Christa Hainz:

Creditor Passivity: The Effects of Bank Competition and Institutions on the Strategic Use of Bankruptcy Filings

Munich Discussion Paper No. 2007-32

Department of Economics
University of Munich

Volkswirtschaftliche Fakultät
Ludwig-Maximilians-Universität München

Online at http://epub.ub.uni-muenchen.de/2028/

Creditor Passivity: The Effects of Bank Competition and Institutions on the Strategic Use of Bankruptcy Filings

Christa Hainz*

University of Munich, CESifo and WDI

September 2007

Abstract: Why do banks remain passive? In a model of bank-firm relationship we study the trade-off a bank faces when having defaulting firms declared bankrupt. First, the bank receives a payoff if a firm is liquidated. Second, it provides information about a firm's type to its competitors. Thereby, asymmetric information between banks is reduced and bank competition intensifies. We find that the better the institutions and the more competitive the banking sector, the higher the bank's incentive to bankrupt defaulting firms. This makes information between banks less asymmetric and thus leads to lower interest rates and less credit rationing.

JEL-Classification: G21, G33, K10, D82

Keywords: Creditor passivity, bank competition, information sharing, institutions, bankruptcy, relationship banking

* Department of Economics, University of Munich, Akademiestr. 1/III, 80799 Munich, Tel.: +49 89 2180 3232, Fax.: +49 89 2180 2767, e-mail: christa.hainz@lrz.uni-muenchen.de. The author would like to thank Martin Hellwig, Isabelle Kronawitter, Maria Lehner, Gyöngyi Lóránth, Anton Malesich, Robert Marquez, Ray Rees, Dorothea Schäfer, Anjolein Schmeits, Monika Schnitzer, Laurent Weill as well as seminar participants at the University of Munich, the Max Planck Institute for Research on Collective Goods in Bonn, the ESEM in Madrid, the Meetings of the German Economic Association in Dresden and the German Finance Association in Tübingen as well as the ICCEES World Congress in Berlin for helpful comments and suggestions. The usual disclaimer applies. This research was completed when I visited New York University, Stern Business School which I thank for its hospitality. Financial support by FOROST and by the German Science Foundation, under SFB-Transregio 15, is gratefully acknowledged.

Introduction

The number of bankruptcy cases (relative to the total firm population) varies significantly across countries. Factors influencing this difference should be the quality of the legal system, the structure and quality of the firm population, and, as well, the behavior of the creditors. Banks play an important role as creditors in many European countries, and thus, in the event of default, their behavior is crucial. However, because they do not take sufficient action against defaulting firms, they are often regarded as passive. So far, the explanations for creditor passivity are based on the fact that, by having firms declared bankrupt, banks reveal information about the quality of their portfolio. However, when banks bankrupt firms they also reveal information about the quality of a firm to both the public, and in particular, to their competitors - the other banks.

If we want to explain why banks remain passive, the following questions arise. What are the gains and losses of creditors when they have defaulting firms declared bankrupt? Which institutions matter for this decision? What is the effect of bank competition on the incentives of creditors? Since the decision to have defaulting firms declared bankrupt should have an impact on the credit market, we also want to know how interest rates and the supply of loans are influenced by the number of bankruptcies filed and by the institutions that determine this number.

Before starting the analysis, it is necessary to clarify how the decision to have a firm declared bankrupt affects the creditor. First, petitioning to have a firm declared bankrupt is supposed to provide the lenders with a return and, second, "bankruptcy information is publicly disseminated to alert present creditors and potential lenders" (Jappelli and Pagano, 2002, p. 2028). Having a firm declared bankrupt therefore influences the information available to the bank's competitors and the rents the banks can extract.

In this paper we study how these two effects influence the bank's decision to file a petition to have a firm declared bankrupt. For our analysis of the bank's incentive, we set up a model of bank-firm relationship. The banking sector consists of two banks that compete in Bertrand

fashion. They have granted loans to firms in the previous period, but these "old firms" defaulted on their loans. However through the business relationship the bank is informed about their future creditworthiness, i.e. it observes whether an old firm is creditworthy (or "good") or not (or "bad"). The market shares of the "informed" banks are different and the bigger bank thus has information about more old firms. Moreover, firms without a bank relationship apply for loans. As the outside bank cannot perfectly screen the firms applying for credit, the repayment it requires if it makes zero expected profit depends on the average quality of borrowers who apply to this bank for credit for the first time. Good old firms cannot signal their type to an outside bank and therefore face a typical hold-up problem.

The main contribution of the paper is to study how the informed bank can use bankruptcy applications strategically. It decides whether to bankrupt a bad old firm or not. In making this decision, there is a trade-off between two opposing effects. If a firm is declared bankrupt, the bank receives a liquidation payoff. If the firm is not declared bankrupt, it will reapply for credit from an outside bank. As more bad old firms apply for credit, the repayment that an outside bank needs to break even increases. This increases the hold-up problem that each good old firm faces and gives the informed bank the opportunity to extract higher rents from its existing customers. Conversely, if a firm is declared bankrupt, the bank loses information rent.

We derive three main results from our analysis. First, banks remain passive and have firms not declared bankrupt strategically in order to soften bank competition and this allows them to extract higher information rents. Second, we show that more bad old firms are declared bankrupt either if institutions improve (and the liquidation value increases) or if bank competition becomes more intense (and the rent extracted decreases). Third, better institutions and more bank competition feed back positively into the credit market. As this increases the number of bankruptcy cases, the adverse selection problem between banks decreases. Thereby, ceteris paribus, the repayment offered decreases and the probability of banks granting loans increases.

This paper relates to the literature on the interdependence between law and finance, on creditor

passivity, and on information exchange through credit registries.[1] The law and finance literature asserts that creditor protection has a positive influence on the development of credit markets (La Porta et al., 1998). Both the legal protection of creditors and the quality of the courts in a country contribute to higher levels of private credit (Djankov et al., 2007). A similar result is obtained for judicial efficiency in Italy. Credit is less widely available in the Italian provinces where trials take longer or backlogs of pending trials are larger (Fabbri and Padula, 2004; Jappelli et al., 2005). In their theoretical model, Fabbri and Padula (2004) argue that a better judicial system increases the liquidation payoff of collateral. If the liquidation value that the bank gets increases, interest rates can fall and more firms will demand loans. However, their study, which uses household data from Italy, shows that the effect of a household pledging collateral on the availability of credit is positive but not significant (Fabbri and Padula, 2004). This suggests that the claim that better institutions increase access to finance via the higher liquidation value the bank gets does not fully explain the observations in Italy. Alternatively, the interaction between the two effects of bankruptcy that we study in this paper, namely the generation of a payoff for the lender and the provision of information about the quality of the borrower, might explain the higher availability of credit in regions with better legal institutions.

Like all creditor rights, the effectiveness of bankruptcy is influenced both by the law itself and its enforcement. Thus, the quality of the institutions determines the lender's liquidation payoff. Claessens and Klapper (2005) show that the number of bankruptcies is higher, the better the institutions. However, they also find that, in combination with stronger creditor rights, greater judicial efficiency results in fewer cases of bankruptcy.[2]

Two explanations are given in the literature for the phenomenon of creditor passivity. First, if

[1] We use the term credit registry to capture both public and private credit registries since we do not discriminate between them. Private credit registries are often called credit bureaus.

[2] In the theoretical literature, the effect of formal bankruptcy rules on *ex ante* and *ex post* incentives has been studied intensively (for a discussion see Stiglitz, 2001). In addition, the relationship between bankruptcy codes and the firm's capital structure has been investigated in several papers.

banks are poorly capitalized, they are gambling that, by rolling over debts to defaulting customers, there is a chance these would eventually repay (Perotti, 1993). Second, it is argued that banks are reluctant to liquidate firms because they do not want to provide information about the share of non-performing loans in their portfolio (Aghion et al., 1999; Mitchell, 2001). The strategic application of bankruptcy filings in these papers only matters if the policy decision of bank recapitalization is considered. However, bank recapitalization does not happen regularly. Moreover, the strategic aspect of the decision to bankrupt a firm matters not only in the (infrequent) interaction with the regulator but, even more so, in the competition with other banks.

Bankruptcy and credit registries can be seen as substitutes as both of them provide information about incumbent customers. Generally, information can either be about the borrower's type or about past performance with regard to the project outcome or default. The exchange of information about borrower type through private credit registries is studied by Pagano and Jappelli (1993). In the basic setup, the banks, which are local monopolies, benefit from an information exchange through declining default rates. Introducing bank competition makes information sharing less likely because it reduces the informational rent a bank can extract. This negative effect of bank competition vanishes in a model in which bank competition improves the incentive for a firm to exert effort and, consequently, increases the rent a bank extracts (Padilla and Pagano, 1997). In a companion paper, Padilla and Pagano (2000) study the case where rents are competed away *ex ante*. In this case, it is better to show information only about the outcome of a project because, here, the firm has the bigger incentive to work hard. The extent to which information about its customers is revealed can also be used by a bank to deter entry (Boukaert and Degryse, 2006).

