Maria Semenova

INFORMATION SHARING
IN CREDIT MARKETS: INCENTIVES
FOR INCORRECT INFORMATION REPORTING

Редакторы серии WP10
«Научные доклады лаборатории институционального анализа»
Я.И. Кузьминов, М.М. Юдкевич

S 46 **Semenova M.** Information sharing in credit markets: incentives for incorrect information reporting. Working paper WP10/2007/03. Moscow: State University — Higher School of Economics, 2007. — 40 p. (in Russian).

The introduction of institutions of credit information sharing — private credit bureaus and public credit registries — in the market for bank loans represents one of the possible solutions of information asymmetry problem, — the problem which most of the creditors tend to face. However the possibility of information sharing influences the bank's incentives in two different ways. While it disciplines the borrowers and, therefore, reduces the share of bad loans, a bank loses the competitive advantage, namely the monopolistic knowledge about the data in its clients' credit histories. Does the bank have an opportunity to use the benefits of information sharing without losing its competitive advantage and its clientele? One way to do so is to report false data on borrowers. In this paper we analyze the bank's incentives to misreport given the bank cannot refuse to participate in the information sharing system as the membership is obligatory. Our main result is that the opportunity to get extra profit and to offer less expensive credit to new clients explains why banks may prefer the strategy of dishonest behavior.

Семенова М.В. Информационное посредничество на рынке банковских кредитов: стимулы к обмену недостоверной информацией: Препринт WP10/2007/03. — М.: ГУ ВШЭ, 2007. — 40 с.

Информационное посредничество, представленное на рынке банковского кредитования частными кредитными бюро и органами государственной регистрации кредитов — один из способов решения проблемы асимметрии информации, неизбежно возникающей между банком и заемщиком. Однако обмен данными влияет на стимулы банка двояким образом: с одной стороны, он дисциплинирует заемщиков, снижая долю безнадежных долгов, с другой — лишает банк такого конкурентного преимущества, как обладание информацией, содержащейся в кредитных историях его клиентов. Есть ли у банка возможность получать все выгоды от информационного обмена, не теряя конкурентных преимуществ и сохраняя свою клиентуру? Один из способов — предоставление ложной информации о заемщиках. В работе представлен анализ стимулов банка к такому виду оппортунистического поведения в случае, если участие в системе информационного обмена является для банка обязательным. Полученные результаты свидетельствуют о том, что перспектива дополнительной прибыли и возможность предложить более дешевый кредит при формировании клиентской базы обусловливают выбор банками стратегии нечестного поведения.

msemenova@hse.ru. Laboratory for Institutional Analysis of Economic Reforms (http://lia.hse.ru), Higher School of Economics, Moscow

1 Introduction[1]

Information about the borrowers represents an asset of a certain value in the market of bank loans. A bank's client who enjoys the advantages of bank loan for ages and who repays fully and regularly, getting new loans on more favorable conditions, would certainly agree that the information is without doubt valuable for borrowers. with this statement. Those who borrow in order to repay old debts would agree with this statement too. And the creditor himself would concur this information is quite useful: the efficiency of its credit policy is tightly connected with availability of this resource. Each bank would like to distinguish between reliable and risky borrowers, minimizing time and funds on data search, collection and analysis and on borrowers' actions monitoring. Each borrower would prefer to obtain the loan on favorable conditions, namely to pay the interest which does not exceed the degree of his own and his project riskiness.

This applies to the existence of an informational intermediary in the bank loans market. This intermediary accumulates data on borrowers, which is received from banks and some other sources, and then renders it to potential creditors. This method is usually faster, cheaper and more accurate for a bank than doing search and analytical work itself. It is particularly true for consumer credit market.

Why is it so important to pay attention to informational intermediation institutions while studying the market for bank loans? The case is that one of the most serious problems of this market is asymmetry of information between a lender and a borrower. The procedures of financial statement analysis, estimation of investment quality, monitoring of borrower's actions are described and discussed quite comprehensively. However they are costly and probably inefficient. Informational intermediaries' activities may be considered as an alternative, which is targeted directly on improvement of the market with information asymmetry:

1. The necessary information is provided and therefore the banks become more aware about their potential clients. This helps to estimate the creditworthiness more precisely, to offer the interest rate at the level more consistent with the particular client's riskiness and to reduce the share of bad loans in bank's credit portfolio.

2. The bank's expenses for information collection and analysis usually decrease.

3. Monitoring becomes cheaper. The fact that his credit history exists and will be used by potential creditors disciplines the borrower, because all the future loans will be granted on the conditions determined by his previous behavior.

4. Informational rent, resulting from bank's exclusive knowledge on borrower's creditworthiness, tends to be diluted. This spurs competition and leads to overall interest rate reduction, adding to borrowers the incentives to borrow and invest in less risky projects.

Formal informational intermediaries in the market of bank loans are *private credit bureaus* and *public credit registries*. Private credit bureaus' functioning is based on principles of voluntary membership and mutuality of data flows. Often they are commercial organizations. Public

credit registries are usually founded by the Central Bank of a country. Information on credits over a certain threshold must be reported without fail. In contrast to private credit bureaus the services of public credit registries may be free of charge.

In practice some sort of informal "segregation of duties" takes place: private credit bureaus concentrate on personal loans, credits to small and medium enterprises, public credit registries accumulate data on large loans. However if informational intermediation is represented by one type of institutions only, it usually copes with all segments of market.

Informational intermediary usually collects the data of two types. *Black* (negative) information includes the data on failures to pay on time, bad loans and other breaches of credit contract. *White* (positive) information consists of different components. Usually it embraces data on loan (amount, interest rates, maturity period, guaranties) and on borrowers' own characteristics.

Quite often information provided by banks is compared to that from other sources the intermediary has access to, some statistical analysis is performed with the use of specially designed software. The particular channel of data control is represented by borrowers themselves: often they have the opportunity to check the information in their credit files for accuracy. Nevertheless credit reports tend to contain different errors, and there may be the situation when such an error influences the prospective creditor's decision about loan granting. The errors are probably caused by some technical defects: banks and information intermediaries are to deal with huge volumes of data. But could other reasons be there?

The case is that the value of information about borrowers as a competitive advantage may be the reason for a creditor, who is a member of information exchange network, to behave opportunistically. Actually bank may prefer to provide its competitors with false information to preserve the competitive advantage. That seem to be an appropriate solution if the reporting is obligatory, for example, due to the Central Bank requirements[2]. The purpose of this paper is to study the banks' incentives for this kind of opportunistic behavior.

This paper is organized as follows. Section 2 contains the review of literature on information asymmetry problems in the market of bank loans and on peculiarities of informational intermediation as a way to solve them. Section 3 offers the model, which is used to analyze bank's benefits provided by misreporting. Section 4 describes some examples of systems for data accuracy and reliability control, which are adopted in different countries, and demonstrates that misreporting takes place even there where these systems are highly developed. Section 5 summarizes the findings.

2 Literature

The information asymmetry in credit markets and problems connected with this phenomenon were mention by the first time in 1970 in seminal paper by Akerlof, which is devoted to adverse selection problem. He wrote about a typical creditor in Indian village - a money-lender: "with his intimate knowledge of those around him he is able, without serious risk, to finance those who would otherwise get no loan at all" (Akerlof, 1970). City banks did not grant loans to those, they did not possess information about - to peasants. This explained monopolistic power of village money-lenders and their opportunity to set the interest rates higher than those, that would be offered by banks.

---

[2]The case of public credit registry is not the only example of obligatory information sharing. There is no credit registry in Russia, for example, but according to Russian legislation each bank must report the information on its borrowers at least to one private credit bureau.

As a result of information asymmetry the price of a loan - the interest rate - is not equal to an equilibrium one, which balances demand and supply. Determining interest rates banks take into account an average probability of credit repayment, because they know about good and unreliable borrowers' existence, but are not able to distinguish between these two types. Stiglitz and Weiss show, that higher interest rate makes more risky projects attractive for borrowers, that is why the bank does not agree to lend money even if borrowers offer higher prices (Stiglitz, Weiss, 1981).

Information sharing proved to be an institution, which allows to solve the problem of information asymmetry on the credit market. With introduction of credit bureaus and credit registries the average interest rates tend to decrease, so does the probability of repayment failure. However there is no distinctness about the total amount of credits. Increased number of refusals to grant a loan due to high degree of risk may be compensated by increased quantity of loans offered to good, reliable borrowers (Jappelli, Pagano, 1993).

