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INFORMATION SHARING AND INFORMATION ACQUISITION IN CREDIT MARKETS

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Information Sharing and Information Acquisition in Credit Markets

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Abstract

Since information asymmetries have been identified as an important source of bank profits, it may seem that the establishment of information sharing arrangements such as credit registers and bureaus will lead to lower investment in acquiring information. However, banks base their decisions on both hard and soft information, and it is only the former type of data that can be communicated credibly. We show that hard and soft information are strategic substitutes, and that when hard information is shared, banks will invest more in soft information. This can potentially lead to more accurate lending decisions and favor small, informationally opaque borrowers. Higher investment in soft technology offers important implications for borrower switching. We test our theory using firm-level data from 24 countries. [1]

Keywords: Bank competition, credit bureaus, hard information, soft information

JEL classification numbers: G21, L13

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1 Introduction

Information is a crucial input in the banking industry. When making lending decision, banks have to know their potential borrowers well, and this requires a significant investment in screening and monitoring. At the same time, collecting useful unique information about borrowers provides a competitive advantage and a source of profits over the lifetime of the banking relationship. Under asymmetric information borrowers will find it difficult to switch from their incumbent bank to its competitors (Sharpe 1990, Von Thadden 2004), and incumbents are therefore able to appropriate monopolistic rents.

Recent developments in technology and information sharing institutions provide possibilities for the exchange of information between banks. When information is shared through an information exchange institution, such as credit bureaus and public credit registers, the higher competition drives down interest rates (Brown, Jappelli and Pagano 2007, Jappeli and Pagano 1993, Love and Mylenko 2003), and reduces benefits derived from otherwise monopolistic information. As a result, it is natural to think that banks will lose their incentives to acquire information on their borrowers. If this scenario is true, and incentives to invest in information do indeed go down, this may lead to less accurate lending decisions and challenge the usefulness of information sharing arrangements.

The growth of credit bureaus and credit registers therefore poses important questions that we address in the paper. As banks share information, how will the incumbent bank's incentives to acquire information change? Will the incumbent make more or less accurate credit decisions by investing more or less in acquiring information about its borrowers?

We provide answers to those questions starting from an important distinction between different types of information. In their attempt to mitigate informational asymmetries, banks acquire two types of information: *hard information*, which can be easily reduced to a numerical entry and transmitted credibly (credit history, balance sheet data, amount borrowed), and *soft information*, which is difficult to summarize in a numeric score (judgement, opinions, notes...), and hard to communicate (Petersen 2004, Petersen and Rajan 2002, Stein 2000, Berger et al 2002).[2]

Thus, we rephrase the questions above: As bank profits are competed away due

[2]As Petersen (2004), Petersen and Rajan (1994) point out, banks collect information which is nether initially available in hard numbers nor easily or accurately reducible to a numerical score. Once the relationship is established, even then this information isn't hard. The firm is still unable to communicate this (relationship) information to the broader lending markets. One can "create an index of honesty for one to ten. This in and of itself does not make the information hard. It must be that my interpretation of a three on this index is the same as yours". Petersen (2004) offers the example of the relationship based on a loan officer as a typical one. The loan officer has a long history with the borrower and based on a multitude of personal contacts has built up an impression of the borrower's honesty, credit worthiness, and likelihood to defaulting. Based on this view of the borrower and the loan officer's experience, the loan can be approved or denied.

to information sharing, how do banks' incentives to acquire soft information change? Will they invest more or less in soft information?

We first answer this question theoretically. We model bank competition with and without hard information sharing. Banks acquire soft information by investing in monitoring their borrowers during the lifetime of the loan.[3] As they invest in soft information, they differentiate borrowers based on two different sources of information that they use for second-period lending: hard information that can be shared, and soft information that cannot be communicated credibly.

We show that lenders will have *higher* incentives to collect costly soft information when hard information is shared, and this may well improve lending decisions. When hard information is not shared, the incumbent lenders' informational advantage is based on both hard and soft data. In contrast, when hard information is shared, bank profits are based only on soft information. The marginal benefit from investing in soft information is higher in the presence of credit bureaus or registers. Banks compensate for the loss of one source of informational rents by investing in the alternative, remaining source.

We conclude that the concern that information sharing will destroy information acquisition seems largely unfounded. Indeed, the overall investment in information may well increase and this can lead to better capital allocation and increased welfare.

Moreover, as information becomes available to competitors, it seems reasonable that switching will increase and interest rates decrease. Our model suggests that the answer to both issues depends on the type of signal resulting from monitoring. Good-signal borrowers receive lower interest rates, while bad-signal borrowers are offered higher interest rates by their incumbent banks. Under information sharing, good-signal borrowers are less likely to switch banks, while bad-signal borrowers are more likely to switch. Faced with higher adverse selection problems, uninformed banks may well increase interest rates.

We test the implications of our model empirically, using data on firms and information sharing arrangements from 24 transition countries. We analyze the impact of introducing private credit bureaus and public credit registries, that share hard information, on the lenders' incentives to invest in soft, proprietary information. Specifically, we test whether soft information acquisition is higher in countries where hard information is shared. We find statistically strong results supporting the hypothesis, using several measures of soft information acquisition. The effects are economically large.

As predicted by our theoretical part, we also find that under hard information sharing switching is lower when produced signals are good and it is higher when signals are bad.

The magnitude of the investment in soft information acquisition (and, therefore,

[3]We have also done the analysis of the game under ex-ante screening, but do not present screening results in the paper for brevity. The expressions are less tractable, however the numerical solutions point to similar results as in the case of monitoring.

the resulting borrower switching or staying with the bank) depends on the level of asymmetric information that it is supposed to overcome; if there is no asymmetric information, there is no payoff to the investment. This may generate a differing impact on different firm sizes: information about small firms from public sources is scarce, as most of them do not have audited financial statements, are not rated by rating agencies, and therefore information asymmetries are most acute for small firms (Petersen and Rajan 2004). In the theoretical chapter, we obtain that optimal investment in soft information increases in asymmetric information, suggesting that our results should be stronger for small firms. We look at the differences between small and large firms in our sample and do indeed find a stronger impact of information sharing in the case of small, presumably more opaque firms.

Our findings have policy implications. As standard hard information is shared, banks will choose higher investment in the acquisition of soft information, and this can improve lending decisions. Thus, the establishment of *a public register or a credit bureau* will improve the allocation of capital and benefit the more creditworthy borrowers.

Our theory also provides implications for bank supervision. The new Basel Accord provides banks with the possibility to use internal assessment of risk (the Internal ratings-based approach to credit risk). Since hard information sharing implies more investment in soft information, small banks which specialize more in small loans (Berger et al 2002) based on soft information, should be given more room for internal risk assessment, than large, distant-lending banks.

In summary, we present the results in three steps in theory: we first derive the equilibrium of the banking competition with and without information sharing (subsection 2.1). We then look at interest rates and switching under information sharing, and show that with increasing level in soft information, the resulting switching and the expected level of interest rates will vary depending on the outcome of soft information (section 2.2). Finally, and most importantly, we show that investment in soft information increases when hard information is shared (2.3). Section 3 describes data and empirical predictions. Section 4 provides the empirical analysis, and section 5 concludes.

2 The Model

We model the interaction between banks and borrowers over two periods. At the starting point, banks do not have information about the quality of potential borrowers. During the lending relationship banks acquire both hard (default)[4] and soft information. At the end of the first round of lending, each bank has acquired soft information about its own borrowers and also knows whether they have managed to repay their

[4]We use default information here, since it is the most basic type of hard information and also the most commonly shared. Hard information can also obviously be any type of verifiable information that can be shared by means of a credit bureau.

loans.

Without information sharing, both types of information are unavailable to competitors and increase the informational rents incumbent banks are able to extract from their borrowers during the second period. When information is shared, the success or default of each borrower becomes known to all banks. The soft information, however, cannot be shared and continues to generate a competitive advantage for incumbent banks.

In what follows we show that banks will invest *more* in acquiring soft information when default information is shared. This is because, without information sharing, default information is an additional source of bank rents, and the marginal benefit from investing in soft information is lower. With the credit bureau, however, banks have to rely on soft information as the main source of their profits. The higher resulting investment in information means that interest rates and lending decisions are more likely to reflect the true quality of each borrower.

2.1 The Setup

We have two banks and a continuum of borrowers with a total mass of 1. Each borrower has an investment project that requires $\$I$, which they borrow from one of the two banks.

There are two types of borrowers:

- High-type borrowers represent a proportion λ in the overall population. They have a probability p_H of producing R, and a probability $1 - p_H$ of producing 0.
- Low-type borrowers represent a proportion $1 - \lambda$ in the overall population. They have a probability p_L ($p_L < p_H$) of producing R, and a probability $1 - p_L$ of producing 0.

The proportions of borrowers and the success probabilities are common knowledge. Borrowers live for two periods, with identical (and independent) projects and no initial funds in both periods. As in Von Thadden (2004), borrowers do not know their own types. We assume both types are creditworthy ($p_H R - I > p_L R - I > 0$).[5]

At the beginning of the first period, without any previous contact with the potential customers, banks do not know the borrowers' types. As a result, they offer the same interest rate to all applicants. During the first period, however, banks can acquire information about their borrowers by monitoring them. The **monitoring** process begins after the first period loans have been extended. It results in a signal η of borrowers' types. The quality of the signal is given by φ:

[5]We make this assumption for ease of exposition, but the extension to the case where low-type borrowers are not creditworthy is straightforward. We discuss this below.

$$Pr(\eta = H|type = H) = Pr(\eta = L|type = L) = \varphi > \frac{1}{2};$$
$$Pr(\eta = H|type = L) = Pr(\eta = L|type = H) = 1 - \varphi.$$

Thus, at the end of the first period banks have two types of information about their borrowers:

- the signal generated by monitoring;
- the repayment history - i.e., whether borrowers have defaulted or not.

The signal is costly: getting a signal of quality φ requires an outlay of $c(\varphi - \frac{1}{2})^2$. As a result, banks have to decide how much to invest in the monitoring technology. The default information and the information resulting from monitoring can be used by banks to update their estimate of the borrowers' types and adjust their interest rates for the second period.

We assume that the outcome of the monitoring process is "soft" information - meaning that it is difficult to communicate credibly between banks. Default information, in contrast, is verifiable and has no such problems. As a result, a credit bureau will only be able to collect and share the latter type of information, and each bank will know which of the other bank's initial customers has defaulted. Without a credit bureau, both default and monitoring information are only available to incumbent banks.

At the end of the first period, banks know both the results of their monitoring and the success or default of each of their own borrowers. As a result, they can distinguish between four types among their first-period customers:

- borrowers that have defaulted and have also generated a bad signal when monitored;
- borrowers that have defaulted, but have generated a good signal when monitored;
- borrowers that have not defaulted, but generated a bad signal when monitored;
- borrowers that have not defaulted and have also generated a good signal when monitored.

The first type is obviously the least likely to produce a positive return in the second period, while the last one is the most likely to be successful.

In the next two subsections we describe the equilibrium strategies of the incumbent and outside bank under information sharing, and no information sharing, respectively. We assume the absence of binding long-term contracts. As shown in Sharpe (1990), this absence is the interesting case to consider, since otherwise the analysis would reduce to standard competitive pricing and ignore the evolution of banking relationships over time (see also von Thadden 2004).

2.1.1 Default information is shared

We start with the case where information is shared in the economy. The actions taken by the banks and borrowers are outlined below.

The timing of the game

$T = 1$

- Banks announce one term lending rates and compete à la Bertrand
- The firm chooses one bank and invests I, the market is shared equally.
- Banks invest in monitoring.
- Borrowers repay whenever they can do so.

$T = 2$

- Banks share payment/default history (hard information).
- Simultaneously the inside (first-period, incumbent) and the outside banks offer second period interest rates. Each bank has two types of information about its first period borrowers, and has received default information concerning its competitor's borrowers.
- The firm chooses an offer and invests I. If indifferent, the firm stays with the inside bank.
- Borrowers repay/ do not repay their loans and this determines the banks' profits.

Lending Competition

If default information is shared, each bank knows which borrowers have been successful in the first period, regardless of whether it has had a lending relationship with them or not. Moreover, within the defaulting/successful subgroups the incumbent bank can distinguish between good- and bad-signal borrowers.

Based on this acquired information and the initial data on the population, banks are able to update borrowers' success probabilities and use them to determine their interest rates. Both banks can condition their rates on default information, but only the incumbent bank can also use the soft information to differentiate the interest rates that it offers to its first-period borrowers.

Banks move *simultaneously* to bid second period interest rates, and do not observe each other's rates. They do not know the borrowers' types, but know the initial proportion of the types, and each type's success probabilities. As showed in von Thadden (2004), there is no pure strategy equilibrium in simultaneous-bid games where one lender knows more than the other. This is a known result from the literature on auctions (Milgrom and Weber 1982). There is however a mixed-strategy equilibrium in

which banks randomize over intervals of interest rates. The second period of the game thus has a mixed-strategy Perfect Bayesian Nash equilibrium.

While the mechanics of the model is not as simple as in the case of a hypothetical pure-strategy equilibrium in which borrowers never switch to less-informed banks, the model intuition described above is arguably realistic. Ioannidou and Ongena (2008) present empirical evidence that is consistent with the idea of incumbents accumulating informational rents and borrowers occasionally switching banks as a result of excessive interest rates.

Proposition 2.1 *There is no pure-strategy equilibrium in the simultaneous game.*

Proof See Appendix.

The intuition behind this result is straightforward. The uninformed bank is afraid of overpaying at any interest rate, since the informed bank can always pick the higher-quality borrowers.

If either bank bids above the break-even interest rate for the bad type, then the other bank can always undercut and still make a positive profit. This means that above that rate banks will compete à la Bertrand and no bids will be made in that region in equilibrium. At the same time, the outside bank will not make bids below the break-even rate for the *average* borrower (whether good or bad), because otherwise it would make an expected loss. The incumbent bank will therefore also avoid that lower region, since bidding there would bring it low profits for no good reason. Thus the bids of both banks can only be between the break-even interest rate for the average borrower and the break-even interest rate for the worst type.

Suppose now that the incumbent bank chooses a given interest rate in that interval. The outside bank can then bid a slightly lower interest rate and capture the whole market, while making positive profits (we are above the break-even rate for the average borrower). Conversely, suppose the outside bank chooses a given interest rate. Then the incumbent bank can bid a slightly lower interest rate, serve just the good types, and the outside bank ends up making losses. We have therefore no pure-strategy equilibrium.

As shown in von Thadden (2004), however, there is a mixed-strategy equilibrium in which both banks compete for borrowers. Both banks will choose interest rates over the interval between the break-even rate for the average borrower and the break-even interest rate for the the worst type. The mixed strategies will de described by the probabilities of choosing various interest rates within that interval. The incumbent bank will choose different rates for the good- and bad-signal borrowers, while the outside bank is unable to make that distinction. Both banks can distinguish between defaulting and non-defaulting borrowers, so we can think of the competition between the two banks as taking place on two separate markets (for defaulting and non-defaulting borrowers respectively).

Let $F_u^K(r)$ denote the bidding strategy of the outside (uninformed) bank. The cumulative density function $F_u^K(r)$ gives the probability that the uninformed bank chooses an interest rate less or equal to r for defaulting ($K = D$) and non-defaulting ($K = N$) borrowers respectively. $F_i^J(r)$ describes the bidding strategies for the informed bank for the good-signal, defaulting ($J = GD$), bad-signal, defaulting($J = BD$), good-signal, non-defaulting ($J = GN$) and bad-signal, defaulting borrowers ($J = BN$).

For a given chosen interest rate for a given group, the informed bank will make a profit provided it has not been undercut by the competing bank. Thus the profit functions for the four types can be expressed as follows:

$$\begin{aligned}
\pi_i^{GN}(r) &= N_{GN}(p_{GN}r - I)(1 - F_u^N(r)) \\
\pi_i^{GD}(r) &= N_{GD}(p_{GD}r - I)(1 - F_u^D(r)) \\
\pi_i^{BN}(r) &= N_{BN}(p_{BN}r - I)(1 - F_u^N(r)) \\
\pi_i^{BD}(r) &= N_{BD}(p_{BD}r - I)(1 - F_u^D(r))
\end{aligned}$$

The outside bank's profits on the two types it can distinguish (defaulters and non-defaulters) will be:

$$\begin{aligned}
\pi_u^D(r) &= N_{GD}(p_{GD}r - I)(1 - F_i^{GD}(r)) + N_{BD}(p_{BD}r - I)(1 - F_i^{BD}(r)), \\
\pi_u^N(r) &= N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)).
\end{aligned}$$

The proportions of the groups are a function of the monitoring intensity φ and are given by:

$$\begin{aligned}
N_{GN} &= \lambda\varphi p_H + (1 - \lambda)(1 - \varphi)p_L; \\
N_{BN} &= \lambda(1 - \varphi)p_H + (1 - \lambda)\varphi p_L; \\
N_{GD} &= \lambda\varphi(1 - p_H) + (1 - \lambda)(1 - \varphi)(1 - p_L); \\
N_{BD} &= \lambda(1 - \varphi)(1 - p_H) + (1 - \lambda)\varphi(1 - p_L); \\
N_N &= N_{GN} + N_{BN} = \lambda p_H + (1 - \lambda)p_L; \\
N_D &= N_{GD} + N_{BD} = \lambda(1 - p_H) + (1 - \lambda)(1 - p_L); \\
1 &= N_N + N_D.
\end{aligned}$$

The Bayesian updated probabilities of success are given by:

$$
\begin{aligned}
p_{GN} &= \frac{\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2}{\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L};\\
p_{BN} &= \frac{\lambda(1-\varphi) p_H^2 + (1-\lambda)\varphi p_L^2}{\lambda(1-\varphi) p_H + (1-\lambda)\varphi p_L};\\
p_{GD} &= \frac{\lambda\varphi p_H(1-p_H) + (1-\lambda)(1-\varphi)p_L(1-p_L)}{\lambda\varphi(1-p_H) + (1-\lambda)(1-\varphi)(1-p_L)};\\
p_{BD} &= \frac{\lambda(1-\varphi) p_H(1-p_H) + (1-\lambda)\varphi p_L(1-p_L)}{\lambda(1-\varphi)(1-p_H) + (1-\lambda)\varphi(1-p_L)}
\end{aligned}
$$

four the four types, and

$$
\begin{aligned}
p_N &= \frac{\lambda p_H^2 + (1-\lambda)p_L^2}{\lambda p_H + (1-\lambda)p_L}\\
p_D &= \frac{\lambda p_H(1-p_H) + (1-\lambda)p_L(1-p_L)}{\lambda(1-p_H) + (1-\lambda)(1-p_L)};\\
p &= \lambda p_H + (1-\lambda)p_L.
\end{aligned}
$$

for non-defaulting, defaulting and the overall universe of borrowers respectively.

