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Zurich** <sup>UZH</sup>

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# Information Sharing as a Way to Overcome Information Asymmetries in Microfinance Markets

Bachelor Thesis in Banking and Finance

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Markets  
BA Thesis in Banking and Finance

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## **Executive Summary**

### **Relevance of Information Sharing**

The present thesis analyzes how information sharing can help microfinance institutions and their (potential) borrowers to overcome the problem of information asymmetry. It is divided into a theoretical and an empirical section, with the latter discussing, among other things, how information is shared in Brazil and Peru.

Owing to adverse selection and moral hazard, microfinance institutions cannot distinguish between good and bad borrowers. The inability to differentiate between a good and a bad borrower leads to an information gap. If this information gap is not overcome, lenders might ration credits (Stiglitz and Weiss, 1981) and extract informational rents (Jappelli and Pagano, 2000), while borrowers might apply for multiple credits without the knowledge of the lenders (McIntosh et al., 2006).

To overcome such exemplary problems resulting from information asymmetry, microfinance institutions (principals) need to align the interests of their borrowers (agents) with their own interests. As Ledgerwood (1999) observes, microfinance institutions can, for example, ask for physical collateral, frequent loan payments, compulsory savings, guarantees, or even threaten their borrowers with public embarrassment and legal action to make sure every borrower is fully motivated to pay back their credit.

Another option of non-physical collateral is information sharing via a credit bureau or a credit registry. Lenders can share data on a borrower's default history (black information), or even exchange default data (black information), along with information about the characteristics of a borrower (white information) with other lenders (Ledgerwood et al., 2013). By so doing, lenders create incentives for borrowers to put in enough effort to improve the probability of a successful investment. A successful investment enables borrowers to pay back their loans. In case a borrower defaults, they are likely to be excluded from future credit (Armendáriz de Aghion and Morduch, 2005). However, information sharing not only puts pressure on borrowers to pay back their loans but also eliminates the informational rents of lenders (Jappelli and Pagano, 2000). Failing to receive the lowest possible interest rate, a borrower can threaten to borrow from another lender. As a result, lenders face a trade-off. They need to

decide whether they want to share any information, such as only black information, which presupposes some information asymmetry, or black and white information, which theoretically eliminates any information asymmetry.

## **Theoretical Results**

This thesis focuses on the five following, theoretical models about information sharing:

- The model of Padilla and Pagano (2000) discusses the ideal behavior of two profit-maximizing banks, concluding that a bank should share black and white information about a predetermined percentage of random borrowers with its competitor. Borrowers would not put in enough effort if white information was fully disclosed. However, if only black information was disclosed, borrowers would exert too much effort.
- It can be concluded from the model of Pagano and Jappelli (1993) that profit-maximizing lenders should adapt their information-sharing behavior depending on a number of factors (see the respective chapter). If, however, the number of borrowers could be maximized, lenders should exchange both black and white information.
- The model of Vercammen (1995) suggests that profit-maximizing lenders share black information. The information should be deleted after some time, for example, by a credit bureau or a credit registry. This deletion will ensure an ideal level of effort on the part of the borrowers.
- The model of McIntosh and Wydick (2005) recommends client-maximizing microfinance institutions share black and white data without any restrictions.
- Jain and Mansuri (2005) suggest that volume-maximizing microfinance institutions share black information.

Please note that no model advises against information sharing.

## **Empirical Results**

The empirical findings of this thesis are mostly based on cross-country studies. For example, several studies find that the sharing of black and white information is the ideal way to exchange information since this may improve the access to credit (Triki and Gajigo, 2012), reduce the portfolio arrears rate of microfinance institutions (Luoto et al., 2007), and allow lenders to better estimate the credit capacity of potential borrowers (GTZ (ed.), 2001).

As mentioned earlier, the thesis gives a detailed overview of the information sharing systems prevalent in Brazil and Peru. According to Miller (2003), Brazilian lenders traditionally prefer sharing black information only. Peruvian lenders, on the other hand, tend to share both black and white information (Valdivia and Bauchet, 2005). Despite the seemingly better information quality in Peru, Brazilian credit bureaus and registries cover a bigger percentage of all adults in the country than their Peruvian counterparts (World Bank, 17.5.2013). Since the quality of data appears to be better in Peru whereas the quantity of data seems to be better in Brazil, one cannot simply conclude in which country microfinance institutions benefit more from sharing information. For this reason, the gross loan portfolios (GLPs) and the number of borrowers of Brazilian and Peruvian microfinance institutions are taken into consideration. According to MIX (9.6.2013), the gross loan portfolio and the number of borrowers of Peruvian microfinance providers grew faster than their Brazilian counterparts. Therefore, it appears that the quality of the shared data might have a bigger impact on microfinance than the quantity of the exchanged data (assuming the two countries are sufficiently similar in all aspects except for their sharing policies and credit coverage).

## **Final Remarks**

Even though the findings and results of this thesis are unambiguous most of the time, it is to be noted that the suggestions of the respective models need to be applied carefully since these models are based on simplistic assumptions which might not be realistic. Moreover, some models were constructed for a general credit market, rather than a particular microfinance credit market, which might reduce their applicability.

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## **Introduction**

This thesis seeks to show how information sharing can help microfinance credit markets to overcome the problem of information asymmetry. It does so on a theoretical as well as on an empirical basis.

Since potential borrowers of microfinance institutions are often too poor to offer physical collateral or guarantees, alternative ways are needed to align the interests of the principal (microfinance institution) and the agent (borrower). Information sharing can enable microfinance institutions to lend to borrowers without financial securities, thereby helping poor borrowers to strive for a financially better future (Ledgerwood et al., 2013). This is why information sharing is a relevant topic.

The thesis first throws light on the general issue of information asymmetry, including adverse selection and moral hazard, using, among other materials, papers of Akerlof (1970) and Stiglitz and Weiss (1981) to support the arguments made in subsequent chapters. The thesis also offers various approaches to solving the problem of information asymmetry and shows how information sharing is especially appropriate to help poor borrowers without collateral to gain access to the credit market.

The thesis then goes on to focus on theoretical models provided by Padilla and Pagano (2000), Pagano and Jappelli (1993), Vercammen (1995), McIntosh and Wydick (2005), and Jain and Mansuri (2005). It shows how different maximization problems of lenders can lead to different outcomes regarding the ideal way of sharing information. For example, it can be useful for lenders to share only information about past defaults of their borrowers (black data), or to share both information about past defaults and the characteristics of their borrowers (black and white data).

The thesis then states some empirical findings made in various parts of the world before particular attention is paid to the current way information is shared in Brazil and Peru. For this purpose, World Bank and MIX Market data were used to compare the two countries. In addition, the empirical findings are linked to the five theoretical models.

## The Agency Problem in the Context of Microfinance

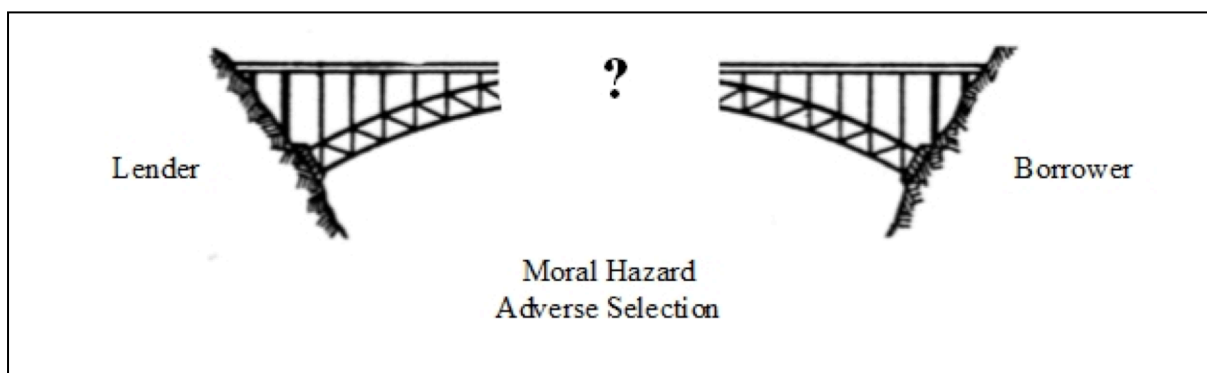
### Problems Resulting from Adverse Selection and Moral Hazard

A primary aspect of microfinance consists in providing credit to the poor. Like normal lenders, microfinance institutions face the risk of not getting their loans repaid. As a result, it is important for sustainable microfinance institutions to attract the right type of borrowers. In so doing, they increase the probability of getting their money back.

Unfortunately, however, it is not easy for a microfinance institution (principal) to gauge the ability and willingness of a borrower (agent) to pay back a loan. There are two main agency problems caused by this kind of information asymmetry—adverse selection and moral hazard.

Figure 1 illustrates the information asymmetry gap between lenders and borrowers. Owing to moral hazard and adverse selection, communication between lenders and borrowers is malfunctioning (see Figure 1). De Janvry et al. (2010) maintain that asymmetric information is particularly present in the target regions of microfinance where poor borrowers can rarely offer enough collateral to facilitate credit transactions. It can be inferred from Figure 1 that microfinance providers need to find a way to overcome this gap.

*Figure 1: The Information Asymmetry Gap*



*Source: Own figure, based on a clip art of the Florida Center for Instructional Technology, the University of South Florida (21.04.2013)*

In the following chapters, the thesis shows why moral hazard and adverse selection are central to microfinance, and how these problems can be bridged.

In consequence of information asymmetry, microfinance organizations cannot distinguish between good and bad borrowers, and are unable to charge each borrower a fair interest rate. A microfinance provider can only vary the general interest rate and try to sort good credit-takers from the bad. Stiglitz and Weiss (1981) observe that a low interest rate attracts both good and bad borrowers, whereas a high interest rate favors only bad borrowers. In an attempt to break even, microfinance institutions use the interest rate as a screening device and might feel forced to raise the interest rate to a level that excludes good borrowers from the credit market (Stiglitz and Weiss, 1981). The attraction of the unwanted, bad borrowers is referred to as adverse selection.

Moral hazard, on the other hand, implies that borrowers might not act in the interest of the principal after the two parties agreed on a contract. In the context of microfinance, some borrowers will not put in enough effort to maximize the probability that their investment is a success and some borrowers, in spite of having the wherewithal, will refuse to pay back the borrowed amount.

Stiglitz and Weiss (1981) emphasize that agency problems can lead to credit rationing and, therefore, to a state in which the demand for credit exceeds its supply (no market clearing). Assuming that microfinance providers want to offer their services to as many customers as possible, the potential exclusion of good borrowers is worrying.

However, there are also scenarios in which incomplete information does not lead to credit rationing. Armendáriz de Aghion and Morduch (2005) state that asymmetric information sometimes leads neither to inefficiency nor to market failure, creating instead distributional disadvantages for the good (safe) borrowers, who are cross-subsidizing their risky counterparts.

In his model about used cars, Akerlof (1970) comes to a conclusion similar to that of Stiglitz and Weiss (1981). According to his model, bad cars (or lemons) tend to push good cars out of the used car market. Akerlof (1970, p. 497) goes on to maintain that “credit markets in underdeveloped countries often strongly reflect the operation of the Lemons Principle.” This observation might be of relevance for microfinance institutions since they are likely to deal with borrowers from underdeveloped countries.

