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THE ROLE OF INFORMATION ASYMMETRY IN BANKING MARKETS

Dissertation Summary

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1. Motivation

Information asymmetry is an intrinsic problem for of the banking markets due to the nature of the products and services, as well as core market participants—banks, borrowers and depositors. Estimating correctly the borrower (either a bank client or a bank himself as a borrower in a deposit or interbank market) credit risks in the current conditions of permanent shocks and increasing uncertainty is the task of particular—and growing—importance for the lenders all around the globe.

Information asymmetry *in credit markets* and the problems associated with this phenomenon were introduced in (Akerlof, 1970). Information asymmetry arises between a bank and a borrower, as the latter is often more aware of his own characteristics and actions as well as the riskiness of project a bank loan is required for. This leads to both adverse selection and moral hazard problems, resulting into high interest rates, low credit availability and debt overhang with low credit quality. Formal information exchange through private credit bureaus (PCBs) and public credit registries (PCRs) appears to be quite effective, at least partially addressing the issue of improving the accuracy of credit risk assessments (Stiglitz and Weiss, 1981; Pagano and Jappelli, 1993; Jappelli and Pagano, 2002; Kallberg and Udell, 2003; Nakamura and Roszbach, 2018; Bennardo, Pagano and Piccolo, 2015; Brown, Jappelli and Pagano, 2009). Two issues, however, may influence the degree the information intermediaries succeed the in making the borrowers more transparent. First, it is not always clear how detailed the credit history information that intermediaries aggregate and transmit to potential lenders should be. A second issue related to the effectiveness of credit information exchange is the accuracy and correctness of the credit reports provided by information intermediaries, especially when such exchange is mandatory. Data for studying such bank incentives are difficult to find, but it is possible – and relevant – to study this issue theoretically.

The market for bank deposits changes the position of the bank in conditions of information asymmetry: here the bank is a borrower, and depositors face the problem of correctly assessing the bank's risks and, therefore, the probability of returning their deposits. Since (Diamond and Dybvig, 1983), the coordination problem in the market for bank deposits has been considered an important source of instability, increasing the risk of bank panics and subsequent bank defaults. The literature on this topic is extensive and focuses on the question of whether depositors are able to make such assessments correctly and exhibit specific pricing and volume decisions when entering into contracts with riskier banks (Hannan and Hanweck, 1988; Ellis and Flannery, 1992; Park, 1995; Goldberg and Hudgins, 1996; Park and Peristiani, 1998; Demirgüç-Kunt and Huizinga, 1999; Martinez Peria and Schmukler, 2001; Goldberg and Hudgins, 2002; Murata and Hori, 2006; Landskroner and Paroush, 2008; Uchida and Satake,

2009; Beyhaghi et al., 2014; Aysan et al., 2015; Arnold et al., 2016). 2016; Hou et al., 2016). If market participants have relevant information about the riskiness of their banks (as implied by the disclosure guidelines of the Basel Committee on Banking Supervision, starting from Pillar III of Basel II “Market Discipline”), they use market discipline mechanisms. Price discipline is rooted in the theory of financial market efficiency and implies that depositors demand higher interest rates from riskier banks. Under the quantitative mechanism, depositors reduce or even close their deposits as a bank’s riskiness increases. Riskier banks face certain difficulties in attracting additional deposits, even when offering higher interest rates. One version of the quantitative mechanism could be the structural break mechanism: depositors at riskier banks switch from riskier long-term deposits to short-term or even demand deposits. Research confirms the existence of market discipline in Russia, but in terms of quantity rather than price (Karas et al., 2006; Urgan et al., 2008; Karas et al., 2010; Karas et al., 2013; Peresetsky et al., 2007; Semenova, 2007; Peresetsky, 2008). Current research in this area aims to identify and describe new mechanisms of market discipline that depositors can use. Our study is no exception: we add the mechanism of currency shifts, which has not been previously covered in the literature, to the list of mechanisms of market discipline.

The main problem of ensuring market discipline is the transparency of the banking system. However, having not found a statistically significant relationship between it and market discipline, we can claim the need for a more in-depth analysis of the factors influencing depositors' decisions to close their deposits before the expiration of the contract. Thus, the role of financial literacy has been understudied in the literature, and to fill this gap, we examine the role of this factor theoretically, experimentally, and empirically.

Market discipline is crucial for efficient allocation of funds in the deposit market, but it is also fragile and can be easily undermined because depositors face high costs of monitoring risks and are sensitive to non-risk-related information available to them. Financial crisis may reduce market discipline (Cubillas, Fonseca and González, 2012; Berger and Turk-Ariss, 2015) because of crisis-related government intervention. Another factor that undermines market discipline is the explicit guarantees provided by deposit insurance schemes (DISs), which contribute to the moral hazard problem. It is therefore important to analyze the extent to which incentives for market discipline are preserved in the context of DISs. Information in the media becomes especially important for market discipline during a crisis. (Hasan et al., 2013a; Wisniewski and Lambe, 2013; Jansen, Mosch and van der Crujisen, 2015; Ziebarth, 2016) show that depositor behavior is influenced by media reports on both the economic situation and financial institutions. The Russian case provides several opportunities to study the impact of crisis events on depositor decision making under some variation in the information environment and under different

information costs for depositors, so we study the effects of media freedom for the 1998 and 2008 crises. Implicit guarantees may also reduce the effectiveness of market discipline, and the source of such guarantees may be the ownership structure of the bank, in particular the fact that the bank is a subsidiary of a foreign financial institution. Depositors of regional banks may also see implicit guarantees in possible connections with regional authorities or, more generally, in a sense of unity with the region and its strength and importance. We study the former effect using the approach of (Disli and Schoors, 2013), the latter is examined basing on the idea of the “familiarity hypothesis” (Huberman, 2001).

The interbank market is crucial for a stable banking system: it helps distribute liquidity among banks and connects them with each other. The existence and effectiveness of market discipline in the interbank market is less studied, although it plays an important role in ensuring the stability of the financial system (Furfine, 2001; King, 2008; Cocco, Gomes and Martins, 2009; Angelini, Nobili and Picillo, 2011). The Russian interbank market again provides a good example for such an analysis: Karas, Schoors and Lanine (2008) show that the interbank market has difficulty distributing liquidity during crises and can freeze, as happened for example in 2004, due to a lack of transparency, which led to a lack of trust on the part of market participants. We see the importance of studying the existence and effectiveness of market discipline in this market, and we make a first attempt to analyze the impact of voluntary (as mandatory disclosure requirements are the same for all banks) disclosure on the ability of banks to borrow in the interbank market.

Finally, the degree of transparency can affect the overall *structure of the banking market*. Although competition is important for the efficient functioning of any market – and banking markets are no exception (Petersen and Rajan, 1994; Boot and Thakor, 2000; Boyd and Nicolo, 2005; Schaeck, Cihak and Wolfe, 2009; Allen, Carletti and Marquez, 2011; Schaeck, Cihák and Cihak, 2014) – research has neglected the relationship between competition in banking markets and the transparency of the banking system.

Summing up, a number of aspects related to the severity of this problem and ways to address it remain unexplored in the literature. For example, the issue of the nonlinearity of the relationship between the depth of credit information disclosure and credit risks, as well as the existence of incentives for banks to provide inaccurate information about borrowers as part of information exchange, remained open. The analysis of factors influencing the functioning of market discipline mechanisms in the deposit market is insufficient, especially during periods of financial crises: explicit and implicit guarantees of various natures, media control and financial literacy require additional study. Discipline through currency shifts, relevant for countries whose economies largely depend on foreign currency, is not studied in the literature. Market discipline

for the interbank lending market is also practically unstudied, and the importance of bank transparency for its functioning is not analyzed. Finally, the relationship between transparency of banking activities and banking competition is insufficiently discussed in the literature.

The desire to fill these important gaps in the literature brings us to the following objective of our thesis and allows coming out with the certain number of more narrow research aims.

2. Objectives of the research

The main **objective** of this collection of papers is to examine—both theoretically and empirically—the ways the information asymmetry problems are addressed by both the market participants and the regulators in typical banking markets: the credit market, the deposit market and the interbank market. We accompany this broad discussion by exploring the link between the banking transparency and bank competition. Our empirical evidence comes from both Russian data and the cross-country comparisons.

For the purpose of this study we **aim**:

- To examine the non-linearity in the relationship between the depth of information sharing in credit markets and banking system credit risk;
- To model the bank's incentives to misreport on borrowers' credit quality under the mandatory information sharing system;
- To examine whether there is the statistically significant and positive relationship between market discipline and banking system transparency;
- To model the deposit market with the information-based bank runs in the assumption that information signals are no longer free of charge and explore the role of information costs on the occurrence of panic bank runs;
- In an experimental set-up of a-la Diamond-Dybvig model with risks, to test the hypothesis that being smart makes depositors withdraw on time. Leaving the use of complicated financial literacy measures for further research, we use a very simple proxy for it—student academic achievements;
- Using the data on Russian banks around the deposit insurance introduction, to trace the DIS effect on market discipline and the difference of this influence for the different types of banks according to their ownership structure;
- To explore the determinants of deposit withdrawals in Russia under the pressure of the 1998 and 2008 crises, with a particular focus on the financial literacy and media freedom.
- To explore a flight to familiarity Russian depositors exhibit in times of 2008 crisis, by reducing the market discipline exerted on familiar banks measured as banks with local or

regional references in their names, relative to the change in discipline exerted on non-familiar banks and disentangle this effect from implicit guarantee from the local government, making retail depositors less sensitive to the risk of these banks.

- To examine the impact of a signal of foreign control in a foreign bank provided by the bank title, on market discipline, testing the differences between banks that are foreign in the eyes of depositors and banks with titles that do not allow such features of their ownership structure to be judged, and examine how these differences change during periods of financial instability of 2008-2009 in Russia;
- To elaborate a new disciplinary mechanism of currency shifts, implying that that depositors react to reduced risk-taking indicators by investing comparatively more in deposits denominated in foreign currency and, therefore, changing the currency structure more intensively in favor of FX deposits, and test whether it works in the Russian market of personal deposits.
- To examine market discipline in the interbank market of Russia around the 2008 financial crisis and to test the hypothesis that market discipline in the interbank market is efficient in constraining the risk-taking behavior of banks;
- To analyze the relationship between voluntary disclosure by Russian banks and their ability to attract interbank loans and to check whether the decision to disclose itself is conditioned by bank's risk, which is fundamental to ensure the fact that the disclosure action of banks is reflecting the overall financial health of the bank;
- To explore the link between mandatory bank information disclosure and bank market power and concentration.

3. Brief literature review

3.1 Information intermediation and information asymmetry reduction

The information asymmetry in credit markets and problems related to this phenomenon were first developed in the seminal paper by (Akerlof, 1970), on adverse selection. He considered a typical creditor in Indian village—a money-lender: ‘with his intimate knowledge of those around him he is able, without serious risk, to finance those who would otherwise get no loan at all’ (Akerlof (1970), p. 499 citing (Darling, 1932), p.204). City banks did not grant loans to those, they did not possess information about—to peasants. This explained the monopolistic power of village money-lenders and their opportunity to set interest rates higher than those that would be offered by banks. As a result of information asymmetry the price of a loan—the interest rate—is not equal to an equilibrium one, which balances demand and supply. In

determining interest rates, banks take into account the average probability of credit repayment, because they know of the existence of both good and unreliable borrowers, but are not able to distinguish between these two types. Additionally, (Stiglitz and Weiss, 1981) show that higher interest rates makes more risky projects attractive for borrowers; hence the bank does not agree to lend money even if borrowers offer to pay higher interest rates.