One would expect from Bayesian rules that *better types have higher updated probabilities*. Indeed, observe that $p_{GN} \geq p_N \geq p_{BN}$, $p_{GD} \geq p_D \geq p_{BD}$, $p_N > p > p_D$ (since $p_H > p_L$, and $\varphi \geq 0.5$). The respective break-even gross interest rate for each of the groups is equal to the investment I divided by the respective probability, $\overline{r}_K = \frac{I}{p_K}$, for $K = D, N, GN, GD, BN,$ or BD, while for the overall population it is equal to $\overline{r} = \frac{I}{p} = \frac{I}{\lambda p_H + (1-\lambda)p_L}$. The break-even interest rates will obviously be lower for better types.

Proposition 2.2 ***Equilibrium Strategy*** *The competition between the incumbent and the outside bank has a mixed-strategy equilibrium. In this equilibrium, the informed bank bids*

$$
F_i^{GN}(r) = 1 - \frac{N_{BN}(I - p_{BN}\overline{r}_N)}{N_{GN}(p_{GN}r - I)}, F_i^{GD}(r) = 1 - \frac{N_{BD}(I - p_{BD}\overline{r}_D)}{N_{GD}(p_{GD}r - I)}
$$

where F_i^{GN} is defined on $[\overline{r_N}; \overline{r_{BN}}]$ and F_i^{GD} on $[\overline{r_D}; \overline{r_{BD}}]$. It bids the break-even interest rate r_{BD} for the bad-signal, defaulting group, and r_{BN} for the bad-signal, non-defaulting group.

The uninformed bank bids

$$
F_u^N(r) = 1 - \frac{p_{GN}\overline{r}_N - I}{p_{GN}r - I}, F_u^D(r) = 1 - \frac{p_{GD}\overline{r}_D - I}{p_{GD}r - I}
$$

on $[\overline{r_N}; \overline{r_{BN}})$ and F_i^{GD} on $[\overline{r_D}; \overline{r_{BD}})$ respectively, with an atom at r_{BD} and r_{BN}, re-

spectively.

Proof See Appendix.

The informed bank will only bid the break-even rate for bad-signal borrowers, since otherwise it would be making an expected loss. It will choose interest rates from the interval $[\bar{r}_K, \bar{r}_{BK}]$ $(K = N, D)$ for good-signal borrowers. In a mixed-strategy equilibrium, the bank has to be indifferent between the interest rates in that interval. This means that profits have to be the same for various interest rates and equal to the profits for rate $\bar{r}_K$ $(K = N, D)$:

$$N_{GK}(p_{GK}\bar{r}_K - I) = N_{GK}(p_{GK}r - I)(1 - F_u^K(r)) = \text{ constant}$$

(we have that $1 - F_u^K(\bar{r}_K) = 1$ since the uninformed bank starts bidding from $\bar{r}_K$). This gives us the expression for F_u^K: $F_u^K = 1 - \frac{p_{GK}barr_N - I}{p_{GK}r - I}$.

As highlighted above, the uninformed bank cannot differentiate between good- and bad-signal borrowers. It chooses interest rates from the interval $[\bar{r}_K, \bar{r}_{BK}]$ $(K = N, D)$ and has to make the same profits by picking any of those interest rates in equilibrium. On $[\bar{r}_K, \bar{r}_{BK})$ this implies

$$\begin{aligned} N_{GK}(p_{GK}r - I)(1 - F_i^{GK}(r)) + N_{BK}(p_{BK}r - I) = N_{GK}(p_{GK}\bar{r}_{BK} - I) \times \\ \times (1 - F_i^{GK}(\bar{r}_{BK})) + N_{BK}(p_{BK}\bar{r}_{BK} - I)(1 - F_i^{GK}(\bar{r}_{BK})) = 0 \end{aligned}$$

since all of the informed bank's bids are lower or equal to $\bar{r}_{BK}$, (only equal in the case of bad-signal borrowers). Solving, we get that $F_i^{GK} = 1 - \frac{N_{BK}(I - p_{BK}r)}{N_{GN}(p_{GK}r - I)}$.

The proposition establishes an intuitive result that will hold throughout the analysis: *better types receive better interest rates (from the incumbent)*, where better is measured by a favorable hard or soft information. Indeed, let's look at the non-defaulter N market separately. The bad signals in this market get $\overline{r_{BN}}$, which is at least as high as what the good signals get $[\overline{r_N}; \overline{r_{BN}}]$. The same is true for D history. At the same time, for a given signal, better hard information guarantees better rates, since $\overline{r_N} < \overline{r_D}, \overline{r_{BN}} < \overline{r_{BD}}$, so that the non-defaulters do better by getting rates in $[\overline{r_N}; \overline{r_{BN}}]$, with an identical distribution as defaulters do in $[\overline{r_D}; \overline{r_{BD}}]$.

The incumbent bank will make positive profits on good-signal borrowers, and zero profits on bad-signal borrowers, that will always be charged their break-even interest rate. Uninformed banks will make zero profits, but they will sometimes get the good-signal borrowers. The incumbent bank's *total* profits can therefore be written as the sum of two positive terms (profits on good-signal, non-defaulting and defaulting borrowers respectively):

$$\pi_{share} = N_{GN}(p_{GN}\overline{r}_N - I) + N_{GD}(p_{GD}\overline{r}_D - I) \tag{1}$$

Plugging in the expressions for the numbers of borrowers, success probabilities and break-even interest rates we get the following result.

Proposition 2.3 *The expected gross profits for the incumbent bank when default information is shared is given by*

$$\pi_{share} = \lambda(1-\lambda)(2\varphi-1)(p_H-p_L)\Big[\frac{p_H p_L}{\lambda p_H^2+(1-\lambda)p_L^2}+\frac{(1-p_H)(1-p_L)}{\lambda p_H(1-p_H)+(1-\lambda)p_L(1-p_L)}\Big]$$

Proof See Appendix.

Gross profits are linearly increasing in φ. Net profits can be obtained by subtracting the cost of monitoring $c(\varphi-\frac{1}{2})^2$: $\pi_i^{\text{share, net}} = \pi_{share} - c(\varphi-\frac{1}{2})^2$.

2.1.2 No information is shared

We describe now the case where there is no credit bureau in the economy. At the beginning of the second period,both default and monitoring information are known only to the incumbent bank. The second period timing is:

$T = 2$

- Banks ***do not*** share hard information.
- Simultaneously the inside and the outside banks offer second period interest rates. Each bank has ***four*** types of information about its first period borrowers, and nothing about the competitor's borrowers.
- The firm chooses an offer and invests I. If indifferent, the firm stays with the inside bank.
- Profits are realized based on default information *and* soft information.

Similar to the case with information sharing, there is no pure strategy equilibrium, but there is a mixed-strategy one.

Let $F_u(r)$ denote the bidding strategy of the uninformed bank - the cumulative density function that describes the uninformed bank's choice of interest rates. Given the first-period monitoring φ, the profit functions for the incumbent bank can be written as follows:

$$\begin{aligned}
\pi_i^{GN}(r) &= N_{GN}(p_{GN}r - I)(1-F_u(r)) \\
\pi_i^{GD}(r) &= N_{GD}(p_{GD}r - I)(1-F_u(r)) \\
\pi_i^{BN}(r) &= N_{BN}(p_{BN}r - I)(1-F_u(r)) \\
\pi_i^{BD}(r) &= N_{BD}(p_{BD}r - I)(1-F_u(r))
\end{aligned}$$

The uninformed bank only has *one* bidding function since it cannot distinguish between any of the types in this case - not even between defaulting and non-defaulting borrowers.

The profit function for the uninformed bank is given as follows:

$$\begin{aligned}\pi_u(r) =& N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{GD}(p_{GD}r - I)(1 - F_i^{GD}(r)) + \\ &+ N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)) + N_{BD}(p_{BD}r - I)(1 - F_i^{BD}(r))\end{aligned}$$

The proportions of the types and their success probabilities are expressed in the same way as in the previous case.

Note that p_{GD} can be either higher or lower than p_{BN}. In particular, from the above expressions we get that $p_{GD} < p_{BN}$ (breakeven rates $r_{GD} > r_{BN}$) whenever

$$\varphi^2 p_L(1 - p_H)(p_H - p_L) < (1 - \varphi)^2 p_H(1 - p_L)(p_H - p_L)$$

which is equivalent to $\sqrt{\frac{1-p_L}{1-p_H}\frac{p_H}{p_L}} > \frac{\varphi}{1-\varphi}$. This means for relatively low value of φ, the default/no default distinction will be more important than the one between good and bad signals, so that those who get a bad signal but have not defaulted are expected to perform better than those who have defaulted but produced a good signal.

We will say that monitoring is **low** whenever the above inequality is satisfied ($p_{GD} < p_{BN}$). The equilibrium strategy depends on the level of monitoring (which made no difference under default information sharing), and we describe it in the case with low monitoring here.[6].

Let us define two important break-even interest rates:

- $\overline{r'}$, the break-even interest rate for the group containing bad-signal borrowers and those that have generated a good signal, but have defaulted - BN, GD, BD, that is all borrower groups except the very best one (good-signal, non-defaulting GN);
- $\overline{r''}$ is the break-even interest rate for the remaining two least qualified groups, the defaulting borrowers GD and BD (both good- and bad-signal).

The break-even interest rates are shown on the real line in Figure 1 (where $\overline{r}_{GD}$ and $\overline{r}_{BN}$ do not have to be above $\overline{r}$)

Proposition 2.4 ***Equilibrium Strategy*** *There is an equilibrium in mixed strategies in which the incumbent bank bids as follows:*

- *bid only for the good-signal borrowers that have not defaulted between $\overline{r}$ and $\overline{r'}$;*

[6]We describe the (similar) equilibrium for high monitoring in the appendix. Our proofs are provided for both cases.

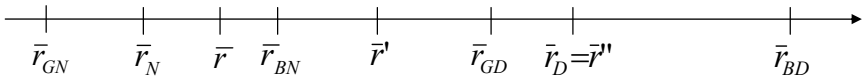

Figure 1: Interest rates (for low φ)

$$F_i^{GN}(r) = 1 + \frac{N_{BN}(p_{BN}r - I) + N_{BD}(p_{BD}r - I) + N_{GD}(p_{GD}r - I)}{N_{GN}(p_{GN}r - I)}$$

- *bid for non-defaulting borrowers that have generated a bad signal between* $\overline{r'}$ *and* $\overline{r}''$*;*

$$F_i^{BN}(r) = 1 + \frac{N_{BD}(p_{BD}r - I) + N_{GD}(p_{GD}r - I)}{N_{BN}(p_{BN}r - I)}$$

- *bid for good-signal borrowers that have defaulted between* $\overline{r}''$ *and* r_{BD}*, where* r_{BD} *is the break-even interest rate on bad-signal borrowers that have defaulted;*

$$F_i^{GD}(r) = 1 + \frac{N_{BD}(p_{BD}r - I)}{N_{GD}(p_{GD}r - I)}$$

  over the $[\overline{r''}, r_{BD}]$ *interval for good-signal defaulting borrowers.*

- *bid only the break-even* r_{BD} *for bad-signal, defaulting borrowers.*

The uninformed bank will bid
$F_u(r) = 1 - \frac{p_{GN}\overline{r}-I}{p_{GN}r-I}$ *over the* $[\overline{r}, \overline{r}']$ *interval,* $F_u(r) = 1 - \frac{p_{GN}\overline{r}-I}{p_{GN}\overline{r}'-I}\frac{p_{BN}\overline{r}'-I}{p_{BN}r-I}$ *over the* $[\overline{r}', \overline{r}'']$ *interval.* $F_u(r) = 1 - \frac{p_{GN}\overline{r}-I}{p_{GN}\overline{r}'-I}\frac{p_{BN}\overline{r}'-I}{p_{BN}\overline{r}''-I}\frac{p_{GD}\overline{r}''-I}{p_{GD}r-I}$ *for* r *in* $[\overline{r}'', r_{BD})$ *and will have an atom at* r_{BD}*.*

Proof: See Appendix.

Once again *better types get better interest rates from the incumbent.* The interest rate strategies are also illustrated in Figures 2 and 3.

The intuition of the proof is as follows. First, note that none of the banks bids below $\overline{r}$, or above r_{BD}. The reasoning is the same as above (losses for the uninformed bank below $\overline{r}$, Bertrand competition above r_{BD}).

The informed bank starts by bidding for the best group GN in the region $[\overline{r}, \overline{r}']$, that is, up to where it reaches the break-even interest rate for the next three lower-quality types. Then, starting from $\overline{r}'$, it switches to bidding for the second-best group. It then bids for the third-best group once the break-even interest rate for the remaining two types ($\overline{r}''$) is reached. Finally, the incumbent bank only bids the break-even interest rate for the worst group – borrowers that have generated a bad signal and defaulted. The structure of the equilibrium is similar in the case of high monitoring (high φ), but in that case the order of the two middle types (BN and GD) is reversed: generating a good signal is more important than not defaulting.

The bidding of the informed bank is similar to that in the case of information sharing (where we only had two types). It starts with the highest-quality type until it gets to the break-even interest rate for the next type (or pooled types under no information sharing). At that rate, bidding for the remaining types becomes profitable for the outside bank. If the informed bank were to start with a lower-quality type, it would be undercut by the outside bank and lose the higher-quality borrowers. (The outside bank would be making positive profits in that case, just as it would by undercutting in the pure-strategy case.)

Given the unique distribution function of the uninformed bank (the uninformed bank cannot distinguish between groups), the informed bank cannot bid the same interest rate for two different groups. This is because the payoffs from these groups are different for different borrower types (different success probabilities, or different slopes of the profit function), and, for a given F_u, the incumbent bank would want to deviate and bid a higher/ lower interest rate in the neighborhood of a given r and increase profits. The bank will bid on consecutive intervals for borrowers of different quality, and choosing any interest rates on those intervals will bring the same expected profits. There will be no deviations to higher/ lower intervals because bidding there would bring lower profits. As it may be expected, better quality borrowers get lower interest rates, and the incumbent bank makes positive profits on all types except the worst one, while the uninformed bank makes zero profits on average.

The incumbent bank's total profits (the sum over four different subgroups) are equal to:

$$\pi_i^{\text{no sharing, high } \varphi} = N_{GN}(p_{GN}\overline{r} - I) + N_{BN}(p_{BN}\overline{r}' - I)(1 - F_u(\overline{r}')) + N_{GD}(p_{GD}\overline{r}'' - I)(1 - F_u(\overline{r}'')),$$

since the last sum $\pi_i^{BD}(r) = N_{BD}(p_{BD}r - I)(1 - F_u(r))$ is equal to 0 (the incumbent bids the break-even rate for the worst type, $r_{BD}p_{BD} = I$), $F_u(\overline{r}) = 0$ (as the outside bank never bids below $\overline{r}$), and profits have to be constant in the interval over which the bank has positive probabilities in the mixed-strategy equilibrium.

Expressing the proportions and success probabilities, as well as the cdf functions as functions of p_H, p_L, λ and I we get the following results:

Proposition 2.5 *For low levels of monitoring (that is,* $\sqrt{\frac{1-p_L}{1-p_H}\frac{p_H}{p_L}} > \frac{\varphi}{1-\varphi}$*), the incumbent bank's gross profits are given by:*

$$\pi_i^{\text{no sharing, low } \varphi} = I\frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H(1-\lambda)p_L}(p_H - p_L + (p_H p_L + (1-p_H)(1-p_L))(2\varphi - 1))$$

(For high levels of monitoring (when $\sqrt{\frac{1-p_L}{1-p_H}\frac{p_H}{p_L}} < \frac{\varphi}{1-\varphi}$*), the informed bank makes gross profits equal to*

$$\pi_i^{\text{no sharing, high } \varphi} = I\frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H + (1-\lambda)p_L}(2\varphi - 1 + 2\varphi(1-\varphi)(p_H - p_L)))$$

Proof See Appendix.

In the next subsection, we look at interest rates and switching under information sharing. We show that their sensitivity to increasing levels of investment in soft information-monitoring, depends on the realization (good or bad) of the soft information. The resulting magnitude will then depend on the level of investment in monitoring. We then show that monitoring is higher under information sharing.

2.2 Interest Rates and Switching

The next two propositions analyze interest rates and switching under information sharing. They show that interest rates and switching may be higher or lower depending whether the signals produced in the monitoring process are bad or good.

Proposition 2.6 *Under information sharing the interest rates bid by the outside bank are at least as low as without information sharing. For the incumbent bank, the same is true when the shared information is positive (no default), while interest rates are weakly higher when the information is negative (default).*

Proof The proof is straightforward: the comparison of the interest rates is illustrated in figures 2 and 3.

In words, information sharing facilitates efficient allocation of credit. Better types are better off, while worse types are worse off. As we shall see later, higher investment in soft technology under information sharing regime strengthens this effect, providing the better types with even lower interest rates. Note for instance, that that the informed bank's cdf under information sharing for group BN is just $\overline{r}_{BN}$, satisfying

$$F_i^{BN} = \overline{r}_{BN} \leq r \in [\overline{r}'; \overline{r}'']$$

where the latter interval is the one in which the incumbent bids for group BN under no information sharing. This prediction is consistent with empirical findings on information sharing (Brown et al 2007, Jappelli and Pagano 2002), and is confirmed in our empirical model specifications in the empirical section.

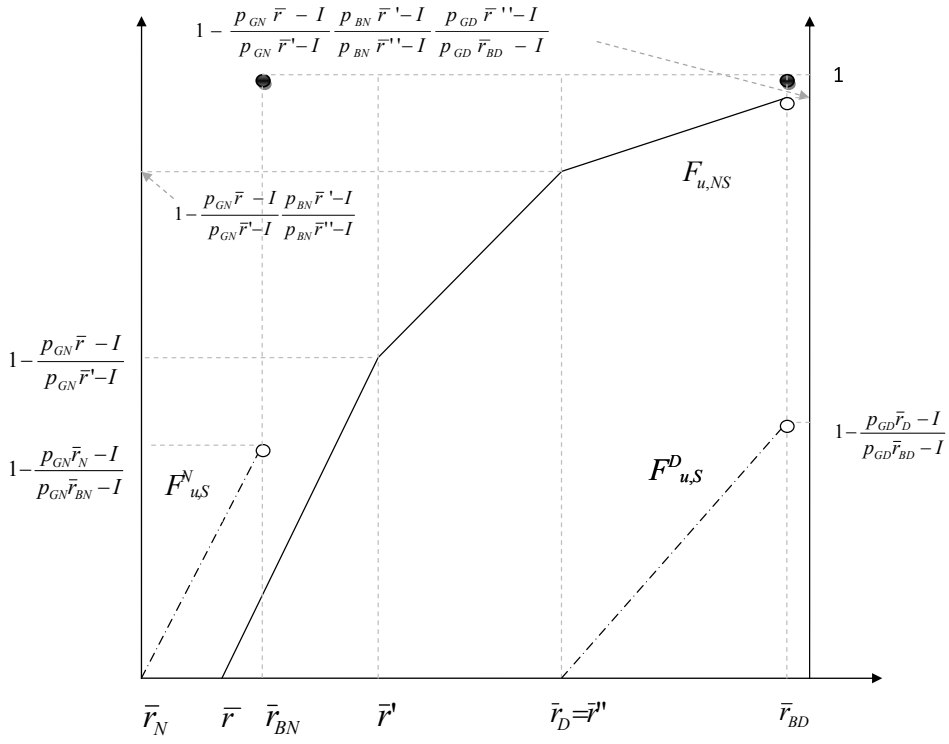

Figure 2: *Uninformed bank*: The dash-dotted lines are the cdf's under information sharing, with atom at $\overline{r}_{BN}$ for group N, and atom $\overline{r}_{BD}$ for group D. The solid piecewise linear function stands for the cdf under no information sharing, with atom at $\overline{r}_{BD}$.

