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Does excessive liquidity creation trigger bank failures?

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Abstract

This paper introduces the "Excessive Liquidity Creation Hypothesis," whereby a rise in a bank's core liquidity creation activity increases its probability of failure. Russia experienced many bank failures over the past decade, making it an ideal natural field experiment for testing this hypothesis. Using Berger and Bouwman's (2009) liquidity creation measures, we find that excessive liquidity creation significantly increased the probability of bank failure during our observation period (2002–2007). This finding survives multiple robustness checks. Our results further suggest that regulatory authorities can mitigate systemic distress and reduce the costs to society from bank failures through early identification and enhanced monitoring of excessive liquidity creators.

JEL Classification: G21; G28
Keywords: liquidity creation, bank failures

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1 Introduction

Predicting bank failure is a persistent challenge, not just for regulators who seek timely warning of an impending failure to deploy monitoring and enhance enforcement, but also owners and taxpayers who want to avoid substantial costs and reduce the time needed to resolve losses.

Two hypotheses dominate the literature on bank failure: the "Weak Fundamentals Hypothesis" (WFH) and the "Liquidity Shortage Hypothesis" (LSH). Under the WFH, poor bank fundamentals foreshadow an impending bank failure. CAMELS proxies are often used in early warning systems, with decaying capital ratios, reduced liquidity, deteriorating loan quality, and depleted earnings are signaling a rising likelihood of bank failure. Whereas bank failures are information-based under the WFH, the LSH supposes that bank fragility stems from irrational behavior of uninformed depositors who are incapable of distinguishing between liquidity and solvency shocks. Under the LSH, banks are assumed to be solvent, but because they finance illiquid assets with liquid liabilities, they are exposed to external shocks that may lead to liquidity shortages. Under a sequential servicing constraint, first-in-line depositors expect to receive all their deposits and the probability of failure rises as the bank's ability to meet deposit withdrawals declines.

The literature on bank failures generally treats fragility from the perspective of asset risk (WFH) or liability risk (LSH) separately. We suggest that the interaction between asset and liability risk could additionally be a driver of bank failure. Following the tradition of Meyer and Pifer (1970) in which financial measure trends are used to discriminate between viable and failing banks, we develop a novel hypothesis on the source of bank distress. We capture the connectedness of asset and liability risk through a comprehensive measure of liquidity creation which, according to the financial intermediation literature, is one of the primary functions of banks. Indeed, banks can create liquidity on their balance sheets by financing relatively illiquid assets with relatively liquid liabilities (Bryant, 1980; Diamond and Dybvig, 1983) or off their balance sheets through loan commitments and other liquidity claims (Kashyap, Rajan, and Stein, 2002). In our view, bank failure can be explained in certain instances as the result of a bank engaging excessively in its role as a liquidity creator. We propose the "Excessive Liquidity Creation Hypothesis" (ELCH) to explain bank failures, augmenting the WFH - which identifies banks with weak fundamentals- and the LSH – which focuses on the inability of banks to meet liquidity commitments.

The ELCH says that the probability of a bank's failure increases with a proliferation of the bank's core output in the form of excessive liquidity creation.

The ELCH has theoretical and empirical foundations. On the theoretical side, Diamond and Rajan (2000, 2001, 2002) argue that the activities of transforming illiquid assets into more liquid demand deposits are fundamentally incompatible and can only prevail in the presence of financial fragility. The model by Allen and Gale (2004) further shows that the role of financial intermediaries as risk transformers and liquidity creators exposes them to risk of failure. When the bank creates liquidity, the likelihood of distress increases and the severity of losses is exacerbated as assets are liquidated to meet liquidity demands. Allen and Gale (2004) even justify regulating bank liquidity provision in the system.[1]

Recent empirical work also suggests that the liquidity creation activity of banks is inextricably coupled with increased exposure to risk. Indeed, liquidity creation expands as a bank sells long-term illiquid loans and is reduced when the bank invests in short-term government bonds (Berger and Bouwman, 2009). However, the risks associated with financing a long-term illiquid loan are generally more pronounced than the risk of investing in short-term government securities. Not only does liquidity creation elevate bank exposure to risk, but Berger and Bouwman (2011) also report that it tends to be high prior to financial crises in the U.S. They propose that curbing liquidity creation may be desirable to contain build-ups in system-wide fragility.

None of the WFH, LSH, or ELCH hypotheses fully define the universe of bank fragility, but identifying the causes of bank failures is important in setting the regulatory agenda. The WFH stresses prudential macroeconomic policies that promote bank stability and limit moral hazard incentives. The LSH addresses confidence-building assistance mechanisms to reduce the depositors' incentives for bank runs (deposit insurance, central bank lender-of-last-resort actions, and government bailouts). The ELCH considers the conditions in which heightened monitoring of liquidity creation in the system is warranted. The sooner a bank is identified as an excessive liquidity creator, the more prompt regulatory action can bring this core activity back to acceptable levels, and thereby reduce the likelihood of failure and potential taxpayer losses.

[1] In contrast, Williamson (1988) argues government intervention may not be warranted even of liquidity provision leads to bank failure.

Russia's banking system provides a natural field experiment to test our ELCH. Over 200 banks failed in Russia between 2000 and 2007 and many of the failures were unrelated to the business cycle. Furthermore, the availability of a rich panel dataset on all banks allows for the measurement of liquidity creation following the methodology of Berger and Bouwman (2009), which requires detailed bank-level data. The quarterly frequency of data enables precise tracking of early developments that lead to the failure of banks. Considering all banks in the system ensures against a selection bias.

To gauge the impact of excessive liquidity creation on the probability of bank failures, we perform logit regressions with bank random effects. We account for excessive liquidity creation with dummy variables based on different thresholds for liquidity creation in a given quarter. Our findings confirm our hypothesis that excessive liquidity creation increases the probability of bank failures, and they are robust to several validity checks. Rather than suggesting a cut-off rate for excessive liquidity creation, we propose a screening procedure for financial intermediaries based on ranking in terms of liquidity creation in the system. The identification of excessive liquidity creators allows regulators target enhanced oversight measures to reduce the number of failures and strengthen incumbent institutions.

The rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 presents the data and the methodology. Section 4 discusses the results. Section 5 concludes.

2 Literature review

We group the extant literature on bank failures under the WFH and the LSH. Broadly speaking, the WFH says banks that fail are ex-ante weaker and have less solid fundamentals than banks that do not fail. Key indicators of impending failure are deteriorating levels of capital adequacy, drying up of liquidity, worsening asset quality, and falling profitability. Two seminal papers deserve mention. Meyer and Pifer (1970) apply a set of financial ratios to predict the likelihood of bank failures. Rolnick and Weber (1984) find that banks with weak fundamentals are disciplined by markets because they fail when market conditions deteriorate and asset prices fall. After US regulators introduced CAMELS ratings to assess bank conditions, a number of scholars used traditional proxies for their components to develop early warning systems. These studies include Avery and Hanweck (1984),

Whalen (1991), Thompson (1991, 1992), Cole and Gunther (1995), Wheelock and Wilson (2000), DeYoung (2003), and Oshinsky and Olin (2005). Research concerning emerging markets also finds that weak bank fundamentals significantly affect the likelihood of failure.[2]

Other studies in the WFH literature focus on particular fundamentals that might predict bank failure. Estrella, Park, and Peristiani (2000) advocate the use of simple and informative measures of capital adequacy such as leverage and the ratio of capital to gross revenues to predict subsequent bank failures. Wheelock and Wilson (2000) make three observations: managerial inefficiency increases the likelihood of bank failure, inefficient banks are less likely to be acquired, and banks close to insolvency are more likely to be acquired. DeYoung (2003) shows that the number of bank failures increases with operational cost inefficiencies for both established and *de novo* banks.

There has been a resurgence of interest in predicting bank failures using bank fundamentals in the wake of the recent global financial crisis. Torna (2010) attributes the underlying causes of deterioration in bank condition and subsequent failures to specific nontraditional banking (modern banking) activities such as investment banking, insurance, securitization, derivatives trading, and venture capital practices. Aubuchon and Wheelock (2010) assess the importance of regional economic characteristics in driving bank failures rather than using bank-specific characteristics. Ng and Roychowdhury (2010) report that additions to loan loss reserves positively relate to subsequent bank failures. Cole and White (2012) revisit traditional proxies for the CAMELS ratings, finding that they do a good job in explaining bank failures and that the most significant predictor is commercial real estate investment.

Unlike the WFH, the LSH attributes bank failures to a liquidity shortage shock that impairs the ability of banks to meet contractual debt obligations. When there is a shock to the real economy, the financing of illiquid assets with liquid liabilities can lead to a liquidity shortage that forces banks to curtail credit (Diamond and Rajan, 2001). In a review of the theory and history of banking crises, Calomiris (2007) identifies panic and fundamentalist views to explain the causes of liquidity shortages that lead to bank failures during events of contagion. Under the panic view, banks fail during fear-driven runs; the liquidity

[2] See Arena (2008) for evidence from Latin America and East Asia; Lanine and Vander Vennet (2006) and Claeys and Schoors (2007) for Russia; Molina (2002) for Venezuela; and Ozkan-Gunay and Ozkan (2007) for Turkey.

shortage is caused by unwarranted deposit withdrawals that are unrelated to bank solvency. Under the fundamentalist view, banks fail during crises following an exogenous adverse change in economic conditions. Fundamental losses to bank borrowers lead to endogenous contractions of deposits and loans and they curb the supply of money and credit, which, in turn, produces a liquidity shortage.

