The Risk Alleviating Role of Interbank Market Lending in Central and Eastern European Countries

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Preliminary. Do not quote

This Version: February 2004

Abstract:

The banking sectors in several Central and Eastern European countries are characterized by a two-tier structure, in which a few large banks dominate the deposit market but are very inactive in the loan market with private borrowers, while many small banks engage in lending but have only small shares of the deposit market. The large banks act as net lenders in the interbank market, while small banks are net borrowers in the market. Typically, the former banks are incumbent institutions from pre-transition times, while the later are new institutions.

In this paper, we ask whether this two-tier structure and the resulting interbank trade has any important risk alleviating effects on the performance of the banking sector. Specifically, we consider the effects on the lending activities of the small banks. We present a model of the credit market based on asymmetric information and moral hazard. Assuming that large banks have monitoring costs benefits compared to depositors regarding the lending activities of the other banks, we show that the two-tier structure induces small banks to engage in less risky lending activities than small banks that finance themselves predominantly in the deposit market.

We test this and related hypotheses using balance sheet data from banks in 10 EU accession candidate countries. This allows us to compare the financial activities of banks in countries where a two-tier structure prevails with those of small banks in markets where such a pattern is not observed. The results generally confirm the main hypothesis of the model.

Key words: bank specialization, interbank market, risk undertaking, transition countries

JEL: G21, E53

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1. Introduction

The banking sectors of the Central and Eastern European (CEE) countries underwent turbulent changes during the last decade. The strongly specialized and concentrated market structure of the monobank system was mostly liberalized and a large number of new players entered the market. But still in some of the sample countries, the incumbent banks (those that are direct successors of the monobank system banks) managed to utilize the benefits of their widespread branch network and customer relations and developed a relative specialization in deposit raising activities thus preserving a large part of their market share in the market for customer deposits. On the other hand, most of the new entrant banks specialize in providing credit to the new emerging private sector.

As a result of the specialization of large incumbent banks in deposit raising activities, these banks persistently have more funds (gathered as customer deposits) than they distribute to the real sector. On the other hand, the new entrant banks, specialized in lending activities, persistently have less customer deposits than the amount of potential projects they could finance. The interbank market in these countries tends to clear these inequalities between gathered deposits and granted loans for banks with strong specialization attitude in the one or the other direction. Thus, a financial intermediation system with a two-tier structure[1] emerges: the first tier of banks (mainly the large incumbents) gather the deposits from the public and transfer them through the interbank market to the second tier banks, mainly new entrants, which themselves provide credit to the real sector.

This phenomenon is described by various studies concerning the CEE banking industry (e.g. Bonin (1998), Petrov (2000)) but also by studies on banking in developing countries (see Cole and Slide (1999) for the case of Indonesia).

The purpose of the current paper is to investigate whether bank specialization and the resulting interbank lending are associated with interbank monitoring of the banks which borrow in the interbank market. Such monitoring would induce lower levels of risk undertaking by the interbank borrowing banks. We employ both theoretical and empirical tools in the analysis to provide a systematic study of the risk effects of bank specialization. The novelty of our study consists of combining two strands of the modern literature in the

[1] In the current paper we use the term "two-tier" structure of the financial intermediation system with a different meaning than the one often used in the literature on transition, namely a banking system consisting of a central bank and commercial banks as separate entities.

unique context of a newly emerged structure of interbank markets in transition economies, which differs significantly from the one observed in developed countries.

The first strand of literature explores the relation between bank specialization and interbank lending. Research in this area is still limited. Most theoretical papers explain the existence of an interbank market as an efficient mechanism for mutual insurance among banks against idiosyncratic liquidity shocks (Bhattacharya and Gale (1987), Hellwig (1994)). Evidence exists that the interbank trade in the developed banking systems is mainly motivated by the reserve requirements imposed by the Central Bank. Banks keep certain amount of liquid funds for the purpose of covering Central Bank reserve requirements. But only shortly before the expiration of the maintenance period they realize whether they have sufficient (or even excess funds) or insufficient funds to cover the reserve requirements. In the former case banks will offer funds in the interbank market, whereas in the latter case they have to borrow interbank funds. Therefore, the volume of trade concentrates mainly on the days before the expiration of the maintenance period (Hamilton (1996)). Theoretical models (see Ho and Saunders (1985)) explain and empirical papers (i.e. Furfine (1999) and Hartmann et al. (2001)) present evidence on the phenomenon that in developed banking systems large banks tend to be net borrowers, and small bank – net lenders.

Only few studies suggest that the pattern of interbank trade could be determined by long-term specialization rather than short-term liquidity insurance (Berger et al (1993) and Manzano and Galmes (1995)). Banks may participate in the interbank trading of funds, because, due to specialization in deposit raising or credit granting they have systematic excess supply of or demand for funds. A bank specialized in deposit raising activities but with underdeveloped credit activities will systematically have excess idle funds that could be channelled to other banks. This indicates the possibility that the interbank market may not only provide a covering of short-term liquidity needs but also fulfil clearing functions in cases of systematic specialization. Apart from the descriptive literature, there does not exist much theory dealing with this type of bank specialization. Calveras (2001) represents one of the few theoretical works on the topic. He builds a theoretical model explaining how different interbank settings affect the strategies of banks to specialize, and in which activity (deposit raising or credit granting). Unfortunately, there exists no systematic study of the magnitude of the phenomenon of specialization in credit or deposit activities and its impact on the interbank market.

The second strand of literature explores the relation between interbank lending and peer monitoring. In a seminal paper, Rochet and Tirole (1996) develop a model of interbank lending where the existence of interbank exposures generates incentives for interbank monitoring. These authors examine the trade-off between the risk alleviating effects of peer monitoring and the risk aggravating effects caused by the increase in systemic risk due to increased linkages between banks. They compare a centralized[2] and a decentralized transfer of funds system and conclude that the decentralized operation of interbank lending must be motivated by peer monitoring and is only optimal, if banks are better suited to acquire and interpret information about each other than the regulatory authorities. In Rochet and Tirole's context, the incentives for monitoring of interbank borrowers are reduced by the implicit insurance of interbank claims that most governments de facto provide by their readiness to rescue distressed borrowing banks. The problem is that, even if interbank-lending banks are suited to accumulate and assess information about interbank-borrowing banks' projects, they will not perform proper interbank monitoring as far as the government in its attempts to minimize systemic risk is likely to bail-out distressed interbank-borrowing banks (thus providing implicit guarantee on interbank deposits).

The theory we introduce below differs from Rochet and Tirole's (1996) in the sense that we analyse markets where bailing-out distressed interbank borrowing banks in order to prevent systemic risk is less likely than in the context described by Rochet and Tirole (1996) and thus interbank monitoring is not hampered by moral hazard issues. Rochet and Tirole focus on a situation where lending banks have weak incentives to monitor their interbank borrowers, since they expect the government to bail out the borrower in case of distress in order to reduce systemic risk. The government will be "forced" to bail out distressed banks because borrowing banks are usually relative large institutions with a large number of lenders and a default of a borrowing bank will generate losses in a large number of other banks (too-big-to-fail doctrine). In the situation we observe in the CEE countries with two-tier financial intermediation system, governments experience lower pressure of bailing-out interbank borrowing banks, because the latter are typically small institutions which mainly borrow from one lending bank and the amount of borrowing is small relative to lending bank's assets. Therefore, the risk of contagion of the whole system is reduced and authorities are less likely to interfere. This implies that lending banks have to provide monitoring themselves in order to reduce shirking by the borrowing banks.

[2] A system in which the Central bank acts as a counterparty and guarantees the finality of payments.

In this settings our model shows that a new entrant bank that finances itself through the interbank market should have a risk level that is not higher than that of a new entrant bank that fully finances itself through customer deposits. The reason is that a bank financed through the interbank market will be monitored because for large creditors (in this case the large incumbent banks) the costs of monitoring are justified by the benefits of the lower risk of the borrower, whereas the bank fully financed by customer deposits will not be monitored as monitoring costs are high relative to amounts of individual deposits.

The empirical part consist of two steps. First, we provide empirical evidence on the transfer of funds from the large banks to the rest of the banking system and determine in which of the sample countries[3] this phenomenon is of significant magnitude. Second, we empirically test the hypotheses of the theoretical model. The analysis is based on financial statements data from banks in 10 EU accession candidate countries for the period 1994-2001. The empirical evidence on different levels of risk provides clues for policy recommendations. If a two-tier structure mitigates risk, measures supporting bank specialization (e.g. deregulation of the interbank market) may be appropriate.

The paper is organised as following. The theoretical model is presented in section 2. Section 3 presents the data sources. Section 4 explains the two-tier financial intermediation system in detail, and proposes variables quantifying the two-tier financial intermediation phenomenon. Section 5 present the econometric models for the comparison of banks' risk characteristics and the results of the estimations, and section 6 concludes.

[3] The sample consists of ten CEE countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia.

2. Risk implications of bank specialization: a model

The following section concentrates on the implications of the existence of a two-tier system on the level of bank risk.

We introduce a model where monitoring of a bank is necessary as a prevention from a credit market collapse but is too costly to be performed by the individual depositors. In this situation the monitoring function can be performed by large banking institutions which lend funds to smaller banks and have cost advantage (due to economies of scale) in providing monitoring of the credit activities of the banks borrowing funds from them. The model aims at a comparison of the level of risk undertaking of banks which fully finance their activities through customer deposits and banks which finance substantial part of their projects through interbank borrowing.

The model is based on the following assumptions[4],:

A1. There are exist two types of entrepreneurs: one with a "good" project and one with a "bad" project. Both projects require an investment of size 1. Table 1 illustrates the probability of success and the returns of the projects.