In markets with high competition among microfinanciers, an additional problem results from information asymmetry. According to McIntosh et al. (2006), some borrowers make use of more than one microfinance institution simultaneously, without informing the other institution(s). Usually, a borrower's risk increases if they receive more than one credit. However, the lack of credit information from other lenders leads microfinance institutions to underestimate the risk of a borrower with multiple credits. Hence, assuming high risk is charged with a high interest rate and low risk with a low interest rate, information asymmetry enables borrowers with many credits to pay rates of interest that are too low.

### **The Benefit of Information Sharing and Credit Bureaus**

According to Armendáriz de Aghion and Morduch (2005), a microfinance institution does not necessarily need to know everything about its potential borrowers in order to align the interest of the agent with that of the principal. The authors state that it is sufficient when contracts are designed in a way that borrowers have no incentive to cheat in the pre-contractual or post-contractual phase.

Since clients of microlenders are often too poor to offer physical collateral, other ways must be found to provide the principal with some kind of security. There are various ways that allow borrowers to prove their credit-worthiness to lenders. Ledgerwood (1999) mentions group guarantee as a possible solution to overcome information asymmetry since peer pressure motivates borrowers to work hard and repay their loans. She also states that frequent loan payments, compulsory savings, personal guarantees of family members, pledging assets at less than the value of the loan, the threat of public embarrassment, and the threat of legal actions (risk of jail) could limit the problem of adverse selection and moral hazard. Moreover, lenders can threaten to take away belongings which are of personal worth to the borrower, even though these items might not be of any value on a market (Armendáriz de Aghion and Morduch, 2005). In case there are only few lenders (e.g. microfinance providers), the threat to stop lending to a borrower might already be sufficient to align the interests of the lender and the borrower because the borrower would not have many alternatives to get a loan if they ruined the relationship to the initial lender (Armendáriz de Aghion and Morduch, 2005).

On top of the just mentioned (non-) physical securities, reputational collateral plays an important role in assuring lenders, such as microfinance institutions, of the borrowing

capacity and the credit-worthiness of a borrower. Reputational collateral can be built if a borrower repays their lender punctually. De Janvry et al. (2010) use the term “relationship banking” to describe reputational collateral.

An important setback of relationship banking (or reputational collateral) is that its usefulness depends on an ongoing relationship between a particular borrower and a particular lender. A borrower who would like to get a credit from another institution cannot simply transfer their reputational capital as it was the case with normal, physical collateral. Once reputational collateral is established, this immobility gives the lender a clear edge over the borrower.

To resolve the issue of reputational immobility, financial institutions can share information about their borrowers. They can do so directly or via a credit bureau or credit registry. Credit bureaus or registries and information sharing are closely related to each other.

Jappelli and Pagano (2000, p. 8) define credit bureaus (or credit reference agencies) as “typical voluntary mechanisms: they are information brokers, which operate on the principle of reciprocity, collecting, filing and distributing the information supplied voluntarily by their members.” They also state that timeliness and authenticity of the received data are important for credit bureaus. Credit reports can usually be bought for a fee from credit bureaus, which are owned privately or publicly (Ledgerwood et al., 2013).

Credit bureaus collect a variety of data, which might include demographic data, data about the loan history of a borrower, information about the enterprise profile of a borrower, and data about financial statements of a borrower (Ledgerwood et al., 2013).

In contrast to credit bureaus, credit registries are run by public institutions and their databases are filled by compulsory reports (Jappelli and Pagano, 2000). Ledgerwood et al. (2013) observe that credit bureaus normally have a wider coverage than public credit registries. However, the coverage of credit bureaus around the world is unequally distributed, reaching 4.9 percent in the Sub-Saharan Africa and 31.5 percent in Latin America and the Caribbean (Ledgerwood et al., 2013).

It is important to distinguish between two types of data, namely black and white data. Black data focuses on past and current defaults, whereas white data includes outstanding loans and

possibly positive information about the repayment behavior of a borrower (Ledgerwood et al., 2013). According to Ledgerwood et al. (2013), the majority of credit bureaus collect both black and white information about borrowers.

Credit bureaus can help to overcome the problems of information asymmetry and thereby prevent credit rationing (Jappelli and Pagano, 2000). Hence, credit bureaus can increase market efficiency and support credit growth (Ledgerwood et al., 2013). In general, credit bureaus might not only benefit lenders but also borrowers.

For example, borrowers benefit from information sharing since exchanged information reduces (or even eliminates) informational rents (Jappelli and Pagano, 2000). If lenders attempted to extract informational rents, borrowers could effectively threaten to go to another credit provider, as a result of information sharing. Their reputational capital is no longer dependent on an ongoing relationship with the initial lender.

Barth et al. (2009) find that borrowers are better protected from corruption because credit bureaus enable borrowers to make use of their reputational capital. Before the introduction of credit bureaus, borrowers might have bribed bank officials to get a loan. However, after the start of information sharing, borrowers have some bargaining power and do not need to bribe. Moreover, bribed employees of a bank would find it harder to legitimize a credit that is not approved based solely on the quality of a borrower, which is observable through the credit history (Barth et al., 2009). Thanks to information sharing, credit is attributed more efficiently, which is to the advantage of poor borrowers who might not have the means to bribe somebody to get a credit (Barth et al., 2009).

Credit bureaus allow speeding up the decision whether a credit should be provided or not, which is another advantage for potential borrowers (Ledgerwood et al., 2013). Moreover, borrowers are protected from over-indebtedness since the reports of credit bureaus warn microfinance institutions of borrowers who have already received a credit by another lender (Bennardo et al., 2008).

Finally, Ledgerwood et al. (2013) state that credit bureaus help to charge borrowers fair interest rates since the types of the borrowers are made known through information sharing. As a result, good borrowers are no longer cross-subsidizing bad borrowers.

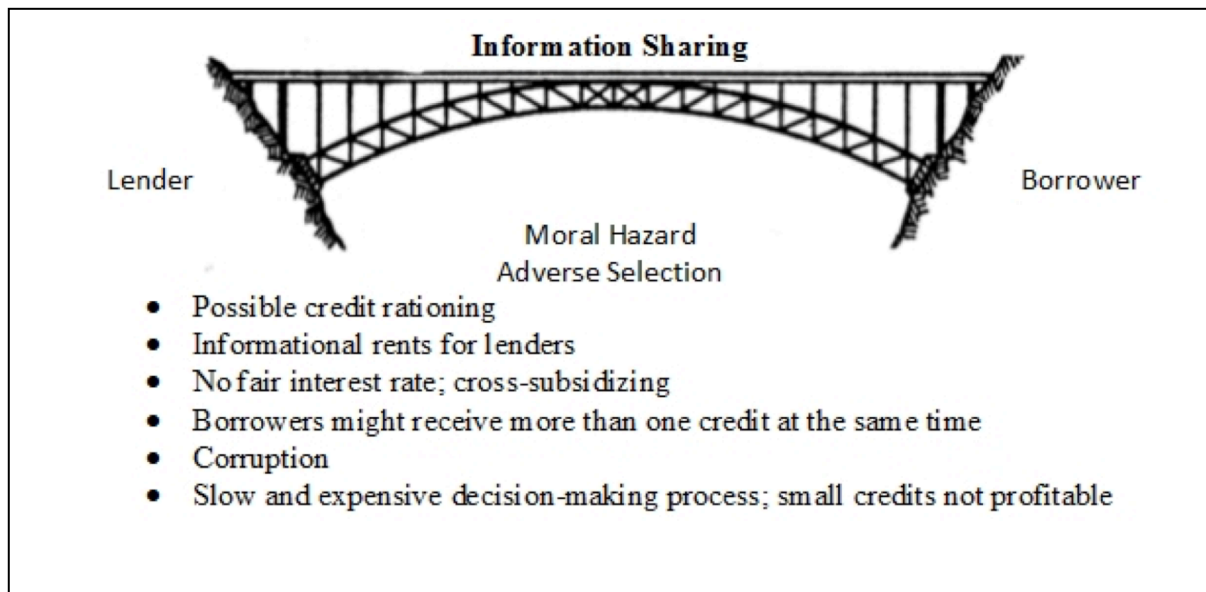
Credit bureaus are useful from a lender's point of view too since they prevent borrowers from accessing multiple credits, which leads to a lower default risk and to a healthier overall portfolio (Ledgerwood et al., 2013). However, microfinance institutions may be unwilling to share all information (black and white) with their peers since this would increase the competition for good borrowers (De Janvry et al., 2010).

Research in Guatemala provides some empirical evidence with regard to the usefulness of credit bureaus for microfinance institutions. According to McIntosh et al. (2006, p. 2), "individual loans with at least one late payment decreased from 67.2% ([...]) to 52.8%," as a result of credit bureau introduction. However, credit bureaus do not seem to have a big influence on the repayment behavior of established clients and are, therefore, more suitable to make the right choice among potential clients (McIntosh et al., 2006).

On a more general note, McIntosh and Wydick (2004) state that the credit access of poor borrowers can be improved through information sharing. Information sharing increases the efficiency of microfinance institutions and turns some previously unprofitable credits into profitable ones. As highlighted by McIntosh and Wydick (2004), less-wealthy borrowers often apply for relatively small credits that cost a lender more than they earn through repayments from the particular borrower. If an institution aims to be sustainable and independent of donor money, it might refuse to offer extremely small credits. Due to efficiency gains through information sharing, even these small credits can become profitable. The fact that slightly unprofitable loans develop into profitable ones is further strengthened by decreasing communication expenses and by better technology, both of which cause information sharing costs to drop (Meyer, 1997).

Figure 2 summarizes the advantages of information sharing. The figure shows that information sharing helps to bridge possible credit rationing, prevents lenders from extracting informational rents, helps lenders to adjust interest rates according to the risks of borrowers, prevents borrowers from accessing multiple credits at the same time without the knowledge of the lenders, and speeds up the decision whether a credit should be granted or not. In other words, Figure 2 illustrates how information sharing can play an important role in the context of the microfinance movement.

Figure 2: Information Sharing as a Bridge between Lenders and Borrowers



Source: Own figure, based on a clip art of the Florida Center for Instructional Technology, the University of South Florida (21.04.2013) and on studies by Barth et al. (2009), Jappelli and Pagano (2000), and Ledgerwood et al. (2013)

## How to Overcome Information Asymmetry: Detailed Theoretical Models

### General Assumptions

The following section will analyze the five different information sharing models. Some of the models will illustrate the usefulness of information sharing for lenders and borrowers in the normal credit market (Padilla and Pagano, 2000, Pagano and Jappelli, 1993, and Vercammen, 1995), while others were designed for the specific sector of microfinance (McIntosh and Wydick, 2005, and Jain and Mansuri, 2005).

In particular, the model of Padilla and Pagano (2000), which suggests that profit-maximizing lenders should share black as well as white information to a certain extent, deserves to be examined in greater detail. It offers some general insights into the positive and negative aspects of information sharing. As this model is discussed at great length, a critical review is included.

Subsequently, the paper also analyzes four other models, which offer a different perspective on information sharing. In contrast to the main model developed by Padilla and Pagano



(2000), Pagano and Jappelli (1993) propose a model in which imperfect competition between lenders continues to exist even after information sharing. Vercammen (1995) provides some additional reasons to the main model why full disclosure of information about borrowers might not be desirable in the long run. McIntosh and Wydick (2005) throw some light on the outcome of a credit market in which lenders are not profit-maximizers, but rather maximizers of the number of borrowers. Finally, the model of Jain and Mansuri (2005) analyzes the outcomes of a credit market in which microlenders maximize the volume of lending.

The five models stated beforehand assume that the effort of borrowers is not observable. Therefore, effort is not contractible, which results in moral hazard. However, the outcome of an investment is observable by the lender. In case of a successful investment, the repayment can be enforced without any additional cost.