Proposition 2.7 *Under information sharing the distribution of interest rates at a lower φ first order stochastically dominates the distribution at a higher φ for the incumbent, if the signal received is good. The converse is true if the signal is bad.*

$$\frac{\partial F_i^{GN}(\varphi)}{\partial \varphi} \geq 0, \frac{\partial F_i^{GD}(\varphi)}{\partial \varphi} \geq 0, \frac{\partial F_i^{BN}(\varphi)}{\partial \varphi} \leq 0, \frac{\partial F_i^{BD}(\varphi)}{\partial \varphi} \leq 0$$

Proof See Appendix.

The main intuition is still preserved: *better types get better interest rates by the incumbent*. However, *better* in this context is measured by either a higher precision of the good signal, or by lower precision of the bad signal.

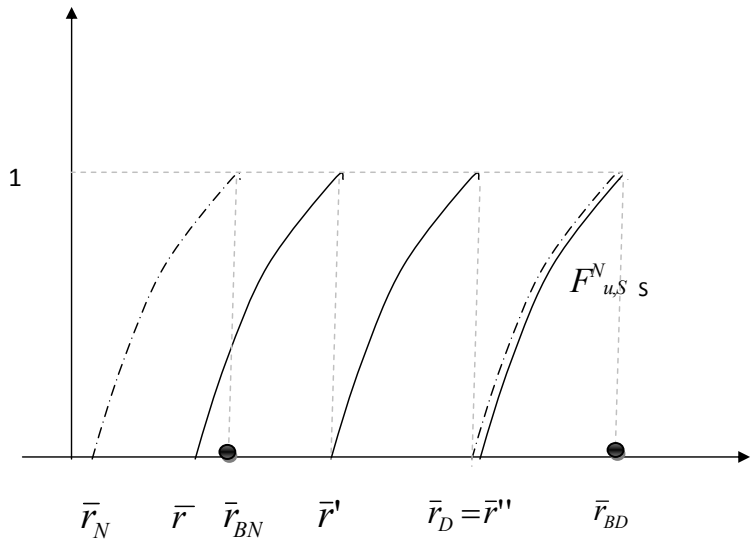

Figure 3: *Informed bank (incumbent)*: The dash-dotted lines are the cdf's under information sharing, for GN and GD groups, atom $\bar{r}_{BN}$ is for group BN, and atom $\bar{r}_{BD}$ is for group BD. The solid function stands for the cdf's of the incumbent under no information sharing.

Proposition 2.8 *The probability of switching for good signal borrowers*

$$\int_{\bar{r}_N}^{\bar{r}_{BN}} (1 - F_i^{GN}(r)) f_u^N(r) dr$$

is non-increasing in the amount of monitoring.

Proof See Appendix.

Thus, under information sharing regime, *if the investment in soft information is higher, we should observe less switching for good signal borrowers, and more for high signal borrowers.* The next subsection will then establish that monitoring is higher under information sharing. The proof first shows that an interest rate distribution offered to good signal borrowers at a given level of φ first-order stochastically dominates to another at a lower level of φ. First note that the updated probability of a borrower being of high ability is higher when the good signal is a result of a higher level of monitoring: $\frac{\partial p_{GN}}{\partial \varphi} \geq 0$. Thus, when the outcome *good signal* is the result of higher monitoring, it is more valuable, and the incumbent tries to keep the borrower by offering higher rates with smaller probability (smaller $F(r)$ at higher φ). In an equilibrium with higher φ, this is incorporated in the outsider's choice: since it understands the

incumbent is even better able to accurately evaluate borrowers, the pool that it faces gets worse: Thus the probability the incumbent bids a higher than any rate bidden by the outsider is lower Thus, this offers a testable prediction: if there is less switching when soft information is good, and more switching when it is bad, then it may be due to higher investment in soft information.[7]

In the next subsection, we show that monitoring is higher under information sharing, and, moreover, hard and soft information are strategic substitutes. We then show that the optimal level of investment in soft information is increasing in the level of adverse selection.

2.3 Optimal Monitoring

We can now compare the optimal choices of monitoring with and without information sharing. Denote $H = 0$ or $H = 1$ for hard information sharing and no sharing, respectively (hard information is/ is not a source of profits).

Proposition 2.9 *Banks choose higher monitoring when default information is shared. Moreover, hard and soft information are strategic substitutes*[8]*:*

$$\frac{\partial \pi(\varphi, H = 0)}{\partial \varphi} \geq \frac{\partial \pi(\varphi, H = 1)}{\partial \varphi}$$

Proof See Appendix.

The intuition behind this result is as follows. When default information is not shared, banks derive their informational advantage – positive profits on high-quality borrowers – from two sources: the "hard" result provided by the actual repayment of a borrower, and the "soft" signal generated by monitoring. When default information is shared, it ceases to be a source of informational rents. Incumbent banks then substitute for this loss by investing more in soft information. With information sharing the marginal benefit of collecting soft information is higher than it is without information sharing. Thus banks will monitor their borrowers more closely when hard information is shared - although their *total* profits will be lower.

The next proposition shows the sensitivity of the optimal investment in soft information with respect to the information asymmetry in the market.

[7]The average rate and switching *across different information regimes* will depend on the proportion of good/bad signal outcome as well as on the exact levels of investing in soft information under the two regimes(the difference in these levels) which will depend on the cost of monitoring. As the next subsection shows, soft information is higher under information sharing. if the cost of monitoring is quite low, then this gap in monitoring investment can be quite large. In that case, if all borrowers produce good signals, then average interest rate may be lower under information sharing. If the signals are , bad they will get much worse rates.

[8]The profit function $\pi(\varphi, 1 - H)$, has increasing differences: that is, there is strategic complementarity between soft information and hard information sharing (Fudenberg and Tirole (1991)).

Proposition 2.10 *Optimal investment in monitoring is increasing in the level of asymmetric information under the information sharing regime.*

$$\frac{\partial \varphi^*_{H=0}}{\partial \lambda(1-\lambda)} \geq 0$$

Proof See Appendix.

First note that $\lambda(1-\lambda)$ is the appropriate measure of asymmetric information: when $\lambda = \frac{1}{2}$ the uninformed bank is most interested to reveal types. In the other extremes, when $\lambda = 0$ or $\lambda = 1$, the uninformed bank has nothing to learn. Since asymmetric information is most acute when firms are small and opaque, we get the prediction that investment in monitoring should be higher when lenders deal with small firms under information sharing arrangement. We test this hypothesis in the empirical chapter.

2.4 Discussion

The conclusion of our paper is in some sense an optimistic one. We show that when default information is shared, banks have an incentive to increase their investment in soft information. As a result, in the presence of a credit bureau, banks will know both their competitors' and their *own* borrowers better. Thus, far from being a danger to information collection, credit bureaus can actually improve lending decisions - as well as increasing bank competition.

Of course, hard information has been modeled in our paper as default information. Default information is an automatic result of the lending process and banks have little leeway in deciding how much to "invest" in it. If banks had the choice about how much to spend on hard information, one may think that they would reduce that outlay in the presence of a credit bureau. The result may well be a decrease in the quality of hard information, which can compensate for the increase in soft information.

We believe that this concern is largely unwarranted. By definition, hard information is verifiable. Therefore a bank that has to collect and transmit the hard information would find it difficult not to do that. Moreover, some of the hard information - such as accounting data - is already in the hands of potential borrowers and and they can easily transfer it from one bank to another even in the absence of a credit bureau. Among the remaining examples of hard information, the most important are the default history and the overall debt exposure of a given borrower. While bad borrowers may have little interest in disclosing this information truthfully, banks face little additional costs in conveying this information to a credit bureau - and the information can then be easily verified.

Given that we have assumed that all borrowers are creditworthy and that there are no deadweight losses of bankruptcy, there is no welfare difference between information sharing and no information sharing in our model. We have made that assumption to

make the exposition easier. If we had assumed that the low types are not creditworthy, we would have also had to decide (more or less artificially) which proportion in the mix of good and bad borrowers is no longer creditworthy. For instance, the group of bad and defaulting borrowers could be creditworthy or not, as could the groups of bad and non-defaulting and/or good and defaulting borrowers, depending on the values of ϕ. Looking into all these possible cases would have complicated the description of the model with no obvious benefits.

It is easy to see however that in the presence of bankruptcy costs/ borrowers that are not creditworthy, the case of information sharing, which generates better lending decisions, increases welfare. The broad message of our paper supports the establishment of credit bureaus.

3 Empirical Evidence: Hypotheses and Data

3.1 Hypotheses

The empirical section tests the theoretical predictions of our paper using a firm-level sample from transition countries.

One of our main theoretical results is that *soft information acquisition increases when hard information is shared*. This is our first hypotheses, that we test using two measures of soft information acquisition. We also look at how the soft information produced relates to interest rates and switching empirically, supporting our theory that *successful soft information outcomes reduce interest rates and switching, while bad outcomes increase both*.

Earlier studies have focused on the influence of information sharing on credit market performance, or firms' access to credit. Jappelli and Pagano (2002) use aggregate data to show bank lending to the private sector is larger and default rates are lower in countries where information sharing is more solidly established and extensive, controlling for other economic and institutional determinants of bank lending, such as country size, GDP, growth rate, and variables capturing respect for the law and protection of creditor rights. Djankov et al. (2007) confirm that private sector credit relative to GDP is positively correlated with information sharing in their recent study of credit market performance and institutional arrangements in 129 countries for the period 1978 to 2003. These papers suggest a possible positive influence of information sharing on credit activity. We delve deeper into the details of credit bureaus and examine the banks' incentives to invest in information acquisition when hard information is shared.

Going beyond our main hypotheses, we also test whether the magnitude of the effects is higher for *small than for large firms*. The model predicts that soft

information acquisition increases when hard information is shared, but also that the optimal level of soft information is higher when asymmetric information is higher. Indeed, earlier research has shown that information can be particularly important for small firms since they are unlikely to be monitored by rating agencies, and information asymmetries are most acute in small firms (see, for example Petersen and Rajan (1994)). Existing evidence also suggests that information sharing benefits all firms, but *it does more for small firms than large firms in terms of credit cost and credit access* (Love and Mylenko 2003, Brown et al 2007). Part of what we test is to complement those results, looking at whether credit cost changes depending on soft information outcome, and whether this is stronger for small firms.

There are a few additional reasons why one may expect a difference in this effect for large vs. small firms. First, credit information sharing arrangements target mainly the small business and consumer markets (unlike credit rating agencies, that usually deal with large firms), and their introduction will affect small firms more. Second, since large firms already have available information, produced for instance by credit rating agencies, or by their more developed internal and external reporting, sharing information via credit bureaus should have a lower impact for these firms. Part of what is available in a standard credit bureau report may already be available without a credit bureau for a large firm - e.g., information on company profile, audited financial statements, risk class of the borrower. Thus, apart from testing that *hard information sharing increases soft information acquisition, we test whether it is stronger for small firms.*

We then go on to study switching and interest rate implications. Specifically, proposition 2.6 in the theoretical chapter predicts that interest rates are on average lower in information sharing countries, supporting earlier empirical results (Brown et al 2007, Jappelli and Pagano 2002). This prediction is also supported in our empirical models. Moreover, according to proposition 2.8, when investment in soft information increases, the incumbent will lower rates for good signals and increase them for bad signals (good and bad signals will be more important when they are the outcome of higher investment in soft information): *the bank gets more responsive with higher informativeness (φ).* We test and support the prediction.

The model derives the prediction that under hard information sharing, switching is increasing in the amount of investment in soft information, when the signals produced are bad, and decreasing when they are good. If the soft information is favorable (it gives good signal about the borrower's operations), the incumbent will be more interested in keeping relationship with the borrower and can afford more lenient contract terms; while holding up the borrower, the advantageous

information will (more likely) be realized through actual lending. However, if the signal produced is bad, it would lower the chances that the incumbent bank extend credit. Thus, borrowers may switch less or more depending if the signal produced is good or bad.

We test whether produced favorable soft signals will give a higher lock-in power to the incumbent, allowing it to keep existing borrowers. We find that under hard information sharing, switching is lower when signals are good and that it is higher when signals are bad, concluding that this is related to higher investment in soft information.

3.2 Data

We draw our data from two main sources. Country level data on information sharing is taken from the World Bank/IFC "Doing Business" database. We relate this to firm-level information taken from the EBRD/World Bank Business Environment and Enterprise Performance Survey (BEEPS).

Between 1991 and 2005 information sharing institutions were established in 17 of the 26 transition countries in Eastern Europe and the former Soviet Union.[9]

We use the *information sharing index* constructed by Brown et al (2007) as one of our measures of the depth of information sharing in different countries. The index measures the presence and structure of public credit registries and private credit bureaus on a scale of 1 to 5. It is constructed as the maximum of two scores, one for PCR's and one for PCB's. The PCR score adds one point for fulfilling each of the following five criteria:

(i) both firms and individuals are covered,
(ii) positive and negative data is collected and distributed,
(iii) the registry distributes data which is at least two years old,
(iv) the threshold for included loans is below per capita GDP, and
(v) the registry has existed for more than 3 years.

The PCB score is computed in the same way. The index is then taken as an average over years 1996 to 1999 for the analysis of year 2002, and average over 2000-2003 for year 2005.

Detailed definitions of all variables are available in Appendix B. The BEEPS 2002 provides data on 6153 firms in 26 transition countries and covers a representative sample of firms for each of these countries (survey was done in all countries where EBRD is operational except Tajikistan), while BEEPS 2005 covers over 9655 firms.

[9]For a comprehensive coverage see Table 1 in Brown et al 2007

We drop all observations from Uzbekistan and Tajikistan, due to lack of institutional data. Together with missing dependent variables, this leaves us with a sample of 5209 firms at best from 24 countries for year 2002 and with 8599 for year 2005.

3.3 Model Specifications

We start our empirical analysis with cross-sectional regressions using the BEEPS 2002. The baseline specification relates each of our dependent variables for firm i in country j to the information sharing index in the firms country, a vector of other country characteristics, and a vector of firm characteristics that may affect firms' incentives to produce soft information. Our dependent variables were collected during 2002, while information sharing is measured as the average value of the index prior to the survey, i.e. from 1996 to 1999 for 2002, and 2001-2003. Thus, we relate firm-level information to countrywide measures of information sharing that are predetermined with respect to credit variables and this should address the potential endogeneity of information sharing with respect to credit market performance (see also Brown et al 2007).

We will test our theory (Propositions 2.4, 2.5, 2.6) using 5 dependent variables. We examine three main aspects:
1) whether soft information acquisition has increased using measures of soft information (dependent variables *react, checking account*);
2) how switching has changed *as a result of soft information acquisition, which may have produced either good or bad signals about the borrower*, using a measure of whether the soft information has been good or bad (variable *soft*);
3) how *cost of capital* has changed depending on the soft signal.

3.3.1 Dependent Variables

We relate our information sharing index to firm-level data on our independent variables taken from the Business Environment and Enterprise Performance Survey (BEEPS)(see Table 1).

We use five dependent variables. The first two measure the investment in proprietary information, the third one is a dummy showing whether the borrower switched from the main bank, and the last one is the firms' cost of capital:

1. the banks' reaction to the borrower's non-repayment during the relationship (the reaction as perceived by the borrowers);
2. the use of checking account;

3. borrower switching/keeping relationship with the main bank;
4. the cost of capital.

Our cross-sectional analysis is based on data from BEEPS 2002 for *(switching, and banks' reaction)*, BEEPS 2005 is used for *checking account* and *capital cost* is available in 2002 and 2005.

The **reaction** variable is based on survey results. The question in the survey asks:

- Now I would like to ask you a hypothetical question. If your firm were to fall behind in its bank repayments, which of the following would best describe how you would expect the bank to react?

The possible answers are:

1. Extend the term of the loan without changing the conditions (=3).
2. Extend the term of the loan but increase the interest rate (=2).
3. Begin legal proceedings to take possession of some assets of the firm (=1).

We argue higher values of the variable suggest the bank has a better knowledge of the firm, that it has a good picture of the potential problems and that it is less likely to react abruptly in the case of late payments. In contrast, a bank that does not invest in monitoring or screening its borrowers will simply take late payments as a pure negative signal about the firm's potential and will be more likely to cease the banking relationship. Similar questions have been used as proxies of soft information on earlier studies, that utilize companies' grading of their main banks in terms of satisfaction (Ogura and Uchida (2006), Uchida, Udell and Yamori (2007)).

The **checking account** variable is taken from the BEEPS 2002 survey. The question in the survey asks: "Does your establishment have a checking or saving account". It has been observed that the use of checking account gives the bank advantageous information on the borrower and works as a monitoring tool for the lender (Nakamura 1991, Degryse and van Cayseele 2000, Norden and Weber 2004). And while the pieces of information received via the checking account are hard, the overall knowledge that the bank can obtain about the borrower is soft (Norden and Weber 2004). Moreover, evidence suggests that there is a positive impact of the checking account existence on the probability of personal communication between the bank and the borrower, as well as a negative impact on the bank size and the distance between the firm and the borrower (Berger et al 2005).

3.3.2 Firm-level explanatory variables

We include six firm-level explanatory variables to control for the variation in credit risk and financing requirements across firms, and we use two different measures of good/bad soft information.[10]

From the BEEPS survey for 2002 and 2005, we construct the summary variable *soft*, that measures how protected the borrower is from different *non-financial* factors. It summarizes answers to 19 questions on "non financial problems of growth". The exact question in the survey asks: *Can you tell me how problematic are these factors for the operation and growth of your business?*. The factors include skills of workers, their education, contract violations by customers and suppliers, among others. Arguably, relationship-specific investment is necessary to evaluate how problematic these factors are for the operations and growth of the firm, and therefore the main bank can have advantage over transactional banks. Each of the questions is answered on a scale from 1-4, where higher values stand for less obstacles (4=no obstacle, 1=major obstacle). We take the sum of the 19 questions, and divide by 19*4, to range it from 0.25 to 1. We then take 1.25 - the value of the variable, so that higher values mean less problems, and the variable still ranges from 0 to 0.75. We use the variable in the regressions for switching and cost of capital, as a proxy for bad vs good signals. If the value of the signal *soft* is important (the banks find it more valuable and more sensitive to it), then it must be that it is the outcome of a higher investment in soft information: the precision (and importance) of the signal is increasing in the amount of φ (in the theory, $\frac{\partial p_{GN}}{\partial \varphi} > 0$). We then use other proxies for the same purpose.

