Essays on Banking for Micro and Small Enterprises

INAUGURAL DISSERTATION ZUR ERLANGUNG DER WÜRDE
EINES DOKTORS DER WIRTSCHAFTSWISSENSCHAFTEN DER
FAKULTÄT FUER WIRTSCHAFTS- UND SOZIALWISSENSCHAFTEN
DER UNIVERSITÄT HEIDELBERG

VORGELEGT VON
JAN SCHRADER
GEBOREN IN LICH

HEIDELBERG DEZEMBER 2009

To
my wife
and
my parents

Acknowledgments

My teachers, colleagues and friends have contributed a great deal to this thesis. In particular, I would like to thank my supervisor Professor Eva Terberger for her invaluable guidance, advice and support. She introduced me into the research field of Banking and Finance and shaped my scientific interests. Many thanks go also to Professor Andreas Roider for co-advising on this work and for giving me many valuable suggestions. Furthermore, working at the chairs of Professor Eva Terberger and Professor Andreas Roider was very stimulating and has broadened my horizon considerably.

Moreover, special thanks go to my co-author Gunhild Berg for working together on our projects and for many good discussions and suggestions. Special thanks go also to my colleagues and friends from the Alfred-Weber-Institute in Heidelberg, where I worked while writing this thesis, for the nice and friendly atmosphere in the department. In particular, I would like to mention Karolin Kirschenmann, Bernhard Pachl, Andrea Leuermann and Philipp Völk for their helpful comments and all the fruitful discussions. Further thanks go to Freya Schadt and Gabi Rauscher.

Ganz besonders möchte ich auch meinen Eltern danken. Ohne ihren ständigen Rückhalt und das Vertrauen in meine Stärken wäre das Studium und die anschlieflende Promotion nicht möglich gewesen.

And at least, but not last, I would like to thank my wife, Veronica, for her endurance, support and love.

Jan Schrader

Contents

List of Tables

List of Figures

1 Introduction

1.1 Financial Systems and Micro and Small Enterprises (MSE)

The financial system is one of the key stones explaining economic growth.[1] Financial institutions produce information about the quality of investment projects and therefore assure that capital is directed towards the projects with the highest return. This role also mitigates the influence of an unequal distribution of wealth on investment decisions. Since individuals with valuable projects always get finance in a well functioning financial system, a low initial endowment of capital will not impede the implementation of investment projects. This role is not only restricted to the selection of projects, but includes also the monitoring of entrepreneurs and firms during the investment period. Furthermore, financial institutions facilitate the management of risk in an economy. Both banks and financial markets provide risk diversification services - cross-sectional as well as intertemporal. The possibility of cross sectional risk diversification will shift the portfolio of risk-averse investors towards projects with higher individual risks and also higher expected returns. Intertemporal risk diversification induces the possibility for entrepreneurs of investing in long term projects and impedes the termination of projects due to a negative economic shock. Finally, a financial system pools small savings and investment and thereby makes it possible to execute large scale projects. These theoretical results on the macro level are confirmed by various empirical cross-country studies conducted in the last decade.

On the micro level, however, it is less clear which institutional structure of the financial system fulfills its role best at different stages of development. In developing countries with a weak rule of law there is a high share of micro and small enterprises (MSE) where information about potential borrowers is scarce. Various authors propose to focus on a relationship based banking system in this countries, because it relies less on a strong rule of law and a wide range of public information about firms than market based systems

[1] See Levine (2004) for a survey of the empirical and theoretical literature.

(Rajan & Zingales 1998, Tadesse 2002). By engaging in a long term relationship with the client, a relationship lender is able to gather information about the client and will be willing to support the client in times of economic crisis, because he is able to offset potential losses in one period at other stages of the business. Consequently, especially for serving micro and small enterprises, relationship banking is considered as the institution that is able to provide the key functions of a financial system in the most efficient way (Terberger 2005). But there is still little empirical evidence concerning the role and the functioning of relationship banks serving MSEs in developing countries and their changing nature in the path of development.

This thesis provides new evidence concerning the way financial intermediaries fulfill the role of distributing capital efficiently to micro and small enterprise and diversify intertemporal risk at different stages of development. Chapter 2 to 4 are mainly empirical and focus exclusively on relationship lending in development countries. Chapter 5 analyses theoretically the institutional structure of cooperatives banks serving MSEs in developed countries and tests the model hypothesis' empirically.

1.2 Aggregate Economic Shocks and Relationship Lending

Chapter 2 and 3 of the thesis are joint work with Gunhild Berg from the University of Frankfurt. They present new evidence about intertemporal risk sharing services provided by relationship banks to microentrepreneurs in developing countries after an aggregate income shock. The analysis is based on a data set in which the customer data of the microfinance institution ProCredit Ecuador is merged with the monthly data of seismic activity and explosions of the volcano Tungurahua in Ecuador from 2001 to 2006. Consequently, it is possible to measure changes in behaviour of clients and the bank after this exogenous aggregate shocks have taken place.

Chapter 2 focuses on the effects of the natural disaster on credit demand and credit approval. Hypotheses are derived from a standardized model highlighting the behaviour of clients after part of their assets were destroyed as

well as the loan approval decision of the relationship bank. Since more clients are in need of finance after the shock, the demand for loans increases. The shock also diminishes the returns of the client investment projects and therefore, banks' profits are going down as well. In order to offset these losses, the bank will rise the average quality of clients that obtain a loan. This effect will be less pronounced for clients that have already proven their diligent behaviour. Since lending to good client is always profitable, there are no lending restrictions for these returning clients after the shock. The empirical analysis found evidence for these results of the model framework. Using a time series approach, it is shown that demand for loans increases after strong volcanic activity. The probability of approval after a volcanic eruption is analysed using a probit regression with the geological data as independent variable. Results indicate that new clients are less likely to receive a loan after the shock, but old clients face no lending restrictions. The conclusion is that relationship banking facilitates intertemporal risk sharing for individuals that have a long term relationship with a bank.

Chapter 3 extends the previous part by analyzing the effect of the volcanic eruption on interest rate and loan default. The model analysis is based on the observation that relationship lending has to be profitable for both, the bank and the entrepreneur in order to be sustainable. Clients always stay at the same bank because he receives insurance in the form of lower interest rates in times of crisis. The bank provides this kind of insurance because it can offset the losses generated by lower interest rates by charging higher interest rates in future periods. But this result holds only for old clients, where the bank can be sure that clients will come back several times. When the bank has no information whether it is able to generate future rents by a client, it will not decrease the interest rate after an aggregate shock. Consequently, default rates also differ between new clients and returning clients. Since interest rates are lower for the latter group, default rates will be higher for new clients. These results are confirmed by the empirical analysis using OLS and Probit regressions. Consequently, intertemporal risk sharing provided by relationship banks is implemented via lower interest rates and thus helps to avoid negative effects such as defaults after an aggregate economic shock.

1.3 The Competition between Relationship Lending and Transaction Lending

Chapter 4 empirically analyses the competition between banks with different lending technologies, relationship lending and transaction lending, in the credit business with micro and small entrepreneurs. Underlying motivation of this work has been theoretical and anecdotal evidence that (i) transaction lending exacerbates the problem of overindebtedness of entrepreneurs in developing countries and that (ii) relationship lending is destroyed by transaction banks because transaction lenders lure away the best clients by offering lower interest rates. For the first time, this analysis is able to tackle this questions directly, since the data set combines data from a lending institution, the microfinance lender ProCredit Ecuador, with credit bureau data containing information about every ProCredit client in the whole banking system. Results indicate that the quality of ProCredit borrowers who have a transaction loan as well is below average. They also have higher default probabilities and mainly demand transaction loans when having payment problems. These results support the hypothesis that especially transaction lending contributes to the problem of overindebtedness in developing countries. Furthermore, ProCredit customers with payment problems prefer to serve their relationship loan while defaulting on their transaction loan. These findings suggest that customers of a relationship bank value their banking relationship and try to protect it as long as possible. This result sheds doubt on the common presumption that the market entrance of transaction lenders will destroy the market for lenders applying relationship lending techniques.

1.4 Institutions in the Path of Development: Credit Cooperatives and the Incentive Effect of Reserves

The focus of chapter 5, which is based on Terberger & Schrader (2008), is about credit cooperatives. These financial institutions were founded in the 19th century to support microentrepreneurs which at that time mostly lacked access to credit. One key feature of their institutional structure was the fact

that members have no ownership rights on the retained profits in order to assure the sustainability of the institution. Nowadays when members are mainly financially motivated and their incentives to monitor the management are weak, this institutional feature has the potential to generate negative incentives for the cooperatives management. The key variable in the model is the share of reserves in total equity, representing the share of equity that has not to be remunerated by the management. The higher this value, the easier it is for the management to fulfill the dividend demands by members. As a consequence, one result of the model is that fringe benefits and thus return on equity will be lower in a cooperative with a higher share of reserves. The second result states that risk taking will also decrease with a higher share of reserves because the relative valuation of high and low outcomes changes: high revenues get less important, but in the case of losses, the management would loose his job. These hypothesis are tested by panel data of German cooperative banks. Whereas the evidence is rather weak concerning the fact that cooperatives with a high share of reserves work less efficient, results suggest that cooperatives with a higher share of reserves invest in less risky assets and distribute a smaller share of profits to their members.

2 Microcredit, Natural Disasters, and Relationship Lending

2.1 Introduction

Low-income households in developing economies face severe income risks arising both from individual-specific and aggregate shocks. While idiosyncratic shocks such as illnesses or the loss of employment can to some degree be insured within a community, aggregate shocks are more difficult to cope with since natural disasters such as earthquakes, droughts or floods affect every single household in a specific region.[2]

It is usually assumed that access to formal credit and insurance markets

[2]This chapter is joint work with Gunhild Berg from the University of Frankfurt.

provided, for instance, by microfinance institutions can lower the vulnerability of households to idiosyncratic income risk (Eswaran and Kotwal 1989, Morduch 1995, 1999a, among others). This assumption is supported by empirical evidence. For instance, Beegle, Dehejia & Gatti (2003) find that households with access to credit rely less on child labor as a buffer against income shocks.[3] Gitter & Barham (2007) report that credit constrained households in Honduras have lower educational attainments of children whereas Gertler, Levine & Moretti (2002) find that access to microfinance can help households in Indonesia to cope with adverse health shocks.

Yet, access to credit crucially depends on the development of the financial system. In an environment characterized by little public information on potential clients and low legal enforcement of creditor rights, it will be difficult for entrepreneurs to signal their creditworthiness, especially when facing financial distress (Rajan & Zingales 1998). However, banks can overcome the problem of asymmetric information by establishing long-term relationships with their clients.[4] Relationship lending allows intertemporal transfers between the bank and the borrower, which implies that banks may subsidize borrowers when facing financial distress if they can expect to recover potential losses through continuous interaction.[5] Consequently, relationship banking can be interpreted as a type of insurance against income risk (Petersen & Rajan 1995). This view is supported by Elsas & Krahnen (1998) who report that relationship banks in Germany provide liquidity insurance in situations of unexpected deterioration of borrower ratings while Petersen & Rajan (1995) find that relationship banking increases credit availability for small firms.

[3]The observation that inefficiently high child labor can arise due to capital market imperfections has already been documented in early theoretical work by Baland & Robinson (2000) and Ranjan (2001).

[4]See Boot (2000) for a detailed overview on relationship banking.

[5]Relationship banking can be defined as a long-term implicit contract between a bank and its debtor. Due to information production and repeated interaction with the borrower over time, the relational bank accumulates private information, thus establishing close ties between the bank and the borrower (**?**). Relationship lending can be distinguished form asset based lending where a banks' lending decision depends on the amount of the clients' collateral, and transaction lending where the lending decision depends on credit scoring (von Pischke 2002).

However, there exists little formal evidence concerning the effect of aggregate income shocks such as natural disasters on access to credit. Since disasters usually have a considerable impact on the environment and the majority of households and entrepreneurs, access to credit may be restricted. Intertemporal transfers will become more difficult because disaster effects can stretch out over a long period of time. Furthermore, banks may face liquidity crunches during and after natural disasters if clients withdraw their savings or save less or others miss loan payments or apply for emergency or recovery loans. Therefore, banks may not be able to insure households against aggregate income risk.

The empirical evidence on the effect of natural disasters on credit demand and approval is scarce as well. While del Ninno, Dorosh & Smith (2003) find that households in Bangladesh borrowed significantly more after a major flood in 1998,[6] they are not able to assess the direct effects of the shock on the individual credit applicants and whether lending was restricted for some households.

This paper attempts to close this gap by testing whether the demand and approval of microfinance loans by ProCredit Bank in Ecuador was influenced by major aggregate income shocks such as volcanic eruptions. Ecuador is a country that has historically been strongly affected by natural disasters such as earthquakes and volcanic eruptions. The last severe outbreak of the most active volcano Tungurahua took place in August 2006. As a consequence, thousands of people had to be evacuated and farming-dependent households living close to the volcano lost a high percentage of their crops.

We use data from ProCredit Ecuador from January 2002 to August 2007 to test whether these volcanic eruptions have an effect on monthly credit demand and approval. We find that after severe volcanic eruptions, monthly credit demand significantly increases. Credit approval, however, also increases, yet considerably less than the demand for credit. When looking only at clients who have received a loan from ProCredit previously, the results indicate that the demand for credit increases as well, yet, in this case,

[6]They report that for 60 percent of all households, borrowing was the dominant coping strategy.

credit approval increases more than the demand for loans.

In order to address the question of how volcanic activity affects the individual credit applicant, we analyse in a second step whether the probability that households in the affected areas receive a loan from ProCredit is also influenced by volcanic eruptions. Our results suggest that high volcanic activity in the last months before the credit application leads to significant decreases in the probability to be approved for a loan. This finding, however, holds only for applicants who have not received a loan from this bank previously. Our results indicate that returning clients do not only have a higher probability to receive a loan in general, but that they are equally likely to be approved for a loan after volcanic shocks occurred. The results are robust to using different indicators for volcanic activity, i.e. volcanic explosions or the seismic activity of the volcano, and varying regional samples.

The finding that the demand for credit increases significantly after severe volcanic eruptions can be explained by more households being in need of financing after they were hit by a shock. Yet, since households who apply for loans after these shocks occurred are likely to have, on average, less financial resources and probably also due to limited resources of the bank, ProCredit will not be able or will not want to completely meet the demand for credit. However, the finding that clients who previously have received a loan from ProCredit are equally likely to receive a loan after high volcanic activity despite of the increased credit demand can be interpreted as support for the relationship banking theory. This implies that microcredit can have an insurance function, yet only for those households who have already established a relationship with the bank.

Despite of the positive effect for old clients, the results also imply that besides microcredit, other measures are needed in order to help those households cope with aggregate income shocks who did not have access to formal financing previously.

The remainder of the paper is organized as follows. In Section 2.2, the theoretical and empirical evidence on income shocks, vulnerability, and poverty is discussed in more detail. In Section 2.3, we present a simple theoretical model that highlights the effect of natural disasters on the demand for credit

and the lending behaviour of a relationship bank. Section 2.4 discusses the data we use and gives some descriptive statistics. The econometric models employed are presented in Section 2.5, while Section 2.6 is concerned with the empirical results. Finally, Section 2.7 closes the argument.

2.2 Income Shocks and Poverty

To reduce the impact of income risk, households have developed sophisticated strategies. Morduch (1995) distinguishes between income and consumption smoothing strategies. Income smoothing or risk-management implies that households attempt to choose less risky forms of income generation through diversifying income. However, by reducing fluctuations in income, households often choose less profitable forms of production or employment which can have very costly long-run effects (Morduch 1995, Dercon 2002). Consumption smoothing or risk-coping strategies are trying to deal with the consequences of shocks. Important strategies include borrowing through formal or informal mechanisms such as family and friends (Rosenzweig 1988, Dercon 2002) or rotating savings and credit associations (ROSCAs) (Bouman 1995, Besley, Coate & Loury 1993, among others). Furthermore, households can insure themselves by using assets as buffer stocks which they build up in good years and deplete in bad years (Deaton 1991, 1992, Rosenzweig and Wolpin 1993). Risk-coping strategies can also involve an adjustment of the labor supply of the household with the objective of earning extra income (Kochar 1995, 1999).

Despite of these various strategies to reduce the effects of income risk, low-income households in developing economies remain vulnerable to adverse income shocks. This is due to the fact that most of these strategies have proved to be insufficient for insuring consumption completely against income risk. Even though households seem to be able to insure consumption to some degree, much risk remains uninsured (Townsend 1994, 1995, Deaton 1997, Grimard 1997, among others). Especially the poorest households seem to have problems to cope with income shocks. Jalan & Ravallion (1999) report that the lower the wealth of households in rural China, the closer consump-

tion tracks income, implying that the poorest households are most strongly affected by income shocks. Furthermore, the characteristics of income risk such as the severity, frequency and also predictability determine how well households can deal with income shocks. Gertler & Gruber (2002) evaluate the ability of households to cope with adverse health shocks and find that households in Indonesia are reasonably well able to cope with small transient shocks, but that they can only insure 38 percent of the costs associated with illnesses that severely limit their physical functioning. In a similar context, Alderman (1996) finds that repeated shocks are more difficult to cope with than single or infrequent shocks.

Difficulties to deal with income risk can have strong negative effects on the living conditions of the poor including decreases in the education or the health of children. Jacoby & Skoufias (1997) find that after adverse income shocks, households in India frequently withdraw their children from school. Similarly, Beegle et al. (2003) report that households in Tanzania use child labor as a coping strategy for transitory income shocks. Regarding health, Foster (1995) finds that child growth was significantly negatively affected during and after the great flood of 1988 in Bangladesh.[7] Obviously, these undesirable coping strategies can have negative impacts not only on human capital formation but also on long-run economic growth.

2.3 Theoretical Framework

Relationship lenders such as microfinance institutions usually aim at establishing long term relationships with their clients in order to accumulate information about the borrowers' quality and to overcome problems of asymmetric information. In order to model relationship banking and its connection to natural disasters, we rely on the seminal paper of Petersen & Rajan (1995). They present a model showing that long-term relationships enable banks to subsidize firms when young or distressed. If borrowers are not able to switch to a different financier easily, the bank is able to offset these losses by extract-

[7]For further evidence on the effects of income shocks on schooling and health outcomes see, for instance, Rose (1999), Jensen (2000), Carter & Maluccio (2003), and Gitter & Barham (2007).

ing higher rents in future periods. Hence, relationship banking may increase credit availability. In order to analyse the effect of external asset shocks which can be induced by natural disasters, we extend their model by allowing for heterogeneity in clients' asset levels.

Let us assume that we are in a risk neutral world. The population of entrepreneurs is normalized to 1.[8] They start out with different amounts of capital A_n. The distribution of assets across firms is described by the cumulative distribution function $G(A)$, indicating the fraction of firms with assets less than A. The total amount of firm capital is then $K = \int_0^\infty G(A)dA$. The demanded loan amount L_n^0 is determined by the difference between the investment level I and the stock of capital A_n. If $A_n < I$, a firm needs at least $L_n^0 = I - A_n$ in external funds to be able to invest. The total fraction of entrepreneurs N in need of additional financing is:

$$N = G(I) \tag{1}$$

Then, the total loan amount demanded by the entrepreneurs is given by

$$L = \int_0^I (G(I)I - G(A))dA \tag{2}$$

Petersen & Rajan (1995) model the mechanism of relationship lending as follows. There exist two types of entrepreneurs: good and bad entrepreneurs.[9] A good entrepreneur has to borrow L_n^0 in order to invest in a safe project with a return of S_n^1 in $t = 1$. When the project ends, he will be able to invest I_n^1 in another safe project with a return of S_n^2 in $t = 2$.[10] In contrast, the

[8]The modeling of the heterogeneity of clients' asset levels is identical to Holmstroem & Tirole (1997).

[9]The bad entrepreneur is the incompetent, lazy, and dishonest in the group of potential entrepreneurs. The incompetent invest in bad projects and consequently waste the investment, the lazy do not put effort in their work and the dishonest steal the money or extract too many private benefits from the firm.

[10]In Petersen & Rajan (1995), good entrepreneurs also have the possibility to switch to a risky project in the first period. Since our main interest is not in modeling the effect of competition on relationship banking, we present a simplified version of their model abstracting from the risk shifting problems. However, even extending the model would not change our main results.

projects of bad entrepreneurs, who also have to borrow L_n^0, will always fail and have a return of zero at $t = 1$. The revenue from the safe project in $t = 1$ is insufficient to finance the project in $t = 1$: $S_n^1 < I_n^1$. Safe projects have a positive net present value for every entrepreneur assuming an interest rate of zero:

$$S_n^1 + S_n^2 - I - I_n^1 > 0 \tag{3}$$

Relationship banks are the only source of finance in this market. Only agents know whether they are good or bad entrepreneurs. At $t = 0$, the bank knows that with a probability of θ, an agent is a good entrepreneur. Thus, θ is a measure of the ex ante credit quality of the agents.[11] Through repeated interaction, the banks are able to accumulate soft information about the borrowers' quality. Therefore, at $t = 1$, the bank becomes fully informed about the type of agent with whom it is dealing.[12] The bank can charge an interest rate from the entrepreneurs in $t = 1$ so that its expected return on loans is equal to R. This interest rate is determined by the competition in the banking sector. The banks' cost of funds is zero since we are in a risk-neutral world.

Good entrepreneurs will try to reduce their own cost of borrowing by asking for terms that help to identify bad entrepreneurs. A bad entrepreneur will have no choice but to ask for the same terms at $t = 0$. Since the bank knows the agents' types after the first period, bad entrepreneurs will not receive any money at $t = 1$. Knowing this, good entrepreneurs will borrow as little as possible at $t = 0$ so that they can take advantage of the lower rate at $t = 1$ when bad entrepreneurs have been exposed. Therefore, a good entrepreneur will seek to borrow only $L_n^0 = I_n^0 - A_n$ at $t = 0$. He proposes to repay the amount $d(L_n^0)$ with $d > 0$ at $t = 1$ after which he will contract a new loan for any subsequent project.[13] A good entrepreneur has to borrow

[11] We assume, that the ex ante credit quality is independent from the initial capital stock A_n.

[12] This assumption is in line with the theoretical literature on relationship banking. See Boot (2000) for an overview.

[13] The variable b can also be smaller than 1.

the loan amount L_n^1 in $t = 1$:

$$L_n^1 = I_n^1 - (S_n^1 - d(I - A_n)) \tag{4}$$

In $t = 1$, he can lend at the interest rate R. Therefore, he will only invest if

$$S_n^2 - RL_n^1 \geq A_n \tag{5}$$

The bank has to recover the investment from $t = 0$. Taking the interest rate R into account, the bank will only lend to the pool if[14]

$$(I - A_n) + \theta L_n^1 = \theta R L_n^1 + \theta d(I - A_n) \tag{6}$$

Using equations (5) and (6), the credit quality of the pool of borrowers sharing the same asset levels and investment projects has to be at least

$$\theta_n^* = \frac{I - A_n}{S_n^1 + S_n^2 - A_n - I_n^1} \tag{7}$$

to be financed. θ_n^* is the lowest credit quality that the bank is able to finance without losses given the initial loan amount $I_n^0 - A_n$, the revenues of the projects and the investment at $t = 1$.[15]

Aggregate Income Shocks

Aggregate income shocks such as natural disasters can have various effects on the well-being of low-income households. Expressed in the simplest terms, a disaster can affect assets (direct damages), the flow for the production of goods and services (indirect losses), and the performance of the main macroeconomic aggregates of the affected country (macroeconomic effects).[16]

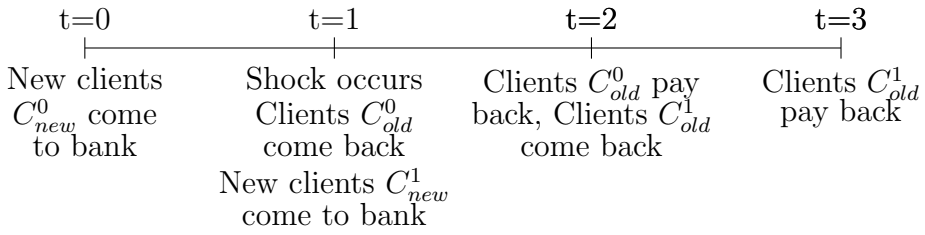
[14]This equation also determines the value of d.