The models also assume that borrowers cannot offer any collateral in any period and that they have a disutility of effort. Besides, it is generally believed that borrowers do not learn from past experiences and that their probability of success solely depends on their type, on the riskiness of their investment, and on their chosen effort level.

All else the same, lenders in these models charge an interest rate depending on the characteristics (type) of the borrower. Since the type of a borrower is often not known to microfinance institutions, past defaults can implicate the risk of a certain borrower, especially to outside lenders. Hence, if black information is shared, borrowers have an incentive to work hard, which minimizes the probability of loan default and reduces future interest rates. However, if information about the type of a borrower (white information) is known and shared, the effort level of borrowers might decrease since defaults have no influence on future interest rates anymore.

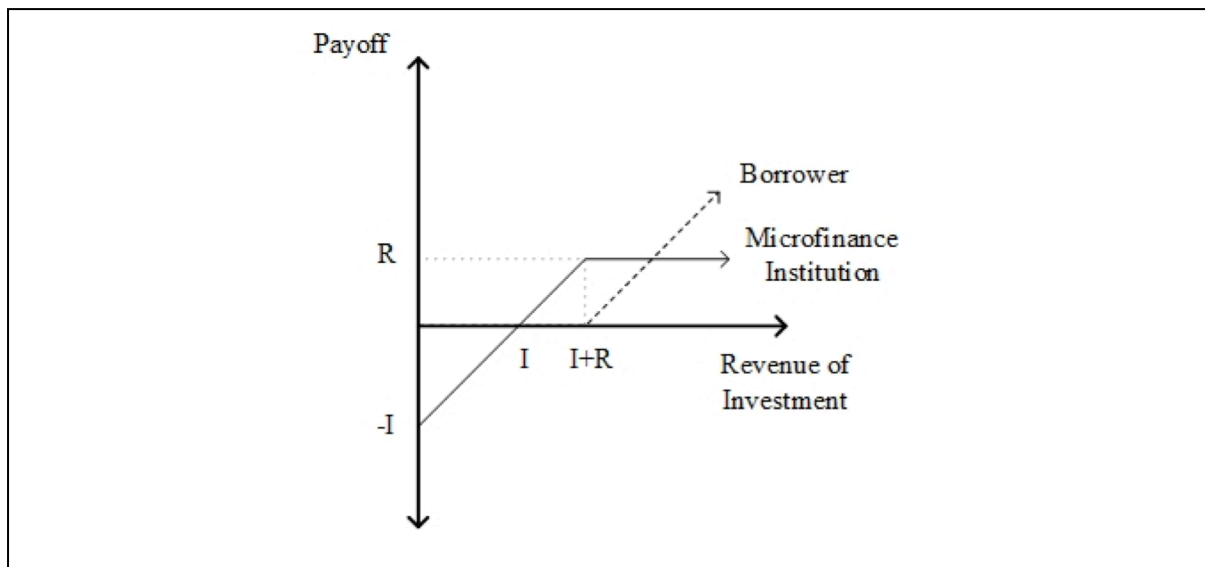
Figure 3 illustrates the payoffs of both borrowers and lenders ( $I$ =Investment,  $R$ =Interest). According to the figure, a microfinance institution receives a maximum revenue of  $I+R$  per borrower, which leads to a profit of  $R$ . Since microfinance institutions cannot earn more than the predetermined number of  $I+R$ , they prefer their borrowers to undertake a safe investment which probably does not earn more than  $I+R$  but achieves the revenue of  $I+R$  with a higher probability. Borrowers, however, might prioritize the risky investment since their earnings

are not capped. In other words, Figure 3 justifies the assumption of the models that while borrowers prefer risky ventures, lenders favor safe investments.

Figure 3 also implies that information sharing creates incentives for borrowers to achieve low interest rates in the future. The payoff of a borrower in Figure 3 resembles the payoff of a European long-call option, of which  $I+R$  would equal the strike. A lower strike in a European long-call option increases the price (value) of the derivative (Hull, 2012). Accordingly, a borrower is better off if  $I+R$  is more to the left, which means that a borrower should strive for as low an interest rate as possible.

Finally, Figure 3 illustrates the assumption that borrowers of the stated models can default, but not get a negative payoff. If a borrower is unable to pay back a loan after a certain period, it is assumed that the debt is forgiven for the next period. As a result, a borrower has a payoff which is non-negative ( $\text{Payoff}_{\text{Borrower}} \geq 0$ ). In comparison, lenders can make a deficit. For example, in the model of Padilla and Pagano (2000), lenders might incur a loss in Period 1 (which is then offset by a positive revenue in Period 2).

*Figure 3: Per-Period Payoffs of Borrowers and Microfinance Institutions, According to the Stated Models*



*Source: Own figure, based on assumptions of the models of Padilla and Pagano (2000), Pagano and Jappelli (1993), Vercaemmen (1995), McIntosh and Wydick (2005), and Jain and Mansuri (2005)*

## **Key Takeaways of Padilla and Pagano’s Model “Sharing Default Information as a Borrower Discipline Device” (Padilla and Pagano, 2000)**

### *Introduction to the Model*

As stated earlier, borrowers’ incentives to repay their loans are particularly high if information about their past defaults is shared with other lenders. The failure to repay might lead to their exclusion from the whole credit market. As a result, borrowers increase their effort, which leads to a higher probability of a successful investment. A successful investment is equal to repaying a loan, which is beneficial for the financial performance of a lender, such as a microfinance institution. However, when information is shared, lenders also face greater competition, which affects their financial performance. Hence, there is some kind of trade-off. One has to analyze whether or not information sharing is financially beneficial for a microfinance institution.

In their paper, Padilla and Pagano (2000) analyze how information sharing can alter the behavior of lenders as well as the effort level of borrowers, and show how different methods of sharing information can change the overall outcome. For example, if only information on past defaults (black information) is shared, there are other equilibria than those when information on the type of borrower (white information) is shared, too. Note that the model itself distinguishes between black and white information.

The model focuses on information asymmetry (adverse selection and moral hazard) between lenders and borrowers in general. It is, therefore, not fully applicable to the relationship of a microfinance institution and its borrowers since microfinance institutions not necessarily maximize profits, as normal lenders do.

There are some underlying assumptions and simplifications embedded in the model. Padilla and Pagano (2000) set up a two-period model in which there are only two types of borrowers, namely low-ability borrowers and high-ability borrowers. Borrowers can access capital for a one-period project and the success of an investment is positively correlated with the effort of the respective borrower. Effort is seen as some sort of cost by borrowers and it demands greater effort on the part of low-ability borrowers than their high-ability counterparts to achieve the same probability that a project is a success. Moreover, it is assumed that low-

ability borrowers always default since they exert zero effort. They participate in the credit market nevertheless.

Borrowers can ask either Bank A or Bank B for money. The offered interest rates of both banks are observable. The two banks are in competition to each other, and are aware of the proportion of high-ability borrowers ( $\gamma$ ) and the corresponding proportion of low-ability borrowers ( $1-\gamma$ ). However, they do not know whether a particular borrower is of high-ability or low-ability before lending money to that borrower at least once.

If a borrower is successful, they earn  $R^*$  units (compared to the initial investment of one unit), whereas they earn zero units in case of a failure. Since borrowers have no collateral, they can only repay the bank if their project is successful. It is assumed that the outcome of the investment (success or failure) is observable by the lending bank (but not by the outside bank). A borrower is forced to fulfill the contract; they cannot run away or hide the wealth earned through the investment. In other words, there is no moral hazard once the outcome of the investment is known.

It is also noteworthy that borrowers who defaulted in Period 1 do not need to carry these debts to Period 2. The height of the interest rate in the second period depends only on the ability of a borrower (high-ability or low-ability). There is no additional fee charged to an unsuccessful borrower, intending to cover the losses of the first period.

#### *Optimization Problem in the Model of Padilla and Pagano (2000)*

High-ability (H) Borrower  $i$  maximizes their expected utility  $U_H(p(i))$ , which depends on the success probability  $p(i)$ , on the excess return of the investment in Period 1 ( $R^*-R_{j1}$ ) and Period 2 ( $R^*-E(R_{j2}^H)$ ), and on the disutility of effort  $V(p(i))$ . It is assumed that  $V(p(i))$  is an increasing, convex function, which means that a higher probability of success corresponds to more disutility of effort. Note that  $j$  can be either Bank A or Bank B. The interest rate charged by Bank  $j$  in Period 2 might depend on whether Borrower  $i$  has defaulted or repaid in Period 1, and is thus an expected interest rate. A slightly modified version of Padilla and Pagano (2000, p. 1956) can be found in Figure 4, which provides an overview of this passage.

Figure 4: Utility Function of a High-Ability (H) Borrower  $i$

$$U_H(p(i)) = p(i)(R^* - R_{j1}) + p(i)(R^* - E(R_{j2}^H)) - V(p(i))$$

Source: Modified from Padilla and Pagano (2000, p. 1956)

If a high-ability borrower receives no credit, their success probability ( $p(i)$ ) will obviously equal zero. In this case, it can be inferred from Figure 4 that their expected utility  $U_H(p(i))$  will be zero, too. Further, according to Figure 4, a given high-ability borrower tries to minimize the interest rates they are charged ( $R_{j1}$  and  $R_{j2}^H$ , respectively), since a high interest rate negatively affects their expected utility. Therefore, a borrower chooses the bank that offers the lower interest rate, which implies that Bank A and Bank B are in a competitive environment.

Banks (lenders) maximize their total profits over the two given periods. They do so by first finding the interest rates and profits for Period 2, before repeating the same process for Period 1 (backward induction). However, there is more than one profit function that needs to be maximized by the banks (in contrast to the single utility function of borrowers) since the functions of both Bank A and Bank B depend on the kind of information that is shared. Instead of getting into details, this thesis provides only an overview of the decision-making process each bank faces (Figure 5).