A large body of evidence supports the LSH, whether the liquidity shortage stems from unwarranted deposit withdrawals or from weakened bank fundamentals. Early evidence from the Great Depression by Friedman and Schwartz (1963) suggests that bank failures result from unwarranted panic and that failing banks tend to be more illiquid than insolvent. Panics are attributed to "mob psychology" or "mass hysteria" (Kindleberger, 1978). In the conceptual framework of Diamond and Dybvig (1983), banks finance illiquid assets with demandable debts and face a first-come-first-served constraint. This leads Postlewaite and Vives (1987) to conclude that bank runs are self-fulfilling prophecies. In a recent study, Vazquez and Federico (2012) provide empirical evidence on the link between liquidity shortage and probability of failure for a bank during the global financial crisis. The authors measure liquidity by the net stable funding ratio defined in the proposed Basel III reform. They observe that banks characterized by weaker liquidity in the pre-crisis period were more likely to fail during the crisis.

Liquidity shortages can also unfold following an economic downturn that reduces the value of bank assets. As the likelihood of the bank not meeting its commitments increases, depositors exert pressure and withdraw their funds. Under the fundamentalist view, bank failures are a rational response to an unfolding economic recession (Gorton, 1988). Calomiris and Gorton (1991) point out that 19th century banking crises were predicted by leading economic indicators. Calomiris and Mason (2003) contend that most bank failures during the Depression can be explained by weakened fundamentals from holding relatively illiquid and low-quality assets, as well as little capital.

A number of authors have modeled banking panics as an aggregate uncertainty risk that results from business-cycle risk (Jacklin and Bhattacharya, 1988; Hellwig, 1994; and Alonso, 1996), and which is heightened when liquidity needs are high (Chari and Jagannathan, 1988). Allen and Gale's (1998) model assumes that depositors can observe a leading economic indicator that correlates with future asset returns, consistent with the business cycle view of bank panics. Fundamental shocks are also the driver of financial crises in Allen and Gale's (2004) general equilibrium framework for understanding crises.

In addition to weak fundamentals that undermine bank solvency, the WFH can apply to a liquidity shortage shock that may lead to individual and systemic bank failures, because liquidity (or the lack thereof) serves as a channel through which contagion is spread from bank to bank (Allen and Gale, 2004). A drop in liquidity creation at banks reduces credit supply and can lead to economic recessions (Bernanke, 1983; Peek and Rosengren, 2000). Liquidity shocks can also result in contagion and a systemic meltdown (Diamond and Rajan, 2005), as well as severe distributional effects across large and small firms in the economy (Khwaja and Mian, 2008).[3]

Just as a liquidity shortage can have serious implications for a bank's survival, excess liquidity creation may have severe repercussions. Diamond and Rajan (2000, 2001, 2002) note that financial fragility is a driver for bank liquidity creation, suggesting that bank failures are more likely to occur when the level of liquidity creation is high. As liquidity creation increases, banks are forced to dispose of their illiquid assets to meet depositor withdrawals, thereby raising the risk of failures when assets are insufficient to meet non-contingent commitments (Allen and Gale, 2004).

Berger and Bouwman (2009) develop a measure of bank liquidity creation and show that this comprehensive measure of bank output in the US increased substantially between 1993 and 2003. In contrasting the characteristics of the top 25% and bottom 25% liquidity creators among large, medium, and small banks, they find that multi-bank holding companies tend to create the most liquidity, that retail banks create far less liquidity per dollar of assets or equity, and that wholesale banks tend to be low liquidity creators. Banks engaged in mergers and acquisition (M&A) activity also tend to create more liquidity than banks with no M&A activity. In a follow-up study, Berger and Bouwman (2011) investigate whether high aggregate bank liquidity creation is a good predictor of a financial crisis. They find that high levels of liquidity creation are a better indicator of crises than GDP, the federal funds rate, or stock market returns. Here, we propose that individual – not just aggregate – bank liquidity creation may have incremental explanatory power in predicting bank failures, even after controlling for the macroeconomic environment.

The intuition that excessive liquidity creation may be detrimental to bank stability is mentioned in the literature on banking crises where private credit is taken as a proxy for liquidity creation. For example, Cottarelli, Dell'Ariccia, and Vladkove (2005) find that the

[3] In the empirical section, we assess whether liquidity shortages affect the probability of a bank failure.

ratio of credit to GDP increases by 5 to 10 percentage points prior to banking crises. Studies by Demirgüç-Kunt and Detragiache (1998), Drees and Pazarbasioglu (1998), and Kaminsky and Reinhart (1999) similarly establish that credit expansion to the private sector usually precedes banking crises.

3 Data description and methodology

3.1 Data

We use bank-level financial statement data for Russian banks from Interfax, a financial information agency that collects and organizes data from the Central Bank of Russia (CBR).[4] This rich dataset has several advantages. First, it provides data on all banks in Russia, and thus avoids the selection bias problem. Second, the quarterly data provide an opportunity to track developments preceding bank failures with reasonable precision. Finally, the dataset contains the detailed financial information necessary for the calculation of liquidity creation measures. The breakdown of loan portfolios enables us distinguish between corporate, household, and government loans; deposits are classified by type; securities portfolios are reported by asset classes; and there is detailed information on the maturity of all liabilities.

The original data feature an unbalanced panel for the period starting from the first quarter of 1999 and running to the fourth quarter of 2009. For our analysis, however, we only use the data covering the period between 2000 and 2007 to exclude possible contamination from bank failures stemming from the Russia's 1998 financial crisis and the global financial crisis.[5] Our goal is to identify bank failures that occur in "normal" economic times, i.e. when the system is not otherwise subject to a major shock but has seen a proliferation in the production of the bank's main output.

To make sure that we consider deposit-taking institutions only, we apply a series of filters on our dataset. First, we drop observations for which the ratio of total loans to total assets is lower than 5%. Second, we exclude observations for which the sum of all de-

[4] For a more detailed description of the dataset, see Karas and Schoors (2005).
[5] Despite the fact that Russian banks were not directly exposed to the financial instruments that triggered the global financial turmoil, both the banking sector and the economy as a whole were hit by the crisis in the second half of 2008 due to a sudden lack of access to foreign financing and a significant drop in the price of oil. In September 2008, the Russian government and the Central Bank of Russia began to implement a wide variety of measures to support the stability of the financial system.

posits equals to 0. Finally, we drop observations where the capital-to-assets ratio is larger than 100%. Our final sample includes over 33,000 bank-quarter observations.

We also augment the main dataset using other information. The CBR's list of failed banks indentifies roughly 230 failed institutions distributed over the whole period of study.[6] We also hand-collect data on the location of banks and their branches from the CBR website. We use this information to control for the regional characteristics of the environments in which banks operate using data from the Russian Federal State Statistics Service (Rosstat).

3.2 Liquidity creation measures

Following the three-step procedure developed by Berger and Bouwman (2009) to construct measures of liquidity creation for Russian banks, we classify bank activities as liquid, semi-liquid or illiquid.[7] We consider all items included under assets, liabilities, and capital, and make our classification based on the ease, cost, and time necessary for banks (customers) to turn their obligations into liquid funds (withdraw funds), taking into account Russian-specific factors, e.g. active trading in certain securities.

We next assign weights to all balance sheet items. In line with financial intermediation theory that banks create liquidity by transforming illiquid assets to liquid liabilities, we apply positive weights to these two balance sheet categories. We also assign negative weights to liquid assets, illiquid liabilities, and capital, since bank liquidity creation is destroyed if illiquid liabilities are used to finance liquid assets.

Equation 1 shows the functional form used to measure bank liquidity creation.

$$\textit{liquidity creation} = \{\tfrac{1}{2} \times \textit{illiquid assets} + 0 \times \textit{semi-liquid assets} - \tfrac{1}{2} \times \textit{liquid assets}\} + \{\tfrac{1}{2} \times \textit{liquid liabilities} + 0 \times \textit{semi-liquid liabilities} - \tfrac{1}{2} \times \textit{illiquid liabilities}\} - \tfrac{1}{2} \times \textit{capital} \quad (1)$$

We construct two measures of liquidity creation (LC) from Eq. 1, using two definitions for each of the right-hand-side terms. The first liquidity creation measure, LC1, is based on a category classification of balance sheet items. The second measure, LC2, is a liquidity creation measure that rests on a maturity classification of bank activities. Table 1 provides

[6] The last column of Table 2 provides the breakdown of the number of bank failures by quarter.
[7] Unlike Berger and Bouwman (2009), we do not consider off-balance sheet items. For most of the sample period, off-balance sheet activities are insignificant in Russia.

a detailed description of balance sheet items used to calculate our two liquidity creation measures, their classification according to categories and maturities, and the weights assigned to each grouping.

Table 1 Liquidity creation measures

LC1: CATEGORY MEASURE	**Illiquid assets (1/2)**	**Semi-liquid assets (0)**	**Liquid assets (-1/2)**
	Loans to firms	Interbank loans	Correspondent accounts with other banks
	Other assets	Loans to government	Government securities (incl. securities issued by regions and municipalities)
		Loans to individuals	Investments in promissory notes
	Liquid liabilities (1/2)	**Semi-liquid liabilities (0)**	**Illiquid liabilities and capital (-1/2)**
	Debt securities issued (promissory notes)	Debt securities issued (deposit and saving certificates, bonds)	Other liabilities
	Claims of non-bank sector: settlement accounts (firms, households, government)	Claims of non-bank sector: term deposits accounts (firms, households, government)	Capital
	Claims of banks		
LC2: MATURITY MEASURE	**Illiquid assets (1/2)**	**Semi-liquid assets (0)**	**Liquid assets (-1/2)**
	Interbank loans (maturity more than 1 year)	Interbank loans (maturity more than a week and less than 1 year)	Interbank loans (maturity less than a week)
	Loans to firms	Loans to government	Correspondent accounts with other banks
	Other assets	Loans to individuals	Government securities (incl. securities issued by regions and municipalities)
			Investments in promissory notes
	Liquid liabilities (1/2)	**Semi-liquid liabilities (0)**	**Illiquid liabilities and capital (-1/2)**
	Liabilities with maturity lower than 90 days	Liabilities (term deposits and debt securities) with maturity less than 1 year	Liabilities (term deposits, debt securities) with maturity more than 1 year and overdue liabilities and liabilities with uncertain term to maturity
	Current and corresponding accounts		Capital

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). LC1 denotes the category-based liquidity creation measure, where bank activities are classified based on different categories. LC2 is the maturity-based liquidity creation measure, and it rests on a category as well as maturity classification for interbank loans and all liabilities.