[15]Since, for simplicity, we have abstracted from the risk shifting problem of good entrepreneurs at $t = 0$, the return rate of the bank R does not affect θ_n^*. Since the entrepreneurs' outside option is 0, the bank cannot increase the interest rate without destroying the incentive to invest.

[16]The actual impact of the disaster depends, of course, on the nature of the shock and the economic sector affected. In the case of volcanic eruptions, direct effects on the manufacturing sector are rare since volcanoes are usually situated in rural areas. The

Direct damages such as the destruction of physical infrastructure usually occur at the moment of the disaster while the latter two types of losses can extend over a period of up to five years (Economic Commission for Latin America and the Caribbean (ECLAC) 2003).

We assume that a shock will occur in the beginning of $t = 1$. At this time, new clients C^1_{new} and returning clients C^0_{old} come to the bank and ask for financing.[17]



An aggregate shock may be reflected in a reduction of δA_n of the capital A_n (direct damage), a reduction of δS^1_n of the entrepreneurs' revenue in the next period S^1_n (indirect losses) or the reduction of δS^2_n of the entrepreneurs' revenue in later periods S^2_n (macroeconomic effects). From our model, the following hypotheses can be derived.

Hypothesis 1: *After aggregate income shocks, the number of loans demanded increases.*

Proof. A reduction of the entrepreneurs' capital of δA_n will shift the distribution function $G(A)$ to the left. Consequently, for more households it will hold that $A_n < I$ which, from equation (1), will result in a higher N. Therefore, the number of households in need of additional loans will increase after the shock occurred. □

impact on the agricultural sector, however, depends on the magnitude of the eruption. While ash falls and toxic gases cause only temporary damage in the case of small eruptions, full production recovery might be impossible after strong volcanic activity. Furthermore, if physical infrastructure such as roads is damaged, this can have indirect effects on other sectors such as the commercial, transportation or tourism sector as well.

[17] Since the analysis focus on the new clients and returning clients in $t = 1$, we display only these client groups and ignore client groups coming to the bank in $t = 2$ and $t = 3$ in the time bar.

Since some entrepreneurs who were able to finance their project completely with their own funds before the shock occurred ($A_n > I$) will now have to borrow from a bank as well ($A_n - \delta A_n < I$), the total loan amount applied for after the shock L_s will increase as well.[18] However, it is not clear whether the average loan amount applied for will rise as well; this will depend on the magnitude of the shock and the types of entrepreneurs affected.[19]

Hypothesis 2: *After aggregate income shocks, the fraction of credit applicants receiving a loan will decrease.*

Proof. An aggregate income shock can be reflected in either a reduction of A_n, S_n^1 or S_n^2. From equation (7) it follows that

$$\frac{\delta\theta_n^*}{\delta S_n^1} = \frac{-(I - A_n)}{(S_n^1 + S_n^2 - A_n - I_n^1)^2} < 0 \tag{8}$$

$$\frac{\delta\theta_n^*}{\delta S_n^2} = \frac{-(I - A_n)}{(S_n^1 + S_n^2 - A_n - I_n^1)^2} < 0 \tag{9}$$

$$\frac{\delta\theta_n^*}{\delta A_n} = -\frac{S_n^1 + S_n^2 - I - I_n^1}{(S_n^1 + S_n^2 - A_n - I_n^1)^2} < 0 \tag{10}$$

The derivatives are all < 0 since it has to hold that $I > A_n$ and that $S_n^1 + S_n^2 - I - I_n^1 > 0$. Otherwise, borrowing would either not be necessary or the project would have a negative present value and no entrepreneur would invest (See equation 3).

Therefore, it follows that if the revenues of the entrepreneurs A_{new}^1 in $t = 1$, respectively in $t = 2$, go down, θ_n will rise. Then the bank has to charge a lower return rate R to ensure that the firm remains profitable (compare equation 5). Yet, a lower return rate limits the ability of the bank to recover the losses from the first period.

[18] Note that we abstract from a change of the interest rate R due to the shock as in Holmstroem & Tirole (1997). In their model, the total loan amount applied for depends on the interest rate which is determined by the equilibrium in the capital market. The change of interest rates depends on the effect of the shock on the demand and the supply of capital. However, for regional shocks, the change of the interest rate might be negligible.

[19] If many entrepreneurs who had no need of external finance before the shock ($A_n > I$) are only slightly affected, but it holds that ($A_n - \delta A_n < I$), then the average loan amount could even go down.

If an entrepreneurs' asset level A_n is partially destroyed, θ_n will increase as well. The reason is that a destruction of the households' assets increases the loan amount and therefore, the bank will have higher expected losses in the first period. Therefore, the bank has to increase lending standards which will result in a refusal of loan applications and lower loan amounts. And especially firms with lower credit quality will lose access to finance.[20]

□

In the disaster management literature, a second channel is proposed that might affect lending behaviour.[21] Bank capital could be insufficient to satisfy the aggregate loan demand completely. First of all, the aggregate loan demand after the shock L_s will rise. Second, it is possible that clients will withdraw their savings or save less. If these demands occur simultaneously, they will result in liquidity shortfalls for unprepared banks, especially if the client pool is not well diversified (Miamidian, Arnold, Burritt & Jacquand 2005) and everyone is affected by the shock. Therefore, in order to maintain profitability, banks will have to restrict lending implying that the additional demand for credit will not be completely met by the bank.[22]

Hypothesis 3: *After aggregate income shocks, returning clients are equally likely to receive a loan.*

Proof. In $t = 1$, the pool of agents C^0_{old} consists only of good entrepreneurs. For the bank, it is always profitable to serve old clients[23] if their projects have a positive net present value ($L^1_n < S^2$), since a default probability does not exist per assumption. Since the costs of screening - the defaulted loans

[20]This result arising out of the relationship lending framework differs from the results which would be obtained when using an asset-based lending model such as in (Holmstroem & Tirole 1997). Since, in this model, the quality of the loan applicant depends on the asset level of the borrower, a reduction of A would lead to a large number of firms with high asset levels entering the market. Since these firms thus also have a higher credit quality, the share of firms obtaining loans would even go up.

[21]See, for example, Pantoja (2002).

[22]Even if liquidity management is successful, a profit-oriented bank could have to restrict lending in times of crises. For instance, if refinancing conditions for additional funds become more costly, banks have to earn a higher return on the loan portfolio which could imply that lending standards have to rise (Holmstroem & Tirole 1997).

[23]We assume that old and new clients are equally affected by the shock.

from period $t = 0$ from agents C^0_{new} - constitute sunk costs in $t = 1$, the bank will always finance returning customers in this model framework. □

Summing up, our theoretical analysis suggests that relationship lenders such as microfinance institutions will restrict lending to new clients with low credit quality if demand rises after an external shock. Consequently, relationship banks may only partly be able to help entrepreneurs cope with aggregate income shocks.

2.4 Description of the Data

For our analysis we use data from ProCredit Bank Ecuador from January 2002 to August 2007. ProCredit Ecuador was founded in October 2001 and received a full banking license in 2005. The bank is part of ProCredit Group which consists of 22 banks operating in transition economies and developing countries in Eastern Europe, Latin America and Africa and is led by ProCredit Holding AG, a holding company based in Germany. The group focuses on providing financing for micro, small and medium sized enterprises and follows a development banking approach. This approach is based on financial institution building directed toward serving lower income clients while covering costs and producing moderate profits at the same time. Therefore, ProCredit can be classified as a typical relationship lender.[24] At the end of 2007, ProCredit Ecuador was operating 25 branches throughout the country.[25]

The data we use was generated using the financial management system of ProCredit Ecuador, which provides detailed information on loan applicants as well as clients for all branches of the bank. In order to analyse the effects of major aggregate shocks on low-income households, we combine the data from ProCredit Ecuador with monthly data on the seismic activity and eruptions of the most active volcano Tungurahua provided by the Instituto Geofísico Ecuador.

[24]See Schrader (2009) for a more detailed discussion concerning the classification of ProCredit as a relationship bank.

[25]See http://www.bancoprocredit.com.ec and http://www.procredit-holding.com for more information.

Table 1: Summary Statistics of Credit Applicants I

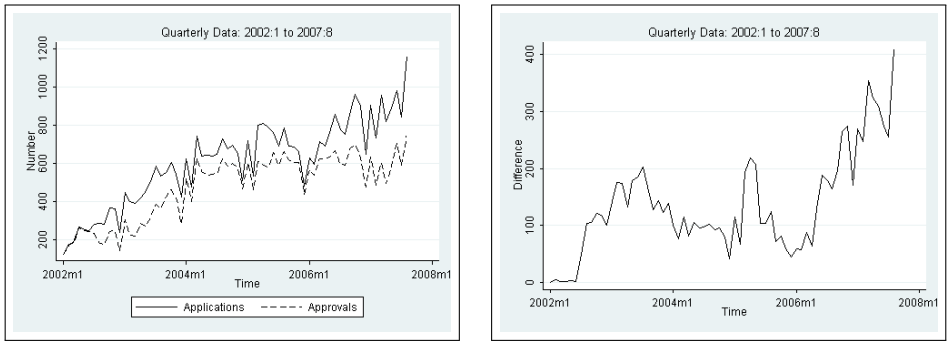
	Ambato & Riobamba	All Branches
Demographic Characteristics		
Male (%)	68.20	65.09
Average Age (years)	39.1	38.4
Married (%)	76.30	75.46
Destination of loan		
Agriculture (%)	31.50	19.65
Business/Trade (%)	28.85	35.25
Livestock/Fish Breeding (%)	4.05	6.92
Production/Construction (%)	15.03	18.91
Transportation (%)	9.75	7.64
Observations	48,736	109,354

Ecuador is a country that has historically been strongly affected by natural disasters such as earthquakes and volcanic eruptions. Sitting atop five tectonic plates, the whole region of Latin America and the Caribbean is prone to intense seismic activity. Regarding active volcanoes, Ecuador has the second largest number in the region after Chile (Charvériat 2000). The last severe outbreak of Tungurahua took place in summer 2006. Even though the eruptive process started already in 1999 and various smaller outbreaks were recorded, the 2006 eruption was the most severe since the last significant period of activity from 1916 to 1925.[26] During the eruption, pyroclastic flows went downhill threatening various smaller communities located at the base of the volcano. The 10 km high eruptive column was blown west and covered vast areas of the two provinces closest to the volcano, Chimborazo with the capital Riobamba and Tungurahua with the capital Ambato. Approximately 19,000 people had to be evacuated and the Ministry of Agriculture and Livestock reported that about 23,000 hectares of crops had been destroyed due to massive ash fall and that livestock experienced serious health problems from grazing in ash-covered pastures.

Table 1 summarizes key demographic characteristics of loan applicants as well as typical destinations of loans for the whole period from January 2002

[26]See the website of the Instituto Geofísico Ecuador (http://www.igepn.edu.ec) for more information.

Figure 1: Loan Applications and Approvals



(a) Number (b) Difference

to August 2007. Since the two provinces closest to the volcano, Chimborazo and Tungurahua, were most strongly affected by the eruptions we focus our main analysis on the ProCredit branches operating in their capitals, i.e. Riobamba and Ambato. However, as a robustness check we always compare the results to the effects on all branches in the Andean region.[27] We have 48,736 observations for Ambato and Riobamba and 109,354 for all branches located in the Andes. Table 1 shows that the majority of credit applicants is male and married and that the difference between Ambato and Riobamba on the one side and all branches taken together on the other side is not high regarding demographic characteristics. However, when it comes to the destination of loans, it is obvious that Ambato and Riobamba have a stronger focus on agriculture compared to the other regions. When looking only at the other Andean provinces, the percentage of loans directed to the agriculture sector even drops to 10.13 percent with the difference between the areas being statistically significant at the 1 percent level.[28]

In order to get an idea about the development of loan applications as well as approvals over time, Figure 1a shows the development of the two variables

[27]We restrict our analysis to the highlands since, first of all, the whole region is relatively comparable with respect to landscape and the structure of the economy and second, it is unlikely that the coastal areas were affected by eruptions of the volcano. The other provinces included in the analysis are Cotopaxi with the capital Latacunga, Imbabura with the cities Ibarra and Otavalo, and Pichincha with Cayambe.

[28]The summary statistics for credit approvals are relatively similar to Table 1 and are therefore not discussed in detail. For the figures please refer to Table A1 in the Appendix.

for the branch of Ambato.[29] As can be seen in the figure, loan applications as well as approvals have been fluctuating over the years, but the positive trend in both variables is clearly visible. It is interesting to observe, however, that the spread between applications and approvals has become wider in the last years (Figure 1b). This shows that the demand for credit has grown faster than the bank was able or willing to respond to.

Table 2: Financial Information (Averages) I

	2002	2003	2004	2005	2006	2007
Ambato & Riobamba						
Credit Amount ($)						
Amount Applied for	2,513	2,864	2,801	3,405	3,586	3,991
Amount Approved	2,185	2,508	2,617	3,094	3,404	3,705
Maturity (months)						
Maturity Applied for	11.1	13.2	14.3	16.3	17.8	19.6
Maturity Approved	10.4	12.3	13.6	15.6	17.1	19.1
Old Clients (%)						
Applied	21.54	34.37	47.63	58.94	47.98	41.68
Approved	22.10	38.66	51.19	64.88	59.42	58.78
No. Applications	3,069	5,863	7,671	8,403	11,946	11,784
No. Approvals	2,462	3,968	6,589	7,016	8,754	6,754
All Branches						
Credit Amount ($)						
Amount Applied for	2,165	2,436	2,425	2,572	2,921	3,143
Amount Approved	1,855	2,079	2,209	2,310	2,738	2,933
Maturity (months)						
Maturity Applied for	11.7	13.1	13.7	14.4	16.0	17.6
Maturity Approved	11.0	12.2	13.2	13.8	15.5	17.2
Old Clients (%)						
Applied	18.24	35.14	48.63	52.71	56.29	50.49
Approved	20.30	41.06	52.99	60.54	65.50	63.43
No. Applications	5,527	12,278	16,182	21,981	27,621	25,765
No. Approvals	4,374	9,077	13,607	17,255	20,068	15,608

Notes: [1] Reported credit amounts were deflated to 2002 prices (Source: CIA World Fact Book). [2] Figures for 2007 refer to the time from January to August.

The financial information about the loans is summarized in Table 2. It is clearly observable that the loan amount as well as the maturity applied

[29] We restrict the analysis here to Ambato due to the fact that the branches were opened in different years which could lead to misinterpretations if the data was analysed together and since Ambato is one of the branches being most affected by volcanic shocks.

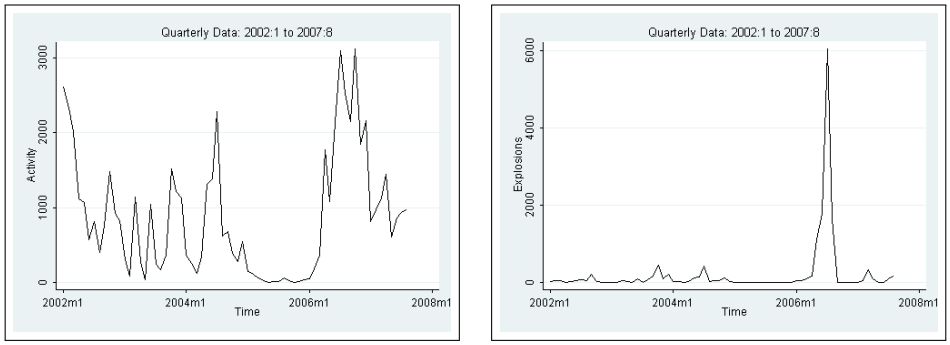
for have, on average, increased over time. This holds for Ambato and Riobamba as well as for all branches located in the Andes. However, what is more interesting is that the amount applied for has, on average, always been considerably higher than the amount approved.[30] The same result holds for the maturity. The maturity applied for is always higher than the maturity approved. These findings are intuitive since higher loan amounts and longer maturities imply higher risk for the bank as well. However, these findings indicate that loan demand is not completely met by the bank, one explanation being that households neither have sufficient expected cash flow, nor collateral or guarantees for receiving the amount or maturity they applied for.

It can also be seen in the table that the percentage of old clients applying for a loan, i.e. households who have already received a loan from this bank previously, is at about 50 percent. That the percentage of old clients actually receiving a loan is considerably higher than the percentage of those applying for credit can be explained by the lower risk those households pose to ProCredit. The fact that the bank already has detailed information about the applicants' background as well as repayment behaviour clearly works to the advantage of the households and it seems as if households who have managed to receive and repay a loan at least once have less problems to receive follow-up financing.

Figure 2 displays the seismic activity and eruptions of Tungurahua over time. Figure 2a shows that the seismic activity has varied considerably over the years with a peak in mid 2006 when the severe outbreak of the volcano occurred. This is even more apparent in Figure 2b which depicts volcanic eruptions over time. The figure shows very clearly how severe the outbreak was compared to the years before and after this shock.

[30]For a better comparability, the amount and maturity applied for are summarized only for future approvals.

Figure 2: Seismic Activity and Explosions of Tungurahua



(a) Seismic Activity (b) Explosions

2.5 Econometric Model

In order to estimate the effect of volcanic activity on low-income households and microfinance institutions we employ different econometric approaches. First, in order to analyse the effect of volcanic eruptions on monthly credit demand and approval over time we use a time series model.[31] The time series depicted in Figures 1 and 2 have to be stabilized first by using first differences, since, as is already apparent at least in Figure 1, the data series is non-stationary. This conclusion is also supported by the Dickey-Fuller and Phillips-Perron tests for stationarity. Having stabilized the time series, we identify the most adequate ARMA model specification by analyzing the autocorrelation (ACF) and partial autocorrelation functions (PACF) and testing different ARMA models using the AIC and BIC criteria. The results suggest that an AR(1,12) model outperforms all other specifications. Therefore, we estimate the following OLS model

$$C_t = \theta + \mu_1 C_{t-1} + \mu_2 C_{t-12} + \phi_1 S_t + ... + \phi_6 S_{t-5} + v_t, \quad t = 1, ..., T \quad (11)$$

where C_t is monthly credit demand or approval. C_{t-1} and C_{t-12} are the relevant autoregressive terms and S_t to S_{t-5} correspond to the different lags of volcanic activity which are equal to monthly volcanic explosions. Since the

[31] Monthly credit demand and approval refer to the number of loan applications and approvals, respectively.

variables are used in first differences, S_t to S_{t-5} include six lags of the shock variables which are used in order to account for different effects over time.[32] Finally, v_t is the error term. In order to estimate the effect of volcanic eruptions on monthly credit demand and approval for returning clients only we use a very similar model. However, the AIC and BIC criteria suggest that in this case an AR(1,2,12) model is the appropriate ARMA model specification.

Second, in order to analyse the effect of volcanic eruptions on the probability to receive a loan, we use a probit model since the credit approval decision is a binary-choice variable. However, in order to compare different econometric approaches, we also estimate the effects using a linear probability model (LPM). The according latent variable model can be written as

$$Y_i^* = \alpha + S_i\beta + X_i\delta + L_i\gamma + \epsilon_i, \quad i = 1, ..., N \tag{12}$$

with the observed variable

$$Y_i = 1\{Y_i^* > 0\}. \tag{13}$$

The dependent variable Y_i equals 1 if the credit applicant has received a loan and zero otherwise. The vector S_i contains the aggregate shocks. In this specification, different indicators for volcanic activity are compared. Therefore, S_i is either monthly volcanic explosions or the seismic activity of the volcano at the time of the credit application. We use up to six lags of the shock variables in this specification as well. However, since the results do not change when using the sum of the individual shock variables, we will usually refer to these estimates, because they are easier to interpret. X_i is a vector of demographic characteristics such as age, marital status and gender. The vector L_i comprises loan characteristics such as the credit amount applied

[32]We use six lags of volcanic activity since we assume that after six months, the effect of the shock is likely to die out. Households would have gone to the bank earlier if they were indeed affected by the shock and were in need of financing. However, a shorter time frame might be appropriate as well, yet not less than three months since households need some adjustment time before being able to apply for a loan. Even though the results are not presented in detail here, it should be noted that they do not change considerably when using less than six time lags.

for and an indicator whether households have received a loan from ProCredit previously. Furthermore, destination of loan, region, and year dummies are included in the regression. Finally, ϵ_i is the error term.

2.6 Estimation Results

The results of the time series regression of monthly credit demand and approval on the autoregressive terms and the number of volcanic explosions in the last six months are summarized in Table 3.[33]

Table 3: Time Series Regressions for Monthly Credit

Demand and Approval		
Variable	Demand	Approval
Autoregressive Terms		
L1.	-0.4796^{***}	-0.4593^{***}
	(0.1492)	(0.1179)
L12.	0.5013^{***}	0.5226^{***}
	(0.1569)	(0.1454)
Volcanic Activity		
Explosions	0.0080	0.0005
	(0.0081)	(0.0043)
L1.	-0.0207^{**}	-0.0169^{***}
	(0.0082)	(0.0046)
L2.	0.0008	0.0028
	(0.0062)	(0.0047)
L3.	0.0247^{***}	0.0173^{***}
	(0.0056)	(0.0051)
L4.	0.0198^{***}	0.0059
	(0.0074)	(0.0057)
L5.	-0.0112	-0.0024
	(0.0074)	(0.0064)
Observations	55	55
F-Test for Volcanic Activity	20.94	19.30

Notes: [1] OLS regression for Ambato with robust standard errors. [2] ***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Standard errors in parentheses. [4] Variables are in first differences.

When looking at credit demand, it can be seen that the first, third and forth lag have the highest effects while only the first and third lag are signifi-

[33] In this regression we focus again on Ambato for the same reasons given above.

cant for credit approval. Yet, the F statistic in both regressions suggests that the lagged terms for volcanic activity are jointly significant at the 1 percent level. Furthermore, the results show that households need some adjustment time after volcanic eruptions occurred since the positive effects become only significant after three months. In contrast, the negative sign on the first lag suggests that volcanic activity, at first, leads to a decrease in credit demand and approval. When calculating the combined effect of volcanic activity on credit demand as well as approval, we find that both effects are positive, yet the impact on demand is stronger than the approval effect.[34]

From this result it follows that the total loan amount demanded will increase as well. Households who were in need of additional financing before the shock occurred will now demand higher loans. Furthermore, some better off households who normally would not have needed to apply for a loan will now be in need of additional capital as well. However, due to the fact that the better off households might only demand small loans, it is unclear ex ante whether this result should also hold for the average credit amount demanded and approved. A regression of the loan amount demanded and approved on volcanic activity and the covariates suggests that, on average, credit amounts are not affected by the shock.[35] This implies that since average loan amounts remain constant, the total credit amount approved increases after volcanic eruptions as well.

