020	0.198
	(0.44)	(0.50)	(0.45)	(0.55)
No. of obs.	35 349	33 099	35 347	33 097
Adjusted R-squared	0.045		0.045	
Number of banks	1 180	1 167	1 180	1 167
Number of instruments		720		740
AR(2) test p-value		0.239		0.229
Hansen OIR test p-value		0.158		0.368

Table 7 Cyclicality of bank liquidity creation by bank size

The table reports the estimation results for different bank size categories. The dependent variable is the growth in liquidity creation based on category measure. Columns 1 and 3 are for the largest 50 banks, Columns 2 and 4 are for the next 150 large banks, and Columns 3 and 6 include all other banks. Regression type (OLS with fixed effects in all cases here) indicated at the top of each column. All variables follow the Table 1 definitions. Robust standard errors in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Δ liquidity creation (CAT)					
	(1)	(2)	(3)	(4)	(5)	(6)
Regression type	OLS with FE	OLS with FE	OLS with FE	OLS with FE	OLS with FE	OLS with FE
	Top 50	Next 150	Rest	Top 50	Next 150	Rest
GDP growth	1.016***	0.728**	0.691***	0.962*	0.780**	0.708***
	(0.343)	(0.340)	(0.189)	(0.519)	(0.362)	(0.190)
State-owned				-0.112	-0.006	0.009
				(0.261)	(0.241)	(0.178)
State-owned x GDP growth				-0.229	0.073	0.313
				(0.760)	(0.789)	(0.333)
Foreign				-0.252	0.025	0.120
				(0.199)	(0.284)	(0.235)
Foreign x GDP growth				0.314	-0.361	-0.745
				(0.620)	(0.605)	(0.784)
Lagged Log(assets)	-0.196	-0.151*	0.039	-0.196	-0.151*	0.038
	(0.119)	(0.082)	(0.035)	(0.120)	(0.083)	(0.035)
Lagged Equity/Assets	-2.775*	-1.115	-0.846***	-2.762*	-1.109	-0.847***
	(1.503)	(0.715)	(0.157)	(1.493)	(0.715)	(0.158)
Lagged Overdue Loans/Loans	-2.217	-1.807**	-1.359***	-2.214	-1.798**	-1.371***
	(1.646)	(0.715)	(0.342)	(1.600)	(0.710)	(0.343)
Lagged Loans/Assets	0.574	0.679**	1.226***	0.629	0.681**	1.226***
	(0.604)	(0.337)	(0.118)	(0.655)	(0.337)	(0.118)
Constant	3.749*	2.687*	-0.655	3.780*	2.676*	-0.647
	(2.192)	(1.405)	(0.485)	(2.235)	(1.412)	(0.484)
No. of obs.	1 834	5 076	28 439	1 834	5 076	28 437
Adjusted R-squared	0.109	0.067	0.042	0.112	0.068	0.042
Number of banks	50	150	980	50	150	980

Table 8 Cyclicality of bank lending

The dependent variable is the growth in bank lending. Regression type (OLS with fixed effects in all cases here) indicated at the top of each column. All variables follow the definitions in Tables 1 and 4. Robust standard errors in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Δ loans		
	(1)	(2)	(3)
Regression type	OLS with FE	OLS with FE	OLS with FE
GDP growth	0.433***	0.405***	
	(0.05)	(0.05)	
High GDP growth			0.162***
			(0.04)
Low GDP growth			-0.296***
			(0.07)
State-owned		-0.068	-0.056
		(0.07)	(0.08)
State-owned x GDP growth		0.165	
		(0.13)	
Foreign		-0.106	-0.103
		(0.07)	(0.06)
Foreign x GDP growth		0.300*	
		(0.17)	
State-owned x High GDP growth			0.177
			(0.16)
State-owned x Low GDP growth			0.762*
			(0.44)
Foreign x High GDP growth			0.347**
			(0.16)
Foreign x Low GDP growth			-0.080
			(0.30)
Lagged Log(assets)	0.023*	0.025*	0.025*
	(0.01)	(0.01)	(0.01)
Lagged Equity/Assets	-0.182**	-0.182	-0.179**
	(0.08)	(0.08)	(0.08)
Lagged Overdue Loans/Loans	-2.277***	-2.267***	-2.258***
	(0.26)	(0.26)	(0.26)
Lagged Loans/Assets	0.202***	0.203***	0.205
	(0.04)	(0.04)	(0.04)***
Constant	-0.023	-0.036	0.016
	(0.20)	(0.20)	(0.20)
No. of obs.	35 149	35 147	35 147
Adjusted R-squared	0.148	0.149	0.149
Number of banks	1 162	1 162	1 162

Table A1 Definition of variables

Variable	Definition
Δ Liquidity creation (cat)	Change in liquidity creation measure based on category calculated by dividing quarterly observations in year *t* by the same quarter in year *t-1*.
Δ Liquidity creation (mat)	Change in liquidity creation measure based on maturity calculated by dividing quarterly observations in year t by the same quarter in year t-1.
GDP growth	Change in GDP per capita by dividing quarterly observations in year *t* by the same quarter in year *t-1*.
Credit growth	Change in net loans to individuals and firms calculated by dividing quarterly observations in year *t* by the same quarter in year *t-1*.
Real investments growth (RIG)	Change in real investments calculated by dividing quarterly observations in year *t* by the same quarter in year *t-1*.
Lagged log(assets)	Logarithm of total assets lagged by one quarter.
Lagged equity/Assets	Book value of total-equity-to-total-assets ratio lagged by one quarter.
Lagged overdue loans/Loans	Nonperforming loans to total gross total loans lagged by one quarter.
Lagged loans/Assets	Total-loans-to-total-assets ratio lagged by one quarter.
State-owned	Dummy variable equals one if majority stake of bank's equity is owned by the federal government, central bank, state-owned companies, or regional governments and municipalities, zero otherwise.
Foreign	Dummy variable equals one if foreign ownership corresponds to at least a 50% share, zero otherwise.
High GDP growth	Actual GDP per capita growth if above the mean, zero otherwise.
Low GDP growth	Actual GDP per capita growth if below the mean, zero otherwise.

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