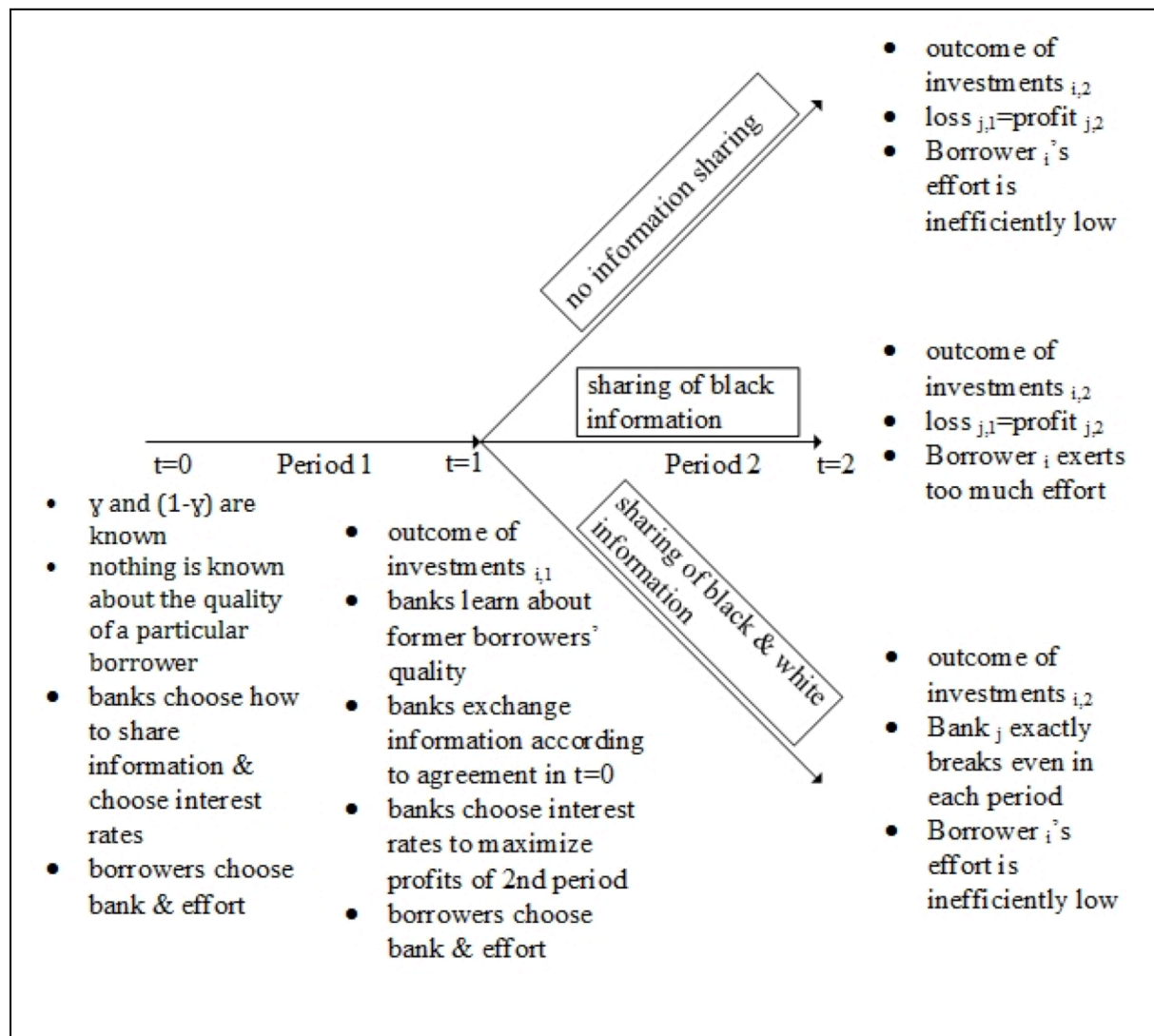
It can be stated that banks are able to offer lower interest rates if high-ability borrowers, on average, exert more effort than they usually do.

Figure 5 shows that lenders (banks) need to decide at  $t=0$  on what kind of information they should share at  $t=1$ . If banks decide not to share any information, or only information on past defaults, they will extract a positive informational rent in Period 2, which equals the profit in Period 2. The situation of the two banks is comparable to the two companies in a Bertrand Competition. In a Bertrand Competition, two companies lower their prices until each of them makes zero profit (Frank, 2010). Similarly, the two banks have to lower their offered interest rates until they make zero profit over the two periods. Therefore,  $|\text{profit}_{j,1}| = \text{profit}_{j,2}$  if no information or only black information is shared. By contrast, if both black and white information is shared, both banks need to break even in each period, which means that their

profit for each period equals zero ( $\text{profit}_{j,1} = \text{profit}_{j,2} = 0$ ). Thus, the two banks are not able to extract any kind of informational rents in case of complete information sharing.

Figure 5 also implies that banks have no knowledge about the quality of an individual borrower at  $t=0$  and that they maximize the revenue in Period 1 depending on the percentage of high-ability borrowers ( $\gamma$ ). Once the first period is over, a bank learns about the type (high-ability or low-ability) of the borrowers to whom it has lent in Period 1. However, a bank still knows nothing about the borrowers of its competitor.

Figure 5: Information Sharing according to Padilla and Pagano (2000)



Source: Own figure, based on the model of Padilla and Pagano (2000)

In case of no information sharing, banks can distinguish only among their previous borrowers from Period 1 and extract informational rents in Period 2. If the competing Bank B tried to offer a lower interest rate for Period 2 to an unknown former client of Bank A, Bank A would undercut this rate when the particular borrower was of high ability and not make a counteroffer when the particular borrower was of low ability (and vice versa). Therefore, under this information regime, Bank j would not try to compete for the former clients of the other bank and charge its own former high-ability borrowers high interest rates in Period 2. Despite the informational rents of Period 2, banks do not make a profit over the two periods. As a result of competition, banks are forced to set the interest rates for Period 1 at such a low level that they make negative profits in Period 1, which offset the positive profits of Period 2. Again, if Bank j would offer only a slightly higher interest rate for Period 1 than the other bank, all clients would choose the bank with the lower interest rate, which is definitely not the best choice for Bank j.

No information sharing leads to an inefficiently low effort level since high-ability borrowers know that no information about their type is shared. Consequently, they have no incentive to maximize the probability of success of their investments in Period 1. A borrower's type will be unveiled (but not shared) by their lender after the first period anyway, no matter whether the investment was a success or not. Hence, the outcome of the investment in Period 1 (default or no default) affects neither the interest rate of Period 1 nor that of Period 2, under this information regime. The effort level remains inefficiently low. No information sharing might lead borrowers to exert zero effort, which leads to a market collapse.

In case of information sharing about defaults (black information), banks inform the respective competitor on whether a borrower defaulted in Period 1 or not. Thus, a borrower who paid off their loan in Period 1 must be a high-ability borrower (low-ability borrowers always default) and can demand low interest rates for Period 2. If a borrower is not able to pay off their loan at the end of the first period, their type will be unveiled by the former lender only. The outside bank is left unclear whether a borrower who defaulted in Period 1 is a high-ability borrower or not. Hence, the initial lender has some leverage about high-ability borrowers who defaulted in Period 1. In the equilibrium, banks lend to their former high-ability borrowers only. It is not optimal to undercut the interest rate for former borrowers of the competing bank. However, banks charge their initial high-ability clients different interest rates, depending on whether a borrower could use information sharing to their advantage. As

a result, high-ability borrowers who defaulted in Period 1 need to accept a higher interest rate than borrowers who did not default in Period 1. Banks make little informational rents in Period 2 through the interest rates charged to the high-ability borrower who defaulted in Period 1. Unsurprisingly, the informational rents are again offset by the loss each of the banks suffers in Period 1.

If only information on default is shared (black information), there is an incentive for a high-ability borrower to maximize the probability that their investment yields success. Otherwise, a high-ability borrower who defaulted in Period 1 cannot be differentiated from a low-ability borrower by the outside bank and is charged too high a rate of interest. Under the regime of information sharing about defaults only, there is an equilibrium in which borrowers exert zero effort, leading to a market collapse (as it is the case under no information sharing). Normally, however, black information sharing increases the probability of a fully functional credit market. Nevertheless, it is not necessarily true that more effort automatically correlates with a more efficient outcome. The disciplinary effect of information sharing only on defaults can lead borrowers to work inefficiently hard.

In case of complete information sharing, high-ability borrowers can force the banks to charge them a competitive interest rate for Period 2 since both banks learn about each borrower's quality at the end of Period 1. As a result, banks make zero profit in the second period. Competition forces banks to set the interest rate for the first period so low that they also make zero profit in Period 1.

Under complete information sharing, high-ability borrowers can be sure that their true type is unveiled and shared to the outside bank, even if they default in Period 1. Thus, high-ability borrowers have no incentive to maximize the probability that their investment is a success for the sake of a lower interest rate in Period 2. In all the equilibria of the complete information sharing regime of this model, borrowers do not work hard enough to achieve an efficient level, which leads to a relatively low  $p(i)$ . Padilla and Pagano (2000, p. 1970) state that complete information sharing can even lead to “a collapse of the credit market.”



### *Conclusion: How to Apply the Model to Microfinance*

Banks make zero profit anyway and it is therefore not important for them how information is shared (no information, black information, or black plus white information). Accordingly, microfinance institutions would not care whether and how information is shared, from a financial point of view.

For high-ability borrowers, however, it is crucial that the effort level  $p$  is sufficiently high since there could be a market collapse otherwise.

Moreover, the authors of the model state that the added interest rate for high-ability borrowers over the two periods remains the same, no matter which information regime is chosen. Padilla and Pagano (2000, p. 1964) define the total interest rate that a high-ability borrower has to pay over the two periods (if there is positive lending) as  $\frac{\check{R}(1+\gamma)}{p\gamma}$ , where  $\check{R}$  is the rate at which banks can raise capital. Since the percentage of high-ability borrowers ( $\gamma$ ) and  $\check{R}$  are exogenously given, high-ability borrowers can only influence their overall interest rate level by adapting the effort level, which is positively correlated with the probability of success  $p$ . Figure 4 implies that low interest rates have a positive influence on the expected utility of a high-ability borrower. To minimize the interest rates of the two periods and therefore positively influence the expected utility of a particular high-ability borrower, the average effort level of high-ability borrowers should be as high as possible, which would lead to a high  $p$ .

As a result, microfinance institutions should choose to share information about defaults only (black information) because such information sharing involves the highest level of effort, which, in turn, holds the promise of the lowest possible interest rate. The downside of this information regime is that in some cases borrowers put in rather too much effort, which is not efficient anymore; the disutility of the high effort on the utility function becomes bigger than the positive influence of low interest rates (see Figure 4). Fortunately, there is a solution to overcome the problem of excessive effort. Lenders (microfinance institutions) could share information about the defaults of their borrowers and add information about the type (white information) of a determined percentage of random borrowers. Since sharing information about the type of a borrower lowers their incentive to perform, the combination of black information and some white information can add to the welfare of high-ability borrowers.

Thus, according to the model of Padilla and Pagano (2000), microfinance institutions should share information about defaults and enrich this data with information about the type of some random borrowers, if borrowers' effort is inefficiently high.

### *Critical Review*

The model of Padilla and Pagano (2000) hinges on some simplistic assumptions which do not seem to be realistic. First, it assumes perfect competition, which means that there are no transaction costs, among other things. However, it appears reasonable to believe that serving borrowers in real credit markets is not for free. Second, the model only includes two possible borrower ability levels (high-ability and low-ability). A continuum of ability levels might be more realistic. Third, it seems illogical to assume that a borrower who is sure to default and enjoys no financial benefits will participate in the credit market. Please note, however, that these three previous assumptions do probably not impact the optimal sharing behavior.

On the contrary, the assumption that debt is forgiven for Period 2 could seriously influence the outcome of the model. As stated, the effort level of high-ability borrowers in case of no information sharing and in case of complete information sharing is likely to be inefficiently low, which can lead to a market collapse. To adjust the effort of borrowers to an efficient level, the model suggests sharing black as well as white information about some borrowers. However, if debt from Period 1 was not forgiven for Period 2, high-ability borrowers had an additional incentive to work hard (increase  $p(i)$ ) since a default would lead to higher costs in the future. A higher effort level, in turn, might help to overcome the problem of a possible market collapse and consequently, serve as a complement (or substitute) for information-sharing mechanisms. This finding could alter the theoretically optimal information-sharing policy. If past defaults were not forgiven, the sharing of no information or the sharing of black plus white information could be as good or even superior to the recommendation of the original model. Since defaults are often not forgiven in real life either, the drop of the initial assumption might considerably improve the applicability of the model and help to gain some valuable insight into an ideal information-sharing strategy.

## **Key Takeaways of Pagano and Jappelli's Model "Information Sharing in Credit Markets" (Pagano and Jappelli, 1993)**

### *Introduction to the Model*

The model of Pagano and Jappelli (1993) shows how banks cope with adverse selection in the credit market. The model does not distinguish between black information and white information, and when it comes to information sharing, the model assumes "full information sharing" about "types" (both black and white information) (Pagano and Jappelli, 1993, pp. 1694 and 1700).