Table 4 summarizes the results of the time series regression of monthly credit demand and approval on the autoregressive terms and the number of volcanic explosions only for those clients who have received a loan from ProCredit previously. As can be seen, in this specification only the first and third lag are significant for credit demand while credit approval is also significantly affected by the second lag of volcanic explosions. However, the F-statistic suggests again that the lagged terms for volcanic activity are jointly significant at the 1 percent level. Similar to the findings in Table 3, the negative sign on the first lag indicates that, at first, credit demand and approval are

[34]The combined effect of volcanic activity calculated as the sum of the individual coefficients is 0.0214 for credit demand and 0.0071 for approval.

[35]The estimation results have not been reported in detail for the sake of brevity, but can be obtained from the authors upon request.

Table 4: Time Series Regressions for Monthly Credit

Demand and Approval - Returning Clients

Variable	Demand	Approval
Autoregressive Terms		
L1.	-0.8086^{***}	-0.6684^{***}
	(0.2018)	(0.1384)
L2.	-0.3829^{***}	-0.2788^{**}
	(0.1412)	(0.1126)
L12.	0.5880^{***}	0.6392^{***}
	(0.2203)	(0.1729)
Volcanic Activity		
Explosions	0.0050	0.0032
	(0.0033)	(0.0042)
L1.	-0.0212^{***}	-0.0174^{***}
	(0.0032)	(0.0041)
L2.	0.0056	0.0103^{***}
	(0.0042)	(0.0039)
L3.	0.0153^{***}	0.0155^{***}
	(0.0037)	(0.0046)
L4.	0.0076	0.0058
	(0.0056)	(0.0051)
L5.	0.0019	0.0063
	(0.0051)	(0.0050)
Observations	55	55
F-Test for Volcanic Activity	39.62	20.34

Notes: [1] OLS regression for Ambato with robust standard errors. [2] ***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Standard errors in parentheses. [4] Variables are in first differences.

negatively influenced by volcanic activity while the effects become positive later on. Interestingly, the combined effect of volcanic explosions on credit demand and approval suggest that both effects are positive, yet that in this specification, the effect on credit approval is stronger than on demand.[36]

The estimation results of the probit regression of the credit approval decision on the covariates is summarized in Table 5. The first two columns depict the estimation results for Ambato and Riobamba using two different indicators for volcanic activity, i.e. the number of volcanic explosions and the seismic activity of the volcano in the last six months. Correspondingly, as a

[36]The combined effect of volcanic activity is equal to 0.0143 for credit demand and 0.0238 for approval.

robustness check, columns (3) and (4) summarize the regression results when using all branches located in the Andean region.[37]

The results suggest that a higher number of explosions as well as higher seismic activity in the last six months leads to a lower probability for a loan to be approved. The effects are equally strong in all four regressions. For instance, when considering a one standard deviation increase in explosions in regression (1), the effect implies a decrease in the probability to receive a loan of 4.8 percent. The results are the same when using the different time lags of volcanic activity individually. The results of regression (1) with the different lags of explosions are displayed in Table A2 in the Appendix. It can easily be seen that the lags are highly significant as well and they are also jointly significant at the 1 percent level. Yet, since the aggregate estimates are easier to interpret and the results do not change when using the time lags individually, we will refer to these results in the following.[38]

[37]Since the branches are located in areas affected differently by the volcano, we adjust the indicators for volcanic activity by using the distance to the volcano. This adjustment is not needed in the regressions for Ambato and Riobamba since they are equidistant from the volcano. However, all indicators for volcanic activity have additionally been divided by 100 in order to allow for an easier interpretation of the rather small coefficients.

[38]The estimation results of the other regressions can be obtained from the authors.

Table 5: Probit Regressions for Credit Approval

	Ambato & Riobamba		All Branches	
Variable	(1)	(2)	(3)	(4)
Volcanic Activity				
Explosions	-0.0013^{***}		-0.0229^{***}	
	(0.0001)		(0.0024)	
Seismic Activity		-0.0009^{***}		-0.0261^{***}
		(0.0001)		(0.0019)
Demographic Characteristics				
Age	-0.0045^{***}	-0.0045^{***}	-0.0017^{**}	-0.0018^{**}
	(0.0012)	(0.0012)	(0.0008)	(0.0008)
$(\text{Age})^2$	0.0000^{***}	0.0001^{***}	0.0000^{**}	0.0000^{**}
	(0.0000)	(0.0000)	$(9.11e-06)$	$(9.12e-06)$
Married	0.0400^{***}	0.0398^{***}	0.0417^{***}	0.0418^{***}
	(0.0052)	(0.0052)	(0.0034)	(0.0034)
Male	-0.0320^{***}	-0.0324^{***}	-0.0334^{***}	-0.0337^{***}
	(0.0045)	(0.0045)	(0.0029)	(0.0029)
Loan Characteristics				
Amount Applied For	$-1.47e-06^{***}$	$-1.48e-06^{***}$	$-2.85e-06^{***}$	$-2.86e-06^{***}$
	$(2.44e-07)$	$(2.44e-07)$	$(1.97e-07)$	$(1.97e-07)$
Old Client	0.2270^{***}	0.2122^{***}	0.2195^{***}	0.2057^{***}
	(0.0048)	(0.0072)	(0.0031)	(0.0038)
Old Client*Explosion	0.0012^{***}		0.0266^{***}	
	(0.0001)		(0.0031)	
Old Client*Seismic Activity		0.0008^{***}		0.0246^{***}
		(0.0001)		(0.0021)
Observations	47,477	47,477	107,643	107,643

Notes: [1] Probit regressions reporting marginal effects. [2] ***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Region, year, and destination of loan dummies included. [4] Standard errors in parentheses.

Table 6: LPM for Credit Approval

	Ambato & Riobamba		All Branches	
Variable	(1)	(2)	(3)	(4)
Volcanic Activity				
Explosions	-0.0013^{***}		-0.0266^{***}	
	(0.0001)		(0.0028)	
Seismic Activity		-0.0012^{***}		-0.0301^{***}
		(0.0001)		(0.0020)
Demographic Characteristics				
Age	-0.0040^{***}	-0.0041^{***}	-0.0013^{*}	-0.0013^{*}
	(0.0011)	(0.0011)	(0.0007)	(0.0007)
$(\text{Age})^2$	0.0000^{***}	0.0000^{***}	0.0000^{**}	0.0000^{**}
	(0.0000)	(0.0000)	$(8.68e-06)$	$(8.67e-06)$
Married	0.0405^{***}	0.0403^{***}	0.0429^{***}	0.0429^{***}
	(0.0048)	(0.0048)	(0.0032)	(0.0032)
Male	-0.0335^{***}	-0.0340^{***}	-0.0337^{***}	-0.0339^{***}
	(0.0043)	(0.0043)	(0.0028)	(0.0028)
Loan Characteristics				
Amount Applied For	$-1.37e-06^{***}$	$-1.38e-06^{***}$	$-2.69e-06^{***}$	$-2.70e-06^{***}$
	$(2.45e-07)$	$(2.46e-07)$	$(2.36e-07)$	$(2.36e-07)$
Old Client	0.2103^{***}	0.1649^{***}	0.2075^{***}	0.1863^{***}
	(0.0046)	(0.0064)	(0.0029)	(0.0036)
Old Client*Explosion	0.0011^{***}		0.0280^{***}	
	(0.0001)		(0.0031)	
Old Client*Seismic Activity		0.0010^{***}		0.0265^{***}
		(0.0001)		(0.0021)
Observations	47,477	47,477	107,643	107,643
R^2	0.1626	0.1639	0.1329	0.1341

Notes: [1] OLS regressions with robust standard errors. [2] ***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Region, year, and destination of loan dummies included. [4] Standard errors in parentheses.

Table 5 also shows that the age of the applicant seems to have a negative but also nonlinear effect on the credit approval decision. Marriage, on the other side, increases the probability to receive a loan by about 4 percent. Interestingly, but not surprisingly, men have a lower probability to receive a loan than women. This can be explained by the fact that women are assumed to be more reliable when it comes to the repayment of loans (Hossain 1988, Hulme 1991). When looking at the effect of the credit amount applied for, it can be seen that the higher the amount, the lower the probability to receive the loan, which can be explained by the higher risk of increasing loan amounts. The indicator whether the applicant is a returning client has the strongest effect on the credit approval decision. The probability to receive a loan increases by about 22 percent compared to new credit applicants.

Interestingly, the interaction effects between volcanic activity and the old client indicator are positive and highly significant in all regressions as well.[39] Since the coefficients on the indicator for volcanic activity and the interaction effect have approximately the same size, old clients are equally likely to receive a loan after they were hit by a shock and that compared to new applicants. Since it is likely that all applicants will have suffered from the shock, this finding can be interpreted as microcredit having an insurance function, at least for clients who have already established a relationship with the bank.[40]

The results of the LPM are summarized in Table 6. Similar to the estimates of the probit regression, the results suggest that higher volcanic activity leads to a lower probability to be approved for a loan, yet again only for new credit applicants. Returning clients are equally likely to receive a loan after volcanic shocks in this specification as well. In addition, the R^2 suggests that the regressions for Ambato and Riobamba have a higher goodness of fit with 16 percent compared to 13 percent for all branches. This is not surprising given the fact that Ambato and Riobamba are likely to be most

[39]The marginal effects reported in the table had to be calculated separately since the cross derivatives cannot be deduced directly from the regression output. See Ai & Norton (2003) for details.

[40]The finding is in line with the results of other empirical studies concerning the insurance function of relationship banking. See, for example, Elsas & Krahnen (1998).

strongly affected by volcanic eruptions. In contrast, according to the R^2, the difference between the two indicators for volcanic activity is not high.

2.7 Conclusion

Poor households in developing countries face substantial income risks, which they handle with sophisticated risk-management and risk-coping strategies. However, despite of these mechanisms, low-income households remain vulnerable to income shocks which can have strong negative effects on the living conditions of the poor, including household outcomes such as health or education.

Access to formal credit markets is usually assumed to contribute positively to a lower vulnerability of households to income risk. However, there has not been a lot of evidence on the direct effect of income shocks. In particular, there exist no study of the effects of aggregate shocks, which affect all households in a specific region, on the demand and approval of credit and the probability to receive a loan.

This paper addressed this question by testing whether the probability to receive a loan from ProCredit Bank in Ecuador is influenced by the volcanic activity of the most active volcano Tungurahua. The main findings of the analysis are that higher volcanic activity leads to a significantly lower probability to be approved for a loan. This finding can be explained by an increased credit demand that will not be completely met by the bank. This result, however, holds only for applicants who have not received a loan from ProCredit previously. Clients who already have established a relationship with the bank are about equally likely to receive a loan after volcanic eruptions occurred. This finding supports the relationship lending theory and is in line with the theoretical framework developed in this paper. The results imply that old clients who always behaved diligently can count on the bank for assisting them after they were hit by severe shocks. Therefore, in this case, microcredit does have an insurance function, yet only for those who managed to receive a loan from this bank previously.

The results show that microcredit schemes can have an insurance func-

tion, yet it depends on the relationship between the microfinance institution and the applicant. While returning clients can count on the bank after they were affected by major shocks, new applicants have to rely on other coping strategies which are likely to be more expensive and less efficient. This implies that microcredit alone is not sufficient for helping those households cope with aggregate income shocks who did not have access to formal financing previously.

3 Relationship Lending in Times of Crises: What About Default and Interest Rates?

3.1 Introduction

Various authors have claimed that close relationships between banks and borrowers can lead to higher welfare especially in an environment of asymmetric information (Boot 2000). Through continuous interaction, lenders are able to gather additional (private) information about borrowers which is not readily available to the public (Berger 1999), yet facilitates informal agreements between borrower and lender. Whereas borrowers receive an implicit credit insurance through more favorable loan terms when facing economic distress, lenders are compensated by information rents during normal times (Petersen & Rajan 1995, Allen & Gale 1999).[41]

These close relationships are easiest to sustain if the ongoing benefits are high for both parties. On the side of a bank, rents are based mainly on its monopoly power (Rajan 1992). If it is costly for a firm to switch lenders, the bank can charge higher interest rates compared to a world of perfect information. Thus, the higher the degree of asymmetric information, the higher the interest rates a bank can charge without driving firms to other lenders (Rajan & Zingales 1998). Additional rents may be generated by cross-selling, that allows banks to spread fixed costs over multiple products (Allen, Saunders & Udell 1991, Nakamura 1991). The higher these rents, the stronger will be the incentive to continue the relationship as long as possible and to support firms in the beginning of the relationship (Greenbaum, Kanatas & Venezia 1989, Sharpe 1990).

Consequently, in such an environment, banks will be willing to subsidize customers in times of crises in order to assure their survival and thus gain additional rents in future periods.[42]

From the perspective of a firm, the additional value generated through

[41] This chapter is joint work with Gunhild Berg from the University of Frankfurt.

[42] Banks may also provide more favorable loan terms in order to reduce incentives for moral hazard (Boot & Thakor 1994, Petersen & Rajan 1995) or allow for easier renegotiation (Boot, Greenbaum & Thakor 1993).

close relationships is provided by liquidity insurance. In times of crises or further expansion, the firm can be nearly certain that it will receive an additional loan from the bank. This intertemporal risk smoothing increases borrowers' welfare especially if risk cannot be diversified at a given point in time (Allen & Gale 1997).[43] Of course, this type of insurance is especially valuable for opaque firms which have difficulties to signal their own creditworthiness and know that the probability of surviving an economic crisis is higher when having close ties with a bank (Boot & Thakor 2000). Thus, banks and firms will agree on an implicit contract (Howitt & Fried 1980) which is beneficial for each contract party.[44]

The empirical evidence supports the prediction that close relationships increase credit availability and are welfare enhancing for both sides. For instance, Degryse & Ongena (2001) show that firms maintaining multiple bank relationships are less profitable compared to those borrowing from one main bank. Berger & Udell (1995) and Petersen & Rajan (1995) find that relationship banking increases credit availability for small firms. Elsas & Krahnen (1998) report that relationship banks in Germany provide liquidity insurance in situations of unexpected deterioration of borrower ratings. Using a sample of Japanese firms, Hoshi (1993) finds that relationship lending allows for easier access to credit and faster recovery in periods of financial distress. Similarly, Ferri, Kang & Kim (2001) analyse a sample of Korean firms after the Asian crisis and report that outstanding loans plunged more for firms with weaker pre-crisis relationship banking. Finally, by analysing lending behaviour after natural disasters, Berg & Schrader (2008) show that clients with close bank relationships have a higher probability to receive a loan after a volcanic eruption in Ecuador.

Results concerning loan terms and in particular interest rates are mixed, however. While Petersen & Rajan (1994) and Berlin & Mester (1998) find no effect of relationship lending on interest rates, Degryse & Van Cayseele (2000)

[43]Those problems are particularly severe in low income countries. See, for example, Townsend (1994), Deaton (1997), Grimard (1997), among others.

[44]Of course, this implicit contract will be difficult to sustain if one of the parties can end the relationship easily or if the bank exploits its monopoly power extensively (Sharpe 1990, Rajan 1992).

find a positive correlation and Berger & Udell (1995) and Ongena & Smith (2000) report a negative influence on interest rates. Elsas & Krahnen (1998) observe no interest rate effect for loans granted after unexpected deterioration of borrower ratings. Petersen & Rajan (1995) find that interest rates decrease over time, but that they are falling to a lesser extend in markets with lower competition. Hubbard & Palia (2002) and Steffen & Wagenburg (2008) report that undercapitalized banks charge higher loan spreads for loans to opaque borrowers in an economic recession while well capitalized banks offer more favorable loan terms. Similar results are obtained by Berlin & Mester (1999) who find the same differences for banks with varying levels of core deposits.

However, since all of these studies use cross-section data, it is possible that different patterns cancel out in the cross-section of borrowers (Elsas & Krahnen 2004). Thus, while interest rates may be lowered in time of crises, this effect may be offset by higher rents in normal times so that the effect of relationship banking on interest rates cannot be detected. Additionally, since the risk level is lower for older firms with high reputation (Diamond 1991), effects might also cancel out over time.

We circumvent this caveat by analysing interest rate adjustments and default rates for clients directly after an exogenous economic shock; namely a volcanic eruption in Ecuador. Our analyses are based on data from ProCredit Ecuador from January 2002 to August 2007 which we combine with geophysical data on volcanic activity of the most active volcano Tungurahua. Thus, with this data we are able to test directly whether firms receive better loan terms after being affected by a shock and whether this effect depends on the bank-client relationship. Furthermore, we can analyse whether potential changes in loan terms translate into different repayment behaviour as well.

Our findings suggest that after a severe volcanic eruption, default probabilities increase significantly for new clients whereas they remain constant for clients who have had a relationship with the bank before. As anticipated, this difference can be associated with better loan terms returning clients receive after they were hit by a shock. More specifically we find that while interest rates for returning clients are lowered, loan terms for new clients remain unchanged.

Our results support the view that relationship lending not only increases credit availability, but also leads to lower interest rates in times of an economic crisis at least for those clients who are already known by the bank. Since default probabilities remain unchanged for returning clients (which implies that the survival of the firm is secured), the bank can ensure that it will receive information rents from those clients in the future. Thus, relationship banking works to the advantage of the customer as well as of the institution itself. For new clients, however, it seems as if the costs of providing better loan terms are higher than the potential benefits for the bank. Consequently, interest rates remain constant which translates into higher default rates as well. This implies that the full benefits of relationship lending can only be provided if the bank-client relationship has already been established before the shock occurs.

The remainder of this paper is organized as follows. In Section 3.2, we present a theoretical model that highlights the effect of natural disasters on microcredit interest and default rates. Section 3.3 discusses the data we use and provides some descriptive statistics on the clients and their loans. The econometric models employed are presented in Section 3.4, while Section 3.5 is concerned with the empirical results. The paper closes with some concluding remarks in Section 3.6.

3.2 Theoretical Framework

Let us assume a risk neutral world. Banks face the two different types of clients in $t = 0$: new clients (n) and returning clients (e). In $t = 0$, both types of agents come to the bank and ask for a loan to execute an investment project. They invest an amount of 1 in a project that pays out $Y > 0$ in $t = 1$. The profit Y is a random variable with the distribution function $G(y)$. For simplicity, we assume Y to be uniformly distributed with the maximal value $\overline{Y}$. Thus, the distribution function is given by $G(y) = \frac{y}{\overline{Y}}$.

The bank knows, that a fraction of $\theta_k(k = n, e)$ agents will return in $t = 1$ and ask for another loan. In $t = 1$, the agents execute a save investment project that pays out Y_R for an investment of 1. The bank has more

information about the returning clients. It knows, that these returning clients will return in $t = 1$ with a probability of $\theta_e = 1$ to the bank. The information about new clients is more scarce. The bank cannot distinguish between agents executing only a one shot project (we call them non-entrepreneurs from now on) and agents, willing to conduct another save project in $t = 1$ (we call them entrepreneurs from now on).[45] It only knows that a fraction $\theta_n < 1$ of agents will be entrepreneurs in the future. Agents themselves also do not know in $t = 0$ if they will execute another project in $t = 1$. Agents have no own capital and have to borrow the total investment amount from a bank. This holds in every period as any net profit earned in the past is consumed and no collateral is generated for subsequent operations.

The banks' cost of funds is 0 as we are in a risk neutral world. They only offer standard one term debt contracts in $t = 0$ with an interest rate of r.[46] In $t = 1$, the bank is able to capture a save rent $R-1$ from every entrepreneur. Thus, the expected rent $E(R-1) = \theta_k(R-1)$ the bank can earn by an agent differs for new and returning clients. The amount $0 < R-1 < Y_R-1$ can be interpreted as the monopolistic rent a bank can yield by gathering relation specific information about opaque firms (Sharpe 1990, Rajan 1992).[47] We assume that these rents are identical for new and returning clients because the bank is not able to determine the time an entrepreneur will participate in the market.

By setting the interest rate r in $t = 0$, the bank can influence the probability of repayment of the agents. A client will pay back the loan, if the projects payoff Y is at least equal to $1 + r$. Otherwise, we assume that he will default on his loan. If a client defaults he will disappear from the market and the bank receives a value of 0. Firms may have to liquidate assets in the case of repayment problems (Freixas 2005) and therefore, the value of the

[45] An alternative would be that non-entrepreneurs switch to a different bank or already have close relationships with other banks.

[46] For a loan of 1 in $t = 0$, the client has to pay back $1 + r$ in the next period.

[47] We will not model the firm side in this model. Yet we assume that firms yield positive profits because banks are not able to capture the full income of the agents. Consequently, interest rates and rents of the bank do not change the decision of a firm to enter the market as for example in the model of Petersen & Rajan (1995).

investment falls to zero.[48] Hence, denoting the default probability with the variable d, the probability of repayment p is given by

$$p(r, \overline{Y}) = 1 - d(r, \overline{Y}) = 1 - \frac{1+r}{\overline{Y}} \tag{14}$$

In order to determine the optimal interest rate r^* for both client types, the bank will set the interest rate r^* that satisfies the following condition:

$$p(r^*)(1+r^*) - 1 + p(r^*)\theta_k(R-1) = 0 \tag{15}$$

Inserting equation 14 yields

$$(1 - \frac{1+r^*}{\overline{Y}})(1+r^*) - 1 + (1 - \frac{1+r^*}{\overline{Y}})\theta_k(R-1) = 0 \tag{16}$$

A bank faces a trade off by setting the interest rate in $t = 0$. Increasing the interest rate yields to a higher income in $t = 0$, but diminishes the rents that the bank is able to gain in $t = 1$.

Analysis

We assume that an aggregate shock will occur at the beginning of $t = 0$.[49] The bank and the agents do not know which client will be affected by the shock. The bank only knows, that the aggregated shock is reflected by a reduction in the maximum income level $\overline{Y}$ by $\delta\overline{Y}$ for all agents: The probability of lower profits will rise for all agents simultaneously. Hence, the default probability $d = \frac{1+r}{\overline{Y}}$ will increase for every agent if the interest rate does not change. At the same time, the interest rate has a stronger effect on the default probability in the shock period since $\frac{\delta d}{\delta r} = \frac{1}{\overline{Y}}$. In the next period $t = 1$, the maximum income level will return to its former level.

[48] We also exclude the possibility of renegotiating the loan in the case of payment problems.

[49] Aggregate income shocks such as natural disasters can have various effects on the well-being of low-income households. Expressed in the simplest terms, a disaster can affect assets (direct damages), the flow for the production of goods and services (indirect losses), and the performance of the main macroeconomic aggregates of the affected country (macroeconomic effects)(Economic Commission for Latin America and the Caribbean (ECLAC) 2003).

Proposition 1: *After aggregate income shocks, interest rates decrease for returning clients if the value of an ongoing relationship is sufficiently high.*

Proof. We can transform equation 16 to the following quadratic equation:

$$-r^{*2} + r^*(\overline{Y} - 2 - \theta_k(R-1)) + \theta_k[(R-1)(\overline{Y}-1)] - 1 = 0 \qquad (17)$$

On the basis of equation 17 it is straightforward to determine the effect of the aggregate income shock on the optimal interest rate r^*. The shock is reflected by an reduction of $\overline{Y}$. Hence, the change of the optimal interest rate is equivalent to $-\frac{\delta r^*}{\delta \overline{Y}}$. Since from equation 17 it can be seen that an optimal interest rate r^* exists,[50] we can calculate the change of the optimal interest rate r^* when $\overline{Y}$ goes down by applying the implicit function theorem:

$$-\frac{\delta r^*}{\delta \overline{Y}} = \frac{r^* + \theta_k(R-1)}{\overline{Y} - 2r^* - 2 - \theta_k(R-1)} \qquad (18)$$

Since the numerator is positive for all values of $R > 1$, $\theta_k > 0$ and r^*, the denominator determines the direction of the interest rate change. If it holds that the denominator $\overline{Y} - 2r^* - 2 - \theta_k(R-1)$ is smaller than zero, that is $\overline{Y} - 2r^* - 2 - \theta_k(R-1) < 0$, the interest rates will decrease after the shock. Hence, we can calculate the minimum rent $R^c - 1$ a returning client ($\theta_e = 1$) must yield in $t = 1$ in order to enjoy a lower interest rate after the shock:

$$R^c - 1 = \overline{Y} - 2(1 + r^*) \qquad (19)$$

If the rents the bank can extract from the client are sufficiently high, that is if $R - 1 > \overline{Y} - 2(1 + r^*)$, the optimal interest rate r^* will go down. Consequently, profits $p(r^*)(1 + r^*)$ in $t = 0$ will go down as well. Yet in contrast to the first period, the revenues $p(r^*)(R-1)$ in $t = 1$ will be considerably higher and offset the additional losses from the first period.