The *management quality* has been documented as one of the most important soft characteristics of the firm (see Grunert, Norden, Weber 2005). In our survey it is the sum of three variables: *previous experience* of the manager within that firm, *the age of the manager*, *the manager's education*. Each of the variables takes several values in the survey. We scale them to 0 and 1, where 0 stands for less favorable values. The variable ranges from 0 to 3, and higher values of the management quality would mean better signals for the lender.

Younger firms are generally considered as riskier than older firms. However, *in transition countries firm age also determines the economic regime* under which the firm emerged. Thus, while older firms may be less risky in general, they may be riskier in transition countries, because they emerged during the pre-transition or transition phase. Rather than controlling simply for firm age, we follow Brown et al (2007) and distinguish firms by three categories depending on

[10] While we use the term *soft* information throughout the model, the important thing in our theory is that the information be proprietary, and give an advantage to the bank that invests in it.

whether they were established *before 1989 (Pre-transition firm), between 1989 and 1993 (Transition firm), after 1993 (Post-transition firm)* (see also Gianetti and Ongena 2005). We further include two control variables for firm ownership. *State-owned firm* is a dummy variable that equals one if the government holds a majority stake in the firm. The effect of this variable is a priori ambiguous. On the one hand, state ownership may reduce firm risk in the eye of a bank, due to the possible government bailout in case of default. On the other, state ownership may increase default risk, owing to the political pressures on management to diverge from profit-maximizing policies (see Brown et al 2007). Moreover, these firms may receive public funding, which reduces their reliance on credit for investment and therefore relieves a constraint on their growth. We include the *the debt ratio*; previous research has shown that firm with higher leverage switch more often (e.g., Ongena and Smith 2001). This finding is confirmed in our data. Firm debt is also related to the firm risk, and may therefore change incentives to acquire soft information: one the one hand raising the leverage will raise the borrower's risk, on the other hand, lower risk firms can afford higher leverage.

As discussed above, we are also interested in the differential effect depending on the firm size. Moreover, it is customary to regard larger firms as less risky, other things equal. We distinguish small firms from large ones by their number of employees (Small firm = 1-49, Large firm $\geq$ 50).

Finally, in all our regressions we include sector dummies, to control for different finance needs of firms.[11]

Firm-level explanatory variables are detailed in the Appendix for variables. Our sample is dominated by small firms (67 %). Exactly half of the firms were established after 1993, and are thus categorized as post-transition firms, while a further 28% were established in the transition phase of 1989 1993. The majority of firms are privately owned, with only a minor share state-owned (14%). Of the 86% of privately owned firms in the sample, 83% are de novo firms, implying that a total of 14% of our firms are privatized companies. Our sample displays a low level of transparency on average.

The data provides a similar sample of non-agricultural firms across all countries. The sample is dominated by small firms (67%) and private firms (86%). The sample includes firms from the service and manufacturing sectors, with the majority of firms (54%) have their main activity in the service sector. All firms in the sample are at least 3 years old. The 2005 survey includes 9655 firms. The sample structure for the 2005 survey resembles by design that of the 2002 survey.

[11] Although some of these variables can be regarded as pieces of hard information, we believe the general picture may have a proprietary nature for the main bank

3.3.3 Country-level variables

We include seven country-level variables to control for differences in the legal environment, the structure of the banking sector, and macroeconomic performance (Table 2 provides means of the variables): an index of creditor rights and payment enforcement, banking reform, a measure of market structure/concentration, a proxy for asymmetric information/borrower risk, a measure of foreign bank presence, per capita GDP, and the inflation rate.

The *banking concentration* measure is the share of the largest 5 banks in terms of deposits (from Barth et al 2001): higher concentration may indicate higher market power of the banks, higher informational lock in, and therefore less switching. Moreover, since larger banks are less efficient in collecting soft information (Berger et al 2005), higher concentration may have a negative impact on the information acquisition. Also, in more competitive markets, banks anticipate a shorter expected lifespan of their relationships, and they may respond by reducing their relationship-specific investments. Weaker relationships may then induce further switching.

We take the share of *non performing loans* as a measure of asymmetric information. In markets with higher degree of risk, switching will be more costly: we expect a negative sign on this variable for switching.

The *Creditor rights* variable is taken from Brown et al (2007): it is an aggregate measure of creditor legal protection built with the methodology proposed by La Porta et al. (1998). Higher values of this index imply that secured lenders are better protected in case a borrower defaults.Indeed, earlier evidence suggests that transition countries with better creditor protection have higher credit market performance (Pistor et al. (2000), Brown et al 2007). However, not only the law on the books matters for credit market development, but also its actual enforcement. As a measure of actual enforcement of creditor protection, we also include the variable *Time to enforce payment*, which measures the (log of the) number of days it takes for a creditor to secure an outstanding payment through the courts if a debtor defaults (variable *ltime*). This variable is taken from the World Bank/IFC "Doing Business" database (available from 2003 to 2007 only). Following (Ongena and Smith 2000), we use the multiplication of creditor rights and a measure of institutional strength(speed of contract enforcement in our example), since enforcement of creditor protection laws may be lax in countries with weak actual enforcement We expect it to be negatively correlated with switching and cost of capital, consistent with the finding that Judicial efficiency is negatively related with firms patronizing a number of banks (Ongena and Smith

2000).[12]

The *banking reform index* is an index showing level of changes from a state owned bank with soft-budget constraints to a commercial bankwith hard budget constraints in a market economy. *Foreign bank share* is the asset share of foreign owned banks in each country. Recent evidence suggests that foreign bank entry has improved credit market performance in transition countries, reducing intermediation spreads and facilitating credit access (Giannetti and Ongena 2005). Also, foreign bank presence may coincide with information sharing, if these banks are familiar with the benefits of credit reports from their home markets, and therefore tend to patronize private credit bureaus also in their host countries. Alternatively, when foreign banks are serving foreign firms in the host country, they might be able to access information on those firms through their home bureaus, and are less interested in information sharing. We include *inflation and log of per capita GDP*, as previous evidence suggests that macroeconomic stabilization is associated with an expansion in financial intermediation in transition countries (Fries and Taci, 2002).

4 Empirical Analysis

4.1 Soft Information Acquisition

Our aim is to provide empirical evidence that in support of the theory: banks invest more in soft information once hard information is shared. In order to examine this hypothesis, which is also the main message of our paper, we look at several aspects:

- the way banks react to late payments from their borrowers;
- the time banks spend analyzing demands for credit;
- the use of checking accounts as a way to accumulate information on borrowers.

We begin with the "reaction" to late payments.

Banks' reaction

We argue that a more flexible reaction from banks to late payments is the result of better soft information. The main regression is ordered probit, although robust OLS estimates have the same significance.

[12]Using creditor right and time to enforce payment separately does not change our results.

When we use the whole sample - both large and small firms - we have high significance for the information sharing index. Columns two and three look at the subsamples of large and small firms. At it may be expected, given the higher importance of soft information for small firms, we get a very strong result for their subsample. Banks are more likely to be flexible with small banks in the presence of information sharing.

Creditor rights times contract enforcement seem to make banks less cooperative (as perceived by the borrowers), especially for small firms. This may be owing for instance to the fact that banks realize starting legal procedures is more likely to result in actual winning. As we expected, bank reform index has a negative sign: banks with binding hard-budget constraints will be stricter to their borrowers. The regression shows that younger firms seem to be less optimistic about their bank's favorable response to a sudden non-repayment: in fact when we replace transition/post transition with age, the coefficients are significant. For younger firms after transition banks may have not yet accumulated enough information via monitoring and therefore their reaction is more rigid.

Checking account

We provide evidence that checking accounts are used more in countries with information sharing, which supports our hypothesis that there is more investment in monitoring when hard information is shared.

Once again, the first column is the total sample. The second column is for small firms, and the third one is for large firms. We do not find evidence in favor of larger importance for small firms for this variable. In all three cases information sharing makes the use of checking accounts more likely.

We do not use debt/aset ratio due to the absence of this variable for year 2005. Concentration has a negative impact, in line with earlier arguments and findings (Berger et al. 2005). Higher concentration suggests that larger banks are dominating in the industry, and less likely to invest in relationship-specific information. The creditor rights times (speed of) payment enforcement is again positive, consistent with earlier findings that banks are willing to monitor borrowers better as relationship is more likely to be single when creditor right and payment enforcement are stronger. The positive effect of per capita GDP is consistent with earlier findings of higher probability of owning a checking account when income is higher (Vermilyea and Wilcox 2002). [13]

[13] As this variable is taken from survey year 2005, we also complement this index with measures of credit information sharing from IFC/Doing Business. We repeat our analysis using:

1. Coverage data that show percentage of population that has data in the bureau
2. An index of Credit Information constructed by IFC/Doing business

4.2 Switching or Staying with the Main Bank?

The switching variable is taken from the BEEPS 2002 survey. The question in the survey asks, *Has your firm changed its main bank (the single bank with which your firm has the closest relationship) since 1998?'*. Possible answers include "yes", "no", "no main bank". 8 percent of the firms report that they have no main bank, and we exclude those firms. This leaves us with a sample of 5209 firms. 26 percent of the firms report that they have switched their main bank. We also use the average information sharing index for year 1996-1998, to estimate switching *after* establishing information sharing. We would like to test whether soft (proprietary) information is important in information sharing countries, and whether it is more important for small firms. Our hypothesis is that *switching will depend on the* ***outcome*** *of the soft information signal,* ***good or bad****: a) borrowers on whom good soft signals were received, switch less b) bad signal borrowers switch more.*

Variable *soft* is the proxy for the outcome of the soft signal. It measures how protected the borrower is from different *non-financial* factors. It summarizes answers to 19 questions on non financial problems of growth. The exact question in the survey asks: *Can you tell me how problematic are these factors for the operation and growth of your business?*. The factors include skills of workers, their education, contract violations by customers and suppliers, among others. Each of the questions is answered on a scale from 1-to 4, where higher values stand for less obstacles (4=no obstacle, 1=major obstacle). We take the sum of the 19 questions, and divide by 4*19. Thus, the variable ranges from 0.25 to 1, where a value of 1 indicates that the received soft signals about the quality of the borrower, have all been good/favorable (19 answers "no obstacle"). We then take 1 - the value of the variable, so that higher values mean less problems.

We test proposition 2.5. The first regression is the basic one. The coefficient of 0.232 in the interaction term is rather large: we calculate its marginal effect (0.066), which shows that going from 0.25 to 1 of the soft signal, the switching

3. Multiply coverage on PCB/PCR by a coefficient that shows the depth, but not coverage, of the information shared

The score adds for each of the following functions: (i) both firms and individuals are covered, (ii) positive and negative data is collected and distributed, (iii) the registry distributed data which is at least two years old. Thus we do not add score for bureaus that share data above a certain amount of loans, or for bureaus that share both individual and firm data, since these are already included in the coverage number (although adding these two results in little changes). We do the same for PCB, and then take the sum of the two numbers (or take the maximum, which does change our results qualitatively). The estimates remain robust.

probability decreases by 6.6 percent, making it possible that firms with *best* signals actually have a higher chance of staying with their main bank: one would expect switching to increase in countries with information sharing. From the lowest value of the information sharing, to the highest, this would mean up to 8 percent of decrease in the switching probability in information sharing countries. This is rather high for a sample average of 26 percent. [14]

The second column adds a third interaction term. We see there that the effect of the soft signals in information sharing countries is higher for small firms. The third column includes the sub-sample where soft signals are above the median value (*Good* signal), while the forth one includes observations where soft signals are below or equal to the median value (*Bad* signal).

The 5th and the 6th columns repeat models in columns 1 and 2 proxying soft signals by *management quality.*[15]

Creditor rights*contract enforcement is negatively related to switching from with the main bank, which is consistent with the finding that Judicial efficiency is negatively related with firms patronizing a number of banks (Ongena and Smith 2000), as well as with theoretical arguments (Hart 1995, Bolton and Scharfstein 1996). Higher risk in the economy, as measured by the non-performing loans, is related with higher probability of staying with the main bank. As we conjectured privatized firms may be less risky, and therefore switching costs can be lighter. Post-transition and transition firms switch less than pre-transition firms: apart from being younger, these firms' behavior may be related with earlier findings

[14]When we *drop per capita GDP and inflation*, as they have no significance in the model, this does not alter our results. We also tried using GDP growth as one of the country controls: evidence suggests that in markets with high growth banks may be more aggressive in establishing market shares (see for example Sharpe 1997). Results do not change qualitatively.

[15]The management quality has been documented as one of the most important soft characteristics of the firm (see Grunert, Norden, Weber 2005). In BEEPS survey it is the sum of three variables: previous experience of the manager within that firm, the age of the manager, the manager's education, as well as the skills and education of the workers. Each of the variables takes several values in the survey. We scale them to range from 0 to 1, 0 standing for less favorable values. Thus, higher values of the "management quality" would mean better signals for the lender. Taken piece by piece some of variables are hard information - not necessarily shared by information bureaus; however, the general picture may have proprietary nature for the main bank. We also use the management quality for other models in the table and get similar results. We then complement the analysis with a variable *overdue payments* on items about which credit bureaus do not share information. We use two different questions in the survey. 1. Do you currently have overdue payments over 90 days to the following: employees, utilities, suppliers, government: 2. Have you had to resolve an overdue payment in the court? While the nature of information is hard, most of the information is not shared via information sharing institutions (information on utilities and retailers is shared only in Estonia and in Kazakhstan). And although one may argue that for example information on taxes may be received through other sources, learning about employee overdue payments can require more efforts from the main bank. One may therefore believe that part of this information is advantageous for the main bank, and it can make better assessments of creditworthiness.

that switching lenders is more probable as the duration of relationship increases (Ongena and Smith 2001). Our post-transition firms, established after 1993, may still be in the beginning of their relationship, and 1998-2001 can be too early a stage to switch.

4.3 Cost of capital

We analyze the effects of information on *cost of capital*. It ranges from 1 to 4, with higher values indicating a higher cost of financing. It equals 4, if cost of finance is reported to be a major obstacle, 3 = moderate obstacle, 2 = minor obstacle, 1 = no obstacle. Unlike Brown et al. (2007) we also take into account soft information. They find that cost of capital is lower in countries with information sharing, and that this effect is larger for small, opaque firms. We would like to test whether soft (proprietary) information influences cost of capital in information sharing countries, and whether it is more important for small firms.

Results. We find that the interaction of soft signal and information sharing has a negative and large sign, indicating that cost of capital goes down when the soft signal gets better (the output is ordered probit, although robust OLS estimated give almost identical results). From the first two rows of the first column one can see that the firms with worst signals (Soft=4.75) will actually experience an increase in cost of capital. The marginal effects show that while cost of access goes up by 0.44 for the worst signal borrower, it actually reduces by 0.25 for the best signals for one point of the information sharing index (and information sharing index is constructed to range from 0 to 5) This is quite large given that the sample average of cost of capital is 2.53. Consistent with our discussion of small and large firms, and proposition 2.4, columns 2 and 3 show that the signal matters more for the small firms. The model confirms that privatized firms are less risky, and experience less problem of capital cost. We did not have any a priori prediction as to the sign post-transition and transition variables, since these are younger firms but, as argued before, may be less risky on the other hand, than pre-transition firms. Stronger creditor rights and *faster* contract enforcement seem to reduce cost of capital. Foreign bank presence seems to increase cost of capital: Karapetyan and Stacescu (2008) show that foreign bank presence is related to *less coverage* of the credit bureaus, where coverage is not captured in our information sharing index due to lack of coverage data in that period. Table 2 table repeats this analysis using panel estimates from 2002 and 2005. The results for *access to capital*, defined similarly, are very similar to table 7 and 8 and are not reported for brevity.

5 Conclusions

It seems reasonable to think that when information is shared via credit bureaus or public credit registers banks will have lower incentives to invest in monitoring their borrowers and the quality of lending decisions may decline.

Starting from the distinction between hard and soft information, and the observation that only the former is likely to be shared through pooling arrangements, we show that banks are actually likely to invest more in acquiring soft information when hard information is shared. The intuition behind the result is simple. When banks do not share any information, they derive informational rents from both hard and soft information, and the marginal contribution of soft information to bank profits is lower. When hard information is shared, then the marginal benefits from soft information are higher and banks will choose a higher level of investment.

Moreover, we show that switching may not necessarily increase after information sharing, as one may otherwise think is the case. The switching result will depend on that actual -positive or negative - value of the soft signal received.

This will improve the accuracy of lending decisions and may be useful for small firms that are differentiated along "soft" characteristics. Thus one of the apparent victims of information sharing – borrowers that require significant investment in information – may actually benefit from the existence of credit bureaus.

Our results obviously present an important argument in favor of information sharing. They also point to an interesting implication in terms of the structure of the banking system. In particular, information sharing may widen the gap between small banks relying on collecting soft information and large banks relying on standardized, hard information (Stein 2002, Berger et al. (2005)): indeed, information sharing increases small banks' incentives to collect soft information and makes it easier for large banks to get their standardized data.

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1 Appendix A

Proof of Proposition 2.1. The proof is done by way of contradiction (see also von Thadden 2004, Hauswald and Marquez (2006) for proofs in similar setups). Consider either of the two pools of borrower population - the defaulters (market D), or the non-defaulters (N). In either of these two markets we have two banks: the incumbent bank, that can distinguish between "good" and "bad" signal borrowers, and the outside bank, which does not observe these signals. The incumbent bank can therefore condition its interest rates on the two observed signals, while the outside bank cannot do the same. Let $r_i(B)$ and $r_i(G)$ be the pure-strategy interest rates charged by the incumbent bank conditional on bad and good signal, respectively, while r_u is the interest rate charged by the outside bank.

1) Suppose first that r_u is lower than both $r_i(B)$ and $r_i(G)$. Then the informed bank could increase its profits by charging an interest rate $r_u - \epsilon$ just for successful borrowers. Thus this cannot be and equilibrium.

2) Suppose next that $r_i(G) \leq r_u \leq r_i(B)$. Then the uninformed bank attracts only bad borrowers. For the uninformed bank to break even, we have to have that $r_u \geq \overline{r_D}$, the break-even rate for bad borrowers. If $r_i(G) < r_u$, then the informed bank could increase the interest rate for good borrowers and boost its profits. If we have equality, then the uninformed bank could raise its profits by charging $r_i(G) - \epsilon$ and lending to all borrowers.