In the academic literature the answer to the question of whether more detailed borrower information accumulated and shared by credit bureaus and credit registries is always associated with higher quality of bank credit portfolios and lower credit risks is, however, not unambiguous. Information exchange is designed to stimulate a more successful functioning of the credit market. It solves the problems of information asymmetry, adverse selection and moral hazard (Stiglitz and Weiss, 1981; Pagano and Jappelli, 1993; Jappelli and Pagano, 2002). With access to borrowers' credit profiles, banks can more accurately assess their creditworthiness, make more informed decisions about granting loans, and set fair interest rates (Kallberg and Udell, 2003; Nakamura and Roszbach, 2018). The exchange of information prevents borrowers from becoming loan overhung, as banks are aware of the size of the debt burden of customers (Bennardo, Pagano and Piccolo, 2015). (Brown, Jappelli and Pagano, 2009) showed that more disclosure (deeper information sharing) improves access to credit in transition countries and the amount of obtained loans especially for opaque borrowers. The sharing of information has a disciplining effect on borrowers: they make more efforts to repay the loan in order to maintain the high quality of their credit history and not face higher interest rates on loans in the future (Vercammen, 1995; Brown and Zehnder, 2007). More detailed credit reports increase the predictive power of scoring models (Chandler and Parker, 1989; Barren and Staten, 2003). All the mentioned effects tend to reduce credit risk.

At the same time, the degree of credit disclosure may have the opposite effect. There exist at least three possible explanations of the negative effect of the volumes of the disclosed information of the credit risk. First of all, the more information contained in credit histories, the less is the disciplining effect on borrowers. In a less transparent market, where the credit reports contain—as suggested in (Padilla and Pagano, 2000)—only negative information, the fact of a default is perceived by a bank as a signal of the borrower's unreliability. On the contrary using the credit report containing detailed information on the borrower it is possible to accurately determine the degree of riskiness of the borrower, and default is no longer perceived as a sign of poor quality of the client. Therefore under more transparent regime borrowers tend to apply less effort to avoid default and as a consequence credit risks increase. Secondly, as suggested by (Sharma, 2017), if the borrower rating in the full and detailed credit report falls below a certain level, in equilibrium he can choose to allow a strategic default so as not to pay higher interest

rates in the future, therefore the overall credit risks increase. Less detailed credit reports may stimulate the borrowers avoid the strategic defaults which implies that the probability of repayment, even being quite low for this type of the borrowers is still positive. Thirdly, longer credit history, meaning more years of bank-borrower relationships included into the credit report, adds less significance to the default facts in the past, resulting into lower influence of each default on the bank's decision on the current loan provision (Vercammen, 1995). Therefore, compared to the regime with shorter credit reports including just the default facts, the regime allowing to keep a long historical track record of the credit discipline might be associated with higher credit risks.

Another issue related to the efficiency of information sharing is the accuracy of the credit reports provided by the information intermediaries. Data on their own borrowers are their competitive advantage. They agree to sacrifice this advantage only if the borrowers, understanding that after revealing information they will be offered lower interest rates, will do their best in order not to default now. On the other hand, a bank has an incentive to announce, that information will be revealed and not to do so. (Padilla, 1997) shows that when inter-borrower communications are absent or are costly, only the existence of a credit bureau may lead banks not to behave opportunistically. Does the already-mentioned disciplinary effect, which affects the borrowers' behaviour in the information sharing regime, depend on the volumes of data reported by banks? (Padilla and Pagano, 2000) find that the exchange of positive information, as well as the absence of any sharing, does not provide the first-best level (no information asymmetry situation). Disciplinary effect appears in case of negative information sharing: for a borrower it is worth applying more effort to repay the loan because this will reduce the interest rate for future loans. Similar conclusions were drawn earlier by (Vercammen, 1995). If that's the case, the bank might have an incentive to report false information about the borrowers in order to enjoy the advantages of disciplinary effects and at the same time to continue informational rent extraction. This question is raised in (Padilla and Pagano, 2000), but no answer is provided before the current paper.

3.2 Bank runs and market discipline under information asymmetry in the deposit market

Starting with (Diamond and Dybvig, 1983) coordination failure in deposit markets has been considered an important source of instability, increasing the risk of bank runs and the subsequent bank defaults. In their model, providing insurance against liquidity shock, the standard 2-period on-demand deposit contract adds to the incentives for early withdrawals for those depositors, who are supposed to live for the whole game. A coordination failure appears as

the bank is not able to repay to everyone if they come earlier than scheduled in the contract and fails to distinguish the depositors facing liquidity shocks and those who are not. Being one of the Nash equilibria a bank run appears when the depositors expect others to withdraw earlier and thus withdraw themselves in order not to come to a failed bank at the end of the game. In contrast to information-based bank runs (Jacklin and Bhattacharya, 1988; Chen and Hasan, 2006), which are usually efficient in terms of redistributing funds from too risky banks to those who are more reliable, panic-based bank runs are not related to increased bank risks – and therefore deposit redistribution – and may ruin even a stable bank.

There are several papers studying depositor behavior via experiments and providing some proof for the theoretical predictions (Madiès (2006), Garratt & Keister (2009), Schotter & Yorulmazer (2009), Arifovic et al. (2013), Kiss et al. (2014a), Chakravarty et al. (2014), Davis & Reilly (2016), Brown et al. (2016), Kiss et al. (2016).

A growing literature has analysed the benefits of bank disclosure and transparency. Disclosing information regarding its financial situation of a bank decreases individual risk and total bank sector risk (Akhigbe and Martin, 2006). The empirical studies on the depositor behaviour usually focus on the different mechanisms of the market discipline. (Disli, Schoors and Meir, 2013) define the depositor discipline as a phenomenon of rewarding or punishing banks by investors (bank depositors) in response to the degree of risk-taking realized by banks, which, consequently, contributes to the stability of the whole banking system.

Empirical studies that focused on depositor sensitivity to bank risks appeared at the beginning of the 1990s. Market discipline gathered significant attention in the mid-2000s, when it was introduced as a separate Pillar in Basel II, implying that enhanced transparency is required to increase the efficiency of the banking markets and increase the stability of the entire banking system. The phenomenon of market discipline is usually studied using regression analysis methodology. The result that would suggest the existence of market discipline is the significance of the correlation between deposits or deposit growth (for quantitative mechanism), shares of deposits of various maturity in total deposits (for quantitative mechanism based on maturity structure shifts) or average deposit interest rates (for price mechanism) and a number of financial indicators of bank financial position and performance (usually the CAMEL rating model is used) (Hannan and Hanweck (1988), Ellis and Flannery (1992), Park (1995), Goldberg and Hudgins (1996), Park and Peristiani (1998), Demirgüç-Kunt and Huizinga (1999), Martinez Peria and Schmukler (2001), Goldberg and Hudgins (2002), Murata and Hori (2006), Landskroner and Paroush (2008), Uchida and Satake (2009). Beyhaghi et al. (2014), Aysan et al. (2015), Arnold et al. (2016), Hou et al. (2016)). Many papers also address market discipline in Russia and provide the evidence of disciplining rather by quantity than by price (Karas et al. (2006), Ungan et al.

(2008), Karas et al. (2010), Karas et al. (2013), Peresetsky et al. (2007), Semenova (2007) (Peresetsky, 2008). Disciplining by maturity shifts is also explored (Murata and Hori, 2006; Semenova, 2007).

A special place in the literature is given to the studies examining the factors that undermine market discipline. We have already mentioned a number of papers confirming a decrease in discipline during periods of financial crises, and also stressed that the introduction of a deposit insurance system could have the same effect, although in Russia, for example, it led not only to an influx of deposits into banks, but also increased competition, since such an influx affected small and regional banks to a greater extent (Chernykh and Cole, 2011). Peresetsky (2008) in terms of price disciplining and Karas et al. (2013) show that the introduction of deposit insurance in 2004-2005 substantially reduced household depositors' sensitivity to bank risk relative to uninsured firm deposits.

Empirical studies show that financial knowledge and skills can increase participation in the market, as they usually make people more prone to saving strategies (Beck and Brown, 2011; Semenova, 2011; Klapper, Lusardi and Panos, 2013), but there is no evidence that they influence information-based bank runs (Semenova, 2012; Brown, Guin and Morkoetter, 2014). The role of financial literacy in ensuring the efficiency of bank runs, which results in optimal risk redistribution in terms of market discipline and an increase in the banking system's stability, is still an issue which needs more exploration.

Information appearing in the media becomes especially important for the market discipline during a crisis. (Hasan et al., 2013a; Wisniewski and Lambe, 2013; Jansen, Mosch and van der Crujssen, 2015) demonstrate that depositor behavior is affected by media reporting on both the economic situation and financial institutions, which is especially important during times of crisis when depositors become more sensitive to incoming information. Another example is (Ziebarth, 2016), who examines a significant number of banks in the United States during the Great Depression of the 1930s. Radio was an important means of information at that time. The results of the study indicate that in those states where radio was more common, bank runs in 1930-1932 were significantly more severe.

Although even for Russia there is the evidence that market discipline for foreign banks differs from that for the other banks—Semenova (2007) shows that depositors of banks controlled by the state or foreign financial institutions are practically insensitive to their risks (unlike depositors of national private banks)—there is only few papers making an attempt to estimate the influence of the signals of the foreign ownership on the market discipline. For example, in a study of market discipline in the transition economies of Central Europe, where foreign banks dominate, (Hasan et al. 2013) showed that depositors were more influenced by

information about the bank's parent company disseminated in the media. (Disli and Schoors, 2013) is the only paper study the impact of a bank name change on market discipline in the Turkish deposit market. The authors show that the effect of rebranding varies depending on whether the bank changed its title from Turkish to English or vice versa. In the Turkish deposit market there exists the consumer ethnocentrism, that is, a tendency to use domestic goods and services rather than those imported from abroad. This effect was first mentioned in (Shimp and Sharma, 1987). The authors note that a consumer may refuse to purchase a foreign product in favor of a local one because he believes that it harms the domestic economy, leads to job losses and is simply unpatriotic. The opposite effect in the literature is called the country of origin effect. Gürhan-Canli, Maheswaran (2000a) show that individuals who minimize the costs of evaluating a product or service are especially susceptible to this effect. This type of client also includes small depositors—individuals who may not have the necessary tools for a complete and high-quality analysis of the financial condition of their banks.

3.3 Is there any information asymmetry in the interbank market?

The papers dealing with market discipline in the interbank market are scarce. Theoretical models often assume frictionless competition, where banks act as price-takers (Ho and Saunders, 1985; Clouse and Dow, 2002). Few empirical papers, however confirm the existence of both types of market discipline in the interbank market. Price discipline in the US interbank market was first noted by (Furfine, 2001). This was subsequently bolstered by the results of (King, 2008), using more recent US data. The existence of market discipline has also been identified in the Portuguese interbank market (Cocco, Gomes and Martins, 2009) and the Italian interbank market (Angelini, Nobili and Picillo, 2011).

While most studies in this area focus on establishing the *existence* of market discipline, it makes sense, once market discipline is identified, to take the next step and measure the *strength* of market discipline or *degree* to which it reduces bank risks. Notable efforts at measuring the degree of market discipline in the interbank market include the cross-country analysis of Nier and Baumann (2006), the examination of Central and Eastern European data by (Dinger and Von Hagen, 2009), and the study of the Dutch interbank market by (Liedorp *et al.*, 2010). These first two papers find market discipline was effective in reducing bank risk, while the third suggests that the disciplining mechanism failed and possibly contributed to contagion. Some of this discrepancy no doubt relates to the different risk measures and observation periods used in the analyses. The closest to ours is the theoretical article (Broll and Eckwert, 2006). In their theoretical framework, transparency affects the volume of interbank loans. Under standard specification of decreasing returns to scale, more interbank market transparency may stimulate or

depress the volume of loans. Although under a quadratic cost function, interbank loans are not sensitive to transparency since the signal emitted is not revealing any information.

3.4 Information asymmetry and bank transparency: the impact on competition

The effect of information disclosure on competition is not unambiguous. According to the industrial organization theory, greater transparency can increase competition by revealing some strategic information and, thus, reducing the competitive advantage of the disclosing organization (this is referred to as “proprietary cost” ((Darrough, 1993), p. 534). On the other hand, (Leuz and Wysocki, 2008) argue that disclosure costs can impede the functioning of smaller institutions as compared to the larger ones due to economies of scale effect (therefore, competition will decline). At the same time mandatory disclosure requirements can make it easier for new entrants to operate in the market, which raises the level of competition. This happens when mandatory disclosure reduces the costs of raising capital, which, in turn, can occur because new entrants are able to credibly commit to information disclosure (Ferrell, 2004). Mandatory disclosure can also intervene into the firms’ strategic decisions to be less transparent in their willingness to retain market power. The theory predicts that at least in certain cases stricter mandatory disclosure requirements reduce the opportunities of market power gains provided by strategic voluntary disclosure (Darrough, 1993).