We contribute to this literature by studying the banks' decision to have defaulting firms declared bankrupt, the strategic aspect of this decision, and its impact on the credit market. We extend the model by Dell'Ariccia et al. (1999) on adverse selection between banks by incorporating the bankruptcy decision. In this framework, we study how asymmetric information between banks allows informed banks to extract rents from its customers. Like information provided by a credit

registry, the fact that a firm is declared bankrupt reveals to the public that a firm is unsuccessful. This influences the information asymmetry between banks and thus the rent that can be extracted. In contrast to displaying information to a credit registry, the bank's decision to have a firm declared bankrupt yields a payoff to the bank. Therefore, our model explains why even competitive banks may have an incentive to display information about their borrower's type. In contrast to most papers in this area, the banks do not face a commitment problem with regard to the display of information.

The paper is organized as follows: in section 2, we first develop the credit market game in a model with two banks and study the impact of corporate bankruptcy on repayments. We limit the analysis there to the case with two banks to make the different effects that interact in this model as clear as possible. In section 3, we analyze the bank's incentive to have defaulting borrowers declared bankrupt. Comparative statics allows us to show how institutions influence the bank's decision. In section 4, we discuss the effects in a model with N identical banks. In section 5, empirical implications are derived. Finally, we discuss alternative policies that improve the decision of the bank with regard to firm bankruptcy.

I. Model of the Credit Market

In the next subsection, we explain the reasons for the setup we chose in section 2.2. and describe the credit market, the decision to have firms declared bankrupt, and institutions that influence them.

(1) Description of the Credit Market

Credit markets are characterized by asymmetric information both between firms and banks and between banks themselves. Information between banks is asymmetric because the informed bank, i.e., the bank that has already established a business relationship with the firm, has better information about its customers than the outside banks. Norden and Weber (2007) find that, by keeping a firm's checking account, a bank becomes informed.

Credit registries have evolved to reduce both kinds of information asymmetries. Usually, the credit registries provide information about past defaults. The reach of credit registries differs significantly between countries. In OECD countries, private and public credit registries cover a substantial share of the population (on average 65 per cent), but their coverage is not universal. Even among the OECD countries, there are countries such as Switzerland where only 25 per cent of the adult population is covered.[3] In other regions, the coverage is significantly lower. For instance, for (Eastern) Europe and Central Asia it is eight per cent (World Bank, 2006). Moreover, the reputation of credit registries in some countries suffers as the data quality is poor and inaccuracies occur. Complaints about the reliability of information are more frequently found in emerging markets (for Russia, see Skogoreva, 2005) but are not unheard of in economies with well-developed institutions (for the US, see Cassady and Mierzwinski, 2004).

Another mechanism through which information is revealed is the decision to have defaulting firms declared bankrupt. In this case, information not only about a borrower's behavior but also about its type becomes publicly available. The latter indicates that the borrower is no longer creditworthy. A bankruptcy filing implies that a borrower's assets are frozen. For the borrower, this means that it becomes more difficult to mimic a borrower that applies for credit at a bank for the first time. One strategy could be to reopen as a new firm which does the same business but under a new name. If the borrower could mimic a new firm, the defaulting borrower might have a chance of getting access to a new bank loan.[4] The chances of getting a new loan increase if information about past financial transactions is opaque either because a firm's financial statement is not informative enough or because a credit registry that contains information about the owner's past behavior is

[3] This example was selected because the coverage reported by Jappelli and Pagano (2002) and by Worldbank (2006) is rather similar. For other countries, the figures diverge significantly. For instance, for Denmark Jappelli and Pagano (2002) report a coverage for the year 1996 through private credit registries of 50.3 per cent whereas the most recent figure by the World Bank (2006) is only 7.7 per cent. For Sweden, Jappelli and Pagano report that, in 1997, 24.1 per cent were covered by private credit registries whereas in World Bank (2006) it is 100 per cent.

[4] For Hungary and Slovakia, there is evidence that some defaulting firms were able to get loans from outside banks. I would like to thank Gyöngyi Lóránth and Anton Malesich for providing me this information.

missing. Evidence from the US shows that accurate credit information has substantially greater predictive power for the performance of firms than data contained in financial statements (Kallberg and Udell, 2003). In emerging markets, this mimicking strategy should be successful more often as auditing hardly ever occurs and overseeing institutions and credit registries are still in the process of being developed.

There is a creditor chapter in the bankruptcy codes of most countries that implies that the bank can commence a bankruptcy procedure and, with the exception of the United States, creditors dominate the bankruptcy initiation decision (Pistor, 2006). Usually, the creditor has some scope for deciding which firm it will have declared bankrupt. The negative experience which Hungary had when it invented an automatic trigger shows that rules should not be formulated too strictly (Bonin and Schaffer, 2002). The aim of the creditor is to get a payoff from the defaulting firm. In general, different routes can be taken in a bankruptcy procedure: either a firm can be reorganized or its assets are liquidated. The recovery rate reflects the quality of the institutions and captures two effects. First, weak institutions imply that the debtor retains part of the collateralizable wealth or its payoff. Secondly, if institutions work imperfectly, there is a significant deadweight loss from liquidating assets, such as the costs of the legal process itself. The Doing Business Report 2006 shows that the recovery rates vary strongly. In the OECD countries the liquidation value, which is the net present value of revenues from selling the assets net of costs, is 74 per cent on average. In the other regions, it is never above 30 per cent (World Bank, 2006).

(2) Model

We use a two-period model à la Dell'Ariccia et al. (1999) to capture the specific relationship between firms and banks. Before starting the analysis, we describe the characteristics of the borrowers and the banking sector. Our analysis starts with the case of two banks. Subsequently, in section 4, we discuss the effects in a model with N symmetric banks. Both banks were lending in the first period but they differ in the number of bad old firms they have information about. The reason for this difference can either be that they had different shares in the credit market or

they had equal shares but the share of bad old firms in their credit portfolio differs. We model a situation in which they had different shares in the credit market and argue in the discussion in section 4 why this is comparable to a situation in which the quality of the portfolios differs. Bank 1 had a market share in the credit market of s_1, bank 2 of $s_2 (= 1 - s_1)$, where we assume that $s_1 > s_2$. There is no entry and no exit in the banking sector at the beginning of period 2. The costs of raising funds are normalized to zero.

There are two different groups of firms. First, there are the new customers who seek to establish a bank-firm relationship for the first time. New firms will be successful with probability q. If successful, a new firm generates a payoff X. Secondly, there are the old customers who already have established a bank-firm relationship by lending from a bank in the first period. We restrict our analysis to all old customers who defaulted on the loans that they received from the informed bank in the first period. The reason for default can either be illiquidity or insolvency and is observed by the bank that has granted the loan. Among these old firms a proportion p defaulted because they are illiquid although they are solvent and will be successful in period 2, generating a return of X. They are called "good old firms". However, a proportion of $(1 - p)$ will fail in the second period as well because they are insolvent; they are called "bad old firms". Moreover, old firms that have a project with a positive return in the first period should also exist. In contrast to the good old firms, which we focus on in our analysis, they could signal their type to an outside bank and would not face the hold-up problem described here. Thus, with our setup we focus our analysis on those firms that have an incentive to announce that they are new ones. The number of firms is normalized to 1; the share of old customers is μ and that of new customers is $(1 - \mu)$.

The distribution of old and new firms and their qualities are common knowledge. In the first period, the old firms received a loan in the amount of I_1 and thereby established a bank-firm relationship in which the informed bank learns their type. Based on the interaction during the previous bank relationship, the informed bank perfectly observes whether a firm's default was

caused by illiquidity or insolvency.[5] We assume that no information sharing through a credit registry takes place. Moreover, the banks cannot screen the credit applicants efficiently. According to the stylized facts, the limited information revealed by financial statements, and the sometimes inaccurate information contained in credit registries (if these exist at all), make it more difficult for a bank to verify whether a firm has previously received a loan.[6] For the model, we assume that banks cannot discriminate between old and new customers. In this setup, banks offer a pooling contract. We discuss the effects of screening and information exchange at the end of section 2.3..

The firms are endowed with assets that are liquidated in the case of bankruptcy. After period 1, the informed bank decides whether to force their defaulting customers to undergo a bankruptcy procedure or to forgive them their debt. We assume that the bank cannot be forced by law to initiate a bankruptcy procedure if it knows that a firm will not be successful in the future. The share of bad old firms that bank 1 (bank 2) has declared bankrupt is denoted by l_1 (l_2). We do not model the different routes taken in a bankruptcy procedure, i.e. liquidation or reorganization. If a firm is declared bankrupt, it becomes common knowledge that it is a bad firm. Moreover, the bank obtains a liquidation value which is denoted by L. The liquidation value of assets is determined by the costs of enforcing contracts and the proportion of the proceeds from liquidating the assets that the bank receives. The liquidation value increases as the quality of the institutions, such as the legal framework, improves. By the end of period 2, the assets become worthless. We assume that the liquidation is socially optimal because the loss from liquidation is lower than the misallocation of capital in the second period.