Table 1: Returns of good and bad projects

"Good" Project	Good state of the world	Bad state of the world
Probability	Π_G	1- Π_G
Return	G	0

"Bad" Project	Good state of the world	Bad state of the world
Probability	Π_B	1- Π_G
Return	B	0

[4] The model is an extended version of a simple model of credit market with moral hazard, based on Freixas and Rochet (1999)

The return of a "good" project is G with probability Π_G (in case of success) or 0 otherwise, the return of a "bad" project is B with probability Π_B and 0 otherwise. "Good" projects have a positive net present value, whereas "bad" projects have a negative net present value:

$$G\,\Pi_G - 1 > 0 > B\,\Pi_B - 1 \qquad (1)$$

$$G < B$$

$$\Pi_G > \Pi_B$$

A2. The population of banks consists of two types of institutions:

- large banks, which are considered to have implicit or explicit guarantee by the government (e.g. due to too-big-to-fail considerations or historical reasons). Deposit rates with these banks (i_{lb}) equal the riskless interest rate, considered for simplicity 0. A large bank should repay to depositors the amount of $D_{lb} = 1 + i_{lb} = 1$ (the rate of repayment to the depositors D_{lb} for a deposited amount of 1 is equal to 1);

- and small banks[5] – banking institutions with non-diversified portfolio and without government protection. Deposits with small banks are considered to be risky, interest rates on customer deposits with these banks are higher than the ones on customer deposits with large banks. Denote by i_{sb} small banks' interest rate on customer deposits, $i_{sb} > i_{lb}$. To simplify the further computation we prefer to work with the amounts of repayment. We denote by D the amount a bank should repay to its depositors for a deposit in volume of 1 ($D = 1 + i_{sb}$, where i_{sb} denotes small banks' interest rate on customer deposits).

A3. Both entrepreneurs and banks have limited liability and are risk neutral

A4. The large banks develop a specialization in deposit gathering activities: the volume of customer deposits they raise is higher than the volume of loans they grant to entrepreneurs (the difference between gathered deposits and granted loans is called idle funds). Depending

[5] Here as in the rest of the text we call the new entrant banks "small". Clearly a lot of new entrant institutions managed to develop themselves into medium-sized or large banks, but in all of the sample countries where a two-tier financial intermediation system exists, we observe that the major deposit taking institutions are incumbent banks. So, the distinction "small"-"large" is conditional on the role of the respective bank on the deposit gathering market.

on its volume of idle funds; a large bank offers a small bank an interbank deposit of α ($0 < \alpha \leq 1$). The repayment that the large bank requires for such an interbank deposits is denoted by d ($d = 1 + i_{ib}$, where i_{sb} denotes the interest rate on the interbank deposit). Therefore, the small bank should repay αd for an interbank deposits of α.

A5. Small banks have total size of the deposits equal to unity (so α is the share of interbank deposits in the total liabilities of the small bank), and they grant a loan to one entrepreneur of total volume of 1 (finance one project). The banks can observe the type of the entrepreneur and set the respective repayment rates R_G and R_B. The expected return of a loan for a "bad" project is negative, whereas the one for a "good" project is positive:

$$R_G \Pi_G - 1 > 0 > R_B \Pi_B - 1 \qquad (2)$$

$$R_B > R_G$$

A6. Customer depositors deposit small amounts, so that n depositors ($n \to \infty$) are needed to raise total deposits of size 1, each depositor invests 1/n.

Let us at this point illustrate the possibility that a bank could have an incentive to finance an investment in a "bad" project, despite of its knowledge of the project's negative net present value:

Denote by R the repayment a bank owes to its creditors ($R = D$ if the bank is fully financed by customer deposits and $R = \alpha d + (1- \alpha)D$ if the bank is partly financed by customer deposits and partly by an interbank deposit).

The bank will choose to invest in the "good" project if and only if the expected net return form a "good" project is not lower than the one from a "bad" project. Therefore, the bank will invest in a good project if and only if:

$$\Pi_G (R_G - R) \geq \Pi_B (R_B - R) \Leftrightarrow \Pi_G R_G - \Pi_B R_B \geq R (\Pi_G - \Pi_B)$$

$$\Leftrightarrow R \leq (\Pi_G R_G - \Pi_B R_B)/(\Pi_G - \Pi_B), \qquad (3)$$

Denote $(\Pi_G R_G - \Pi_B R_B)/(\Pi_G - \Pi_B) = R_C$. Then R_C is a critical value of the repayment above which the bank will choose to invest in a "bad" project. That is, a bank will invest in a good project is and only if:

$$R \leq R_C \qquad (3')$$

If $R_C < 1$ small banks have incentive to invest in "bad" projects for every feasible repayment rate and the credit market collapses, therefore we assume that $R_C \geq 1$, for now on.

If small banks are fully financed with customer deposits, a competitive equilibrium on the market for deposits in small banks requires that the expected repayment to depositors should equal the amount deposited. That is

$$D\,\Pi_D = 1 \qquad (4)$$

where Π_D denotes the probability of repayment to the depositors:

$$\Pi_D = \begin{cases} \Pi_G \text{ if } D \leq R_C, \text{ and the bank invests in a "good" project} \\ \Pi_B \text{ if } D > R_C, \text{ and the bank invests in a "bad" project.} \end{cases}$$

The following two cases have to be considered:

A. $\Pi_G R_C \geq 1$ (moral hazard is not too strong)

In this case there exists D such that $D \leq R_C$ and $\Pi_G\, D = 1$. There exist equilibrium on the market for deposits in small banks in which small banks invest in good projects.

B. $\Pi_G R_C < 1$ (strong moral hazard issue)

If $D > R_C$ the bad project will be financed and the repayment probability is Π_B, but $D\Pi_B < R_B\Pi_B < 1$. On the other hand if $D \leq R_C$, then the repayment probability is Π_G but $\Pi_G D \leq \Pi_G R_C < 1$. Therefore, in this case, there exist no repayment rate on customer deposits D which fulfils the equality $D\Pi_D = 1$. Therefore, in the absence of monitoring the credit market will collapse as depositors realize losses in expectations. Further on in the model we will concentrate on this case.

A7. Let us introduce now a monitoring technology. At cost $M > 0$ the creditors of a small bank can screen the type of the project and introduce different interest rates according to the type of the project and if only good projects are preferred by the small banks creditors they can enforce investment in a "good" project[6].

[6] We adopt the broad concept of monitoring introduced in Hellwig (1991), according to which monitoring includes:

- screening of projects (a priori)
- preventing opportunistic behaviour of the borrower during the realisation of the project (moral hazard)

It is obvious that retail depositors prefer investment in a good project, otherwise they will realize loss in expectations. Furthermore, under the assumption of low deposit rates of large banks we can prove that the large banks are only interested in investing in "good" projects. This result is formalized in Proposition 1.

Proposition 1: If D < RC large banks will realize higher net returns if they provide interbank deposits only to small banks which invest in "good" projects.

Proof: See Appendix

In order for monitoring to take place the monitoring cost M should be lower than the benefits of it. Therefore, monitoring by customer depositors is impossible (if $n \rightarrow \infty$, $1/n(\Pi_G D - \Pi_B D) < M$).

On the other hand, the large bank as creditor of the small bank will monitor if and only if the benefit of monitoring, that is the difference of the expected repayments is not lower than the monitoring costs, from which it follows that:

$$\alpha d(\Pi_G - \Pi_B) \geq M$$

$$\alpha \geq M/d(\Pi_G - \Pi_B) = \alpha_{mc} \qquad (5)$$

Note, furthermore, that since monitoring is costly, customer depositors are not able to distinguish whether a small bank is borrowing on the interbank market and is thus been monitored by the lending bank or not. As a consequence depositors require an uniform repayment rate on their deposits from all small banks irrespective of the fact that some of them get financing from large banks which monitor them and thus undertake less risky projects.

Let us illustrate the problems of the large and the small bank in order to derive the possible equilibria.

The problem of the large bank:

If $\alpha \geq M/(\Pi_G * d - \Pi B * d) = \alpha_{mc}$ then the large bank will lend the small bank a monitored interbank loan forcing it to invest prudently.

- punishing or auditing a borrower who fails to meet contractual obligations.

If $\alpha < \alpha_{mc}$ (the volume of idle funds is too low or the monitoring costs are too high), the large bank reckons with opportunistic behaviour of the small bank and will prefer not to provide the interbank loan.

The problem of the small bank:

If $\Pi_G R_C < 1$, then $1/\Pi_G > R_C$, but $D \geq 1/\Pi_G$ (otherwise depositors will anticipate the expected loss) from which it follows that $D > R_C$ and in absence of interbank financing/monitoring each small bank will misbehave.

$D > R_C$ implies the following alternatives for the small bank:

(i) to fully finance itself through customer deposits. In this case it has the possibility to invest in a "bad" project. The expected net return of the small bank is given by the expected loan return minus the due repayment to depositors (as the small banks has limited liability the repayment is equal to 0 if the project fails). Formally the net expected return in this case is expressed as:

$$\Pi_B(R_B - D) \qquad (6)$$

(ii) to accept an interbank deposit. In this case its behaviour is monitored and the bank should invest in a "good" project. The expected net return of the bank is equal to the expected loan return minus the due repayment to customer and interbank depositors (again due to limited liability the repayment to depositors is equal to 0 if the project fails). Formally the net expected return is expressed as:

$$\Pi_G(R_G - \alpha d - (1- \alpha)D) \qquad (7)$$

The small bank will prefer to accept the interbank loan under the condition of monitoring if and only if the net expected return from alternative (i) is higher than the one from alternative (ii), that is if (7) is higher then (6):

$\Pi_G(R_G - \alpha d - (1- \alpha)D) > \Pi_B(R_B - D)$, from which follows

$$\alpha > (\Pi_B(R_B - D) - \Pi_G(R_G - D))/ (\Pi_G (D - d)) = \alpha_{lc} \qquad (8)$$

If $D > R_C$ the bank would have incentives to invest in the bad project, but it could invest in the good one if it has the possibility to receive a monitored interbank loan that is large enough (α is high). Notice that if $D > R_C \Rightarrow \Pi_B^*(R_B - D) - \Pi_G^*(R_G - D) > 0$ and $\alpha_{lc} > 0$. The critical

value of α is determined by the difference of expected return from a bad and a good project and by the difference of the repayments on customer relative to interbank deposits.