The specificity of the banking sector (at least compared to the non-financial firms) makes the effect of greater transparency even more complicated and ambiguous because of the high degree of information asymmetry associated with bank risks. This effect may depend, at least to some extent, on market discipline features. Some studies show that greater disclosure of information improves social welfare ((Boot and Schmeits, 2000), (Hyytinen and Takalo, 2004), (Baumann and Nier, 2003)) while enhancing financial stability (cf. (Nier, 2005)) and decreasing lending corruption (cf. (Barth *et al.*, 2009)). As shown in (Chen and Hasan, 2006), an increase in the level of transparency in the banking system can lead to a higher probability of bank runs. Moreover, higher transparency may lower the willingness of creditors to roll over their funds (if they get a negative information signal) and, therefore, banks have to compensate this by raising their risk-taking appetite. (Moreno and Takalo, 2012) show, that there is an optimal level of transparency after which the total welfare (which is the creditors’ ex-ante expected payoffs in their model) starts to decrease. Therefore, the increased market discipline tends to intensify the competition in the banking sector with high-quality stable banks, but if most banks are risky, the more detailed information on that may lead to reduction in competition with few stable banks accumulating the market power. Other, mostly theoretical, papers show some negative effects of the increased information disclosure. Higher transparency can cause the overreaction to

potentially noisy public signals ((Morris and Shin, 2002), (Chen and Hasan, 2006)). (Landier and Thesmar, 2011) it is argued that higher transparency reduces social welfare because complex financial information can be analysed mainly by some advanced agents.

Finally, a direct link between mandatory disclosure and the nature of banking competition is discussed in a theoretical paper (Cordella and Levy Yeyati, 2002). Considering a model of spatial competition (based on the Salop model (Salop, 1979)), the authors demonstrate that mandatory information disclosure to depositors or to a deposit insurance agency forces banks to switch from price competition to asset quality competition. This, in turn, leads to higher profits in the short term and to a greater number of players (and, therefore, increased competition) in the long term. However, in (Bikker and Spierdijk, 2009) the authors argue that higher transparency can tighten oligopoly (as opposed to perfect competition) due to possibility of coordinated actions by banks.

4. Methodology

4.1 Information asymmetry in credit markets: the role of information intermediation

4.1.1 The non-linear relationship between the depth of credit information disclosure and credit risk.

To examine the relationship between credit risks and the depth of credit information disclosure we estimate the following dynamic panel model using the GMM techniques:

$$\begin{aligned}
 \textit{Credit risk}_{it} &= \gamma \textit{Credit risk}_{it-1} + \beta_1 \textit{Cii}_{it-1} + \\
 &+ \beta_2 (\textit{Cii}_{it-1})^2 + \textit{Bank controls}_{it} \cdot \delta_1 + \\
 &+ \textit{Macro}_{it} \cdot \delta_2 + \textit{Year}_{it} \cdot \delta_3 + \alpha_i + \varepsilon_{it}, i = 1, \dots, N, t = 1, \dots, T.
 \end{aligned} \tag{1}$$

where i —is a country index, t —is a year index, α_i —is an individual fixed effect. $\textit{Credit risk}_{it}$ stands for the ratio of the overdue loans to the total amount of loans issued in a country i in period t , \textit{Cii} is the index of the depth of credit information disclosure. $\textit{Bank controls}$ stay for control variables related to banking sector, \textit{Macro} is a vector of macroeconomic control variables, \textit{Year} denote year fixed effects.

The credit disclosure depth index began to be calculated within the World Bank's Doing Business project in 2004. This index had 6 criteria: if any criterion was met for information intermediaries in the selected country, then it was assigned the value of 1, and 0 otherwise. Then the criteria were summed up. The resulting number reflected the depth of credit information disclosure: the higher is the index, the more information is disclosed in credit reports. The

criteria that were taken into account in the index were as follows: (1) information intermediaries collect information on both individuals and legal entities; (2) both "black" and "white" information is distributed; (3) information is collected from financial institutions, retailers and utilities; (4) credit reports contain information for at least two recent years; (5) data on loans, the amount of which is less than 1% of income per capita, is disseminated; (6) borrowers have access to their credit reports. In 2013, the methodology for calculating this index was supplemented with two more criteria: (7) banks can access credit reports online; (8) as an additional service the assessment of the borrower's creditworthiness is offered to banks. We address this issue by estimating the equations separately for 2004-2012 and for 2013-2020.

We estimate the regression on the panel data from 2004 to 2020 and the dataset we use is combined from the data from several World Bank databases: World Development Indicators (WDI), Doing Business; Global Financial Development; Worldwide Governance Indicators. After data cleansing we ended up with a panel, which included around 100 countries in which no more than half of the period observations were missing for any of the variables selected in the main model.

The next step in our estimations is related to the influence of the country institutional and financial development on the relationship we analyze. First of all we introduce the measure overall quality of formal institutions in the country. We use Government Effectiveness index (*GE*) compiled by the World Bank for more than 200 countries over the period 1996-2018. This indicator are based on the opinion of a large number of surveyed enterprises, citizens, and experts, in addition, a number of data sources prepared by scientific research institutions, analytical centers, non-profit organizations, etc., and measures the quality of public service delivery and its independence from political pressure. We use Physical Property Rights index (*PPR*) to proxy the extent to which private properties rights are legally protected in the country. This index is a component of the International Property Right Index, compiled by the Property Rights Alliance. The Physical Property Rights index represents the degree of registration of properties, availability of loans, and actual compliance with property rights (i.e., how the de facto system works). It represents annual data from 2007 to 2020. For 2020, representatives of 129 countries participated in the surveys. Finally we check for the influence of the country financial development. For that purpose we use Financial Institutions Depth Index, compiled by the IMF over the period 1980-2020 for 192 countries. This indicator reflects the size, availability, and effectiveness of financial institutions and the financial market. For each of the variables we separate our sample to two subsamples—above and below the median—of the indicator and re-estimate our basic regressions. This allows comparing the nature of the relationship between the depth of credit information disclosure and credit risks for the countries

with high and low degree of institutional and financial development.

4.1.2 Model of “dishonest bank”

The main features of the set-up we use are described in papers by Padilla and Pagano (Padilla, 1997; Padilla and Pagano, 2000). We consider a two-period model of the market for bank loans. The contract in this market involves two agents: a bank (creditor) and an entrepreneur (borrower)—and implies a loan for a 1-period-long investment project of the latter. The project requires the loan of 1 unit, which must be repaid in the end of the current period.

There is a continuum $[0,1]$ of risk-neutral entrepreneurs, who are divided into two groups: high-ability (H) and low-ability (L) (their proportions of the total population are γ and $(1 - \gamma)$ respectively). High-ability entrepreneurs invest in the projects which yield R^* per period with the probability p (the probability of success) and 0 otherwise. The projects chosen by low-ability entrepreneurs yield nothing. Initially an entrepreneur has no own capital, so he is to borrow money for his projects. All the profits are consumed in current period and cannot be transferred into the next one, therefore, the loan must be used in the second period too. The liability is limited, i.e. if the project gives zero return, the loan is simply not repaid. A default in the first period does not mean that the borrower must repay it in the second one, or is not allowed to invest at all.

There are two identical banks— A and B —in this economy, the cost of capital for both creditors equals to \underline{R} . In the first period banks have symmetrical information about potential borrowers. Initially they cannot distinguish between high- and low-ability entrepreneurs but they know the average expected probability of success for each type: p and 0 respectively. They are also aware of the proportions of two types in the population. Granting a loan in the first period, the bank receives the information about the client’s type. Therefore by the second period banks obtain the competitive advantage provided by the information about their clients.

Given there is perfect competition on the market of bank loans, total profits of both banks are equal to zero. This means that expecting positive profits in the second period, in the first one they suffer losses equal to expected gains, so the competition in the first period is not limited by zero profits if there are positive expected profits in the second one. We call this feature *the principle of zero total profits*.

An *entrepreneur* is characterized by total undiscounted utility function and by rational expectations about future interest rates. However he cannot affect the rates as he is a price-taker. If a high-quality entrepreneur i does not borrow, he gets zero utility. If he borrows, then he maximizes the following utility function (linear in pay-offs):

$$U_H(p_i) = p_i [(R^* - R_{j1}) + (R^* - E(R_{j2}))], j=A,B \quad (2)$$

where R_{j1} is gross interest rate, assigned by bank j for the first period, $E(R_{j2})$ is expected gross interest rate, assigned by bank j for the second period.

Low-ability entrepreneurs are aware of the fact that all their projects yield nothing. The existence of entrepreneurs of this type could be explained by some nonnegative utility which these entrepreneurs receive "being in business".

A bank chooses the interest rate for the loan it offers. Its choice depends on the scope of information about the borrower a bank has at disposal. The banks offer their interest rates sequentially. In the second period each bank offers the rates first to its clients, and then to the clients of the competitor, i.e. the first offer is received from the bank, which has the information about the type of an entrepreneur. Suppose that in the first period the first offer is made by bank A (if we choose bank B , nothing will significantly change, because in this period there is no information asymmetry). The entrepreneurs always choose the bank offering cheaper loan. If the interest rates are the same, in the first period the borrowers choose this or that bank with probability σ_j , $j = A, B$, where $\sigma_A = \sigma$ and $\sigma_B = (1 - \sigma)$ (σ is determined exogenously). We consider that in the second period they choose the bank, they collaborated with in the past. This assumption is quite realistic, because the entrepreneurs usually prefer to borrow from the bank they had a chance to borrow from in the past and choose another one only if they are offered lower interest rates.

Banks deal with the undiscounted profit. Each bank obtains the profit from those entrepreneurs who are able to repay and who became his borrowers and performed their projects successfully. In the first period bank j is chosen by σ_j of entrepreneurs γ of which are of high-ability type. They gain profit from the projects with average expected probability p , so the banks expected gain is equal to $\sigma_j \gamma p R_{j1}$. As the bank has to pay for resources granted to σ_j of borrowers, the cost of funds accounts for $\sigma_j \underline{R}$. In the second period banks grant no loans to low-ability borrowers or to the competitor's clients. So the cost of funds is reduced by $\sigma_j \underline{R} (1 - \gamma)$. Given the above-mentioned profit components the banks are characterized by the following total profit function:

$$\Pi_j = \sigma_j [(\gamma p R_{j1} - \underline{R}) + \gamma (p E(R_{j2}) - \underline{R})] \quad (3)$$

$p \geq \underline{R}/R^*$

Each bank is obliged by some external authority to share the information on the borrowers' experience or types with another bank in the beginning of the second period (we analyze these reporting systems one by one). Therefore each bank decides, whether to report honestly or not.

Which strategy allows bank to extract informational rent? Is the dishonest behavior the strategy we are looking for? In an attempt to answer this question we should start with determining what it means to be "dishonest". A bank may report a case of success as a case of default, or vice versa. In a chosen set-up we are to deal with both variants simultaneously.

- *The case of obligatory reporting of negative information.* The average probability of high-ability borrower's success is a common knowledge, so a dishonest bank cannot report less than $p\gamma$ successes. The only possible strategy for dishonest reporting is to claim certain proportion of successes to be defaults and a certain proportion of defaults to be successes. Table 1 summarizes the scenarios.