For LC1, the liquid assets category consists of (a) correspondent accounts with other banks (i.e. central bank, domestic, and foreign banks) (b) investments in government securities,

and (c) investments in promissory notes. We do not consider investments in non-government securities as their values are quite low for most of the observation period.[8]

In examining loans, we follow the literature and consider corporate loans as illiquid assets since banks generally lack the option of selling them to meet liquidity needs. We classify other types of loans as semi-liquid assets, including consumer loans, loans to the government, and interbank loans. As mortgage lending is quite a recent phenomenon in Russia, the majority of consumer loans here are short-term loans to buy consumer goods. We view consumer loans as semi-liquid following the idea that items with shorter maturity tend to be more liquid than longer-term items, notwithstanding rare loan securitization in Russia. All other assets (calculated as the difference between total assets and the sum of all loans and liquid assets) include fixed assets and are regarded as illiquid items.

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, claims of the non-banking sector are of two types. The first category includes the settlement accounts of clients (domestic and foreign firms, government, and households). These are classified as liquid because customers can easily withdraw these funds without penalty. The second category of claims of non-banking sector contains term deposits classified as semi-liquid because it may be difficult or costly to withdraw them immediately. The final liabilities category, debt securities issued by banks, consists of promissory notes, deposit and saving certificates, and bonds. Since Russia has liquid markets for promissory notes, we classify these instruments as liquid liabilities. Markets for deposit and savings certificates, as well as bonds, have only emerged in recent years. Issuance of these instruments is insignificant in our sample period, so we categorize these as semi-liquid liabilities. Following the same logic as on the asset side of the balance sheet, we calculate other liabilities as the difference between total liabilities and the sum of all of the above-mentioned claims and view them as illiquid items, similar to the treatment of bank capital.

Careful examination of the balance sheet information of Russian banks shows a more detailed breakdown of the reporting of some items based on maturity. Maturity-based

[8] Russia's capital markets are still too illiquid for banks to invest in non-government securities. Unlike government securities, banks also have little incentive to hold these securities as they cannot be used as collateral when borrowing from the CBR. Finally, data on investments in non-government securities is only available starting from 2004, i.e. several years into the observation period. Even so, we went ahead and recalculated two liquidity creation measures using this data. The results showed trends in line with those of LC1 and LC2.

information provides us with important additional information to define liquidity creation in a more precise manner and construct our second liquidity creation measure, LC2. On the asset side, the maturity breakdown is available for interbank loans only. Thus, we classify all assets other than interbank loans as in LC1. Next, we group interbank loans with a maturity of less than one week in the category of liquid assets, interbank loans with a maturity of more than one year and nonperforming interbank loans are treated as illiquid, and all other interbank loans are labeled as semi-liquid assets.

The classification of liabilities for the LC2 calculation is based solely on maturity. We apply the general principle that items of shorter maturity are more liquid than longer term liabilities. The liquid liabilities category includes term deposits and debt securities with maturities shorter than 90 days, as well as current and correspondent accounts. Liabilities with maturities between 90 days and one year fall into the semi-liquid category, and liabilities with maturities over a year, overdue liabilities, and liabilities with uncertain terms to maturity are classified as illiquid. Like with LC1, we treat bank capital as an illiquid portion of the balance sheet. Both liquidity creation measures, LC1 and LC2, are normalized by total assets for better comparability across banks and to avoid attributing excessive liquidity creation weight for large banks.

3.3 Methodology

We examine the distribution of the liquidity creation measures in each quarter and generate a series of dummy variables corresponding to four segments of the upper and lower tails of their distribution to account for excessive and extremely low liquidity creation. Our aim here is to capture both excessive liquidity creation and shortages in liquidity creation.

The dummy variables *LC_80-85%*, *LC_85-90%*, *LC_90-95%*, and *LC_Top5* are equal to 1 if the liquidity creation measure in a given quarter ranges between the 80^{th} and 85^{th} percentile, between the 85^{th} and 90^{th} percentile, between the 90^{th} and 95^{th} percentile, and above the 95^{th} percentile, respectively. The dummy variables *LC_15-20%*, *LC_10-15%*, *LC_5-10%*, and *LC_Bottom5* are equal to 1 if the liquidity creation measure in a given quarter falls between the 15^{th} and 20^{th} percentile, between the 10^{th} and 15^{th} percentile, between the 5^{th} and 10^{th} percentile, and below the 5^{th} percentile, respectively.

To gauge the impact of different levels of liquidity creation on the probability of bank failures and test the ELCH, we implement a panel logit model under the random ef-

fect assumption. We estimate a bank-level model in which the dependent variable is a dummy variable equal to 1 if the bank's license is withdrawn in a given quarter and 0 otherwise. Bank failure is defined as the official closure of a bank when it is declared as no longer viable and its license is withdrawn. This definition of bank failures is in line with prior studies on the determinants of bank failures in Russia (e.g. Claeys and Schoors, 2007; Fungáčová and Weill, 2009).

In addition to our primary explanatory variable expressed in terms of different levels of liquidity creation, we also consider bank-specific control variables common in bank failure literature, as well as control variables related to the local market environment in which a particular bank operates. At the bank level, we control for size measured by the logarithm of total assets (*Size*) and for bank profitability proxied by return on assets (*ROA*). The scale of operations may influence the probability of failure as it affects their ability to diversify the loan portfolios (Calomiris and Mason, 2000), so we expect the sign on the estimated coefficient of *Size* to be negative. The "too big to fail" thesis supports this expectation and conforms with the view that larger banks are more likely to receive the support of the government and not fail. As for bank profitability, the WFH predicts that weak bank performance to be a major determinant of bank failure. By considering profitability as an ex-ante measure of asset risk (Arena, 2008), we expect a negative association between the probability of bank failure and *ROA.*

About half of Russian banks are headquartered in Moscow. The rest are geographically spread throughout the country. Our region-level variables take into account the local macroeconomic environment of the regions in which each bank operates. We assign banks to particular regions based on the location of their headquarters and branch activities. Given that we do not have information regarding the operations associated with each branch, we use the distribution of branch offices as a proxy for bank output in a given region. Each of the regional variables for a given bank is thus calculated as a weighted average of the regional variable's value for the regions in which a bank operates, using the distribution of branch offices in particular regions as weights. For the regional variable *Household Income Growth,* household income is defined as regional household income per capita. For *Small Business Growth,* small business is proxied by the number of small and medium-sized enterprises (SMEs) in a given region multiplied by the average number of employees that SMEs have in that region. We expect a negative relation between each of the regional variables and the probability of bank failure as a more favorable macroeco-

nomic environment is expected to foster bank activity and enhance financial stability. We additionally consider local market concentration in the robustness checks.

4 Results

Table 2 summarizes the quarterly evolution of LC1 and LC2 normalized by total assets.

Table 2 Development of the Main Variables

	Obs.	LC1/assets (mean in %)	LC2/assets (mean in %)	Size	Number of failures
2000q1	1214	20.91	17.50	1 280.7	14
2000q2	1222	21.30	17.89	1 389.5	7
2000q3	1227	22.49	18.84	1 597.7	9
2000q4	1218	21.63	18.23	1 739.4	8
2001q1	1217	23.64	19.83	1 882.7	3
2001q2	1223	23.44	19.71	2 031.5	6
2001q3	1219	24.37	20.51	2 207.4	8
2001q4	1227	23.70	20.03	2 348.0	6
2002q1	1149	25.38	20.60	2 605.7	5
2002q2	1227	25.72	21.01	2 658.8	8
2002q3	1235	25.96	21.10	2 786.1	5
2002q4	1231	25.53	20.54	3 074.9	6
2003q1	1228	26.27	21.42	3 349.4	3
2003q2	1233	26.08	21.04	3 630.7	5
2003q3	1229	27.04	21.21	3 920.2	5
2003q4	1234	25.22	20.04	4 196.0	5
2004q1	1238	26.34	19.94	4 436.6	3
2004q2	1225	28.12	20.72	4 664.4	4
2004q3	1208	26.16	18.19	4 951.8	10
2004q4	1198	25.01	18.80	5 488.3	12
2005q1	1197	26.02	18.21	5 886.5	11
2005q2	1191	26.89	18.41	6 429.5	5
2005q3	1175	26.65	17.68	7 059.0	19
2005q4	1163	25.27	17.43	7 803.9	6
2006q1	845	30.35	18.39	11 127.6	7
2006q2	850	30.11	18.82	12 175.8	14
2006q3	934	29.35	18.41	12 060.9	12
2006q4	984	28.05	19.11	13 171.9	9
2007q1	996	29.59	18.74	14 435.8	3
2007q2	995	29.69	18.96	16 026.3	4
2007q3	987	30.56	19.40	17 020.2	7
2007q4	983	28.60	18.63	19 276.4	4

This table presents the development of the main variables employed in our analysis. As explained in Table 1, *LC1* and *LC2* are the category and maturity liquidity creation measures, respectively. They are expressed as proportion of total assets. *Size* denotes total assets in millions of rubles. We also report the number of failed banks that occurred in every quarter by considering those failed banks for which data are available four quarters before the failure.