In the second period, the firms want to finance an indivisible investment project. They therefore need credit amounting to I because they do not have their own liquid funds (for notational conve-

[5] If the informed bank had imperfect information about its incumbent customers, the size of effects would change but not the insights gained.

[6] A survey about consumer loans in the US shows that 54 per cent of credit reports contain personal demographic information that was, for instance, misspelled, outdated, or otherwise incorrect. About 38 per cent of the reports did not mention major credit, loan, mortages, or other consumer accounts (Cassady and Mierzwinski, 2004).

nience, we do not use a subscript here). We assume that the expected return of the second period X is high enough to cover the investment in the second period, i.e. $X > I$. Thus, it is optimal to refinance the good old firms. If a bad old firm manages to receive credit from an outside bank, it invests the credit, as it gets private benefits from staying in business. However, the investment undertaken by the bad old firm is inefficient as it will always fail and therefore the bad old firm cannot repay the informed bank even though it is refinanced by the outside bank.[7] It is socially optimal to finance new firms as $qX \geq I$. Moreover, we assume that it is efficient for bank 2 to lend to new applicants because the return generated by new firms is high enough to cover the losses made with bad old customers, i.e. $(qX - I)(1 - \mu) > \mu s_1 (1 - l_1^*) I (1 - p)$ where l_1^* is the optimal share of bad firms that bank 1 will have declared bankrupt. From this assumption it follows that, relative to the rent extracted in the second period which is determined by I, the liquidation value obtained from selling the assets of a debtor that defaulted in period 1 is high enough, i.e. $L > I$.[8] Otherwise bank 1 would not have any defaulting firm declared bankrupt. In that case, bank 2 would make an expected loss and social welfare would decrease as bank 2 does not lend to new applicants at all.

The timing of events is as follows: at the end of the first period, the informed bank decides about filing a petition to have defaulting customers declared bankrupt.[9] Credit is granted at the beginning of the second period. We assume that banks have two sequential moves. First, they simultaneously choose the repayment for new applicants. Second, they determine the repayments

[7] We could also assume that the firm's manager takes the loan from the outside bank and runs away with the money.

[8] Evidence from emerging markets in Eastern Europe indicates that the value of assets pledged as collateral considerably exceeds the amount of the loan (EBRD, 2006).

[9] Banks might have an incentive to let firms apply to the credit market and then decide about having them declared bankrupt. This would allow the firm to demand a loan from the outside bank and use this loan to repay the incumbent bank. Since we assume that the firms have an incentive to invest in order to stay in business, this it not a feasible strategy for the banks. A firm would always invest the loan it gets from the outside bank and not repay the incumbent bank.

by their good old customers and deny credit to bad old customers. Finally, firms demand credit from the bank with the best credit offer.

Moreover, we need some technical assumptions. Firms apply for credit at each bank in proportion to their share in the total population. Old customers continue to borrow from the informed bank if they are indifferent between the offers of incumbent and outside banks. Both the old customers who do not stay with their informed bank and the new customers apply to the bank which offers the lowest repayment. If the two banks offer the same repayment, the market is split between them.

(3) Credit Contract

The game is solved by backward induction.[10] The informed bank does not refinance a bad old firm since it would make an expected loss. Therefore, bad old firms apply at the outside bank unless they were declared bankrupt.[11] Thus, the outside bank faces a winner's curse problem (see Broecker, 1990, Sharpe, 1990, and von Thadden, 2004). In this section, we describe the credit contract for a given share of bad old customers which their banks had declared bankrupt. Here, we assume that $(1-l_1)\,s_1 > (1-l_2)\,s_2$ which we prove to be true in section 3.

Good old firms always stay with their informed bank. Therefore, we first characterize the repayment made by the firms that apply at an outside bank in the second period, which, like Dell'Ariccia et al. (1999), we will call "free market". It can be shown that the informed bank demands the same repayment as the outside bank does. Therefore, good old firms stay with their informed bank and they pay as much as the firms that switch their bank or apply for credit for

[10] The hold-up problem which firms face in our model could be solved if banks granted credit lines. However, in many emerging markets credit lines are not widely available. Instead, each investment is financed by an individual loan. In a theoretical analysis, Schmeits (2005) finds that contracts for individual loans dominate credit lines if the bank's monitoring ability is low and bank competition is limited. Both these criteria apply to emerging markets and therefore her results justify our approach.

[11] Note that if a bad old firm were to reapply to its incumbent bank, the bank would recognize this firm and would not grant a loan.

the first time. In the free market, an equilibrium in pure strategies does not exist. The reason is that a marginal change in the repayments can lead to a discontinuous change in the bank's profits. Banks decide about the repayment R, the cumulative distribution function of the repayments F_1 and G_2, and the probability of denying credit $prob(D)$. Proposition 1 shows the equilibrium in mixed strategies.

Proposition 1. *In period* 2*, the banks offer the following repayments on the free market:*

- *Bank* 1 *offers a repayment, according to the following cumulative distribution function*

$$\begin{aligned} F_1(R_1) &= 1 - \frac{\mu s_1 (1-l_1)(1-p)}{(1-\mu)(qR-I)} I \forall R_1 \epsilon \left[\frac{(1-\mu)+\mu s_1 (1-l_1)(1-p)}{(1-\mu) q} I, X \right) \\ \text{and } prob(R_1 = X) &= \frac{\mu s_1 (1-l_1)(1-p)}{(1-\mu)(qX-I)} I. \end{aligned}$$

  Bank 1 *makes an expected profit of* $I\mu(1-p)((1-l_1)s_1 - (1-l_2)s_2)$ *from newly applying firms.*

- *Bank* 2 *does not make an offer with probability* $prob(D) = \frac{\mu s_1 (1-l_1)(1-p)}{(1-\mu)(qX-I)} I$*. Provided that it offers a loan, it chooses repayments according to the following cumulative distribution function*

$$\begin{aligned} G_2(R_2) = & \frac{(qX-I)((1-\mu)(qR-I) - \mu s_1 (1-l_1)(1-p) I)}{(qR-I)((1-\mu)(qX-I) - \mu s_1 (1-l_1)(1-p) I)} \\ & \forall R_2 \epsilon \left[\frac{(1-\mu)+\mu s_1 (1-l_1)(1-p)}{(1-\mu) q} I, X \right]. \end{aligned}$$

  Bank 2 *makes zero expected profit.*

Proof: See the Appendix.

When offering the terms of a credit contract, the outside bank makes the first move. The informed bank can always offer a credit contract to a good old customer that is as favorable as the one offered by the outside bank. Thus, in equilibrium, the good old customers stay with their informed bank and repay as much as all other customers. The banks offer a pooling contract for the

remaining customers, namely the bad old firms and the new firms, because they cannot discriminate between them.

As Dell'Ariccia et al. (1999) show there is no equilibrium in pure strategies for the repayment terms. In equilibrium, the banks mix continuously on the range $[\underline{R}, X)$ or do not bid at all. The lowest repayment $\underline{R}$ is determined by the condition that the expected profit of bank 2, which has had a lower market share in the previous period, is zero. Due to its resulting informational disadvantage compared to bank 1, bank 2 stays out of the market with positive probability and, therefore, makes zero expected profit from the newly applying customers. The repayment that bank 2 needs to break even depends on bank 1's market share as this determines the degree of asymmetric information between banks. Bank 1's repayments are chosen such that, in expected terms, it matches bank 2's repayment. Thus, bank 1 makes an expected profit of $\Pi^{FM} = I\mu\,(1-p)\,((1-l_1)\,s_1 - (1-l_2)\,s_2)$ from new applicants for credit in period 2 where FM is used to denote the free market. The profit is based on bank 1's informational advantage over bank 2 with regard to old firms.

The informed banks can extract a rent from all its good old customers denoted by Π^{GO}. The rent is described in the following proposition.

Proposition 2. *All good old firms receive a loan from their informed bank. However, they face a hold-up problem. This allows both bank* 1 *and bank* 2 *to extract from* ***each good old*** *firm a rent of*

$$\Pi^{GO} = \frac{s_1\,(1-l_1)\,\mu\left(\ln\left(\frac{(qX-I)(1-\mu)}{\mu s_1(1-l_1)I(1-p)}\right)+1\right)(1-p)+(1-q)\,(1-\mu)}{(1-\mu)\,q} I.$$

Proof: See the Appendix.

The good old customers face a hold-up problem because they cannot signal their type to an outside bank. Thus, the informed bank can match the repayment the outside bank demands and thereby it extract rents from each of these firms.[12] Both banks mix on the same range and put the

[12] For the Czech Republic, where according to World Bank (2006) about one third of the population is covered by private credit registries, information is available about the interest rates for outstanding loans and new businesses for

same weight on each repayment. If bank 2 does not offer a loan, bank 1 demands X as a repayment from its incumbent customers. If bank 1 demands a repayment of X, bank 2 also demands X from its incumbent customers. The probability that bank 1 demands X and that bank 2 does not offer a loan are identical. As a result, both banks extract the same rent from their incumbent customers.