- *The case of obligatory reporting of positive information.* The share of high-ability borrowers is also a common knowledge, so a dishonest bank cannot report less than γ of high-ability clients among its borrowers. The strategy for dishonest reporting is to claim certain proportion of high-ability borrowers to be low-ability ones and vice versa. Table 2 summarizes both possible scenarios:

Table 1. Misreporting, defaults

Proportion of borrowers	Reported 1st period result	True 1st period result	Borrower's type
<i>Scenario 1 ($p\gamma < 1 - \gamma$)</i>			
$p\gamma$	Success	Default	High-ability
γ	Default	Default/ Success	High-ability
$1 - \gamma - p\gamma$	Default	Default	Low-ability
<i>Scenario 2 ($p\gamma > 1 - \gamma$)</i>			
$1 - \gamma$	Success	Default	High-ability
$p\gamma - 1 - \gamma$	Success	Default/ Success	High-ability
$1 - p\gamma$	Default	Default/ Success	Low-ability

Table 2. Misreporting, borrowers' types

Proportion of borrowers	Reported borrower's type	True borrower's type
<i>Scenario 1 ($\gamma < 1 - \gamma$)</i>		
γ	High-ability	Low-ability
$1 - 2\gamma$	Low-ability	Low-ability
γ	Low-ability	High-ability
<i>Scenario 2 ($\gamma > 1 - \gamma$)</i>		
$1 - \gamma$	High-ability	Low-ability
$2\gamma - 1$	High-ability	High-ability
$1 - \gamma$	Low-ability	High-ability

Solving the profit maximization task with backward induction we show that maximizing the second period profits both banks prefer to behave opportunistically and to misreport. A serious question may arise here. If each bank realizes that dishonest reporting is the strategy he personally prefers, without any doubt it is aware of the fact, that this strategy would be preferred by the competitor too. If the banks take into account the dishonest reporting of the competitor, the equilibrium interest rates change due to changes in conditional probabilities that are based on the volumes of available information. However in a chosen set-up the banks prefer to misreport and close their eyes on misreporting by their competitors. Actually this means that obtaining the credit files from some information intermediary the bank will not check it for accuracy and that is what we may observe in real credit information sharing process. Moreover the second period profits under misreporting regime are higher than those of honest banks even if misreporting provides lower borrowers' efforts and—therefore—average probability of projects' success. Higher second period profits result in competitive advantage in the first period—the possibility to assign lower interest rates to obtain proper market share. Competing for borrowers banks offer equal and the lowest possible rates. Actually if only one bank reports dishonestly, it will become a monopolist, controlling all the market in the first period. In order not to lose the market in the very beginning the second bank chooses the same strategy too.

4.2 Transparency and market discipline: evidence from deposit markets

4.2.1 In search the direct relationship between banking system transparency and market discipline

To estimate the relationship between market discipline and banking system transparency we use the Probit regression methodology controlling for the characteristics of the countries' economies and banking systems. The basic model stays as follows:

$$\Pr(MD_i = 1) = \alpha + \mu'Transp_i + \gamma'_1 Macro_i + \gamma'_2 Banking_i + \rho Period + \varepsilon \quad (4)$$

where MD stands for market discipline variable, $Transp$ represents a transparency proxy, $Macro$ replaces the macroeconomic controls (the average GDP per capita, external and instrumented by the corruption perception index and the financial crisis binary variable by (Laeven and Valencia, 2013)), $Banking$ stands for a vector of banking system characteristics (the share of domestic credit provided by banks, deposit insurance existence, nominal capital adequacy requirement), i is a country index. Finally, we control for the periods for which we have the data: we include a binary variable equal to 0 for the first period and to 1 for the second one ($Period$).

To check for our results' robustness and stability we estimate an extended model controlling also for a set of characteristics of banking markets (namely the market structure as well as the state and foreign capital involvement):

$$\Pr(MD_i) = \alpha + \mu'Transp_i + \gamma'_1 Macro_i + \gamma'_2 Banking_i + \gamma'_3 Market_i + \rho Period + \varepsilon \quad (5)$$

where *Market* stands for a vector of banking market characteristics.

To construct the dependent variables measuring market discipline we use the results of two cross-country studies: (Demirgüç-Kunt and Huizinga, 1999) and (Hosono, Iwaki and Tsuru, 2004). These studies contain the results for the regression estimations for market discipline existence for numerous countries: 52 countries for 1990-1997 and 63 countries for 1992-2002 respectively. Thus we have the opportunity to construct a binary variable equal to 1 if the disciplining quantity was revealed in a country and to 0 if it was not. We consider the mechanism to be revealed is at least one bank fundamental proved to be significant in a corresponding regression. Combining the results of both studies, we construct unbalanced pseudo-panel for market discipline with two points in time correspondent with two abovementioned periods.

We use two measures of banking system transparency. First one is the Nier Index, first introduced by (Nier, 2005) then used in (Nier and Baumann, 2006) and (Huang, 2006). Basing on the Bankscope (now BankFocus) data for 1994-2000, the authors constructed the banking system transparency index for 31 countries. This index aggregates 17 sub-indices, characterizing disclosure of the information related to four basic groups of bank risks (interest rate risk, credit risk, liquidity risk, market risk). The sub-indices are based on the bank fundamentals taken from balance sheet: if a corresponding group of fundamentals is presented in the database, the sub-index is equal to 1 and otherwise it equals to zero. The aggregated index is an average from 17 sub-indices. We have this index for the period from 1994 to 2004 so we calculate the average indices for each of the studied periods for available years. Another measure of banking system transparency is constructed using the results of the World Bank «*Bank Regulation and Supervision*» cross-country surveys. The results of these surveys are presented for 151 countries. For our purposes we construct the transparency index basing on the answers for three questions from the World Bank questionnaire:

- *Are off-balance sheet items disclosed to the public?*
- *Must banks disclose their risk management procedures to the public?*
- *Are bank directors legally liable if information disclosed is erroneous or misleading?*

Positive answer for each of these questions may witness for higher degree of banking system transparency and adds 1 to our indicator (so it may account from 0 to 3 points for each

country). We calculate this index using “end of the period” data (namely the surveys of 1998 and 2003).

In search of any significant difference in the basic characteristics for the countries with and without market discipline, we firstly conducted the t-tests for the means for the country characteristics equality. Then we perform the OLS estimation and the IV approach with endogenous GDP.

4.2.2 The model of deposit market with costly information

Following (Postlewaite and Vives, 1987) we assume for simplicity that there are two depositors and one bank functioning on the simulated deposit market. There are three periods in the model ($t=0, 1, 2$). The depositors are risk-neutral, have a unit of funds that he/she may either invest as a bank deposit or store without any loss, and have the following utility function¹:

$$U = c_1 + c_2, \quad (5)$$

where c_k stands for the level of consumption in $t=k, k=1, 2$.

A bank accumulates the deposited funds and invests them into a risky project lasting two periods. If withdrawn early, the investments bring no return. It is commonly known at $t=0$ that if withdrawn after two periods, the investments guarantee the return R , where $R>1$, per invested unit with a probability $(1-\theta)$, such that θ is the probability of project failure. If the project is closed earlier, in the first period, then the gross profitability of early withdrawn investments r will be less than one. We assume that $0,75 < r < 1$.

The bank operates in a competitive environment and enters the market if its expected profit is zero. Thus, when choosing a deposit rate for two period deposit, the bank proceeds from the equality: $E\Pi_B = \theta(R - R_D) = 0$, where R_D —is the 2-period deposit rate. Therefore, $R_D = R$. The contract does not prohibit early withdrawal, however, if it happens, depositor receives zero net return. In this case, he will not refuse to open a deposit, since even in the event of early withdrawal, he will receive the invested unit of funds.

We use the approach of modeling the information environment proposed in (Alonso, 1996). At time $t=1$, the bank receives updated information about the success of the projects in which funds are invested. With probability p , $0 < p < 1$, the project will bring profit with probability θ_H , respectively, with probability $(1-p) - \theta_L$, $p\theta_H + (1-p)\theta_L = \theta$.

Let's call the appearance of information that $\theta = \theta_L$ *bad news*, and *good news* is the information that $\theta = \theta_H$. Thus, p is the probability of receiving good news, news about a decrease in the probability of an unfavorable outcome. Let there be a significant decrease in the

¹ The depositor consume in the second period so, if we draw a parallel, they refer to the second-type depositors in Diamond-Dybvig model and models of information-based bank runs (see, for instance, *Postlewaite, Vives, 1987*)

probability of project success in the case of bad news, and a significant increase in the case of good news:

$$\theta_H > \frac{3\theta}{2} > \theta > \frac{\theta}{2} > \theta_L \quad (6)$$

Since upon receipt of bad news the expected utility of the investor in the second period is lower than the utility upon withdrawal of funds in the first period, therefore, it is not profitable for him to maintain the deposit until the second period, $t = 2$, he will prefer to close it in the first period. However, in order to make such a decision, the investor must know that the probability of success of the projects in which the bank invests has decreased to θ_L .

In this model, the information signals that investors receive are not free. We assume that obtaining and interpreting information incurs certain fixed costs for investors. Let's denote them with c . In the first period, the depositor decides whether to bear these costs or not to increase the amount of information available to him.

Why might a depositor choose to gain access to new information? Obviously, because the loss from a worsening situation if the investor does not know about it and retains the deposit until the second period may be greater than the costs of obtaining and interpreting the information.

The decision-making sequence in this game can be represented by Figure 1.

The decision to close or maintain the deposit in the first period, $t=1$, is thus influenced by two factors: the ability to acquire information about changes in risks, dependence of the volume of funds available to the bank on the period and volume of withdrawals (coordination problem).

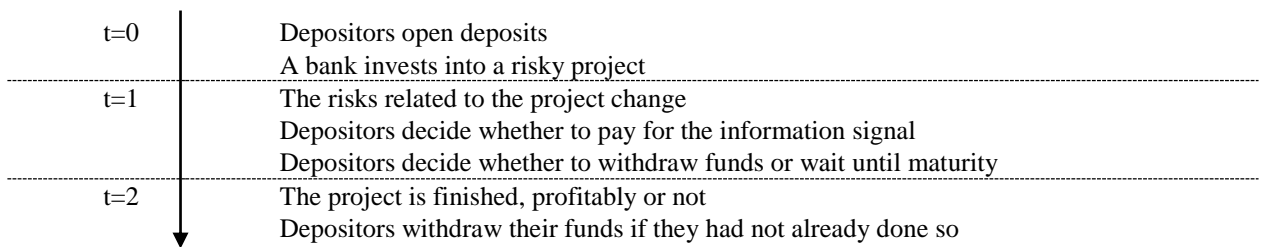


Figure 1 Timing of the game with signals

Let's consider possible strategies for investors. In the zero period, depositors always make a positive decision regarding investing funds in bank deposits. Thus, the strategies will differ in the actions of investors in the first and second periods. Possible strategies are shown in Table 3.

Table 3. Depositors' strategies

Strategy	$t=0$	$t=1$	$t=2$
----------	-------	-------	-------

$s1$	open deposit	1) do not pay for information 2) withdraw funds	
$s2$	open deposit	1) do not pay for information 2) do not withdraw funds	withdraw funds
$s3$	open deposit	1) pay for information 2) withdraw funds in case of bad news	withdraw in the case of good news

Let us call the *maximum acceptable level of costs* the maximum level of costs at which, if one investor acquires information, it is also profitable for the second investor to purchase it (if he does not close the deposit in the first period).

The Nash equilibria analysis allows us to show, that maximum acceptable level of costs—in other words, the willingness of depositors to pay for information—is lower, the higher the probability of receiving good news and the probability of success in the case of bad news, as well as the return on deposits and the penalty for early closure of the project. Consequently, even if depositors are risk neutral, as the likelihood and size of losses in the event of bad news increase, they will be willing to pay more for an information signal that will allow them to learn about the appearance of such news.

We solve the model for identical costs for receiving an information signal. However, if we interpret the variable c as the cost of collecting and interpreting information, it seems logical to consider its value as depositor internal characteristic. Indeed, for different groups of depositors, searching and processing financial information may be associated with different costs, and they may have different abilities to perform such actions. So the second step is to solve the model with differentiated costs. Then we introduce the deposit insurance system introduction. In the event of bank bankruptcy, that is, with probability θ , depositors receive some part of the funds that are assumed by the deposit agreement, namely compensation in the amount of αR . Thus, the system implies coinsurance.