Between 2000 and 2007, LC1 is consistently larger than LC2, exhibiting an upward trend from 22 to 30 percent of assets whereas LC2 hovers around 18 to 21 percent of assets. LC1 also exhibits more volatility than LC2, which is relatively more stable over the sample pe-

riod. The growth in both LC ratios results from increasing levels of liquidity creation throughout the sample period at a time where total bank assets are also rising.

We next present the results of multivariate logit regressions.

4.1 Regression results

In all of the logit regressions, we show the results using the top and bottom percentile ranges for both LC1 and LC2 ratios across four lags (one lag for each of the four quarters preceding a bank failure). We present the results of the baseline models in Table 3.

The figures in Table 3 indicate that the coefficient estimate of *LC_Top5* is positive and significant at the 1% level across all quarters preceding bank failure and using both measures of liquidity creation. The findings suggest that banks with liquidity creation ratios exceeding the 95^{th} percentile of the liquidity creation distribution in the system in all four quarters prior to failure are more likely to fail compared to banks with more moderate levels of liquidity creation. This estimation result lends strong support to the hypothesis that excessive liquidity creation increases the probability of bank failure. We also observe some other positive and significant coefficients for *LC_85-90%* and *LC_90-95%*. In line with the theoretical work of Allen and Gale (2004) and the empirical evidence from the US (Berger and Bouwman, 2011), the likelihood of bank distress increases when the financing of liquid liabilities with illiquid assets proliferates. The more liquidity banks create, the greater the likelihood of failure. Indeed when financial intermediaries carry a larger share of illiquid loans on their balance sheets, they become more sensitive to liquidity risk; and similarly, when the deposit share in total liabilities increases, banks become more vulnerable to bank runs. Thus, the problem of high liquidity creation ratios might originate from an excessive concentration on either or both sides of a bank's balance sheet. As the bank becomes more focused on its core liquidity creation activity, a detrimental process emerges that increases the probability of failure and may eventually reduce the common pool of liquidity creation in the economy.

Table 3 Liquidity Creation and Bank Failures: Baseline Model

	LC1/Assets				LC2/Assets			
	Quarters before failure							
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
LC_Bottom5	1.002***	0.766***	0.570**	0.522*	1.153***	0.859***	0.485*	0.453
	[3.97]	[3.15]	[2.21]	[1.92]	[4.55]	[3.54]	[1.74]	[1.58]
LC_5-10%	0.054	-0.497	0.426	0.447	0.529	-0.109	0.165	0.207
	[0.14]	[1.18]	[1.58]	[1.61]	[1.63]	[0.30]	[0.52]	[0.65]
LC_10-15%	-0.618	0.341	-0.346	0.183	-0.253	0.295	0.075	0.502*
	[1.23]	[1.19]	[0.92]	[0.60]	[0.55]	[0.96]	[0.22]	[1.81]
LC_15-20%	0.079	-0.675	-0.157	-0.350	-0.084	-0.591	0.471*	-0.143
	[0.21]	[1.47]	[0.45]	[0.90]	[0.20]	[1.29]	[1.70]	[0.39]
LC_80-85%	-0.192	-0.167	-0.131	-0.249	0.295	-0.172	-0.095	-0.578
	[0.42]	[0.43]	[0.36]	[0.64]	[0.79]	[0.44]	[0.26]	[1.26]
LC_85-90%	0.515	-0.152	0.100	0.223	0.713**	0.366	0.226	0.663**
	[1.52]	[0.39]	[0.30]	[0.70]	[2.28]	[1.20]	[0.71]	[2.53]
LC_90-95%	0.560*	0.127	0.129	0.835***	-0.086	0.230	0.493*	0.430
	[1.66]	[0.36]	[0.39]	[3.39]	[0.20]	[0.72]	[1.78]	[1.50]
LC_Top5	1.714***	1.493***	1.104***	1.096***	1.770***	1.344***	1.148***	1.373***
	[7.95]	[7.37]	[4.91]	[4.79]	[8.59]	[6.54]	[5.29]	[6.84]
Size	-0.195***	-0.176***	-0.153***	-0.123***	-0.163***	-0.155***	-0.144***	-0.106***
	[4.77]	[4.64]	[4.13]	[3.38]	[4.00]	[4.13]	[3.94]	[2.94]
ROA	-5.283***	-3.965***	-3.559***	-4.123***	-5.431***	-4.235***	-3.401***	-4.091***
	[6.84]	[4.04]	[3.57]	[3.84]	[6.74]	[4.20]	[3.46]	[3.77]
Small business growth	-0.111	-0.080	-0.063	-0.011	-0.117	-0.084	-0.067	-0.017
	[0.64]	[0.58]	[0.46]	[0.10]	[0.66]	[0.59]	[0.49]	[0.16]
Household income growth	-0.014***	-0.010**	-0.017***	-0.007*	-0.013***	-0.010**	-0.016***	-0.007*
	[2.75]	[2.20]	[4.06]	[1.77]	[2.62]	[2.07]	[4.03]	[1.70]
Constant	-2.645***	-2.930***	-2.143***	-3.553***	-3.007***	-3.152***	-2.273***	-3.721***
	[3.72]	[4.42]	[3.59]	[5.81]	[4.27]	[4.74]	[3.81]	[6.07]
Observations	35287	34966	34748	34586	35287	34966	34748	34586
Number of banks	1386	1385	1386	1385	1386	1385	1386	1385
LogLikelihood	-1072.677	-1250.062	-1316.295	-1339.396	-1068.246	-1255.674	-1316.477	-1331.950

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when the bank's license is revoked and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; and *Household Income Growth* is the growth in regional household income per capita. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Dummy variables for quarters and years are included in the regressions, but not reported.

In parallel, the estimated coefficient of the lowest liquidity creators in the system, *LC_Bottom5*, is positive and significant. This suggests that shortages in liquidity creation

may also be associated with a greater probability of failure, i.e. banks with very low liquidity creation ratios are also prone to fail. This finding is not so surprising at second glance. The *raison d'être* of banks is liquidity creation for the economy, so the inability to perform this function likely signals trouble.[9] Alternatively, it could be that banks with low liquidity creation ratios rely less on core funding and more on volatile non-deposit long-term sources of funds such as bonds or syndicated loans. While reduced reliance on deposit funding makes a bank less sensitive to bank runs, the large share of alternative sources of financing may increase the bank's exposure to sudden reductions in access to funding and thereby increase the risk of failure (Hahm, Shin, and Shin, 2011). Further, shortages in liquidity creation may stem from a smaller concentration in loans and a larger share in other investments, making the bank more sensitive to market risk.

The control variables that enter our baseline specification are all of the expected sign in corroboration with the former literature (e.g. Arena, 2008). We observe a negative and significant sign for *Size* and *ROA* in all estimations. Larger banks have a lower probability of failure, probably because they are either too big to fail or they may have highly diversified loan portfolios and investments. The negative and significant sign on *ROA* indicates that banks with strong fundamentals are less likely to fail, a finding that accords with the predictions of the WFH and the fact that their higher charter value likely precludes excessive risk-taking.

Finally, in line with our expectations, the signs on the estimated coefficients of the regional macroeconomic variables, small business growth and household income growth, are negative. They are also consistently significant for the latter variable. These findings confirm that a prosperous macroeconomic environment enhances the financial situation of banks by reducing loan losses and increasing the demand for financial services (Jimenez and Saurina, 2006). The fact that household income growth plays a greater role in preserving bank stability than small business growth suggests that Russian banks are more sensitive to the financial situation facing households than SMEs.

4.2 Alternative estimations

We perform a series of alternative estimations to test the sensitivity of our results to alternative specifications.

[9] Liquidity shortages can also induce to a systemic contagion of failures (Diamond and Rajan, 2005).