A comparative static analysis provides some important insights into the composition of the rents. In general, we find that the more severe the adverse selection problem between banks, the higher is the rent that the incumbent bank can extract. Interestingly, the rent extracted does not depend on bank 2's market and the share of firms it has declared bankrupt (l_2). The expected repayments depend on the degree of adverse selection the smaller bank (bank 2) faces, which, in turn, is determined by bank 1's market share and the share of firms bank 1 has declared bankrupt (l_1). As bank 1 has more firms declared bankrupt (l_1 increases), the number of bad old firms in the population decreases. Thus, the quality of firms applying to the outside bank (bank 2) in the second period improves. As a result, the severity of the adverse selection problem decreases, and therefore, the average repayment paid at the outside bank (bank 2) decreases. This reduces the hold-up problem that good old firms face. Thus, the adverse selection problem between the two banks increases in the market share of bank 1, s_1, since bank 1 releases more bad old firms into the pool of borrowers who then apply to an outside bank in period 2. Therefore, the expected repayment increases because bank 2 puts more weight on higher repayments and denies credit with a higher probability. The same argument applies if p, the share of old firms, increases. Finally, the distribution of new customers matters. The higher the proportion of good new firms, i.e. q, the lower the repayment. The intuition is equivalent to a change in the make-up of the population of old firms.

The discussion so far has shown that the size of the rent depends on the degree of adverse selection between the two banks. We have assumed that banks do not perform any screening and

non-financial firms. There, incumbent customers indeed pay higher interest rates, which is consistent with the fact that they are held up by their informed bank (Czech National Bank, 2005).

that they are not able to distinguish between old and new firms. Clearly, the degree of adverse selection between banks decreases if information about applying firms can be generated, be it through screening or through credit registries. However, as long as information is imperfect, the adverse selection problem will remain.

II. Banks' Decision to Have Defaulting Firms Declared Bankrupt

(1) Banks' Incentives to Have Defaulting Firms Declared Bankrupt

In the analysis so far we have not explicitly modelled the decision of a bank to have its bad old customers declared bankrupt and instead assumed that bank 1 releases more bad old firms into the pool of borrowers than bank 2, i.e., $(1-l_1)\,s_1 > (1-l_2)\,s_2$. In the next step, we derive the optimal share of bad old firms declared bankrupt by bank 1 and bank 2 denoted by l_1 and l_2, respectively. When deciding about filing petitions to have firms declared bankrupt, the bank trades off two effects. On the one hand, having firms declared bankrupt generates a payoff for the bank. On the other hand, it lowers the degree of asymmetric information between banks and thereby the rents to be extracted. The rents come potentially from two sources: from the good old incumbent firms that face the hold-up problem (Π^{GO}) and from the free market (Π^{FM}). Both banks can hold-up their incumbent customers but only the bank with the higher share of bad old firms in its portfolio makes an expected positive profit on the free market. The size of the rents depends on the share of bad old firms, that each of the banks will have declared bankrupt, relative to the other. As shown in Propositions 1 and 2, the decision of the bank that releases more bad old borrowers into the pool of applicants determines the size of the rents.

Thus, bank i maximizes the following objective function when deciding about l_i:

$$\Pi_i\left(l_i, l_j\right) = \mu s_i l_i \left(1-p\right) L + \mu s_i p \Pi^{GO}\left(l_i, l_j\right) + \Pi^{FM}\left(l_i, l_j\right) \tag{1}$$

The optimal decision of each bank depends on the decision of its competitor. By having a defaulting firm declared bankrupt, the number of firms it has private information about - relative

to its competitor - changes. The following proposition shows the liquidation decisions taken in equilibrium.

Proposition 3. *Bank* 1 *has a fraction* $l_1^* = 1 - \frac{(1-\mu)(qX-I)}{s_1\mu(1-p)Ie^{q(1-\mu)\frac{L-I}{\mu p s_1 I}}}$ *of its bad old customers declared bankrupt whereas bank* 2 *has all of them declared bankrupt, i.e.,* $l_2 = 1$.

Proof: See the Appendix.

Interestingly, the decision to liquidate a firm is independent of the outstanding debt, i.e. I_1. The amount of credit granted in the first period is comparable to a sunk cost that no longer influences the bank's decision. Actually, the optimal fraction of firms bankrupted is determined by the condition that the marginal loss in information rent equals the marginal return in liquidation proceeds. The banks' information rents depend on the degree of asymmetric information between banks which is determined by the highest number of bad old firms a bank releases into the pool of new applicants. For the bank which expects that its competitor will release a higher number of bad old firms than it does itself, this implies that the marginal loss in information rents does not depend on its own decision. For this bank, having a firm declared bankrupt creates a liquidation payoff but does not influence the rents from asymmetric information. Thus, the best decision is to have all bad old firms declared bankrupt. In contrast, if a bank expects to release the higher number of bad old firms into the pool of new applicants, its decision is determined by the trade-off between the marginal payoff from liquidation and the marginal loss in rents from asymmetric information. Which of the banks releases more bad old firms in equilibrium? In Proposition 3 we have proven that it is always optimal for bank 2 to have all its bad old firms declared bankrupt. Thus, bank 1 will release a fraction of $(1 - l_1^*)$ of its bad old firms into the pool of new applicants. Given the optimal decision of each of the banks, the (absolute) number of bad old firms released into the pool of new applicants is always higher for bank 1 (the bigger bank).[13]

[13] If the two banks are identical in terms of market shares, mulitiple equilibria exist. Either bank 1 has a fraction l_1^* of its bad old firms declared bankrupt and bank 2 has all of them declared bankrupt or bank 2 has a fraction l_2^* of its bad old firms declared bankrupt and bank 1 has all of them declared bankrupt.

The following proposition summarizes how the equilibrium liquidation decision is influenced by parameter changes.

Proposition 4. *The higher the degree of bank competition, i.e., the lower s_1, the higher the total fraction of bad old firms declared bankrupt. However, the effect of s_1 on l_1^* is ambiguous: for $s_1 \leq \widetilde{s_1} \equiv \frac{q(1-\mu)(L-I)}{\mu p I}$ we obtain $\frac{\partial l_1^*}{\partial s_1} \leq 0$ and for $s_1 > \widetilde{s_1}$ we obtain $\frac{\partial l_1^*}{\partial s_1} > 0$. As the liquidation value L increases, the total fraction of bad old firms declared bankrupt increases.*

Proof: See the Appendix.

For the whole banking sector, we find that the total number of bankruptcy filings decreases in s_1. Since $l_1^* < l_2^* = 1$, an increase in the market share of bank 1 implies that the share of bad old firms declared bankrupt must decrease. The impact of bank competition on bank 1's decision to have firms declared bankrupt depends on bank 1's market share s_1. In equilibrium, the marginal loss in information rent equals the marginal payoff from liquidating assets. Bank 1's market share s_1 influences bank 1's marginal information rent both through the number of firms it receives a rent from and the amount of the information rent that can be extracted from each firm. However, the effect of s_1 on the marginal information rent is ambiguous. For s_1 below the threshold value $\widetilde{s_1}$, a higher s_1 decreases the marginal information rent. In equilibrium, the marginal loss of information rent must equal the marginal benefit of liquidation. For this reason, bank 1 lowers the share of firms declared bankrupt (l_1) such that the adverse selection problem becomes more severe again and thus the marginal information rent increases so that it is equal to the marginal benefit from liquidation. For s_1 above the threshold value, a higher s_1 increases the marginal information rent. Thus, bank 1 increases the share of firms declared bankrupt (l_1) such that the marginal information rent decreases to its optimal level.

Obviously, better institutions increase the liquidation value and therefore provide better incentives for liquidation. Therefore, the fraction of firms declared bankrupt increases as the liquidation value L increases. In the setup of our model, it is vital that the liquidation value, which reflects the

quality of (legal) institutions, exceeds a certain threshold. For this reason, we assumed that $L > I$. Note that the threshold value for L depends only on the investment made in the second period (denoted by I). The reason is that I determines the size of the information rents. If the condition $L > I$ is not fulfilled, neither bank would have an incentive to have a bad old firm declared bankrupt ($l_1^* = l_2^* = 0$). This would imply that the adverse selection problem between banks is severe. As a result, the banks would not lend in the second period and new applicants would not receive loans. Thus, for too low liquidation values, financial intermediation breaks down for new firms. Formally, this condition ($L > I$) is obtained from the fact that it must be profitable to make loans in the second period, i.e. $(qX - I)(1 - \mu) > \mu s_1 (1 - l_1^*) I (1 - p)$ with l_1^* as stated in Proposition 3.

From the perspective of social welfare, the total number of bankruptcy filings is relevant. In our setup, it is socially optimal if all bad old firms are declared bankrupt. In Proposition 4, we have shown that the number of firms declared bankrupt increases as the market share of bank 1 goes down. As banks become more symmetric, the degree of competition increases, the number of firms declared bankrupt increases and, in turn, social welfare improves.