There are two actors in the model, banks and borrowers. Banks maximize their profits, whereas borrowers attempt to minimize the interest rate for their investment. There is a percentage  $p$  of safe borrowers and a corresponding percentage  $(1-p)$  of risky borrowers. Risky borrowers have a lower probability of repaying a loan. However, this probability is not equal to zero, as it is in the model of Padilla and Pagano (2000).

There are  $M$  towns, each including one bank. At first, the banks are not allowed to compete for borrowers of other towns. As a result, banks offer their services only to the people of their town. Subsequently, this constraint is eased and the banks feel the pressure of competition. Unlike other credit models, such as Padilla and Pagano (2000), it does not advocate perfect competition. It takes outside banks an additional cost  $c$  to provide services to borrowers from other towns. For this reason, banks still make profit, even if information is shared.

The model analyzes how information sharing impacts the lending behavior and the profits of the banks under both scenarios (with and without competition). Furthermore, it describes how information sharing can increase or decrease lending volume, depending on whether or not safe borrowers are excluded from the credit market owing to astronomical interest rates.

In the model, a proportion ( $m$ ) of the borrowers of each town moves to other towns in each period. The type of these immigrants, risky or safe, is unknown to the bank of the respective new town. Banks only know about the type of borrowers who lived in their town for at least one period. Three different interest rates are charged— $R_s$  for safe borrowers,  $R_r$  for risky borrowers, and  $R_m$  for immigrants.

### *Optimization Problem in the Model of Pagano and Jappelli (1993)*

Initially, it is assumed that banks face no competition from other lenders and that they can set interest rates as a monopolist. As stated, banks differentiate between safe borrowers, risky borrowers, and immigrants. Banks raise the interest rates for known risky borrowers and safe borrowers in such way that people in both groups have no consumer surplus anymore. Equivalently, Pagano and Jappelli (1993, p. 1696) state that “for these households ([...]) the marginal value of the loan equals its interest cost.” In contrast, the interest rate charged to unknown immigrants depends on whether the banks’ profits are higher if safe immigrants stay or leave the market. If safe immigrants stay in the market, immigrants will consist of  $p$  safe borrowers and  $(1-p)$  risky borrowers. However, if the interest rate charged to all immigrants is above a given level, safe immigrants are no longer willing to borrow and drop out of the credit market. In this case, the interest rate for risky borrowers is equivalent to the interest rate for immigrants ( $R_r=R_m$ ). In any case, high mobility ( $m$ ) lowers the expected profits of banks.

Following this basic analysis, Pagano and Jappelli (1993) introduce competition between banks. Information sharing helps lenders to distinguish between safe and risky borrowers, which allows for price discrimination. However, lenders are under pressure to lower their interest rates because borrowers can choose to go to another lender. In other words, borrowers’ reputational collateral is no longer bound to a single lender; rather, it is now common knowledge among lenders.

The effect of information sharing on the volume of lending is unclear in the case of no competition among lenders. However, information sharing definitely increases the lending volume under competition.

As a result of competition, lenders would normally make zero profit. In this model, however, each bank faces an additional cost  $c$  if it wants to compete for borrowers of other towns. Therefore, a native bank has a cost advantage over outside banks and can still extract some consumer surplus as long as the interest rate it offers is just as competitive as the offer of outside banks. The larger the  $c$ , the greater is the incentive for lenders to share information since their cost advantage over outside lenders is relatively big. Nevertheless, information sharing forces lenders to decrease interest rates and consequently, they lose out on some

informational rents even when  $c$  is large. However, the additional lending volume makes up for the reduced profit due to decreased interest rates, which means that lenders are willing to share information if  $c$  is large enough.

### *Conclusion: How to Apply the Model to Microfinance*

Lenders are encouraged to share information when borrowers are heterogeneous, mobile, and large in number. In contrast, lenders might be discouraged to share information with their competitors when the cost advantage over outside lenders is not big enough and as a result, information sharing can decrease profits.

Hence, profit-maximizing microfinance institutions should carefully analyze whether the additional lending volume makes up for the reduced interest rate if  $c$  is small and information sharing can be introduced.

However, it seems reasonable that not all microfinance institutions are interested in maximizing profits; rather, their goal could be to help poor borrowers to get access to the credit market. The model suggests that information sharing increases lending volume if there is competition in the credit market. Therefore, competing microfinance institutions attempting to maximize the lending volume should consider setting up a credit bureau and sharing black and white information even if they have no significant cost advantage over their competitors.

### **Key Takeaways of Vercammen’s Model “Credit Bureau Policy and Sustainable Reputation Effects in Credit Markets” (Vercammen, 1995)**

#### *Introduction to the Model*

The model of Vercammen (1995) shows how a borrower can overcome information asymmetry, such as adverse selection and moral hazard, through the use of reputational capital. The model further explains how reputational capital in credit markets increases borrowers’ welfare and how this positive effect can be sustained in the long run. Surprisingly, the model also suggests that optimal aggregate borrower welfare requires some level of

adverse selection and consequently, one should not completely overcome information asymmetry.

A unique aspect of the model is that it does not analyze whether and how lenders should share information, or how competition influences the outcome of information sharing. Instead, it assumes that there is a credit bureau that provides each lender with the same information about previous defaults of borrowers. Note that information about defaults is only black information and hence, lenders do not learn about the type of a specific borrower. However, lenders use the information about past defaults to approximate the type of the borrower and to set an appropriate interest rate. The longer the credit history of a borrower is, the better it is for lenders to estimate their quality. It is impossible to find out anything else about a borrower other than the default data, which is common knowledge among lenders.

Lenders cannot observe the actions of a borrower once they receive a credit. The model assumes that borrowers would normally choose risky projects and a low level of effort, which is not in the interest of lenders. However, borrowers with a low default rate are rewarded with a comparatively lower interest rate in the future and as a result, choose safe investments and a high level of effort to build reputational capital.

As opposed to other models, this model assumes that there are not only two types of borrowers (low-ability and high-ability), but that there is a continuum of borrowers whose only difference is their disutility of effort  $\theta$ . A higher  $\theta$  corresponds to a harder working borrower with a relatively low disutility of effort. Since effort is positively correlated with a successful investment, borrowers with a relatively higher  $\theta$  are charged a relatively lower interest rate if their type is known to a lender.

Lenders learn about the type of their borrowers through repeating information about the outcome of an investment (default or no default). In other words, lenders receive black information about a particular borrower at the end of each period and use this information to figure out the type of the borrower (white information). Note that the model itself does not use the terms “black” and “white” information. The terms are applied since they correspond to the description of Vercammen’s (1995) model and allow for a comparison with other models of this thesis.

Even though the interaction between lenders and borrowers takes  $T$  periods in this model, borrowers need to repay their loan at the end of each period. Consequently, borrowers can also change their lenders at the end of each period, which is conducive to a competitive environment.

#### *Optimization Problem in the Model of Vercammen (1995)*

Borrowers receive a loan of size one and repay the initial loan plus an interest  $1*(1+r)$ . They are risk-neutral and in each period choose a lender that offers the lowest interest rate ( $r$ ). Hence, borrowers maximize their expected utility through minimizing  $1*(1+r)$ . They do so not only for the current period, but also for the periods to come, knowing that more effort in the current period decreases the probability of default and therefore, positively impacts future interest rates. However, borrowers do not necessarily put in maximum effort since a high effort level is also seen as costly and reduces the expected utility of a borrower.

Lenders set the interest rate for each borrower depending on their credit history. The credit history of a borrower is common knowledge, which forces lenders to offer a competitive interest rate. For example, lenders set the interest rate for each borrower at such a level that they can exactly cover their opportunity costs. Thus, lenders only break even, even though their attempt is to maximize profits.

#### *Conclusion: How to Apply the Model to Microfinance*

In this model, borrowers exert extra effort to be rewarded by lower interest rates in the following periods, which adds to their welfare since it also partly overcomes information asymmetry. Otherwise, interest rates would be suboptimally high.

As stated, lenders get to know a borrower better and better over time until they nearly know about their type. In other words, adverse selection vanishes gradually and reputational capital becomes meaningless, as a result. The reduction of adverse selection is reasonable from a fairness point of view since every borrower can then be priced according to their actual risk (type), which reduces cross-subsidizing. It is stated, however, that the aggregate borrower welfare decreases since the gain of higher-ability borrowers (high  $\theta$ ) is more than offset by

the loss of lower-ability borrowers (low  $\theta$ ). Therefore, if credit histories are too long, reputation effects result in a lower level of aggregate borrower welfare.

Since microfinance institutions might look to increase the total welfare of their borrowers, they should be concerned about the disappearance of adverse selection. Vercammen (1995) states that governmental interventions can help to overcome the problem of long credit histories by limiting the time during which default data is accumulated and by forcing credit bureaus to delete old data.

Hence, according to the model, microfinance institutions should set up a credit bureau to share black information, and advise the government of their respective countries to make sure that old data is deleted.

### **Key Takeaways of McIntosh and Wydick's Model "Competition and Microfinance" (McIntosh and Wydick, 2005)**

#### *Introduction to the Model*

The model focuses on a credit market in which microfinance institutions do not maximize profits, but rather maximize the number of borrowers. McIntosh and Wydick (2005) did not create a model about the general credit market but introduced a concept that clearly emphasizes the needs and singularities of lending to poor borrowers.

The model does not distinguish between high-ability and low-ability borrowers. Instead, it differentiates between poor and wealthy borrowers, and between impatient and patient borrowers. The authors rank borrowers based on their wealth from  $k_1$  to  $k_n$ , where  $k_1$  corresponds to the poorest borrower and  $k_n$  to the wealthiest one. The model assumes that borrowers can only access credit through a moneylender or through microfinance institutions. Moneylenders have higher costs of capital and as a result, have difficulties competing with microfinance institutions. Moreover, McIntosh and Wydick (2005, p. 286) use terms such as "lista negra" and "lista blanca," which correspond to black information and white information, respectively.



Wealthier individuals are more likely to repay their loans than poorer borrowers, and a larger loan is riskier than a smaller loan. Hence, the interest rate for poor borrowers and that for larger loans should be the highest. Higher interest rates can be circumvented by cross-subsidizing poor borrowers, and by multiple small loans instead of one big loan. It is obvious that multiple loans are not desirable from a microfinance institution's point of view. McIntosh and Wydick (2005) come up with the idea of credit bureaus as a possible solution for the problem of multiple loans.

#### *Optimization Problem in the Model of McIntosh and Wydick (2005)*

Prior to introducing credit bureaus and information sharing, the model analyzes how competition of an additional microfinance institution influences the welfare of the poor borrowers and the number of loans. Initially, there was only a moneylender and a single, client-maximizing microfinance institution competing for borrowers.

A microfinance institution maximizes the number of their clients under the restriction of a balanced budget. It makes profits on wealthier borrowers and uses the surplus to cross-subsidize poorer borrowers. To maximize the number of borrowers, the microfinance institution starts subsidizing borrowers who are only slightly unprofitable ( $k_{\text{slightly unprofitable}}$ ) and then cross-subsidizes  $k_{\text{slightly unprofitable}-1}$ , etc. This process is finished when the microfinance institution runs out of surplus of profitable borrowers. Hence, if the surplus of profitable borrowers is not high enough, the poorest borrowers are not able to receive a credit from the microfinance institution and are forced to pay the high interest rates to the moneylender.