Table 4 Liquidity Creation and Bank Failures: Longer Lags

	LC1/Assets				LC2/Assets			
	Months before failure							
	15 months	18 months	21 months	24 months	15 months	18 months	21 months	24 months
LC_Bottom5	0.816***	0.848***	1.069***	0.520*	0.907***	0.800***	1.142***	0.367
	[3.15]	[3.36]	[4.37]	[1.68]	[3.51]	[3.03]	[4.79]	[1.10]
LC_5-10%	0.362	0.155	0.434	0.434	-0.028	0.140	-0.014	0.110
	[1.18]	[0.47]	[1.41]	[1.41]	[0.08]	[0.42]	[0.04]	[0.31]
LC_10-15%	0.522*	0.340	0.662**	0.837***	0.488*	-0.136	0.166	0.655**
	[1.88]	[1.15]	[2.44]	[3.32]	[1.71]	[0.37]	[0.50]	[2.42]
LC_15-20%	-0.255	0.052	0.344	0.427	0.231	0.472*	0.793***	0.634**
	[0.65]	[0.16]	[1.12]	[1.44]	[0.73]	[1.71]	[3.16]	[2.35]
LC_80-85%	0.092	-0.101	0.007	-1.101*	0.290	-0.343	-0.838	-0.025
	[0.28]	[0.29]	[0.02]	[1.88]	[0.95]	[0.88]	[1.64]	[0.07]
LC_85-90%	0.649**	-0.326	0.475*	-0.230	-0.393	0.215	-0.002	-0.589
	[2.46]	[0.83]	[1.65]	[0.59]	[0.94]	[0.71]	[0.01]	[1.28]
LC_90-95%	0.017	0.379	0.138	0.536*	0.438	0.112	0.428	0.431
	[0.05]	[1.32]	[0.41]	[1.92]	[1.54]	[0.35]	[1.50]	[1.51]
LC_Top5	0.829***	0.738***	0.756***	0.978***	1.049***	0.735***	0.889***	0.854***
	[3.17]	[2.83]	[2.77]	[3.94]	[4.58]	[2.93]	[3.62]	[3.41]
Size	-0.035	-0.004	-0.002	0.007	-0.026	-0.002	0.001	0.006
	[0.91]	[0.11]	[0.04]	[0.18]	[0.67]	[0.04]	[0.02]	[0.15]
ROA	-3.355**	-3.521**	-1.575	-0.882	-3.324**	-3.640**	-1.556	-1.007
	[2.27]	[2.43]	[0.78]	[0.40]	[2.27]	[2.52]	[0.78]	[0.44]
Small business growth	-0.058	-0.089	0.016	0.077	-0.062	-0.090	0.015	0.079
	[0.42]	[0.57]	[0.18]	[1.36]	[0.44]	[0.57]	[0.16]	[1.40]
Household income growth	-0.006	-0.004	-0.007*	-0.008*	-0.006	-0.004	-0.007*	-0.008*
	[1.34]	[1.05]	[1.66]	[1.81]	[1.31]	[1.03]	[1.65]	[1.81]
Constant	-4.184***	-4.417***	-4.180***	-4.116***	-4.260***	-4.437***	-4.161***	-4.073***
	[6.47]	[6.78]	[6.46]	[6.38]	[6.57]	[6.82]	[6.43]	[6.29]
Observations	31310	30280	29291	28279	31310	30280	29291	28279
Number of banks	1311	1294	1280	1267	1311	1294	1280	1267
LogLikelihood	-1275.407	-1275.440	-1261.489	-1209.891	-1271.945	-1275.870	-1254.357	-1215.736

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when the bank's license is revoked and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; and *Household Income Growth* is the growth in regional household income per capita. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Dummy variables for quarters and years are included in the regressions, but not reported.

In the first robustness check, we include longer time lags in our baseline model, considering time horizons prior to failure of 15, 18, 21, and 24 months to test whether our results are sensitive to the number of chosen lags chosen. This analysis is important as it provides information on the possible use of liquidity creation measures as early warning indicators. Considering longer time horizons also helps identify at an early stage whether the probability of failure of certain banks increases as a bank gets closer to failure. Table 4 displays the estimations results in line with our main findings. We find support for the ELCH as the sign of the estimated coefficient for *LC_Top5* is positive and significant across all estimations. We also show that the coefficient concerning *LC_Bottom5* is positive and significant in most estimations, pointing to a positive relation between liquidity shortage and the probability of bank failure. Overall, these estimations support the view that liquidity creation indicators can be used for early identification of impending bank failure.

In the second robustness check, we use an alternative definition of bank failure based on the level of the equity-to-assets ratio to allow for a better coverage of banks with solvency problems, since a decision to revoke a banking license may be influenced by non-economic concerns. For example, Brown and Dinç (2005) show that political considerations play a significant role in delaying government intervention to allow a bank to fail in emerging markets. In choosing an alternative definition of bank failure, we follow the approach of Wheelock and Wilson (2000) in their analysis of bank failure determinants in the US. The authors first consider banks closed by the FDIC (similar to our approach), and then apply an alternative definition of bank failure (a ratio of equity less goodwill to total assets below 2%). We use the same threshold and define failed banks in Russia as those institutions with a ratio of equity to total assets below 2%. Table 5 presents the estimations results using this alternative definition of failed banks.

Table 5 Liquidity Creation and Bank Failures: Alternative Measure of Failure

	LC1/Assets				LC2/Assets			
	Quarters before failure							
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
LC_Bottom5	0.190	0.645	0.930	0.400	-0.539	0.580	1.010*	0.168
	[0.25]	[1.02]	[1.46]	[0.53]	[0.52]	[0.93]	[1.83]	[0.23]
LC_5-10%	-0.449	-21.346	0.899	-20.627	-23.962	-22.546	0.289	-22.716
	[0.44]	[0.00]	[1.41]	[0.00]	[0.00]	[0.00]	[0.39]	[0.00]
LC_10-15%	-0.476	-0.486	-0.328	0.331	0.155	0.134	0.225	0.096
	[0.46]	[0.47]	[0.31]	[0.44]	[0.21]	[0.18]	[0.30]	[0.13]
LC_15-20%	-22.869	0.141	-0.318	0.704	0.583	0.133	-21.639	0.082
	[0.00]	[0.19]	[0.31]	[1.12]	[0.94]	[0.18]	[0.00]	[0.11]
LC_80-85%	0.415	-0.365	-0.230	0.744	-24.022	-22.290	0.190	0.441
	[0.55]	[0.35]	[0.22]	[1.18]	[0.00]	[0.00]	[0.26]	[0.72]
LC_85-90%	0.415	0.701	0.432	1.234**	0.881	0.104	-21.859	0.726
	[0.55]	[1.10]	[0.57]	[2.38]	[1.60]	[0.14]	[0.00]	[1.33]
LC_90-95%	1.400***	1.531***	2.075***	1.076*	0.865	0.990*	0.764	0.316
	[2.72]	[3.20]	[4.83]	[1.92]	[1.57]	[1.95]	[1.37]	[0.51]
LC_Top5	2.548***	2.011***	2.265***	2.142***	1.950***	1.702***	2.019***	1.485***
	[7.13]	[5.06]	[5.57]	[5.39]	[5.29]	[4.30]	[5.47]	[3.62]
Size	-0.157**	-0.116	-0.071	-0.027	-0.068	-0.049	-0.001	0.039
	[1.96]	[1.43]	[0.90]	[0.35]	[0.85]	[0.60]	[0.01]	[0.50]
ROA	-2.247***	-3.693***	-3.827**	-4.474***	-2.739***	-3.799***	-3.855**	-5.192***
	[2.85]	[2.97]	[2.16]	[3.01]	[3.46]	[3.08]	[2.39]	[3.63]
Small business growth	-0.749	-0.402	-0.430	-0.131	-0.783	-0.427	-0.485	-0.152
	[1.14]	[0.75]	[0.76]	[0.41]	[1.20]	[0.79]	[0.84]	[0.46]
Household income growth	0.028***	0.040***	0.041***	0.041***	0.028***	0.041***	0.041***	0.043***
	[3.01]	[5.52]	[6.88]	[7.08]	[3.19]	[5.72]	[7.13]	[7.39]
Constant	-9.81***	-11.76***	-12.39***	-12.62***	-10.164***	-12.105***	-12.6***	-12.93***
	[6.99]	[9.41]	[11.02]	[11.38]	[7.49]	[9.70]	[11.31]	[11.60]
Observations	35287	34966	34748	34586	35287	34966	34748	34586
Number of banks	1386	1385	1386	1385	1386	1385	1386	1385
logLikelihood	-319.684	-308.610	-307.394	-320.817	-328.219	-311.776	-310.477	-328.191

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when a ratio of equity to total assets is below 2% and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; and *Household Income Growth* is the growth in regional household income per capita. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Dummy variables for quarters and years are included in the regressions, but not reported.

Table 6 Liquidity Creation and Bank Failures: Moscow Banks Only

	LC1/Assets				LC2/Assets			
	Quarters before failure							
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
LC_Bottom5	0.506	0.388	0.158	-0.288	0.676**	0.479	-0.079	-0.261
	[1.51]	[1.21]	[0.48]	[0.72]	[2.02]	[1.50]	[0.21]	[0.65]
LC_5-10%	-0.215	-1.046*	0.018	-0.175	0.262	-0.111	0.007	-0.005
	[0.49]	[1.76]	[0.05]	[0.47]	[0.68]	[0.28]	[0.02]	[0.02]
LC_10-15%	-0.834	0.195	-1.178**	-0.048	-0.657	-0.064	-0.201	0.025
	[1.40]	[0.57]	[1.99]	[0.14]	[1.10]	[0.16]	[0.50]	[0.07]
LC_15-20%	-0.466	-0.642	-0.402	-0.386	-0.331	-1.280*	-0.027	-0.540
	[0.89]	[1.24]	[0.94]	[0.90]	[0.63]	[1.78]	[0.07]	[1.17]
LC_80-85%	0.063	0.011	-0.430	-0.365	0.465	0.358	-0.495	-0.933
	[0.12]	[0.02]	[0.83]	[0.71]	[0.98]	[0.83]	[0.83]	[1.30]
LC_85-90%	0.286	-0.510	0.119	-0.410	0.839**	0.194	0.490	0.466
	[0.61]	[0.86]	[0.30]	[0.80]	[2.06]	[0.42]	[1.31]	[1.25]
LC_90-95%	0.047	-0.589	0.048	0.885***	0.472	0.316	0.150	-0.060
	[0.09]	[0.99]	[0.12]	[3.06]	[1.00]	[0.73]	[0.35]	[0.13]
LC_Top5	1.605***	1.583***	0.989***	1.125***	1.721***	1.630***	1.339***	1.577***
	[6.19]	[6.75]	[3.74]	[4.32]	[6.38]	[6.61]	[5.21]	[6.69]
Size	-0.297***	-0.244***	-0.206***	-0.214***	-0.242***	-0.200***	-0.175***	-0.165***
	[5.38]	[4.84]	[4.31]	[4.60]	[4.47]	[4.09]	[3.77]	[3.62]
ROA	-5.225***	-5.489***	-5.257***	-3.097	-5.350***	-5.294***	-5.058**	-3.343
	[4.42]	[3.40]	[2.58]	[1.46]	[4.35]	[3.42]	[2.46]	[1.51]
Constant	-3.287***	-3.376***	-3.420***	-3.432***	-3.717***	-3.684***	-3.688***	-3.733***
	[9.46]	[10.57]	[11.29]	[11.74]	[10.49]	[11.46]	[12.17]	[12.59]
Observations	16240	16029	15886	15776	16240	16029	15886	15776
Number of banks	687	686	687	688	687	686	687	688
logLikelihood	-638.736	-733.685	-804.263	-816.328	-638.438	-738.292	-802.579	-808.479

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when the bank's license is revoked and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; and *Household Income Growth* is the growth in regional household income per capita. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. As we only consider banks located in Moscow, we skip the regional variables *Small business growth* and *Household income growth* from the estimations. Dummy variables for quarters and years are included in the regressions, but not reported.