Therefore, interbank lending will occur in equilibrium if and only if $\alpha \geq \max(\alpha_{mc}, \alpha_{lc})$.

What remains to be proven is the existence of equilibrium of the market for customer deposits in small banks under conditions (i) $\Pi_G R_C < 1$ and (ii) a proportion of small banks are monitored. We have to prove that there exist an equilibrium repayment rate on customer deposits in small banks D, such that $D\Pi_D = 1$ for the population of small banks as a whole (pooling together "monitored" and "unmonitored" small banks as individual depositors are not able to distinguish among them and charge an uniform repayment rate).

Denote by m the number of small banks in the economy and by β the proportion of those of them which receive interbank financing and are thus monitored. The amount deposited by customer depositors in the monitored banks equals $(1-\gamma)\beta m$, where $\gamma = (\Sigma\alpha_i)/m$ (i = 1, 2, …, m, $\alpha_i = 0$ if the small bank is not financed on the interbank market) denotes the average amount of interbank deposits. The amount deposited by customer depositors in banks which are not monitored equals $(1- \beta)m$. The expected repayments are expressed by $(1-\gamma)\beta m\Pi_G D$ and $(1- \beta)m\Pi_B D$ respectively. Existence of competitive equilibrium for the population of small banks requires that the sum of expected repayments equal the amounts deposited, that is:

$$(1-\gamma)\beta m\Pi_G D + (1- \beta)m\Pi_B D = (1-\gamma)\beta m + (1- \beta)m, \text{ from which follows:}$$

$$D = (1-\gamma\beta)/((1-\gamma)\beta\Pi_G + (1-\beta)\Pi_B) \qquad (10)$$

Furthermore, as β belongs to the interval (0, 1] and γ belongs to the interval (0,1), D belongs to the interval $[1/\Pi_G, 1/\Pi_B]$. Therefore, for all feasible β and γ there exists a deposit rate D for which a competitive equilibrium in the market for customer deposits in small banks exists. If $\beta = 1$ (all the small banks get interbank financing and are therefore monitored), then $D = 1/\Pi_G$ (all financed projects are good). $\beta = 0$ is not a feasible option as it means none of the small banks is monitored, therefore they all finance a bad project and the credit market collapses.

The analysis above proved the existence of an equilibrium of the market for customer deposits in small banks if assumption A8 holds, that is if customer depositors are not able to distinguish among small banks (monitored or not) and charge an uniform interest rate on their

deposits. Let us now consider the situation where depositors are able to observe whether a small bank is financed through interbank deposits or not and are aware that interbank financing implies monitoring and thus less risk. Let us impose the following alternative to assumption A8.

A8'. Customer depositors in small banks are able to observe at no cost whether a small bank borrows on the interbank market or not and require different repayment rates on their deposits accordingly.

Let us denote by D_{low} the repayment rate on deposits in small banks which borrow on the interbank market and by D_{high} the repayment rate on deposits in small banks which do not borrow on the interbank market. If individual depositors are able to distinguish among those two types of small banks then both equilibrium D_{low} and D_{high} should exist.

Equilibrium D_{high} should fulfil the following two conditions:

- small banks without interbank financing have non-negative expected return:

$$\Pi_B(R_B - D_{high}) \geq 0 \qquad (11)$$

(11) implies that $D_{high} \leq R_B$, but $R_B < 1/\Pi_B$ (see (1)) therefore $D_{high} \leq R_B < 1/\Pi_B$.

- individual depositors in small banks which are not monitored should become expected repayment which is in expectation equal to the amount deposited, that is:

$$\Pi_B D_{high} = 1 \qquad (12)$$

and therefore $D_{high} = 1/\Pi_B$

(11) and (12) cannot hold simultaneously, which implies that if customer depositors are able to distinguish between monitored and unmonitored banks there exists no equilibrium deposits rate for deposits in small banks which do not receive interbank financing.

To recapitulate, in the case of low moral hazard issue ($\Pi_G R_C \geq 1$) the type of financing does not have an impact on the choice of the project which will be financed by the small bank: an equilibrium deposit rate exists such that both banks and customer depositors make no losses in expectation and financing a project with positive net present value is always more profitable for the bank than financing a project with negative net present value. On the other hand, in the case of strong moral hazard issue ($\Pi_G R_C < 1$), an equilibrium on the market for

customer deposits is only possible if a monitoring technology is introduced and some of the small banks are monitored. Crucial assumption for the existence of such an equilibrium is the one that individual depositors cannot distinguish between monitored and unmonitored small banks. In this case, whether a bank will invest in a "good" or a "bad" project depends on the whether it is financed by customer or by interbank deposits. The small bank will have lower risk level if it receives an interbank deposit from a large bank. The volume of the interbank deposit should by sufficiently large as compared to the monitoring costs.

That is how the theory of asymmetric information could be employed for the explanation of why only few banks gather the deposits from the public. Namely, these banks could be understood as monitors of the small banks.

In the empirical part of the paper we compare different measures of bank's risk and try to answer the questions: are the small banks that are financed through the interbank market less risky; does a two-tier financial intermediation system means lower risk level of all the small banks (this is to test the hypothesis of a spill-over effect of the monitoring of some of the banks over the whole population of small banks) and do small banks, borrowing on the interbank market in a two-tier financial intermediation system, undertake less risky projects than the rest of the sample small banks.

3. The data

The sample covers banking institutions from ten CEE countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. For the macro level variables we use data provided by IMF in the International Financial Statistics. The variables we use on the micro level stem from banks balance sheet, the data is provided by BankScope[7].Our sample includes 296 banks, of which 28 Bulgarian, 35 Czech, 12 Estonian, 36 Hungarian, 28 Latvian, 14 Lithuanian, 56 Polish, 34 Romanian, 24 Slovakian, and 29 Slovenian. In each of the sample countries, BankScope covers between 70-90% of the banks (calculated as percentage of banking assets). Table 2 presents the coverage of the BankScope per country and year. All large and medium-sized banks are covered. The banks not covered by the BankScope are minor banking institutions.

Due to data availability we restrict the analysis to the period 1994-2001, so we have observations of eight years. Data for some of the banks are available in only some of the years, which results in an unbalanced panel dataset.

Table 2: Number of banks in the sample and the share of the total banking system they represent

	1994		2001	
	number of banks included	represented share of the total banking assets	number of banks included	represented share of the total banking assets
Bulgaria	11	0.83	22	0.90
Czech Republic	24	0.81	22	0.84
Estonia	8	0.77	3	0.82
Hungary	25	0.84	27	0.98
Latvia	15	0.68	19	0.90
Lithuania	7	0.78	8	0.81
Poland	35	0.73	29	0.72
Romania	5	0.70	24	0.77
Slovakia	10	0.71	15	0.81
Slovenia	14	0.84	16	0.96

[7] BankScope is a database created by IBCA and Bureau van Dijk

4. The two-tier financial intermediation system

In this section we will present a description of the factors that have caused a strong specialization of banks in some of the CEE countries and an approach of distinguishing among systems with one- and with two-tier financial intermediation. Such a distinction is based on the volume of funds transferred from banks dominating the deposit market to the rest of the banks. The task is to present quantity measures for the degree to which major deposit gathering institutions transfer funds to the rest of the system, thus indicating underdevelopment of their lending activities and a relative specialization in deposit gathering.

Two major features of banking sector development in CEE determine the phenomenon of bank specialization and the emergence of two-tier financial intermediation systems.

1. Incumbent banks still have privileged access to the market of customer deposits

The historical argument is strongly presented in the literature (Anderson and Kegels, 1998 and Miller and Petranov, 2001). Its arguments concentrate on the inertia in the bank-customer relationships. Even if nowadays a lot of new entrant banks exist, people still prefer depositing in the incumbent banks, because they are used to. Incumbent banks are the ones that already have developed branch network and expertise in retail banking.

Another argument is that the public assigns more trust to the former state-owned banks as it is persuaded in the too-big-to-fail doctrine: the government will not let the largest (to higher or lower extend still state-owned) banks fail and will intervene in case of distress. This argument has especially strong impact for the early transition period when these were the only banks enjoying deposit guarantees. So in this period new entrant banks had to offer higher deposit rates than the incumbent banks in order to attract deposits. Starting in 1994 most of the CEE countries introduced deposits insurance schemes but their public confidence is limited (see Demirgüc-Kunt and Huizinga, 1998), so the too-big-to-fail doctrine continues to play a role for the depositors.

2. Large incumbent banks are very inactive on the market for credits for private

If the large banks are able to gather deposits with lower interest rate than the new entrant banks one may assume that these bank will also have comparative advantage in credit allocation, but the reality supports the opposite situation. Often presented argument in the literature (see again Anderson and Kegels (1998) and Miller and Petranov (2001)) is that

most incumbent banks lack relations to newly created enterprises, expertise in proper credit allocation activities and state-of-the-art market orientation. Similar arguments are often represented in the literature on banking in developing countries (see Slide and Cole (1999)). Another reason could be the fact that for a private enterprise receiving a credit from a large bureaucratic banking institution is associated with bearing some extra costs beyond the interest rate paid. Typically such costs would include time spent in a bureaucratic credit approval procedure, but in extreme case it could also include bribery, etc.

The rest of the section concentrates on providing empirical measures for the existing of two-tier financial intermediation. As an initial indicator for the existence of a two-tier financial intermediation system we will use the existence of an "inverse" correlation between the size of a bank and its interbank position (inverse is understood as the opposite of the pattern observed in the developed countries). When large banks have statistically significant more net interbank assets than small banks it is an indication that larger banks have relative to small banks higher amount of the difference between the amounts of customer deposits they gather and the amounts of credits they grant and securities they hold. Such a relationship indicates that large banks are more likely to be specialized in deposit raising. Table 3 presents the sign of the correlations between interbank ratio (expressed as the ratio between bank's interbank assets and bank's interbank liabilities[8]) and bank size (proxied by total assets of the bank).