3) If $r_i(B) \leq r_u \leq r_i(G)$, then the uninformed bank is making positive profits on successful borrowers and the informed bank is making nonnegative profits on defaulting borrowers. The informed bank could then undercut to $r_u - \epsilon$ for successful borrowers, and increase profits while capturing the whole market. This means there is no pure-strategy equilibrium in the bidding game.

Proof of Proposition 2.2.

If default information is shared, each bank can separate its competitor's successful borrowers from the failing ones. The incumbent bank can additionally distinguish between good and bad-signal borrowers, so it retains some informational advantage.

The informational advantage - the G or B signal - is in place for two different markets (pools of borrowers)- for (a)defaulters, and for (b) non-defaulters. As a result, for each of these two pools the competition between the incumbent and

the outside bank has only a mixed-strategy equilibrium: the bad signal borrowers in each of the two markets are the worst group of borrowers in the respective market, over whom the incumbent has no informational advantage.

Given the bidding strategy of its competitor, the expected profits for the incumbent can be written as

$$\begin{aligned}
\pi_i^{GN}(r) &= N_{GN}(p_{GN}r - I)(1 - F_u(r)), \\
\pi_i^{GD}(r) &= N_{GD}(p_{GD}r - I)(1 - F_u(r)), \\
\pi_i^{BN}(r) &= N_{BN}(p_{BN}r - I)(1 - F_u(r),) \\
\pi_i^{BD}(r) &= N_{BD}(p_{BD}r - I)(1 - F_u(r)),
\end{aligned}$$

The uninformed bank will not be able to make that distinction -distinction between good and bad signal, but it will make profits of the two different pools

$$\begin{aligned}
\pi_u(r)^D &= N_{GD}(p_{GD}r - I)(1 - F_i^{GD}(r)) + N_{BD}(p_{BD}r - I)(1 - F_i^{BD}(r)), \\
\pi_u(r)^N &= N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)),
\end{aligned}$$

As in the proof of proposition 1, we now concentrate on either of the market (D or N), since the proof repeats identically for the other. The informed bank gets

$$\begin{aligned}
\pi_i^{GN}(r) &= N_{GN}(p_{GN}r - I)(1 - F_u(r)), \\
\pi_i^{BN}(r) &= N_{BN}(p_{BN}r - I)(1 - F_u(r),)
\end{aligned}$$

The uninformed bank gets

$$\pi_u(r)^N = N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)),$$

The construction of the mixed strategy equilibrium follows *a sequence of standard arguments*, which is similar to that outlined in Hauswald and Marquez 2000 and Hauswald and Marquez 2006.

Lemma 1 Both banks randomize their loan offers over the same interval $[r_N; r_{BN}]$. Moreover, the informed bank earns positive expected profits and the uninformed one breaks even.

Proof Claim 1. *Both banks offer loan rates $[\overline{r}_N, [\overline{r}_{BN}]$, where R is the return from the project.*

The uninformed bank will never bid less than $\overline{r}_N = \frac{1}{p_N}$, since borrowers switch banks at any offer so that the loan pool has a success probability of at most p_N: But then, the informed bank will never offer rates below $\overline{r}_N$ to its high quality customers (Signal=G) making positive profits on high-quality borrowers: $\pi_i^{GN}(r) > 0$: Clearly, neither the informed nor the uninformed bank will offer (gross) rates above $\overline{r}_{BN}$, since any of the lender can undercut and get all of the borrowers and make positive profits on them:

Claim 2. *Continuity of F_i on its support.*

Suppose there otherwise there is an r' in the support, such that $F_i^G(r'^-) < F_i^G(r')$. But then $\pi_u(r'^-) > \pi_u(r')$ (since $p_{GN}r - I > 0$, and F_i is right continuous). Since π_u^N is also right-continuous, there exists a neighborhood $[r'; r' + \epsilon]$, $\epsilon > 0$, on which F_u must be constant implying $F_u(r') = F_u(r'^-)$. Hence, by expression of the profit function above, $F_i(r)$ is continuous at r' and strictly increasing in the neighborhood; but then, it can not have any mass on $[r'; r' + \epsilon]$ so that$F_i(r') = F_i(r'^-)$, contradicting the assumption of an atom at r'.

Claim 3 *The lower and upper bounds of the supports are equal.*

Denote lower bounds by $\underline{r}$. Let's first show $\underline{r}_i \geq \underline{r}_u$. Note that otherwise $\pi_i = 0$ for $r \in (\underline{r}_u; \underline{r}_i)$, which contradicts the positivity of profits for the informed bank. Then, suppose $\underline{r}_i > \underline{r}_u$. In that case $\pi_u(r_i) > \pi_u(r_u)$, since the uninformed bank has the same probability of having the lowest interest rate at r_i as at r_u. Therefore the two lower bounds must be the same. Denote the upper bound ((denote $r*$):

Now, if $r*_u < r*_i$, then again $\pi_i < 0$ for $(r*_u; r*_i]$, contradicting positivity of i's profits thus $r*_i \leq r*_u \leq \overline{r}_{BN}$. Also it can't be that $r*^G < \overline{r}_{BN}$, since then the informed bank would not be bidding in $(r*_i^G; \overline{r}_{BN})$, and then the uninformed bank would be better off increasing its rate. Thus, $r*_i = r*_u = \overline{r}_{BN}$

Claim 4. *The uninformed bank breaks even: thus the lower bounds are equal to $[\overline{r}_N]$ and the supports for both banks are given by the interval $[\overline{r}_N, \overline{r}_{BN}]$.*

It is a standard result in models of competition under asymmetric information that a bidder, all of whose information is known by some other competitor, makes zero profits (see, e.g., Milgrom and Weber (1993), von Thadden 2004).

Claim 5. *The informed bank bids $\overline{r}_BN$ for the bad signal borrowers.*

We have already argued by using the standard undercutting argument, that r^g cannot exceed $\overline{r}_BN$. Now, it also cannot be strictly smaller, since the informed bank would be making losses.

Lemma 2 *The equilibrium distribution functions F_i, F_u are continuous and strictly increasing over an interval $[\overline{r}_N, \overline{r}_{BN}]$, so that profits π_u and π_i are constant there.*

See also Hauswald and Marquez 2000. Our proof is otherwise identical.

Concluding, while the incumbent will only bid the breakeven interest rate on the bad-signal borrowers and make zero profits on those borrowers, it will randomize over the interval $[\overline{r}, r_B]$ for the good signal borrowers, and make positive profits on those particular subgroups.

The outside bank will randomize over the $[\overline{r}_N, \overline{r}_{BN}]$ interval and make zero profits. As argued, it will have to charge an interest rate equal to at least $\overline{r}_N$, since it always faces the risk of attracting the low-quality borrowers. The incumbent bank will make positive expected profits (it will offer at least to its successful borrowers, which actually have a higher probability of success than).

The incumbent bank will choose different interest rates for the defaulters and non-defaulters, getting the following profits:

$$\pi_i^{GN}(r) = N_{GN}(p_{GN}r - I)(1 - F_u(r)),$$
$$\pi_i^{GD}(r) = N_{GD}(p_{GD}r - I)(1 - F_u(r)),$$

since the other two expressions are now 0.

Lemma 3: *The unique mixed strategy equilibrium.*

Let us keep on proving only for the N case. Since in the mixed strategy equilibrium the incumbent has constant profits over the whole support (for any individual market), we can write for some constant k

$$\pi_i^{GN}(r) = N_{GN}(p_{GN}r - I)(1 - F_u(r)) = k$$

Note now, that $F_u^N(\overline{r}_N) = 0$, sine the uninformed never bids below the breakeven rate. Thus

$$\pi_i^{GN}(\overline{r}_N) = N_{GN}(p_{GN}\overline{r}_N - I) = k = \pi_i^{GN}(r)$$

And therefore

$$1 - F_u^N(r) = \frac{\pi_i^{GN}(r)}{N_{GN}(p_{GN}r - I)} = \frac{N_{GN}(p_{GN}\overline{r}_N - I)}{N_{GN}(p_{GN}r - I)}$$

Thus,

$$F_u^N(r) = 1 - \frac{N_{GN}(p_{GN}\overline{r}_N - I)}{N_{GN}(p_{GN}r - I)}$$

on $[\overline{r}_N; \overline{r}_{BN}]$ with a mass at $\overline{r}_{BN}$ of $\frac{N_{GN}(p_{GN}\overline{r}_N - I)}{N_{GN}(p_{GN}\overline{r}_{BN} - I)}$).
Following similar arguments for group D

$$F_u^D(r) = 1 - \frac{N_{GD}(p_{GD}\overline{r}_N - I)}{N_{GD}(p_{GD}r - I)}$$

on $[\overline{r}_D; \overline{r}_{BD}]$, with a mass at$\overline{r}_{BD}$ of $\frac{N_{GD}(p_{GD}\overline{r}_N - I)}{N_{GD}(p_{GD}\overline{r}_{BD} - I)}$).
Now, looking for the distribution of the informed, observe that
The uninformed bank gets

$$\pi_u(r)^N = N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)) = 0,$$

so that

$$F_i^{GN}(r) = 1 + \frac{N_{BN}(p_{BN}r - I)}{N_{GN}(p_{GN}r - I)} = 1 + \frac{N_{BN}(p_{BN}r - I)}{N_{GN}(p_{GN}r - I)}$$

on $[\overline{r}_N; \overline{r}_{BN}]$ and $r_i^{BN} = \overline{r}_{BN}$ as we saw in Lemma 2.
Also,

$$F_i^{GD}(r) = 1 + \frac{N_{BD}(p_{BD}r - I)}{N_{GD}(p_{GD}r - I)} = 1 + \frac{N_{BD}(p_{BD}r - I)}{N_{GD}(p_{GD}r - I)}$$

on $[\overline{r}_D; \overline{r}_{BD}]$ and $r_i^{BD} = \overline{r}_{BD}$.
Proof of Proposition 2.3
The profit functions for the uninformed bank are:

$$\pi_u(r)^D = N_{GD}(p_{GD}r - I)(1 - F_i^{GD}(r)) + N_{BD}(p_{BD}r - I)(1 - F_i^{BD}(r)),$$
$$\pi_u(r)^N = N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)).$$

In the mixed-strategy equilibrium, as shown above, the outside bank will bid over the whole interval $[\overline{r}, \overline{r}_{BK}]$, for both types, and it will make zero profits.

The profit functions for the incumbent bank are:

$$\begin{aligned}
\pi_i^{GN}(r) &= N_{GN}(p_{GN}r - I)(1 - F_u^N(r)) \\
\pi_i^{GD}(r) &= N_{GD}(p_{GD}r - I)(1 - F_u^D(r)) \\
\pi_i^{BN}(r) &= N_{BN}(p_{BN}r - I)(1 - F_u^N(r)) \\
\pi_i^{BD}(r) &= N_{BD}(p_{BD}r - I)(1 - F_u^D(r))
\end{aligned}$$

The incumbent makes zero profits on the bad-signal borrowers, but it makes positive profits on the good-signal borrowers.

We have the proportion of each borrower type:

$$\begin{aligned}
N_{GN} &= \lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L \\
N_{GD} &= \lambda\varphi(1-p_H) + (1-\lambda)(1-\varphi)(1-p_L) \\
N_{BN} &= \lambda(1-\varphi)p_H + (1-\lambda)\varphi p_L \\
N_{BD} &= \lambda(1-\varphi)(1-p_H) + (1-\lambda)\varphi(1-p_L).
\end{aligned}$$

and the updated probabilities:

$$\begin{aligned}
p_N &= \frac{\lambda p_H^2 + (1-\lambda)p_L^2}{\lambda p_H + (1-\lambda)p_L} \\
p_D &= \frac{\lambda p_H(1-p_H) + (1-\lambda)p_L(1-p_L)}{\lambda(1-p_H) + (1-\lambda)(1-p_L)} \\
p_{GN} &= \frac{\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2}{\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L} \\
p_{BN} &= \frac{\lambda(1-\varphi)p_H^2 + (1-\lambda)\varphi p_L^2}{\lambda(1-\varphi)p_H + (1-\lambda)\varphi p_L} \\
p_{GD} &= \frac{\lambda\varphi p_H(1-p_H) + (1-\lambda)(1-\varphi)p_L(1-p_L)}{\lambda\varphi(1-p_H) + (1-\lambda)(1-\varphi)(1-p_L)} \\
p_{BD} &= \frac{\lambda(1-\varphi)p_H(1-p_H) + (1-\lambda)\varphi p_L(1-p_L)}{\lambda(1-\varphi)(1-p_H) + (1-\lambda)\varphi(1-p_L)}.
\end{aligned}$$

and

$$F_u^N = 1 - \frac{p_{GN}\bar{r}_N - I}{p_{GN}r - I}, F_u^D = 1 - \frac{p_{GD}\bar{r}_D - I}{p_{GD}r - I}.$$

with an atom at r_{BD} and r_{BN} respectively.

Expected profits have to be constant over the whole interval - they are therefore equal to the profits estimated at $\overline{r}_K$.

Thus

$$\pi_i^{GN} = N_{GN}(p_{GN}\overline{r}_N - I)$$
$$\pi_i^{GD} = N_{GD}(p_{GD}\overline{r}_D - I)$$

Plugging in the expressions for N, p and $\bar{r}$ we get:

$$\pi_i^{share} = \pi_i^{GN} + \pi_i^{GD} = \lambda(1-\lambda)(p_H - p_L)(2\phi - 1)I \times \Big(\frac{p_H p_L}{\lambda p_H^2 + (1-\lambda)p_L^2} + \frac{(1-p_H)(1-p_L)}{\lambda p_H(1-pH) + (1-\lambda)p_L(1-p_L)}\Big) - c\Big(\phi - \frac{1}{2}\Big)^2.$$

Proof of Propositions 2.4 and 2.5

In the mixed-strategy equilibrium, the informed bank can pick different interest rates for each type, and profits will be different for each of them:

$$\pi_i^{GN}(r) = N_{GN}(p_{GN}r - I)(1 - F_u(r)),$$
$$\pi_i^{GD}(r) = N_{GD}(p_{GD}r - I)(1 - F_u(r)),$$
$$\pi_i^{BN}(r) = N_{BN}(p_{BN}r - I)(1 - F_u(r)),$$
$$\pi_i^{BD}(r) = N_{BD}(p_{BD}r - I)(1 - F_u(r)),$$

where F_u is the cumulative density function that describes the uninformed bank's choice of interest rates. As we will see, similar to the case without information sharingthe incumbent will bid the break-even rate for the bad signal borrowers:

The outside bank will not be able to distinguish between borrowers based on hard or soft information. It will therefore bid unconditional interest rates which will attract those borrowers that have not received better offers from the incumbent bank. The profit function for the uninformed bank can be written as follows:

$$\pi_u(r) = N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{GD}(p_{GD}r - I)(1 - F_i^{GD}(r)) + N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)) + N_{BD}(p_{BD}r - I)(1 - F_i^{BD}(r)).$$

In equilibrium, each of the banks has to be indifferent between the interest rates that it bids with positive probability – for each type, in the case of the informed bank.

In equilibrium, the uninformed bank will not bid below $\overline{r}$, since otherwise it would make an expected loss. It will randomize over the interval $[\overline{r}, r_{BD}]$.

In order to describe the bidding strategy of the incumbent bank let us take $\overline{r}'$ as defined in detail in the body of the paper (the breakeven rate for the mixed group BN, GD, BD) and $\overline{r}''$ as the break-even interest rate for the group of defaulting borrowers. The informed bank will pick interest rates from the interval $[\overline{r}, \overline{r}']$ for the good-signal, non-defaulting borrowers. Why? Suppose it otherwise bids up to $\overline{r}'^{+\epsilon}$. But then the uninformed bank can offer $\overline{r}'$ in pure strategy, give loans to the mixed group BN, GD, BD, and sometimes to GN and thus make positive profits at the expense of the incumbent. By similar reasoning, the incumbent offers interest rates from the $[\overline{r}', \overline{r}'']$ interval for the bad-signal, non-defaulting borrowers, interest rates from the $[\overline{r}'', r_{BD}]$ for good-signal, defaulting borrowers and just r_{BD} for the bad-signal defaulting borrowers. In a mixed-strategy equilibrium, the banks have to get the same payoff for any interest rate they offer with a positive probability. This allows us to solve for the density functions used by either bank. The profits on good-signal, non-defaulting borrowers have to be constant over the $[\overline{r}, \overline{r}']$ interval:

$$\pi_i^{GN}(r) = N_{GN}(p_{GN}\overline{r} - I)(1 - F_u(r)) = k$$

Evaluating the expression at $\overline{r}$ we get that $k = N_{GN}(p_{GN}\overline{r} - I)$. Therefore the cumulative density function for the uninformed bank over the $[\overline{r}, \overline{r}']$ interval is

$$F_u(r) = 1 - \frac{p_{GN}\overline{r} - I}{p_{GN}r - I}.$$

By a similar reasoning, the profits on non-defaulting bad-signal borrowers are equal to $\pi_i^{BN} = N_{BN}(p_{BN}\overline{r}' - I)(1 - F_u(\overline{r}'))$, where $F_u(\overline{r}') = 1 - \frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r}' - I}$. The density function F_u will be $F_u(r) = 1 - \frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r}' - I}\frac{p_{BN}\overline{r}' - I}{p_{BN}r - I}$ over the $[\overline{r}', \overline{r}'']$ interval.

Profits on the good-signal, defaulting borrowers will be $\pi_i^{GD} = N_{GD}(p_{GD}\overline{r}'' - I)(1 - F_u(\overline{r}''))$, where $F_u(\overline{r}'') = 1 - 1 - \frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r}' - I}\frac{p_{BN}\overline{r}' - I}{p_{BN}\overline{r}'' - I}$. The density function F_u will be $F_u(r) = 1 - \frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r}' - I}\frac{p_{BN}\overline{r}' - I}{p_{BN}\overline{r}'' - I}\frac{p_{GD}\overline{r}'' - I}{p_{GD}r - I}$ for r in $[\overline{r}'', r_{BD})$ and will have an atom at r_{BD}.

The uninformed bank's profits should be constant over the interval $[\overline{r}, r_{BD}]$.