When the ongoing relationship has a very high value for the bank, it will decrease interest rates for returning clients in order to assure the survival of the entrepreneurs. By saving these entrepreneurs from insolvency, it is able to

[50] Using the quadratic formula, it can be shown that for $R > 1$ and $\theta_k > 0$ and $\overline{Y}$ there exists a solution for r^*.

earn additional rents from them in the next period, since saving entrepreneurs is more valuable than increasing the interest rate revenues.

□

Proposition 2: *After an aggregate income shock, interest rates increase for new clients if the share of entrepreneurs is sufficiently low.*

Proof. We know from equation 18, that the term $\overline{Y} - 2r^* - 2 - \theta_n(R-1)$ determines the direction of the interest rate change. Equivalent to equation 19, we can calculate the minimum share of entrepreneurs θ_n^c for a given rent R[51] that must exist in the market to induce a negative change of the interest rate:

$$\theta_n^c = \frac{\overline{Y} - 2(1+r^*)}{R-1} \tag{20}$$

Consequently, it holds for all values $\theta_n < \theta_n^c$ that the interest rate will increase after an aggregate shock has occurred. The reason is that in this case the expected rents $\theta_n(R-1)$ are too small to make a decrease in interest rates profitable.[52] Thus, the bank will offset the losses induced by a higher default probability by rising interest rates in $t = 0$. Revenues $p(r^*)(1+r^*)$ in $t = 0$ will be higher after the shock, whereas the profits $p(r^*)\theta_n(R-1)$ in $t = 1$ will be lower.

□

Proposition 3: *After an aggregate shock, default rates will decrease for returning clients and increase for new clients.*

Proof. Assuming that $R > R^c$ and $\theta < \theta_n^c$, interest rates fall for returning clients and rise for new clients. These changes affect also the default probabil-

[51] Remember that the rent R is equal for new and returning clients, only the expected rents may differ.

[52] This result differs from the result obtained by models where banks capture all rents from the agents, see for example Petersen & Rajan (1995). Since the shock increases the default probability, banks would have to lower interest rates for all client groups in order to satisfy the participation constraints of the agents.

ity of agents in the period after the shock. The default probability d depends upon r^*:

$$d = 1 - p(r^*(\overline{Y})) = \frac{1 + r^*(\overline{Y})}{\overline{Y}} \tag{21}$$

After the shock, $\overline{Y}$ decreases. This leads to a change of the default rates of

$$-\frac{\delta d}{\delta \overline{Y}} = \frac{(1 + r^*) + \frac{\delta r^*}{\delta \overline{Y}} \overline{Y}}{\overline{Y}^2} \tag{22}$$

For returning clients, it holds that $-\frac{\delta r^*}{\delta \overline{Y}} < 0$. Consequently, $\frac{\delta d}{\delta \overline{Y}}$ is negative if $1 + r^* < (-)\frac{\overline{Y} \delta r^*}{\delta \overline{Y}}$:

$$1 + r^* < \frac{\overline{Y}[r^* + \theta_k(R-1)]}{\overline{Y} - 2r^* - 2 + \theta_k(R-1)} \tag{23}$$

From equation 23, we derive the critical θ_k^d for which the change in default rates will be negative.

$$\theta_k^d < \frac{\overline{Y} - 2(1 + r^*)^2}{(R-1)(\overline{Y} - 1 - r)} \tag{24}$$

It holds that $\theta_k^d < \theta_n^c$. The critical value for which default rates fall is smaller than the critical value for which the change in interest rates is negative for new clients. Consequently, we can conclude that $-\frac{\delta d}{\delta \overline{Y}} < 0$ for all cases where $-\frac{\delta r^*}{\delta \overline{Y}} < 0$.

The aggregated shock increases default rates. The bank will decrease interest rates in order to bring default rates back to its former level because the ongoing relationship has a certain value for the bank. However, the bank also has to offset the interest rates losses. For this reason, default rates have to fall slightly.

For new clients, it holds that $-\frac{\delta r^*}{\delta \overline{Y}} > 0$. Consequently, it follows from equation 22 that the change in default rates will be positive. Since default rates in this case only slightly react on interest rate changes, the bank can offset the losses with higher interest rates.

□

Summing up, our analysis suggests that banks have an incentive to save returning clients after an aggregate shock by lowering the interest rates. For new clients, this effect will be less pronounced. Consequently, interest rates for new clients might even go up after the shock. As a consequence, this effect will also be reflected in default rates. For new clients, default rates should go up. For returning clients, default rates even might go down.

3.3 Description of the Data

Our empirical analyses are based on data from ProCredit Bank in Ecuador from January 2002 to August 2007. ProCredit Ecuador was founded in October 2001 and is part of ProCredit Group which consists of 22 banks operating in transition economies and developing countries in Eastern Europe, Latin America and Africa.[53] Schrader (2009) has classified ProCredit as a typical relationship lender.

We use data from the management information system of ProCredit Ecuador which provides detailed information on loan applicants as well as clients for all branches of the bank. In order to analyse the effects of major aggregate shocks on low-income households, the data from ProCredit Ecuador was combined with monthly data on the eruptions of the most active volcano Tungurahua provided by the Instituto Geofísico Ecuador.

Ecuador is a country that has historically been strongly affected by natural disasters such as earthquakes and volcanic eruptions. The last severe outbreak of Tungurahua took place in 2006, led to the evacuation of approximately 19,000 people, and had disastrous consequences on the surroundings.[54] Since the two provinces closest to the volcano, Chimborazo and Tungurahua, were most strongly affected by the eruptions, we focus our analyses

[53] A detailed description of the institution and the data used can be found in Berg & Schrader (2008). See also http://www.bancoprocredit.com.ec and http://www.procredit-holding.com for more information.

[54] See the website of the Instituto Geofísico Ecuador (http://www.igepn.edu.ec) and Berg & Schrader (2008) for more information.

on the ProCredit branches operating in their capitals, i.e. Riobamba and Ambato.

Table 7: Summary Statistics of Credit Approvals II

Demographic Characteristics	
Male (%)	68.15
Average Age (years)	39.4
Married (%)	78.86
Destination of loan	
Agriculture (%)	33.31
Business/Trade (%)	26.25
Livestock/Fish Breeding (%)	4.16
Production/Construction (%)	15.51
Transportation (%)	10.31
Observations	35,543

Table 7 summarizes key demographic characteristics of loan approvals as well as typical destinations of loans for the whole period from January 2002 to August 2007. In total, there are 35,543 observations for loans approved between 2002 and 2007 in Ambato and Riobamba. Table 7 shows that the majority of credit applicants is male and married. The average age of the clients is just below 40. When it comes to the destination of loans, it can be seen that most loans go to the agricultural sector, followed by business and trade and production and construction.

Table 8: Financial Information (Averages) II

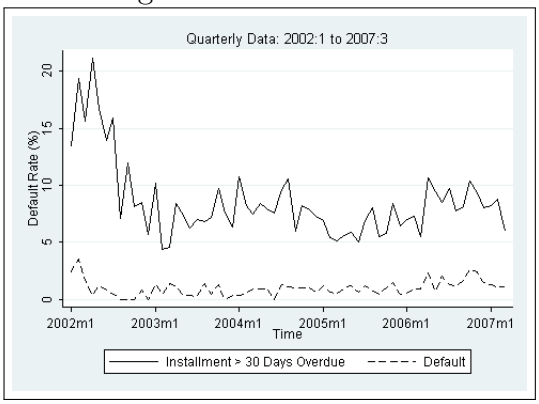
	2002	2003	2004	2005	2006	2007
Credit Information						
Amount ($)	2,185	2,508	2,617	3,094	3,404	3,705
Maturity (months)	10.4	12.3	13.6	15.6	17.1	19.1
Interest Rate (%)	9.65	9.46	10.04	11.71	12.87	9.13
Default Rates (%)						
Installment > 30 Days Overdue	13.44	7.38	8.33	6.27	8.60	7.61
Final Default	0.85	0.71	0.83	0.88	1.59	1.17
No. Approvals	2,462	3,968	6,589	7,016	8,754	6,754

Notes: [1]Reported credit amounts were deflated to 2002 prices (Source: CIA World Fact Book). [2]Figures for 2007 refer to the time from January to August for the credit information and until March for default rates.

Table 8 summarizes the financial information on the loans approved in the Riobamba and Ambato branches. It can be seen that the loan amount as well as the maturity approved have, on average, increased over time. The same is true for the interest rate charged. However, it is interesting to observe that the interest rate dropped considerably between 2006 and 2007.[55]

In order to analyse default rates over time, two definitions are used. First, along the definition used by ProCredit for arrears rates, default is defined as having a loan outstanding on which an installment has been more than 30 days overdue. However, since we are able to observe whether a client defaulted completely, implying the liquidation of the loan, we use this stronger definition of default in a second step as well. As can be seen in Table 8, the percentage of loans on which an installment was more than 30 days overdue decreased over time. On average, the percentage was 7.23 percent for the whole time span. Yet, being in arrears for more than 30 days does not necessarily imply that the client defaults completely. The percentage of loans that had to be liquidated is with 0.8 percent comparably small. This corresponds to a repayment rate of over 99 percent over time. However, it can also be seen that especially between 2005 and 2006 default rates increased which led to an average final default rate in 2006 of nearly double the size of 2005.

Figure 3: Default Rates



With respect to the relation between default and interest rates, the cor-

[55]For means of comparability, the average interest rate charged in Ecuador in 2007 was approximately 11 percent according to the Banco Central de Ecuador.

relation between both default indicators and interest rates is positive and significant at the 1 percent level.[56] This indicates that loans with higher interest rates are indeed more difficult to repay even though of course, higher interest rates are also an indicator for higher risk.

Figure 4: Explosions of Tungurahua

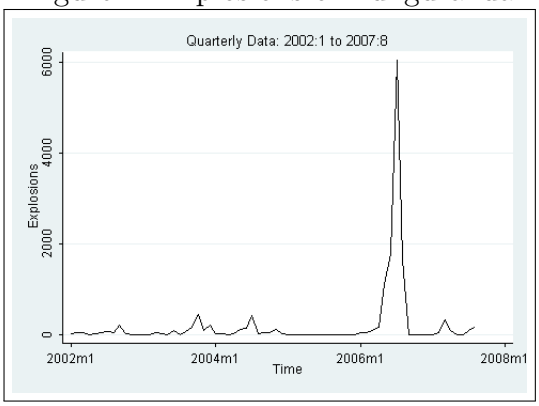


Figure 3 provides a more detailed picture of the development of the two indicators for default over time. Again, it can be seen that ProCredit was able to recover most of the loans that were in arrears for more than 30 days. After the first year of operation in which default rates were comparably high, both indicators for default remained relatively stable over time. Whereas the percentage of loans on which an installment was more than 30 days overdue fluctuated between 4 and 11 percent, the final default rate was usually in the range of 0 to 1.5 percent. However, in 2006, default rates increased to 2.6 and 2.4 percent in October and November, respectively, explaining the average increase in default rates between 2005 and 2006.

In order to give an idea about the volcanic activity of Tungurahua, Figure 4 displays the volcanic eruptions of the volcano over time. The figure shows very clearly how severe the outbreak in 2006 was compared to the years before and after this shock.

[56]The correlations are 0.0887 and 0.0403 for more than 30 days overdue and final default, respectively.

3.4 Econometric Model

In order to estimate the effect of volcanic activity on default rates of microfinance clients we use a linear probability model (LPM).[57] The corresponding latent variable model can be written as

$$Y_{it}^* = \alpha_1 + S_t\beta_1 + X_{it}\delta_1 + L_{it}\gamma_1 + \epsilon_{it}, \quad i = 1, ..., N, \quad t = 1, ..., T \tag{25}$$

with the observed variable

$$Y_{it} = 1\{Y_{it}^* > 0\}. \tag{26}$$

The dependent variable Y_{it} equals one if the client defaults on a loan i that was taken up at time t and zero otherwise. As indicators for default, we use the two different default definitions discussed above. The vector S_t contains the aggregate shocks, in particular monthly volcanic explosions at the time of the credit application. Up to six lags of the shock variables are used.[58] However, since the results do not change when using the sum of the individual shock variables, we will refer to these estimates since they are easier to interpret. Thus, the vector S_t contains the sum of the volcanic explosions of the last six months at the time of the credit application. X_{it} is a vector of demographic characteristics such as age, marital status and gender. The vector L_{it} comprises loan characteristics such as the credit amount and maturity approved and an indicator whether households have received a loan from ProCredit previously. Furthermore, destination of loan, region, and year dummies are included in the regression. Finally, ϵ_{it} is the error term.

In order to determine whether the interest rate is affected by the shocks,

[57] A probit or logit model would be equally appropriate for estimating the effects of interest. Yet, since the results are independent from the econometric model we choose, we restrict our analyses to the LPM case.

[58] We use six lags of volcanic activity since we assume that after six months, the effect of the shock is likely to die out. If households were indeed affected by the shock and were in need of financing they would have gone to the bank earlier. However, a shorter time frame might be appropriate as well, yet not less than three months since households need some adjustment time before being able to apply for a loan. Even though the results are not presented in detail here, it should be noted that they do not change considerably when using less than six time lags.

a standard OLS model is used. The model can be written as

$$I_{it} = \alpha_2 + S_t\beta_2 + X_{it}\delta_2 + L_{it}\gamma_2 + u_{it}, \quad i = 1, ..., N \tag{27}$$

where I_{it} reflects the interest rate for a loan granted at time t and the vectors S_t, X_{it}, and L_{it} contain the same variables as in equation 25. u_{it} is the error term. The loan characteristics comprised in L_{it} can be used in this regression since the interest rate is ultimately an outcome of the credit amount and maturity negotiated. By including these variables in the regression, it can be determined whether volcanic eruptions have an effect on the interest rate given the loan amount and maturity approved. However, it could be argued that the results may be biased since it is likely that the shock will have an effect on the loan amount and maturity approved as well. Therefore, the results are compared to the regression in reduced form as well. Since the same could be argued for the default regressions, the results of these estimations are compared to the regressions in reduced form as well.

3.5 Estimation Results

The estimation results of the LPM regression of default on the covariates are summarized in Table 9. The first two columns depict the estimation results for default defined as being in arrears for more than 30 days, first estimated in the reduced form and second including the loan amount and maturity approved. Consequently, the second two columns show the estimation results using the stronger default definition, again estimated in reduced form and loan characteristics including.[59]

The results suggest that loans approved after high volcanic activity have a significantly higher default probability.[60] Comparing the results of the estimations in reduced form to the regressions including the loan characteristics, it can be seen that the results are very similar. However, the results seem to

[59] All indicators for volcanic eruptions have been divided by 100 in order to allow for an easier interpretation of the coefficients.

[60] The results are the same when using the different time lags of volcanic activity individually. Yet, since the aggregate estimates are easier to interpret we only refer to these results.

be stronger when defining default as those loans on which an installment is more than 30 days overdue as can be seen in the first two columns. This is understandable since this definition is weaker compared to the strict default definition used in columns 3 and 4. However, in all regressions, the number of volcanic explosions is significant at the 1 percent level. When considering a one standard deviation increase in explosions, the effects imply an increase in the probability to default of 1.14 percent in column 2 and 0.4 percent in column 4, respectively. Relating those figures to the average default rates over time of 7.23 and 0.8 percent, respectively, shows that final default is even more strongly affected. In this case, a one standard deviation increase in explosions corresponds to an increase of 50 percent compared to the average default rate over time.

Table 9 also shows that the age of the applicant as well as marriage have a negative effect on defaulting whereas gender does not seem to be a strong explanatory variable. Only in the first regression, the indicator is significant, but only at the 10 percent level. This is surprising since it is usually assumed that women are more reliable than men when it comes to the repayment of loans (Hossain 1988, Hulme 1991). Even though our findings do not contradict this presumption, they are also not strongly supporting it.

When looking at the effect of the credit amount and maturity approved in columns 2 and 4, it can be seen that the higher the amount and maturity, the higher the default probability. However, since the loan amount and maturity are highly interrelated, an interaction term was included in the regression as well. In order to facilitate the interpretation of the coefficients, again, a one standard deviation increase can be considered given a specific value of the second variable. For instance, for average maturity, a one standard deviation increase in the loan amount approved leads to an increase in the probability to default of 0.73 percent for the first default definition and 0.25 percent for final default. Correspondingly, a one standard deviation increase in maturity for the average loan amount approved leads to an increase in the default probability of 1.43 and 0.18 percent, respectively. These findings can be explained by the higher risk of increasing loan amounts and maturities.

Table 9: LPM Regressions for Default

	Installment > 30 Days Overdue		Final Default	
Variable	(1)	(2)	(3)	(4)
Volcanic Activity				
Explosions	0.0003^{***}	0.0003^{***}	0.0001^{***}	0.0001^{***}
	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Demographic Characteristics				
Age	-0.0005^{***}	-0.0005^{***}	-0.0001^{***}	-0.0002^{***}
	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Married	-0.0334^{***}	-0.0357^{***}	-0.0091^{***}	-0.0094^{***}
	(0.0039)	(0.0039)	(0.0016)	(0.0016)
Male	0.0055^{*}	0.0036	0.0012	0.0009
	(0.0032)	(0.0032)	(0.0012)	(0.0012)
Loan Characteristics				
Amount Approved		$1.86e-06^{**}$		$7.05e-07^{**}$
		$(8.40e-07)$		$(3.30e-07)$
Maturity Approved		0.0015^{***}		0.0002^{***}
		(0.0002)		(0.0001)
Amount*Maturity Approved		$-3.23e-08^{*}$		$-1.69e-08^{***}$
		$(1.76e-08)$		$(5.92e-09)$
Old Client	-0.0107^{***}	-0.0118^{***}	-0.0025^{**}	-0.0027^{**}
	(0.0034)	(0.0034)	(0.0012)	(0.0012)
Old Client*Explosion	-0.0004^{***}	-0.0003^{***}	-0.0001^{**}	-0.0001^{**}
	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Observations	34,301	34,301	34,301	34,301

Notes: [1]OLS regression with robust standard errors. [2]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3]Region, year, and destination of loan dummies included. [4]Standard errors in parentheses.

The indicator whether the applicant is a returning client has a strong effect on the probability to default as well. The probability is 1.18 percent points lower in regression 2 and 0.27 percent points lower in regression 4. The results of the reduced form regressions are not considerably different from these results. Interestingly, the interaction effects between explosions and the returning client indicator are negative and highly significant in all regressions as well. Since the coefficients on the indicator for volcanic activity and the interaction effect have approximately the same size, this implies that only new clients are more likely to default after they were hit by a shock whereas the probability to default does not change for returning clients.

Concerning new clients, this finding is in line with the theoretical model arguing that new clients are more likely to default after being affected by shocks. For returning clients, however, the predictions of the model are not consistent with the empirical results. Whereas hypothesis 3 states, that default rates will decrease after shock, the empirical results show that default rates remain constant. One possible explanation is that the decrease in default rate predicted by the model is so small that we could not measure it with our data set.

As an explanation it was suggested that the bank will offer more favorable loan terms to their returning clients by lowering interest rates whereas new clients will face higher interest rates as in normal times. The reason for this supposition is that for returning clients the bank can be certain that it will be able to offset the losses generated during the shock period through the higher rents it can extract from those clients in the future. For new clients, however, the bank is still facing the problem of asymmetric information implying that it cannot be sure that clients will indeed return in the following periods. Thus, it is only profitable for the bank to subsidize clients who are already known to the institution.

In order to test whether returning clients indeed receive more favorable loan terms in times of crisis compared to new clients, in Table 10, the results of a regression of the interest rate charged on volcanic activity and the covariates are presented. While column 1 summarizes the reduced form estimates, the loan amount and maturity approved are included in column 2.

Table 10: OLS Regressions of the Interest Rate

Variable	(1)	(2)
Volcanic Activity		
Explosions	-0.0012	-0.0001
	(0.0008)	(0.0007)
Demographic Characteristics		
Age	-0.0084^{***}	-0.0025^{*}
	(0.0015)	(0.0014)
Married	-0.1893^{***}	0.0485
	(0.0427)	(0.0386)
Male	-0.2420^{***}	-0.0238
	(0.0390)	(0.0342)
Loan Characteristics		
Amount Approved		-0.0003^{***}
		(0.0000)
Maturity Approved		-0.1368^{***}
		(0.0031)
Amount*Maturity Approved		$5.00e-06^{***}$
		$(2.76e-07)$
Old Client	0.3053^{***}	0.4321^{***}
	(0.0373)	(0.0340)
Old Client*Explosion	-0.0039^{***}	-0.0045^{***}
	(0.0010)	(0.0008)
Observations	34,301	34,301

Notes: [1]OLS regression with robust standard errors. [2]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3]Region, year, and destination of loan dummies included. [4]Standard errors in parentheses.

As it can be seen, the number of volcanic explosions is insignificant in both regressions. However, the interaction effect between returning clients and volcanic activity suggests that the interest rate only remains unaffected for new credit approvals whereas old customers receive loans with lower interest rates after they were hit by shocks. This finding holds in the reduced form regression as well as when controlling for the loan amount and maturity approved.

Apart from the explosion variables, married men seem to receive the best loan terms indicated by low interest rates as can be seen in regression 1. However, when controlling for the loan amount and maturity approved, it becomes obvious that the demographic variables are less correlated with the

interest rate as such, and even more with the credit amount and maturity approved, since the effects are rendered insignificant in regression 2. This implies that the effects of age, gender, and marriage are already captured in the loan amount and maturity. The coefficients on the amount and maturity approved suggest that the higher those two terms, the lower the interest rate. In order to take the potentially high correlation between those two variables into account, again an interaction term has been included which is also highly significant. The coefficient on the interaction effect is, however, comparably small which implies that, on average, the effect of higher loan amounts and maturities is indeed negative.

The indicator whether the client is a returning customer has a strong and positive effect on the interest rate in both regressions and even increases in size once controlling for the loan amount and maturity approved. This finding is in line with the presumption that microfinance institutions charge higher interest rates from their returning clients in order to offset the losses generated in earlier periods. Furthermore, since it is not unlikely that returning customers also apply for loans for more complex projects since they have progressed over time which may also imply higher debt ratios, interest rates may also be higher.

The findings for the interaction effect between returning clients and the number of volcanic explosions suggests that, compared to new credit approvals, returning clients indeed receive better loan terms after they were hit by shocks. In both specifications, the interest rate is significantly lower for returning clients whereas loan terms are not altered for new credit approvals.

For new clients, these findings are in line with the theoretical model. For returning clients, in difference to hypothesis 2, we observe no increase in interest rate after the shock. This difference could be explained by competition between different banks. Since we analysed a regional shock, the bank perhaps abstained from rising interest rate for new clients in order to impede the movement of clients to other banks. Yet, the model nevertheless would predict higher default rates for new clients after the shock, if interest rate remain constant.