Table 3: Correlation between interbank ratio and total assets for the banks in selected CEE countries

	1994	1995	1996	1997	1998	1999	2000	2001
Bulgaria	-	+**	+	+	+*	+*	+***	+**
Czech Republic	+***	+***	+	-	+	+**	+***	+***
Estonia	-	-	-	-	-*	-	-	-
Hungary	+	-	+***	+*	+*	-	+***	+**
Latvia	+	+	+	-	-	-	-	-
Lithuania	+	+	+*	+*	-	+	+	-
Poland	+***	+***	+***	+*	+**	+***	+***	+
Romania	-	-	-	+	-	-	-	-
Slovakia	+**	+**	+**	+**	-	+*	+*	-
Slovenia	-	-	-	-	-	-	-	-

*, **, *** indicate significance at 10%, 5% and 1% level respectively

[8] The format of balance sheet used by BankScope determines interbank assets as "deposits with banks" – an entry in the "other earning assets" section of the assets side and interbank liabilities as "banks deposits" – an entry in the "deposits" section of the liabilities side (see Figure A1 in the Appendix for the structure of the balance sheet as presented by BankScope).

Source: Own calculations based on BankScope data

Bulgaria, the Czech Republic, Hungary, Poland and Slovakia show positive correlations for almost all observed years. For the Czech Republic, Hungary, Poland and Slovakia for most of the years this correlations are also significant. On the other hand only in Estonia and Slovenia we observe persistent negative correlation between interbank ratios and banks' size.

The interbank positions by themselves are not enough to argue that a two-tier banking system exists, as it could be the case that the large banks have better liquidity positions and therefore are less probable to need funds to cover short term liquidity needs. In addition, we should rather prove that the magnitude of the funds channelled from the large to the small banks is substantially large.

We will analyse the magnitude of the interbank funds channelling using two variables measuring the transfer of funds from large to small banks. The first variable is the ratio $NIA_{lb}/CD_{lb,}$ where NIA denotes net interbank assets, (calculated as the difference between deposits with banks and deposits from banks (equals the net position of the bank on the interbank market), CD denotes customer deposits and the subscript lb stands for large banks. This ratio (NIA_{lb}/CD_{lb}), which we call large banks' lending, is intuitionally at closest to the phenomenon we study and represents the share of deposits of the large banks that are further channelled to other banks. If this ratio is positive then large banks are net lenders on the interbank market, a negative value of the ratio is a result of negative net interbank assets and means that the large banks borrow funds on the interbank market.

The measure given by the value of large banks' lending can be misleading for the existence of a two-tier structure of the financial intermediation. The existence of high NIA_{lb}/CD_{lb} ratio alone is not sufficient as it could be the case that large banks have a large proportion of customer deposits that they channel to other banks, but it's not necessary that these borrower banks are domestic institutions[9]. Such a situation has other implications that go beyond the scope of this study.

That is why, we are also interested in another variable that we call small banks' borrowing, expressed by the net interbank position of the small banks relative to their loans as an

[9] As capital account regulations have been progressively relaxed in the past several years banks have the possibility to deposit money with foreign banking institutions and to receive deposits from foreign banks. What we observe in practice is that CEE banks deposit money with foreign banking institutions, but are seldom recipients of funds. The reason is that foreign banks restrain from depositing in CEE banks due to lack of information and appropriate credit ratings.

indicator of how much of the funds that small banks allocate to credits is financed through the interbank market. The ratio NIA_{sb}/L_{sb} (where NIA denote net interbank assets again, L denotes loans and the subscript sb stands for small banks) is used as an indicator of whether small banks rely on funds gathered on the interbank market (this will imply a negative sign of the ratio) for the financing of their loan supply. We use loans as a denominator because we are ultimately interested in the financial intermediation chain "savers – entrepreneurs". Positive level (or negative but small in absolute value) of the ratio would mean that the small banks have their own sources of funds for the loans they distribute. High absolute value negative ratio results from relative strong reliance of the small banks on the funds from other banks. It is also important to mention that if a bank has a low level of loans to total assets then the ratio NIA_{sb}/L_{sb} will have higher absolute value indicating a lower importance of the interbank market funds for a bank. This implication is only correct in the frame of the analysis we follow here, namely when we are interested only in the credit activity of the bank and not in the investment in securities (for the structure of the balance sheet used in the analysis see Figure A1 in the Appendix).

The construction of the above variables is clearly influenced by the distinction between large and small banks. We choose to treat as large banks those institutions, each of which gathers at least 20% of the total amount of customer deposits in the respective banking system[10]. All the banks which are not defined as large become the status of small banks, so we do not introduce a medium size category.

The values of the transfer of funds variables per country and year are presented in Table 4 and Table 5.

Table 4: Large banks' interbank position

	1994	1995	1996	1997	1998	1999	2000	2001
Bulgaria	n.a.	0.17	-0.50	0.29	0.47	0.44	0.66	0.49
Czech Republic	0.20	0.13	0.06	0.16	0.20	0.34	0.53	0.51
Estonia	0.29	0.20	0.00	-0.14	-0.12	-0.13	-0.05	0.06
Hungary	0.00	0.02	0.22	0.10	0.14	0.15	0.11	0.17
Latvia	0.29	0.12	0.13	0.09	-0.11	0.00	0.07	-0.09
Lithuania	0.04	0.04	0.00	0.01	-0.04	-0.03	0.09	0.09
Poland	0.15	0.10	0.10	0.09	0.07	0.08	0.10	0.12
Romania	0.60	0.35	-0.27	-0.61	0.08	-0.07	0.07	0.06
Slovakia	0.16	0.15	0.09	0.07	0.06	0.11	0.12	0.17
Slovenia	-0.21	0.26	0.24	0.10	-0.02	-0.04	-0.07	-0.11

Source: Own calculations based on Bankscope and IFS

[10] The banks that have at least 20% share in the respective deposit market and year are listed in Table A2 in the Appendix

Table 5: Small banks' interbank position

	1994	1995	1996	1997	1998	1999	2000	2001
Bulgaria	-0.66	-0.24	1.60	1.03	0.76	0.73	0.76	0.66
Czech Republic	-0.38	-0.33	-0.31	-0.22	-0.09	-0.04	0.05	-0.12
Estonia	0.43	0.10	0.03	-0.16	-0.25	-0.09	0.22	0.07
Hungary	-0.42	-0.26	-0.17	-0.25	-0.17	-0.11	-0.12	-0.07
Latvia	0.50	1.10	1.56	1.02	0.16	0.38	1.08	0.83
Lithuania	-0.10	-0.17	0.04	0.27	-0.05	-0.03	-0.06	0.00
Poland	0.05	-0.11	-0.19	-0.08	-0.19	-0.11	-0.04	-0.06
Romania	0.37	0.18	0.11	0.52	0.33	0.32	0.30	0.37
Slovakia	-0.41	-0.34	-0.29	-0.36	-0.30	-0.32	0.00	-0.01
Slovenia	0.05	0.10	0.17	0.07	0.07	0.01	0.05	0.05

Source: Own calculations based on Bankscope and IFS

Table A3 in the Appendix presents the correlation coefficient between the transfer of funds variables (NIA_{lb}/CD_{lb} and NIA_{sb}/L_{sb}). The degree of correlation differs substantially across the sample countries and the correlation in the whole sample is very low, providing further evidence that the net interbank assets of large banks alone are not a sufficient description of the phenomenon we study.

As depicted in Table 4 Bulgaria, the Czech Republic, Hungary, Poland and Slovakia have persistently high positive values of "large banks' lending", whereas Lithuania, Romania and Slovenia have very low (mostly negative) values of this variable. The values for Estonia and Latvia vary a lot across the years. The countries with high value of the large banks' net interbank assets variable are all countries with strong incumbent banks, whereas the countries where we observe low value of this variable are countries where no incumbent banks exist (Estonia, Latvia, Lithuania and Slovenia are newly independent countries which have not inherited institutions from pre-transition time; Romanian incumbent banks lost customer confidence in the early transition period when the first periods of distress were observed, later on one of the major incumbent banks went insolvent).

Concerning the variable measuring the interbank position of the small banks Bulgaria (after 1995), Estonia (for most of the observed periods), Latvia, Lithuania (to a lower extend), Romania and Slovenia show high values which indicate that small banks do not depend in their credit activity on funds gathered on the interbank market. On the other hand, the Czech Republic, Hungary, Poland and Slovakia show very low values of this variable (even below -30% in the early years) which indicates that in these countries a large proportion of the small (new entrant banks) heavily depend on funds form the interbank market for the financing of their credit activities.

What are the appropriate values of the variables measuring interbank transfer of funds in order to assume the existence of a two-tier structure of the financial intermediation? We assume that as the central bank reserve requirements in most of the CEE countries are in the range of 2-8% of eligible deposits, a ratio of net interbank assets to customer deposits or to loans higher than 8% could hardly be caused by short term liquidity support connected with the central bank reserve requirements and indicates that specialization in deposit raising/credit allocating stays behind the interbank positions. Therefore, we could define the Czech Republic, Hungary, Poland and Slovakia as countries with a two-tier financial inetrmediation systems.

To sum up in all the countries where incumbent banks still have dominant position in the market for customer deposits (except Bulgaria) we observe the phenomenon of significant transfer of funds through the interbank market from the incumbent banks to the rest of the banking sector. In the countries where due to historical reasons no incumbent banks exist or they lost customers' confidence in the early transition, banks dominating the deposit market do not channel significant amounts of funds to the rest of the banking system. In some of the sample countries we even observe the contrary case where large banks are net receivers of funds but the magnitude of this transfer is much lower and could be associated with the classical motivation of interbank borrowing, namely covering of short term liquidity.

It is important to mention that the countries defined by the variables measuring the magnitude of transfer of funds as two-tier financial intermediation systems are exactly the ones that have positive significant correlations between interbank ratios and total banking assets discussed above. Bulgaria is an interesting exception proving the necessity to involve those variables but not only the sign of the correlations in the distinguishing among the countries. Bulgaria shows positive (mostly significant) correlations between interbank ratio and banks' size, but could not be defined as a two-tier financial intermediation system according to the variables measuring interbank transfer of funds. The reason is that almost all Bulgarian banks have positive net interbank assets. It is an indication that Bulgarian banks trade not only among themselves, but in general they have net positive positions against foreign banks. The speculations about the reasons of this outflow of deposits are beyond the scope of this paper[11].