(2) Effect of the Bankruptcy Filings on the Credit Market

We have shown that the repayment offered to new applicants depends on the degree of bank competition. According to this "direct effect", the lower bank 1's market share, the lower the repayment. Moreover, the repayment is influenced by the bankruptcy decision of the banks. This decision is also determined by the market share of the banks. According to this "indirect effect", an increasing market share of bank 1 increases ($s_1 \geq \widetilde{s_1}$) or decreases ($s_1 < \widetilde{s_1}$) the number of bankruptcy filings and thereby the repayment decreases or increases. Thus, these are two opposing effects for high market shares of bank 1. The ultimate question is how bank competition influences the repayment for new applicants.

Proposition 5. *New applicants expect to repay less and have a higher probability of receiving a loan as the degree of bank competition increases, i.e., as s_1 decreases, and as the liquidation value L increases.*

Proof: See the Appendix.

Suppose that bank 1 has a market share significantly below the threshold value $\widetilde{s_1}$. For a low market share the adverse selection problem between banks is less severe. As bank 1's market share increases, the adverse selection problem becomes more severe and the repayment increases. Moreover, the number of bankruptcy filings by bank 1 decreases so that the adverse selection problem becomes even more severe. Here the indirect effect magnifies the direct effect.

What happens if the market share of bank 1 is rather high ($s_1 \geq \widetilde{s_1}$)? Then an increase in s_1 increases the share of bad old firms declared bankrupt. Therefore, the adverse selection problem decreases. However, the direct effect of competition which increases the repayment dominates. Thus, as bank 1's market share increases, competition between banks becomes less intensive. But the increasing direct effect of a higher market share is reduced by the higher share of firms declared bankrupt.

Moreover, the liquidation value also influences the probability of new firms getting loans. Since a higher liquidation value gives bank 1 the incentive to have more bad old firms declared bankrupt, bank competition intensifies, the new applicant's expected repayment decreases and the probability of it getting a loan increases. The institutional environment has an impact on new firms through this mechanism. If the quality of institutions such as the legal system is poor, the terms of the credit contract are less attractive and access to finance is more difficult. This increases the costs of financing for the firms.

III. Discussion of Results

So far, we have focussed on the case of two banks that have different market shares. This difference in market shares implies that they have information about a different fraction of the old customer population. Because information is asymmetric, banking is not perfectly competitive. A comparable situation would arise if the banks had identical market shares in the initial period but different shares of bad old firms in their portfolios, i.e. if $(1-p)$ differed between bank 1 and bank

2. The bank that has more bad old firms in the portfolio can (potentially) release more bad old firms into the pool of new applicants. In the terms of our model, it would be considered to be the bigger bank (bank 1). The more asymmetric the banks, the lower the incentive to have bad old firms declared bankrupt.

In a model with N identical banks, the adverse selection problem which each bank faces is much higher than in the case of two banks. Each bank has information only about a fraction of $\frac{1}{N}$ of the old firms. Thus, each bank faces the risk that a share of $(1 - l_j)\left(1 - \frac{1}{N}\right)$ of bad old firms applies (where l_j is the share of bad old firms which the other banks had declared bankrupt). The degree of asymmetric information determines the repayment. Thus, the higher the number of banks, the more severe the adverse selection problem and the higher the repayment (for a given liquidation decision of all other banks).[14]

The objective function of bank i when it decides about having bad old firms declared bankrupt is, as before, given by equation (1). It trades off the effect which its decision has on the liquidation payoff, the rent extracted from the good old firms, and the profit from the free market. The profit from the free market will be positive if bank i files fewer firms for bankruptcy than the other banks.

For very high liquidation values, all banks have their defaulting customers declared bankrupt. For very low liquidation values, banks do not have any of their customers declared bankrupt. For intermediate liquidation values, the optimal fraction of firms which bank i will have declared bankrupt depends on the expectation bank i has about the decisions taken by all other banks. If bank i expects that all other banks have only a low share of bad old firms declared bankrupt, it, too, will only have a low share of firms declared bankrupt. However, if bank i expects that all other banks have a high share of firms declared bankrupt, it will also have a high share of firms declared bankrupt. If the other banks have a high share of bad old firms declared bankrupt, the degree of

[14] A similar problem arises, for example, in Broecker (1990). Banks can invest in screening and generate signals on the creditworthiness that are independent of each other. Since they reject those applicants that generate a negative signal, information between banks is asymmetric. The empirical evidence provided by Shaffer (1998) is consistent with a higher degree of asymmetric information in less concentrated markets.

asymmetric information decreases and thereby the rents that can be extracted from good old firms and new applicants decrease as well. Thus, bank i's incentive to have firms declared bankrupt is higher. Since all banks are equal, a symmetric equilibrium exists in which, depending on the expectations, either a low share or a high share of defaulting firms is declared bankrupt.

The results of the comparative static analysis are largely confirmed. As the liquidation values increases, the number of bankruptcies increases and thereby decreases the repayment. A higher number of banks implies that more bad old firms are filed for bankruptcy. Since the rents that can be extracted by bank i depend less on its own decision if there are more banks, what is gained from having the firms declared bankrupt is relatively higher than the information rent which must be given up. Therefore, the share of bad old firms declared bankrupt increases in the number of banks. Moreover, we have argued that, for a given level of bankruptcy filings, a higher number of banks increases the repayment because the adverse selection problem between banks is more severe (direct effect). However, the rate of bankruptcy filings increases in N. A higher rate of bankruptcy filings implies a lower repayment (indirect effect). In total, the repayment increases in N, which implies that the indirect effect is not strong enough to reverse the direct effect although it does reduce its size.

Moreover, we focus on a situation without a credit registry. Information sharing will reduce the rents from asymmetric information that the informed bank obtains. As long as there is some asymmetric information, the bank faces the trade-off described in the model. Given the limited coverage of credit registries in most parts of the world, and the fact that inaccuracies and errors occur, some asymmetric information prevails. The incentive to have a defaulting firm declared bankrupt decreases as information becomes more symmetric.

IV. Empirical Implications

From our model, we can derive hypotheses for the effect of the quality of institutions and bank competition on the number of bankruptcies and on the credit market. There are several

empirical studies about the effects that we have shown in the model. However, none of these studies investigates all the effects derived in the model, each focuses on one particular effect. In general, the results of our model are confirmed by the empirical evidence.

Concerning the number of bankruptcy filings the prediction is very clear. As the legal environment improves and the banking sector becomes more competitive, the number of bankruptcy filings should increase. Most data is on the aggregate number of bankruptcy filings. In the European Union, there is a clear difference between western European countries and the new EU member states where institutions are still deficient but improving. In the latter region, the number of bankruptcy filings per 10,000 firms is significantly lower (Creditreform, 2006). However, these numbers do not reveal who initiated the bankruptcy procedure. In Hungary, banks are the creditors least likely to initiate bankruptcy and contribute only about 11 per cent of the cases (Franks and Lóránth, 2004). Similar figures are found for Russia, where about 20 per cent of the cases were initiated by private creditors including banks (Pistor, 2006). These figures indicate that banks remain passive. Within the banking sector, our model predicts that bigger banks are more passive. To test this prediction more detailed data about who initiates bankruptcy would be needed.

Regarding the interest rates, we predict that these decrease as the legal environment improves and bank competition becomes more intense. The effect that better judicial efficiency and judicial enforcement (as measured by the degree of property rights protection and the rule of law) lower the interest rate spreads of banks is confirmed by Laeven and Majnoni (2005) for a large cross-section of countries. Jappelli et al. (2005) study the effect of the quality of legal enforcement (as measured by the length of trials and the stock of pending trials) on the interest rate. However, the effect that better legal enforcement reduces interest rates is not significant in all regressions. To test the mechanism described in this paper, we would need data about the number of bankruptcy cases initiated by banks (either as a time-series or as a cross-section). We predict that, as the legal environment improves and/ or bank competition increases, the number of bankruptcy cases increases, and as a consequence, the interest rate decreases.

Finally, we can derive predictions for the probability of credit rationing and the share of non-performing loans. As the legal environment improves and/ or bank competition increases, the share of non-performing loans that the outside banks grant falls as more bad old firms are declared bankrupt. As a consequence of the lower information asymmetry, banks grant loans with a higher probability. Thus, credit rationing is reduced. A recent cross-country study confirms that countries with a better legal environment enjoy higher degrees of financial intermediation. However, if the sample is split up into rich and poor countries, the coefficient is only significant for the rich countries (Djankov et al., 2007). But evidence from poorer countries, such as Argentina and Brazil, shows that more loans are granted in states with better legal protection (Castelar Pinheiro and Cabral, 2001; Cristini et al., 2001). For Argentina, it is also found that banks in states with higher judicial efficiency have lower shares of credits in arrears (Cristini et al., 2001). However, neither of these studies takes into account the creditworthiness of the applicants. Better data is available for households in Italy. There, the probability that a credit proposal is turned down increases as judicial inefficiency becomes more severe. This could indicate that, as a result of judicial inefficiency, the liquidation value decreases and therefore banks are less willing to lend. By providing higher amounts of collateral, borrowers could improve their access to bank loans. Interestingly, the effect of the availability of collateral on the probability of credit approval is insignificant although it has the expected positive sign (Fabbri and Padula, 2004). Our study shows that an additional explanatory variable should be taken into account. The lower the number of bankruptcy cases in a province, the more severe the adverse selection problem and the less banks are willing to grant loans. This implies that, by controlling for the number of bankruptcy cases in a province, the effect of the availability of collateral should become significant.