4.2.3 A bank run in the classroom

We conducted a series of experiments with students, modeling the a-la Diamond-Dybvig deposit market with liquidity shocks, changing macroeconomic conditions, and risk-based investment technologies. Our database covers 7 waves of the experiment over four years. The students are diverse in terms of their years of study, varying from 2nd year undergraduates to 2nd year graduates. All the students participated in classes where both the theory and practice of bank runs and market discipline were discussed. The depositors have 100 units at the beginning of each round and open deposits for 2 periods, investing the whole amount. The bank invests all the accumulated funds in a project (or production technology, as in Diamond & Dybvig (1983)) which in the long run is profitable earning $R > I$ in period 2 for each unit invested. The invested

funds can, however, be withdrawn from the project earlier, in period 1, but there is an early withdrawal penalty, and each invested unit receives $0 < r_0 < 1$. The deposit contract is also 2-period long, providing patient depositors with R per deposited unit at the end of the round. The contract is a standard on-demand deposit contract and there is no loss for an early withdrawal— withdrawing the deposit in period 1, the depositor receives back her funds. This contract is subject to fund availability. In any period, if the funds are not sufficient to provide the necessary returns, all the available funds are distributed equally among those who came for them. This experiment design means that in the best case of coordination all the depositors will wait for period 2 and earn R . However, if at least one depositor withdraws earlier this reduces the returns for all those waiting until the end of the game. A coordination failure stimulates depositors to withdraw early if they suspect other depositors at their bank will also withdraw. We call a bank run the situation where at least one depositor who should wait until period 2 withdraws in period 1 (which is an analogue of the “partial bank run” introduced by Madiès (2006)). The game consists of 10 independent rounds, each of them introduces one change in the market characteristics, mentioned above.

The Diamond-Dybvig game means that the optimal choice for every depositor is to wait until the end of the game no matter what the economy shows. We call the depositor’s withdrawal an *on-time withdrawal* if she withdraws in the second period for any case except round 3 for a small bank, and if she withdraws early in this particular case.

We are interested in the determinants of the probability of withdrawing on time in the chosen set-up. Our hypothesis is that being smart makes students withdraw on time. We estimate the following Probit model for the probability of on-time withdrawals:

$$\begin{aligned} \text{Pr ob}(O_{\text{time}_{i,r}} = 1) = & \mu_1 \text{Grade}_i + \mu_2 \text{Round}_r + \mu_3 \text{Gender}_i + \mu_4 \text{Economy}_r + \mu_5 \text{BankSize}_b + \\ & + \mu_6 \text{StudyYear}_i + \mu_7 \text{Season} + \varepsilon_i \end{aligned} \quad (7)$$

In this model, $O_{\text{time}_{i,r}}$ is a binary variable equal to 1 if the student withdraws on time in round r , and 0 otherwise. The gain of a particular student depends on her choice and on the withdrawal choices of all the others in her bank.

Grade_i stands for the student’s average grade for the semester before the one the experiment is organized in. We use publicly available student ratings, where the average grades are calculated. The grades at HSE University vary from 1 to 10.

Another robustness check of our results involves examining the influence of student grades on the share of correct decisions among all the decisions. We estimate the following OLS regressions:

$$\begin{aligned}
\text{Overtime}_{i,r} = & \mu_1 \text{Grade}_i + \mu_3 \text{Gender}_i + \mu_4 \text{Economy}_r + \mu_5 \text{BankSize}_b + \\
& + \mu_6 \text{StudyYear}_i + \mu_7 \text{Season} + \varepsilon_i
\end{aligned} \tag{8}$$

Our main hypothesis is that smarter students should withdraw on time more frequently as they understand that these withdrawals ensure higher returns in the chosen set-up.

4.2.4 Deposit insurance influence on bank risk-taking

To address the issue of the DIS influence on market discipline we use the data from financial statements of 327 banks published by the Bank of Russia. The study is based on data from April 1, 2004 to January 1, 2008. In choosing an econometric model, we follow the logic of most studies on this topic and for the quantitative mechanism we estimate the following type of regression:

$$\text{Dep}_{i,t} = \alpha_{D,i} + \mu'_D \text{BF}_{i,t-1} + \theta'_D \text{Dummy}_{DIS} * \text{BF}_{i,t-1} + \mathcal{G}'_D \text{Dummy}_{Quarter}_t + \varepsilon_{D,i,t} \tag{9}$$

where $\text{Dep}_{i,t}$ is the average volume of deposits of individuals in bank i in quarter t . $\text{BF}_{i,t-1}$ is a vector of risk level indicators associated with bank i . Information about them is available to investors with some delay, so these variables are included in the regression with a lag. To control the influence of all other factors, dummy variables were introduced for each quarter.

To test the hypothesis of structural changes, a regression of the following type is estimated:

$$\frac{\text{Dep}^M_{i,t}}{\text{Dep}_{i,t}} = \alpha_{D,i} + \mu'_D \text{BF}_{i,t-1} + \theta'_D \text{Dummy}_{DIS} * \text{BF}_{i,t-1} + \mathcal{G}'_D \text{Dummy}_{Quarter}_t + \varepsilon_{D,i,t} \tag{10}$$

where M is the type of deposit by maturity (we call short-term deposits with a maturity of less than six months, long-term deposits with a maturity of more than six months, the third type of deposits is demand deposits).

To compare the effect of the market disciplinary mechanism before and after the inclusion of banks in the DIS, it is necessary to separate these two time intervals. The process of banks joining the system, formally starting at the beginning of 2004, continued until the end of 2005. Therefore, in any time interval randomly selected from the studied range, with the exception of only the first and last two quarters, it is characterized by the presence of both banks that have entered and those that have not joined the insurance system. Using information from the register of banks that joined the deposit insurance system, a dummy variable was introduced, which is equal to zero for quarters during which the bank was not a member of the DIS, and one—after joining the system. We estimate regressions separately for state-owned, foreign, and domestic private banks.

4.2.5 Bank runs during the 1998 crisis: the role of transparency and financial literacy

To gain a better insight into the nature of this mild run on Sberbank, we employ unique monthly data on Sberbank household ruble deposits across Russian regions, made available by Sberbank. We focus on the change in the ruble deposits from the first of August till the first of October, because this short two-month period covers the immediate post default period and predates the time when the deposits transferred from other insolvent banks show up in Sberbank books. Specifically, we estimate the following specification:

$$SD_i = \beta_1 Economic_i + \beta_2 Demographic_i + \beta_3 Govt\ involvement_i + \beta_4 Institutional_i + \varepsilon_i \quad (11)$$

The dependent variable SD is the percentage drop of Sberbank regional household ruble deposits in the period August—September across Russian regions. In the baseline regression we include a number of standard economic variables. In a second specification we also include demographic variables. In the next specification we introduce direct measures of government involvement in markets circa 1997. Finally we include two purely institutional variables, namely an early measure of corruption and a measure of early media freedom.

Then we turn to data from the Monitoring of Economic and Social Changes Survey performed on a bi-monthly basis by the All-Russian Public Opinion Research Center. Based on a representative nationwide sample of Russia's population, questions address respondents' economic circumstances, employment and social status as well as perceptions of social institutions. The November 1998 round of the survey, which targeted 2409 respondents across 105 sampling points, included a number of questions relating to household welfare and behavior in the aftermath of the August 1998 financial crisis. We focus attention on those questions that address the actions of those reporting having held ruble deposits on August 17th. Those who reported having held bank deposits in early August 1998, accounted for 18.6 percent of all the respondents. Among them, we observe that roughly half tried to withdraw deposits between August 17th and the November survey. Only one-third of all depositors, however, reported having withdrawn their deposits. Presumably, those that reported being unsuccessful had deposits at banks that experienced hardships in meeting their obligations.

Noting the correlation from the region-level data between media freedom and net deposit flows, we use the individual survey data to explore further the relationship between the channels for acquiring news and depositor behavior in the aftermath of the 1998 crisis. Given the poor information environment confronted by depositors, we might expect media coverage of financial market developments to have a disproportionately large effect.

We use the Monitoring Survey to determine the household characteristics that explain attempted depositor withdrawals in the wake of the crisis. Specifically, we estimate the following model:

$$WD_i = \beta_1 X_{1i} + \beta_2 X_{2i} + \lambda_j + \varepsilon_i \quad (12)$$

The dependent variable, WD_i takes on the value of one (zero, otherwise) if household i , with ruble bank deposits on August 17th, drew down (or at least attempted to) those deposits in the crisis' wake. Independent variables include a vector of the respondent's individual and household characteristics, X_1 and X_2 , respectively. We also control for region-level fixed effects, λ_j , to filter out the influence of regional heterogeneity that might impact deposit-related behavior.

4.2.6 The other crisis, the same media freedom and financial literacy effects: depositor runs in 2008

We use data for 79 regions of Russia for 2001–2010 to test the hypothesis that in regions where the press is controlled to a greater extent, the intensity of depositor runs during the crisis is be lower, all other things being equal. Using the panel fixed effects approach we estimate models of the following form:

$$Depgrow_{t,r} = \beta_0 + \beta_1 FreePress_{t,r} + \beta_2 Crisis_t + \beta_3 Crisis_t \times FreePress_{t,r} + \omega Controls_{t,r} + \theta Region_r + \varepsilon_{t,r} \quad (13)$$

$Depgrow_{t,r}$ is the increase in bank deposits of individuals in region r in year t . Data on deposit volumes for each region were obtained from the Bank of Russia databases. $FreePress_{t,r}$ is an indicator of media freedom. To take into account differences in the degree of media independence across Russian regions, we use data from the Glasnost Defense Foundation, a non-profit organization whose goal is to preserve and maintain the legal space within which the media operate. Among other things, the foundation monitors cases of violation of the rights of journalists, print and electronic publications throughout Russia as part of monthly monitoring. These data, supplemented by expert opinions collected through questionnaires. Regions are divided into three groups: with high, medium and low levels of media freedom. Thus, the index we use can take a value of 1, 2 or 3 for regions with low, medium and high levels of media freedom, respectively. The index is available for five years: 2001, 2002, 2006, 2008 and 2010. In order to identify the crisis effect, we introduce a binary variable $Crisis_{t,r}$ equal to 1 for the crisis year 2008 and 0 for other years. The model also includes a number of control variables to highlight the influence of key regional characteristics that may influence differences in the growth rates of individual deposits ($Controls_{t,r}$).

As we discussed in the previous section, it seems important to consider the ability to interpret information received from the press as a factor influencing the nature of the relationship between media freedom and deposit growth. To this end, we modify the model as follows:

$$\begin{aligned}
Depgrow_{t,r} = & \beta_0 + \beta_1 FreePress_{t,r} + \beta_2 Crisis_t + \beta_3 Crisis_t \times FreePress_{t,r} + \\
& + \beta_6 FreePress_{t,r} \times irp_{t,r} + \beta_7 Crisis_t \times FreePress_{t,r} \times irp_{t,r} + \\
& + \omega_2 Crisis_t \times irp_{t,r} + \omega_5 Controls_{t,r} + \theta Region_r + \varepsilon_{t,r}
\end{aligned} \tag{14}$$

We introduce $irp_{t,r}$ as a measure of financial literacy proxied by the Human Development Index, a socio-economic indicator calculated by the Independent Institute of Social Policy. The index is calculated within the framework of the project “Social Atlas of Russian Regions” according to formulas and criteria approved by the UN. It takes into account such characteristics of social development as life expectancy, education of the region's population and well-being. Using this ratio allows to understand how adequately people react to information received from the press. We assume that the effect of media independence will be greater in regions where higher values are observed, and therefore where the level of financial literacy among people is also higher.

4.2.7 Flight to familiarity in the Russian deposit market

To test the flight to familiarity hypothesis we estimate the following regressions for all banks excluding Moscow banks²:

$$\begin{aligned}
MD_{r,i,t} = & \alpha + \beta_1 X_{r,i,t-1} + \beta_2 F_{r,i,t} + \beta_3 F_{r,i,t} X_{r,i,t-1} + \\
& + \beta_4 Crisis_t + \beta_5 Crisis_t X_{r,i,t-1} + \beta_6 F_{r,i,t} Crisis_t + \\
& + \beta_7 F_{r,i,t} Crisis_t X_{r,i,t-1} \\
& + \beta_8 Controls_{r,i,t} + \beta_9 Time_t + \beta_{10} Region_{r,t} + \varepsilon_{r,i,t}
\end{aligned} \tag{15}$$

MD stands for the measure of market discipline at bank i in region r in quarter t . Our measures of MD are the household deposit rate (IR) for price discipline and the household deposit growth rate (DG) for quantity discipline. X stands for a vector of bank fundamentals measuring bank riskiness.

F is a binary proxy for bank familiarity. In the robustness check section, we replace it with Fb , which represents a broader definition of bank familiarity. We introduce a simple proxy for depositor familiarity with a bank: if the bank's name contains verbal cues referring to its regional or geographical position, we assume a local household depositor of the same region feels more familiar with the bank. A bank is considered familiar to household depositors of a region in the narrow sense of familiarity (F) if the name contains the name of the region (e.g. Altay Bank), the name of a city in this region (e.g. Bank of Moscow) or a place in this city (e.g.