Again, the coefficient on *LC_Top5* is positive and highly significant, lending support to the ELCH. The coefficient on *LC_90-95%* is also positive and significant in all LC1 estimations, but significant only once with LC2. We do not observe that banks with very low liquidity creation ratios have a greater probability of failure; *LC_Bottom5* is not significant in any of the estimated specifications.

In the third robustness check, we perform all estimations for Moscow-based banks only. About half of banks in Russia are headquartered in Moscow, and banks in the capital city include the largest financial institutions in the country. Cole and Gunther (1994) note that regulatory flexibility differs for large and small banks, thus justifying the special treatment for Moscow-based banks. Once again, the results (reported in Table 6) are broadly consistent with the ELCH as *LC_Top5* is positive and significant across all estimations, but low liquidity creation has no impact on the incidence of bank failures.

In the fourth robustness check, we consider domestic private banks exclusively in our estimations. It is possible that the probability of bank failure at state-controlled banks and foreign banks is lower than for domestic banks. State-controlled banks may be less likely to fail *because* of the higher likelihood of state intervention in times of trouble and because of the greater confidence from depositors. Similarly, foreign banks are likely to benefit from the support of their parent institutions abroad. Thus, it could be that the relation between excessive liquidity creation and the incidence of bank failures is clouded by the presence of state-controlled and foreign banks in our sample. Table 7 presents the estimation results for the sample of domestic private banks.

The coefficient on *LC_Top5* is positive and significant at the 1% level, again corroborating the ELCH. Interestingly, unlike the two former robustness checks, we observe positive and significant coefficients for *LC_Bottom5* as in the case of the baseline model.

In the fifth robustness check, we investigate the effect of introducing the deposit insurance scheme that the Russian authorities implemented in 2004. Our expectations here follow the consensus among researchers on banking crises that the greater the protection offered by a country's bank safety net, the higher the risk of a banking collapse (e.g. Wheelock and Wilson, 1995; Caprio and Klingebiel, 1996; Demirgüc-Kunt and Detragiache, 2002; Barth et al., 2006). We thus generate a dummy variable (*Deposit Insurance*) equal to 1 for quarters following the introduction of the deposit insurance scheme, i.e. starting from beginning of 2005, and re-run our baseline model using both liquidity creation measures for four different lags. The results appear in Table 8.

Table 7 Liquidity Creation and Bank Failures: Domestic Private Banks Only

	LC1/Assets				LC2/Assets			
	Quarters before failure							
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
LC_Bottom5	1.064***	0.828***	0.635**	0.589**	1.291***	0.996***	0.622**	0.595**
	[4.20]	[3.39]	[2.46]	[2.17]	[5.06]	[4.08]	[2.23]	[2.07]
LC_5-10%	0.091	-0.456	0.471*	0.494*	0.577*	-0.059	0.217	0.261
	[0.24]	[1.08]	[1.74]	[1.78]	[1.78]	[0.16]	[0.68]	[0.82]
LC_10-15%	-0.591	0.368	-0.319	0.213	-0.233	0.314	0.090	0.519*
	[1.17]	[1.28]	[0.85]	[0.69]	[0.50]	[1.02]	[0.27]	[1.87]
LC_15-20%	0.094	-0.660	-0.142	-0.333	-0.070	-0.574	0.488*	-0.123
	[0.25]	[1.44]	[0.41]	[0.85]	[0.17]	[1.25]	[1.76]	[0.33]
LC_80-85%	-0.211	-0.185	-0.147	-0.266	0.294	-0.171	-0.094	-0.576
	[0.45]	[0.47]	[0.40]	[0.68]	[0.79]	[0.44]	[0.26]	[1.26]
LC_85-90%	0.500	-0.166	0.088	0.215	0.720**	0.376	0.234	0.669**
	[1.48]	[0.42]	[0.27]	[0.68]	[2.30]	[1.23]	[0.74]	[2.55]
LC_90-95%	0.548	0.116	0.116	0.824***	-0.092	0.223	0.485*	0.419
	[1.62]	[0.33]	[0.35]	[3.35]	[0.21]	[0.69]	[1.75]	[1.46]
LC_Top5	1.730***	1.509***	1.124***	1.120***	1.757***	1.331***	1.136***	1.366***
	[8.04]	[7.45]	[5.00]	[4.90]	[8.53]	[6.48]	[5.24]	[6.81]
Size	-0.163***	-0.143***	-0.120***	-0.088**	-0.131***	-0.122***	-0.111***	-0.071*
	[3.85]	[3.65]	[3.12]	[2.32]	[3.09]	[3.16]	[2.94]	[1.91]
ROA	-5.278***	-3.951***	-3.589***	-4.241***	-5.461***	-4.263***	-3.458***	-4.256***
	[6.83]	[3.97]	[3.59]	[3.95]	[6.74]	[4.16]	[3.50]	[3.90]
Small business growth	-0.115	-0.083	-0.067	-0.013	-0.120	-0.086	-0.069	-0.019
	[0.65]	[0.60]	[0.48]	[0.12]	[0.67]	[0.60]	[0.50]	[0.18]
Household income growth	-0.014***	-0.010**	-0.016***	-0.007*	-0.013***	-0.009**	-0.016***	-0.007
	[2.73]	[2.15]	[4.00]	[1.67]	[2.59]	[2.02]	[3.97]	[1.61]
Constant	-2.796***	-3.093***	-2.302***	-3.749***	-3.167***	-3.316***	-2.430***	-3.911***
	[3.90]	[4.63]	[3.81]	[6.06]	[4.47]	[4.94]	[4.03]	[6.31]
Observations	33097	32802	32598	32450	33097	32802	32598	32450
Number of banks	1322	1322	1323	1322	1322	1322	1323	1322
Log Likelihood	-1063.419	-1238.971	-1304.143	-1326.320	-1058.613	-1244.493	-1304.736	-1319.304

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when the bank's license is revoked and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; and *Household Income Growth* is the growth in regional household income per capita. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Dummy variables for quarters and years are included in the regressions, but not reported.

Table 8 Liquidity Creation and Bank Failures: Effect of Deposit Insurance

	LC1/Assets				LC2/Assets			
	Quarters before failure							
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
LC_Bottom5	0.936***	0.694***	0.546**	0.504*	1.131***	0.815***	0.469*	0.442
	[3.64]	[2.83]	[2.12]	[1.86]	[4.31]	[3.35]	[1.69]	[1.53]
LC_5-10%	0.008	-0.546	0.407	0.435	0.509	-0.144	0.153	0.202
	[0.02]	[1.29]	[1.51]	[1.57]	[1.55]	[0.39]	[0.48]	[0.63]
LC_10-15%	-0.657	0.303	-0.361	0.170	-0.283	0.266	0.063	0.485*
	[1.30]	[1.06]	[0.96]	[0.56]	[0.61]	[0.87]	[0.19]	[1.72]
LC_15-20%	0.049	-0.709	-0.171	-0.366	-0.121	-0.615	0.460*	-0.162
	[0.13]	[1.55]	[0.49]	[0.93]	[0.28]	[1.34]	[1.66]	[0.44]
LC_80-85%	-0.159	-0.128	-0.117	-0.230	0.326	-0.146	-0.084	-0.562
	[0.34]	[0.33]	[0.32]	[0.59]	[0.87]	[0.37]	[0.23]	[1.22]
LC_85-90%	0.558	-0.114	0.118	0.246	0.738**	0.378	0.234	0.683**
	[1.64]	[0.29]	[0.36]	[0.77]	[2.33]	[1.23]	[0.74]	[2.55]
LC_90-95%	0.611*	0.179	0.152	0.862***	-0.048	0.246	0.499*	0.443
	[1.79]	[0.51]	[0.46]	[3.50]	[0.11]	[0.77]	[1.80]	[1.53]
LC_Top5	1.775***	1.550***	1.130***	1.126***	1.803***	1.350***	1.154***	1.391***
	[7.93]	[7.63]	[5.01]	[4.91]	[8.17]	[6.57]	[5.32]	[6.59]
Size	-0.248***	-0.235***	-0.180***	-0.154***	-0.211***	-0.207***	-0.168***	-0.137***
	[5.22]	[5.81]	[4.59]	[4.03]	[4.39]	[5.22]	[4.38]	[3.43]
ROA	-5.516***	-4.079***	-3.583***	-4.112***	-5.718***	-4.372***	-3.426***	-4.159***
	[6.05]	[4.19]	[3.59]	[3.80]	[6.22]	[4.37]	[3.48]	[3.62]
Small business growth	-0.157	-0.135	-0.084	-0.034	-0.162	-0.139	-0.088	-0.041
	[0.83]	[0.91]	[0.59]	[0.31]	[0.84]	[0.92]	[0.62]	[0.36]
Household income growth	-0.011**	-0.006	-0.015***	-0.005	-0.011*	-0.005	-0.015***	-0.005
	[1.99]	[1.16]	[3.58]	[1.18]	[1.96]	[1.09]	[3.57]	[1.16]
Deposit Insurance	0.617***	0.770***	0.376**	0.511***	0.574***	0.723***	0.358**	0.507**
	[3.12]	[4.74]	[2.27]	[2.99]	[2.77]	[4.50]	[2.17]	[2.39]
Constant	-2.999***	-3.375***	-2.245***	-3.775***	-3.384***	-3.590***	-2.378***	-3.978***
	[3.80]	[4.71]	[3.62]	[5.97]	[4.27]	[5.02]	[3.85]	[5.97]
Observations	35287	34966	34748	34586	35287	34966	34748	34586
Number of banks	1386	1385	1386	1385	1386	1385	1386	1385
logLikelihood	-1067.144	-1239.353	-1313.824	-1335.181	-1063.627	-1246.031	-1314.215	-1328.136