However, the observation that interest rates are lower for returning clients

are in line with the model. Apart from the close interaction between the microfinance institution and the clients, this result provides an explanation on why returning clients are not more likely to default after high volcanic activity.

3.6 Conclusion

Relationship lending is usually assumed to have a high value for both, banks and borrowers. Through the establishment of informal agreements, borrowers may be subsidized in times of economic crises, whereas banks benefit from the higher information rents they can charge during normal times. The evidence found proves strongly that relationship lending can indeed increase credit availability and can serve as an implicit insurance against risk. However, it is less clear whether this insurance works through more favorable loan terms in times of crises or only through a close interaction between bank and borrower. Furthermore, it is unclear whether this support indeed facilitates the continuation of the relationship.

This paper addressed those questions by analysing the changes in default probabilities and interest rate adjustments directly after an aggregate shock, in particular a volcanic eruption in Ecuador. The main findings of the analyses rely on the fact that after high volcanic activity, default rates remain constant for returning clients whereas clients who are new to the bank face significantly higher probabilities to default. Furthermore, when analysing the effects on interest rates, the results suggest that loan terms are indeed improved for clients who have had a relationship with the bank before. In contrast, interest rates remain unchanged for new clients, which can explain the higher default probabilities as well.

Our findings suggest that relationship banking can help firms to survive in times of economic shocks. This is indicated by the unchanged default probabilities for returning clients. The bank supports those clients through better loan terms, in particular lower interest rates, which also works in advantage of the bank, because it does not loose the additional rents from these clients in future periods. The expected rents from new clients, however, are too low

for the bank, implying that interest rates will not decrease. Inevitably, this leads to higher default rates for those clients, a result that can be directly associated with asymmetric information. In such an environment, the full benefits of relationship banking may thus only be reaped if the client-bank relationship has already been established before a shock occurs.

4 The Competition between Relationship - Based Microfinance and Transaction Lending

4.1 Introduction

For microfinance in developing and transition countries, relationship lending is considered the most appropriate lending technique when lending to young firms and micro and small entrepreneurs (MSEs). In an environment characterized by little public information on potential clients and low legal enforcement of creditor rights, relationship lenders are able to overcome market imperfections by establishing a long-term relationship with a firm, gathering firm specific information during the relationship (Rajan & Zingales 1998). During the last decade, microfinance institutions (MFIs) have shown that by applying relationship lending techniques they were able to extend the outreach of financial services to the poor while developing micro- and small enterprise lending into a profitable business at the same time (Armendáriz de Aghion & Morduch 2005).

However, this success has induced new players to enter the microfinance markets in various countries. As markets have become increasingly saturated, many countries now see various different lenders competing directly for the same clients. Among the competitors, there are not only socially motivated MFIs applying relationship techniques, but also private for-profit institutions supplying transaction based loans. In contrast to typical MFIs, the latter try to overcome the problems of asymmetric information and high enforcement costs by applying credit scoring systems saving on fixed costs for loan officers' salaries (Rhyne 2002). Usually, their main focus lies on consumer finance, but they provide loans to MSEs as well.

Various papers have pointed out that competition in the banking sector might not be a purely positive phenomenon driving prices down and enhancing efficiency. Competition may cause unwanted effects like excessive risk taking (Allen & Gale 2004) or suboptimal levels of screening (Cetorelli &

Peretto 2000). Concerning competition between relationship and transaction banks, two strands of theoretical literature can be identified. Representing the first strand, Rajan (1992) argues that relationship banking might be destroyed by competition, as this lending technique can only be applied if the lender has some monopolistic power. In a market with information spill overs and with many institutions competing for the same clients, relationship customers with positive credit records might switch to transaction banks, because they offer more favorable credit terms. Hence, transaction lenders undermine the possibilities of relationship lenders to establish long term relationships and provide liquidity insurance to their customers in times of crisis (Petersen & Rajan 1995). Representing the second strand of literature, Boot & Thakor (2000) show, that both, transaction lending and relationship lending, can co-exist when focusing on different market segments. Borrowers who earn a fixed salary and can easily supply reliable information and collateral turn to transaction lenders. Opaque borrowers, however, like MSE prefer relationship loans because relationship lenders invest in information gathering and provide insurance in times of crisis. Accordingly, relationship banks will survive the market entrance of transaction lenders by focusing on clients for whom the distribution of information is highly asymmetrical.

Empirical results for industrial countries provide evidence that higher levels of competition result in lower access to credit and higher lending costs for low quality borrowers like MSEs (Petersen & Rajan 1995). However, since in developed economies lending institutions usually apply both, relationship lending and transaction based lending technologies at the same time, these studies do not specifically analyse the effect of competition between relationship lenders and transaction lenders, but hat of banking competition in general. Studies analysing competition between relationship lenders in developing countries find that competition is associated with higher default rates of MSE borrowers. This effect is not strong enough, however, to undermine the outreach or the financial sustainability of the microbanks themselves (McIntosh, de Janvry & Sadoulet 2005, Schaefer, Siliverstovs & Terberger 2009, Chaudhury & Matin 2002).

Neither of the above mentioned studies answers the question how competi-

tors purely focused on transaction lending affect pure relationship lenders and whether opaque borrowers actually do prefer relationship banking to transaction based lending. Rhyne (2002) provides anecdotal evidence describing the situation of the Bolivian microfinance market in the end of the nineties. She claims, much in line with Petersen & Rajan (1995), that transaction based institutions lure the good clients away from MFIs and encourage customers to take several loans simultaneously. As a consequence, the relationship between MSEs and the relationship lender is destroyed. Additionally, the amount of collateral that the lender can recover from an insolvent client is decreasing with multiple loans as customers have to serve their transaction loan beside their micro loan. Navajas, Conning & Gonzalez-Vega (2003) analyse competition between two relationship lenders in Bolivia. They find that the borrower pool of the lender with the most standardized loan contract has lower quality. Vogelgesang (2003) tries to provide empirical evidence for Rhynes' hypothesis on transaction lenders undermining relationship based microfinance. However, as Vogelgesang lacks of data concerning different banking types, her study is only able to analyse the general competition effect.

This paper attempts to close this gap by analysing a unique data set of the ProCredit Bank in Ecuador. Besides information from the internal management system of the bank, the data set includes credit bureau information on ProCredit's clients about every single one of their loans in the whole Ecuadorian banking system within a period of one year. Categorizing banking types, we are able to directly tackle the question whether there is a special competition effect of pure transaction lenders and which strand of the theoretical literature is more adequate analysing competition between the two lending types in environments with highly asymmetrical information.

Our results suggest that besides the competition effect in general, there exists an additional negative effect of transaction banks. Default probability of ProCredit clients increases by four percentage points if the client also has another relationship loan. For clients with loans from multiple sources who borrow from a transaction bank, default probability is even two percentage points higher. These findings suggest that competition leads to higher risk taking, in other words, banks granting loans to clients with a higher probabil-

ity of payment problems. Since transaction banks do not screen borrowers as thoroughly as relationship banks, the effect is larger for the former banking type. This also supports the hypothesis that transaction banks in particular contribute to the overindebtedness-problem in environments with highly asymmetrical information.

Additionally, we find support for the argument of Boot & Thakor (2000) that a banking relationship has a value on its own for the borrower. Although the average interest rate of transaction banks is lower, clients with payment problems prefer to repay their relationship loan instead of their transaction loan to keep their credit window at the relationship lender open. We find no evidence for the hypothesis that high quality clients turn to transaction lenders. In contrast, the probability of a ProCredit client having a transaction loan on top of the micro loan is higher if the client has liquidity problems, that is, if the relationship lender does not provide the loan amount demanded, if the client's relationship loan is close to maturity or if the client has a high number of loans. Consequently, we conclude that relationship banks can survive competition with transaction banks in developing countries.

The remainder of the paper is organized as follows. Section 4.2 describes the differences between relationship and transaction lending in more detail. Section 4.3 presents the theoretical framework and our hypotheses. Section 4.4 discusses our data set and gives some descriptive statistics. The econometric models employed are presented is Section 4.5 while Section 4.6 is concerned with the empirical results. Finally, Section 4.7 closes the argument.

4.2 Relationship and Transaction Lending

The central feature of the lending approach of relationship banks is cash-flow based lending. Repayment is based on the expected net cash flow generated by businesses over the life of a loan. This approach enables those clients without collateral, as it is usually the case in developing countries, to obtain a loan (von Pischke 2002). In order to determine the expected repayment capacity, relationship banks aim to gain and to use "soft" qualitative information

about their customers besides hard financial information. Soft information is obtained during the continuous interaction with the client, for example through the provision of loans (Berger, Udell & Klapper 2001) and depositing service and other financial products (Cole 1998). Furthermore, suppliers of microfinance gather additional information through contact with the local community of the client such as neighbors, business customers or suppliers. The local community can give specific information about the history of the firm, the creditworthiness of the owner and general information about the business environment in which the MSE operates (Morduch 1999b). This information is especially valuable if the firm is in financial distress. Based on this information the bank can make a superior judgment whether the crisis is of a temporary or a permanent nature, whether the investment project of the firm still has a positive net present value, and whether the client's default might be strategically motivated and he is trying to divert cash away from the bank and into his own pocket. If the project and the borrower's repayment morals are of good quality, the bank will continue the relationship and provide liquidity insurance in times of crisis. In case of strategic default, close ties with the local community may be used as a disciplining device. Spreading the information of the default in the social environment of the borrower may worsen his reputation among clients and suppliers and thus lower the incentive for strategic default all together (Rahman 1999). Another important disciplining device applied by relationship lenders is the threat of cutting off the customer from the bank's future credit supply in case of default. This threat, combined with the promise of access to progressively higher loan amounts and longer maturities when keeping repayment discipline, can be a powerful weapon against borrowers' moral hazard (Armendariz de Aghion & Morduch 1999). The methodology of progressive lending also enables the lender to test borrowers with small loans at the start in order to filter out the worst borrowers within the first credit cycle (Tedeschi 2003).

Relationship lending requires a certain organisational structure of the bank. As the loan officer has the greatest access to soft information about the firm, about the owner, and his community, and as this information is hard to quantify and difficult to communicate through the organisational

structure, a large amount of decision authority has to be handed over to the loan officer (Berger & Udell 2002).[61]

In contrast to relationship banking, granting loans in transaction-based lending is based only on "hard", quantitative information that is relatively easily available at the time of loan origination. This could be information from financial statements or from salary income slips. Transaction lenders often apply credit scoring systems.[62] In addition, important weight is put on the financial condition and history of the principal owner, given that the creditworthiness of the firm and the owner are closely related for most small businesses (Berger & Udell 2002). The main focus of transaction lenders is on consumer loans, that is, rapidly disbursed loans directed towards buying specific goods. However, borrowers might also use consumer loans to invest into their business.

Hence, the organisational structure of transaction lenders differs substantially from the one in relationship banking. Instead of one loan officer being responsible for one customer, the work is broken up into various steps, each performed by a different person. In assembly-line fashion, each person performs his own special task. The credit officers granting the loans act like salesmen, making most of their money on provisions. After that, separate staff enter data, verify data accuracy, evaluate the credit (using credit scoring), verify client identity, notarize documents, disburse, and collect. This has important implications in case of default. Transaction lenders usually are far more lax about delinquency than relationship lenders, since they do not have information on the customer anyway. Within the first week of delinquency, a transaction lender usually would not call on the client to try to collect the loan. Higher default rates are compensated by the pricing system (Rhyne 2002). Consequently, transaction lenders have lower personnel costs and charge high overdraft fees. The differences between relationship banking

[61] In order to obtain information, he also typically lives in the local community, has contacts with other local firms and is in charge of the same customers over several cycles of the relationship (Rhyne 2002).

[62] Credit scoring determines debt capacity using a defined and relatively limited set of variables that can be quite precisely quantified or sorted as yes/no or with/without. On the base of statistical distribution of these variables, probabilities of risk are distilled (von Pischke 2002).

and transaction lending are summarized in Table 11:

Table 11: Relationship vs. Transaction Lending

	Relationship	Transaction
Loan Types	Mainly productive loans	Mainly consumer lending
Basis for Loan Approval	Enterprise and household cash flow credit history	Salary, credit score
Basis for Repayment	Motivation for continued access to credit; peer pressure	Steady salary and high overdraft fees
Tolerance for Delinquency	"Zero Tolerance" policy. Expected delinquency: low	Not worried in the first days Expected delinquency: high
Method of Follow up	Immediate, personal visit	A letter in the mail
Staff Organisation	Loan officer responsibility for client from start to finish	Assembly-line loan processing.
Economic Sector	All sectors	Urban sectors
Shareholder Philosophy	Profit and development	Profit

Notes: [1] Table is based on Rhyne (2002).

4.3 Theoretical Framework

Based on these differences between relationship lenders and transaction - based lenders and drawing on the literature on banking competition, we turn to the development of the hypotheses that are to be tested.

In general, various authors predict higher risk taking of banks if competition increases. Allen & Gale (2004), for example, show in a simple model relying on the same mechanism as Stiglitz & Weiss (1981), that competition can induce higher risk taking. Banks' margins are falling with higher competition. Hence, the limited liability of managers and shareholders will induce higher risk taking. But also other reasons might contribute to risk shifting. When banks compete for the same market share, the bank that ends up with the largest share may be able to exploit its market power to increase profitability. Consequently, institutions competing with each other will be more willing to grant loans to borrowers with a loan of the competitor bank in order to gain their market share. Both banks will be willing to accept borrowers with higher default risk, if borrowers also have a loan of the competitor bank. Adverse selection, however, makes it difficult for a bank to draw off another banks' good clients without also attracting the less desirable ones as well. For

the microfinance sector, most adequate is a paper by Hoff & Stiglitz (1998) which examines the role that multiple uncollateralized lenders[63] will play in reducing each other's abilities to use dynamic incentives effectively. Competition has an adverse effect on the threat of cutting off a defaulting client from future credit supply since the switching costs for the borrowers are lower. This effect might raise contract enforcement costs for all relationship banks and lead to a lower loan supply. However, information sharing about the credit record of customers may help to overcome this problem in the microfinance sector at least partially (Padilla & Pagano 2000). In summary, theory suggests that default rates and the number of loans per customer will rise with competition. Banks will grant riskier loans and repayment incentives diminish.

Consequently, clients that borrow from multiple sources are likely to have a higher default probability than clients with only one loan. Furthermore, the more fiercely the competition between two banks, the higher will be the risk taking of both banks and the higher will be the default rates of clients having loans of both competitors. At the same time, competition effects will also differ across lending types. Since transaction banks are lacking in depth screening mechanisms and are specialized on disbursing loans rapidly, they will grant riskier loans in environments with highly asymmetrical information. Thus, clients in the need of another loan to cover up payment problems tend to end up with a transaction loan. Therefore, default rates and the number of loans will most likely be higher for those relationship banks' customers that have a transaction bank as one of their borrowing sources. Accordingly, our first hypothesis can be phrased as follows:

Hypothesis 1a: *Relationship customers who borrow from multiple sources have higher default rates than customers borrowing only from one source, and relationship customers for whom at least one loan is supplied by a transaction lender have higher default probabilities than multiple source borrowers who stick only to relationship lenders.*

If hypothesis 1a is true, all relationship clients who are having an addi-

[63]Uncollateralized lenders will apply cash-flow-based lending.

tional transaction loan will be characterized by factors usually associated with higher default rates. In addition, clients who have been turned down by the relationship lender or whose loan demand was not met will have a higher probability of having a transaction loan.

Hypothesis 1b: *Borrowers' quality will be lower for relationship clients who are borrowing from a transaction bank at the same time.*

This hypothesis crucially depends on the assumptions concerning the nature of relationship lending in comparison to transaction lending. There exist two opposite views. Petersen & Rajan (1995) argue that switching to a transaction lender will always be favorable for clients of relationship banks because being a client of a relationship bank serves as a signal for good quality. Hence, the transaction bank is able to offer more favorable loan terms to relationship clients, because it does not have to compensate for expensive information gathering. In contrast, Boot & Thakor (2000) assume in their model that relationship lending has a certain additional value for the client. Relationship loans add a value to the borrowers' payoff since the bank provides liquidity support in times of crisis. This additional payoff gets smaller for borrowers with higher quality, since they are able to get other loans at any point in time. Consequently, the additional value of the relationship loan will be higher in an environment with highly asymmetrical information. Our hypotheses are consistent with the view of Boot & Thakor (2000). Otherwise, following Petersen & Rajan (1995), relationship banking would have broken down in the market, or at least all relationship clients regardless of their quality would take multiple loans from other transaction lenders. No additional negative competition effect of transaction banks could be observed. If relationship loans are actually preferred by the clients, we can state the following additional hypothesis:

Hypothesis 2: *Borrowers protect their credit window at the relationship lender.*

Hypothesis 2 implies that we should find two results. First, if low quality borrowers try to protect their access to relationship loans, they will demand

transaction loans in order to assure the payment of the installments of their relationship loans. Following this line of thought, the probability of observing a transaction loan should be higher if the relationship loan is close to maturity. Close to maturity, the balance of the relationship loan is closer to zero, only a small number of installments to be served is left, and accordingly the likelihood of solving the payment problem and keeping the good client record at the relationship lender by turning to the transaction lender is high. Second, we should observe that clients with payment problems will rather stop to pay the installments of the transaction loan than those of the relationship loan.

4.4 Description of the Data

The Ecuadorian Microfinance Sector

The microfinance market in Ecuador is in a stable growth setting after having overcome a severe banking crisis with a GDP decrease of 7 percent by the end of the nineties. The share of the microcredit portfolio in the GDP rose from 0.29 percent in December 2002 to 1.98 percent in December 2005.[64] The regulated microfinance sector in Ecuador consists today of 17 private banks (54% of the total regulated microcredit portfolio), 2 state-owned institutions (3%), 36 cooperatives (40%) and 7 associated companies (3%). In addition, there exist around 500 small institutes in the non-regulated sector, that roughly account for one third of total microloans granted in the country (Interamerican Development Bank 2006). The largest private institute is Banco Solidario, founded by the private microfinance consultancy ACCION in 1998, with a share in 53 percent of the microcredit portfolio of all private banks in 2006. Banco Pichincha, one of the largest banks in the country, with its subsidiary Credife, founded in 1999, follows with 22 percent. The third largest MFI in Ecuador is Banco ProCredit with a share of 16 percent of the total micro loan portfolio.

[64]Information is taken from the Ecuadorian banking supervision homepage, if not otherwise stated (http://www.superban.gov.ec/).

A classification of all these banks[65] in either transaction or relationship lenders is difficult, since some of the banks engage in both lending types. Therefore, it is impossible to distinguish between both kinds of loans observing only the loan issuing bank. Accordingly, it is important to identify the private banks whose business model corresponds most closely to one of the lending types.

It is fairly easy to identify the relationship banking type, as those were typically set up with the support of a development agency. This is true for Banco ProCredit and Banco Solidario. Shareholders in both banks are international development agencies as well as the microfinance consultancies ACCION (Solidario) or IPC (ProCredit). Unibanco has bought 33% of Banco Solidario shares in September 2006. However, both institutions, ProCredit and Banco Solidario, clearly have communicated that they apply relationship lending techniques.[66] Banco Pichincha, as the second largest provider of micro loans, has not been classified as a typical relationship bank. As one of the largest banks in the country, it is applying both lending techniques in various market segments and therefore cannot be classified as neither a pure relationship lender, nor a pure transaction lender.

In a personal interview with the CEO of ProCredit Bank, Pedro Arriola Bonjour, on the 25 September, 2007, he describes two Ecuadorian banks as typical transaction lenders, Centro Mundo[67] and Unibanco. This information is supported by a report of the Ecuadorian Banking Supervisor Authority from 2006, in which Centro Mundo and Unibanco are described as transaction lenders focusing on MSEs (Superintendencia de Bancos del Ecuador 2006). Shareholders of both banks are international investment groups. Table 12 presents various indicators for the different lending types.

The transaction banks have the highest share of consumer loans, that is, loans which are usually not directed towards productive usage, although it

[65] In the following, we focus only on lending institutions having an official banking license.

[66] See http://www.bancoprocredit.com.ec and http://www.procredit-holding.com for information about ProCredit Ecuador and http://www.banco-solidario.com and http://www.accion.org for information about Banco Solidario.

[67] Centro Mundo was taken over by Banco Pichincha in May 2007. Since the majority of loans were granted before the takeover, we treat Centro Mundo as an independent company.

Table 12: Classification of Private Banks

	Relationship Banks		*Transaction Banks*	
Indicator	ProCredit	Solidario	Unibanco	Centro Mundo
Loan Types				
Share of Consumer Loans (%)	0	18	76	76
Share of Commercial Loans (%)	23	19	0	0
Share of Housing Loans(%)	1	6	0	0
Share of MSE Loans(%)	76	56	24	24
Outstanding Loan				
Outstanding Loan (average)	2,898	1,916	538	782
Average Interest Rates				
MSE Loans (%)	13.3	13.1	12.6	10.6
Consumer Loans (%)	0	12.8	12.4	11.29
Default Rates				
Share of Default MSE Loans (%)	2.2	8.8	20.1	17.6
Share of Default Consum Loans (%)	0	3.4	12.4	13.1

Notes: [1] Table is based on information from the Ecuadorian Banking Supervision. [2] Loan Types: Consumer loans are loans not directed towards productive usage. MSE loans are smaller than 40,000$ and directed towards firms with sales less than 100,000$. Commercial loans are loans to firms that are not MSE loans. [3] Average interest rate reported for May 2005 until August 2007. [4] Loan is reported as default if loan is overdue since five days. Shares are averages from June 2006 until August 2007. [5] Average Outstanding loans is calculated with credit bureau data.

cannot be ruled out that borrowers invest these loans into their own enterprises. Consequently, the average loan amount outstanding is considerably smaller for a transaction bank than for a relationship bank. The latter has a high share of loans to small enterprises. These are defined as loans with a loan amount less than 40,000$ to firms with annual sales less than 100,000$. Default rates are considerably higher for transaction banks, since it is part of their business model. Between the 5 may, 2005 - the month ProCredit became part of the regulated banking system - and the 1 September, 2007 the average interest rate of the transaction banks was lower than the average interest rate charged by the relationship banks. This fact reflects the larger financial scope of the transaction banks due to lower fixed costs. Therefore, clients that are able to signal their quality could be inclined to switch to the transaction lender.

Descriptive Statistics

For our analysis we use data from ProCredit Bank Ecuador and the corresponding credit bureau information ProCredit acquired from September 2006 until August 2007. ProCredit Ecuador was founded in October 2001

and received a full banking license in 2005. The bank is part of the ProCredit Group which consists of 22 banks operating in transition economies and developing countries in Eastern Europe, Latin America and Africa. ProCredit Group is led by ProCredit Holding AG, a holding company based in Germany. The group focuses on providing financing for micro, small and medium sized enterprises and follows a development banking approach based on financial institution building directed towards providing services for lower income clients, while covering costs and producing moderate profits at the same time. At the end of 2007, ProCredit Ecuador was operating 25 branches throughout the country and had granted loans with a total amount of $166 million.[68]

The customer data was generated using the financial management system of ProCredit Ecuador. It provides detailed information on clients and loans for all branches of the bank at the key date 1 September, 2007. Additionally, we also have delinquency data for the same client pool at the key date 1 December, 2008. The credit bureau information was provided to the bank by a private Ecuadorian credit bureau on request. The data contains the loan status of every loan in the whole banking system for each ProCredit borrower at the date of request. There were seven data requests of ProCredit at the credit bureau between September 2006 and September 2007. Requests were made in 2006 on 30 September, 31 October, and 31 December and in 2007 on 28 February, 31 May, 31 July, and 31 August. In order to analyse the effects of competition between different banking types, we combine the data from the customer data base of ProCredit Ecuador with the credit bureau data. Hence, all results are based only on ProCredit clients. We included all $54,077$ clients in the analysis that have been ProCredit clients at one point in time between September 2006 and August 2007. For every client, we used the most current credit bureau data available. If the client for example has repaid the loan on 30 April, credit bureau data from 28 February was used to determine the number of loans and loans from other banks in the banking system. Credit bureau data from 31 August, 2007 was used for all clients

[68] See http://www.bancoprocredit.com.ec and http://www.procredit-holding.com for information.

whose loan was still active.