V. Conclusion

In this paper, we argue that to soften competition bank's have an incentive to apply the decision to have a firm declared bankrupt strategically. We have shown that the incentive to liquidate

defaulting firms depends on the quality of institutions and the degree of bank competition. Institutions, in turn, determine the payoff a creditor gets from liquidating a firm. Therefore, our analysis further explains why creditors in countries with deficient institutions are passive. This creates a kind of soft budget constraint for inefficient firms - since their informed bank does not have them declared bankrupt, they may receive loans from outside banks. However, if creditors remain passive, the degree of asymmetric information between banks is high. Due to the resulting adverse selection problem, the repayments are also high and banks are less willing to grant loans to new applicants.

We have shown that the decision to have firms declared bankrupt has a strategic effect as it reduces asymmetric information between banks and renders bank competition more intensive. We are also able to evaluate an increase in the number of banks. If more banks compete on the market, the individual bank has a higher incentive to have bad old firms declared bankrupt. As a result, the number of bankruptcy filings increases in the number of banks and this has a negative effect on repayments.

What can be done by governments in order to improve the situation? The appropriate policy measures are the improvement of institutions, the reduction of the adverse selection problem, and an increase in bank competition. With respect to our analysis, an important step is to improve the legal framework. The liquidation of a firm's assets is expensive from a social welfare point of view because seizing the assets is costly and the secondary markets work inefficiently. The social loss will decrease if the legal systems function better. Reforms are necessary in two respects. Laws have to be drafted more carefully in order to avoid ambiguities. Even more importantly, the law enforcement must be faster and its results more predictable.

Furthermore, there should be more competition in the banking sector. Information plays a crucial role in fostering bank competition. The adverse selection problem between banks must be mitigated through different measures. By improving the informational contents of financial statements, a firm's financial situation becomes less opaque for potential lenders. However, reaching

a significant improvement will take time. In the meantime, inventing public credit registries could serve as a means for publishing information about inefficient firms. Jappelli and Pagano (2000) observe that public credit registries are more frequent in countries where law enforcement is less efficient and creditor rights are not very well protected. At least in theory, the degree of adverse selection between banks decreases through credit registries, and the incentive to liquidate firms increases. However, it is not obvious why banks are willing to provide information about a firm. From our analysis it is clear that they will not give information about a firm's *type* if they are not compensated by a sufficiently high liquidation payoff. Thus, public credit registries have to be designed carefully to make sure that the reports banks submit are correct. Survey evidence about the information contained in private credit registries in the US suggests this is a challenge for the system (Cassady and Mierzwinski, 2004). This challenge would be even greater in emerging market economies where they are needed most.

Appendix

Proof of Proposition 1

Step 1: We show that old customers stay with their informed bank.

- Bad old customers are denied credit by their informed bank because they generate a payoff of $0 < I$.
- Due to the sequential nature of offers, bank 1 underbids bank 2 marginally (and vice versa) and keeps its good old firms, i.e. $R_1 = R_2$, because the old firms have a slight preference for the informed bank.

Step 2: We show that no equilibrium in pure strategies exists.

$\underline{R}$ denotes the repayment that bank 2 needs for making zero expected profit.

Suppose there exists a symmetric equilibrium with $R_1 = R_2 > \underline{R}$. Bank 1 has an incentive to marginally undercut R_2 and still make a positive expected profit. Suppose that $R_1 = R_2 = \underline{R}$. Bank 1 has an incentive to undercut bank 2 and still make positive expected profit. In this case, bank 2 would make an expected loss and, thus, it would be better to make no offer at all. Then, bank 1 would act like a monopolist and demand $R_1 = X$. The optimal reaction of bank 2 would be to marginally undercut bank 1 and make positive expected profits. As a result, no symmetric equilibrium in pure strategies exists.

Suppose there exists an asymmetric equilibrium in pure strategies. Suppose that $R_1 > R_2 > \underline{R}$. Bank 1 has an incentive to marginally undercut bank 2 and make positive expected profit. Suppose that $R_1 > R_2 = \underline{R}$. Bank 1 has an incentive to undercut bank 2 and still make positive expected profit. In this case, bank 2 would make an expected loss and, thus, it would be better to make no offer at all. Suppose that $R_2 > R_1 \geq \underline{R}$. Bank 2 has incentive to demand a marginally lower repayment than bank 1 and make a non-negative profit. Thus, we do not find an asymmetric equilibrium in pure strategies.

Step 3: We show that $F_i(R)$ and $F_j(R)$ are continuous and strictly monotonously increasing on an interval $(\underline{R}, X)$.

Suppose that F_j is discontinuous at R^*, i.e. there exists an atom in F_j, then bank i's action of playing $R^* - \epsilon$ strictly dominates playing $R^* + \epsilon$, $\epsilon > 0$. Therefore, bank i will not bid a free-market repayment $[R^*, R^* + \epsilon)$. But then bank j can raise its repayment without losing customers, so R^* cannot be an optimal action for bank j. Hence, F_j must be continuous.

Suppose that F_j is non-increasing over some interval, i.e. there exists an interval $(R_a, R_b) \subseteq (\underline{R}, X)$ for which $f_i(R) = 0 \ \forall \ R\epsilon(R_a, R_b)$. But then $prob(R_i < R_j \mid R_i = R_a) = prob(R_i < R_j \mid R_i \epsilon(R_a, R_b))$, but profits are strictly higher for $R_i > R_a$ (conditional on winning), so that bank i maximizes its payoff by playing $R_i = R_b$ and hence would never offer a repayment in the interval. But then bank j can increase its profits by playing $R_j = R_b - \epsilon$ with positive probability, where $\epsilon < R_b - R_a$, since this will lead to strictly higher profits than any interest rate offer in a neighborhood of R_a. However, this contradicts the assumption that $f_i(R) = 0 \ \forall \ R\epsilon(R_a, R_b)$.

Step 4: We determine the equilibrium in mixed strategies as described in the proposition.

Consider the profit function of bank i ($i \neq j$ and $i = 1, 2$) conditional on bank j's offer.

$\Pi_i(R_i) = (1-\mu)(1 - F_j(R_i))(qR_i - I) + \mu s_j (1 - l_j)(1 - p)(-I) \ \forall R_i \epsilon [\underline{R}, X)$.

Bank i will participate only if $\Pi_i(R_i) \geq 0$ or

$$\lim_{R \to X} (1 - F_j(R)) \geq \frac{\mu s_j (1 - l_j)(1 - p)}{(1 - \mu)(qR_i - I)} I$$

There are two ways for getting $\lim_{R \to X} (1 - F_j(R)) > 0$:

- There is an atom at X in F_j. However, an atom cannot exist in both F_i and F_j since then neither $R_i = X$ nor $R_j = X$ would be optimal.
- Either bank i or bank j does not always bid on the free market. As shown below, this has to be the smaller bank. This implies that its expected profit is zero because each offer generates

the same profit.

Step 5: We determine the minimum repayment $\underline{R}$. $\underline{R}$ is determined by the condition that bank 2 wins the free market with certainty:

$$\Pi_2(\underline{R}) = (1-\mu)(q\underline{R} - I) + \mu s_1 (1-l_1)(1-p)(-I) = 0$$

$$\underline{R} = \frac{(1-\mu) + \mu s_1 (1-l_1)(1-p)}{(1-\mu) q} I$$

Step 6: We determine bank 1's expected profit.

Bank 1's return for $\underline{R}$ is:

$$\begin{aligned} \Pi_1(\underline{R}) &= (1-\mu)(q\underline{R} - I) + \mu s_2 (1-l_2)(1-p)(-I) \\ &= (s_1(1-l_1) - s_2(1-l_2))\,\mu(1-p)\,I \equiv \overline{\Pi_1} > 0 \end{aligned}$$

Thus, it is shown that bank 2 does not always bid on the free market and therefore makes zero expected profit.

Step 7: We determine the mixing probabilities.

Let us use the fact that $\Pi_1(R_1) = \overline{\Pi_1}$ and $\Pi_2(R_2) = 0$ for each repayment.

- For bank 1 we determine $F_1(R)$ by setting

$$\Pi_2(R_2) = (1-\mu)(1 - F_1(R_2))(qR_2 - I) + \mu s_1 (1-l_1)(1-p)(-I) = 0$$

Accordingly, $F_1(R) = 1 - \frac{\mu s_1 (1-l_1)(1-p)}{(1-\mu)(qR-I)} I \ \forall R_1 \in \left[\frac{(1-\mu)+\mu s_1 (1-l_1)(1-p)}{(1-\mu)q} I, X\right)$ and $prob(R_1 = X) = \frac{\mu s_1 (1-l_1)(1-p)}{(1-\mu)(qX-I)} I$.