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when the bank's license is revoked and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; and *Household Income Growth* is the growth in regional household income per capita. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. We include here the dummy variable *Deposit Insurance*, which is equal to one for the quarters after the implementation of deposit insurance scheme in 2004. Dummy variables for quarters and years are included in the regressions, but not reported.

The coefficient for *Deposit Insurance* is positive and highly significant across all estimations, suggesting that the implementation of a deposit insurance scheme increases the probability of bank failure. More importantly, our main findings are reinforced; the estimated coefficient of *LC_Top5* is still positive and significant across all estimations. We also find evidence that a shortage in liquidity creation is associated with a higher probability of bank failure.

Finally, in deference to the unsettled debate on "competition-fragility" and "competition-stability," we check to see whether our results are sensitive to controlling for bank concentration. In the context of Russian banking, Fungáčová and Weill (2009) provide evidence in support of the "competition-fragility" view using the Lerner index as a measure of bank competition and other concentration indices.[10] We measure bank concentration by the Herfindahl-Hirschman index for assets (*Herfindahl*) computed at the regional level by applying the same approach as in the case of other regional variables included in our estimations. Table 9 reports the results.

The results are again in concordance with the ELCH; the sign on *LC_Top5* is positive and highly significant across all estimations, and the coefficients for *LC_90-95%* and *LC_85-90%* are positive and significant in some estimations. The coefficient on *LC_Bottom5* is significant in half of the estimations, providing only limited evidence of a positive link between liquidity shortages and the probability of bank failure. In parallel, we observe a significant and negative coefficient for bank concentration, which is in line with the view that concentration reduces the probability of bank failure in Russia.

Overall, the robustness tests are congruent with our main finding that excessive liquidity creation increases the probability of bank failure in Russia. In all estimations, we show that banks with a liquidity creation measure above the 95th percentile have a significantly greater probability of failure compared to other banks. This result lends support to the ELCH.

Our analysis provides only limited evidence in favor of a link between low liquidity creation or liquidity creation shortages and the probability of bank failure. While the main estimations are in favor of such a relation, this result is not maintained under alternative specifications, notably when considering an alternative definition of bank failure and when the sample is limited to Moscow banks only.

[10] Berger and Bouwman (2009) examine the role of bank concentration in relation to liquidity creation.

Table 9 Liquidity Creation and Bank Failures: Effect of Bank Concentration

	LC1/Assets				LC2/Assets			
	Quarters before failure							
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
LC_Bottom5	0.811***	0.579**	0.374	0.333	0.969***	0.681***	0.291	0.262
	[3.19]	[2.36]	[1.44]	[1.22]	[3.80]	[2.79]	[1.04]	[0.91]
LC_5-10%	-0.166	-0.685	0.231	0.258	0.315	-0.303	-0.040	0.018
	[0.44]	[1.62]	[0.85]	[0.92]	[0.96]	[0.82]	[0.12]	[0.06]
LC_10-15%	-0.725	0.196	-0.476	0.032	-0.413	0.144	-0.089	0.343
	[1.48]	[0.68]	[1.28]	[0.10]	[0.89]	[0.47]	[0.27]	[1.23]
LC_15-20%	-0.058	-0.796*	-0.287	-0.480	-0.226	-0.721	0.333	-0.273
	[0.16]	[1.73]	[0.83]	[1.23]	[0.53]	[1.57]	[1.20]	[0.74]
LC_80-85%	-0.125	-0.110	-0.076	-0.196	0.417	-0.057	0.017	-0.468
	[0.27]	[0.28]	[0.21]	[0.50]	[1.11]	[0.15]	[0.05]	[1.02]
LC_85-90%	0.588*	-0.097	0.149	0.264	0.822***	0.462	0.320	0.756***
	[1.74]	[0.25]	[0.45]	[0.83]	[2.62]	[1.51]	[1.00]	[2.87]
LC_90-95%	0.628*	0.178	0.168	0.876***	0.003	0.318	0.569**	0.499*
	[1.85]	[0.51]	[0.51]	[3.55]	[0.01]	[0.99]	[2.04]	[1.73]
LC_Top5	1.693***	1.482***	1.086***	1.089***	1.807***	1.377***	1.171***	1.406***
	[7.84]	[7.31]	[4.82]	[4.76]	[8.76]	[6.69]	[5.39]	[7.00]
Size	-0.300***	-0.269***	-0.245***	-0.208***	-0.265***	-0.245***	-0.234***	-0.189***
	[6.58]	[6.42]	[6.01]	[5.21]	[5.88]	[5.96]	[5.86]	[4.81]
ROA	-5.193***	-3.659***	-3.711***	-3.894***	-5.251***	-3.847***	-3.494***	-3.829***
	[7.22]	[3.76]	[3.73]	[3.57]	[7.11]	[3.87]	[3.55]	[3.48]
Small business growth	-0.080	-0.041	-0.029	0.037	-0.090	-0.045	-0.033	0.031
	[0.36]	[0.25]	[0.17]	[0.31]	[0.39]	[0.27]	[0.19]	[0.25]
Household income growth	-0.016***	-0.011**	-0.018***	-0.007*	-0.015***	-0.011**	-0.018***	-0.007*
	[3.07]	[2.38]	[4.12]	[1.78]	[2.96]	[2.25]	[4.09]	[1.72]
Herfindahl	-3.838***	-3.376***	-3.520***	-3.306***	-3.941***	-3.481***	-3.627***	-3.430***
	[5.90]	[5.89]	[6.26]	[6.04]	[6.01]	[6.03]	[6.41]	[6.20]
Constant	-1.253	-1.769**	-0.943	-2.555***	-1.600**	-2.013***	-1.077	-2.722***
	[1.63]	[2.49]	[1.44]	[3.90]	[2.09]	[2.84]	[1.64]	[4.16]
Observations	35287	34966	34748	34586	35287	34966	34748	34586
Number of banks	1386	1385	1386	1385	1386	1385	1386	1385
Log Likelihood	-1051.129	-1229.105	-1292.319	-1317.256	-1045.804	-1233.703	-1291.320	-1308.623

Logit estimations are performed under the random effects assumption. The dependent variable is a dummy variable, bank failure that is equal to one when the bank's license is revoked and zero otherwise. *LC1* denotes the category-based liquidity creation measure. *LC2* is the maturity-based liquidity creation measure. These measures enter into the regressions as dummy variables depending on their distribution across several percentiles. *Size* is the logarithm of total assets; *ROA* is return on assets; *Small business growth* is the growth in regional SMEs; *Household Income Growth* is the growth in regional household income per capita, and *Herfindahl* is regional bank concentration measured by the Herfindahl-Hirschman index. Marginal effects of a change in the relevant explanatory variable are reported. Standard errors appear in square brackets below estimated coefficients. *, **, *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Dummy variables for quarters and years are included in the regressions, but not reported.

5 Conclusions

This paper introduces a novel hypothesis to explain bank failures related to the core liquidity-creating role of banks. The "Excessive Liquidity Creation Hypothesis" (ELCH) asserts that excessive liquidity creation by banks can increase the probability of failure. Russia experienced many bank failures over the past decade, making it an ideal natural field experiment for testing this hypothesis. We propose a screening procedure of banks, ranking them based on their liquidity creation in the system. Specifically, we define excessive liquidity creators as banks where the liquidity creation level in a given quarter exceeds the 95^{th} percentile of the distribution of liquidity creation in the system. When liquidity creation becomes excessive, the probability of failure for such a bank increases significantly more than for other banks. Our results are robust to alternative measures of liquidity creation and definitions of bank failure, and controlling for bank location, market concentration, and regulatory changes. They are also in line with the theoretical predictions of Allen and Gale (2004) and empirical results for the US (Berger and Bouwman, 2011).

The ELCH has two main implications. First, it suggests that liquidity creation by banks can be counterproductive when it becomes excessive. Liquidity creation above a certain threshold increases the probability of bank failure, leading eventually to the disappearance of a liquidity-creating institution and even a reduction in the volume of liquidity creation in the economy. Therefore, regulatory authorities may need to be cautious when assessing liquidity-creating activities by banks. Second, our main finding provides insight for regulatory authorities interested in identifying vulnerabilities in the financial system and predicting bank failure. Specifically, regulators may want to consider incorporating liquidity creation into early warning systems to identify financial institutions beginning to experience distress and subject them to additional oversight to either prevent bank failure or impose an orderly winding-down of the bank to limit taxpayer losses.