Evaluating the expression for π_u at $\overline{r}$ we get $\pi_u(\overline{r}) = 0$; the uninformed bank makes zero overall profits (see von Thadden (2004) for the details). Remember now that

$$\begin{aligned}\pi_u(\overline{r}) = 0 =& N_{GN}(p_{GN}r - I)(1 - F_i^{GN}(r)) + N_{GD}(p_{GD}r - I)(1 - F_i^{GD}(r)) + \\ &+ N_{BN}(p_{BN}r - I)(1 - F_i^{BN}(r)) + N_{BD}(p_{BD}r - I)(1 - F_i^{BD}(r)).\end{aligned}$$

To get the expression for $F_i^{GN}(r)$, note that $F_i^{GD}(r)$,$F_i^{BN}(r)$,$F_i^{BD}(r)$ are equal to 0 in $[\overline{r}, \overline{r}']$ Thus, in equilibrium, the incumbent bank's strategy for GN is characterized by the following cumulative density function:

$$F_i^{GN}(r) = 1 + \frac{N_{BN}(p_{BN}r - I) + N_{BD}(p_{BD}r - I) + N_{GD}(p_{GD}r - I)}{N_{GN}(p_{GN}r - I)}$$

over the $[\overline{r}, \overline{r}']$ interval for good-signal. Similarly, for non-defaulting borrowers we have,

$$F_i^{BN}(r) = 1 + \frac{N_{BD}(p_{BD}r - I) + N_{GD}(p_{GD}r - I)}{N_{BN}(p_{BN}r - I)}$$

noting that $F_i^{GN}(r) = 1$ and $F_i^{GD}(r) = 0$, $F_i^{BD}(r) = 0$ over the $[\overline{r}', \overline{r}'']$ interval.

Then,

$$F_i^{GD}(r) = 1 + \frac{N_{BD}(p_{BD}r - I)}{N_{GD}(p_{GD}r - I)}$$

over the $[\overline{r''}, r_{BD}]$ interval for good-signal defaulting borrowers. Finally, the informed bank will always bid r_{BD} for the bad-signal, defaulting borrowers.

The informed bank will not want to bid for the good-signal, non-defaulting borrowers above $\overline{r}'$, since profits would be lower in that region. It will also not bid for the bad-signal, nondefaulting borrowers below $\overline{r}'$ or above $\overline{r}''$, since profits are again lower in those regions – and it will also not want to bid for good-signal, defaulting borrowers below $\overline{r}''$. This is because, given the expression for F_u, profits would be increasing (decreasing) in $\overline{r}$ below (above) the region where the bank is bidding for a given type of borrowers.

Summing up, the expected profits of the informed bank in the low-φ case are:

$$\pi_i = N_{GN}(p_{GN}\overline{r} - I) + N_{BN}(p_{BN}\overline{r'} - I)\frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r'} - I} + N_{GD}\frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r'} - I}\frac{p_{BN}\overline{r'} - I}{p_{BN}\overline{r''} - I}$$

$$\pi_i = (p_{GN}\overline{r} - I)\Big(N_{GN} + \frac{p_{BN}\overline{r'} - I}{p_{GN}\overline{r'} - I}\Big(N_{BN} + N_{GD}\frac{p_{GD}\overline{r''} - I}{p_{BN}\overline{r''} - I}\Big)\Big).$$

We plug in step by step the expressions for probabilities and interest rates:

$$p_{GD}\overline{r''} - I = \frac{\lambda(1-\lambda)(p_H - p_L)(1-p_H)(1-p_L)(2\phi - 1)}{(\lambda(1-p_H)\phi + (1-\lambda)(1-p_L)(1-phi))(\lambda p_H(1-p_H) + (1-\lambda)p_L(1-p_L))}$$

$$p_{BN}\overline{r''} - I = \frac{\lambda(1-\lambda)(p_H - p_L)(p_H(1-p_L)(1-\phi) - p_L(1-p_H)\phi)}{(\lambda p_H(1-\phi) + (1-\lambda)p_L\phi)(\lambda p_H(1-p_H) + (1-\lambda)p_L(1-p_L))}$$

$$\frac{p_{GD}\overline{r''} - I}{p_{BN}\overline{r''} - I} = \frac{(1-p_H)(1-p_L)(2\phi - 1)}{p_H(1-p_L)(1-\phi) - p_L(1-p_H)\phi}\frac{\lambda p_H(1-\phi) + (1-\lambda)p_L\phi}{\lambda(1-p_H)\phi + (1-\lambda)(1-p_L)(1-phi)}$$

$$N_{BN} + N_{GD}\frac{p_{GD}\overline{r''} - I}{p_{BN}\overline{r''} - I} = (\lambda p_H(1-\phi) + (1-\lambda)p_L\phi)\Big(1 + \frac{(1-p_H)(1-p_L)(2\phi - 1)}{p_H(1-p_L)(1-\phi) - p_L(1-p_H)\phi}\Big)$$

$$p_{BN}\overline{r'} - I = \frac{\lambda(1-\lambda)(p_H - p_L)(p_H(1-p_L(1-\phi))(1-\phi) - p_L(1-p_H\phi)\phi)}{(\lambda p_H(1-\phi) + (1-\lambda)p_L\phi)(\lambda p_H(1-p_H\phi) + (1-\lambda)p_L(1-p_L(1-\phi)))}$$

$$p_{GN}\overline{r'} - I = \frac{\lambda(1-\lambda)(p_H - p_L)(p_H(1-p_L(1-\phi))\phi - p_L(1-p_H\phi)(1-\phi))}{(\lambda p_H\phi + (1-\lambda)p_L(1-\phi))(\lambda p_H(1-p_H\phi) + (1-\lambda)p_L(1-p_L(1-\phi)))}$$

$$\frac{p_{BN}\overline{r'} - I}{p_{GN}\overline{r'} - I} = \frac{p_H(1-p_L(1-\phi))(1-\phi) - p_L(1-p_H\phi)\phi}{p_H(1-p_L(1-\phi))\phi - p_L(1-p_H\phi)(1-\phi)}\frac{\lambda p_H\phi + (1-\lambda)p_L(1-\phi)}{\lambda p_H(1-\phi) + (1-\lambda)p_L\phi}$$

$$\frac{p_{BN}\overline{r'}-I}{p_{GN}\overline{r'}-I}\Big(N_{BN}+N_{GD}\frac{p_{GD}\overline{r''}-I}{p_{BN}\overline{r''}-I}\Big)=$$
$$\frac{p_H(1-p_L(1-\phi))(1-\phi)-p_L(1-p_H\phi)\phi}{p_H(1-p_L(1-\phi))\phi-p_L(1-p_H\phi)(1-\phi)}(\lambda p_H\phi+$$
$$(1-\lambda)p_L(1-\phi))\Big(1+\frac{(1-p_H)(1-p_L)(2\phi-1)}{p_H(1-p_L)(1-\phi)-p_L(1-p_H)\phi}\Big)$$

$$p_{GN}\overline{r}-I=I\frac{\lambda(1-\lambda)(p_H-p_L)(p_H\phi-p_L(1-\phi))}{(\lambda p_H+(1-\lambda)p_L)(\lambda p_H\phi+(1-\lambda)p_L(1-\phi))}$$

Finally,

$$\pi_i^{\text{low }\phi}=I\frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H(1-\lambda)p_L}(p_H-p_L+(p_Hp_L+(1-p_H)(1-p_L))(2\phi-1))$$

In the case of high monitoring, incumbents make again profits on the three higher-quality types:

$$\pi_i=\pi_1^{GN}+\pi_i^{GD}+\pi_i^{BN}$$

The informed bank will only bid for the good, non-defaulting borrowers over the interval $[\overline{r},\overline{r'}]$. It will bid for good-signal, defaulting borrowers over $[\overline{r'},\overline{r'''}]$, and for bad-signal, non-defaulting borrowers over $[\overline{r'''},r_{BD}]$.

In equilibrium, expected profits have to be constant over each of those segments.

$$N_{GN}(p_{GN}\overline{r}-I)=N_{GN}(p_{GN}r-I)(1-F_u(r))$$

Thus

$$F_u(r)=\frac{p_{GN}\overline{r}-I}{p_{GN}r-I}$$

for any r in $[\overline{r},\overline{r'}]$.

For the next interval, $r\in[\overline{r'},\overline{r'''}]$ we have

$$N_{GD}(p_{GD}\overline{r'} - I)\frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r'} - I} = N_{GD}(p_{GD}r - I)(1 - F_u(r))$$

thus

$$F_u(r) = \frac{p_{GN}\overline{r} - I}{p_{GN}r - I} \times \frac{p_{GD}\overline{r'} - I}{p_{GD}r - I}.$$

For the last interval, $r \in [\overline{r'''}, r_{BD}]$:

$$N_{BN}(p_{BN}\overline{r'''} - I)\frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r'} - I}\frac{p_{GD}\overline{r'} - I}{p_{GD}\overline{r'''} - I} = N_{BN}(p_{BN}r - I)(1 - F_u(r))$$

thus

$$F_u(r) = \frac{p_{GN}\overline{r} - I}{p_{GN}\overline{r'} - I} \times \frac{p_{GD}\overline{r'} - I}{p_{GD}\overline{r'''} - I} \times \frac{p_{BN}\overline{r'''} - I}{p_{BN}r - I}.$$

The expected profits of the informed bank can then be written as:

$$\pi_i = (p_{GN}\overline{r} - I)\Big(N_{GN} + \frac{p_{GD}\overline{r'} - I}{p_{GN}\overline{r'} - I} \times \Big(N_{GD} + N_{BN}\frac{p_{BN}\overline{r'''} - I}{p_{GD}\overline{r'''} - I}\Big)\Big)$$

$$p_{BN}\overline{r'''} - I = I\frac{\lambda(1-\lambda)\phi(1-\phi)(p_H - p_L)^2}{(\lambda p_H(1-\phi) + (1 - lambda)p_L\phi)^2}$$

$$p_{GD}\overline{r'''} - I = I\frac{\lambda(1-\lambda)(p_H - p_L)(\phi^2(1-p_H) - (1-\phi)^2(1-p_L)))}{(\lambda p_H(1-\phi) + (1 - lambda)p_L\phi)(\lambda(1-p_H)\phi + (1-\lambda)(1-p_L)(1-phi))}$$

$$\frac{p_{BN}\overline{r'''} - I}{p_{GD}\overline{r'''} - I} = \frac{\phi(1-\phi)(p_H - p_L)}{\phi^2(1-p_H) - (1-\phi)^2(1-p_L)}\frac{\lambda(1-p_H)\phi + (1-\lambda)(1-p_L)(1-\phi)}{\lambda p_H(1-\phi) + (1 - lambda)p_L\phi}$$

$$N_{BN}\frac{p_{BN}\overline{r'''}-I}{p_{GD}\overline{r'''}-I}=\frac{\phi(1-\phi)(p_H-p_L)}{\phi^2(1-p_H)-(1-\phi)^2(1-p_L)}(\lambda(1-p_H)\phi+(1-\lambda)(1-p_L)(1-\phi))$$

$$\begin{aligned}&N_{GD}+N_{BN}\frac{p_{BN}\overline{r'''}-I}{p_{GD}\overline{r'''}-I}\\&=(\lambda(1-p_H)\phi+(1-\lambda)(1-p_L)(1-\phi))\Big(1+\frac{\phi(1-\phi)(p_H-p_L)}{\phi^2(1-p_H)-(1-\phi)^2(1-p_L}\Big)\end{aligned}$$

$$p_{GD}\overline{r'}-I=I\frac{\lambda(1-\lambda)(p_H-p_L)((1-p_H)(1-p_L(1-\phi))\phi-(1-p_L)(1-p_H\phi)(1-\phi))}{(\lambda(1-p_H)\phi+(1-\lambda)(1-p_L)(1-\phi))(\lambda p_H(1-p_H\phi)+(1-\lambda)p_L(1-p_L(1-\phi)))}$$

$$p_{GN}\overline{r'}-I=I\frac{\lambda(1-\lambda)(p_H-p_L)(p_H(1-p_L(1-\phi))\phi-p_L(1-p_H\phi)(1-\phi))}{(\lambda p_H\phi+(1-\lambda)p_L(1-\phi))(\lambda p_H(1-p_H\phi)+(1-\lambda)p_L(1-p_L(1-\phi)))}$$

$$\frac{p_{GD}\overline{r'}-I}{p_{GN}\overline{r'}-I}=\frac{(1-p_H)\phi^2-(1-p_L)(1-\phi)^2}{p_H\phi-p_L(1-\phi)}\frac{\lambda p_H\phi+(1-\lambda)p_L(1-\phi)}{\lambda(1-p_H)\phi+(1-\lambda)(1-p_L)(1-\phi)}$$

$$\begin{aligned}&\frac{p_{GD}\overline{r'}-I}{p_{GN}\overline{r'}-I}\Big(N_{GD}+N_{BN}\frac{p_{BN}\overline{r'''}-I}{p_{GD}\overline{r'''}-I}\Big)\\&=\frac{\lambda p_H\phi+(1-\lambda)p_L(1-\phi)}{p_H\phi-p_L(1-\phi)}(2\phi-1)((1-p_H)\phi+(1-p_L)(1-\phi))\end{aligned}$$

$$\begin{aligned}&N_{GN}+\frac{p_{GD}\overline{r'}-I}{p_{GN}\overline{r'}-I}\Big(N_{GD}+N_{BN}\frac{p_{BN}\overline{r'''}-I}{p_{GD}\overline{r'''}-I}\Big)\\&=(\lambda p_H\phi+(1-\lambda)p_L(1-\phi))\Big(1+\frac{(2\phi-1)((1-p_H)\phi+(1-p_L)(1-\phi))}{p_H\phi-p_L(1-\phi)}\Big)\end{aligned}$$

$$p_{GN}\overline{r}-I=I\frac{\lambda(1-\lambda)(p_H-p_L)(p_H\phi-p_L(1-\phi))}{(\lambda p_H+(1-\lambda)p_L)(\lambda p_H\phi+(1-\lambda)p_L(1-\phi))}$$

Summing up, we get:

$$\pi_i = I\frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H+(1-\lambda)p_L}(p_H\phi - p_L(1-\phi)+(2\phi-1)((1-p_H)\phi+(1-p_L)(1-\phi)))$$

$$\pi_i = I\frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H+(1-\lambda)p_L}(2\phi-1+2\phi(1-\phi)(p_H-p_L))$$

Proof of proposition 2.7

Suppose for convenience I=1 (or equivalently, think of r as r/I and divide everything by I) $\frac{d\left(F_i^{GN}\right)}{d\phi}$ is now the sum of the following two expressions

$$\frac{\left(\lambda p_H-(1-\lambda)p_L-\left(\lambda p_h^2-(1-\lambda)p_l^2\right)r\right)\left((\lambda\phi p_h^2+(1-\lambda)(1-\phi)p_l^2)r-(\lambda\phi p_H+(1-\lambda)(1-\phi)p_L)\right)}{N_{GN}^2(p_{GN}r-I)^2}+$$
$$+\frac{\left(\left(\lambda p_h^2-(1-\lambda)p_l^2\right)r-(\lambda p_H-(1-\lambda)p_L)\right)\left((\lambda(1-\phi)p_h+(1-\lambda)\phi p_l)-(\lambda(1-\phi)p_H^2+(1-\lambda)\phi p_L^2)r\right)}{N_{GN}^2(p_{GN}r-I)^2}$$

Denote now $y \equiv (\lambda p_H-(1-\lambda)p_L)$, $x \equiv (\lambda p_h^2-(1-\lambda)p_l^2)$, $A \equiv (\lambda\phi p_h^2+(1-\lambda)(1-\phi)p_l^2)$, $a \equiv (\lambda(1-\phi)p_h^2+(1-\lambda)\phi p_l^2)$, $B \equiv (\lambda\phi p_H+(1-\lambda)(1-\phi)p_L)$, $b \equiv (\lambda(1-\phi)p_H+(1-\lambda)\phi p_L)$.

The numerator will now be

$$(y-xr)(Ar-B)+(y-xr)(ar-b) = (xr-y)(B-Ar)+(xr-y)(b-ar)$$

Note first that $b/a = \overline{r}_{BN} \geq r$, since $r \in [\overline{r}_N;\overline{r}_{BN}]$ Now observe that $xr \geq x\overline{r}_N > y$. The last inequality is true since $\frac{x}{p_H} > y$ and $\overline{r}_N > \frac{1}{p_H}$.

Also, when $\phi = 0.5$, it is easy to see that $A = a$, $B = b$, so that at that value $2(xr-y)(b-ar) \geq 0$. Finally, observe that $\frac{\partial b}{\partial\phi} = -y = -\frac{\partial B}{\partial\phi}$, $\frac{\partial a}{\partial\phi} = -x = -\frac{\partial A}{\partial\phi}$. This means that

$\frac{\partial\left((xr-y)(B-Ar)+(xr-y)(b-ar)\right)}{\partial\varphi} = 0$, so that the non-negativity of the numerator is true for all values of φ and therefore $\frac{d\left(F_i^{GN}\right)}{d\phi} \geq 0$.

For defaulters, observe that to get $\frac{d\left(F_i^{GD}\right)}{d\phi} \geq 0$, we need to perform all the steps identically, but denoting

$y \equiv (\lambda(1-p_H)-(1-\lambda)(1-p_L))$, $x \equiv (\lambda p_H(1-p_H))-(1-\lambda)p_L(1-p_L))$, $A \equiv (\lambda\phi p_H(1-p_H)+(1-\lambda)(1-\phi)p_L(1-p_L))$, $a \equiv (\lambda(1-\phi)p_H(1-p_H)+(1-\lambda)\phi p_L(1-p_L))$, $B \equiv (\lambda\phi(1-p_H)+(1-\lambda)(1-\phi)(1-p_L))$, and that as before, $xr \geq x\overline{r}_N > y$.

For the outsiders we have to show that

$$\frac{d\big(1-F_u^N)\big)}{d\phi} = -\frac{d\big(F_u^N)\big)}{d\phi} < 0$$

$$\frac{d\big(1-F_u^D)\big)}{d\phi} = -\frac{d\big(F_u^D)\big)}{d\phi} > 0$$

To see this, let's first show that

$$\frac{\partial p_{GN}}{\partial \varphi} > 0$$

$$\frac{\partial p_{GN}}{\partial \varphi} = \frac{(\lambda p_H^2 - (1-\lambda)p_L^2)\big(\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L\big)}{N_{GN}^2} -$$

$$- \frac{\big(\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2\big)(\lambda p_H - (1-\lambda)p_L)}{N_{GN}^2}$$

The numerator is equal to
$\lambda p_H^2(1-\lambda)(1-\varphi)p_L - \lambda p_H(1-\lambda)\varphi p_L^2 + \lambda p_H^2(1-\lambda)\varphi p_L - \lambda p_H(1-\lambda)(1-\varphi)p_L^2$.
Summing over φ,

$$\frac{\partial p_{GN}}{\partial \varphi} = \frac{\lambda(1-\lambda)p_H p_L(p_H - p_L)}{N_{GN}^2} = z_n > 0$$

This is intuitive: the updated probability of a good signal borrower should increase with the good signal precision.