- For bank 2 we determine $F_2(R)$ by setting

$$\Pi_1(R_1) = (1-\mu)(1 - F_2(R_1))(qR_1 - I) + \mu s_2 (1-l_2)(1-p)(-I) = \overline{\Pi_1}$$

Bank 2 does not make an offer with probability $prob(D) = \frac{\mu s_1(1-l_1)(1-p)}{(1-\mu)(qX-I)} I$. With probability $1-prob(D)$ it chooses repayments according to $F_2(R) = 1-\frac{\mu s_1(1-l_1)(1-p)}{(1-\mu)(qR-I)} I \; \forall R_1 \; \epsilon \left[\frac{(1-\mu)+\mu s_1(1-l_1)(1-p)}{(1-\mu)q} I, X\right)$. Provided that bank 2 offers a loan it chooses repayments according to the following cumulative distribution function $G_2(R) = \frac{(qX-I)((1-\mu)(qR-I)-\mu s_1(1-l_1)(1-p)I)}{(qR-I)((1-\mu)(qX-I)-\mu s_1(1-l_1)(1-p)I)} \; \forall R_2 \; \epsilon \left[\frac{(1-\mu)+\mu s_1(1-l_1)(1-p)}{(1-\mu)q} I, X\right]$ where $G_2(R) = \frac{F_2(R)}{1-prob(D)}$. Note that $G_2\left(\frac{(1-\mu)+\mu s_1(1-l_1)(1-p)}{(1-\mu)q} I\right) = 0$ and $G_2(X) = 1$. Q.E.D.

Proof of Proposition 2

From the good old firms in its portfolio bank 1 demands the same R as offered by bank 2. If bank 2 does not offer a loan, bank 1 demands $R = X$. This happens with $prob(D)$. From the good old firms in its portfolio bank 2 demands the same R as offered by bank 1. If bank 1 demands X, bank 2 demands X as well. This happens with $prob(R_1 = X) = prob(D)$. Bank 1 and bank 2 also mix on the same range and put equal weight on each repayment ($F_1(R) = F_2(R)$ and $prob(R_1 = X) = prob(D)$). Thus, both banks get the same rent from the good old firms, denoted by Π_i^{GO}, that is determined as follows:

$$\begin{aligned}
\Pi_i^{GO} &= \int_{\underline{R}}^{X} prob(R)\, RdR + (1 - Fj(X))\, X - I \text{ with } i \neq j \\
&= \int_{\underline{R}}^{X} \left(\frac{q\mu s_1 (1-l_1)(1-p) I}{(1-\mu)(qR-I)^2}\right) RdR + \frac{\mu s_1 (1-l_1)(1-p) I}{(1-\mu)(qX-I)} X - I \\
&= I\frac{s_1(1-l_1)\mu\left(\ln\left(\frac{(qX-I)(1-\mu)}{\mu s_1(1-l_1)I(1-p)}\right)+1\right)(1-p) + (1-q)(1-\mu)}{(1-\mu)q}
\end{aligned}$$

where $prob(R)$ is given by $\frac{\partial F(R)}{\partial R} = \frac{q\mu s_1(1-l_1)(1-p)I}{(1-\mu)(qR-I)^2}$. $\ln\left(\frac{(qX-I)(1-\mu)}{\mu s_1(1-l_1)I(1-p)}\right) > 0$ because we assumed that $(qX-I)(1-\mu) > \mu s_1 I(1-p)$. Q.E.D.

Proof of Proposition 3

Step 1: We assume that $(1-l_2)s_2 < (1-l_1)s_1$.

Bank 1 maximizes its expected payoff $\Pi_1(l_1, l_2)$ by choosing l_1

$$\begin{aligned}
\Pi_1(l_1, l_2) &= l_1\mu(1-p)s_1 L + \mu p s_1 I\frac{(1-l_1)s_1\mu\left(\ln\left(\frac{(qX-I)(1-\mu)}{\mu(1-l_1)s_1 I(1-p)}\right)+1\right)(1-p) + (1-q)(1-\mu)}{(1-\mu)q} \\
&\quad + ((1-l_1)s_1 - (1-l_2)s_2)\mu(1-p)I
\end{aligned}$$

Differentiating this payoff with respect to l_1 yields the following first order condition:

$$\begin{aligned}\mu s_1 (1-p) \frac{\mu p s_1 I \ln\left((qX-I)\frac{1-\mu}{\mu(1-l_1)s_1 I(1-p)}\right) - q(1-\mu)(L-I)}{(1-\mu)q} &= 0 \text{ or} \\ \underbrace{I\frac{\mu p s_1 \ln\left((qX-I)\frac{1-\mu}{\mu(1-l_1)s_1 I(1-p)}\right) + (1-\mu)q}{(1-\mu)q}}_{\text{marginal cost (information rent)}} &= \underbrace{L}_{\text{marginal benefit}}\end{aligned}$$

Thus, we get $l_1^* = 1 - \frac{(1-\mu)(qX-I)}{s_1\mu(1-p)I\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)}$.

Step 2: We assume that $(1-l_2)s_2 > (1-l_1)s_1$.

Bank 2 maximizes its expected payoff by choosing l_2

$$\begin{aligned}\Pi_2(l_1,l_2) &= l_2\mu(1-p)s_2 L + \mu p s_2 I\frac{(1-l_2)s_2\mu\left(\ln\left(\frac{(qX-I)(1-\mu)}{\mu(1-l_2)s_2 I(1-p)}\right)+1\right)(1-p)+(1-q)(1-\mu)}{(1-\mu)q} \\ &\quad + ((1-l_2)s_2 - (1-l_1)s_1)\mu(1-p)I\end{aligned}$$

Differentiating this payoff with respect to l_2 yields the following first order condition:

$$\mu s_2(1-p)\frac{\mu p s_2 I\ln\left((qX-I)\frac{1-\mu}{\mu(1-l_2)s_2 I(1-p)}\right) - q(1-\mu)(L-I)}{(1-\mu)q} = 0.$$

Therefore, $l_2^* = 1 - \frac{(1-\mu)(qX-I)}{s_2\mu(1-p)I\exp\left(q(1-\mu)\frac{L-I}{\mu p s_2 I}\right)}$.

Step 3: We show that $(1-l_2^*)s_2 < (1-l_1^*)s_1$

Inserting l_1^* and l_2^*, we get that $(1-l_2^*)s_2 < (1-l_1^*)s_1$ if

$$\frac{(1-\mu)(qX-I)}{s_2\mu(1-p)I\exp\left(q(1-\mu)\frac{L-I}{\mu p s_2 I}\right)}s_2 < \frac{(1-\mu)(qX-I)}{s_1\mu(1-p)I\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)}s_1.$$

This is always the case since

$$\begin{aligned}\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right) &< \exp\left(q(1-\mu)\frac{L-I}{\mu p s_2 I}\right) \text{ or} \\ q(1-\mu)\frac{L-I}{\mu p s_1 I} &< q(1-\mu)\frac{L-I}{\mu p s_2 I}\end{aligned}$$

as $s_2 < s_1 < 1$ and $I < L$. Q.E.D.

Proof of Proposition 4

1. Effect of liquidation value on l_1^*

$\frac{\partial l_1^*}{\partial L} = \frac{q(1-\mu)^2(qX-I)}{\exp\left(q(L-I)\frac{1-\mu}{\mu p s_1 I}\right)p(1-p)I^2 s_1^2\mu^2} > 0.$

Thus, as the liquidation value increases, bank 1 has more bad old firms declared bankrupt.

2. Effect of competition on the number of firms declared bankrupt

- Effect on l_1^*

$\frac{\partial l_1^*}{\partial s_1} = (1-\mu)(qX-I)\frac{q(1-\mu)(I-L)+\mu p s_1 I}{\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)p(1-p)I^2 s_1^3\mu^2} = 0$

as the sign of the denominator is ambiguous because $\underbrace{q(1-\mu)(I-L)}_{-} + \underbrace{\mu p s_1 I}_{+}$.

From $\frac{\partial l_1^*}{\partial s_1} = 0$ we derive the threshold value $\widetilde{s_1} = \frac{q(1-\mu)(L-I)}{I\mu p}$ for which the sign of the derivation changes. For $s_1 < \widetilde{s_1}$ we get $\frac{\partial l_1^*}{\partial s_1} < 0$ and for $s_1 > \widetilde{s_1}$ we get $\frac{\partial l_1^*}{\partial s_1} > 0$.

- Effect on total number of firms declared bankrupt $(s_1 l_1^* + (1-s_1)1)$

The total number bankruptcy filings is

$$(s_1 l_1^* + (1-s_1)1) = 1 - \frac{(1-\mu)(qX-I)}{\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)\mu I(1-p)}$$

Comparative statics with respect to s_1 yields

$$\frac{\partial\left((s_1 l_1^* + (1-s_1)1)\right)}{\partial s_1} = -\frac{q(1-\mu)^2(L-I)(qX-I)}{\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)\mu^2 I^2(1-p)ps_1^2} < 0$$

Thus, as the market share of bank 1 increases, the number of firms declared bankrupt decreases.