² Moscow banks often have numerous branches in other regions, so the changes in the deposit growth or changes in the market share are not purely regional.

“Okhotny Ryad”³ Bank). A bank is considered familiar to regional household depositors in the broad sense of familiarity (*Fb*) either if the bank satisfies the conditions for familiarity in the narrow sense or if the bank name includes verbal cues referring to regional characteristics or regional objects (e.g. Volga Bank named after the Volga river), to larger geographic areas (e.g. South-Eastern Bank) or to the word “region” (e.g. InvestRegion Bank). We go through the list of all Russian banks in the sample period 2000–2010 and check whether bank names contain regional cues in the way described above (*F* and *Fb*) to define familiarity in the eyes of depositors.

Although we know our measure of familiarity does not measure government ownership, depositors may still interpret regional cues in the bank’s name as a signal of the strength of the bank’s ties with the regional government. This introduces an identification problem. If we find a flight to familiarity effect in crisis times, how can we make sure it is really driven by familiarity and not by perceived implicit protection by the regional government in a crisis period. We address this identification problem by verifying whether the flight to familiarity effect is stronger in regions with more trust in the regional authorities (in which case we cannot reject the alternative hypothesis of perceived implicit government protection) or whether the flight to familiarity effect is possibly more pronounced in regions with more regional affinity (which would validate the flight to familiarity effect). Regional affinity measures to what extent citizens of a region positively identify themselves with and are emotionally attached to that region.

We measure depositors’ trust in regional and local authorities by the share of the region’s population that believes that the regional government deserves trust. This share is calculated on the data coming from the results of the “Socio-economic changes monitoring” surveys of Russian citizens, conducted regularly and nation-wide by the largest Russian companies for sociological research—WCIOM and Levada.

The regional affinity measure is based on the wave 14 (2005) of the Russia Longitudinal Monitoring Survey (RLMS-HSE), which is the series of nationally representative surveys of Russian households. This is the only wave in the survey series, which includes the question allowing creating a proxy for regional affinity: “Meeting different people during our lives, we easily find a common language with some of them, we understand them. Others, though they close to us, are always strangers. If we talk about you, how often—often, sometimes or never, do you feel closeness, unity with the people I will now mention? How often could you say “we” about them?”⁴ One of the options is “The residents of your region”. The proxy of regional

³ Metro stop in Moscow.

⁴ In Russian: Встречая в жизни разных людей, с одними мы легко находим общий язык, понимаем их. Иные же хоть и живут рядом, остаются всегда чужими. Если говорить о Вас, то как часто—часто, иногда или

affinity is the share of the regional population choosing the answer “Often”. As the period of the survey lies within the period of our study, to ensure the exogeneity of the regional affinity proxy we instrument it with the regionalism index, calculated in our earlier paper (Schoors, Semenova and Zubanov, 2017) and measuring the possible historical roots of regionalism dating back to the early transition period or even the late Soviet period, using data provided by Berkowitz, Hoekstra, and Schoors (2014). We assume that depositors will have a stronger emotional attachment to their region (affinity) in regions with a more homogenous and stable population. To test the hypotheses on the channels of familiarity we separate the sample by the median values of the regional affinity proxy and then the proxy of trust in regional authorities.

4.2.8 Implicit guaranties for foreign banks: what’s in the name?

We use the traditional approach to identifying quantity and price market discipline and modify it to test the significance of the foreign bank title effect. We focus on foreign banks which are identified using the list of banks that are 100% owned by non-residents of the Bank of Russia, as well as the list presented in (Vernikov, 2015). For foreign banks, we estimate regressions of the following form:

(16)

$$DEPG_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Name_{i,t} + \alpha_3 Risk_{i,t-1} \times Name_{i,t} + \alpha_4 Controls_{i,t} + \tau_t + \varepsilon_{i,t}$$

$$IEPG_{i,t} = \beta_0 + \beta_1 Risk_{i,t-1} + \beta_2 Name_{i,t} + \beta_3 Risk_{i,t-1} \times Name_{i,t} + \beta_4 Controls_{i,t} + \theta_t + \mu_{i,t}$$

(17)

In these equations, $DEPG_{i,t}$ is the increase in deposits of individuals in bank i in year t . $IEPG_{i,t}$ is the average interest rate on deposits of bank i in period t , calculated as the ratio of interest paid on deposits of individuals to the total volume of such deposits. $Risk_{i,t-1}$ is a vector of variables characterizing the bank’s risks. Following market discipline scholars, we include characteristics such as capital adequacy, liquidity, and asset quality.

$Name_{i,t}$ is binary variable we created to measure the impact of a foreign name. It takes the value 1 if the bank's name contains a signal about its foreign origin. Such a signal can be either a foreign word in the name (for example, Banca Intesa, Ziraat Bank), or a direct indication of the foreign origin of the bank (for example, Eurasian Bank, Royal Bank of Scotland). The variable is zero for banks whose names do not contain a detailed signal. If there is a country-of-

origin effect in the Russian deposit market, then a signal of foreign origin in the bank title will weaken the sensitivity of depositors to risk.

To analyze the impact of the crisis on the studied dependencies, we modify the basic model and include the variable $Crisis_t$. This binary variable takes the value 1 for 2008 and 2009 and 0 for the remaining periods. The modified regressions look like this:

$$DEPG_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Name_{i,t} + \alpha_3 Risk_{i,t-1} \times Name_{i,t} + \alpha_4 Controls_{i,t} + \alpha_5 Crisis_t + \alpha_6 Crisis_t \times Risk_{i,t-1} + \alpha_7 Crisis_t \times Risk_{i,t-1} \times Name_{i,t} + \tau_t + \varepsilon_{i,t} \quad (18)$$

$$IDEP_{i,t} = \beta_0 + \beta_1 Risk_{i,t-1} + \beta_2 Name_{i,t} + \beta_3 Risk_{i,t-1} \times Name_{i,t} + \beta_4 Controls_{i,t} + \beta_5 Crisis_t + \beta_6 Crisis_t \times Risk_{i,t-1} + \beta_7 Crisis_t \times Risk_{i,t-1} \times Name_{i,t} + \theta_t + \mu_{i,t} \quad (19)$$

Risk sensitivity may increase as depositors become more aware of bank riskiness during periods of financial instability. However, the opposite effect is also possible due to the predominance of panic in the market. For banks that signal foreign origin, we expect to find a decrease in risk sensitivity due to the strengthening of the country-of-origin effect.

4.2.9 The currency shifts as a disciplining mechanism

We estimate the following regressions that address share growth and deposit growth:

$$SGROWTH_{i,t} = \alpha_{si} + \mu_{s1} SGROWTH_{i,t-1} + \mu_{s2} SHARE_{i,t-1} + \beta_s BF_{i,t-1} + \gamma_s IR_DIF_{i,t} + \omega_{s1} EXCH_{i,t} + \omega_{s2} EXCH_{i,t}^2 + \theta_s Macro_{i,t} + \varepsilon_{it} \quad (20)$$

$$DGROWTH_{i,t} = \alpha_{di} + \mu_{d1} DGROWTH_{i,t-1} + \mu_{d2} DEPOSIT_{i,t-1} + \beta_d BF_{i,t-1} + \gamma_d IR_DIF_{i,t} + \omega_{d1} EXCH_{i,t} + \omega_{d2} EXCH_{i,t}^2 + \theta_d Macro_{i,t} + \delta_{it} \quad (21)$$

$SGROWTH_{i,t}$ stands for the growth rate of the share of deposits denominated in foreign currency in the total personal deposits of bank i in quarter t . $SHARE_{i,t-1}$ controls for the starting point for every bank, as the share of foreign currency deposits in the previous quarter.

$DGROWTH_{i,t}$ stands for the growth rate of foreign currency deposits in bank i in quarter t . $DEPOSIT_{i,t-1}$ controls for the starting conditions, as the amount of foreign currency deposits as a share of total liabilities in the previous quarter.

Both share growth and deposit growth are cleaned of the influence of the exchange rate dynamics. For the former, we examine the share change attributable to the quantitative effect (changes in volumes of currency deposited). For the latter, we use the growth of deposits measured in foreign currency and not rubles.

In both equations, the vector of the independent variables that is important for the market discipline is $BF_{i,t-1}$. This vector includes a number of risk measures in correspondence with the CAMEL model. We assume that depositors prefer deposits denominated in foreign currency in reliable banks. Therefore, for less risky banks, we expect to observe higher share growth and deposit growth rates. The vector of bank fundamentals includes the capital adequacy ratio (HI), the liquidity ratio ($H3$), the share of nonperforming loans in total loans (NPL), return on equity (ROE), and bank size ($\ln A$).

Depositor decisions on the currency structure depend strongly on the interest spread between deposits denominated in foreign currency and those denominated in rubles. Higher spreads make foreign currency investments more attractive. To control for this effect, we introduce the difference between the average interest rates for foreign currency and ruble deposits (IR_DIF), which is a supply-side effect, given that the spread also reflects the bank's demand for foreign currency and, therefore, the supply of foreign currency deposits. Therefore, controlling for the spread, we obtain the net (undistorted by the price effect) impact of a bank's risk on quantitative variables.

We include the exchange rate to control for the effects caused by currency rate dynamics ($EXCH$). Because the majority of the foreign currency deposits are denominated in U.S. dollars or euros, we use the reverse exchange rate weighted by a dual currency basket. The cost of the dual currency basket in Russia is composed of euro and dollar exchange rates in the ratio of 45 to 55%, respectively, according to the CBR guidelines. We presume that, with an increase in the exchange rate, individuals prefer to make deposits in foreign currency. We also include the squared exchange rate to control for the outflow effect. Experiences from financial crises show that, after a certain increase in the exchange rate, individuals are incentivized to keep their foreign currency savings in cash, outside the financial sector.

We use bank-level quarterly panel data for 900 banks for the period between the first quarter of 2005 and the second quarter of 2015. We estimate regressions using the Blundell-Bond dynamic panel-data system GMM estimation techniques as we consider the previous period dependent variable levels.

4.3 Interbank market under information asymmetry

4.3.1 Market discipline in the Russian interbank market under the crisis pressure

We examine the existence of quantity-based market discipline in the Russian interbank market and test its efficiency employing the Blundell-Bond estimations for dynamic panel data. For the purposes of our analysis, we use quarterly financial data of the Russian banks for the period 1Q2007–2Q2011.

To determine how borrowing in this market is influenced by information about bank characteristics, including bank risk, we follow a standard approach widely used in the literature. Market sensitivity to bank fundamentals is tested with the following econometric model:

$$MD_{i,t} = \beta_i + \alpha MD_{i,t-1} + \gamma BF_{i,t} + \rho I_{i,t-1} + \lambda C_t + \mu C_t * BF_{i,t} + T_t + \varepsilon_{it} \quad (22)$$

The dependent variable $MD_{i,t}$ is an indicator of market discipline. We concentrate on quantity-based disciplining mechanism which is measured, within our framework, by the natural logarithm of interbank borrowing average volume during a period t over total assets in the period t ($LnTO_{i,t}$). It does not show exactly the value of the bank's interbank borrowing, but rather reflects how active a bank is in the interbank market *during* a reporting period. Taking into account the short-term nature of the interbank market, we cannot rely on the end of period interbank borrowings, which is the standard market discipline measure used in the literature. Even if a bank is active in the market during the reporting period, the end-period figure can be zero. Therefore, interbank borrowing volume (or turnover) *during* the period represents a reasonable alternative for estimating quantity-based market discipline. We scale interbank borrowing volume using total bank assets in order to eliminate the size effect.

We separately examine market discipline from non-resident lenders using as a dependent variable the natural logarithm of foreign interbank average borrowing volume over total assets ($LnTO_{f,i,t}$). Non-resident lenders could potentially be more efficient in disciplining Russian banks than their domestic counterparties as they are less sensitive to internal rumors and other non-financial information.

Our explanatory variables include bank fundamentals that characterize bank risk-taking ($BF_{i,t}$), an indicator of the bank's involvement in the interbank market ($I_{i,t-1}$), quarter dummies (T), a dummy variable for the crisis period (C_t) that is equal to 1 for 2008–2009 and 0 otherwise and bank fundamentals multiplied by the dummy variable for the crisis period ($C_t * BF_{i,t}$). This structural breakpoint in the first half of 2008 is when the CBR marks start of deteriorating conditions in the financial sector.