If a client-maximizing microfinance institution is not only competing with a moneylender but also with a profit-maximizing microfinance institution, the client-maximizing microfinance institution also becomes profit-maximizing as a result of competition. Bertrand Competition (see Frank, 2010) ensures that both microfinance institutions make zero profits, and consequently, poor borrowers do not benefit from cross-subsidizing. Therefore, competition in this model helps wealthier borrowers and harms poorer borrowers.

A borrower can be poorer or wealthier, and more patient or less patient. All borrowers try to minimize the interest rate they are charged. On top of that, less patient borrowers try to

maximize the size of their loan. As stated earlier, a larger loan is riskier and increases the probability of default. Nevertheless, impatient borrowers prioritize their current utility and neglect the fact that a larger loan probably decreases their utility in the future. Hence, interest rates for impatient borrowers should be risk-adjusted and increased. However, the lack of information sharing enables less patient borrowers to receive multiple loans from different microfinance providers. The total interest rate of the multiple loans is lower than the interest rate of one large loan. Microfinance institutions know about the additional risk in the market caused by multiple lending, but are unable to spot the impatient borrowers and charge them a higher interest rate. As a result, the average interest rate in the credit market rises to the disadvantage of patient borrowers. Marginally profitable loans are not profitable anymore and the poorest borrowers ( $k_{low}$ ) are dropped by microfinance institutions due to information asymmetry aggravated by multiple loans.

*Conclusion: How to Apply the Model to Microfinance*

Competition and multiple loans are problems for client-maximizing microfinance institutions. Both issues force the poorest borrowers out of the credit market.

It is suggested that these problems can either be solved through collusion between microfinance institutions or through information sharing. Collusion would allow microfinance institutions to extract profits from wealthier borrowers with the intent to cross-subsidize unprofitable, poorer borrowers. However, collusion might not be desirable in a free market economy. Information sharing, on the other hand, can overcome the problem of multiple loans, which is why McIntosh and Wydick (2005) recommend microfinance institutions maintain a “lista negra” as well as a “lista blanca”.

Therefore, McIntosh and Wydick (2005) suggest that credit bureaus which share black and white data are necessary in credit markets with more than one microfinance institution to protect some of the poorer borrowers from missing out on credit from microfinance institutions.

## **Key Takeaways of Jain and Mansuri’s Model “Information Sharing among Competing Microfinance Providers” (Jain and Mansuri, 2005)**

### *Introduction to the Model*

The goals of microfinance institutions are not necessarily comparable to those of normal lenders, with the latter being more interested to maximize profits to satisfy their shareholders. Microfinance institutions can set themselves various goals, such as to provide the poorest with credit. Other possible aims of a microfinance institution could be to reach as many borrowers as possible or to maximize the volume of lending. The latter is described in the model of Jain and Mansuri (2005).

The model is not created for the general credit market; rather, it is designed for the specific context of microfinance. It has some similarities with the model of Pagano and Jappelli (1993) since it also assumes that a local bank has some kind of informational advantage over outside banks.

In this two-period model, it is assumed that there are some good and some bad borrowers. The latter always default. Each borrower can invest their loan in a safe or in a risky way. The risky method is in the favor of good borrowers since the expected payoffs of risky projects are higher than the payoffs of safe projects. Lenders, however, always earn the predetermined interest on the loan. The safe method leads to a higher probability of repayment. Hence, lenders prefer the safe method.

### *Optimization Problem in the Model of Jain and Mansuri (2005)*

If microfinance institutions want to maximize the volume of lending, they try to offer loans which are larger than the size borrowers desire. In other models, such as McIntosh and Wydick (2005), it was the borrowers who requested larger loans, leading to the problem of multiple loans. Hence, in the model of Jain and Mansuri (2005), there is the opposite problem concerning the size of a loan.

Under no information sharing, it is assumed that local microfinance institutions know more about local borrowers than do outside lenders. Under these circumstances, a microfinance

institution that maximizes the volume of lending offers the largest possible loan that still fits its break-even constraint, knowing that borrowers will choose the risky approach since there is no incentive for borrowers not to do so. Without information sharing, it is not beneficial for borrowers to choose an outside microfinance institution since outside lenders are not aware of the quality of borrowers and consequently, do not offer a competitive loan size. For this reason, local microfinance institutions can force borrowers to accept a larger loan size as initially wanted by the borrower in both periods if no information is shared. The borrower, in turn, chooses a risky way of investing under no information sharing.

*Conclusion: How to Apply the Model to Microfinance*

Jain and Mansuri (2005) state that information sharing is a useful way to increase the volume of lending.

Because of information sharing, borrowers will choose a safe investment instead of a risky one. A safe investment reduces the probability of default. A successful investment, in turn, gives borrowers some leverage in negotiations in Period 2. Borrowers are then able to receive the loan amount they want.

Note that the model does not differentiate between black and white information. However, the fact that good borrowers try to maximize the probability of a successful investment in Period 1 leads to the conclusion that only black information is shared. If black as well as white information was shared, good borrowers would not choose the safe investment since their type would be known to the other lenders in Period 2 anyway, even if they defaulted in Period 1 (see Padilla and Pagano, 2000).

Microfinance institutions have financial incentives to share information with their competitors. The prospect of better loan conditions in the future motivates good borrowers to choose the safe investment over the risky investment, which increases the chance that lenders will be repaid and eases their financial constraint. An easier constraint leads lenders to increase the size of the loans in Period 1. The model assumes that the lenders' overall volume is larger if information is exchanged since the larger loans from Period 1 make up for the smaller loans from Period 2, which result from information sharing.

Assuming the volume of loans should be increased, microfinance institutions should share black information, according to the model of Jain and Mansuri (2005).

### **The Outcomes of the Models in Comparison**

In preceding sections of this thesis, models of Padilla and Pagano (2000), Pagano and Jappelli (1993), Vercammen (1995), McIntosh and Wydick (2005), and Jain and Mansuri (2005) have been explained. In the following, the outcomes of the respective models are accumulated to allow for a conclusion on how information should be shared by microfinance institutions.

Table 1 offers an overview of the previous models. According to Table 1, it is not clear whether microfinance institutions should only share black information or share black as well as white information. Depending on the goals of microfinance institutions, they should change the degree to which they share information, as one can deduce from Table 1.

Interestingly, not sharing any information about borrowers is not a superior strategy in any of the described models, as stated in Table 1. Therefore, the five analyzed models of this thesis suggest that microfinance institutions should make use of credit bureaus and exchange information depending on their circumstances and goals.

Table 1: Summary of the Discussed Models

Padilla and Pagano (2000)	Pagano and Jappelli (1993)	Vercammen (1995)	McIntosh and Wydick (2005)	Jain and Mansuri (2005)
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Maximization of Problem of Microfinance Institutions	Profit Maximization	a) Profit Maximization b) Number of Borrowers)	Profit Maximization	Number of Borrowers	Volume of Lending / Size of Loans
Suggested Method of Information Sharing	Black and White Information about a Predetermined Percentage of Random Borrowers	a) Depends on a Variety of Factors b) Black and White Information	Black Information + Government that Deletes Data of a Certain Age	Black and White Information	Black Information

Source: Own table, based on assumptions of the models of Padilla and Pagano (2000), Pagano and Jappelli (1993), Vercammen (1995), McIntosh and Wydick (2005), and Jain and Mansuri (2005)

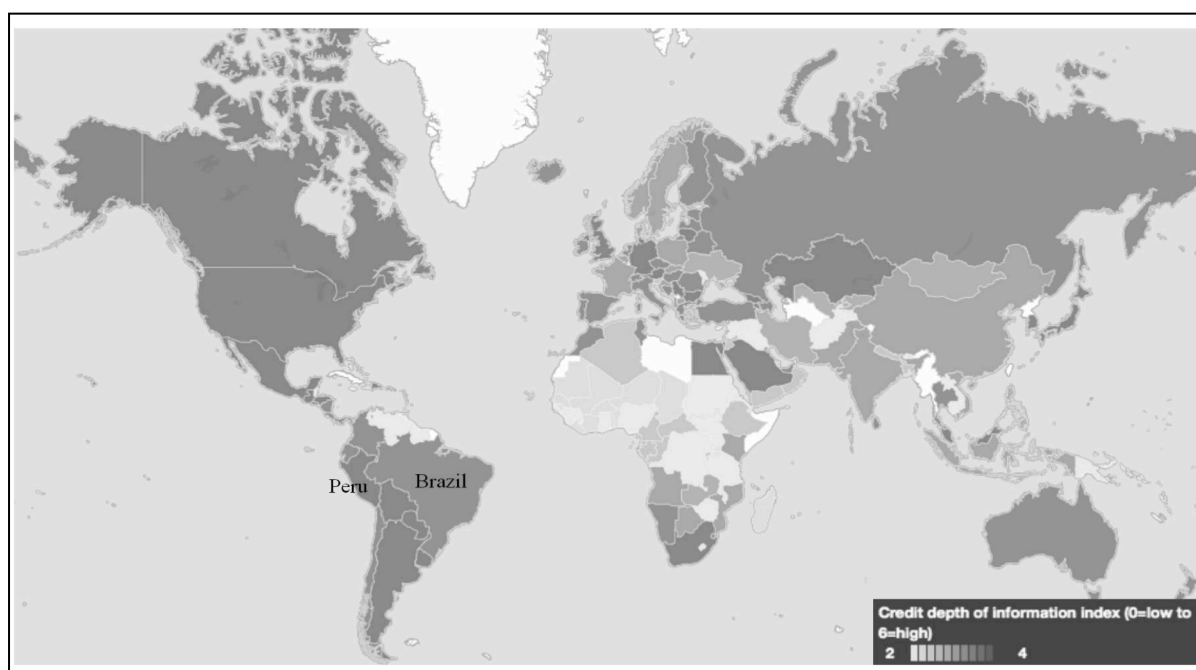
## Empirical Results and Comparison of Countries

This chapter aims to give some empirical evidence on how information is shared in reality and why information sharing is in favor of poor borrowers. For this reason, findings of recent studies, especially cross-country studies, are presented. Some of the empirical evidence is then compared with the previously discussed models of Padilla and Pagano (2000), Pagano and Jappelli (1993), Vercammen (1995), McIntosh and Wydick (2005), and Jain and Mansuri (2005). Finally, this chapter will focus on the information sharing methods and backgrounds of Brazil and Peru in greater detail.

## General Empirical Findings

According to recent data of the World Bank (14.5.2013), most countries share at least some kind of information. Figure 6 illustrates where the Credit Depth of Information Index is higher (darker color) and where it is lower (lighter color). According to this index, the quality of information sharing in a country can consist of any integer from zero (lowest) to six (highest). The score depends on whether data on firms and individuals is distributed, positive and negative information is distributed, information of financial institutions and retailers is distributed, the length of distributed data is more than two years, information on small loans (smaller than 1% of income per capita) is distributed, and on the access of borrowers to their data (World Bank, 14.5.2013). Each criterion accounts for one point. To get the full score of six points, each of these six criteria must be fulfilled.

*Figure 6: Credit Depth of Information Index 2008-2012*



*Source: Modified from World Bank (14.5.2013)*

An empirical investigation by Djankov et al. (2007) in 129 countries shows that information sharing can be a substitute for an insufficient law enforcement system. An insufficient law enforcement system might create incentives for borrowers to not pay back their loans. However, information sharing can re-establish the incentives to repay a credit. Assuming poor countries lack developed legal systems, credit registries are of particular relevance in

these countries. Djankov et al. (2007) argue that both private and public bureaus can play their parts in creating incentives to pay back a loan. Moreover, they find empirical evidence that public credit registries boost private credit markets in developing countries. Since microfinance institutions are likely to focus on such developing markets, information sharing might help microcredit markets to prosper.