In the same time banks may have no incentives to take part in information sharing. The case is that data on their own borrowers is their competitive advantage. They agree to sacrifice this advantage only if the borrowers, understanding that after information revealing they will be offered lower interest rates, will do their best in order not to default now. On the other hand, a bank has an incentive to announce, that information will be revealed and not to do so. Padilla and Pagano show that in situation when inter-borrower communications are absent or are costly only existence of a credit bureau may make banks not to behave opportunistically (Padilla, Pagano, 1997).

Does the already mentioned disciplinary effect, which affects the borrowers' behavior in the information sharing regime, depend on the volumes of data reported by banks? Padilla and Pagano find out that the exchange of positive information, as well as the absence of any sharing, does not allow to reach the first-best level (no information asymmetry situation). Disciplinary effect appears in case of negative information sharing: for a borrower it is worth applying more efforts to repay the loan because this will reduce the interest rate for future loans (Padilla, Pagano, 1999). Similar conclusion was drawn earlier by Vercammen (Vercammen, 1995).

If that's the case, does the bank have an incentive to report false information about the borrowers in order to enjoy the advantages of disciplinary effect and in the same time to continue informational rent extracting? This question is raised in paper by Padilla and Pagano (Padilla, Pagano, 1999), but there is no answer in this paper as well as in any other. Using the model of market of bank loans (offered in Padilla, Pagano, 1997, 1999) we will analyze an additional strategy - the strategy of dishonest behavior - in a framework offered in the latter paper.

3 The model of dishonest bank

The main features of the set-up we use are described in papers by Padilla and Pagano (Padilla, Pagano, 1997, 1999). Consider a two-period model of the market for bank loans. The contract in this market involves two agents: a bank (creditor) and an entrepreneur (borrower) - and implies a loan for a 1-period-long investment project of the latter. The project requires the loan of 1 unit, which must by repaid in the end of the current period.

3.1 Agents' characteristics

There is a continuum [0,1] of risk-neutral *entrepreneurs*, who are divided into two groups: - high-ability (H) and low-ability (L) (their proportions of the total population are γ and $(1 - \gamma)$ respectively). High-ability entrepreneurs invest in the projects which yield R^* per period with the probability p (the probability of success) and 0 otherwise.

The projects chosen by low-ability entrepreneurs yield nothing in any case.

Initially an entrepreneur has no own capital, so he is to borrow money for his projects. All the profits are consumed in current period and cannot be transferred into the next one, therefore the loan must be used in the second period too. The liability is limited, i.e. if the project gives zero return, the loan is simply not repaid. A default in the first period does not mean that the borrower must repay it in the second one, or is not allowed to invest at all.

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

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

3.2 Strategies

An entrepreneur is characterized by total undiscounted utility function and by rational expectations about future interest rates. However he cannot affect the rates as he is a price-taker.

If a high-quality entrepreneur i does not borrow, he gets zero utility. If he borrows, then he maximizes the following utility function (linear in pay-offs):

$$U_H(p_i) = p_i[(R^* - R_{j1}) + (R^* - E(R_{j2}))] \tag{1}$$

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

The entrepreneur participates the transaction if the utility he expects to obtain is not negative.

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

A bank chooses the interest rate for the loan it offers. Its choice depends on the scope of information about the borrower a bank has at disposal. The banks offer their interest rates sequentially. In the second period each bank offers the rates first to its clients, and then to the clients of the competitor, i.e. the first offer is received from the bank, which has the information about the type of an entrepreneur. Suppose that in the first period the first offer is made by

bank A (if we choose bank B, nothing will significantly change, because in this period there is no information asymmetry). The entrepreneurs always choose the bank offering cheaper loan. If the interest rates are the same, in the first period the borrowers choose this or that bank with probability $\sigma_j, j = A, B$, where $\sigma_A = \sigma$ and $\sigma_B = (1 - \sigma)$ (σ is determined exogenously). We consider that in the second period they choose the bank, they collaborated with in the past (this bank offers its interest rate first). This assumption is quite realistic, because the entrepreneurs usually prefer to borrow from the bank they had a chance to borrow from in the past and choose another one only if they are offered lower interest rates.

Banks deal with the undiscounted profit. Each bank obtains the profit from those entrepreneurs who are able to repay and who became his borrowers and performed their projects successfully. In the first period bank j is chosen by σ_j of entrepreneurs γ of which are of high-ability type. They gain profit from the projects with average expected probability p, so the banks expected gain is equal to $\sigma_j \gamma p R_{j1}$. As the bank has to pay for resources granted to σ_j of borrowers, the cost of funds accounts for $\sigma_j \overline{R}$. So the first period profit is the following:

$$\Pi_{j1} = \sigma_j(\gamma p R_{j1} - \overline{R}) \tag{2}$$

In the second period banks grant no loans to low-ability borrowers or to the competitor's clients (later we will show why). So the cost of funds is reduced by $(1 - \gamma)\sigma_j \overline{R}$ and the second period profit equals to:

$$\Pi_{j2} = \sigma_j \gamma(p E(R_{j2}) - \overline{R}) \tag{3}$$

Given the above-mentioned profit components the banks are characterized by the following total profit function:

$$\Pi_j = \sigma_j[(\gamma p R_{j1} - \overline{R}) + \gamma(p R_{j2} - \overline{R})] \tag{4}$$

$$p \geq \overline{R}/R^* \tag{5}$$

The inequality (5) guarantees that the market exists: a bank may cover the costs of capital.

Each *bank* is obliged by some external authority to share the information on the borrowers' experience or types with another bank in the beginning of the second period. Therefore the bank decides whether to report honestly or not. Granting a loan in the first period a bank obtains the information on the type of its borrowers, therefore by the beginning of the second period each bank has a competitive advantage. A bank obviously prefers to preserve it, under obligatory information sharing it seems to be impossible unless the bank misreports.

Which strategy allows bank to extract informational rent on condition that borrowers choose high level of efforts? Is the dishonest behavior the strategy we are looking for?

In an attempt to answer this question we should start with determining *what it means to be "dishonest"*. A bank may report a case of success as a case of default, or vice versa. In a chosen set-up we are to deal with both variants simultaneously.

- The case of obligatory reporting of negative information.

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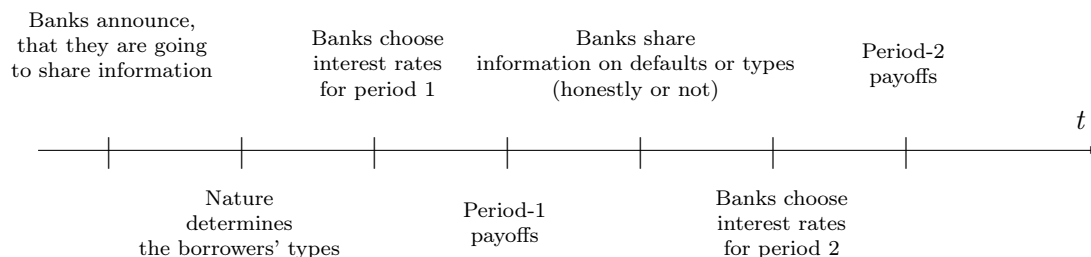
- The case of obligatory reporting positive information.

The share of high-ability borrowers is a common knowledge, so a dishonest bank cannot report less than γ of high-ability clients. The strategy for dishonest reporting is to claim certain proportion of high-ability borrowers to be low-ability ones and vice versa.

We are going to discuss these strategies in details laterun.

The timing of the game is the following (Figure 1). At the beginning of the first period both banks announce that they are going to share information[3] about their borrowers. Then the nature determines the borrowers' types. Banks solve the second period profit maximization problem and then assign interest rates for the first period according to the principle of zero total profits. Then the projects are performed and the payoffs of the period are determined. Banks obtain the information on their borrowers' types. At the beginning of the second period the banks share positive or negative information, honestly or not. Interest rates for the second period are assigned subject to available information and keeping in mind the possible actions of the competitor. Then the projects are performed again and second period payoffs are determined.

Figure 1. Timing of actions in the model

3.3 Sharing information about defaults

3.3.1 Honest bank[4]

Suppose that at the beginning of the second period the banks share information on defaults honestly. Therefore if an entrepreneur borrowed from bank A in the first period, and in the second one decides to borrow from bank B, he will be offered a rate according his performance in bank A. The characteristics of this equilibrium are marked with *is* (information sharing).

At this stage it is necessary to introduce formally the conditional probabilities:

$\mu(H|D)$ - probability of being a high-ability entrepreneur conditional on having defaulted in the first period,
$\mu(H|\overline{D})$ - probability of being a high-ability entrepreneur conditional on not having defaulted in the first period.