Table 13: Customer Characteristics

	Total	ProCredit Only	ProCredit and Another Loans of				
			Solidario	Transaction	Private	Cooperative	Other
Personal Characteristics							
Average Age (Years)	39.6	39.1	40.6	39.7	40.0	40.7	41.3
Male (%)	60	61	51	56	60	63	46
Married (%)	67	69	64	59	63	69	63
Number of loans (Average)	1.8	1	3.1	3.3	3.1	3.0	3.1
Destination of Loan							
Agriculture(%)	10.9	15.5	4.9	1.3	3.2	11.1	8.5
Business/Trade(%)	42.6	39.61	53.5	48.6	48.4	37.5	48.3
Livestock(%)	5.5	7.4	4.9	1	2.4	4.2	5.9
Production (%)	15.6	15.8	14.3	16.5	15.4	12.9	11.3
Transportation (%)	9.9	7.9	8.6	10.4	12.3	19.7	11.4
Other Services (%)	15.5	14.3	15.8	22.3	18.4	14.5	14.6
Loan ProCredit							
Loan Amount (Approved)	3,741	3,017	3,874	3,191	5,539	4,248	4,605
Payments	211	177	223	193	298	231	247
Maturity (Month)	17.4	16.9	17.5	16.4	18.5	18.8	17.6
Customer							
Number	54,077	28,997	7,006	6,318	13,846	5,536	2,466
(%)	100	53.6	13.0	11.7	25.6	10.2	4,6

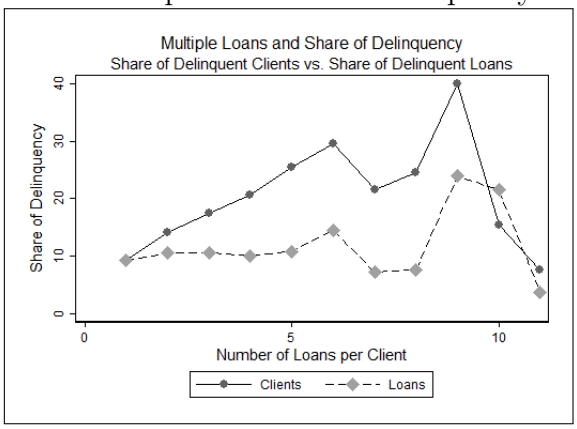
Notes: [1] The data is based on internal client informations of ProCredit and the credit bureau data set.

Table 13 summarizes key personal characteristics of the ProCredit customers as well as typical destinations of loans for the whole period from September 2007 for different banking types. Individual characteristics and loan data are taken from the ProCredit data base of September 2007. Out of the 54,077 clients analysed, 28,997 customers had multiple loans. 13% (24% of customers with multiple loans) of all customers also had a loan at Banco Solidario, 10.7% (22%) from either Unibanco or Centro Mundo. Not surprisingly, MFIs such as Banco Solidario and other small MFI,[69] have the highest share of female customers. The transaction lenders have the lowest share of married customers and almost no loans in the agricultural and livestock sector, which reflects both the urban character of their branching network and their business model based on "hard" information. On average, customers of the transaction lenders have a slightly higher number of loans. The loan amount approved by ProCredit is smallest for clients with only one loan and clients of transaction banks.

Figure 5 displays delinquency rates for customers with different numbers of loans. The solid line indicates the share of clients with at least one overdue

[69]The most prominent example is the international village bank organisation FINCA. FINCA was still no part of the regulated banking system in 2007.

Figure 5: Multiple Loans and Delinquency Rates



loan at one bank, the interrupted line plots the share of overdue loans. The solid line is rising sharply with the number of loans, whereas the interrupted line shows almost no increase.[70] The probability of late payments seems to be rising with the number of loans. However, clients do not stop payments for all loans simultaneously, but decide to cease payments of only a small number of loans. Thus, the interesting question is which banking types have the highest probability of being served.

Table 14 presents evidence concerning order of payment. In this table, we pooled the credit bureau data from all seven dates of request. That way we do not throw away valuable information about payment behaviour at different points in time. Then we end up with $261,767$ observations of $54,077$ clients. Table 14 reports cross tabulations for overdue payments at different points in time for transaction banks on the one hand and on the other hand pure relationship lenders such as ProCredit and Banco Solidario. In each case, we display only observations for clients that have been a customer of the two banking types compared.

When looking at borrowers who have a loan at ProCredit as well at a transaction bank, it can be seen that it is more likely that a client's transaction loan is overdue than it is his ProCredit loan. Interestingly, this result is not only observable for loans overdue for less than 10 days (9.5% to 2.3%),

[70]Since the number of customers with ten loans or more are below 10, changes in the share of delinquency are quite large.

Table 14: Order of Payment

		Days Overdue ProCredit			Days Overdue Solidario		
		0	< 10	> 10	0	< 10	> 10
Transaction	0 Days Overdue	79.4	2.3	0.2	75	2.9	0.1
	< 10 Days Overdue	9.5	1.4	1.6	12	0.8	0.1
	> 10 Days Overdue	1.8	3.5	6.7	2.3	3.5	7.4
	Observations		33,268			7,419	
Solidario	0 Days Overdue	83.7	3.7	0.4			
	< 10 Days Overdue	3.4	3.9	2.2			
	> 10 Days Overdue	0.2	1.3	5.2			
	Observations		34,504				

Notes: [1] All numbers are in percent. [2] Table reports cross-tabulation of order of payments for relationship and transaction lenders. [3] Table is based on credit bureau data only.

but also for loans overdue for more than 10 days (1.6% to 0.2%). Comparing transaction lenders and Banco Solidario, we have the same pattern: We observe a Solidario loan defaulted while the transaction loan of the same customer is diligent in only 0.1 percent of the observations, whereas the opposite type of observation with the transaction loan in default and the Solidario loan being served accounts for 2.3 percent of the observations. Comparing repayment behaviour for ProCredit and Banco Solidario, there is not much difference in payment behaviour. These findings support Hypothesis 2: Clients prefer to repay the relationship loan instead of the transaction loan although overdraft fees of transaction lenders are higher and interest rates are lower. In addition, it seems that results are not only driven by low enforcement methods of the transaction lender. We observe the same behavioural pattern not only for loans being overdue for just a few days, but also for loans with a delay longer than 10 days. Since the difference in enforcement methods between the two lending types are especially striking in the first overdue days, the results for loans with long delay suggest that clients actively decide to preferentially repay the relationship loan.

4.5 Econometric Model

The data set offers two different set of indicators measuring repayment behaviour. In the credit bureau data, repayment status of every loan at one point in time is displayed. In the customer data, aggregate repayment behaviour during the whole loan period is reported. Evaluating repayment be-

haviour of ProCredit loans over the full duration of the loan (and not at one point in time) is quite complicated, since many loans have different repayment schedules. The structure of these payments could affect the number of days payments are overdue. Therefore, we use the internal rating of ProCredit to determine late payments and default ex post. This rating consists of five types indicating the quality of repayment behaviour. For normal loans with monthly repayment, clients are part of the highest category 1, if their average number of days overdue is smaller than one. The average number of overdue days is calculated dividing the total number of overdue days by the number of realized installments. If the average number of days overdue is higher than five or if the number of days overdue exceeds 15 days, the client is rated in the lowest category 5. However, for loans with different repayment schedules (for example agricultural loans), another rating system is applied, but results are translated into the same five categories. Consequently, these risk categories are a good proxy measuring repayment behaviour. Our analysis distinguishes between only two categories: In the first category we comprise all loans in the rating classes 1, 2, 3 and 4 because even in class 4 repayment behaviour is still regarded as sufficiently reliable by ProCredit, while all loans in risk class 5 – in analogy to the ProCredit interpretation – we consider as heavily overdue or defaulted (we denote a loan in this category as "default loan" from now on).

We observe the full duration of the loans only if they were repayed during the available time interval. Since the number of these loans is very small, we also include the loans still active in September 2007. However, in order to account for different default probabilities at different stages of maturity, we run two different regressions. In the first one, we calculate estimates for all loans that on 1 September, 2007 were in the first half of maturity, in the second one we include all loans that on 1 September, 2007 were in the second half of maturity or already had been terminated. To analyse the effect of being a customer of a transaction bank on late payment or default at ProCredit ex post, we estimated the following probit model:[71]

[71]In order to compare different econometric approaches, we also estimated the effects using a linear probability model (LPM). Results do not change in comparison to the Probit

$$Y_i^* = \alpha + B_i\beta + L_i\delta + X_i\gamma + \epsilon_i, \quad i = 1, ..., N \tag{28}$$

with the observed variable

$$Y_i = 1\{Y_i^* > 0\}. \tag{29}$$

The dependent variable Y_i equals 1 if the ProCredit loan was in the "default loan" category of the customer data set. B_i is a vector containing dummy variables for the different banking types. The dummies take the value of 1 if a client is a customer of the respective banking type. Using this setting, we are able to compare the likelihood of default for transaction clients and clients having only one ProCredit loan. The vector L_i comprises loan characteristics of the ProCredit loans such as the credit amount and maturity. X_i is a vector of personal characteristics such as age, marital status, gender and the net non-business income reported to ProCredit. Furthermore, destination of loan and region dummies are included in the regression. Finally, ϵ_i is the error term.

In order to analyse determinants of being a customer of a transaction bank, we use a probit model since the decision for a certain bank is a binary-choice variable.[72] We will estimate this model two times with different data sets. First, we run the regression with the whole data set. Second, we exclude all clients from the sample that have no loans from other lenders, since we are especially interested in comparing the decision for a certain banking type, not in determinating the reasons for having multiple loans.[73] The according

results.

[72]In order to compare different econometric approaches, we also estimated the effects using a linear probability model (LPM) Results do not change in comparison to the Probit results.

[73]With this selection, I assume that the decision to have more than one loan in the mean is independent from the decision for a certain banking type. An alternative estimation method would be an Heckman-Selection model. Since we are lacking appropriate instrumental variables, that affect only the decision of taking another loan and not the decision of choosing different banking types, we simply run two Probit regressions with different data sets.

latent variable model can be written as

$$Y_i^* = \alpha + L_i\beta + X_i\delta + B_i\gamma + \epsilon_i, \quad i = 1, ..., N \tag{30}$$

The dependent variable Y_i equals 1 if the ProCredit customer is also a customer of a transaction bank and 0 otherwise. The vector L_i comprises loan characteristics of the ProCredit loans such as the credit amount, maturity and also the dummy "Close to Maturity", that equals 1, if the loan is in the last quarter of maturity. Additionally, it contains a dummy that indicates whether households have received a loan from ProCredit previously and a dummy that indicates if the demanded loan amount was higher than the loan amount approved. The vector B_i contains all other banking types as control variables. Finally, ϵ_i is the error term.

Moreover, using credit bureau data as in Table 14 to determine the probability of overdue payments instead of the customer data enables us to analyse the order of payment for the different banking types in a similar regression. We are interested in the probability of overdue payments of ProCredit loans at one point in time, given that a client has defaulted on the loan of another banking type. Therefore, we will estimate the same regression equation as above, including as the dependent variable Y_i a binary variable taking the value of 1 if the client has a delay of more than 24 days[74] of a ProCredit loan at one point in time. B_i is a vector containing dummy variables indicating default (defined as a delay of more than 24 days) of a certain banking type. To avoid measuring the difference between clients that have only one loan and clients that have multiple loans, we use only a reduced data set including only clients that have multiple loans.

[74]Since we here use only the credit bureau data, we cannot rely on the internal rating system of ProCredit in order to determine delay. In the credit bureau data set, only delays of at least 1, 2, 5, 12, 24 and 36 days are presented. Using another indicator of delay such as 12 oder 24 days does not change the results.

4.6 Estimation Results

Table 15 shows the competition effect for the probit regression of different banking types on delinquency of ProCredit loans for all loans in the first half of maturity. Since default mainly occurs towards the end of maturity, banking coefficients are not significantly different from zero. But when looking at the results for all loans in the second half of maturity, it can be seen that significance levels rise substantially. Generally, the age of the applicant, being married and a high non-business income decrease the probability of delinquencies. Perhaps surprisingly, the gender dummy is not significant. Coefficients of the banking dummies are all positive, indicating higher probability of defaulting loans for clients with multiple loans. However, there exist certain differences between banking types. The effect of cooperative banks and other banks on default are smaller and have lower significance levels.

Being a customer of another private bank has no significant effect on default. This can be explained by the fact that especially large successful clients turn to private banks in order to get higher loan amounts. For clients of the relationship bank competing most fiercely with ProCredit, Banco Solidario, likelihood of default is four percent higher. Being a customer of a transaction bank increases the probability of default. The probability of default is 6 percent higher than for clients having only ProCredit loans. The difference to Banco Solidario is 2 percent and significant at the 5 percent level using a Wald-Test. This difference of 2 percent is quite high, since the coefficients for being married or being a returning client, – factors usually considered as being highly negatively correlated with default rates – are also around 2 percent. Denoting loans with rating categories 2, 3 and 4 also as defaulting loans does not change the results, in this case significance levels are even higher. These results support Hypothesis 1a. Multiple source borrowing increases the probability of late payments and default, and the probability of ProCredit clients having repayment problems is highest for those multisource borrowers who borrow from transaction banks.

The results of the Probit regression of being a customer of a transaction bank on different client characteristics is presented in table 16. When looking

Table 15: Other Loans and Delinquency

	1. Half of Maturity	2. Half of Maturity
Other Loans		
Solidario Client	0.000266	0.0401***
	(0.82)	(7.13)
Transaction Client	-0.000316*	0.0603***
	(-1.69)	(9.58)
Private Client	-0.000164	0.00586
	(-0.93)	(1.45)
Cooperative Client	0.000127	0.0126**
	(0.41)	(2.24)
Other Client	0.000967	0.0204**
	(1.30)	(2.39)
ProCredit Loan		
Loan Amount	-2.51e-08	-0.00000190*
	(-1.40)	(-1.90)
Maturity	0.0000157**	-0.00736***
	(2.50)	(-17.46)
Old Client	0.0000281	-0.0230***
	(0.14)	(-6.59)
Personal Characteristics		
(Net)Non-Business Income	-0.000000527**	-0.0000252***
	(-2.40)	(-3.77)
Age	-0.00000385	-0.000409***
	(-0.48)	(-2.76)
Male	0.000155	-0.00361
	(0.85)	(-1.04)
Married	-0.000604*	-0.0153***
	(-1.95)	(-4.05)
Wald Test: Difference of Solidario and Transaction Clients		
χ^2	3.02*	5.18**
Observations	21,872	31,339

Notes: [1] Robust Probit regression reporting marginal effects. [2] t statistics in parentheses. ***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Region, year, and destination of loan dummies included.

at the loan characteristics of the ProCredit loan for the full data set, it can be seen that factors usually correlated with higher default rates are mainly positively correlated with having a consumer loan: The ProCredit loan amount approved is lower, the loan demand applied for was met with a lower probability, (net)non-business income is lower and borrowers are rather not married and younger. However, it is important to distinguish which of these

results reflect the decision to have multiple loans, and which result determine the probability of being a customer of a transaction bank. Therefore, we run a second regression including only clients with multiple loans. Being married is no longer significant, suggesting that this variable has only an impact on the decision to have multiple loans. Older, more experienced clients have a higher probability of having a transaction loan as well. The significance level of the other coefficients does not change running the second regression, in this case the size of the coefficients even increases.

Table 16: Determinants of Loan at a Transaction Bank

	Full Dataset	Multiple Loans Only
ProCredit Loan		
Loan Amount	-0.00000117***	-0.00000584***
	(-4.82)	(-7.03)
Maturity	0.000417***	0.000507
	(2.78)	(1.28)
Loan Amount<	0.0140***	0.0191***
Amount Applied	(5.25)	(3.27)
Close to Maturity	0.0202***	0.0441***
	(5.40)	(5.21)
Personal Characteristics		
(Net)Non-Business Income	-0.0000322***	0.0000430***
	(-6.74)	(4.55)
Old Client	0.0127***	0.0185***
	(5.04)	(3.24)
Age	-0.000283***	-0.00150***
	(-2.74)	(-5.87)
Married	-0.00914***	-0.0146**
	(-3.41)	(-2.43)
Male	-0.00354	0.00399
	(-1.39)	(0.69)
Observations	54,086	25,053

Notes: [1] Robust Probit regression reporting marginal effects. [2]t statistics in parentheses. [3]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [4] Region, year, and destination of loan dummies included.

These results support Hypothesis 1b. First, being married, usually correlated with lower default, is negatively correlated with being a transaction client. Second, (net)non-business income is negatively correlated with having a transaction loan. Higher (net)non-business income is usually correlated with lower default rates as can be seen in Table 16. However, in comparison to multisource borrowing from other banks, (net)non-business income is positively correlated with being a transaction client. This result reflects the scoring system of the bank: Only clients that can provide hard information

such as income statements get a loan from a transaction bank. Third, the probability of being a client of a transaction bank is higher, if the client's loan demand was not met, which is also characteristic for low quality borrowers. Consequently, results suggest that transaction clients tend to have a lower quality than clients having only ProCredit loans.

Table 16 also provides evidence that clients protect their relationship lending window. The probability of having a transaction loan in comparison to having a loan from another competing bank is four percent higher if the relationship loan at ProCredit is close to maturity. This result hints at clients trying to repay their relationship loan with a transaction loan since defaulting on a relationship loan and being denied future relationship credit is more devastating to the client when he has almost fulfilled his payment duties. When looking at the results of the regression for loans in the first half of maturity in table 15, our presumption that clients use transaction loans to cover up payment problems seems to get further support. The probability of being a transaction client is lower in the first half of the ProCredit loan maturity, but being a client of a transaction bank even has a negative effect on default. But since default rates are higher for clients in the second half of maturity, having a transaction loan in the first period only postpones default, and does not prevent it. However, this coefficient is not significant.

Finally, Table 17 displays the result of the probit regression, estimating the probability of overdue payments of ProCredit loans at one point in time, given that a client has defaulted on the loan of another banking type. We observe that having defaulted on a loan rises probability of default of a ProCredit loan for every banking type. Contrary to the regression on ex post payment behaviour, we find that the coefficient of the transaction bank dummy is the lowest of all banking dummies. This difference is significant at the one percent level.[75] As expected, coefficients for relationship banks as cooperatives and Banco Solidario have the highest values. The coefficient for other banks is smaller - probably because it includes unregulated and state owned institutions. These results support Hypothesis 2 and further back the

[75]The results of the Wald tests of difference can be otained from the authors upon request.

Table 17: Order of Default

Pro Credit Loan Default	Multiple Loans
Transaction Loan Default	0.0406***
	(4.08)
Solidario Loan Default	0.207***
	(5.57)
Private Loan Default	0.148***
	(5.35)
Cooperative Loan Default	0.241***
	(4.70)
Other Loan Default	0.0879***
	(3.54)
Observations	120099

Notes: [1] Robust Probit regression reporting marginal effects. [2] t statistics in parentheses. [3]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [4] Region, year, destination of loan dummies included. [5] Control variables for personal and loan characteristics included.

findings in Table 14. Clients default on the transaction loan, but still serve the relationship loan.[76] For this reason, the correlation of defaulting on a transaction loan and a ProCredit loan simultaneously is so much lower than for all the other banking types. Since the difference in enforcement methods between the two lending types are especially striking in the first overdue days and default in this case indicates a delay of more than 24 days, differences cannot only be attributed to different enforcement methods, but especially in different preferences concerning banking types.

4.7 Conclusion

There exist quite contrasting views and hypotheses concerning the effects of competition between relationship lenders and transaction lenders in an environment of highly asymmetrical information. While authors like Boot & Thakor (2000) assume, that relationship lending has an additional value for the borrower in such an environment, Petersen & Rajan (1995) and the

[76]The coefficient for other banks is smaller - probably because it includes unregulated and state owned institutions.

microfinance practitioners' literature highlight that transaction lenders lure away the good clients from relationship lenders and free-ride on the spillovers of relationship-specific information. Yet, empirical evidence in support of either of these views is lacking.

This paper attempted to close this gap by tackling the question whether there really exists a unique competition effect of transaction banks and whether the view of the one strand of theoretical literature is more adequate than the other, when the two lending types are competing in an environment of highly asymmetrical information.

The main findings of our analysis support the hypothesis that relationship lending has an additional value for borrowers. The probability of having a transaction loan as well as a relationship loan is positively correlated with factors usually associated with higher default rates. In addition, clients clearly prefer to repay the relationship loan instead of the transaction loan. These findings support the hypothesis of Boot & Thakor (2000). On average, mainly bad quality clients of a relationship lender will borrow from the transaction bank as well. Default probability of ProCredit clients is six percentagepoints higher if the client is also a customer of a transaction bank while it is only four percentage points higher if the ProCredit client at the same time is serving a loan from another relationship lender. This also supports the hypothesis that not only multiple source borrowing, but transaction lending in particular is contributing to the overindebtedness-problem in environments with highly asymmetrical information.

In summary, our results might reflect the failure of pure transaction lenders in Bolivia during the economic crisis in the end of the nineties and in Ecuador (Centro Mundo has been bought by Banco Pichincha after making severe losses in 2007, Unibanco has purchased 33% of Banco Solidario in order to develop a business model that incorporates transaction and relationship lending). The business model of pure transaction lending is difficult in an environment where asymmetrical information is high and, accordingly, there is a great number of opaque clients. However, this does not imply that certain transaction lending techniques cannot or should not be incorporated into the microfinance sector. This will be a promising area for future research.

5 Institutions in the Path of Development: Cooperatives and the Incentive Effects of Retained Earnings

5.1 Introduction

In the 19th century, cooperative banks emerged as self-help institutions of small farmers or craftsmen who as individuals were lacking access to the financial services of private banks.[77] Although the original motivation to form these institutions has long been overcome in industrialized countries, credit cooperatives still play an important role in the banking landscape in Europe and the United States. Nowadays they serve members and non-members alike in the credit and savings-business as well as in other financial services. The voluntary management of cooperatives by selected members has long been forbidden by the banking law and was replaced by a professional bank management.[78]

The institutional structure, however, has not substantially changed in every aspect. One central difference in comparison to stock corporations is the right of members on undistributed profits. Members (and de facto owners) of the cooperatives are not the residual claimants (Fama & Jensen 1983a).[79] They receive a dividend for every share like in stock corporations, but they usually cannot participate in accumulated reserves. While shareholders can always buy and sell an equity stake for a price that will reflect undistributed profits, a credit cooperative is entered by requiring the new member to pay in the face value of a member share. When leaving a cooperative, the member has to denounce the membership and can only reclaim the money in his equity account. Undistributed reserves have to be left behind. Theoretically, undistributed reserves are paid out to members when they vote for the liqui-

[77] Cooperative banks were not successful in all countries, see for example Guinnane & Henriksen (1997) and Guinnane (1994).

[78] This chapter is based on a working paper by Terberger & Schrader (2008).