Q.E.D.

Proof of Proposition 5

1. Effect of liquidation value

- on repayment

We have shown that $\frac{\partial l_1^*}{\partial L} > 0$ and that $\frac{\partial R}{\partial l_1^*} < 0$. It follows that $\frac{\partial R}{\partial L} < 0$.

- on the probability of getting a loan

Bank 1 offers a loan with probability 1. However, bank 2 does not offer a loan with probability $prob\,(D) = \frac{\mu s_1(1-l_1)(1-p)}{(1-\mu)(qX-I)} I$. From $\frac{\partial l_1^*}{\partial L} > 0$ it follows that $\frac{\partial prob(D)}{\partial L} < 0$. Thus, a higher liquidation value increases the probability that a new applicants gets a loan.

2. Effect of bank 1's market share

- on repayment

We evaluate $E\,(R)$ at $l_1^* = \left(1 - \frac{(1-\mu)(qX-I)}{s_1\mu(1-p)I\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)}\right)$. Thus,
$E\,(R) = \frac{(qX-I)\left(q(L-I)\frac{1-\mu}{\mu p s_1 I}\right)+\exp\left(\left(q(L-I)\frac{1-\mu}{\mu p s_1 I}\right)\right)I+qX-I}{\exp\left(q(L-I)\frac{1-\mu}{\mu p s_1 I}\right)q}$.
Comparative statics with respect to s_1 yield
$\frac{\partial E(R)}{\partial s_1} = (L-I)\,(1-\mu)\left(q\,(L-I)\,\frac{1-\mu}{\mu p s_1 I}\right)\frac{qX-I}{\mu p s_1^2 I\exp\left(q(L-I)\frac{1-\mu}{\mu p s_1 I}\right)} > 0.$

- on the probability of getting a loan

Bank 1 offers a loan with probability 1. However, bank 2 does not offer a loan with probability $prob\,(D) = \frac{\mu s_1(1-l_1)(1-p)}{(1-\mu)(qX-I)} I$. A comparative static analysis shows that evaluated at l_1^* $\frac{\partial prob(D)}{\partial s_1} = \frac{q(1-\mu)}{I^2\exp\left(q(1-\mu)\frac{L-I}{\mu p s_1 I}\right)}\frac{L-I}{\mu p s_1^2} > 0$. Thus, as the market share of bank 1 increases, the probability that a new applicant gets a loan decreases.

Q.E.D.

References

Aghion, Philippe, Bolton, Patrick and Fries, Steven (1999), Optimal Design of Bank Bailouts: the Case of Transition Economies, *Journal of Institutional and Theoretical Economics* **55**, 1: 51-70.

Bonin, John P. and Schaffer, Mark E. (2002), Revisiting Hungary's Bankruptcy Episode, in: Meyendorff, Anna and Thakor, Anjan V. (eds.), *Designing Financial Systems in Transition Economies*, Cambridge and London: MIT Press, pp. 59-99.

Boukaert, Jan and Degryse, Hans (2006), Entry and Strategic Information Display in Credit Markets, *Economic Journal* **116**, 702-720.

Broecker, Thorsten (1990), Credit-Worthiness Tests and Interbank Competition, *Econometrica* **58**, 2: 429-452.

Cassady, Alison and Mierzwinski, Edmund (2004), Mistakes Do Happen: A Look at Errors in Consumer Credit Reports, National Association of State PIRGs, June 2004.

Castelar Pineiro, Armando and Celia Cabral (2001), Credit Markets in Brazil: The Role of Judicial Enforcement and Other Institutions, in: Pagano, Marco (ed.), *Defusing Default: Incentives and Institutions*, Washington: Johns Hopkins University Press, pp. 157-188.

Claessens, Stijn and Klapper, Leora F. (2005), Bankruptcy Around the World: Explanations of Its Relative Use, *American Law and Economics Review* **7**, 1: 253-283.

Cristini, Marcela, Ramiro A. Moya and Powell, Andrew (2001), The Importance of an Effective Legal System for Credit Markets: the Case or Argentina, in: Pagano, Marco (ed.), *Defusing Default: Incentives and Institutions*, Washington: Johns Hopkins University Press, pp. 119-156.

Creditreform (2006), *Insolvencies in Europe 2005/06*, Neuss: Verband der Vereine Creditreform.

Czech National Bank (2005), Time series database - ARAD, Table B2: Bank interest rates on CZK-denominated loans by Czech residents, http://www.cnb.cz/docs/ARADY/HTML/index_en.htm.

Dell'Ariccia, Giovanni, Friedman, Ezra and Marquez, Robert (1999), Adverse Selection as a Barrier to Entry in the Banking Industry, *RAND Journal of Economics* **30**, 3: 515-534.

Djankov, Simeon, McLiesh, Caralee and Shleifer, Andrei (2007), Private Credit in 129 Countries, *Journal of Financial Economics* **84**, 2: 299-329.

EBRD (2006), *Transition Report 2006: Finance in Transition*, EBRD: London.

Fabbri, Daniela and Padula, Mario (2004), Does Poor Legal Enforcement Make Households Credit-constrained? *Journal of Banking and Finance* **28**, 2369-2397.

Franks, Julian and Lóránth, Gyöngyi (2004), A Study of Inefficient Going Concern in Bankruptcy, unpublished manuscript, March 2004.

Jappelli, Tullio, Pagano, Marco and Bianco, Madga (2005), Courts and Banks: Effects of Judicial Enforcement on Credit Markets, *Journal of Money, Credit and Banking* **37**, 2: 223-245.

Jappelli, Tullio and Pagano, Marco (2002), Information Sharing, Lending and Defaults: Cross-Country Evidence, *Journal of Banking and Finance* **26**, 2017-45.

Jappelli, Tullio and Pagano, Marco (2000), Information Sharing in Credit Markets: A Survey, CSEF Working Paper No. 36, Salerno: Centre for Studies in Economics and Finance, March 2000.

Kallberg, Jarl G., and Udell, Gregory F. (2003), The Value of Private Sector Business Credit Information Sharing: The US Case, *Journal of Banking and Finance* **27**, 3: 449-469.

La Porta, Rafael, Lopez-de-Silanes, Florencio, Shleifer, Andrei, and Vishny, Robert (1998), Law and Finance, *Journal of Political Economy* **106**, 6: 1113-55.

Laeven, Luc and Majnoni, Giovanni (2005), Does Judicial Efficiency Lower the Cost of Credit? *Journal of Banking and Finance* **29,** 7: 1791-1812.

Mitchell, Janet (2001), Bad Debts and the Cleaning of Banks' Balance Sheets: An Application to Transition Economies, *Journal of Financial Intermediation* **10**, 1-27.

Norden, Lars and Weber, Martin (2007), Checking Account Information and Credit Risk of Bank Customers, unpublished manuscript, University of Mannheim.

Pagano, Marco and Jappelli, Tullio (1993), Information Sharing in Credit Markets, *Journal of Finance* **43**, 5: 1693-1718.

Padilla A. Jorge and Pagano, Marco (2000), Sharing Default Information as a Borrower Discipline Device, *European Economic Review* **44**, 1951-80.

Padilla A. Jorge and Pagano, Marco (1997), Endogenous Communication Among Lenders and Entrepreneurial Incentives, *Review of Financial Studies* **10**, 1: 205-36.

Perotti, Enrico C. (1993), Bank Lending in Transition Economies, *Journal of Banking and Finance* **17**, 5: 1021-1032.

Pistor, Katharina (2006), Who Tolls the Bells for Firms? Tales from Transition Economies, unpublished manuscript, April 2006.

Schmeits, Anjolein (2005), Discretionary Contracts and Bank-Firm Relationships, unpublished manuscript, July 2005.

Shaffer, Sherrill (1998), The Winner's Curse in Banking, *Journal of Financial Intermedation* **7**, 359-392.

Sharpe, Steven A. (1990), Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships, *Journal of Finance* **45**, 1069-1087.

Skogoreva, Anastasiya (2005), Russians do not Trust their Credit Bureaus (Rossiyane ne Veryat Kreditnym Buro), August 11, 2005, http://www.gazeta.ru/money/2005/08/11_a_352986.shtml.

Stiglitz, Joseph E. (2001), Bankruptcy Laws: Basic Economic Principles, in: Claessens, Stijn, Djankov, Simeon and Mody, Ashoka (eds.), *Resolution of Financial Distress. An International Perspective on the Design of Bankruptcy Law*, WBI Development Studies, Washington, D.C.: World Bank, pp. 1-23.

von Thadden, Ernst-Ludwig (2004), Asymmetric Information, Bank Lending, and Implicit Contracts: The Winner's Curse, *Finance Research Letters* **1**, 1: 11-23.

World Bank (2006), Doing Business Report, http://www.doingbusiness.org/.