---

[3]Positive or negative, depending on the external regulator's requirements.
[4]Analyzed in Padilla, Pagano, 1999

$\mu(L|D)$ - probability of being a low-ability entrepreneur conditional on having defaulted in the first period,

$\mu(L|\overline{D})$ - probability of being a low-ability entrepreneur conditional on not having defaulted in the first period.

If an entrepreneur repays a loan he is identified as being high-ability, because a low-ability entrepreneur is not available to repay by no means. Therefore,

$\mu(H|\overline{D}) = 1 - \mu(L|\overline{D}) = 1$

If an entrepreneur defaulted it is not possible to reveal his type unambiguously. According to Bayes' rule for conditional probability:

$$\mu(H|D) = 1 - \mu(L|D) = \frac{\gamma(1-p)}{\gamma(1-p) + (1-\gamma)} \tag{6}$$

It is worth noting that $\mu(H|D) < \gamma < \mu(H|\overline{D}) = 1$.

We assume some constraints on the model's parameters and variables:

$$R^* \geq \frac{\overline{R}}{\mu(H|D)} \tag{7}$$

$$R^* \geq \overline{R}/\gamma p \tag{8}$$

These two inequalities ensure the equilibrium interest rates do not exceed project maximum yield and we do not deal with a corner solution.

We start our analysis of bank's decisions from the second period. Bank offers the rates to its client according to whether the borrower defaulted in the first period or not, i.e. patterns the behavior on the behavior of the competitor, and does not offer loans to the low-ability borrowers or the competitor's clients. The latter should be clarified. Keeping in mind that borrowers choose "their" banks other thing equal, a bank has the only possibility to lure the competitor's clients - to offer lower interest rates. However that's impossible given the competitor offers minimum rates that a bank can offer with the information on the these borrowers it possesses: further rate reduction leads to losses for uninformed bank.

Bank's expected profit in the second period equals to:

$$\Pi_{j2}^{is} = \sigma_j \gamma(pE(R_{j2}^{H,is}) - \overline{R}), j = A, B \tag{9}$$

Expected interest rate depends on the probability of project's success (as interest rates are different for those, who repaid and those, who did not):

$$E(R_{j2}^{H,is}) = pR_{j2}^{H,is}(\overline{D}) + (1-p)R_{j2}^{H,is}(D) \tag{10}$$

Thus for p fitting the inequality (7) maximization of (9) given (10) provides:

$$R_{j2}^{H,is}(D) = \frac{\overline{R}}{\mu(H|D)p} \tag{11}$$

$$R_{j2}^{H,is}(\overline{D}) = \overline{R}/p \tag{12}$$

It is important to emphasize here that even being aware of its client's type the bank offers the interest rates which depend on conditional probability of default. The case is that the

competitor may offer them not less than this rate, so the best response for the bank is to assign this particular rate.

Table 1 demonstrates the shares of clients of each type in each bank in the second period as well as the interest rates.

Table 1. Honest reporting: second period contracts

Proportion of borrowers	1st period result	Borrower's type	Bank A: interest rate	Bank B: interest rate
σ_A				
$p\gamma$	Success	High-ability	$\overline{R}/p$	-
$(1-p)\gamma$	Default	High-ability	$\frac{\overline{R}}{\mu(H\|D)p}$	-
$1-\gamma$	Default	Low-ability	-	-
σ_B				
$p\gamma$	Success	High-ability	-	$\overline{R}/p$
$(1-p)\gamma$	Default	High-ability	-	$\frac{\overline{R}}{\mu(H\|D)p}$
$1-\gamma$	Default	Low-ability	-	-

Putting (11) and (12) into (10) and then into (9) provides the following expected profits for the banks in the second period:

$$\Pi_A^{is} = \sigma\gamma(1-p)(p * \frac{\overline{R}}{\mu(H|D)p} - \overline{R}) \tag{13}$$

$$\Pi_B^{is} = (1-\sigma)\gamma(1-p)(p * \frac{\overline{R}}{\mu(H|D)p} - \overline{R}) \tag{14}$$

Bank chooses the interest rate for the first period according to the principle of zero total profits: it suffers losses equal to profits expected in the next period[5].

$$R_{j1} = \overline{R}/p \tag{15}$$

3.3.2 Dishonest bank

We are going to start the analysis by finding out how the bank which reports dishonestly, may benefit from such a behavior. Characteristics of equilibrium are marked as *dh* (dishonest). Suppose bank A reports dishonestly, but bank B shares true information about defaults of its clients. Bank A claims that its borrowers, who did not defaulted, to be defaulters in the first period. In this case bank B would offer them the second period rate, which depends on conditional probability $\mu(H|D)$. The competitive advantage is that bank A may offer the high-ability borrowers, who did not default, the same interest rate. If a honest bank have known that the borrower had not defaulted, it would identify the high-ability entrepreneur and would offer the minimal interest rate, which provides zero profit ($\overline{R}/p$). Bank A would have to act in the same way. But as bank A reports dishonestly, bank B cannot identify high-ability borrowers and has to assign higher interest rate ($\frac{\overline{R}}{\mu(H|D)p}$) and bank A makes good use of the situation, obtaining additional profit in the second period.

Keeping in mind the banks awareness about average probability of high-ability borrower's success – p – the following strategy may be used: dishonest bank reports the necessary $p\gamma$ of

---

[5]Derived by putting (13) or (14) into the corresponding modification of (4), equal to zero.

successes but the maximum possible number of these borrowers are defaulters in reality. In doing so the bank provides a false signal for the competitor so the latter treats defaulters as high-ability borrowers. If the proportion of low-ability borrowers is high, the dishonest bank has enough low-ability clients to announce they are not defaulters. If the low-ability borrowers are not so numerous, some high-ability borrowers are also included are also reported as non-defaulters. Table 2 summarizes both possible scenarios:

Table 2. Dishonest reporting

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

Is this strategy more profitable for banks than that of honest behavior? To find out we should analyze what happens when one bank (for example bank A) reports dishonestly, and when both banks report false information. We are going to study both cases one by one.

Table 3 demonstrates the interest rates offered by banks and accepted by borrowers in the second period. Bank A enjoys the opportunity to offer higher interest rate to all its high-ability clients, because even those of them, who did not default, are not recognized by the competitor as high-ability borrowers.

Table 3. Dishonest reporting by bank A: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1 σ_A (borrowers of Bank A)		
$p\gamma$	-	-
γ	$\frac{\overline{R}}{\mu(H|D)p}$	-
$1 - \gamma - p\gamma$	-	-
Scenario 2 σ_A (borrowers of Bank A)		
$1 - \gamma$	-	-
$p\gamma - (1 - \gamma)$	$\overline{R}/p$	-
$1 - p\gamma$	$\frac{\overline{R}}{\mu(H|D)p}$	-
Both scenarios σ_B (borrowers of Bank B)		
$p\gamma$	-	$\overline{R}/p$
$(1 - p)\gamma$	-	$\frac{\overline{R}}{\mu(H|D)p}$
$1 - \gamma$	-	-

Thus the honest bank's second period profit remains unchanged, but the dishonest bank yields more than in case of honest reporting.

$$\Pi_{A2}^{dh} = \sigma\gamma(p * \frac{\overline{R}}{\mu(H|D)p} - \overline{R}) \tag{16}$$

Under scenario 1 extra profit is provided by all dishonest bank's high-ability non-defaulters, because they accept higher interest rates. Given (8) extra profit is the following:

$$\Delta\Pi_A^{dh} = \Pi_{A2}^{dh} - \Pi_{A2}^{is} = p\sigma\gamma(p * \frac{\overline{R}}{\mu(H|D)p} - \overline{R}) = \frac{\sigma p\overline{R}(1-\gamma)}{1-p} \tag{17}$$

Under scenario 2 extra profit is provided by those dishonest bank's high-ability borrowers, who were not included into the group of reported as non-defaulters:

$$\Pi_{A2}^{dh} = \sigma\gamma(1-p\gamma)(p * \frac{\overline{R}}{\mu(H|D)p} - \overline{R}) \tag{18}$$

$$\Delta\Pi_A^{dh} = \Pi_{A2}^{dh} - \Pi_{A2}^{is} = p\sigma\gamma(1-\gamma)(p * \frac{\overline{R}}{\mu(H|D)p} - \overline{R}) = \frac{\sigma p\overline{R}(1-\gamma)^2}{1-p} \tag{19}$$

In the latter case extra profit is lower but still positive.

If it is bank B who misreports the results obviously will be the same, accurate to the proportion of borrowers chosen the bank in the first period other things equal (bank B is chosen by $(1-\sigma)$ of borrowers).