By way of analogy, for history D, $\frac{\partial p_{GD}}{\partial \varphi}$ is calculated analogically: (observe the difference between the expressions for p_{GD} and p_{GN}:p_H is replaced by $1-p_H$ p_H^2 is replaced by $p_H(1-p_H)$, p_L is replaced by $1-p_L$).

$$\frac{\partial p_{GD}}{\partial \varphi} = \frac{\lambda(1-\lambda)(1-p_H)(1-p_L)(p_H - p_L)}{N_{GN}^2} = z_d < 0$$

For outside bank, note

$$\frac{\partial F_u^N}{\partial \varphi} = -\frac{z_n \overline{r}_N (p_{GN} r - I) - r z_n (p_{GN} \overline{r}_N - I)}{(p_{GN} r - I)^2} = \frac{z_n \overline{r}_N I - r z_n I}{(p_{GN} r - I)^2} \leq 0$$

since $\overline{r}_N \leq r$ on where F_u^N is defined $[\overline{r}_N : \overline{r}_{BN}]$.

For D the proof is analogical with $z_d < 0$ instead of $z_n > 0$.

Proof of Proposition 2.8

We first prove for the BN group of borrowers. The switching probability is given by

$$\frac{d}{d\phi} \int_{\overline{r}_N}^{\overline{r}_{BN}} (1 - F_i^{GN}(r)) f_u^N(r) dr$$

where $f_u^N = \frac{\partial (1 - \frac{p_{GN} \overline{r}_N - I}{p_{GN} r - I})}{\partial r} = \frac{p_{GN}(p_{GN} \overline{r}_N - I)}{(p_{GN} r - I)^2}$ is the pdf of the uninformed bank's bidding distribution. We can calculate its sensitivity to ϕ using Leibnitz's formula. Thus the derivative of the integral

$$\frac{d}{d\varphi} \int_{\overline{r}_N}^{\overline{r}_{BN}} (1 - F_i^{GN}(r)) f_u^{GN}(r) dr$$

is equal to

$$(1 - F_i^{GN}(r_{BN})) f_u^N(r_{BN}) \frac{d\overline{r}_{BN}}{d\phi} - (1 - F_i^{GN}(r_N)) f_u^N(\phi, r_N) \frac{dr_N}{d\varphi} +$$

$$+ \int_{\overline{r}_N}^{\overline{r}_{BN}} \frac{d\big((1 - F_i^{GN}) f_u^{GN}\big)}{d\varphi} dr$$

Note that

$$(1 - F_i^{GN}(\overline{r}_{BN})) = 0$$

since the informed bank never bids above r_{BN}, and that

$$\frac{\partial \overline{r}_N}{d\varphi} = 0$$

since $\overline{r}_N$ does not depend on φ.

Note now that

$$\int_{\overline{r_N}}^{r_{BN}} \frac{d\big((1-F_i^{GN})f_u^{GN}\big)}{d\phi}dr = \int_{\overline{r_N}}^{r_{BN}} \frac{d\big(1-F_i^{GN})\big)}{d\phi}f_u^{GN}dr + \int_{\overline{r_N}}^{r_{BN}} (1-F_i^{GN})\frac{d\big(f_u^{GN}\big)}{d\phi}dr$$

For the first one, note

$$\frac{d\big(1-F_i^{GN})\big)}{d\phi} = -\frac{d\big(F_i^{GN})\big)}{d\phi}$$

We know from proposition 2.4 that $\frac{d\left(F_i^{GN})\right)}{d\phi} \geq 0$ (as well as $\frac{d\left(F_i^{GD})\right)}{d\phi} \geq 0$).

Now we need to show $\frac{d\left(f_u^{GN}\right)}{d\phi} < 0$.

Remembering that

$$\frac{\partial p_{GN}}{\partial \varphi} = \frac{\lambda(1-\lambda)p_H p_L(p_H - p_L)}{N_{GN}^2} = z_n > 0$$

and noting that

$$\frac{\partial f_u^{GN}}{\partial \varphi} = \frac{\big(z_n(p_{GN}\overline{r}_N - I) + p_{GN}z_n\overline{r}\big)(p_{GN}r - I)^2 - 2p_{GN}(p_{GN}\overline{r} - I)(p_{GN}r - I)z_n r}{(p_{GN}r - I)^2}$$

$$\frac{\partial f_u^{GN}}{\partial p_G N} = (p_{GN}r - I)(-z_n I p_{GN}r + z_n I^2 - r p_{GN}^2 \overline{r} z r - 2p_{GN}^2 I z_n) < 0$$

since $p_{GN}r > I$

Also $\frac{\partial f_u^{GD}}{\partial p_G D}$ is shown identically to be less than 0, since

$$\frac{\partial p_{GD}}{\partial \varphi} = \frac{\lambda(1-\lambda)(1-p_H)(1-p_L)(p_H - p_L)}{N_{GN}^2} = z_d < 0$$

As a final step, note that the role of φ is replaced every by that of $1-\varphi$ for the bad signal expressions.

Proof of Proposition 2.9

Remember that based on our definitions of the priors

$$
\begin{aligned}
N_{GN} &= \lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L \\
N_{GD} &= \lambda\varphi(1-p_H) + (1-\lambda)(1-\varphi)(1-p_L) \\
N_{BN} &= \lambda(1-\varphi)p_H + (1-\lambda)\varphi p_L \\
N_{BD} &= \lambda(1-\varphi)(1-p_H) + (1-\lambda)\varphi(1-p_L) \\
p_{GN} &= \frac{\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2}{\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L} \\
p_{BN} &= \frac{\lambda(1-\varphi)p_H^2 + (1-\lambda)\varphi p_L^2}{\lambda(1-\varphi)p_H + (1-\lambda)\varphi p_L} \\
p_{BD} &= \frac{\lambda(1-\varphi)p_H(1-p_H) + (1-\lambda)\varphi p_L(1-p_L)}{\lambda(1-\varphi)(1-p_H) + (1-\lambda)\varphi(1-p_L)} \\
p_{GD} &= \frac{\lambda\varphi p_H(1-p_H) + (1-\lambda)(1-\varphi)p_L(1-p_L)}{\lambda\varphi(1-p_H) + (1-\lambda)(1-\varphi)(1-p_L)} \\
N_N &= \lambda p_H + (1-\lambda)p_L \\
p_N &= \frac{\lambda p_H^2 + (1-\lambda)p_L^2}{\lambda p_H + (1-\lambda)p_L} \\
N_D &= \lambda(1-p_H) + (1-\lambda)(1-p_L) \\
p_D &= \frac{\lambda p_H(1-p_H) + (1-\lambda)p_L(1-p_L)}{\lambda(1-p_H) + (1-\lambda)(1-p_L)}.
\end{aligned}
$$

and that respective interest rate is $\overline{r}_{JK} = \frac{I}{p_{JK}}$. we first look at the incumbent's profits.

Under information sharing

We know that the total profits of the incumbent bank are given by:

$$\pi_{share} = N_{GN}(p_{GN}\overline{r}_N - I) + N_{GD}(p_{GD}\overline{r}_D - I)$$

where N_{GN} is the number of successful good-signal borrowers, N_{GD} is the number of defaulting good-signal borrowers, p_{GN} is the success probability of good-signal borrowers that have not defaulted and so on.

Plugging in the expressions for probabilities and interest rates we get the following expression for the second-period profits with information sharing:

Assuming $I = 1$ (same as to divide everything by I and assuming r is now what r/I as defined earlier), we get

$$N_{GN}(p_{GN}\overline{r}_N - I) = \left(\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2\right)\overline{r}_N - \left(\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L\right)$$

since

$$N_{GN}p_{GN} = \frac{\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2}{\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L} = N_{GN}\frac{\lambda\varphi p_H^2 + (1-\lambda)(1-\varphi)p_L^2}{N_{GN}}$$

Now,

$$N_{GN}(p_{GN}\overline{r}_N - I) = \frac{2\lambda(1-\lambda)p_H p_L(p_H - p_L)(2\varphi - 1)}{\lambda p_H^2 + (1-\lambda)p_L^2}$$

On the defaulting borrowers, note the similarity with non-defaulters since we will usually use this technique: a close look will reveal that p_H are changed by $(1-p_H)$, p_L by $(1-p_L)$, p_H^2 by $p_H(1-p_H)$, p_L^2 are changed by $p_L(1-p_L)$.

Indeed,

$$N_{GD}p_{GD} = \frac{\lambda\varphi p_H(1-p_H) + (1-\lambda)(1-\varphi)p_L(1-p_L)}{\lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L} =$$

$$= N_{GD}\frac{\lambda\varphi p_H(1-p_H) + (1-\lambda)(1-\varphi)p_L(1-p_L)}{N_{GD}}$$

and that

$$N_{GN} = \lambda\varphi p_H + (1-\lambda)(1-\varphi)p_L$$
$$N_{GD} = \lambda\varphi(1-p_H) + (1-\lambda)(1-\varphi)(1-p_L)$$

That is, by analogy

$$N_{GD}(p_{GD}\overline{r}_D - I) = \frac{2\lambda(1-\lambda)(1-p_H)(1-p_L)(p_H - p_L)(2\varphi - 1)}{\lambda p_H(1-p_H) + (1-\lambda)p_L(1-p_L)}$$

Therefore the sum of the two

$$\pi_{share} = \lambda(1-\lambda)(2\varphi-1)(p_H-p_L)\Big[\frac{p_L p_H}{\lambda p_H^2+(1-\lambda)p_L^2}+\frac{(1-p_L)(1-p_H)}{\lambda p_H(1-p_H)+(1-\lambda)p_L(1-p_L)}\Big].$$

No information sharing

Plugging in the expressions for probabilities and interest rates, and going through a series of algebraic simplifications, we get the following expression for the second-period profits with information sharing:

$$\pi_{share} = \lambda(1-\lambda)(2\varphi-1)(p_H-p_L)\Big[\frac{p_L p_H}{\lambda p_H^2+(1-\lambda)p_L^2}+\frac{(1-p_L)(1-p_H)}{\lambda p_H(1-p_H)+(1-\lambda)p_L(1-p_L)}\Big].$$

and the gross profits without information sharing,

$$\pi_i = \frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H+(1-\lambda)p_L}(\varphi(2(1-p_H)(1-p_L)+2p_L p_H)+2p_H-2p_H p_L-1)$$

We have two linear, increasing functions of φ. It can be shown that the slope in the case of information sharing is higher than in the case when default information is private information for each bank.

The slope in the case of information sharing is

$$\frac{\partial \pi^{share}}{\varphi} \equiv S_{share} = 2\lambda(1-\lambda)(p_H-p_L)\Big[\frac{p_L p_H}{\lambda p_H^2+(1-\lambda)p_L^2}+\frac{(1-p_L)(1-p_H)}{\lambda p_H(1-p_H)+(1-\lambda)p_L(1-p_L)}\Big]$$

while without a credit bureau it is

$$S_i = \frac{\lambda(1-\lambda)(p_H-p_L)}{\lambda p_H+(1-\lambda)p_L}(2(1-p_H)(1-p_L)+2p_L p_H).$$

$S_{share} > S_i$ is then equivalent to

$$(\lambda p_H^2+(1-\lambda)p_L^2)^2(1-p_L)(1-p_H)+(\lambda p_H(1-p_H)+(1-\lambda)p_L(1-p_L))^2 p_H p_L > 0,$$

which is obviously true.

The intuition is that under information sharing, the outside bank knows about the non-defaulters good payment history and is able to offer them interest rates in as low region, as $[\overline{r}_N;\overline{r}_{BN}]$, while the same borrowers can be offered $\overline{r}$ at the lowest, and competition requires that the incumbent not bid lower. This can

be seen by comparing the first terms in each expression: the denominator for the case no sharing is rather low, $\lambda p_H + (1-\lambda)p_L$, which exactly the $\overline{r}$ being high, compared to $\overline{r}_N$, which is the rate the outsider can afford. For the insider therefore, there is quite a bit to win by gaining some soft information - to move up fast, while it cannot move as fast when the success history is observed by outsiders, and therefore he can safely begin already at the high $\overline{r}$.

Writing now the net profits for each case we get

$$\pi^{net}_{share} = S_{share}\varphi + k_{share} - c(\varphi - 0.5)^2$$

and

$$\pi^{net}_{i} = S_{i}\varphi + k_{i} - c(\varphi - 0.5)^2,$$

where k represents constant terms. The optimal φ will be equal to $\frac{S_{share}}{c}$ in the first case and $\frac{S_i}{c}$ in the second. Thus the banks will choose higher monitoring when default information is shared.

The relationship also holds in the case of constant marginal costs of information, when it is possible that the banks choose "no monitoring" when default information is not shared and "full monitoring" when information is shared.

Proof of Proposition 2.10

Net profits with information sharing:

$$\phi_i^{sharing} =$$

$$= \lambda(1-\lambda)(p_H - p_L)(2\phi - 1)I\Big(\frac{p_H p_L}{\lambda p_H^2 + (1-\lambda)p_L^2} + \frac{(1-p_H)(1-p_L)}{\lambda p_H(1-pH) + (1-\lambda)p_L(1-p_L)}\Big) - c\Big(\phi -$$

Optimal monitoring increases when asymmetric information increases:

$$\frac{\partial \phi}{\partial(\lambda(1-\lambda))} > 0$$

$$\frac{f(\lambda(1-\lambda))}{g(\lambda(1-\lambda))} =$$

$$= \frac{\lambda^2(1-\lambda)p_H^2(1-p_H) + \lambda(1-\lambda)^2 p_L^2(1-p_L)}{\lambda^2 p_H^3(1-p_H) + \lambda(1-\lambda)p_H^2 p_L(1-p_L) + \lambda(1-\lambda)p_H p_L^2(1-p_H) + (1-\lambda)^2 p_L^3(1-p_L)}$$

$$\frac{\partial f}{\partial(\lambda(1-\lambda))} =$$
$$=\lambda p_H^2(1-p_H)+(1-\lambda)p_L^2(1-p_L)+\lambda(1-\lambda)(1-2\lambda)p_H^2(1-p_H)-\lambda(1-\lambda)(1-2\lambda)p_L^2(1-p_L)$$

$$\frac{\partial g}{\partial(\lambda(1-\lambda))} =2\lambda(1-2\lambda)p_H^3(1-p_H)-2(1-\lambda)(1-2\lambda)p_L^3(1-p_L)+$$
$$(1-2\lambda)^2p_H^2p_L(1-p_L)+(1-2\lambda)^2p_Hp_L^2(1-p_H)$$

It can then be verified that

$$p_H^5(1-p_L)^2\lambda^3(1-(1-\lambda)(1-2\lambda))+p_L^5(1-p_L)^2(1-\lambda)^3(1+\lambda(1-2\lambda))+$$
$$p_H^4(1-p_H)p_L(1-p_L)\lambda^2(1-\lambda)(1+(1-\lambda)(1-2\lambda)-(1-2\lambda)^2)+$$
$$p_H(1-p_H)p_L^4(1-p_L)\lambda(1-\lambda)^2(1-\lambda(1-2\lambda)-(1-2\lambda)^2)+$$
$$p_H^3(1-p_H)^2p_L^2\lambda^2(1-\lambda)(1+(1-\lambda)(1-2\lambda)-(1-2\lambda)^2))+$$
$$p_H^2(1-p_H)p_L^3(1-p_L)\lambda(1-\lambda)^2(1+(1-\lambda)(1-2\lambda)+2\lambda(1-2\lambda))+$$
$$p_H^3(1-p_H)p_L^2(1-p_L)\lambda^2(1-\lambda)(1-\lambda(1-2\lambda)-2(1-\lambda)(1-2\lambda))+$$
$$p_H^2p_L^3(1-p_L)^2\lambda(1-\lambda)^2(1-\lambda(1-2\lambda)-(1-2\lambda)^2)>0$$

2 Appendix B

2.1 Dependent Variables

Source: BEEPS 2002 survey, except where other source is mentioned.

Stay. Definition: Dummy variable that takes value 1 if the firm has answered "no" to the question in the survey, 'Has your firm changed its main bank (the single bank with which your firm has the closest relationship) since 1998?'. Possible answers include "yes", "no", "no main bank". (8 percent of the firms report that they have no main bank, and we exclude those firms, this leaves us with a sample of 5209 firms).

React. Definition based on answer to the question: "Now I would like to ask you a hypothetical question. If your firm were to fall behind in its bank repayments, which of the following would best describe how you would expect the bank to react?" Possible answers include: 1. Extend the term of the loan without changing the conditions(=3) 2. Extend the term of the loan but increase the interest rate (=2) 3. Begin legal proceedings to take possession of some assets of the firm(=1).

Days. Definition:"How many days did it take to agree the loan with the bank from the date of application?" The mean is 25 while standard deviation is 37. The output is the robust OLS measure (we also do Poisson regressions, where we have high significance in all columns).

Checking Account Definition: Dummy variable that takes value 1 if the firm has answered "yes" to the question in the survey,"Does your establishment have a checking or saving account".(source BEEPS 2005)

Caccess. Definition: Caccess measures access to finance; higher values indicate higher access to finance. It equals 4, if access is reported to be of no obstacle, 3=moderate obstacle, 2= Minor obstacle, 1=No obstacle.

Ccost. Definition: Ccost is cost of finance; higher values indicate higher cost of financing. It equals 4, if cost of finance is reported to be of no obstacle, 3=moderate obstacle, 2= Minor obstacle, 1=No obstacle.

2.2 Firm Level

Source: BEEPS 2002 survey.

Soft. *Soft* measures how protected the borrower is from different *non-financial* factors. It summarizes answers to 19 questions on non financial problems of growth. The exact question in the survey asks: *Can you tell me how problematic are these factors for the operation and growth of your business?*. The factors include skills of workers, their education, contract violations by customers and suppliers, among others. Each of the questions is answered on a scale from 1-to 4, where higher values stand for less obstacles (4=no obstacle, 1=major obstacle). We take the sum of the 19 questions, and divide by 4*19. Thus, the variable ranges from 0.25 to 1, where a value of 1 indicates that the received soft signals about the quality of the borrower, have all been good/favorable (19 answers "no obstacle"). We then take 1 - the value of the variable, so that higher values mean less problems.

Management quality adds: 1 point if the manager has prior experience in the company, 1 point if the manager is older than 40, 1 point if the manager has higher education.

Small firm. Definition: Dummy Variable that takes value 1 if total number of full-time employees is less then 50. Source: s4a2.

Large (and medium) firm. Definition: Sample of firms that are not small Source: s4a2.

Transition firm. Definition: Firm was established in the years 19891993. Source: s1a.

Post-transition firm. Definition: Firm was established after 1993. Source: s1a.

State-owned firm. Definition: State controlled firm (yes/no). Source: s2b.

Privatized firm. Definition: privatized firm (yes/no). Source: q9aa.

Sector. Definition: Mining, Construction, Manufacturing transport and communication, Wholesale, retail and repairs, Real estate, renting and business

service, Hotels and restaurants, Others. Source: q2.

2.3 Country Level

Source: Brown et al. (2007).