Turning to the examination of the market discipline efficiency in the interbank market, we test the *peer-monitoring hypothesis*, implying that bank's risk levels and regulatory capital are influenced by its interbank borrowing. In particular, borrowing in the interbank market leads to lower risk values and higher capital levels of a bank.

Following (Nier and Baumann, 2006), we examine the effect of market discipline on the level of bank capital and the level of bank credit and overall risk. The econometric model employed is presented below:

$$Y_{it} = \beta_i + \varphi Y_{i,t-1} + \gamma x_{i,t-1} + \alpha z_{it} + \mu C_t * x_{it} + \delta C_t * z_{it} + T + \varepsilon_{it} \quad (23)$$

Y_{it} includes indicators of bank's capital level, credit and overall bank risk. The overall bank risk is approximated by the ratio of risk-weighted assets over total assets (rwa_as). A bank's capital level is represented by the capital adequacy ratio (NI). To reflect a bank's credit risk, we employ the ratio of $NPLs$ to total loans of bank i .

To examine the effect of market discipline on the risk behavior of bank i , we use the following explanatory variables (x_{it-1}): the natural logarithm of the average interbank borrowing volume over total assets of bank i ($LnTO$) and the natural logarithm of the interbank foreign borrowing volume over total assets of bank i ($LnTO_f$). These variables are taken with a one-quarter lag as the adjustment of risk-taking behavior of banks is not instant and obviously takes some time. If market discipline is efficient then higher borrowing in the interbank market will result in higher levels of bank capital and lower levels of bank credit and overall risk. In order to isolate the effects of our market discipline indicators, we employ a set of bank-level control variables (z_{it}) that might influence risk-taking behavior of a bank. We also include time dummies and the explanatory and control variables multiplied by the crisis dummy to examine the efficiency of market discipline during periods of distress.

4.3.2 Voluntary disclosure in the interbank market

We use the data from for 179 Russian banks, which accounts for almost 77% of the interbank market in 2013, over the period of 2004-2013.

To measure the degree of bank voluntary disclosure, we compute a set of yearly transparency sub-indexes to cover 6 different aspects: a global index which sums up 5 sub-indices: ownership structures, corporate procedure, financial information, risk management and board information. These criteria are based on the S&P approach. The data were collected manually by web scrapping using the questions used in the S&P survey and collected at the point of the last available year (2014), with regards to all of the available reports on banks webpages. For example, at the end of the year 2014, we collected the available data for any year mentioned on bank website: if a bank discloses the information online regarding "Identity of the largest shareholder" for 2014, 2013, and 2012, we then have the data for the 3 years. If the information on a criterion within the (sub-)index was found online, the criterion takes the value 1, and 0 if not. For example, if a bank provides a review of the last shareholder meeting, then the criteria takes the value 1 for section Q24 "*The existence of a review of last shareholders meeting*". We then add up individual criteria per category and computed the score of the bank on a 30 scale. The maximum score 30 means that the information of each of the 30 criteria is available. The scores are calculated for each year, providing us with some volatility over the period of analysis.

For a robustness check, we also use a transparency index based on the principle component analysis over all transparency measures.

For this analysis, we used a two-step regression over dynamic panel data as in (Blundell and Bond, 1998). The first step concerns disclosure being an indicator of financial health, while the second step concerns our main research question. The first step equation is:

$$\begin{aligned}
TR_{i,t} = & \beta_i + \alpha.Efficiency_{i,t-1} + \phi.CA_{i,t-1} + \gamma.NPL_{i,t-1} + \delta.DtoAsset_{i,t-1} \\
& + \rho.LoanToAsset_{i,t-1} + \lambda.Ownership_{i,t-1} + \theta.Macro_{t-1} + \epsilon_{i,t}
\end{aligned}
\tag{24}$$

The use of a CAMEL-type variables allow us to test the representativeness of transparency regarding the past financial health of a bank. $Efficiency_{i,t-1}$ represents the personnel expenses divided by the size of the asset, providing information relative to the ability of efficient labour cost management. CA is the main bank equity capital adequacy ratio. We also use the non-performing loan (NPL) ratio to total asset to measure the asset quality of the bank. The last two financial variables we use are *Deposit to total Asset ratio* and the *Loan to total Asset ratio*. We use a set of ownership variables, controlling for state (*State*) and foreign (*Foreign*) ownership. Lastly, we use a set of macroeconomic variable (*Macro*) predicted by principle component analysis and composed of GDP growth rate and the interbank interest rates of several maturities. The higher the *Macro* variable, the worse the macroeconomic situation is.

To determine the impact of transparency and the ability of banks to attract interbank loans, we follow a standard approach, widely used in the empirical literature related to disclosure. We use the following econometric model for each transparency component:

$$\begin{aligned}
IBL_{i,t} = & \beta_i + \alpha.IBLoans_{i,t-1} + \gamma.TRp_{i,t} + \rho.BF_{i,t} + \lambda.C_{i,t} + \phi.MACRO_t \\
& + \zeta.Quarter_t + \delta.Year_t + \epsilon_{i,t}
\end{aligned}
\tag{25}$$

$IBLoans_{i,t}$ is composed of the sum of interbank loans and deposits attracted by bank i , no matter the maturity, divided by the total liabilities, to account for the bank size. It captures the overall level of interbank funds a bank is able to attract. We consider only the quantitative aspect of market discipline as the change of credit limits is a quick instrument which is widely used by banks in the interbank market. Our explanatory variables include a set of predicted transparency indicators, one per regression, coming from the first step, CAMEL-type bank fundamentals, and a set of control variables, including the ownership structure and the systemic characteristics of the bank. Lastly, we used a principle component analysis predicted variable based on GDP growth and Moscow interbank interest rate for multiple maturities (*Macro*).

1.4 Competition

The hypothesis we test is that higher transparency is associated with lower concentration and lower market power in the banking system following the logic in (Cordella and Levy Yeyati, 2002).

In order to examine the link between the level of competition and concentration and the level of information disclosure in the banking system, we use the following econometric model:

$$Y_{it} = \beta_i + \gamma_1 Tr_{it} + \gamma_2 NPL_{it} + \gamma_3 Tr_{it} \times NPL_{it} + \gamma_4 Tr_{it} \times NPL_{it}^2 + \gamma_5 Tr_{it}^2 + \alpha z_{it} + \varepsilon_{it} \quad (26)$$

Dependent variables (Y_{it}) include the average banking sector Lerner index and interest margin as two proxies for the level of *bank power* in a country i in a year t and the share of three largest banks' assets in total banking system assets as a proxy for the level of *bank concentration*^{5,6}. We separately estimate the model for each of these banking sector characteristics.

Lerner index is a standard measure of the market power in the banking system (as well as in any other market) (Berger, Klapper, and Turk-Ariss 2009). In application to the banking system, it is calculated following the methodology described in (De Guevara, Maudos and Pérez, 2005) and implemented by the World Bank (see (Anzoategui, Martinez Peria and Rocha, 2010), (Anginer, Demirgüç-Kunt and Zhu, 2012) and others).

The explanatory variable of the largest interest for us is the proxy for the banking system transparency (Tr_{it}), constructed following an approach proposed in (Semenova, 2012) and described in section 4.2.1. This *transparency index* is based on the World Bank Banking Regulation and Supervision Survey questions related to bank disclosure and transparency:

- *Are off-balance sheet items disclosed to the public?*
- *Must banks disclose their risk management procedures to the public?*
- *Are bank directors legally liable if information disclosed is erroneous or misleading?*
- *Is an outside licensed audit obligatory for a bank?*

A positive answer for each question receives 1 point and a negative one receives 0 points. The maximum level of the index is, therefore, equal to 4. We also employ the transparency index

⁵ We use this simple measure of concentration as, according to (Bikker and Haaf, 2002), different concentration indices result in similar rankings of countries. Moreover, rankings of countries based on HHI and the share of the largest 3 banks are the closest (with correlation 0.98).

⁶ We do not consider more complicated competition measures, e.g. H-statistics or Boone indicator. They measure completion less broadly through efficiency as a competitive advantage, which is difficult to interpret, and not always appear to be a channel in real world (see a critical review in (Leon 2014)). The results we get (available upon request) are not significant, which can be caused by both lack of data for all the years we consider and the drawbacks of the methodology used.

components separately in our regressions in order to investigate what dimension of the disclosure regulation is more effective with respect to market structure.

Market discipline principles suggest that the effect of additional disclosure requirements depends nonlinearly on the reliability of banks: more transparency strengthens the position of a few reliable banks, while if the number of banks with low-quality assets is larger more transparency can increase bank concentration and market power. Therefore, we also test whether bank asset quality affects the relationship between transparency and concentration and market power. As an indicator of the asset quality we use the share of non-performing loans of the total loan portfolio of the banks in a country (NPL_{it}). Furthermore, as shown in a theoretical work (Gomez and Ponce, 2013), the relationship between competition and bank asset quality is U-shaped, which confirms the appropriateness of our empiric model (in part where we include $Tr_{it} * NPL_{it}^2$). We also test whether there is an optimal level of transparency by means of including Tr_{it}^2 variable in our econometric model.

To capture cross-country macroeconomic and banking system differences we introduce a number of control variables (Z_{it}). First of all, we control for the size of a banking system, the share of bank licenses denied in total number of licenses applied for, the index of the overall restrictions on banking activities, the existence of a deposit insurance scheme, the shares of the state-owned bank assets and foreign-owned bank assets. Finally, we include concentration as an explanatory variable following the theory of industrial organizations (Bain, 1956; Hannan, 1991). In order to correct for the endogeneity issue we instrument the concentration index with macroeconomic indicators—GDP per capita and inflation. In order to test whether the effect from higher information disclosure requirements differs in countries at the different economic development levels, we additionally carry our estimations for developed and developing countries. In developed countries disclosure requirements can be less efficient due to higher quality of existing regulation and better institutional environment.

We estimate the model using the panel data random effect model. We use the data from the World Bank database “Global Financial Development Database” and the Bank Regulation and Supervision Surveys. The surveys cover only the years 1998, 2001, 2005 and 2010. Therefore, we limit our period under consideration to these years. We use the data on 63-102 developed and developing economies (depending on the model specification).

5. Contribution

We contribute to the literature at least in the following ways:

1. We explore the non-linearity in relationship between the depth of the credit information disclosure and the stability of the banking sector in terms of credit risks in a cross-country perspective. The influence of the economic and institutional development, as well as financial sector size on the nature of the relationship under consideration are explored.
2. We are the first to model the bank's incentives to misreport within the information sharing system where as the membership is obligatory.
3. We enrich the theoretical literature on the information-based bank runs in the ala Diamond-Dybvig set-up by incorporating the costs the depositors bear to obtain information signals on increased bank risks. In addition we explore the role of the deposit insurance system with co-insurance as a guarantee mechanism allowing avoiding panic bank runs but preserving the market disciplining within the model of deposit market with costly signals.
4. We are the first to combine the results of an experimental simultaneous game of the deposit market with multiple independent rounds, modelling several economic scenarios, aiming to detect coordination failure under different conditions, with the student academic achievements as a proxy of financial literacy.
5. We are the first to perform the bank run analysis on the Russian 1998 crisis data, exploring the influence of financial literacy and media freedom on the intensity of the bank runs. We provide the evidence that both factors were significant during the 2008-2009 crisis as well.
6. We make a first attempt to explore the flight to familiarity effect in the deposit market and to provide the evidence for Russian regional banks during the 2008 financial crisis, constructing a new characteristic of bank familiarity based on the bank title. We prove it was driven by familiarity and not by implicit guarantees from a trusted regional or local government.
7. Ours is the only paper on the impact of rebranding of foreign banks on Russian depositor behaviour. We construct a new characteristic of bank, signaling the foreign control, based on the bank title.
8. We offer a new mechanism of market discipline by deposits—currency shifts—that implies that more reliable banks attract more foreign currency funds and show a higher foreign currency deposit share in total personal deposits. We provide the evidence for this mechanism working in the Russian deposit market
9. We break new ground by attempting to measure not only the existence of market discipline but also its efficiency in the Russian interbank market. We are the first to empirically show that voluntary disclosure, when it conveys information on bank fundamentals, increases interbank borrowing capacities.
10. Despite the fact that the link between competition and transparency has been examined within theoretical context the empirical analysis of this issue (in a banking system, in

particular) has not been conducted. We fill this gap examining the link between bank mandatory information disclosure and bank market power and concentration in a cross-country context