[79] Therefore, cooperatives can be described with the definition of Hansmann (2000) as non-profit firms because "there are no persons who have a share in both control and residual earnings".

dation of the cooperative (Davis 2001). In reality, however, the probability of liquidation is very small because of the managements bargaining power and the collective action problem of members (Hetherington 1991).[80]

As a result, the return on their investment is made up purely of their dividends, while changes of reserves are more or less irrelevant for their economic wealth. For bank managers, however, the magnitude of reserves and the structure of equity is most likely not irrelevant. The volume of equity decides on the amount of risk capital they can use to earn the return on equity. The structure of equity determines which part of the equity has to be served by dividends. Consequently, a cooperative with a higher share of reserves of total equity needs a lower return on equity in order to pay dividends. Since monitoring the management is difficult in cooperatives nowadays with more than 1000 members, this structural effect might influence management decisions if the manager maximizes his own utility. First, it might cause the management to engage in empire building and to invest in fringe benefits (Jensen & Meckling 1976). Second, it diminishes the incentives to invest in risky projects. Since the manager is not the full residual claimant, he will follow an investment policy that protects his own job and does not necessarily maximizes the total value of the cooperative bank (Fama & Jensen 1983b).

The empirical evidence on the effect of retained earnings on management behaviour is scarce. Main focus of the literature is the comparison between cooperative banks and commercial banks. To our knowledge, there exists no study that analyses in particular the specific influence of the level of undistributed reserves on management decisions.

This paper attempts to close this gap by testing whether a higher level of reserves is associated with higher administrative expenses and the investment in less risky assets. We use accounting data of 412 German cooperative banks in the period of 1987 until 2002. German cooperative banks have every feature of a successful modern cooperative group: Besides the private commercial

[80]This view is also confirmed by a Supreme Court in the United States. It described the value of undistributed reserves for members with the following words:"It stretches the imagination very far to attribute any real value to such a remote contingency, and when coupled with the fact that it represents nothing which a member can readily transfer, any theoretical value reduces almost to the vanishing point"(Hetherington 1991).

banks and the public savings bank group, having a market share of 33% and 50% respectively, the banking group has developed into the third force in the banking market, having a rather stable market share of 17% over the last 15 years (Bonus & Schmidt 1990).

Our results suggest that cooperatives with higher reserves have higher administrative costs, which might represent higher fringe benefits. Furthermore, we find evidence that volatility of profits decrease with a higher share of reserves in total profits. Since reserves do not have to be remunerated, a higher level of reserves makes it easier for the manager to meet members' dividend target. Consequently, as the manager does not participate in higher profits, he will rather invest in less risky assets in order to protect his job.

In contrast to this finding, we find no evidence of a lower profitability of cooperatives with a higher share of reserves. Possible reasons for this finding might be data problems such as an omitted data problem caused by cooperative mergers or some other control mechanisms not captured by the data such as the internal cooperative auditing association.

The remainder of the paper is organized as follows. In Section 5.2, we discuss the cooperative literature overview focused on the problem of retained earnings. Section 5.3 presents theoretical model that highlights the effect of reserves on the behaviour of the management. Section 5.4 discusses the data we use and gives some descriptive statistics. Section 5.5 is concerned with the econometric models employed while section 5.6 presents the empirical results. Finally, Section 5.7 closes the argument.

5.2 Literature Overview

The basic corporate governance mechanisms were designed for a small group of people living together in regional communities. In order to assure the participation of the whole community, the number of cooperative shares per member was restricted and every member had only one vote in the general assembly (Guinnane 2002, Banerjee, Besley & Guinnane 1994). Applying these rules to a cooperative bank today with several thousand of members rises severe agency problems. The main problem is not that the ownership is diffuse,

for this is also true of most stock companies (Berle & Means 1923). What is more important is that members cannot concentrate ownership by buying a large number of shares. In contrast to stock corporations, there exists not threat of ownership concentration disciplining the management as in stock corporations (Rasmusen 1988); the market for corporate control does not exist for cooperatives. Furthermore, contractual arrangements are different and more diffuse compared to those in stock corporations (Hansmann 2000). The reason is that managers are told to pursue a broader range of goals than simply maximize the economic value of the cooperative for its members. They also should serve the interests of a special group of people, tied by a specific "common bond" (Fonteyne 2007). This common bond can be a residency in a specific town or region, a common employer, or a profession, among other things.

There are quite some arguments that favor the cooperative form. Hansmann (2000) argues that inefficiencies may arise from stock corporations seeking to satisfy the preferences of the marginal consumer (to maximize sales/profits) rather than those of the average consumer (which would maximize consumer surplus). Since decision making in cooperatives is still based on the one-man-one-vote principle, a cooperative will choose conditions to satisfy the preferences of the median consumer, who is closer to the average consumer than the marginal one is. This advantage, however, might be smaller in competitive markets (Hart & Moore 1998). However, this theoretical predictions are based on the assumption that all customers, or at least a representative group, participate in the decision process. This will not be the case when members are no longer living near their credit cooperative.

Turning to the effect of undistributed reserves on management decisions nowadays, there exists no formal analysis of the problem. Höser (1989), Terberger (1993) and recently Fonteyne (2007) discuss the issue and point to potential negative incentives of the level of retained earnings on the effort choice of the management. Hansmann (2000) describes that the special rule concerning members' rights on reserves was usually introduced to support the survival of the institution in the 19th century.[81]

[81]See also Sties (2005), who analyses this point formally. Similar to the liquidity insur-

Focusing on the competition effects of undistributed reserves, Fonteyne (2007) points out that retained earnings may also constitute a comparative advantage in comparison to commercial banks. Since many cooperatives have accumulated a large amount of undistributed profits over the last 150 years, their economic value (net of debts and the nominal value of member shares) constitutes an intergenerational endowment without final owners. This intergenerational endowment, mainly appearing as reserves in balance sheets, is equity that has not to be remunerated. Moreover, member shares are also not remunerated very generously. Although the motivation of a cooperative membership nowadays is mainly profit driven,[82] low control incentives impede the enforcement of higher dividend payments. However, this lower cost of capital should allow cooperatives to incorporate their profits into their products and offer products below the market price

There is no empirical evidence concerning the incentives of reserves, but there exists literature that compares the behaviour of cooperative and commercial banks. Many papers focus on the US, because quite a large part of the Saving and Loans (S&Ls) were cooperatives. Akella & Greenbaum (1988) find that cooperatives tend to expand deposits and loans beyond profit-maximizing levels. Mester (1993a) finds evidence of diseconomies of scope at mutual S&Ls. In a later paper (Mester 1993b), she finds that allowing for different production technologies, investor-owned S&Ls are less efficient than mutual S&Ls. Also the studies of Brunner, Decressin, Hardy & Kudela (2005), Gurtner & Ory (2002) and Altunbas, Evans & Molyneux (2001) find no striking differences between cooperative banks and commer-

ance mechanism in the banking model of Diamond & Dybwig (1983), potential members are uninformed about their type in the beginning. They will learn in the next period, however, whether they belong to the group of entrepreneurs with profitable future investment projects and therefore will need more loans in the second period or whether they belong to the non-entrepreneurial group who just had a one-shot investment project. Members mutually find it advantageous to agree on accumulating profits in the first period and waiving their right on them when denouncing membership in the second period. The expected future advantage of those members turning out to be entrepreneurs outweighs the disadvantage of the later non-entrepreneurs.

[82]Höser (1990) reports that according to a survey among German cooperative banks, more than 90% of the CEOs regard favorable service conditions for members as impractical for competitive reasons. Again, over 90% of CEOs regard dividend payments as a legitimate way of meeting the member service requirement.

cial banks. Kotz & Nagel (2002) find that cooperative banks have lost market shares and seen their profitability and efficiency decline with the rising competition in the 90's. Nevertheless, they still have high interest margins and returns on assets compared to other types of banks in Germany.

There exists quite some evidence that cooperative are more stable than commercial banks. Again for S&Ls, Hermalin & Wallace (1994) find that investor-owned banks were more likely to invest in an inefficient portfolio of assets than mutual banks. Brunner et al. (2005) report in a large survey over the whole world that cooperative banks fail less often than their commercial counterparts. This finding is based on the lower volatility of cooperatives' returns which more than offsets their lower profitability and capitalization. Beck, Hesse, Kick & von Westernhagen (2009) analyse differences in ownership in the German banking system. Again, they point out that cooperatives are the most stable financial institutions in Germany, followed by saving banks and commercial banks. Similar results are reported by Lamm-Tennant & Starks (1993) analysing mutual insurance companies. Brunner et al. (2005) in contrast argue that it might be difficult for cooperatives to increase capital in times of crisis. For instance, the Swedish cooperative sector did not survive the crisis of the early nineties in the cooperative form, as it faced high marginal capital costs - the need to restore capital was a major factor to demutualize. To sum up, the main focus of the empirical literature is the comparison between cooperative banks and commercial banks. But to our knowledge, there exists no study that analyses in particular the specific influence of the level of undistributed reserves on management behaviour.

5.3 Theoretical Framework

Assumptions

We aim to model the key features of a cooperative bank manager's decision on how much effort to invest into meeting the financial targets set by the owner-members, assuming that membership is driven exclusively by the for-profit motive of earning an adequate rate of return on their equity investment. Defining N as the face value of a German cooperative's equity at a

given time t, and keeping in mind that members enter a cooperative by paying the face value of a cooperative share, N represents the sum of all members' equity investments. Assuming members as purely financially motivated, they demand a rate of return on N, determined by the risk equivalent alternative rate of return r. If liquidation or change of legal status to a shareholders' company is ruled out, members cannot reclaim anymore than their share of N (plus any dividend which they did not withdraw) when denouncing membership. Accordingly, the (expected) dividend rate d on N must be at least equivalent to r; otherwise members would prefer to leave the cooperative and choose the alternative investment. Assuming zero transaction cost of leaving and re-entering a cooperative, the target of (expected) $d \geq r$ actually has to be met in every period because members could always leave the cooperative for a period with expected underperformance and re-enter when dividend expectations have risen to an adequate level. With a similar argument, it can be ruled out that the expected dividend rate is actually greater than r, because any outperformance would attract new members until dividend expectations have come down to the adequate level.

Accordingly, we assume that every period, members demand a dividend rate on the subscribed capital of $d = r$. This yields a total dividend of $D = dN = rN$ every period, if members' targets are met.

To meet this target without dissolving any reserves, the cooperative bank's manager in every period has to earn a net profit π of at least rN which is distributed to members. As profit is defined as the return on equity RoE multiplied by the amount of equity, the latter being the sum of subscribed capital N and undistributed profits or reserves R, the dividend target can be met as long as

$$\pi \equiv (N + R) \times RoE \geq Nd = Nr \tag{31}$$

It can be seen immediately that as long as the RoE is positive, any $R > 0$ will help the manager to meet the dividend target, even if $RoE < d = r$. Dividends can be distributed as expected as long as the profit on reserves is

sufficiently high to close the dividend gap:

$$RoE \times R \geq N \times (d - RoE) \Longleftrightarrow RoE \geq \frac{d}{\frac{R}{N} + 1} \tag{32}$$

All variables determining the value of the dividend gap are summarized in the term $\frac{d}{\frac{R}{N}+1}$. It can be seen that the dividend gap is widened when the dividend target d or members' equity N increases. In contrast, a higher level of retained earnings R diminish the dividend gap. Furthermore, the return on equity necessary to meet the dividend target is always smaller than the dividend target d if $R > 0$.

The manager can choose the net return rate of his whole investment portfolio. The investment portfolio has a two point return structure: for each euro invested, the cooperative will receive a return of $(1 + y)$ with $y \in [0, 1]$ with probability $p(y) = 1 - y$; with probability y he gets back only a return of $1 + i$ with $i < \frac{d}{\frac{R}{N}+1}$. Even if the investment has no success, the return will be positive. But these minimum revenues are lower than the return on equity necessary to meet the dividend target. By ensuring a minimum return of $1 + i$, we abstract from the possibility of an insolvency of the cooperative, since the equity capital cannot diminish.[83]

Note that the manager chooses also the riskiness of the portfolio by choosing the target return $1 + y$ on the investment. Probability of success and returns are negatively correlated, it holds that $p'(y) < 0$ and $p''(y) < 0$. The variable y can be interpreted in various ways. It describes at the same time the target return and the probability of having no success. Consequently, it can also be described as the variance of profits.

Furthermore, we assume that the rate of return RoE is also determined by the bank manager's effort $0 \leq e \leq 1$. The effort level is not observable for cooperative members. Effort induces opportunity costs of e^2. The effort is a measure that reflects the efficiency of the manager's work. If e takes the value of 1, the manager works very efficient and 0% of the profits are diverted for his consumption on the job. Thus, e represents the share of profits that are

[83] In Germany, for instance, there has never been an insolvency of a cooperative bank. If a bank has payment problems, the cooperative association assures the survival of the institution, often by merging the bank with other cooperative banks.

not used for inefficient activities. We assume that the manager will first make his effort choice and then decide about the target return y.[84] The marginal effect of the target return y on the value of the overall return rate RoE is then rising with a higher effort e, because a smaller share of profits are spent for fringe benefits:

$$\pi = (y \times e)(N + R) \tag{33}$$

To model the decision of the manager on target return $y > 0$ and effort $e > 0$, we assume that the manager is interested in his fixed wage w[85] and in meeting the dividend target $D = dN = rN$. In this case his management position as well as his reputation is secured. Members will be satisfied with his work and will extend his contract. These intangible remunerations of the manager which depend on meeting the dividend target, we denote by F. Ad hoc, we assume F taking the value of 1 when meeting the target in a given period, and 0 otherwise.[86] Obviously, the manager can influence the likelihood of meeting the dividend target $p(\pi > D)$ and receiving a positive F by exerting effort e and setting a high target return $1 + y$ because π in rising in e and y. Thus, the manager's utility function is given by:

$$U(e, p) = \begin{cases} w + F - e^2, & \text{falls } (e \times y)(N + R) \geq dN \\ w - e^2, & \text{falls} (e \times y)(N + R) < dN \end{cases} \tag{34}$$

This leads to an expected utility function of

$$E(U) = w + p(y \times e(N + R) > D) - e^2 \tag{35}$$

Analysis

The probability of keeping the job by matching members' dividend target is the key term determining the manager's expected utility. The expected

[84] Since the cooperative will have a minimum return on equity of i, the manager will always divert a certain share $1 - e$ for his own consumption.

[85] Since participation of members in the decision process is very limited, it seems reasonable that their interests such as a high dividend are not incorporated into the executive compensation plans.

[86] The outside option for the manager is zero.

utility function implies that the manager chooses a return rate y and an effort level e that assures the expected dividend payments demanded by members:[87]

$$(y \times e)(N + R) \geq dN \tag{36}$$

Our model has only one period. Consequently, the manager is only interested in reaching the dividend target once, because his utility only depends upon the likelihood of matching members' demands in one period. Since job security is more important in comparison to a high level of fringe benefits, we know that the manager will always choose the target return that will exactly match the dividend target and the level of fringe benefits. Extending the model to more than one period, this result obviously would not hold anymore. Setting a target return rate that corresponds exactly to the dividend target would always yield to expected profits below the demanded dividend. This would not be an equilibrium situation, since members would change to an alternative investment when expected profits are lower than $dN = rN$. Hence, in a multi period setting, it has to hold that expected profits equal the demanded dividends: $E(\pi) = (1 - y^*)y^*e(N + R) = dN$. Yet the results concerning the influence of retained earnings on the manager's behaviour do not change in a multi period setting. For this reason, in the following we present the mathematically more traceable one period analysis. The results for the multi period setting are found in the Appendix.

The likelihood of reaching the dividend target $p(\pi > D)$ is determined by the return target y, since it holds that the probability of receiving a return of y is given by $p(y) = 1 - y$. Thus, given the level of subscribed capital N and reserves R, a manager that faces a target dividend of d will choose the level of effort e and the target return of the investment y to solve the following

[87] Otherwise, it would hold that $p(\pi > D) = 0$, which obviously would not be a utility maximisation solution.

maximisation problem[88]

$$\begin{aligned} &\text{Max } E(U) = w + 1 - y + e^2 \\ &\text{subject to: } ye(N + R) \geq dN \end{aligned}$$

Since the constraint is binding,[89] we obtain the optimal target return y^* by solving equation 36 to y:

$$y^* = \frac{dN}{(R + N)e} \tag{37}$$

The return rate y^* also determines the likelihood of reaching the dividend target $p(\pi > D)$. Hence, the return target y can also be interpreted as the probability of not reaching the dividend target. Consequently, we can include $p(y)$ into the expected utility function:

$$E(U) = w + 1 - y - e^2 \tag{38}$$

Equations 37 and 38 clarify that the effort choice has a direct and an indirect effect on utility: Reducing effort (for example by increasing fringe benefits) decreases the effort costs (direct effect), but also increases the probability of loosing the job (indirect effect) since the manager has to choose a higher return rate in order to meet the dividend target. The interplay between these two effects determines the effort choice of the manager. In order to obtain the optimal effort choice of the manager, we insert y^* in equation 38 and derive the utility function with respect to e:

$$e^* = (\frac{dN}{2(R + N)})^{\frac{1}{3}} \tag{39}$$

It can be seen that the effort level is increasing with the size of the dividend gap. The reason is that a higher dividend gap induces higher costs in form of a higher probability of loosing the job. Consequently, the manager

[88] Note that in the first best solution, the manager would maximize total expected welfare $W = (1 - y)ye(N + R) - e^2$. The optimal target return y^{FB} would be $\frac{1}{2}$, and $e^{FB} = \frac{1}{8}(R + N)$.

[89] The constraint is binding, because the direct marginal utility of e is increasing, and the marginal influence of e on $1 - y^*$ is falling.

will choose a higher effort level in order to reduce these costs.

Now it is straightforward to analyse the effects of retained earnings on the variance of profits and the manager's effort. Concerning the effort level, we can state the following hypothesis:

Proposition 1: *The optimal effort level e^* decreases with a higher level of retained earnings.*

Proof

Proof. Deriving e^* with respect to R, we get:

$$\frac{\delta e^*}{\delta R} = -\frac{1}{3}(\frac{dN}{2(R+N)})^{\frac{1}{3}}(\frac{dN}{2(R+N)^2}) < 0 \tag{40}$$

The optimal effort level is decreasing when the level of reserves is rising. The reason is that the utility of the manager crucially depends on the probability of reaching the dividend target. Higher retained earnings make it easier to match members' dividend demands since retained earnings do not have to be remunerated. Since exerting effort is costly for the manager, he will decrease the effort if the level of reserves is rising. It can also be seen that the strength of this effect depends on the dividend gap. The higher the dividend gap, the stronger will be the effect. The reason is that the probability of loosing the job y exhibits falling marginal returns with respect to R and e. The higher the likelihood of reaching the dividend gap, the more difficult it is to increase this probability.

□

Proposition 2: *The variance of profits decreases with a higher level of retained earnings.*

Proof. Given e^*, the target return y^* of the investment policy is given by:

$$y^* = (\frac{dN}{(R+N)})(\frac{dN}{2(R+N)})^{-\frac{1}{3}} = (\frac{d}{\frac{R}{N}+1})^{\frac{2}{3}}2^{\frac{1}{3}} \tag{41}$$

Maximising y^* with respect to R yields

$$\frac{\delta y^*}{\delta R} = -2^{\frac{1}{3}}\frac{2}{3}(\frac{dN}{R+N})^{\frac{2}{3}}(\frac{1}{(R+N)^2}) < 0 \tag{42}$$

It can be seen that the risk level of the investment policy is decreasing with higher retained earnings. When reserves are rising, it gets easier to match dividend demands. Since the manager's utility directly depends on the probability of reaching the dividend target, he will decrease the target return rate. This will automatically increase the probability of reaching the dividend target, since the target return rate and the probability of success are negatively correlated. As for the manager's effort, the strength of the effect is positively correlated with the size of the dividend gap.

□

Proposition 3: *The expected return on equity RoE decreases with a higher level of retained earnings if the dividend target does not exceed a certain threshold.*

Proof. The expected return on equity is given by:

$$E(RoE) = (1-y^*)y^*e^* = (1-(\frac{dN}{R+N})^{\frac{2}{3}})\frac{dN}{R+N} \tag{43}$$

Deriving $E(RoE)$ with respect to R, we get

$$\frac{\delta E(RoE)}{\delta R} = \frac{dN(\frac{5}{3}dN - (R+N)(\frac{dN}{R+N})^{\frac{1}{3}})}{(\frac{dN}{R+N})^{\frac{1}{3}}(R+N)^3} \tag{44}$$

From equation 44, we can determine the critical value of the dividend target d^{crit} for which it holds that $\frac{\delta E(RoE)}{\delta R} = 0$:

$$d^{crit} = \frac{3}{25}(\frac{\sqrt{15}(R+N)}{N}) \tag{45}$$

From equation 45, it can be seen that the direction of change of RoE depends on the level of the dividend gap. If it holds for the dividend target that $d > d^{crit}$, return on equity is rising with higher reserves. The reason for this result is that in this case, the manager has chosen such a high risk level y^*,

that an decrease of y^* actually rises the expected return.[90] If the dividend gap is rather small, then we observe that the expected RoE is decreasing with higher retained earnings. Consequently, the relation between RoE and y^* consists in an inverted U-shaped curve.

□

In reality, however, observing a cooperative where the manager has to choose such a high risk level that return on equity is rising with higher risk level, is not very probable. The probability of constant underperformance would be too high. Such cooperatives would be merged with others, more successful ones. This view is reinforced by the multi period analysis found in the Appendix. In the multi period setting we know that $E(\pi) = (1 - y^*)y^*e(N + R) = dN$. A cooperative with such a high dividend gap could not exist, because its expected return on equity would be too low to match dividend demands constantly.

Discussion of the results

This simple analysis showed that cooperative managers have incentives to decrease effort and the risk level of investments if reserves are high. Retained earnings diminish the dividend gap and the manager will respond with reducing every activity that present a certain cost for him. In the model, there exists a certain trade-off between reducing effort costs and increasing job security: Working less efficient induces the manager to invest in riskier assets in order to meet the dividend target. Nevertheless, the maximum expected return on equity RoE will always be lower than the dividend rate d in the model when retained reserves are larger than zero. This holds also in the multi period setting. The reason is that the gap is closed with the profits earned by retained earnings.

Our analysis has abstracted from the manager's incentive to maximize profits. One important way to increase job security would be to yield high

[90] Mathematically, this result is determined by the interplay between target return y and probability of success $p(y)$. Since the graph of y and expected returns $(1 - y)y$ consists in an inverted U-shaped curve with the maximum at $y = 1/2$, decreasing y when $y > 1/2$ actually increases the expected return rate.

profits in order to augment the level of retained earnings. Thus, in reality the aim of job security will always be balanced with the aim of increasing the level of reserves. Including this incentive, however, would not affect the key results of the model. The utility of increasing reserves would be strongest if the level of retained earnings is rather low. Consequently, we would expect that the changes in e and y for low levels of reserves would be smaller. Additional, the results depend crucially on the assumption that cooperative members have not implemented any form of performance linked wages. If members anticipate the agency problems and adopt certain compensation plans, results would no longer hold.

5.4 Description of the Data

Our dataset provided by the German information company "Hoppenstedt" includes annual information on the balance sheet and the profit and loss statement as well as several other business indicators of 442 German cooperative banks for the period of 1987-2002. Since we can observe many mergers among small cooperative banks in the 1990s as a result of stronger competition in the German banking sector, the panel is unbalanced. We exclude all cooperative banks with an anomalous ownership structure since the incentive structure might be different in these institutes. The latter group encompasses church managed institutes, institutes serving a single special purpose, closed cooperatives which exclusively serve one professional group[91] and the PSD-Cooperative Banks, the recently privatized former cooperative banks for postal employees. This leaves us with a final sample of 377 cooperative banks and 3494 observations.