Now suppose that both banks report dishonestly. We mark this equilibrium with $2dh$. In this case most of high-ability borrowers are not identified by competitor. Table 4 demonstrates equilibrium interest rates accepted by different groups of borrowers:

Table 4. Dishonest reporting by both banks: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1		
σ_A (borrowers of Bank A)		
$p\gamma$	-	-
γ	$\frac{\overline{R}}{\mu(H|D)p}$	-
$1-\gamma-p\gamma$	-	-
σ_B (borrowers of Bank B)		
$p\gamma$	-	-
γ	-	$\frac{\overline{R}}{\mu(H|D)p}$
$1-\gamma-p\gamma$	-	-
Scenario 2		
σ_A (borrowers of Bank A)		
$1-\gamma$	-	-
$p\gamma-(1-\gamma)$	$\overline{R}/p$	-
$1-p\gamma$	$\frac{\overline{R}}{\mu(H|D)p}$	-
σ_B (borrowers of Bank B)		
$1-\gamma$	-	-
$p\gamma-(1-\gamma)$	-	$\overline{R}/p$
$1-p\gamma$	-	$\frac{\overline{R}}{\mu(H|D)p}$

Therefore informational rent is extracted by both banks ($\Pi_j^{2dh} = \Pi_j^{dh}$).
Under scenario 1 banks enjoy the following extra profits:

$$\Delta \Pi_A^{2dh} = \Pi_{A2}^{2dh} - \Pi_{A2}^{is} = \frac{\sigma p \overline{R}(1 - \gamma)}{1 - p} \qquad (20)$$

$$\Delta \Pi_B^{2dh} = \Pi_{B2}^{2dh} - \Pi_{B2}^{is} = \frac{p \overline{R}(1 - \sigma)(1 - \gamma)}{1 - p} \qquad (21)$$

Under scenario 2 banks yield the following extra profits:

$$\Delta \Pi_A^{2dh} = \Pi_{A2}^{2dh} - \Pi_{A2}^{is} = \frac{\sigma p \overline{R}(1 - \gamma)^2}{1 - p} \qquad (22)$$

$$\Delta \Pi_A^{2dh} = \Pi_{B2}^{2dh} - \Pi_{B2}^{is} = \frac{p \overline{R}(1 - \sigma)(1 - \gamma)^2}{1 - p} \qquad (23)$$

Finally we obtain the following matrix:

		B	
		honest	*dishonest*
	honest	$(\Pi_{A2}^{is}; \Pi_{B2}^{is})$	$(\Pi_{A2}^{is}; \Pi_{B2}^{dh})$
A			
	dishonest	$(\Pi_{A2}^{dh}; \Pi_{B2}^{is})$	$(\Pi_{A2}^{2dh}; \Pi_{B2}^{2dh})$

Here $\Pi_{j2}^{2dh} = \Pi_{j2}^{dh} > \Pi_{j2}^{is}$, $j = A, B$. So maximizing the second period profits both banks prefer to behave opportunistically and to misreport.

A serious question may arise here. If each bank realizes that dishonest reporting is the strategy he personally prefers, without any doubt it is aware of the fact, that this strategy would be preferred by the competitor too. If the banks take into account the dishonest reporting of the competitor, the equilibrium interest rates change due to changes in conditional probabilities, that are based on the volumes of available information. Actually under scenario 1 the dishonest bank competitor understands that those reported as non-defaulters are low-ability borrowers, so we are to introduce new probability to be high-ability borrower if the first period result is a default:

$$\mu'(H|D) = \frac{\gamma}{1 - p\gamma} > \mu(H|D) \qquad (24)$$

Under scenario 2 the dishonest bank competitor realizes that those reported as defaulters are high-ability borrowers, and there are low-ability ones among those reported as non-defaulters, so new probability to be high-ability borrower if the first period result is a success is now less than 1:

$$\mu''(H|\overline{D}) = \frac{p\gamma - (1 - \gamma)}{p\gamma} < 1 \qquad (25)$$

Keeping in mind this logic we are going to find out whether the strategy of dishonest reporting is still preferred by banks. We start again by considering that only one bank (bank A as we chose earlier)and then we turn to the case of two misreporting banks. We mark the equilibrium by *dc ("dishonest competitor")*.

Table 5 demonstrates the interest rates offered by banks in the second period under condition that honest bank B takes into account its competitor pulls the wool over its eyes. Bank A continues enjoying the opportunity to offer higher interest rate to all its high-ability clients,

but this rate is lower than in previous case of dishonest reporting due to new conditional probability. Contracts offered to honest bank's clients remain unchanged.

Table 5. Dishonest reporting by bank A: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1 σ_A (borrowers of Bank A)		
$p\gamma$	-	-
γ	$\frac{\overline{R}}{\mu'(H\|D)p}$	-
$1-\gamma-p\gamma$	-	-
Scenario 2 σ_A (borrowers of Bank A)		
$1-\gamma$	-	-
$p\gamma-(1-\gamma)$	$\overline{R}/p$	-
$1-p\gamma$	$\frac{\overline{R}}{\mu''(H\|\overline{D})p}$	-
Both scenarios σ_B (borrowers of Bank B)		
$p\gamma$	-	$\overline{R}/p$
$(1-p)\gamma$	-	$\frac{\overline{R}}{\mu(H\|D)p}$
$1-\gamma$	-	-

It is easy to see that the dishonest bank yields less than in case of honest reporting: a decrease in interest rates is not compensated by higher proportion of high-ability borrowers they are offered to. For scenario 1 we have:

$$\Pi_{A2}^{dc} = \sigma\gamma(p * \frac{\overline{R}}{\mu'(H|D)p} - \overline{R}) \tag{26}$$

$$\Delta\Pi_A^{dc} = \Pi_{A2}^{dc} - \Pi_{A2}^{is} = -p\sigma\gamma\overline{R} < 0 \tag{27}$$

Under scenario 2 a decrease of dishonest bank profit is the same:

$$\Pi_A^{dc} = \sigma(p\gamma-(1-\gamma))(p * \frac{\overline{R}}{\mu''(H|\overline{D})p} - \overline{R}) \tag{28}$$

$$\Delta\Pi_A^{dc} = \Pi_{A2}^{dc} - \Pi_{A2}^{is} = -p\sigma\gamma\overline{R} < 0 \tag{29}$$

Now we are going to analyze the situation when both banks report dishonestly. We mark this equilibrium with $2dc$. Table 6 demonstrates equilibrium interest rates accepted by different groups of borrowers:

Table 6. Dishonest reporting by both banks: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1		
σ_A (borrowers of Bank A)		
$p\gamma$	-	-
γ	$\frac{\overline{R}}{\mu'(H|D)p}$	-
$1 - \gamma - p\gamma$	-	-
σ_B (borrowers of Bank B)		
$p\gamma$	-	-
γ	-	$\frac{\overline{R}}{\mu'(H|D)p}$
$1 - \gamma - p\gamma$	-	-
Scenario 2		
σ_A (borrowers of Bank A)		
$1 - \gamma$	-	-
$p\gamma - (1 - \gamma)$	$\frac{\overline{R}}{\mu''(H|\overline{D})p}$	-
$1 - p\gamma$	$\overline{R}/p$	-
σ_B (borrowers of Bank B)		
$1 - \gamma$	-	-
$p\gamma - (1 - \gamma)$	-	$\frac{\overline{R}}{\mu''(H|\overline{D})p}$
$1 - p\gamma$	-	$\overline{R}/p$

Thus both banks bear losses:

$$\Delta\Pi_A^{2dc} = -p\sigma\gamma\overline{R} < 0 \tag{30}$$

$$\Delta\Pi_B^{2dc} = -p\gamma(1 - \sigma)\overline{R} < 0 \tag{31}$$

The matrix we obtained on the previous stage is now changed:

$$
\begin{array}{ccc}
 & \multicolumn{2}{c}{\text{B}} \\
 & honest & dishonest \\
honest & (\Pi_{A2}^{is}; \Pi_{B2}^{is}) & (\Pi_{A2}^{is}; \Pi_{B2}^{dc}) \\
A & & \\
dishonest & (\Pi_{A2}^{dc}; \Pi_{B2}^{is}) & (\Pi_{A2}^{2dc}; \Pi_{B2}^{2dc})
\end{array}
$$

Here $\Pi_{j2}^{2dh} = \Pi_{j2}^{dh} < \Pi_{j2}^{is}$, $j = A, B$.

An equilibrium strategy here is to report honestly. However we cannot declare we obtained the proof for the absence of bank incentives to misreport. It is worth returning to the results of the previous stage and ask the question: whether banks prefer to treat the competitors as dishonest ones? The key consideration here is the following: if the banks believe each other - or at least do not treat each other as "wrong-doers" - we simply return to the first matrix with misreporting as an equilibrium strategy.