6. Main findings

Our main results come as follows:

1. Based on data on more than 90 countries for 2004–2020, we show that the relationship between disclosure and credit risk is reverse U-shaped: credit risk is low when credit bureaus either disclose very little information (for instance when they are just introduced) or disclose full, detailed information about borrowers. Credit risks decrease with increasing depth of disclosure by credit bureaus and credit registers in a high-quality institutional environment and in well-developed financial markets (Iakimenko, Semenova and Zimin, 2022);
2. We theoretically demonstrated that the banks have the incentives to report false information about credit discipline of their borrowers as well as about borrowers' intrinsic characteristics. Possessing unique databases a bank continues to extract informational rent and therefore enjoys a competitive advantage even being a member of the system of information sharing. Our model additionally shows that the banks themselves are not interested in exerting data quality control (Semenova, 2008);
3. Using the cross-country data we show, there exists no statistically significant difference in transparency between countries with and without market discipline. The econometric analysis shows no positive and statistically significant relationship between banking system transparency and market discipline as well (Semenova, 2012);
4. We theoretically show that in the case where the costs for one of the depositors are prohibitively high, an equilibrium characterized by effective deposit withdrawals never arises. At low values of profitability and the costs of the second depositor exceeding the minimum value in the model, an equilibrium arises characterized by an ineffective run. Analysis of the model also shows that if the costs of one of the investors are minimal, then the equilibrium characterized by effective deposit withdrawals will be the only one even in the case of costs other than the minimum (but not exceeding the maximum acceptable level), regardless of the profitability of deposits and the probability of project success in case of bad news (Семенова, 2011). If the deposit insurance system implies coinsurance, then although the minimum acceptable level of costs decreases under deposit insurance guarantees, it remains positive provided that depositors continue to need to acquire information. This indicates that there are conditions under which the deposit insurance system allows not only

- to avoid ineffective bank runs, but also to maintain the possibility of effective ones (Семенова, 2011). Our empirical results suggest that the guarantees provided by the deposit insurance system of that kind in Russia did not fully undermine the incentives to monitor the safety of investments and implement market discipline. However, the foreign banks became less disciplined, for all the rest more focus appeared on profitability and the importance of credit risks became lower (Семенова, 2008);
5. We experimentally show that being smart makes depositors less prone to getting involved in an inefficient bank run: students demonstrating better academic achievements choose the strategy of avoiding early withdrawals more frequently (Semenova, 2023). This result is supported empirically: we show that during the 1998 crisis well educated people were less likely to run on Sberbank, they were more likely to run on banks in general, lending support to the idea that well-educated people understand the too big to fail nature of Sberbank better (Семенова, 2008);
 6. We find that the regions with lower degree of media freedom faced less severe bank runs during the 1998 crisis (Pyle *et al.*, 2012). The same is true for the 2008-2009 crisis: we show that in regions where media freedom is controlled to a greater extent, there was a significantly less serious decline in the growth of bank deposits of individuals. The reduction in the deposit growth in the regions with higher degree of media freedom is more significant if depositors demonstrate a high level of financial literacy (Semenova and Kaul, 2017);
 7. Using 2001-2010 bank-level and region-level data for Russia, we show evidence for the flight to familiarity effect in the Russian deposit market: the sensitivity to bank riskiness, which is strong for all banks in stable times, disappears for familiar banks during the crisis. The effect is strongly present in regions with strong regional affinity, while the effect is rejected in regions with more trust in regional and local governments (Schoors, Semenova and Zubanov, 2019);
 8. We found evidence of quantitative market discipline for foreign banks in Russia along with the effect of consumer ethnocentrism: foreign banks signaling the foreign control via their titles require closer monitoring in depositor eyes. During the 2008 crisis we did not receive the expected reduction in the intensity of quantitative market discipline for banks that signaled foreign ownership (Семенова, Козлова, 2017);
 9. Using the bank-level quarterly panel data for 900 Russian banks for 2005-2015 we show that less risky banks—at least in terms of capital adequacy and credit portfolio quality—more intensively gain higher FX deposit share. The FX deposit growth rate is also higher for these banks. Therefore we provide the evidence for currency shifts as a disciplinary mechanism (Semenova and Shapkin, 2019);

10. The market discipline in the Russian interbank market was absent during stable times, but emerged during the 2008 crisis with respect to credit risk. The efficiency of market discipline in Russian interbank market appears only during the crisis period: a higher level of total interbank borrowing average volume over total bank assets corresponds to a decline in the level of credit risk and to a rise in capital adequacy levels in the following quarter (Andrievskaya and Semenova, 2015). Higher transparency levels increase the level of interbank loans attracted by Russian banks (Guillemin and Semenova, 2020);
11. Using the data on 63-102 developed and developing economies for 1998, 2001, 2005 and 2010 we show that banking markets are less concentrated in the countries with stricter disclosure requirements. This effect grows with the growth of the bank credit risks, which is in line with market discipline theory. Nevertheless, when these risks are too high, the regulation with respect to information disclosure becomes less effective and can lead to the opposite results: the link between concentration and disclosure requirements becomes even positive. The relationship between transparency and market power, though, is less obvious: the results demonstrate a positive link between transparency and Lerner index and a negative relationship with the interest margin, which is an indicator of a reduction of market power (Andrievskaya and Semenova, 2016);

7. Approbation of the results of the research

The results of the papers included into this dissertation were presented at numerous conferences, both international and Russian ones:

- II and VIII International conference «Modern Econometric Tools and Applications—META» 2015, 2021 (HSE Nizhny Novgorod)
- 7th International Conference of the Financial Engineering and Banking Society (FEBS), 2017 (Glasgow, UK).
- 6th Cross Country Perspectives in Finance Conference (CCPF 2021), online
- iCare 9—International Conference on Applied Research in Economics 2021 (HSE Perm).
- International Risk Management Conference (IRMC) 2020, online
- IX, XI, XII, XVII, XIX, XX April International Academic Conference On Economic and Social Development, HSE, 2008, 2010, 2011, 2016, 2018, 2019 (HSE, Moscow)
- Analytics for Management and Economics Conference (AMEC-2018), HSE Saint Petersburg, Russia

- 20th Annual Conference of the Society for Institutional & Organizational Economics (SIOE 2016), Paris, France, June 15-17, 2016
- 4th and 6th International Finance and Banking Society Conference (IFABS) 2014 (Valencia, Spain) and 2016 (Barcelona, Spain)
- 29th and 32th GdRE International Symposium on Money, Banking and Finance, 2012 (Nantes, France) and 2015 (Nice, France)
- 3rd European Conference on Banking and the Economy, 2014 (Winchester, UK)
- 49th Eastern Finance Association Conference, 2013 (St. Pete Beach, FL, USA)
- 31st CIRET Conference "Economic Tendency Surveys and Economic Policy", 2012 (Vienna, Austria)
- NES/HSE Conference 2011, New Economic School, Moscow (Russia)
- 42nd Annual Conference of the Money, Macro and Finance Research Group, 2010 (Limassol, Cyprus);
- 14th Annual Conference of the International Society of New Institutional Economics (ISNIE), 2010 (Stirling, UK);
- 2008, 2009 and 2010 Spring Meeting of Young Economists (SMYE), 2008 (Lille, France), 2009 (Istanbul, Turkey) and 2010 (Luxemburg);
- International workshop on Money, Banking and Financial Markets, 2009 (Düsseldorf, Germany)
- International workshop Monetary and Financial Transformations in Central and Eastern Europe 2008 (Paris, France);
- The Ronald Coase Institute's Workshop, 2007 (Reykjavik, Iceland);
- International Conference on Risk, Regulation and Competition: Banking in Transition Economies 2006 (Ghent, Belgium);

8. List of articles

The results discussed in this text are presented in the following publications:

Основные результаты диссертационного исследования опубликованы в 14 работах общим объемом 17,1 p.s.; personal contribution автора составляет 12,9 p.s.

Journal article	Personal contribution	Publication is in		
		Web of Science/ Scopus/ MathSciNet	HSE journal list (A-D)	List of peer-reviewed scientific journals recommended by the Higher Attestation Commission

1. Semenova M. Do Smart Depositors Avoid Inefficient Bank Runs? An Experimental Study // Emerging Markets Finance and Trade. 2023. Vol. 59. No. 8. P. 2710-2726.	1 p.s.	Scopus, Q1	yes, List A	yes
2. Iakimenko I., Semenova M., Zimin E. The more the better? Information sharing and credit risk // Journal of International Financial Markets, Institutions and Money. 2022. Vol. 80. Article 101651.	in co-auth., personal contribution - 0,5 p.s.	Scopus, Q1	yes, List A	yes
3. Guillemin F., Semenova M. Transparency and market discipline: evidence from the Russian interbank market // Annals of Finance. 2020. Vol. 16. No. 2. P. 219-251.	in co-auth., personal contribution - 1,5 p.s.	Scopus, Q2	yes, List A	yes
4. Semenova M., Shapkin A. Currency Shifts as a Market Discipline Device: The Case of the Russian Market for Personal Deposits // Emerging Markets Finance and Trade. 2019. Vol. 55. No. 10. P. 2149-2163.	in co-auth., personal contribution - 0,5 p.s.	Scopus, Q1	yes, List A	yes
5. Schoors K., Semenova M., Zubanov A. Depositor discipline during crisis: Flight to familiarity or trust in local authorities? // Journal of Financial Stability. 2019. Vol. 43. P. 25-39.	in co-auth., personal contribution - 0,6 p.s.	Scopus, Q1	yes, List A	yes
6. Semenova M., Kozlova A. Foreign banks and market discipline in the Russian market for personal deposits: what's in the name? // HSE Economic Journal. 2017. Vol. 21. № 1. P. 66-88. (In Russian).	in co-auth., personal contribution - 1 p.s.	Scopus, Q4	yes, List B	yes
7. Semenova M., Kaul A. Bank Panics and Media Freedom during the 2008–2009 Financial Crisis: Evidence from Russian Regions. 2017. Vol. 11. № 2. P. 15-31. (In Russian)	in co-auth., personal contribution – 0,8 p.s.	no	yes, List D	yes
8. Semenova M., Andrievskaya I. Does banking system transparency enhance bank competition? Cross-country evidence // Journal of Financial Stability. 2016. Vol. 23. P. 33-50.	in co-auth., personal contribution - 0,6 p.s.	Scopus, Q1	yes, List A	yes
9. Semenova M., Andrievskaya I. K. Market Discipline in the Interbank Market: Evidence from Russia // Eastern European Economics. 2015. Vol. 53. No. 2. P. 69-98.	in co-auth., personal contribution - 1,2 p.s.	Scopus, Q3	yes, List C	yes
10. Pyle W., Schoors K., Semenova M., Yudaeva K. Bank Depositor Behavior in Russia in the Aftermath of Financial Crisis // Eurasian Geography and Economics. 2012. Vol. 53. No. 2. P. 267-284.	in co-auth., personal contribution – 0,4 p.s.	Scopus, Q1	yes, List A	yes
11. Semenova M. Market discipline and banking system transparency: Do we need more information? // Journal of Banking Regulation. 2012. Vol. 13. No. 3. P. 241-248.	0,5 p.s.	Scopus, Q3	yes, List C	yes
12. Semenova M. Bank runs and Costly Information // Journal of New Economic Association. 2011. Vol. 10. P. 31-52. (In Russian)	1,4 p.s.	no	yes, List B	yes
13. Semenova M. Information Sharing in Credit Markets: Incentives for Incorrect Information Reporting // Comparative Economic Studies. 2008. Vol. 50. No. 3. P. 381-415.	2,2 p.s.	Scopus, Q3	yes, List B	yes

14. Semenova M. Deposit insurance and Russian depositor strategies // Russian Journal of Money and Finance. 2008.Vol. 10. P. 21-31. (In Russian)	0,7 p.s.	no	yes, List D	yes
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