References

Allen, F. and D. Gale (1998). Optimal Financial Crises. *Journal of Finance* 53, 1245-84.

Allen, F. and D. Gale (2004). Financial Intermediaries and Markets. *Econometrica* 72, 1023-61.

Alonso, I. (1996). On Avoiding Bank Runs. *Journal of Monetary Economics* 37, 73-87.

Arena, M. (2008). Bank Failures and Bank Fundamentals: A Comparative Analysis of Latin America and East Asia during the Nineties using Bank-Level Data. *Journal of Banking and Finance* 32, 229-310.

Aubuchon, C. and D. Wheelock (2010). The Geographic Distribution and Characteristics of U.S. Bank Failures, 2007-2010: Do Bank Failures Still Reflect Local Economic Conditions? *Federal Reserve Bank of St. Louis Review*, 395-416.

Avery, R. and G. Hanweck (1984). A Dynamic Analysis of Bank Failures. Proceedings of the 20th Annual Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 380-395.

Barth, J., G. Caprio, and R. Levine (2006). Rethinking Bank Regulation: Till Angels Govern. New York: Cambridge University Press.

Berger, A. and C. Bouwman (2009). Bank Liquidity Creation. *Review of Financial Studies* 22, 3779-3837.

Berger, A. and C. Bouwman (2011). Bank Liquidity Creation, Monetary Policy, and Financial Crises. Working Paper, Wharton Financial Institutions Center.

Bernanke, B. (1983). Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression. *American Economic Review* 73(3), 257-76.

Brown, C. and S. Dinç (2005). The Politics of Bank Failures: Evidence from Emerging Markets. *Quarterly Journal of Economics* 120(4), 1413-1442.

Bryant, J. (1980). A Model of Reserves, Bank Runs, and Deposit Insurance. *Journal of Banking and Finance* 4, 335-344.

Calomiris, C. and G. Gorton (1991). The Origins of Banking Panics, Models, Facts, and Banking Regulation, in R.G. Hubbard (ed.), *Financial Markets and Financial Crises*, Chicago, IL: University of Chicago Press.

Calomiris, C. and J. Mason (2003). Fundamentals, Panics and Bank Distress during the Depression. *American Economic Review* 93, 1615-47.

Calomiris, C. (2007). Bank Failures in Theory and History: The Great Depression and Other "Contagious" Events. NBER Working Papers 13597, National Bureau of Economic Research, Inc.

Caprio, G. and D. Klingebiel (1996). Bank Insolvencies: Cross-Country Experience. Policy Research Working Paper No.1620. Washington, D.C.: World Bank.

Chari, V. and R. Jagannathan (1988). Banking Panics, Information, and Rational Expectations Equilibrium. *Journal of Finance* 43, 749-60.

Claeys,, S. and K. Schoors (2007). Bank Supervision Russian Style: Evidence of Conflicts between Micro- and Macro-Prudential Concerns. *Journal of Comparative Economics* 35, 630-657.

Cole, R., Gunther, J. (1994). When Are Failing Banks Closed? Federal Reserve Bank of Dallas. Financial Industry Studies, 1-12.

Cole, R. and J. Gunther (1995). Separating the Likelihood and Timing of Bank Failure. *Journal of Banking and Finance* 19, 1073-89.

Cole, R. and L. White (2012). Déjà Vu All Over Again: The Causes of U.S. Commercial Bank Failures *This* Time Around. *Journal of Financial Services Research* 42, 5-29.

Cottarelli, C., G. Dell'Ariccia, and I. Vladkova-Hollar (2005). Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and in the Balkans. *Journal of Banking and Finance* 29, 83-104.

Demirgüç-Kunt, A., and E. Detragiache (1998). The Determinants of Banking Crises in Developing and Developed Countries. IMF Staff Papers 45 (1), 81-109.

Demirgüç-Kunt, A. and E. Detragiache (2002). Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation. *Journal of Monetary Economics* 49, 1373-1406.

DeYoung, R. (2003). De Novo Bank Exit. *Journal of Money, Credit, and Banking* 35, 711-28.

Diamond, D. and P. Dybvig (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy* 91, 401-19.

Diamond, D. and R. Rajan (2000). A Theory of Bank Capital. *Journal of Finance* 55, 2431-65.

Diamond, D. and R. Rajan (2001). Liquidity Risk, Liquidity Creation and Financial Fragility: A Theory of Banking. *Journal of Political Economy* 109, 287-327.

Diamond, D. and R. Rajan (2002). Bank Bailouts and Aggregate Liquidity. *American Economic Review* 92(2), 38-41.

Diamond, D. and R. Rajan (2005). Liquidity Shortages and Banking Crises. *Journal of Finance* 20(2), 615-646.

Drees, B., and C. Pazarbasioglu (1998). The Nordic Banking Crises: Pitfalls in Financial Liberalization? IMF Occasional Paper No. 161 (Washington D.C.: International Monetary Fund).

Estrella, A., Park S. and S. Peristiani (2000). Capital Ratios as Predictors of Bank Failure. *Economic Policy Review*. Federal Reserve Bank of New York, 33-5.

Friedman, M. and A. Schwartz (1963). A Monetary History of the United States, 1867-1960. Princeton, NJ: Princeton University Press, 1963.

Fungáčová, Z. and L. Weill (2013). Does Competition Influence Bank Failures? Evidence from Russia. *Economics of Transition* (forthcoming).

Gorton, G. (1988). Banking Panics and Business Cycles. *Oxford Economic Papers* 40, 751-81.

Hahm, J., H. Shin, and K. Shin (2011). Non-Core Bank Liabilities and Financial Vulnerability, Presentation for the Federal Reserve Board Conference, September 15-16, 2011.

Hellwig, M. (1994). Liquidity Provision, Banking, and the Allocation of Interest Rate Risk. *European Economic Review* 38, 1363-89.

Jacklin, C. and S. Bhattacharya (1988). Distinguishing Panics and Information-Based Bank Runs: Welfare and Policy Implications. *Journal of Political Economy* 96, 568-92.

Jimenez, G. and J. Saurina (2006). Credit Cycles, Credit Risk, and Prudential Regulation. *International Journal of Central Banking* 2, 2, 65-98.

Kaminsky, G., and C. Reinhart (1999). The Twin Crises: the Causes of Banking and Balance of Payments Problems. *The American Economic Review* 89, 473-500.

Karas, A. and K. Schoors (2005). Heracles or Sisyphus? Finding, Cleaning and Reconstructing a Database of Russian Banks. Ghent University Working Paper 05/327.

Kashyap, A., R. Rajan, and J. Stein, (2002). Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking. *Journal of Finance* 57, 33-73.

Khwaja, I. and A. Mian (2008). Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market. *American Economic Review* 98(4), 1413-42.

Kindleberger, C. (1978). Manias, Panics, and Crashes. *A History of Financial Crises*. New York: Basic Books.

Lanine, G. and R. Vander Vennet (2006). Failure Prediction in the Russian Bank Sector with Logit and Trait Recognition Models. *Expert Systems with Applications* 30, 463-78.

Meyer, P. and H. Pifer (1970). Prediction of Bank Failures. *Journal of Finance* 25(4), 853-68.

Molina, C. (2002). Predicting Bank Failures using a Hazard Model: The Venezuelan Banking Crisis. *Emerging Markets Review* 3, 31-50.

Ng, J. and S. Roychowdhury (2010). Loan Loss Reserves, Regulatory Capital, and Bank Failures: Evidence from the 2008-2009 Economic Crisis. Available at the Social Science Research Network: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1646928

Oshinsky, R., and V. Olin (2005). Troubled Banks: Why Don't They All Fail? *Federal Deposit Insurance Corporation Banking Review* 18, 22.

Ozkan-Gunay, E. and M. Ozkan (2007). Prediction of Bank Failures in Emerging Financial Markets: An ANN Approach. *The Journal of Risk Finance* 8, 465-80.

Peek, R. and E. Rosengren (2000). Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States. *American Economic Review* 90(1), 30-45.

Postlewaite, A. and X. Vives (1987). Bank Runs as an Equilibrium Phenomenon. *Journal of Political Economy* 95, 485-91.

Rolnick, A. and W. Weber (1984). The Causes of Free Bank Failures: A Detailed Examination. *Journal of Monetary Economics* 14, 267-92.

Thomson, J. (1991). Predicting Bank Failures in the 1980's. Federal Reserve Bank of Cleveland. *Economic Review* 27, 9–20.

Thomson, J. (1992). Modeling the Bank Regulator's Closure Option: A Two-Step Logit Regression Approach. *Journal of Financial Services Research* 6, 5-23.

Torna, G. (2010). Understanding Commercial Bank Failures in the Modern Banking Era. Available at: http://www.fma.org/NY/Papers/ModernBanking-GTORNA.pdf

Vazquez, F. and P. Federico (2012). Bank Funding Structures and Risk: Evidence from the Global Financial Crisis. IMF Working Paper 12/29.

Whalen, G. (1991). A Proportional Hazards Model of Bank Failure: An Examination of its Usefulness as an Early Warning Tool. Federal Reserve Bank of Cleveland. *Economic Review*, 20-31.

Wheelock, D. and P. Wilson (1995). Explaining Bank Failures: Deposit Insurance, Regulation, and Efficiency. *Review of Economics and Statistics* 77(4), 689-700.

Wheelock, D. and P. Wilson (2000). Why Do Banks Disappear? The Determinants of U.S. Bank Failures and Acquisitions. *Review of Economics and Statistics* 82(1), 127-38.

Williamson S. (1988). Liquidity, Banking, and Bank Failures. *International Economic Review* 29(1), 25-43.

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