To find out which strategy will be preferred by banks we should construct and analyze the following matrix covering both possible cases of misreporting:

	B			
	honest, believe	*honest, don't believe*	*dishonest, believe*	*dishonest, don't believe*
honest, believe	$(\Pi_{A2}^{is};\Pi_{B2}^{is})$	$(\Pi_{A2}^{dc};\Pi_{B2}^{is})$	$(\Pi_{A2}^{is};\Pi_{B2}^{dh})$	$(\Pi_{A2}^{is};\Pi_{B2}^{dc})$
honest, don't believe	$(\Pi_{A2}^{dc};\Pi_{B2}^{is})$	$(\Pi_{A2}^{dc};\Pi_{B2}^{dc})$	$(\Pi_{A2}^{is};\Pi_{B2}^{dc})$	$(\Pi_{A2}^{is};\Pi_{B2}^{dc})$
dishonest, believe	$(\Pi_{A2}^{dh};\Pi_{B2}^{is})$	$(\Pi_{A2}^{is};\Pi_{B2}^{dc})$	$(\Pi_{A2}^{dh};\Pi_{B2}^{dh})$	$(\Pi_{A2}^{dh};\Pi_{B2}^{dc})$
dishonest, don't believe	$(\Pi_{A2}^{dc};\Pi_{B2}^{is})$	$(\Pi_{A2}^{dc};\Pi_{B2}^{is})$	$(\Pi_{A2}^{dc};\Pi_{B2}^{dh})$	$(\Pi_{A2}^{dc};\Pi_{B2}^{dc})$

(The row label *A* appears at the left between the second and third rows.)

While $\Pi_{j2}^{dc} < \Pi_{j2}^{h} < \Pi_{j2}^{dh}$, $j = A, B$ the only equilibrium is $(\Pi_{A2}^{dh};\Pi_{B2}^{dh})$, so the banks should prefer to ignore the fact that a competitor reports dishonestly. Higher second period profits result in competitive advantage in the first period - the possibility to assign lower interest rates to obtain proper market share. As already mentioned above, competing for borrowers banks offer equal and the lowest possible rates. Actually if only one bank reports dishonestly, it will become a monopolist, controlling all the market in the first period. In order not to lose the market in the very beginning the second bank chooses the same strategy too. It is worth noting one more important aspect: if a bank prefers to report honestly, he find it more profitable to treat a competitor as a "wrong-doer", because in this case the competitor obtains lower second period profit providing competitive advantage to honest bank. But understanding this the competitor will not behave opportunistically, and as a response the previously honest bank will prefer to misreport, so we obtain the same picture of misreporting as an equilibrium strategy. It is useful to construct decision chains to demonstrate our logic more clearly[6]

1) Bank B do not treat bank A as a "wrong-doer" $\Rightarrow$ Bank A prefers to misreport prefers to misreport without taking into account competitor's dishonest behavior $\Rightarrow$ Bank B prefers to misreport prefers to misreport without taking into account competitor's dishonest behavior

2) Bank B treats bank A as a "wrong-doer" $\Rightarrow$ Bank A prefers to report honestly $\Rightarrow$ Bank B prefers to misreport without taking into account competitor's dishonest behavior $\Rightarrow$ Bank A prefers to misreport without taking into account competitor's dishonest behavior

At last we may make an important conclusion: in a chosen set-up the banks prefer to misreport and close their eyes on misreporting by their competitors. Actually this means that obtaining the credit files from some information intermediary the bank will not check it for accuracy and that is what we may observe in real credit information sharing process.

Now let us turn to the first period, keeping in mind the banks' choice to misreport. According to the principle of zero total profits:

$$\Pi_j = \sigma_j(\gamma p R_{j1} - \overline{R}) + \Pi_{j2} = 0, j = A, B \qquad (32)$$

Therefore for scenario 1 we obtain:

$$R_{j1} = \frac{\gamma - p}{\gamma(1 - p)} * \frac{\overline{R}}{p} \qquad (33)$$

Under scenario 2 the first period interest rate is the following:

$$R_{j1} = \frac{\overline{R}}{p\gamma^2(1 - p)} * (\gamma(1 - p\gamma) - (1 - \gamma)) \qquad (34)$$

---

[6]The chains are constructed just to make the logic clearer, in our set-up banks make the offers one by one, but cannot observe the offers of competitors and adjust their own ones using this information.

It is worth emphasizing that theoretically first period interest rate may be even negative. It takes place when $p > \gamma$ under scenario 1 and when $p > 2/\gamma^{-1} - 1/\gamma^{-2}$ under scenario 2, i.e when the share of high-ability borrowers is low enough, but expected probability of their projects' success is high. This result may be interpreted in the following way: a bank is ready to offer loans free of charge in the first period only to obtain the information about the type of the borrowers. When the bank understands that the borrower is high-ability it assigns higher second-period interest rate in order to cover the losses. But negative rates are not permitted in the model, so suppose that in case of theoretically negative interest rate this rate is equal to zero in bank contracts. Some share of the "loss opportunities" is not used, losses are smaller than expected profits. Therefore the total profits are positive, so the strategy of dishonest behavior is unambiguously more preferable than that of honest behavior.

3.3.3 Borrower's choice in case of sharing information about defaults

Our discussion was based on the assumption that p is an exogenous parameter, this is a fixed characteristic of the the borrower. Now we'll analyse the influence of disciplinary effect on the bank's choice.

The existing literature[7] shows that sharing negative information increases the level of efforts compared with regimes with no information sharing and positive information sharing. A high-ability entrepreneur prefers to apply more efforts to repay a loan, because only in this case he will be identified as a high-ability one and will be offered a lower interest rate. If there is a default the rate will be based on the conditional probability - the probability that defaulted borrower is high-ability one ($\mu(H|D)$) and will obviously be higher. Why an entrepreneur is offered a lower rate if he is identified as a high-ability one? In this case there is no more information asymmetry, so the banks compete only by interest rates. That is why the equilibrium rates are the minimum possible ones and are determined only by cost of capital for bank and the probability of success for high-ability entrepreneur - $\overline{R}/p$.

Let us assume that the probability of success p includes the disciplinary effect and in case the borrower knows the second period interest rates will not be lower after borrower's first period success his average probability of success is $\widetilde{p} < p$. In two-period model there is no source of suspicion, so a borrower makes his choice under influence of disciplinary effect. However the case of suspicious, distrustful borrower should also be considered (we could add this assumption to borrower's characteristics). So now we are going to examine the situation of banks' dishonest behavior given the borrowers are distrustful and to find out if there are such p and $\widetilde{p}$ – or, better to say, $(p - \widetilde{p})$ – that the banks still prefer the strategy of misreporting.

To check whether the banks still choose misreporting behavior we compare the second period profits of the honest bank and misreporting bank given the probability of borrower's success is lower in the latter case.

Under scenario 1 we obtain:

$$\Delta\Pi_j = \Pi_j^{2dh}(\widetilde{p}) - \Pi_j^{is}(p) =$$
$$= \sigma_j\gamma(\widetilde{p} * \frac{\overline{R}}{\mu(H|D)\widetilde{p}} - \overline{R}) - \sigma_j\gamma(1-p) * (\frac{\overline{R}}{\mu(H|D)p} - \overline{R}) =$$
$$= \sigma_j\gamma\overline{R}(\frac{1-\gamma\widetilde{p}}{\gamma(1-\widetilde{p})} - 1) - \sigma_j\gamma\overline{R}(1-p) * (\frac{1-\gamma p}{\gamma(1-p)} - 1) = \frac{\sigma_j\widetilde{p}\overline{R}(1-\gamma)}{1-\widetilde{p}} > 0,$$
$$\text{j=A,B}$$

Under scenario 2 the difference in profits is the following:

---

[7]Vercammen, 1995; Padilla, Pagano, 1999.

$$\Delta\Pi_j = \Pi_j^{2dh}(\widetilde{p}) - \Pi_j^{is}(p) = \sigma_j\gamma(1 - \widetilde{p}\gamma)(\widetilde{p} * \frac{\overline{R}}{\mu(H|D)\widetilde{p}} - \overline{R}) -$$
$$- \sigma_j\gamma(1-p) * (\frac{\overline{R}}{\mu(H|D)p} - \overline{R}) = \frac{\sigma_j\widetilde{p}\overline{R}(1-\gamma)^2}{1-\widetilde{p}} > 0, j = A, B$$

Thus the second period profits under misreporting regime are higher than those of honest banks even if misreporting provides lower borrowers' efforts and - therefore - average probability of projects' success.