[11] For a detailed discussion see Hristov (2002). ECB (2002) mentions the scarcity of good domestic lending opportunities as a determinant of the large foreign investments of Bulgarian banks.

5. Comparison of banks risk characteristics: empirical evidence

In the following section we test whether the banks' net positions in the interbank market and the type of the banking system they operate in (two-tier or classical intermediation) cause significant differences in bank levels of risk undertaking.

The purpose is to empirically test two basis hypotheses. The first hypothesis is directly derived from the theoretical model and states that banks, which borrow on the interbank market finance projects with lower risk levels than the ones that are fully financed by customer deposits. This would imply that the interbank-lending banks engage in interbank monitoring.

The second hypothesis tests for the average risk alleviating effects of a two-tier banking system structure. It states that a two-tier structure of the banking system in which the banks dominating the deposit market channel a large proportion of the funds gathered to smaller banking institutions implies lower risk on average for the whole population of small (non-dominating the deposit market) banks. If a two-tier structure, in the way we define it in this paper, implies lower risk levels of the small banks, this will indicate that it does matter whether banks are financed by funds provided by single large interbank-depositor or by numerous small interbank-depositors or retail depositors.

5.1. Econometric models

We use the following two econometric models to test the first and the second hypotheses, respectively. Model (11) is used to test the hypothesis of the risk effects of interbank borrowing. Model (12) is used to test the impact of a two-tier structure of the financial intermediation on the level of risk of small banks.

$$BR_{ijt} = \beta_1 + \beta_2 * NIP_{ijt} + \beta_3 * X_{ijt} + \beta_4 * Y_{jt} + \beta_5 * C_j + \beta_6 * T_t + \varepsilon_{ijt}, \quad (13)$$

$$BR_{ijt} = \beta_1 + \beta_2 * TS_{jt} + \beta_3 * X_{ijt} + \beta_4 * Y_{jt} + \beta_5 * C_j + \beta_6 * T_t + \varepsilon_{ijt}, \quad (14)$$

where:

BR_{ijt} denotes the level of risk undertaking of bank i in country j in time t;

NIP_{ijt} denotes the net interbank position of bank i in country j in time t;

TS_{jt} is the vector of variables describing the type of the financial intermediation system (two-tier or one-tier);

X_{ijt} is a vector of control variables on the individual bank level;

Y_{jt} is a vector of control variables on the level of country of operations, and

ε_{ijt} is the error term.

We perform the regressions on a sample consisting only of the banks that are regarded as small by the construction of the transfer of funds variables. We exclude from the sample the banks defined as large, since the relation between interbank borrowing and interbank monitoring could be different for large banks. If large banks heavily borrow in the interbank market they do so from a large number of lender banks and free rider and too-bog-to-fail concerns may hamper the lending banks' incentives to monitor the large borrowing bank.

Dependent variable

Key problem for a comparison of levels of bank risk undertaking is the choice of variables used as measures for banks risk undertaking (BR_{ijt}). In the current paper we focus on four such variables that have widely been used in the literature[12]: loan loss reserves to gross loans (LLR), loan loss provisions to gross loans, non-performing loans to gross loans (NPL) and net-charge offs to gross loans (NCO).

The ratio of loan loss reserves to gross loans expresses what proportion of the total loan portfolio has been provided for but not charged-off. Loan loss reserves are an entry on the liability side of the balance sheet and represent accumulated provisions for expected loan losses. Assuming similar accounting policy and regulations of provisioning, higher LLR ratio would imply that banks expect losses on higher proportion of their loans and is thus an indicator for riskier loan portfolio of the bank[13].

Loan loss provisions are expenses against current earnings in the profit and loss account. They represent allocations in the current period to the loan loss reserves and should reflect estimated losses for specifically identified loans as well as estimated probable credit losses inherent in the remainder of the portfolio at the balance sheet date[14]. Again, assuming similar

[12] See Martin (1977) and Gonzales-Hermosillo, et al (1996)
[13] Cavallo and Majnoni (2001)
[14] Cavallo and Majnoni (2001)

accounting policy and regulations of provisioning, higher LLP ratio implies riskier loan portfolio.

Non-performing loans to gross loans represent the proportion of impaired (doubtful) loans in the loan portfolio[15]. A high value of this ratio indicates that a large proportion of a bank's loans have not been served according to the repayment schedule. Thus, it suggests that a high proportion of bank debtors may default on their loans.

The ratio of net charge-offs to gross loans (NCO) illustrates the proportion of written-off loan losses[16] in the amount of the gross loan portfolio. The lower the NCO ratio, the lower the level of risk undertaking of a bank as long as the write-off policies are consistent across comparable banks. Since charge-offs illustrated in current financial statements reflect the risk of loans distributed in previous balance periods, we use as dependent variables the values of the NCO ratio for one year ahead (one-year lead NCO). In other words, we regress the values of the NCO ratio in period t on the lagged values of the explanatory variables (from periods t-1).

Following Demsetz (1996) we prefer to use in the econometrical estimations the logarithmic form of all dependent variables.

Explanatory variables

To measure the impact of interbank borrowing on bank risk levels we include as a regressor the net interbank position of a bank as measured by the ratio of net interbank assets to total assets (NIA/TA). If this ratio has negative values, the bank borrows on the interbank market. On the other hand, positive values of the ratio indicate that the bank is a net provider of interbank funds. However, a one-stage OLS estimation of the effect of a bank's net interbank position on a bank's risk may suffer under simultaneity, because as described in the theoretical model, the interbank position variable will be an outcome of the same equilibrium that determines a bank's level of risk undertaking. To deal with the simultaneity problem we choose to instrument a bank's net interbank position (NIA/TA) with the lagged net interbank position (NIA/TA_{t-1}), a bank's current ratio of loans to total assets (Loans/TA), and the transfer of funds variables (NIA_LB and NIA_SB) based on the ratios of large banks lending

[15] see BankScope: "Ratio definitions"
[16] Net charge-offs are defined as the amount written-off from loan-loss reserves minus recoveries (see BankScope: "Ratio definitions")

(NIA_{lb}/CD_{lb}) and small bank borrowing (NIA_{sb}/L_{sb})[17], respectively. Each of these instruments can be considered as exogenous with respect to current risk, but is correlated with a bank's current interbank position. As expected, lagged net interbank position (NIA/TA_{t-1}) is strongly correlated with current interbank position, since interbank borrowing is mainly determined by long-term specialization. The ratio of loans to total assets is also strongly correlated with a bank's current interbank position and indicates a banks specialization in credit supply. The transfer of funds variables indicate the system average interbank positions of large and small banks and are significantly correlated with individual small banks interbank position (see Table A4 in the Appendix for the reduced form estimations of NIA/TA).

In the estimation of the impact of the type of the financial system on bank risk (the model defined in equation (14)) we include as regressors the variables measuring the interbank transfer of funds, defined in Section 4 as indicators for the existence of a two-tier financial intermediation. Thus, the vector TS_{jt} consists of two variables measuring the transfer of funds (NIA_LB and NIA_SB) based on the ratios of large banks lending (NIA_{lb}/CD_{lb}) and small bank borrowing (NIA_{sb}/L_{sb}), respectively. A high value of NIA_LB implies that large banks have high net interbank assets. A high value of NIA_SB implies that small banks have high net interbank assets. Therefore, in two-tier financial intermediation systems, where large banks lend and small banks borrow substantial amounts in the interbank market, the values of NIA_LB will be high and those of NIA_SB will be low.

Several control variables are included in the estimations of both econometric models. On the individual bank level we introduce bank size, capitalization level and foreign ownership as control variables. We proxy a bank's size by the ratio of its total assets to the median bank total assets in the respective sample country. The normalization aims at a better comparability across banks with different countries of origin and neutralizes the effects of exchange rate deviations. In addition, we use the squared bank size term to control for non-linear form of the dependence between bank's size and risk undertaking. Capitalization is measured by the ratio of equity to total assets. Foreign ownership is measured by a dummy variable equal to one if at least 50% of a bank's equity is owned by an institution based abroad and to 0 otherwise. We include this variable to account for the possibility that foreign-owned banks have better technology for assessment of credit worthiness and are thus less probable to generate non-performing loans.

[17] As illustrated in Table A3 in the Appendix the correlation between NIA_{lb}/CD_{lb} and NIA_{sb}/L_{sb} is low, that allowes us to include both variable as regressors without multicolinearity concerns.

On the level of country of operations we include the following macroeconomic variables as controls: inflation, per capita GDP and the rate of GDP[18]. Inflation is defined as the percentage change in the GDP deflator. Per capita GDP is used as a general index of economic development and is measured in thousands of US dollar. GDP growth is used to measure cyclical effects on bank risk and is measured as the growth rate of real per capita GDP. Time and country fixed effects are introduced in the in the regressions in order to capture other unobserved variables.

5.2. Estimation technique

As mentioned above in order to deal with the simultaneity of the net interbank position variable we estimate the model defined by equation (13) using two-stage least squares. We use the instruments to estimate the predicted value of NIA/TA and plug the predicted value of NIA/TA into the structural model.

To correct for heteroskedasticity and autocorrelation, which are indicated by diagnostic tests (for panel-level heteroskedasticity and autocorrelation) we estimate the two-stages of the model specified by equation (13) using the panel corrected standard errors (PCSE) technique as proposed by Beck and Katz (1995). The estimations of the impact of the type of financial system on the level of bank risk undertaking (the model specified by equation (14)) are performed by one-stage PCSE.

5.3. Estimation results

In the current subsection we present the results of the empirical analysis of the impact of interbank borrowing and the type of the financial intermediation system on the levels of bank risk undertaking.