Another empirical study by Galindo and Micco (2010), which was conducted across 61 countries, finds that information sharing can reduce the financing gap between small and large firms. They argue that information sharing reduces the monitoring costs, which is particularly beneficial for smaller firms since monitoring costs account for a big percentage of the total costs of a small borrower. As a result, smaller companies not only gain access to the credit market in cases where they would probably not have been able to do so without information sharing, but they also choose safer projects since the lower monitoring costs encourage safer projects with a lower expected revenue (Galindo and Micco, 2010). Assuming that potential, economically backward borrowers of microfinance institutions undertake relatively smaller investments in comparison to established, wealthier borrowers, information sharing could be desirable for bridging the financing gap between poor borrowers and wealthier borrowers.

A study by Triki and Gajigo (2012) in 42 African countries reveals that the access to finance is normally better in countries with private credit bureaus than with public credit registries. Furthermore, Triki and Gajigo (2012) state that borrowers of countries that report both black and white information have fewer difficulties accessing a credit. This observation is consistent with the theoretical models of Pagano and Jappelli (1993) and McIntosh and Wydick (2005), in which lenders try to maximize the numbers of borrowers by sharing black and white information.

Galindo and Miller (2001) conducted studies in 20 countries to see if credit registries have an impact on financial constraints. According to them, information sharing predominantly benefits small and young companies, which is an important finding given that the target-borrowers of microfinance institutions are most likely small and young “companies”. They further state that credit registries make financial intermediation more efficient, which leads to greater access to credit and fewer financial constraints. According to these authors, this effect



was particularly strong in Latin American countries, of which two (Brazil and Peru) will be discussed in greater detail later in this thesis.

The research of Jappelli and Pagano (2000) focuses on different developing countries. They opine that private and public credit registries can be seen as substitutes or as complements, depending on the circumstances. They also advise microfinance institutions to first start sharing black information only, since this kind of information could be easier to implement and to handle.

Brown and Zehnder (2007) put emphasis on borrower mobility and strong competition among lenders. In this context, we recall that information sharing reduces informational disadvantage for lenders on the one hand, but reduces their informational rents on the other. In their paper, Brown and Zehnder (2007) state that a high borrower mobility provokes more frequent information sharing, whereas strong competition discourages frequent information sharing, just as it was the case in the theoretical models of Pagano and Jappelli (1993) and Jain and Mansuri (2005). A unique aspect of Brown and Zehnder's (2007) paper is that it discusses the simultaneous effect of high mobility and high competition on the credit market. In conclusion, the authors say that information is shared frequently in the wake of these two counteracting impacts, which means that lenders see the potential problem of information asymmetry as more severe as the potential losses incurred through reduced informational rents.

GTZ (ed.) (2001) studies the singularities of different Latin American countries. It finds that credit registries can be more important than guarantees or financial statements to evaluate the credit-worthiness of a potential borrower. According to the editor, empirical evidence suggests that credit histories (reputational collateral) better predict the fulfillment of a contract than normal collateral such as guarantees. Thus, credit registries help to reduce the arrear rate (GTZ (ed.), 2001). It also states that both black and white information should be shared to ensure better prediction of the credit capacity of a potential borrower. These findings may be encouraging for microfinance institutions, whose borrowers are often too poor to offer a guarantee, since the findings prove that non-physical collateral can overcome information asymmetry, too.

In their empirical study about microfinance in Guatemala, Luoto et al. (2007) find that the screening effect of information sharing causes the level of portfolio arrears to decrease. In their study, this effect causes arrears to decline between 2 percent and 3.5 percent six months after the implementation of credit information systems. The researchers argue that both positive and negative data should be shared with other microfinance institutions since the recently grown credit market makes the environment of financial institutions more complex. However, microfinance institutions should not only focus on the creation of information-sharing systems, but also make their borrowers aware of the implementation and its consequences concerning future access to credit (Luoto et al., 2007).

## **Empirical Evidence from Selected Latin American Countries**

### *Selection of Countries*

Powell et al. (2004) describe Latin America as the region with the highest coverage of public credit registries. This finding is supported by Luoto et al. (2007, p. 14), who state that “Latin America’s lead in credit information sharing has recently extended to the microfinance sector as well” and by Campion (2001, p. 45), who states that “credit bureaus are now sprouting up, particularly in Latin America.” Based on these observations, two Latin American countries were selected for closer examination in this subchapter.

For a closer examination of the issue, the Latin American neighbors Brazil and Peru have been selected. A comparison of how information is shared in the two countries is interesting since the dates of their registry introduction are exactly opposite. In Brazil, the first private registry was introduced in 1968, whereas it opened its first public registry in 1997 (Love and Mylenko, 2003). On the contrary, Peru first established a public registry (1968) and then introduced a private registry (1997) (Love and Mylenko, 2003).

### *Empirical Findings from Brazil*

According to Doing Business (17.5.2013), Brazil’s private credit bureaus currently report information about 77,441,040 individuals and 5,456,200 firms (62.2% of the total), while public credit registries report information about 57,875,972 individuals and 4,597,767 firms (46.8% of the total).

Until a policy change in 1994, Brazil faced a serious problem with high inflation and as a result, lending was not a priority of the financial system (Miller, 2003). Since credits were not important to financial institutions back then, lenders hesitated to invest in technologies and strategies (such as effective information sharing) that allowed for a modern assessment of potential borrowers (Miller, 2003). However, the number of consumer and personal loans started growing after 1994, which led to increased default rates and even resulted in bankruptcies of some banks (Miller, 2003).

According to Miller (2003), credit analysis was then improved and some changes in the regulation of banks were made, which led to a lower level of default rates. These changes notwithstanding, the Brazilian credit market remained segmented into the retail market, the middle market, and the market for foreign and large national corporations (Miller, 2003).

The retail market, which is important for poor borrowers, such as the borrowers of a microfinance institution, is characterized by a decentralized credit-decision process, high interest rates, many borrowers, and small loans (Miller, 2003). Since small loans only offer limited profit, the costs of the assessment of these loans must be kept low. For this reason, economically disadvantaged borrowers in Brazil are mainly assessed with the help of credit bureaus and credit registries (Miller, 2003).

There is “no specific credit bureau for microfinance” in Brazil; “however, the Central Bank increased the scope of the official Sistema de Informação de Crédito (credit information system) in 2012; it now analyses payments of more than R1,000 or US\$492 (down from more than R5,000 or US\$2,463 previously)” (IFC (ed.), 2012, p. “Country\_Detail”).

According to Miller (2003), Brazilian (public) credit registries traditionally collected only black data, which was deleted immediately after the repayment took place. Moreover, Powell et al. (2004) believe that private-sector credit reporting in Brazil focuses only on black data.

However, international credit bureaus that share black and white information recently entered the Brazilian credit market, slowly forcing the traditional bureaus and registries to share white information as well (Miller, 2003). For example, Brazil’s largest private credit bureau is now implementing a system that allows sharing white information (IFC (ed.), 2012).

Beck (2000, p. 6) estimates that the level of private credit between 1980 and 1995 would have been “45% of the GDP instead of 25%,” had bureaus and registries in Brazil not largely refused to share white information on top of black information.

As mentioned before, profit-maximizing Brazilian lenders used to favor sharing black information only. This information-sharing behavior contradicts the theoretical suggestions of Padilla and Pagano (2000). According to their model, profit-maximizing lenders should share black information as well as some white information.

In contrast to the concerns of lenders that white information sharing reduces the informational rents and therefore the overall profitability of lenders, the empirical results from Brazil (Powell et al., 2004) suggest that sharing white information actually adds value in favor of lenders.

Therefore, empirical and theoretical research implies that Brazilian microfinance institutions should share black and at least some amount of white information to make lenders better off.

#### *Empirical Findings from Peru*

According to Doing Business (19.5.2013), Peru’s private credit bureaus currently report information about 7,800,000 individuals and 230,000 firms (42.5% of the total), while public credit registries report information about 5,650,000 individuals and 240,000 firms (31.2% of the total).

In 1990, some crucial structural adjustments took place in Peru, such as market liberalization and privatization (Trivelli et al., 1999). The adjustments were meant, among other things, to increase the access of small and micro-businesses to the formal credit market (Trivelli et al., 1999).

As a result of these changes, inflation decreased while the increase in lending made the Peruvian credit market prosper (Trivelli et al., 1999). “At the end of 1998, bank loans were about 25% of the GDP, significantly higher than the 8% of the GDP allocated by these institutions in 1993” (Trivelli et al., 1999, p. 3).

However, it was not only the general lending market that got a boost. Ebentreich (2005, pp. 3 and 10) states that microfinance institutions in particular have been the “fastest growing financial institutions over the last decade” and that, by the end of 2004, “there were 40 microfinance institutions operating in Peru, with total assets of US\$1.2 billion, representing 5.8% of total assets of the entire Peruvian financial system.”

In the 1990s, better information-sharing systems were developed to meet the demands of both the formal and the informal sectors, which led to a diminished importance of guarantees when lenders had to assess a potential borrower (Trivelli et al, 1999). According to Trivelli et al. (1999), legal enforcement was weak in Peru, which might be a potential reason why information sharing became more important than guarantees (see Jappelli and Pagano, 2000 and Brown et al., 2009).

An empirical study conducted by Frisancho (2012) builds on the experience of an important Peruvian microfinance institution (FINCA) that decided to share white information along with the already shared black information. It was found that after the sharing of white data, default rates were increasing. One of the reasons for this phenomenon could be that competing lenders tried to lure good borrowers away from FINCA, by offering them better terms such as lower interest rates (Frisancho, 2012). The latter argument is also found in some of the previously discussed theoretical models, such as that by Padilla and Pagano (2000). Frisancho (2012) concludes that though the sharing of white information hurts the particular microfinance provider, it helps borrowers who either receive larger credits or lower interest rates as a result of white information sharing.

Valdivia and Bauchet (2003) maintain that since 1980 Peruvian public credit registries shared white information such as the number of institutions a borrower had obligations with. In the 1990s, private credit bureaus, which share even more extensive white information than did the public credit registries, started to offer their services in Peru (Valdivia and Bauchet, 2003).