3.4   Sharing information about borrowers' types

3.4.1   Honest bank[8]

Now let us analyze the case of information sharing about borrowers' types. Suppose that at the beginning of the second period the banks do not misreport. In this case the the borrowers' performance in the first period does not affect the rates offered by banks in the second one as there is no information asymmetry. The characteristics of this equilibrium are marked with cs (complete sharing), as in Padilla, Pagano, 1999.

In the second period the high-ability borrowers are offered the minimum possible rate - the rate that is enough only to cover banks' expenses:

$$R_{j2}^{H,is} = \overline{R}/p \tag{35}$$

Table 7 demonstrates the shares of clients of each type in each bank in the second period and the interest rates accepted by borrowers.

Table 7. Honest reporting of borrowers' types: second period contracts

Proportion of borrowers	Borrower's type	Bank A (dishonest): interest rates	Bank B (honest): interest rates
σ_A (borrowers of Bank A)			
γ	High-ability	$\overline{R}/p$	-
$1-\gamma$	Low-ability	-	-
σ_B (borrowers of Bank B)			
γ	High-ability	-	$\overline{R}/p$
$1-\gamma$	Low-ability	-	-

The expected profits for the banks in the second period are equal to zero and - according to the principle of zero total profits - the first period profits equal to zero too:

$$\Pi_{A2}^{cs} = \Pi_{B2}^{cs} = \Pi_{A1}^{cs} = \Pi_{B1}^{cs} = 0 \tag{36}$$

The corresponding first period interest rate is the following:

$$R_{j1} = \overline{R}/p\gamma \tag{37}$$

3.4.2   Dishonest bank

Again we start the analysis by describing the mechanism of misreporting and finding out whether the use of this mechanism is attractive for banks. Characteristics of equilibrium are marked with cdh. Suppose bank A reports dishonestly, but bank B shares true information about borrowers' types.

---

[8]Analyzed in Padilla, Pagano, 1999

The banks are aware of the proportion of high-ability borrowers – γ. However the following strategy of misreporting is available: dishonest bank reports the necessary γ of high-ability borrowers but they are low-ability ones in reality. If the proportion of low-ability borrowers is high enough, all high-ability borrowers are reported dishonestly, otherwise some high-ability borrowers are not misreported. Table 8 summarizes both possible scenarios:

Table 8. Dishonest reporting borrowers' types

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

Again we start from analyzing the case when only one bank - say, bank A[9] - misreports and then we examine the situation when both banks are dishonest.

The interest rates accepted by borrowers in the second period are shown in Table 9. Bank A enjoys the opportunity to offer the highest interest rate - R^* - to its high-ability clients, as the competitor cannot offer the lower one.

Table 9. Dishonest reporting by bank A: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1		
σ_A (borrowers of Bank A)		
γ	-	-
$1 - 2\gamma$	-	-
γ	R^*	-
Scenario 2		
σ_A (borrowers of Bank A)		
$1 - \gamma$	-	-
$2\gamma - 1$	$\overline{R}/p$	-
$1 - \gamma$	R^*	-
Both scenarios		
σ_B (borrowers of Bank B)		
γ	-	$\overline{R}/p$
$1 - \gamma$	-	-

As in case of defaults misreporting the dishonest bank yields more than in case of honest reporting (the profits of the honest bank remain unchanged).

Under scenario 1 extra profit is provided by all dishonest bank's high-ability borrowers, because they accept higher interest rates. Given (8)* extra profit is the following:

$$\Pi_{A2}^{cdh} = \Delta\Pi_A^{dh}(\Pi_{A2}^{cs} = 0) = \sigma\gamma(pR^* - \overline{R}) > 0 \tag{38}$$

Under scenario 2 extra profit is provided by those dishonest bank's high-ability clients, who were not reported as being high-ability:

---

[9]Because of the symmetry the results for dishonest bank B will be the same, accurate to the proportion of borrowers chosen the bank in the first period other things equal.

$$\Pi_{A2}^{cdh} = \Delta\Pi_A^{dh}(\Pi_{A2}^{cs} = 0) = \sigma(1-\gamma)(pR^* - \overline{R}) > 0 \tag{39}$$

In both cases extra profit is positive.

Now let us turn to the case of both banks being misreporters. We mark this equilibrium with $2cdh$. In this case both banks report high-ability borrowers as low-ability ones and vice versa. Table 10 demonstrates equilibrium interest rates accepted by different groups of borrowers:

Table 10. Dishonest reporting by both banks: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1		
σ_A (borrowers of Bank A)		
γ	-	-
$1-2\gamma$	-	-
γ	R^*	-
σ_B (borrowers of Bank B)		
γ	-	-
$1-2\gamma$	-	-
γ	-	R*
Scenario 2		
σ_A (borrowers of Bank A)		
$1-\gamma$	-	-
$2\gamma-1$	$\overline{R}/p$	-
$1-\gamma$	R^*	-
σ_B (borrowers of Bank B)		
$1-\gamma$	-	-
$2\gamma-1$	-	$\overline{R}/p$
$1-\gamma$	-	R*

Now informational rent is extracted by both banks ($\Pi_{j2}^{2cdh} = \Pi_{j2}^{cdh}$ and $\Delta\Pi_j^{2cdh} = \Delta\Pi_j^{cdh}$). The second period profits matrix is now the following:

$$
\begin{array}{ccc}
 & \multicolumn{2}{c}{B} \\
 & honest & dishonest \\
honest & (\Pi_{A2}^{is};\Pi_{B2}^{is}) & (\Pi_{A2}^{is};\Pi_{B2}^{cdh}) \\
A & & \\
dishonest & (\Pi_{A2}^{cdh};\Pi_{B2}^{is}) & (\Pi_{A2}^{2cdh};\Pi_{B2}^{2cdh})
\end{array}
$$

As $\Pi_{j2}^{2cdh} = \Pi_{j2}^{cdh} > \Pi_{j2}^{is}$, $j = A, B$, therefore both banks choose the strategy of misreporting.

Following the path of the previous discussion now we take into account the banks' awareness of the competitor's choice to report types dishonestly. Under scenario 1 the dishonest bank competitor realizes that those reported as high-ability borrowers are low-ability ones and some of the low-ability-reported borrowers are of high-ability type. Here we introduce conditional probability to meet high-ability borrower among competitor's "low-ability" clients:

$$\mu(H|L) = \frac{\gamma}{1-\gamma} \tag{40}$$

Under scenario 2 the dishonest bank competitor takes into account that the competitor's "high-ability" clients are all low-ability and there are some low-ability borrowers among those who are reported as high-ability borrowers. For second scenario we introduce the conditional probability to meet high-ability client among those who are reported by competitor as being high-ability ones:

$$\mu(H|H) = 2 - \frac{1}{\gamma} \tag{41}$$

As γ exceeds 0,5 under scenario 2, this conditional probability is positive.

Will the strategy of misreporting be profitable for banks? Consider bank A misreports the borrowers' types but bank B knows about misreporting. We mark the equilibrium by cdc.

Table 11 demonstrates the equilibrium interest rates. Bank A continues enjoying the opportunity to offer higher interest rate to all its high-ability clients, but this rate is lower than in previous case of dishonest reporting due to new conditional probability. Contracts offered to honest bank's clients remain unchanged.

Table 11. Dishonest reporting by bank A: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1		
σ_A (borrowers of Bank A)		
γ	-	-
$1 - 2\gamma$	$\frac{\overline{R}}{\mu(H|L)p}$	-
γ	-	-
Scenario 2		
σ_A (borrowers of Bank A)		
$1 - \gamma$	-	-
$2\gamma - 1$	-	-
$1 - \gamma$	$\frac{\overline{R}}{\mu(H|H)p}$	-
Both scenarios		
σ_B (borrowers of Bank B)		
γ	-	$\overline{R}/p$
$1 - \gamma$	-	-

For scenario 1 we have:

$$\Pi_{A2}^{cdc} = \sigma\gamma(p * \frac{\overline{R}}{\mu(H|L)p} - \overline{R}) = \sigma\overline{R}(1 - 2\gamma) \tag{42}$$

Given $\Pi_2^{is} = 0$, $\Delta\Pi_A^{cdc} = \Pi_A^{cdc}$. As $\gamma > 0,5$ the extra profit is positive.