Table 6 illustrates the results of the regressions of the different proxies for bank risk undertaking on the measure of bank's net interbank position. For all measures of bank risk, but the non-performing loans ratio (NPL), the net interbank position of a bank as measured by the ratio of net interbank assets to total assets has a significant positive coefficient. The coefficient of NIA/TA in the regression using NPL as a proxy for bank risk is also positive but statistically insignificant.

[18] The usage of these variables as controls for bank risk has been proposed by Demsetz et al (1996)

These results indicate that higher share of net interbank assets in total assets imply higher risk levels of the loan portfolio, as measured by the LLR, LLP and lead NCO ratios. Therefore, net interbank borrowing, which necessary implies negative net interbank assets is associated with lower level of risk undertaking. Banks borrowing on the interbank market have on average lower LLR, LLP, and NCO ratios than banks fully financed through customer deposits.

Table 6: Two-stage panel regressions of bank risk on interbank position

	LLR	LLP	LNCO	NPL
net interbank assets/total assets	**0.763** ***	**1.045** ***	**3.579** ***	**0.124**
	0.255	0.361	0.697	0.529
bank size	**0.048** **	**0.004**	**-0.182**	**0.060** ***
	0.020	0.033	0.145	0.019
bank size squared	**-0.001**	**-0.001**	**0.024** *	**-0.001** ***
	0.001	0.002	0.013	0.000
equity/total assets	**-0.014** ***	**-0.009**	**-0.021** *	**-0.004**
	0.003	0.007	0.012	0.010
foreign	**-0.575** ***	**-0.538** ***	**-1.062** ***	**-0.386** **
	0.094	0.109	0.249	0.159
inflation	**0.001** **	**0.000**	**0.002**	**-0.001** *
	0.000	0.000	0.001	0.001
per capita GDP	**-0.320** ***	**-0.277** *	**-0.414**	**0.031**
	0.093	0.143	0.327	0.141
GDP growth	**-4.778** ***	**-14.850** ***	**-5.390**	**-7.575** ***
	1.334	1.682	5.242	2.063
country dummies	yes	yes	yes	yes
time dummies	yes	yes	yes	yes
R2	0.53	0.77	0.53	0.58
Observations	814	820	181	401
Groups	217	239	79	131

Note: Coefficients in bold, standard errors below coefficients. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

The results of the estimations of the impact of the type of financial intermediation system are illustrated in Table 7.

The level of net interbank assets of small banks (NIA_SB) has a significant positive coefficient in all, but the lead NCO, regression specifications. In systems where small banks are the providers of interbank funds, the risk levels of the small banks is in general higher than in systems where small banks are receivers of interbank funds (have lower net interbank assets). Net interbank assets of large banks (NIA_LB) have negative coefficients in all specifications, but statistically significant are only those in the regressions using LLR and NPL as proxies for bank risk. Therefore, banking systems where large banks are providers of interbank funds will be characterized by lower risk levels of the population of small banks. These results indicate that in general small banks in two-tier systems, where small banks have

low net interbank assets and large bank have high net interbank assets, have lower levels of risk than small banks in one-tier systems.

Table 7: Panel regressions of bank risk on the type of financial system

	LLR	LLP	LNCO	NPL
net interbank assets LBs (NIA_LB)	**-0.292 ***	**-0.145**	**-0.494**	**-1.010 ***
	0.178	0.221	1.016	0.591
net interbank assets SBs (NIA_SB)	**0.635 *****	**0.534 *****	**0.383**	**0.659 *****
	0.137	0.202	0.483	0.243
bank size	**0.066 *****	**0.008**	**0.044**	**0.060 *****
	0.018	0.018	0.152	0.018
bank size squared	**-0.001 *****	**0.000**	**0.011**	**-0.001 *****
	0.001	0.001	0.014	0.000
equity/total assets	**-0.004**	**-0.004**	**0.021**	**-0.003**
	0.003	0.003	0.013	0.008
foreign	**-0.617 *****	**-0.568 *****	**-0.709 ****	**-0.452 *****
	0.087	0.092	0.286	0.145
inflation	**0.000 ****	**0.001 ***	**0.002**	**-0.002 *****
	0.000	0.000	0.001	0.001
per capita GDP	**-0.058**	**-0.073**	**-0.451**	**0.150**
	0.083	0.122	0.346	0.126
GDP growth	**-2.365 ****	**-9.586 *****	**-0.199**	**-6.458 *****
	1.051	1.505	4.366	1.998
const	**2.480 *****	**-2.344 ****	**0.437**	**1.500**
	0.685	0.962	2.981	0.977
country dummies	yes	yes	yes	yes
time dummies	yes	yes	yes	yes
R2	0.51	0.75	0.48	0.64
Observations	999	1036	214	450
Groups	227	251	85	136

Note: Coefficients in bold, standard errors below coefficients. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

Control variables

Bank size has positive significant effect, and bank size squared has negative significant effect on LLR and NPL, indicating that the level of bank risk undertaking increases with the size of a bank until a critical threshold of relative bank size is overshot. The coefficients of the bank size variables are insignificant in the regressions using LLP and lead NCO as risk proxies.

Equity to total assets has a significant negative impact on LLR and lead NCO, which is compliant with the theoretical expectation that banks with higher proportion of own capital invest in less risky projects. In the specifications using LLP and NPL as proxy for risk the coefficients of equity to total assets are mostly insignificant.

The foreign ownership dummy has significant negative coefficients in all regression specifications, presenting evidence for lower levels of risk undertaking by banks owned by

foreign entities. This result supports similar findings in the literature of foreign bank entry in transition and developing countries[19].

And finally among the macroeconomic variables, higher inflation is associated with higher levels of LLR and LLP, indicating that banks reckon with higher risk of their portfolio, in high inflation periods. The negative significant coefficients in the NPL regressions indicates that de facto loan defaults are lower in high inflation times, which is an intuitive result as long as loans have been contracted to pay a fixed interest. Per capita GDP has negative significant impact on LLR and LLP indicating lower risk levels of banks in higher income countries, but is insignificant in the NCO and NPL regressions. GDP growth significantly reduces bank risk as measured by LLR, LLP and NPL indicating the cyclical impact on bank risk.

To summarize, we find empirical evidence supporting the hypothesis that interbank borrowing is associated with lower levels of risk undertaking, that is an indicator that interbank-borrowing banks are being monitored. This result implies that interbank-lending banks feel themselves responsible for losses they incur on interbank transactions and are thus monitoring their interbank-debtors in order to control the risk of the investments.

Furthermore, the estimations of the impact of the type of the financial intermediation system indicate that small banks in two-tier financial intermediation systems undertake on average lower risk levels than small banks in one-tier financial intermediation systems. In systems where funds in the interbank market are provided by large banks, rather than small ones, banks undertake less risk on average. Such a result is compliant with our notion that interbank monitoring is mostly feasible when few institutions lend large (as relative to monitoring costs) amounts, which is mainly the case in two-tier financial intermediation systems. In one-tier financial intermediation system, where mostly small banks lend funds in the interbank market, monitoring of borrowing banks is not guaranteed, as each lending bank is small relative to the borrowing banks. Larger banks borrow from numerous small ones and three problems reduce small banks' incentives to monitor the large borrowing banks. First, the amount of interbank lending could be too small in order to justify monitoring costs. Second, free rider problems may emerge due to the high number of creditors. And third, if borrowing banks are large institutions, governments may be forced to bail them out in case of distress, thus generating moral hazard that hampers lending banks' incentives to monitor.

[19] Clarke et al (2003)

5.4 Discussion of the results

The evidence on the interbank monitoring role of incumbent banks has important implications for the stability of the banking systems. If it were the case that incumbent banks extend credits to other banking institutions without monitoring them it would mean that first, the risk of the incumbent banks is higher[20] and second, if funds are channeled through the interbank market without controlling for the risk of the borrowing bank, the risk of a system-wide contagion through the interbank market would be accelerated.

We provided the econometric estimations using two-stage least squares to control for the fact that the level of risk undertaking and interbank borrowing may be the outcomes of the same equilibrium and are thus, according to the introduced theoretical model, simultaneously determined variables. An interesting extension of the monitoring issues studied in this paper is to prove whether reputation concerns also contribute to the lower risk levels of interbank-borrowing banks. If reputation is in force banks which have a history of "good behavior" and have thus built a positive reputation would be more likely to receive interbank funds than banks that have undertaken riskier projects in the past. Whether reputation is in force or not would have important implications for the future behavior of new entrants as it creates an additional disciplining instrument.

As an extension to the provided results we test the validity of the reputation hypothesis. Keeping in mind that reputation may have become a valid mechanism for reducing the level of risk undertaking in a later stage of the transitions (it is possible that in the very early transition period reputation is not a reliable mechanism for judging among borrowing banks, as it takes time for a bank to accrue a history of prudent behavior), we perform the tests not only for the whole observed period but also for different plausible sub-periods.

To test for the existence of reputation mechanism we look for evidence of whether the amount of interbank borrowing in the current period, as measured by the ratio of net interbank assets to total assets (NIA/TA), is significantly influenced by past risk characteristics. As measures of previous risk levels we use the lagged values of the risk proxies introduced in 5.1., namely LLR, LLP, NCO, and NPL (all in logarithmic form). Since interbank borrowing depends on a bank's specialization and long-term investment in networks, we include the value of the lagged net interbank assets to total assets (NIA/TA_{t-1}) as a control variable, when estimating the effect of lagged risk characteristics on present interbank borrowing. As a result we have to

[20] Implying higher risk for the government to be involved in costly bail-out operations in the future.

estimate a dynamic panel model. We use the technique proposed by Arellano and Bond (1991) for the estimations.

The results of the estimations are illustrated in Tables A5 to A8 of the Appendix. In all regression specifications the lagged risk levels have no significant impact on the net interbank position. Therefore, current interbank borrowing seems not to be conditional on previous risk. This is a rather surprising result that confirms the specific nature of banking in transition countries.