Information sharing. For each year between 1996 and 2004 we compute an index for private credit bureaus and one for public credit registers: 1 point if it exists for more than 3 years; 1 point if individuals and firms are covered; 1 point if positive and negative data are collected; 1 point if PCR/PCB distributes data which is at least 2 years old; 1 point if threshold loan is below per capita GDP. We then take the maximum of the index for credit bureaus and public credit registers. We use 19961999 values for the 2002 BEEPS, and 20012003 value for the 2005 BEEPS.

Creditor rights. We use the index of creditor rights based on methodology of La Porta et al. (1998). A score of one is assigned when each of the following rights of secured lenders are defined in laws and regulations. First, there are restrictions, such as creditor consent or minimum dividends, for a debtor to file for reorganization. Second, secured creditors are able to seize their collateral after the reorganization petition is approved. Third, secured creditors are paid first out of the proceeds of liquidating a bankrupt firm. Fourth, if management does not retain administration of its property pending the resolution of the reorganization. We use 19962000 values for the 2002 BEEPS, and 20012003 value for the 2005 BEEPS.

Time to enforce payment. Definition: The time taken to resolve a dispute in which a debtor defaults on a payment equal to 50% of a countrys per capita GDP. The indicator measures the (log of the) number of days from the moment the plaintiff files the lawsuit in court until the moment of actual payment. We use 2005 value for both surveys, because earlier values are not available.

Foreign bank assets. Definition: The share of banking sector assets controlled by banks with a majority (at least 50%) foreign ownership. We use 19962000 values for the 2002 BEEPS, and 2001 2003 value for the 2005 BEEPS.

Av. GDP. Definition: Log of per capita GDP in thousands of US dollars. We use 19962000 values for the 2002 BEEPS, and 20012003 value for the 2005 BEEPS.

Inflation. Definition: average annual growth rate of consumer price index (CPI). We use 1996 2000 values for the 2002 BEEPS, and 20012003 value for the 2005 BEEPS.

Bank concentration. The fraction of deposits held by the five largest banks: Source Barth et al 2001.

NPL. Share of non-performing loans in total loans: Source, EBRD transition Report.

Bank reform index. A score of 1 represents little change from a socialist banking system apart from the separation of the central bank and commercial banks, while a score of 2 means that a country has established internal currency convertibility and has liberalized significantly both interest rates and credit allocation. A score of 3 means that a country has achieved substantial progress in developing the capacity for effective prudential regulation and supervision, including procedures for the resolution of bank insolvencies, and in establishing hardened budget constraints on banks by eliminating preferential access to concessionary refinancing from the central bank. A score of 4+ represents a level of reform that approximates the institutional standards and norms of an industrialized market economy. Source, EBRD transition Report.

Table 1: Means of key variables by country.

Detailed explanations of variables are given in the Variables Section of the Appendix. *No Switching* is a binary indicator of not having changed the main bank since 1998. *Days* is the number of days the bank needed to approve the loan of the borrower. *React* is an ordinal score (1 to 4), higher values indicate more lenient reaction by the bank to a borrower's failure of payment. *Caccess* is cost of access (from 1 to 4) and *ccost* stands for capital cost (from 1 to 4); higher values indicate higher cost of and access to financing. *Ch. Account* is an indicator for having a checking account. *Soft signal* is a score indicating soft information about non-financial problems of growth.

country	Mean						
	No Switching	Days	React	Caccess	Ccost	Ch. Account	Soft Signal
Albania	0.74	53.94	3.02	2.07	2.59	0.96	8.29
Armenia	0.78	24.91	2.90	2.34	2.52	0.79	11.29
Azerbaijan	0.74	21.66	2.17	2.16	2.20	0.82	12.90
Belarus	0.74	18.91	2.92	2.47	2.78	0.84	9.75
Bosnia	0.72	36.75	3.00	2.52	2.79	0.07	10.01
Bulgaria	0.70	43.69	2.97	2.80	2.88	0.93	10.17
Croatia	0.71	38.39	2.70	2.18	2.27	0.21	11.16
Czech Rep	0.88	43.22	3.03	2.45	2.53	0.99	10.68
Estonia	0.93	12.63	2.27	1.94	2.01	0.97	11.05
Georgia	0.64	23.88	2.90	2.21	2.53	0.66	9.57
Hungary	0.80	27.96	2.87	2.22	2.31	0.99	11.76
Kazakhstan	0.77	21.18	2.64	2.00	2.16	0.88	11.99
Kyrgyzstan	0.58	13.78	2.67	2.24	2.40	0.82	11.15
Latvia	0.80	17.95	2.45	1.85	2.01	0.97	10.86
Lithuania	0.77	23.63	2.54	1.62	1.99	0.99	10.61
Macedonia	0.77	33.21	2.53	2.08	2.38	0.10	10.77
Moldova	0.87	13.16	2.71	2.49	2.95	0.65	9.15
Poland	0.76	24.46	2.56	2.65	3.17	0.93	9.02
Romania	0.74	21.36	3.04	2.55	2.80	0.98	9.63
Russia	0.68	14.94	2.55	2.31	2.24	0.92	10.59
Serbia	0.56	14.30	2.67	2.43	2.78	0.09	10.43
Slovak Rep	0.75	63.22	2.95	2.50	2.58	0.99	10.04
Slovenia	0.66	24.85	2.77	1.82	2.20	1.00	12.22
Ukraine	0.69	14.79	2.77	2.44	2.62	0.94	10.08
Total	0.74	25.61	2.74	2.31	2.53	0.82	10.46

Source: BEEPS 2002, except variable checking which is BEEPS 2005.

Table 2: Means of Macro-level variables by country

Information is an average information sharing index taken from Brown et al 2007, over the years 1996-2000: the index adds 1 point if PCR/PB exists for more than 3 years; 1 point if individuals and firms are covered; 1 point if positive and negative data are collected; 1 point if PCR/PCB distributes data which is at least 2 years old; 1 point if threshold loan is below per capita GDP. *Foreign Bank* is the share of banking sector assets controlled by banks with a majority foreign ownership, taken over 1996-2000 , *Av. GDP* is the average per capita GDP during 1996-2000, *Creditor Rights* is the creditor rights index based on methodology of La Porta et al (1998),*CR* is the banking concentration ratio measuring the asset share of the largest five banks, and *NPL* is the share of non-performing loans in total loans.

country	Mean						
	Information	Foreign Bank	Av. GDP	Inflation	Creditor Rights	CR	NPL
Albania	0.00	27.10	1.20	0.10	3.00	86.70	3.75
Armenia	0.00	44.90	0.60	-0.80	2.00	54.60	1.97
Azerbaijan	0.00	4.40	0.60	1.80	3.00	71.90	2.67
Belarus	0.00	3.60	0.80	168.60	2.00	81.10	2.72
Bosnia	0.00	12.70	1.20	1.90	3.00	56.00	2.63
Bulgaria	0.80	59.10	1.60	10.30	1.50	56.50	2.39
Croatia	0.00	62.20	4.20	5.30	3.00	66.50	2.99
Czech Rep	0.00	51.90	5.50	3.90	3.00	69.00	3.68
Estonia	4.00	93.60	4.00	4.00	3.00	98.90	0.26
Georgia	0.00	16.80	0.70	4.10	2.00	57.30	1.97
Hungary	3.80	64.50	4.50	9.80	1.00	62.50	1.13
Kazakhstan	3.60	19.80	1.20	18.70	3.00	70.20	0.74
Kyrgyzstan	0.00	20.60	0.30	13.20	3.00	51.40	2.79
Latvia	0.00	74.20	3.20	2.70	3.00	66.20	1.61
Lithuania	4.60	45.90	3.30	1.00	2.00	87.90	2.38
Macedonia	2.00	32.50	1.80	6.60	3.00	72.10	3.84
Moldova	0.00	37.10	0.30	31.30	2.00	71.00	3.03
Poland	0.00	61.00	4.50	10.10	1.00	57.40	2.82
Romania	0.60	45.20	1.40	45.70	2.00	65.20	1.34
Russia	0.00	10.10	1.80	20.80	1.00	42.80	2.78
Serbia	0.00	0.50	1.00	8.80	3.00	42.40	3.33
Slovak Rep	1.20	33.40	3.70	60.40	2.00	66.50	3.27
Slovenia	2.80	10.10	9.50	12.00	2.00	69.00	2.23
Ukraine	0.00	10.80	0.60	28.20	2.00	37.00	3.48
Total	0.85	33.95	2.42	21.05	2.14	61.83	2.55

Source: BEEPS 2002.

Table 3: Cross-section estimation results (Ordered-probit): Dependent variable *React*.

React shows banks' reaction as perceived by borrowers. it is based on the hypothetical question, "If your firm were to fall behind in its bank repayments, which of the following would best describe how you would expect the bank to react?" Possible answers include: a). Extend the term of the loan without changing the conditions(=3) b). Extend the term of the loan but increase the interest rate (=2) c). Begin legal proceedings to take possession of some assets of the firm(=1).Regressions are ordered probit. The first row is the total sample,the second row is the sample for small firms, the third one is the sample for large firms. Stars *, **, ***,indicate significance, at 10, 5, 1 percent respectively

variable	(1)	(2)	(3)
	All	Small	Large
information	0.087***	0.146***	0.016
	(0.030)	(0.043)	(0.042)
concentration	0.248	0.457	0.289
	(0.299)	(0.401)	(0.459)
non-performing loan	0.013	0.072	-0.057
	(0.042)	(0.059)	(0.061)
creditor rights*contract enforcement	-0.046*	-0.087**	-0.020
	(0.026)	(0.036)	(0.038)
foreign bank	0.991***	1.397***	0.406
	(0.210)	(0.282)	(0.332)
bank reform index	-0.496***	-0.688***	-0.287**
	(0.086)	(0.121)	(0.125)
debt/asset	0.035	-0.064	0.048
	(0.115)	(0.170)	(0.160)
post-transition	-0.122*	-0.220	0.018
	(0.069)	(0.141)	(0.087)
transition	-0.064	-0.130	-0.002
	(0.075)	(0.146)	(0.097)
state owned	0.078	-0.048	0.051
	(0.090)	(0.199)	(0.105)
GDP per capita	0.078*	0.074	0.093
	(0.047)	(0.063)	(0.073)
inflation	-0.417***	-0.444***	-0.447***
	(0.096)	(0.136)	(0.137)
Number of obs.	2000	1076	924
Pseudo R2	0.01	0.02	0.01

Table 4: Cross-section estimation results (probit): Dependent variable *checking account.*

Checking account indicates the existence of checking account for the borrower. The first row is the total sample,the second row is the sample for small firms, the third one is the sample for large firms. The forth column includes an interaction term.Stars *, **, ***,indicate significance, at 10, 5 ,1 percent respectively

variable	(1) All	(2) Small	(3) Large
information	0.287***	0.262***	0.402***
	(0.019)	(0.022)	(0.045)
concentration	-3.098***	-2.683***	-5.401***
	(0.181)	(0.204)	(0.484)
non-performing loan	-4.204***	-3.783***	-6.961***
	(0.284)	(0.314)	(0.837)
creditor right*contract enforcement	0.098***	0.095***	0.115***
	(0.009)	(0.010)	(0.022)
foreign bank	-0.882***	-0.745***	-1.638***
	(0.160)	(0.180)	(0.406)
bank reform index	-0.210**	-0.144	-0.627**
	(0.103)	(0.117)	(0.244)
post-transition	-0.063	-0.071	0.196*
	(0.055)	(0.069)	(0.114)
transition	0.058	0.012	0.248**
	(0.058)	(0.072)	(0.113)
state owned	0.077	-0.040	-0.003
	(0.081)	(0.125)	(0.120)
GDP per capita	0.503***	0.490***	0.736***
	(0.045)	(0.052)	(0.102)
inflation	-0.230	0.077	-2.300**
	(0.459)	(0.526)	(1.041)
Const.	3.119***	2.399***	6.260***
	(0.346)	(0.426)	(0.827)
Number of obs.	7513	5331	2182
Pseudo R-Squared	0.17	0.16	0.26

Table 5: Cross-section estimation results(probit): Dependent variable *Switching* from the main bank.

Switching is the dependent variable. It is a dummy that equals 1 if the firm replies yes to the following question: *Has your firm changed its main bank (the single bank with which your firm has the closest relationship) since 1998?*. Information is an index - depth of (hard)information shared by a credit register/bureau: it is 0 for countries with no sharing. *Soft* is a summary measure for soft/proprietary information that is not shared by credit bureaus. It includes answers to questions regarding 19 nonfinancial problems.It shows how protected the borrower is from factors that may hinder operation and growth of business. Higher values of *soft* indicate *better* soft information. Sector dummies not reported. The first column is the baseline regression on total sample. The second column includes a third interaction term to see if small firms get larger impact as soft information improve. In both columns, all interactions are statistically significant. The third column is the regression of all firms above the median value of the soft-signal variable. The forth one is all the sample, but for values of the soft information variable that are below or equal to its median. Standard variations are clustered by country. The fifth and sixth column repeat the first two columns for *management quality*(manager experience, skills, education, age). Stars *, **, ***,indicate significance, at 10, 5 , 1 percent respectively.

variable	(1)All	(2)All	(3) Good	(4) Bad	(5)All M	(6)All M
information	0.165***	0.157***	-0.020	0.080**	0.073*	0.083**
	(0.060)	(0.060)	(0.034)	(0.035)	(0.039)	(0.039)
information*soft	-0.232**	-0.197*				
	(0.097)	(0.104)				
inform*soft*small		-0.112**				
		(0.049)				
concentration	-0.459*	-0.448*	-0.350	-0.713**	-0.248	-0.226
	(0.257)	(0.258)	(0.433)	(0.335)	(0.216)	(0.216)
non-performing loan	-0.258	-0.268	-1.034***	0.257	-0.231	-0.243
	(0.232)	(0.232)	(0.381)	(0.310)	(0.192)	(0.192)
creditor right*enforcing contract	-0.066***	-0.066***	-0.064	-0.044	-0.066***	-0.068***
	(0.025)	(0.025)	(0.041)	(0.033)	(0.021)	(0.021)
foreign bank	-0.360*	-0.385**	-0.477*	-0.198	-0.406**	-0.429***
	(0.187)	(0.187)	(0.253)	(0.290)	(0.163)	(0.164)
bank reform index	-0.148*	-0.143*	-0.101	-0.204*	-0.111*	-0.107*
	(0.076)	(0.076)	(0.112)	(0.107)	(0.063)	(0.063)
debt/asset	0.213*	0.188	0.383**	0.072	0.249**	0.221**
	(0.122)	(0.122)	(0.190)	(0.159)	(0.102)	(0.103)
post-transition	-0.159**	-0.147**	-0.133	-0.197**	-0.207***	-0.195***
	(0.064)	(0.065)	(0.095)	(0.089)	(0.055)	(0.055)
transition	-0.090	-0.082	-0.069	-0.122	-0.164***	-0.152**
	(0.072)	(0.072)	(0.106)	(0.099)	(0.061)	(0.061)
state own	-0.118	-0.128	-0.064	-0.170	-0.126*	-0.132**
	(0.078)	(0.078)	(0.105)	(0.118)	(0.066)	(0.066)
GDP per capita	0.012	0.015	0.035	0.021	-0.007	-0.007
	(0.044)	(0.044)	(0.068)	(0.058)	(0.036)	(0.036)
inflation	-0.204**	-0.206**	-0.128	-0.225**	-0.132*	-0.137*
	(0.087)	(0.087)	(0.140)	(0.114)	(0.072)	(0.072)
inform*managament					-0.021*	-0.008
					(0.012)	(0.013)
inform*management*small						-0.029***
						(0.008)
Number of obs.	3668	3668	1726	1942	5144	5144
Pseudo R2	0.03	0.03	0.04	0.03	0.03	0.03

Table 6: Cross-section estimation results (Ordered probit): Dependent variable *Cost of capital*.

Cost of capital equals 4, if cost of finance is reported to be of no obstacle, 3=moderate obstacle, 2= Minor obstacle, 1=No obstacle. The first column is the regression of the total sample, the second column takes only small firms, while the third one takes large firms. Stars *, **, *** indicate significance at 10, 5, 1 percent respectively.

variable	(1) All	(2) Small	(3) Large
information	0.486***	0.513***	0.457***
	(0.048)	(0.059)	(0.081)
information*soft	-1.040***	-1.071***	-1.026***
	(0.079)	(0.097)	(0.140)
concentration	-0.004	0.069	-0.156
	(0.188)	(0.235)	(0.321)
non-performing loan	0.397**	0.591***	0.078
	(0.171)	(0.212)	(0.295)
creditor right*contract enforcement	-0.150***	-0.163***	-0.127***
	(0.017)	(0.021)	(0.029)
foreign bank	0.487***	0.698***	0.073
	(0.149)	(0.180)	(0.267)
bank reform index	0.097	0.094	0.111
	(0.061)	(0.076)	(0.106)
debt/asset	0.006***	0.006***	0.007***
	(0.001)	(0.001)	(0.002)
post-transition	0.017	0.029	-0.074
	(0.047)	(0.074)	(0.070)
transition	0.034	0.078	-0.078
	(0.055)	(0.082)	(0.081)
state owned	0.153***	0.102**	0.150**
	(0.040)	(0.052)	(0.069)
GDP per capita	-0.153***	-0.164***	-0.136**
	(0.031)	(0.039)	(0.054)
inflation	0.235***	0.198**	0.349***
	(0.067)	(0.083)	(0.115)
Number of obs.	3906	2581	1325
Pseudo R-Squared	0.05	0.05	0.05

Table 7: Panel estimation results: Dependent variable *Cost of capital.*

The first column is the fixed effects regression of the total sample, the second column is random effects estimation. The third one takes only small firms (Fixed effects), while the forth one takes large and medium firms (fixed effects). Stars *, **, ***,indicate significance, at 10, 5 ,1 percent respectively

variable	(1)	(2)	(3)	(4)
	All(FE)	All (RE)	Small(FE)	Large(FE)
information	0.617***	0.286**	0.255**	0.592***
	(0.057)	(0.127)	(0.115)	(0.220)
information*soft	-0.061***	-0.038***	-0.047***	-0.055***
	(0.005)	(0.010)	(0.009)	(0.017)
bank reform	0.024	0.146	0.016	-0.122
	(0.087)	(0.310)	(0.336)	(0.455)
concentration	-0.005***	0.000	0.000	0.000
	(0.002)	(0.000)	(0.000)	(0.000)
non performing loan	-0.001	-0.014**	-0.003	-0.009
	(0.002)	(0.006)	(0.007)	(0.010)
GDP per capita	-0.009	-0.299	1.115*	-0.240
	(0.047)	(0.598)	(0.609)	(0.939)
inflation	0.001**	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)
foreign bank	-0.000	0.003	-0.002	0.002
	(0.001)	(0.005)	(0.005)	(0.007)
Const.	2.751***	2.389***	2.040**	2.935**
	(0.244)	(0.838)	(0.866)	(1.207)
Number of obs.	1843	1240	1248	595
R-squared	0.08	0.07	0.08	0.06