Under scenario 2 a decrease of dishonest bank profit is the same:

$$\Pi_A^{cdc} = \Delta\Pi_A^{cdc} = \sigma(2\gamma - 1)(p * \frac{\overline{R}}{\mu(H|H)} - \overline{R}) = \sigma\overline{R}(1 - \gamma) > 0 \tag{43}$$

Finally we turn to the case of two misreporting banks. We mark this equilibrium with $2cdc$. Table 12 demonstrates equilibrium interest rates accepted by different groups of borrowers:

Table 12. Dishonest reporting by both banks: second period contracts

Proportion of borrowers	Bank A (dishonest): interest rates	Bank B (honest): interest rates
Scenario 1		
σ_A (borrowers of Bank A)		
γ	-	-
$1 - 2\gamma$	-	-
γ	$\frac{\overline{R}}{\mu(H\mid L)p}$	-
σ_B (borrowers of Bank B)		
γ	-	-
$1 - 2\gamma$	-	-
γ	-	$\frac{\overline{R}}{\mu(H\mid L)p}$
Scenario 2		
σ_A (borrowers of Bank A)		
$1 - \gamma$	-	-
$2\gamma - 1$	$\frac{\overline{R}}{\mu(H\mid H)p}$	-
$1 - \gamma$	-	-
σ_B (borrowers of Bank B)		
$1 - \gamma$	-	-
$2\gamma - 1$	-	$\frac{\overline{R}}{\mu(H\mid H)p}$
$1 - \gamma$	-	-

Contrary to the case of reporting borrowers' defaults under sharing information about types regime banks earn positive second period profits. Under scenario 1:

$$\Pi_{j2}^{2cdc} = \Delta\Pi_j^{2cdc} = \sigma_j \overline{R}(1 - 2\gamma) \tag{44}$$

$$(\text{j=A,B})$$

Under scenario 2:

$$\Pi_{j2}^{2cdc} = \Delta\Pi_j^{2cdc} = \sigma_j \overline{R}(1 - \gamma) \tag{45}$$

$$(\text{j=A,B})$$

Therefore the strategy of misreporting is preferred by both banks.

However whether the banks should treat each other as misreporters - as it was in case of sharing information about borrowers' types - still the question. Let us compare the extra profits for two situations. Under scenario 1 we obtain:

$$\Delta = \Pi_{j2}^{2cdc} - \Pi_{j2}^{2cdh} = \sigma_j(\overline{R}(1 - \gamma) - \gamma p R^*) \tag{46}$$

This expression is positive if:

$$p < \frac{\overline{R}(1 - \gamma)}{\gamma R^*} \tag{47}$$

Under scenario 2 the corresponding expression is the following:

$$\Delta = \Pi_{j2}^{2cdc} - \Pi_{j2}^{2cdh} = \sigma_j(-\gamma)(2\overline{R} - p R^*) > 0 \tag{48}$$

This expression is positive if:

$$p < \frac{2\overline{R}}{R^*} \tag{49}$$

Let us construct the matrix of outcomes taking into account the "don't believe the competitor" strategy:

		B			
		honest, believe	honest, don't believe	dishonest, believe	dishonest, don't believe
	honest, believe	$(\Pi_{A2}^{cs};\Pi_{B2}^{cs})$	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cs})$	$(\Pi_{A2}^{cs};\Pi_{B2}^{cdh})$	$(\Pi_{A2}^{cs};\Pi_{B2}^{cdc})$
	honest, don't believe	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cs})$	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cdc})$	$(\Pi_{A2}^{cs};\Pi_{B2}^{cdc})$	$(\Pi_{A2}^{cs};\Pi_{B2}^{cdc})$
A					
	dishonest, believe	$(\Pi_{A2}^{cdh};\Pi_{B2}^{cs})$	$(\Pi_{A2}^{cs};\Pi_{B2}^{cdc})$	$(\Pi_{A2}^{cdh};\Pi_{B2}^{cdh})$	$(\Pi_{A2}^{cdh};\Pi_{B2}^{cdc})$
	dishonest, don't believe	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cs})$	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cs})$	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cdh})$	$(\Pi_{A2}^{cdc};\Pi_{B2}^{cdc})$

Thus if the probability of the borrowers' projects' success is rather high ($\Pi_{j2}^{cdc} > \Pi_{j2}^{cdh}, j = A, B$) the banks will prefer to behave as in case of sharing information about defaults. However if this probability is low enough ($\Pi_{j2}^{cdc} < \Pi_{j2}^{cdh}, j = A, B$) under both scenarios the banks choose to misreport and to take into account that the competitor prefers the same strategy.

Table 13 demonstrates the possible first period interest rates[10]:

<div style="text-align:center">Table 13. Dishonest reporting: first period interest rate</div>

Scenario 1	$p < \frac{\overline{R}(1-\gamma)}{\gamma R^*}$	$p > \frac{\overline{R}(1-\gamma)}{\gamma R^*}$
R_{j1}	$\frac{2\overline{R}}{p}$	$\overline{R}(\frac{1+\gamma}{\gamma p}) - R^*$
Scenario 2	$p < \frac{2\overline{R}}{R^*}$	$p > \frac{2\overline{R}}{R^*}$
R_{j1}	$\frac{\overline{R}}{p}$	$\overline{R}(\frac{2-\gamma}{\gamma p}) - R^*(\frac{1-\gamma}{\gamma})$

Noteworthy we obtain negative first period interest rates for high probability of project success again. R_{j1} is negative if $p > \frac{\overline{R}(2-\gamma)}{R^*(1-\gamma)}$ for scenario 1 and if $p > \frac{\overline{R}(1+\gamma)}{R^*\gamma}$ for scenario 2. As in case of negative information sharing the interest rates should not be negative. Therefore given the probability of success is high enough the banks offer "free-of-charge loans" and obtain positive total profits.

Let us summarize our findings. We have examined the model, which allows analyzing one type of bank's opportunistic behavior - sharing false information about borrowers' types or first period experience. It shows that the banks have incentives to report dishonestly. Moreover we have offered one possible explanation of the "free-of-charge loan" phenomenon. Given that in most cases banks prefer to behave as if they do not suspend their competitors in misreporting the borrowers seem to be the only agents interested in initiating the check-up procedures.

---

[10]Extracted by putting (38), (39), (42) or (43) into (32).

4   Empirical evidence

4.1   The ways to solve the problem

In practice the problem of credit report data accuracy is being solved in two possible ways. First of all, an informational intermediary applies various sanctions to a dishonest bank. These sanctions vary from implying fines to excluding from the network. The latter variant causes the largest losses for a bank in the case of public credit registry being the informational intermediary. Mutual flows become one-sided, so the bank loses its competitive advantage, but does not receive an access to benefits of information sharing.

Secondly, informational intermediaries constantly improve their methods of accuracy control. For example experts from *Inter-American Development Bank* point out four common procedures of control: comparison with the data provided by other financial institutions, the opportunities for clients to check the data, regular statistical checks, software programs to identify abnormalities in the data. To characterize the quality of control systems an accuracy checks index was constructed. According to presence these or those procedures, this index is in the range from 0 to 4. One more important parameter is the legal requirement to respond to complaints. Table 14 presents this information (PCB - private credit bureau, PCR - public credit registry)[11]:

Table 14. Data quality

Country/region	Legal requirement to respond to complaints	Accuracy checks index (from 0 to 4)	
		PCB	PCR
Latin America	47%-yes	2,54	2,14
United States	yes	4	-
Other OECD countries	yes	2,8	3,71
Other emerging markets	42%-yes	2,6	2,73

The US data accuracy control system is considered as being the most efficient.This may be explained by long, 170-year history of informational intermediation (for comparison in Latin America the industry has a 20-year history, transition economies informational intermediaries have been functioning only for several years), and therefore by rich databases and solid experience in the sphere of technical innovations.

Private informational intermediation in European countries is limited by strict laws concerning borrowers' rights and data confidentiality. In the same time these laws provide for proper control in the sphere of data accuracy an reliability. Checking by borrowers is one of the most efficient methods of control, and in many countries the law does not impose restrictions on the quantity of times the borrower may obtain the access to his or her file free of charge.

Let us pay attention to Latin countries, where 2,5-3 out of 4 methods are commonly used, and in 53% of countries the borrowers are to prove the mistakes in their files. But the case is that the degree of trust of Latin banks is quite high: if some negative information is found in the

---

[11]"Unlocking Credit. The Quest for Deep and Stable Bank Lending", The 2005 Report on Economic and Social Progress in Latin America, Inter-American Development Bank, The Johns Hopkins University Press, Baltimore and London, Ch.13, www.iadb.com

borrower's report nearly 45% of banks will refuse to grant a loan[12]. Thus it may be supposed that even if the data accuracy control systems are not perfect, they are enough to provide that banks report honestly in necessary degree. On the other hand, this may be explained by sanctions for dishonest reporting - the topic we do not analyze here in detail.