Therefore, it can be said that Peru is a country in which registries and credit bureaus share black as well as white information. According to the theoretical models of Pagano and Jappelli (1993) and McIntosh and Wydick (2005), sharing both black and white information

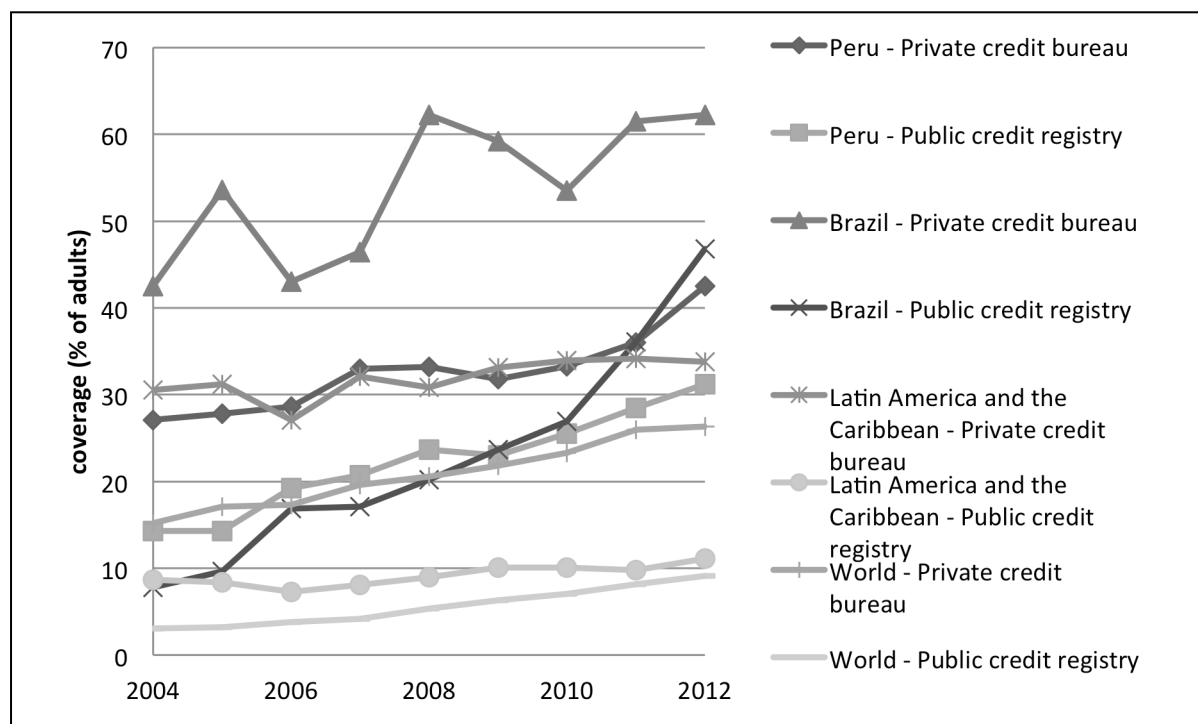
maximizes the number of borrowers, which might partly explain the recent growth of the Peruvian credit market and the growth of the Peruvian microfinance institutions.

Recently, the biggest Peruvian private credit bureau has signed an agreement, which enables “nearly one hundred microfinance institutions nationwide ([...]) to access data bases of debtors with current and overdue debts conferred by both regulated and unregulated financial institutions” (IFC (ed.), 2012, p. “Country\_Detail”).

*Comparison of Brazil and Peru with Other Latin American Countries and the World*

Figure 7 shows that the coverage of both private and public credit reporting is higher in Latin America and the Caribbean than it is in the world (on average). Brazil and Peru, in turn, have a higher coverage than Latin America and the Caribbean, whereas Brazil has a higher coverage than Peru (Figure 7). Compared among the respective countries, it can be stated that private credit bureaus have a higher coverage than public credit registries, according to Figure 7.

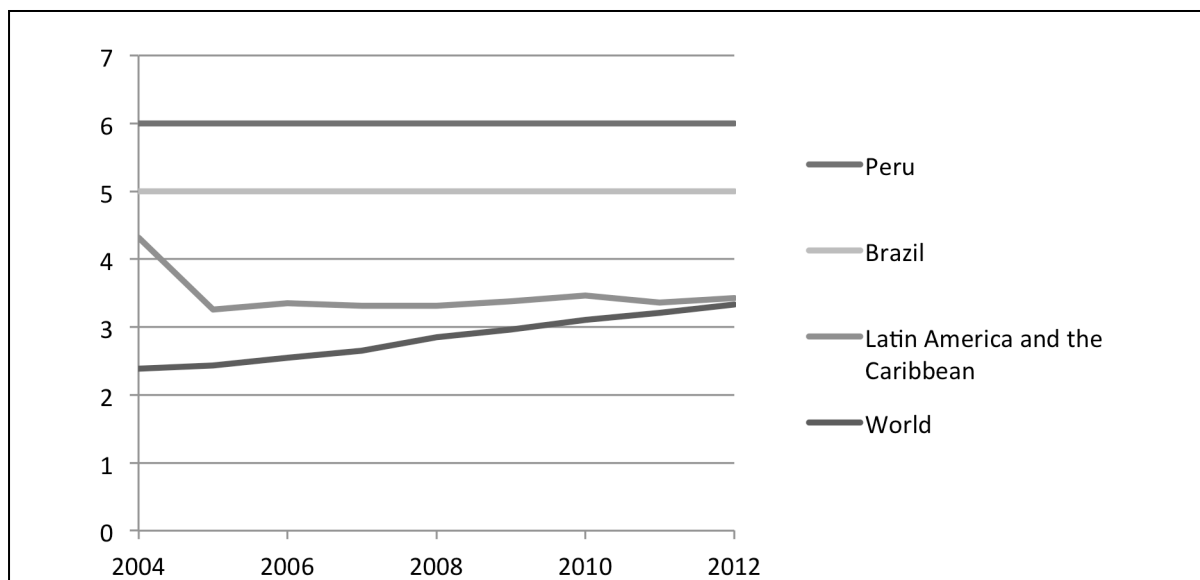
*Figure 7: Private Credit Bureau Coverage and Public Credit Registry Coverage of Brazil, Peru, Latin America and the Caribbean, and the World between 2004 and 2012*



Source: Own figure, based on World Bank data (17.5.2013)

Figure 8 illustrates that Peru has the highest Credit Depth of Information Index, followed by Brazil, Latin America and the Caribbean, and the world. Interestingly, Brazil seems to have a higher coverage than Peru (Figure 7), but the Credit Depth of Information index is higher in Peru (6) than in Brazil (5) (Figure 8). The difference is caused by the lack of historical credit information. According to Doing Business (17.5.2013), Brazil does not distribute credit information, either publicly or privately, which is more than two years old. For this reason, Brazil gets only five out of six points (Figure 8).

*Figure 8: Credit Depth of Information Index (0=low to 6=high) of Brazil, Peru, Latin America and the Caribbean, and the World between 2004 and 2012*



*Source: Own figure, based on World Bank data (17.5.2013)*

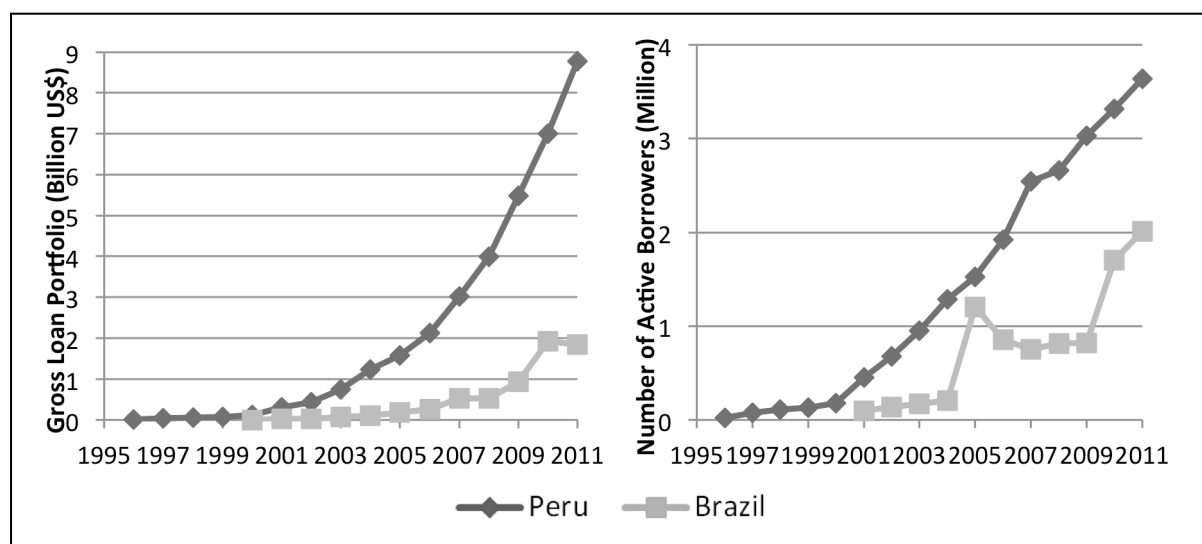
As stated in preceding subchapters, both Brazil and Peru suffered from inflation before their governments changed economic policies in the 1990s (Miller, 2003 and Trivelli et al., 1999). However, the information-sharing methodology differs in the two countries: in Brazil, mainly black information is shared, while in Peru both black and white information is shared (Miller, 2003 and Valdivia and Bauchet, 2003). Although more information is shared in Peru than in Brazil, one cannot say that information sharing in Peru is more effective than in Brazil since the coverage of Brazilian credit bureaus and registries is far superior to that of their Peruvian counterparts (Figure 7).

Hence, there has to be a better way to see whether the coverage or the sharing of white data has a bigger impact on the microcredit market. Figure 9 facilitates comparing the increase in

the gross loan portfolios of Brazilian and Peruvian microfinance institutions. Over the past few years, the non-adjusted gross loan portfolio of Peruvian microfinance providers grew faster than the Brazilian equivalent (Figure 9). For sure, one cannot attribute the whole difference to the unequal sharing systems. However, assuming the two neighboring nations are sufficiently similar in all aspects except for their sharing policies and credit coverage, it can be concluded that the influence of white information sharing might be more important than a higher credit bureau and credit registry coverage, since the GLP of Peruvian microfinance institutions increased faster than that of Brazilian microlenders.

In addition, Figure 9 suggests that the number of active borrowers of microfinance institutions grew more rapidly in Peru than in Brazil. Once again, this difference could be attributed to many factors. However, it might be possible that the sharing of white data partly explains the Peruvian lead in the number of active borrowers. If so, the finding would be consistent with the theoretical models of Pagano and Jappelli (1993) and McIntosh and Wydick (2005), which imply that client-maximizing lenders should share black and white information.

*Figure 9: Gross Loan Portfolio and Numbers of Borrowers of Brazilian and Peruvian Microfinance Providers (Non-Adjusted Data)*



*Source: Own figure, based on MIX data (9.6.2013 and 10.6.2013)*



### *Recommendations Based on the Theoretical Models*

Assuming that microfinance institutions in Brazil share only black information and that they are primarily interested to attract as many borrowers as possible, Brazilian microfinance institutions might consider revising their information-sharing policy since the theoretical models of Pagano and Jappelli (1993) and McIntosh and Wydick (2005) suggest that client-maximizing lenders should share black and white data. Currently, reforms towards the implementation of white information are under way, which already boosted the Brazilian “microscope credit bureau index” (IFC (ed.), 2012, p. “Country\_Detail”).

Peruvian lenders, on the other hand, already share black and white information (Valdivia and Bauchet, 2003), which is theoretically optimal from the point of view of a client-maximizing microfinance market (Pagano and Jappelli, 1993 and McIntosh and Wydick, 2005).

### **Conclusion**

The thesis starts by showing how information asymmetry can harm both microfinance institutions and their borrowers. It then provides some possible solutions to overcome the problems resulting from adverse selection and moral hazard. In particular, it argues how information sharing can help to reduce information asymmetry in microfinance markets.

Following this, five theoretical models are presented and it is argued, based on the models, whether only black or both black and white information should be shared. Please note that none of the models suggests not sharing information at all. Consequently, it does not matter whether a microfinance institution attempts to maximize the number of borrowers, the size of loans, or its own profit; according to the models, a microfinance institution should always share at least black information with its competitors.

Finally, the thesis applies the theoretical models to the empirical findings of how information is actually shared. The thesis specifically focuses on the Brazilian and Peruvian credit markets. Interestingly, Brazilian lenders seem to be far more conservative when it comes to white information sharing than their Peruvian neighbors. Based on the theoretical models, the thesis also shows which sharing behavior could improve the situation of the microfinance institutions in Brazil and Peru.

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