6. Conclusion

The paper presents evidence on the risk effects of the strong level of bank specialization in some of the transition economies in Central and Eastern Europe. The phenomenon we study in the paper consists of specialization of the large incumbent banks in deposit gathering activities, and of new entrant banks in credit extending. This phenomenon has been pointed out in several descriptive papers, but its effects have not systematically been studied yet.

A theoretical model based on information asymmetries between a bank and its depositors, illustrates that in case of high moral hazard, banks may have incentives to finance risky projects even such with negative net present value and indicates the monitoring of bank's activities as a remedy against collapsing of the credit market. As monitoring is costly it can not be performed by customer depositors, whose deposits are relatively small as compared to monitoring costs. On the other hand, large banks can provide monitoring of the activities of their interbank borrowers as the amounts of interbank borrowing are high enough to justify the costs. Therefore, banks which partly finance themselves through interbank deposits will be characterised by lower levels of risk undertaking as compared to those banks that fully finance themselves through customer deposits.

Using data from banks' financial statements we construct variables measuring the interbank transfer of funds to pick up those of the sample countries where the level of bank specialization is so high that we can argue that the banking system consists of two-tiers of banks: the banks from one tier gather deposits and channel the funds gathered to the banks from the other tier which themselves provide credit to privates. We call these financial systems "two-tier financial intermediation" systems. The values of the transfer of funds variables suggest the Czech Republic, Hungary, Poland and Slovakia as "two-tier financial intermediation" systems.

The empirical part of the paper provides econometric evidence on the existence of risk alleviating effects of interbank borrowing. We test the impact of interbank borrowing and the existence of a two-tier financial intermediation structure on different parameters used as proxies for bank's level of risk undertaking. The results show a significant effect of interbank borrowing: banks which borrow on the interbank market undertake less risky projects. Furthermore, the results provide empirical evidence on the risk-alleviating impact of the existence of two-tier structure: small banks in countries where the large banks are the

providers of interbank funds are characterized by lower risk levels than small banks in countries where interbank funds are provided by small banks.

In general we can argue that the large incumbent banks in some of the CEE countries adopt monitoring functions over those of the new entrant banks which finance themselves through interbank deposits. In an environment of inefficient banking regulation and undiversified portfolios of the new entrant banks, monitoring by the large banks could play essential role for the establishment of prudent investment behaviour. Furthermore, the specialization phenomenon may be a remedy against collapse of the credit market due to moral hazard.

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Appendix:

Proof of Proposition 1:

Assume the large bank can by investing M in monitoring screen the projects that the small banks prefer to finance. Then the large bank will require different interest rates on their interbank deposits depending on the type of project that is to be financed. If the large bank can assure that the small bank will invest in a good project, than it will require an repayment of d_g. If a bad project will be financed then the required repayment is set at d_b.

$$d_g\Pi_G - 1 > 0 > d_b\Pi_B - 1 \qquad (1A)$$

$$d_g < d_b$$

Denote by δ the share of the large bank's portfolio that is invested in projects been screened as "good" and (1- δ) is the share of projects screened as "bad". Assume the large bank has total volume of assets equal to m. Then δm denotes the total volume of investment in good projects, whereas (1- δ)m denotes the volume of investment in bad projects. Table A1 illustrates the net expected return (NER) of the large bank.

Table A1: Expected return of the large bank

Bad Good	Succeeds Probability: Π_B	Fails Probability: $1 - \Pi_B$
Succeeds Probability: Π_G	All (both good and bad) projects succeed Probability: ΠGΠB NER: $(\delta d_g + (1- \delta)d_b - D)m\ \Pi_G\Pi_B$	Bad projects fail, good projects succeed Probability: $\Pi_G(1-\Pi_B)$ NER: max $((\delta d_g - D)m, 0)\Pi_G(1-\Pi_B)$
Fails Probability: $1- \Pi_G$	Good projects fail, bad projects succeed	All projects fail

	Probability: $(1- \Pi_G)\ \Pi_B$ NER: $\max((1- \delta)d_b - D)m, 0)(1-\Pi_G)\Pi_B$	Probability: $(1 - \Pi_G)(1 - \Pi_B)$ NER: 0

Summarizing the information from Table A1, we derive the following expression for the large bank's NER:

$NER = (\delta d_g + (1- \delta)d_b - D)m\ \Pi_G\Pi_B + \max((\delta d_g - D)m, 0)\ \Pi_G(1-\Pi_B) + \max((1- \delta)d_b - D)m, 0)\ (1- \Pi_G)\ \Pi_B + 0$

The large bank will choose δ so that it maximizes its NER.

$MaxNER\delta = (\delta d_g + (1- \delta)d_b - D)m\ \Pi_G\Pi_B + \max((\delta d_g - D)m, 0)\ \Pi_G(1-\Pi_B) + \max((1-\delta)d_b - D)m, 0)\ (1- \Pi_G)\ \Pi_B + 0$

It is trivial that the large bank will be solvent and has to repay D to its depositors if all projects succeed. Similarly if all projects fail the bank will have return of 0, no repayment to depositors will be made and the banks net return is 0. In the cases where only good/bad projects succeed it depends on the relation between δ , d_g, d_b and D whether bank's returns will be sufficient to cover repayments to depositors. The net return in this cases equally the return from good(bad) projects net of depositor repayment, and since the bank can repay only what it has this net return cannot be negative. To solve the maximization problem we have to define the values of $\max((\delta d_g - D)m, 0)$ and $\max((\delta d_g - D)m, 0)$, that is to study whether the bank will be solvent if:

(i) only the "good" projects succeed: the bank will be solvent $((\delta d_g - D)m > 0)$ if $\delta > D/d_g$

(ii) only the "bad" projects succeed: the bank will be solvent $((1-\delta)d_b - D)m > 0)$ if $\delta < 1 - D/d_b$

We constrain the analysis to the case that both d_g an d_b are smaller than 2 ($d_g < d_b < 2$), therefore $1- D/d_b < D/d_g$. Then we have to study the following three cases for δ:

$D/d_g < \delta \leq 1$: In this case the bank is solvent if all projects succeed and if only the good projects succeed and is insolvent if only the bad projects succeed. The NER has the following form:

$NER = (\delta d_g + (1- \delta)d_b - D)m\ \Pi_G\Pi_B + (\delta d_g - D)m\Pi_G(1-\Pi_B)$

The first order condition is:

$\partial NER/\partial\delta = d_g\Pi_G - (d_b\Pi_B)\ \Pi_G$, which is always positive, since $d_g\Pi_G > d_b\Pi_B$ and $0<\Pi_G<1$. Therefore, NER is increasing in δ and the local maximum for the interval $(D/d_g; 1]$ is at 1.

(2) $1- D/d_b \leq \delta \leq D/d_g$: In this case the bank is only solvent if all projects succeed. The NER has the following form:

$NER = (\delta d_g + (1- \delta)d_b - D)m\ \Pi_G\Pi_B$

The first order condition is:

$\partial NER/\partial\delta = d_g m\Pi_G\Pi_B - d_b m\Pi_G\Pi_B$, which is always negative, since $d_g < d_b$. Therefore NER is a decreasing function of δ and the local maximum for the interval $[1-D/d_b; D/ d_g]$ is at $1-D/ d_b$.

(3) The bank is solvent if all projects succeed and if only the bad projects succeed. The NER has the following form:

$NER = (\delta d_g + (1- \delta)d_b - D)m\ \Pi_G\Pi_B + ((1-\delta)D/d_b - D)m(1-\Pi_G)\Pi_B$

The first order condition is:

$\partial NER/\partial\delta = d_g\Pi_G\Pi_B - d_b\Pi_B = \Pi_B(d_g\Pi_G - d_b)$, which is always negative, since $d_g < d_b$ and $0 < \Pi_G < 1$. Therefore, NER is decreasing in δ and the local maximum for the interval $[0; 1-D/d_b]$ is at 0.

Now it remains to compare the local maximums at the three cases.

If $\delta = 1$, $NER = \Pi_G(d_g - D)$

If $\delta = 1 - D/d_b$, $NER = \Pi_G\Pi_B(d_g - Dd_g/d_b)$

If $\delta = 0$, $NER = \Pi_B(d_b - D)$

We assume that $D < D_c = (\Pi_G d_g - \Pi_B d_b)/(\Pi_G-\Pi_B) = R_c - \varepsilon$, where $d_g = R_g - \varepsilon$, and $d_b = R_b - \varepsilon$.

Therefore, the NER if $\delta = 1$ (investment only in good projects) is higher than the one in the case of $\delta = 0$ (investment only in bad projects). Furthermore, the NER in the case of $\delta = 1 - D/d_b$, that is equal to:

$\Pi_G\Pi_B(d_g - Dd_g/d_b) = \Pi_B\,(d_b - D)\,\Pi_G d_g/d_b$

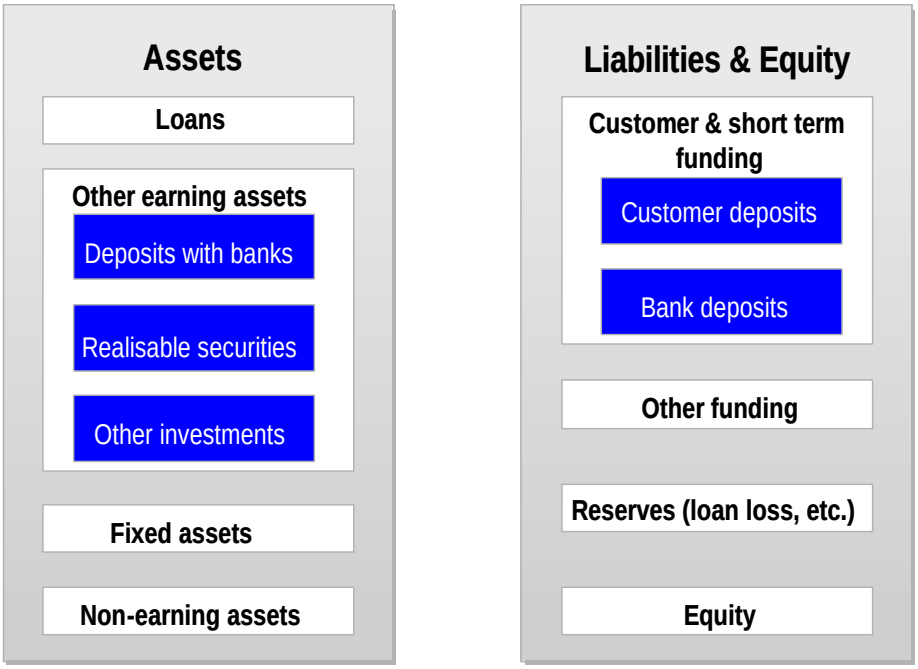
which is lower than $\Pi_B\,(d_b - D)$, since $\Pi_G d_g/d_b$ is lower than 1 (both Π_G and d_g/d_b are in the interval (0; 1). Therefore, in order to maximise its net expected return the large bank will choose $\delta = 1$ (invest only in good projects). Q.E.D.