At last it is important to outline that in transition economies, especially where the functions of informational intermediaries are performed by public credit registries, the control systems are still underdeveloped. It may explain the reason why the problems of banks' distrustfulness, unwillingness to invest money in formal credit report purchasing are still unsolved. Such sources of information as informal networks and bank's own databases prevail.

4.2 Misreporting

Another way to examine the problem, additional to how-to-solve point of view, is to look at actual data accuracy. A good example that demonstrates that theoretical results correspond with real state of affairs is surprisingly the USA. Cassady and Mierzwinski describe the results of the state Public Interest Research Groups study, which clearly demonstrate, that quite often incorrect information that the bank obtain from the intermediary influences the decision to grant a loan (Cassady, Mierzwinski, 2004). But these are not credit bureaus who should be blamed as the only wrongdoers. The mistakes of information intermediaries are mostly technical ones. The misreporting by creditors is more likely to be intentional. Cassady and Mierzwinski stress that sometimes banks deflate the credit scores of their clients in order to hide their true creditworthiness from potential competitors [13]. The report by Cassady and Mierzwinski shows that after a number of measures undertaken to improve the situation[14], the share of reports containing serious errors is still high. They asked adults from 30 states to check their credit reports for accuracy and found out that 25% of the reports surveyed contained the mistakes which in principle may cause the refusal to grant a loan (Cassady, Mierzwinski, 2004, p.11). Serious misreporting included incorrectly marking the accounts as delinquent or as being in collection, or - in the terms of our model - representing the borrower who had no defaults as a defaulter. Another reason for potential denial of loan is the fact that the consumer is over-extended in credit (the account that is already closed is reported as open one). 30% of the reports included such a mistake (Cassady, Mierzwinski, 2004, p.12) and it seems quite possible that these are not credit bureaus who are misreporting. "We're telling the story as its presented to us," says Rod Griffin, manager of public education for Experian, one of "big three" in the US credit reporting industry. "We don't make up the information. We're the messenger, which puts us sometimes in a difficult position"[15].

Given this state of affairs in the USA where the accuracy control system, as it was noted earlier, is well developed, it is not surprising that the borrowers in the countries where credit information reporting is in its infancy are likely to distrust information intermediaries. For

---

[12] According to "Unlocking Credit. The Quest for Deep and Stable Bank Lending", The 2005 Report on Economic and Social Progress in Latin America, Inter-American Development Bank

[13] The confirmation of this idea may be found in the release of the speech of chief national bank regulator, Comptroller of the Currency John D. Hawke, Jr.: "...borrowers may be rudely surprised when they discover that their good credit history as a subprime borrower isn't reflected in their credit files when they seek credit in the future and that they are unable to obtain better rates based on their good credit record".

[14] Including the Fair Credit Reporting Act (FCRA) amendments introduced in 1996 and the enactment of Fair and Accurate Credit Transactions Act (FACT Act) in December 2003 among other things aimed to enhance the accuracy of information in credit reports.

[15] Block, S., *"Fixing errors in credit report is no small task"*, USA TODAY, 12.10.2005, (www.usatoday.com)

example according to Metrobank's study, customers of Russian banks do not agree with their credit information transmission to credit bureaus because they are feared of information misreporting, not only of identity theft[16].

5   Conclusion

One of the most serious problems of the credit market caused by information asymmetry is lack of information about the borrowers. Information intermediaries are aimed to solve it, accumulating and distributing credit files, which contain credit histories and, consequently, the data on the borrowers' credit discipline. In many countries reporting to these agencies is obligatory. The reason is quite clear: the banks prefer not to share their databases, because in this case they loose the competitive advantage provided by access to exclusive information. On the other hand, the possibility to obtain the benefits of data sharing without these losses still exists: incorrect information reporting.

We have demonstrated that the banks have the incentives to report false information about credit discipline of their borrowers as well as about borrowers' intrinsic characteristics. Possessing unique databases a bank continues to extract informational rent and therefore enjoys a competitive advantage even being a member of the system of information sharing. This conclusion is driven for negative as well as positive information sharing regimes.

The banks themselves are not interested in exerting data quality control. That is why informational intermediary - an independent credit bureau or a public credit registry - should not be considered only as a mechanism of information transmission: it should perform the function of checking whether the transmitted credit files is trustworthy and reliable.

---

[16]Gazeta.ru, August, 2005

References

[1] Akerlof, G.A., *"The Market for "Lemons": Quality Uncertainty and the Market Mechanism"*, The Quarterly Journal of Economics, Vol. 84, No. 3 (Aug., 1970), pp. 488-500.

[2] Block, S., *"Fixing errors in credit report is no small task"*, USA TODAY, 12.10.2005, (www.usatoday.com).

[3] Jappelli, T., Pagano M., *"Information Sharing in Credit Markets"*, The Journal of Finance, Vol. 48, No.5 (Dec., 1993), pp 1693-1718.

[4] Cassady, A., Mierzwinski, E., *"Mistakes Do Happen: A Look at Errors in Consumer Credit Reports"*, National Association of State PIRGs, June 2004.

[5] Jappelli, T., Pagano M., *"Information Sharing, Lending and Defaults: Cross-Country Evidence"*, CSEF Working Paper №22, May 1999, revised version March 2000.

[6] Jappelli, T., Pagano M., *"Information Sharing in Credit Markets: The European Experience"*. CSEF Working Paper №22, March 2000.

[7] Jappelli, T., Pagano M., *"Information Sharing in Credit Markets: a Survey"*. CSEF Working Paper №36, March 2000.

[8] Klein, D.B., *"Credit-Information Reporting. Why Free Speech Is Vital to Social Accountability and Consumer Opportunity"*, The Independent Review, Vol.5, №3, Winter 2001, pp. 325–344.

[9] Luna, S. A., *"Case Studies of Selected Credit Bureaus in Several Latin American Countries"*, J.E. Austin Associates, Inc., October 2001.

[10] Luoto, J., McIntosh, C., Wydick, B.,*"Credit Information Systems in Less-Developed Countries: Recent History and a Test"*, mimeo, UC Berkeley, September 2004.

[11] Miller, M. J., *"Credit Reporting systems and the International Economy"*, The MIT Press, Cambridge, Massachusetts, London, 2003.

[12] Olegario, R., *"Credit-Reporting Agencies: Their Historical Roots, Current Status, and Role in Market Development"*, mimeo, University of Michigan Business School, 2000.

[13] Padilla A.J, Pagano, M., *"Endogenous Communication Among Lenders and Entrepreneurial Incentives"*, The Review of Financial Studies, Spring 1997, Vol. 10, No. 1, pp. 205-236.

[14] Padilla A.J, Pagano, M., *"Sharing Default Information as a Borrower Discipline Device"*, CSEF Working Paper №21, July 1999.

[15] Stiglitz, J.E., Weiss, A., *"Credit Rationing in Markets with Imperfect Information"*, The American Economic Review, Vol 71, No3 (June, 1981), pp. 393-410.

[16] Vercammen, J.A., *"Credit Bureau Policy and Sustainable Reputation Effects in Credit Markets"*, Economica, New Series, Vol.62, No 248 (Nov., 1995), pp. 461-478.

[17] *"Financial Sector Assessment, A Handbook"*, The International Bank for Reconstruction and Development/The World Bank/The International Monetary Fund, 2005.

[18] *"Россияне не верят кредитным бюро"*, Gazeta.ru, 11.08.2005 (*www.gazeta.ru*).

[19] *"Unlocking Credit. The Quest for Deep and Stable Bank Lending"*, The 2005 Report on Economic and Social Progress in Latin America, Inter-American Development Bank, The Johns Hopkins University Press, Baltimore and London, Ch.13.

[20] *"Comptroller Urges Industry to End Abusive Practices And Elevate Customer Service Standards"*, release of the speech by Comptroller of the Currency John D. Hawke, Jr, San-Francisco, June 7, 1999 (*http www.occ.treas.gov/ftp/release/99-51.txt*).

[21] *"Doing Business In 2004: Understanding Regulation"*, A copublication of the World Bank, the International Finance Corporation, and Oxford University Press, 2004, Ch.5.

[22] Семенова, М.В., *"Информационный обмен на рынке банковского кредитования: правда - хорошо, а счастье - лучше*, Серия препринтов "Научные доклады Лаборатории институционального анализа", WP10/2005/01, ГУ-ВШЭ, 2005.

М.В. Семенова

**Информационное посредничество
на рынке банковских кредитов:
стимулы к обмену недостоверной информацией**

(на английском языке)

Для заметок