A1: Largest deposit gathering institutions in CEE [1)]

Country	Banks dominating the deposit market
Bulgaria	up to 1995 only DSK, 1996-2001 DSK and Bulbank
Czech Republic	up to1999 only Sporitelna and Komercni, 2000-2001 Sporitelna, Kommercni and Obchodni
Estonia	up to 1994 Savings and Uhis, 1995-1996 Savings, Uhis and Hansa, 1997-2001 only Hansa and Uhis
Hungary	1994-2001 OTP
Latvia	up to 1997 Uni and Parekss, 1998-2001 Uni, Parekss and Hansa
Lithuania	1994 Commercial and Agricultural, 1995-1996 Commercial, Agricultural and Hansa, 1997-2001 Hansa and Vilniaus
Poland	1994-2001 PKO BP
Romania	1994-1997 Bancorex, 1998-2001 Banca Kommerziala
Slovakia	1994-2001 Sporitelna and Vseoshta Uverova
Slovenia	1994 Nova Matibor and Nova Ljubljanska, 1995-2001 only Nova Ljubljanska

1) Large banks are the largest banking institutions in terms of gathered customer deposits, each of them gathers ≥ 20% of the customer deposits in the respective country and year

A2: Structure of banks' balance sheets



A3. Correlation between NIA_{lb}/CD_{lb} and NIA_{sb}/L_{sb} over the period 1994-2001

Country	Correlation coefficient
Bulgaria	-0.455
Czech Republic	0.765
Estonia	0.810
Hungary	0.786
Latvia	0.339
Lithuania	-0.180
Poland	0.804
Romania	-0.251
Slovakia	0.288
Slovenia	0.755
Total	**-0.016**

A4. First-stage estimation (NIA/TA on instruments)

	NIA/TA
lagged net interbank assets/total assets	**0.600** ***
	0.028
loans/total assets	**-0.324** ***
	0.034
net interbank assets LBs (NIA_LB)	**0.014** **
	0.007
net interbank assets SBs (NIA_SB)	**0.037** *
	0.021
bank size	**0.006** **
	0.003
bank size squared	**0.000**
	0.000
equity/total assets	**0.003** ***
	0.001
foreign	**0.015**
	0.010
inflation	**0.000** *
	0.000
per capita GDP	**0.028** **
	0.014
GDP growth	**-0.435** **
	0.198
country dummies	yes
time dummies	yes
R2	0.7
Observations	1137
Groups	265

A5. Dynamic panel regressions of net interbank assets to total assets on lagged loan loss reserves

	1994-2001	1994-1996	1997-2001	1994-1997	1998-2001
lagged NIA/TA	**0.459 *** **	**0.610 ** **	**0.400 *** **	**0.456 *** **	**0.334 * **
	0.075	0.254	0.152	0.126	0.208
lagged LLP	**-0.004**	**-0.019**	**-0.003**	**-0.003**	**-0.005**
	0.007	0.026	0.008	0.016	0.008
bank size	**0.002**	**0.017**	**0.004**	**-0.001**	**0.009**
	0.006	0.033	0.006	0.013	0.008
bank size squared	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
	0.000	0.000	0.000	0.000	0.000
equity/total assets	**0.004 *** **	**0.001**	**0.004 *** **	**0.006 *** **	**0.003 *** **
	0.001	0.003	0.001	0.002	0.001
foreign	**0.016**	**(dropped)**	**0.011**	**0.098**	**-0.007**
	0.035		0.034	0.078	0.037
inflation	**0.000**	**0.003**	**0.000**	**0.000**	**0.000**
	0.000	0.002	0.000	0.000	0.000
per capita GDP	**0.014**	**0.128**	**0.014**	**0.062**	**0.019**
	0.024	0.140	0.024	0.053	0.025
GDP growth	**-0.474 * **	**-0.033**	**-0.374**	**-1.303 ** **	**0.045**
	0.243	0.041	0.256	0.511	0.325
const	**0.002**	**-0.023**	**0.003**	**-0.014**	**0.005**
	0.005	0.041	0.005	0.011	0.007
time dummies	yes	yes	yes	yes	yes
observations	653	87	566	194	459
groups	195	87	187	116	161

Note: Coefficients in bold, standard errors below coefficients. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively

A6. Dynamic panel regressions of net interbank assets to total assets on lagged LLP

	1994-2001	1994-1996	1997-2001	1994-1997	1998-2001
lagged NIA/TA	**0.439 *** **	**0.490 ***	**0.470 ** **	**0.525 *** **	**0.423 ***
	0.080	0.279	0.199	0.157	0.244
lagged LLP	**0.002**	**-0.026**	**0.006**	**-0.015**	**0.010**
	0.005	0.017	0.006	0.011	0.007
bank size	**-0.009**	**0.016**	**-0.010**	**-0.012**	**0.008**
	0.006	0.028	0.007	0.014	0.010
bank size squared	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
	0.000	0.000	0.000	0.000	0.000
equity/total assets	**0.006 *** **	**0.005 ***	**0.006 *** **	**0.007 *** **	**0.005 *** **
	0.001	0.003	0.001	0.002	0.001
foreign	**0.018**	**(dropped)**	**0.018**	**0.091**	**-0.015**
	0.042		0.043	0.095	0.048
inflation	**0.000**	**0.002**	**0.000**	**0.000**	**0.000**
	0.000	0.002	0.000	0.000	0.000
per capita GDP	**0.021**	**0.140**	**0.019**	**0.062**	**0.019**
	0.024	0.126	0.025	0.053	0.027
GDP growth	**-0.473 ***	**-0.273 ***	**-0.354**	**-1.355 ** **	**0.030**
	0.249	0.149	0.272	0.534	0.356
const	**0.002**	**-0.028**	**0.014 ** **	**-0.021**	**-0.034**
	0.018	0.039	0.006	0.028	0.026
time dummies	yes	yes	yes	yes	yes
observations	591	94	497	205	386
groups	200	94	193	122	164

Note: Coefficients in bold, standard errors below coefficients. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively

A7. Dynamic panel regressions of net interbank assets to total assets on lagged NCO

	1994-2001	1994-1996 [1)]	1997-2001	1994-1997	1998-2001
lagged NIA/TA	**0.227 ****		**-0.010**	**0.641 ***	**0.029**
	0.117		0.214	0.392	0.449
lagged LLP	**0.008**		**0.008**	**0.001**	**0.008**
	0.005		0.005	0.019	0.006
bank size	**-0.012**		**-0.008**	**0.007**	**-0.008**
	0.015		0.015	0.059	0.019
bank size squared	**0.000**		**0.000**	**0.000**	**0.000**
	0.000		0.000	0.002	0.000
equity/total assets	**0.005 *****		**0.004 ****	**0.009**	**0.003**
	0.002		0.002	0.006	0.004
foreign	**0.030**		**0.036**	**(dropped)**	**0.031**
	0.043		0.044		0.049
inflation	**-0.002**		**0.000**	**-0.007**	**0.000**
	0.003		0.003	0.010	0.003
per capita GDP	**-0.007**		**-0.006**	**0.066**	**0.006**
	0.034		0.033	0.148	0.037
GDP growth	**0.026**		**0.255**	**-3.550**	**0.780**
	0.459		0.456	2.480	0.520
const	**-0.038**		**0.009**	**-0.026**	**0.035 ***
	0.054		0.018	0.052	0.021
time dummies	yes		yes	yes	yes
observations	124		120	20	104
groups	54		53	17	50

Note: Coefficients in bold, standard errors below coefficients. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively

1) Estimation not possible – insufficient number of observations

A8. Dynamic panel regressions of net interbank assets to total assets on lagged NCO

	1994-2001	1994-1996[1)]	1997-2001	1994-1997	1998-2001
lagged NIA/TA	**0.501 *** **		**0.624 ** **	**1.176 ** **	**1.314**
	0.188		0.304	0.488	1.278
lagged LLP	**-0.006**		**-0.008**	**0.018**	**-0.026**
	0.013		0.016	0.041	0.036
bank size	**-0.002**		**-0.002**	**0.028**	**-0.005**
	0.011		0.012	0.048	0.020
bank size squared	**0.000**		**0.000**	**0.000**	**0.000**
	0.000		0.000	0.002	0.000
equity/total assets	**0.005 *** **		**0.005 ** **	**0.013 *** **	**0.003**
	0.002		0.002	0.005	0.004
foreign	**0.051**		**0.064**	**-0.023**	**0.175**
	0.063		0.071	0.105	0.174
inflation	**0.000**		**0.000**	**0.001**	**-0.003**
	0.003		0.003	0.009	0.006
per capita GDP	**-0.005**		**0.004**	**-0.383**	**0.038**
	0.041		0.045	0.192	0.075
GDP growth	**-0.447**		**-0.651**	**-0.353**	**-0.866**
	0.479		0.540	1.701	1.113
const	**0.001**		**-0.031**	**0.102**	**0.005**
	0.014		0.037	0.100	0.022
time dummies	yes		yes		
observations	230		216	41	189
groups	93		92	29	83

Note: Coefficients in bold, standard errors below coefficients. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively

1) Estimation not possible – insufficient number of observations