Table 18 provides summary statistics of cooperative characteristics, divided by urbanisation levels and regions.[92] When looking at the differences across cities, we observe that most of the cooperative banks in the sample are located in villages with less than 50.000 inhabitants, reflecting the decentralized structure of the German cooperative sector. The high number of

[91] For example the Deutschen Apotheker- und Ärztebank, the cooperative bank for doctors and druggists.

[92] Summary statistics of relevant variables are found in the table A3 in the Appendix.

Table 18: Special Summary Statistic

	Mean				
	RoE	$\frac{R}{N}$	Div.	Tot. Assets	Mem.
Urbanisation					
$x > 300.000$ (15%)	5.3	58	5.4	1114	51.1
$300.000 > x > 50.000$ (22%)	5.4	57	5.4	598	31.6
$x < 50.000$ (62%)	5.3	59	5.5	487	19.1
Total (100%)	5.3	58	5.5	653	26.6
Region					
East (2%)	4.2	58	5.9	1623	66.4
North (9%)	5.8	67	5.5	580	29.1
West (24%)	5.3	61	5.6	605	23.8
Middle (18%)	5.6	59	5.7	737	32
South (45%)	5.2	55	5.3	598	25.9
Total (100%)	5.3	58	5.5	653	26.6

Notes: [1] x is the number of inhabitants of the cities cooperative are operating. [2] Share of bank units stated for urban and regional categories. [3] $EAST$ contains the east part of Germany including Berlin, $North$ includes the Schleswig Holstein, Niedersachsen, Hamburg and Bremen, $WEST$ contains Nordrhein-Westfalen and Saarland, $MIDDLE$ contains Hessen and Rheinland-Pfalz and $SOUTH$ Baden-Würrtemberg and Bayern.

cooperative banks in the southern regions has its origin in the village structure of this region and in the high number of inhabitants compared to other regions.[93]

The share of reserves in total equity is lowest in medium sized cities. There, also the return on equity and the dividend rate is higher than in large cities and villages. Across regions, the share of reserve is decreasing from north (67%) to south (55%). Dividend rates vary across regions, with the highest dividend rates (apart from the special case of eastern Germany) paid in Hessen and Rheinland Pfalz and the lowest in the southern region, reflecting the very low grades of urbanisation and competition. The number of members in nearly all cooperatives in the sample exceeds the number of 3000, therefore, the institutional structure of all banks will be very similar.

[93]East Germany with Berlin as the dominant factor does not fit into this picture as we do not have appropriate data for this region.

The german cooperative law states that cooperatives with more than 3000 members must install an assembly of delegated members that controls the management. Participants of this board are elected by all members. Consequently, the agency conflict will be very similar in all cooperatives. We do not have to account for the fact that control of the management might be more effective and therefore profitability might be higher in cooperatives with less members (Berle & Means 1923).[94]

When comparing the dividend rate DIV and the return on equity RoE, it can be seen that, on average, the dividend rate is higher than the return on equity over the whole period. This difference can be explained by the high level of reserves of most cooperatives. Reserves are capital that does not have to be remunerated. Nevertheless, the cooperative is able to yield profits with this capital and is able to pay a dividend rate on share capital above the return on equity. The mean share is 58 percent, so roughly 60 percent of the equity consists in capital provided by past generations. Considering this relation, cooperatives, on average, only pay one third of total profits to members and retain two thirds of total profits.

Table 19: Percentiles of Share of Reserves in Total Equity

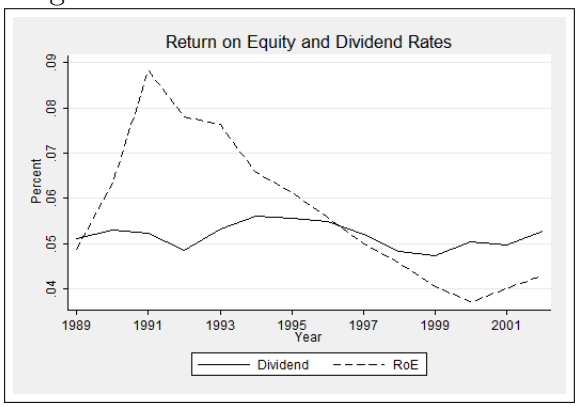
Perc.	1%	5%	10%	25%	50%	75%	90%	95%	99%	100%
ES	24%	34%	40%	49%	59%	69%	77%	80%	88%	97%

Calculating the percentiles of the share of reserves in total equity of all cooperatives over all periods, Table 19 gives a detailed insight into the structure of total equity. Even in the first percentile, the banks still have a share of reserves in total equity of 24 percent. This rather large share of reserves can partially be explained by the fact that cooperatives have only restricted access to capital markets, because shares cannot be traded and the number of shares per person is restricted. Consequently, they have to retain a larger share of earnings to finance the expansion of their business.

In figure 6 we display the change of the return on equity and the divi-

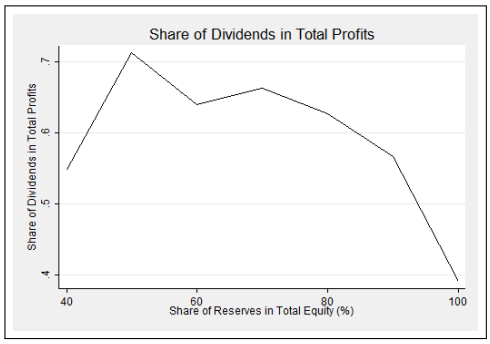
[94]See for example Gorton & Schmid (1999), who provide evidence for a better management control of cooperatives with a small number of members analysing Austrian cooperatives.

Figure 6: RoE and Dividends over Time

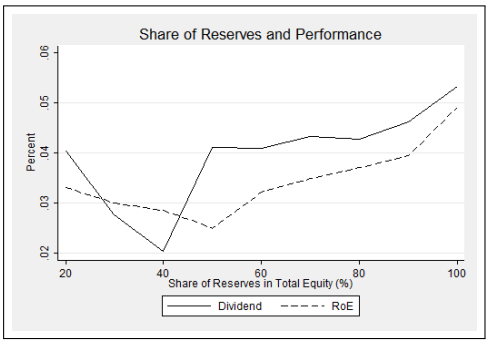


dend over time of the cooperatives in the sample. We observe a very favorable time for the cooperative sector in the beginning of the nineties reflecting the boom after the German unification. Over the nineties, return on equity is going down and even falls below the average dividend rate, which hardly changes over time. These findings reflect another role of reserves: They act as a risk buffer in bad times. Since reserves have not to be remunerated, a high share of reserves enables the management to keep dividend rates constant even in periods of low profits. Moreover, this figure supports the assumption in our model that members will only demand a return equivalent to an alternative investment, and so there are not able to enforce higher dividends: Dividend rates are not adjusted to higher earnings and rise only slightly in the profitable times following the German unification.

Figure 7: Share of Dividends in Total Profits



(a) Return on Equity and Dividend Rate



(b) Share of Reserves and Performance

Moreover, this assumption gains further support looking at figure 7(a). The share of dividends in total profits is decreasing when the share of reserves in total equity rises. Although the likelihood of insolvency is decreasing, managers retain a larger share of earnings.

Figure 7(b) displays dividend rates and return on equity for different shares of reserves in total equity. Return on equity, dividend rate and the share of reserves are positively correlated. A cooperative with higher profits is able to pay higher dividends and can accumulate more reserves. As predicted in the model, cooperatives pay constantly a dividend rate above the return on equity since they can offset the difference by using the capital earned by retained earnings. For cooperatives with low reserves, we observe that the return on equity is higher than the dividend rate. One explanation could be that these cooperatives retain a large share of earnings to build up reserves in order to finance the growth of their business and eventually pay higher dividends in the future. Cooperatives with a higher share of reserves seem to have reached such a high level that they are able to grow and to pay a high dividend.

5.5 Empirical Model

Our analysis is based on an unbalanced panel data set with a high number of cross-sectional units (442) and a small number of time units (16).[95] The main focus of our empirical analysis lies on explaining the heterogeneity in the cross-section, and not on explaining the development over time. Basically, there are three different approaches for this kind of data sets, the Ordinary Least Square approach (OLS), the Fixed Effects (FE) and the Random Effects (RE) approach (Verbeek 2003). The ordinary least square approach rests on the assumption of homogeneity over the intercepts of all units, which seems unreasonable here. It is to be expected that every unit, that is every cooperative bank, has unique features due to its special regional environment, the different management skills etc., and therefore intercepts cannot

[95]Constructing a balanced panel by including only units with full information for time and cross-sectional data does not lead to different results compared to the unbalanced panel.

be assumed to be identical over all units.

FE and RE approaches both assume that the differences across cross-sectional units and time units can be captured in differences in the constant term. So they use a dummy variable in order to capture these individual differences. The two approaches differ in their treatment of the individual effect, however: In the RE-models, it is assumed that the individual effect is not correlated with the explanatory variables, whereas in the FE-models, it is assumed that the individual effect might have an influence on the explanatory variables (Wooldridge 2001). In order to decide which of the two approaches is more appropriate, we apply a Hausman test which compares the main coefficients of both models and tests them for a significant difference. If they are significantly different, it is assumed that this is due to the correlation between individual effect and explanatory variables, and accordingly, the FE approach should be applied. In the following setting, theory suggests to use the FE model: We should observe a correlation between the individual effect and the explanatory variables due to the influence of the unique economic environment of any cooperative. As cooperatives are rather small, the influence of the regional environment, competition or a very skilled management on the profits is more predominant than in large companies (Verbeek 2003). Empirically, we applied the Hausman test in every regression in order to decide whether an FE or the RE model should be used. In all regressions, the null Hypothesis of "No Fixed Effects" was rejected at a statistically significant level (at the 1% level). Thus, we report only the reults of the fixed effect model in our analysis. The disadvantage of FE-models is that all time invariant variables, e.g. dummy variables, are excluded from the model. Hence, the regional and urbanisation dummies cannot be incorporated because, among others, these influences will be captured in the fixed effects dummies.

$$Y_i^* = \alpha + RE_i\beta + X_i\delta + \epsilon_i, \quad i = 1, ..., N \tag{46}$$

The dependent variable Y_i contains one of several performance measures. To measure the effort of the management, we employ efficiency measures

of the cooperative. The assumption is that lower effort of the management will corresponds with higher expenses for fringe benefits. Fringe benefits are proxied by the sum of administration expenditure, defined as the sum of expenditure for tangible assets and personnel. To measure volatility of returns, we use the variance of operative profits in the available time period as a proxy. Then we receive one value for every cooperative representing the variance of profits. Therefore, we use a normal OLS-regression to test hypothesis 2, because we have only one observation per cooperative and there exists no panel structure anymore. Fringe benefits are proxied by the sum of administration expenditure, defined as the sum of expenditure for tangible assets and personnel. In order to assess the overall effect of effort and risk choice, we also use the return on equity,[96] based on the operative result, as a profitability measure.[97]

The variable RE_i indicates reserves divided by total equity. X_i is a vector of control variables. Total assets are used to control for size effects such as decreasing returns to scale. The ratio of liabilities to equity is employed to address the leverage effect. We also need to control for the fact that cooperatives with a high quality management will also have a higher intergenerational endowment, because the bank was able to accumulate more reserves in the past. Therefore, we also include the dividend rate or the operative result or administrative spending divided by total asset in the regression, assuming that a higher dividend, a higher operative result or lower administrative spending is a proxy for management quality. Since including these variables could lead to problems of multicollinearity, we also present the result of the reduced regression. All independent variables are included in the regressions with one lag to control the fact that decisions of the management in one period are affected by the economic situation of a cooperative one period

[96]The results do not change using only the operative result as a performance measure.

[97]In order to measure profitability, it is more convenient to employ the bank's operative profits instead of the annual net profit ("Jahresüberschuss"). The reason for this choice is that German banks can build up undisclosed hidden reserves pursuant to section 340(f) of the German commercial code, which are already accounted from in the annual net profit. Moreover, German banks use these undisclosed reserves to smooth their annual net profits and, consequently, using annual net profits would not represent a good proxy for the profitability of the bank.

before. In the OLS regression, we use urban and regional dummies to control for regional differences[98] and year dummies to control for the macroeconomic environment. Finally, ϵ_i is the error term.

5.6 Empirical Results

Table 20 displays results analysing the relation between undistributed profits and fringe benefits, measured by administrative expenses divided by total assets. We run three different regressions with different control variables of management quality. In column 1, the control variable is the dividend rate. The coefficient of the share of reserves is significant at the 5% level and positive, indicating higher administrative expenses with higher reserves. Using operative profits as a control variable like in column 2 confirms the result; the significance level even rises. When droping these control variables, however, the coefficient no longer is significant as it can be seen in column 3. The strength of the effects are rather low. An increase in the share of reserves by 100 percent would raise administrative expenditure only between 5 and 7 percent. Turning to the effect of the control variables, we see that the coefficient of total assets has a negative sign, indicating economies of scale. The dividend rate and the level of profits are negatively correlated with higher administration expenditure. If administrative expenditures are high, profits and the dividend will turn out lower. A higher share of liabilities is negatively correlated with administrative expenditure, indicating lower profits and therefore there are less ressources available.

The results in Table 21 suggest that cooperatives with a higher share of reserves in 1987 have a lower variance of operative profits. The coefficient of the reserves/total equity ratio is significantly negative. Controlling for management quality by using the dividend rate in column 2 does not change the results. The level of total assets is positively correlated with the variance of operative profits since the quantitative variations in profits are more pronounced in large cooperatives. These findings are consistent with the Hypothesis that a high share of reserves acts as an incentive for a cooperatives

[98] Of course, these variables are not employed in the fixed effects regression.

Table 20: Undistributed Profits and Administration Costs

Dependent Variable	Administration Expenditure		
	(1)	(2)	(3)
ln(Reserves/Members Equity)	0.0451**	0.0745***	0.0106
	(1.96)	(4.11)	(0.57)
ln(Total Assets)	-0.0758***	-0.0420***	-0.0841***
	(-6.09)	(-3.33)	(-6.67)
ln(Liabilities/Equity)	-0.0867***	-0.115***	-0.0791***
	(-4.63)	(-6.13)	(-4.19)
ln(Dividend Rate)	-0.124***		
	(-4.74)		
ln(Operative Profits)		-0.0487***	
		(-9.83)	
R-squared within	0.3021	0.3433	0.2703
Observations	3433	3452	3433

Notes: [1] Fixed Effects Regression with robust standard errors. [2]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3]Year dummies included. [4]t-statistic in parentheses.

management to invest in assets, which are less risky. Another explanation of this finding is that cooperatives with a low share of reserves do not have an efficient management or operate in a region with a shaky economy. Since we used regional and urbanisation dummies, as well as the dividend rate as a control variable, this should not play a major role here. Hence, this result seems robust, since also using operational results as dependent variable assures that these result might not be caused by accounting decisions by the management, for instance in the case of profit smoothing.

However, the finding of the previous regressions alone still do not indicate any negative influence of reserves on cooperatives' performance. Higher administration and personnel costs could also be offset by higher profits when for example high qualified personnel is hired. Therefore, in Table 22, we present results for the regression with the return on equity as dependent variable. Again, we used models with different control variables for management quality. In all specifications, we do not find any significant relation between the share of reserves in total equity and the return on equity. Consequently, hypothesis 4 is not confirmed by the data. There are several possible

Table 21: Variance of Profits

Dependent Variable	ln(Variance of Operative Result)	
	(1)	(2)
ln(Reserves/Members Equity)	-0.589***	-0.692***
	(-3.77)	(-4.24)
ln(Total Assets)	0.992***	1.021***
	(10.10)	(10.48)
ln(Dividend Rate)		0.732***
		(2.83)
R-squared	0.3604	0.3823
Observations	392	392

Notes: [1] OLS Regression with robust standard errors. [2]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Regional and urbanisation dummies included. [4] t-statistics in parentheses.

reasons for this finding. First, it could be that the internal auditing system of the federation of cooperatives prevents any severe inefficiencies. Second, the reason for not finding any influence could be due to the fact that cooperatives with lower reserves invest in riskier assets. When these institutions fail, they are merged with other cooperatives. Then they no longer appear in our data set. This would have a strong bias on the regression results. However, using only cooperatives for which data is available over the 15 year period do not change the results. Another reason could be that compensation plans for managers include performance based payments, which would reduce the incentive to execute less effort.

In various regressions presented before, multicollinearity might be a problem. For instance, the share of reserves in total equity is positively correlated with the dividend rate and personnel and administrative spending. Moreover, also liabilities/equity might be correlated with other explanatory variables. One sign of multicollinearity is the insignificance of several individual regression coefficients that at the same time are statistically significant as a group (Greene 2003). This is not the case here. Another problem is that regression coefficients may represent the influence of more than one explanatory variable. This leads to large changes in the regression coefficients when some of

Table 22: Undistributed Profits and Return on Equity

Dependent Variable	ln(Operative Profits / Equity)		
	(1)	(2)	(3)
ln(Reserves/Members Equity)	0.0604	-0.0958	0.0298
	(0.64)	(-0.84)	(0.31)
ln(Total Assets)	-0.0955*	-0.0797	-0.0444
	(-1.68)	(-1.40)	(-0.77)
ln(Liabilities/Equity)	0.599***	0.694***	0.658***
	(7.20)	(8.61)	(7.89)
ln(Admin.Costs/T.A.)	-0.529***		
	(-5.29)		
ln(Dividend Rate)		0.469***	
		(3.28)	
R-squared within	0.3119	0.3309	0.3105
Observations	3042	3042	3042

Notes: [1] Fixed Effects Regression with robust standard errors. [2]***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3]Year dummies included. [4]t-statistic in parentheses.

the variables are dropped from the equation (Greene 2003). Dropping the coefficient of total assets or the coefficient of liabilities/equity does not change the results. Dropping the coefficients controlling for management quality, the effect of reserves divided by members equity gets smaller as expected. Thus, there is little concern that these regression coefficients may have picked up part of the influence of the correlated variable. As further robustness checks, we run all regressions with a reduced dataset, eliminating all observation smaller than the second percentile and larger than the 98th percentile for all variables. Results do not change.

5.7 Conclusion

The fact that cooperatives do not have a residual claimant has various implications for management incentives. Various authors have argued that this feature of the cooperatives' institutional structure will decrease risk taking, but increase the consumption of fringe benefits. We have shown, that this effect is reinforced by the fact that cooperatives have accumulated retained profits in the past. This intergenerational endowment will lead to empire

building because members incentives to control the management is very low due to the low value of cooperative shares.

Our empirical findings of 412 credit cooperatives in Germany in the period from 1988 until 2002 mainly support these claims. We find evidence for the hypothesis that the management continuously accumulates reserves in order to avoid the insolvency of the institution and assure a constant dividend level in times of crisis. Cooperative managers do not distribute additional profits generated by a higher intergenerational endowment to members, but invest it in the cooperative itself. This finding might not be of interest for the members, who nowadays are mainly profit oriented.

Concerning investment policy, we find that cooperatives with a higher share of reserves in total equity exhibit a lower variability of profits. Furthermore, evidence suggests that cooperatives with a higher intergenerational endowment compared to members equity have higher administration costs divided by total profits, indicating higher fringe benefits. However, we find no evidence that a higher share of reserves also is negatively related to the return on equity.

Our findings are consistent with the results of the literature comparing cooperative banks with banks with a different ownership structure. Cooperative banks are found to have a lower variability of profits (Beck et al. 2009). Our results suggest that the dispersed ownership structure and the incentives set by the share of reserves are the reasons for this finding. Moreover, as in other previous studies, we are not able to detect any differences in profitability (Brunner et al. 2005).

Developing a mechanism to let members participate in the profits generated by undistributed profits might be difficult.[99] On the one side, paying a dividend rate above the return rate of an alternative investment would lead to high demand for the shares of cooperatives that have high reserves.

[99]In history, there exist examples for such laws trying to regulate the size of reserves. The first mutual in New York, the Bank for Savings, first did not permit it to keep a surplus. The difference between profits and dividends had to be zero. In 1852, the New York State Assembly passed a bill (never enacted) that would effectively confiscated the reserves of the saving bank. This threat induced it to pay extra dividends to its members (Rasmusen 1988).

Then current members might want to restrict the admission of new members. Additionally, the distribution of profits between members who are already part of the cooperative for many years and new members has to be defined. The reform of this institutional structure will be a promising area of future research.

References

Ai, C. & Norton, E. (2003). Interaction Terms in Logit and Probit Models. *Economics Letters*, 80, pp. 123–129.

Akella, S. R. & Greenbaum, S. (1988). Savings and Loan Ownership Structure and Expense-Preference. *Journal of Banking and Finance*, 12, pp. 419-437.

Alderman, H. (1996). Saving and Economic Shocks in Rural Pakistan. *Journal of Development Economics*, 51, pp. 343-365.

Allen, F. & Gale, D. (1997). Financial Markets, Intermediaries, and Intertemporal Smoothing. *Journal of Policical Economy*, 105(3), pp. 523-546.

Allen, F. & Gale, D. (1999). Innovations in Financial Services, Relationships, and Risk Sharing. *Management Science*, 45(9), pp. 1239-53.

Allen, F. & Gale, D. (2004). Competition and Financial Stability. *Journal of Money, Credit and Banking*, 36, pp. 453-480.

Allen, L., Saunders, A. & Udell, G. (1991). The Pricing of Retail Deposits: Concentration and Information. *Journal of Financial Intermediation*, 1(4), pp. 335-361.

Altunbas, Y., Evans, L. & Molyneux, P. (2001). Bank Ownership and Efficiency. *Journal of Money, Credit and Banking*, 33, pp. 926-954.

Armendariz de Aghion, B. & Morduch, J. (1999). Microfinance Beyond Group Lending. *Economics of Transition*, 8(2), pp. 401-420.

Armendáriz de Aghion, B. & Morduch, J. (2005). The Economics of Microfinance. The MIT Press: Cambridge.

Baland, J.-M. & Robinson, J. (2000). Is Child Labor Inefficient?.*Journal of Political Economy*, 108(4), pp. 663-679.

Banerjee, A., Besley, T. & Guinnane, T. (1994). Thy Neighbor's Keeper: The Design of Credit Cooperatives with Theory and a Test. *Quarterly Journal of Economics*, 109, pp. 491-515.

Beck, T., Hesse, H., Kick, T. & von Westernhagen, N. (2009). Bank Ownership and Stability: Evidence from Germany. Working Paper. Universities of Frankfurt and Tilburg.

Beegle, K., Dehejia, R. & Gatti, R. (2003). Child Labor, Income Shocks, and Access to Credit. World Bank Policy Research Working Paper 3075.

Berg, G. & Schrader, J. (2008). Microcredit, Natural Disasters, and Relationship Lending. Working Paper. Universities of Frankfurt and Heidelberg.

Berger, A. (1999). The "Big Picture" of Relationship Finance. In: Blanton, J., Williams, A., and Rhine, S. (eds.). *Business Access to Capital and Credit.* A Federal Reserve System Research Conference, pp. 390-400.

Berger, A. N. & Udell, G. F. (2002). Small Business Credit Availability and Relationship Lending: The Importance of Bank Organisational Structure. *The Economic Journal*, 112, pp. F32-F53.

Berger, A. N., Udell, G. F. & Klapper, L. F. (2001). The Ability of Banks to Lend to Informationally Opaque Small Businesses. *Journal of Banking and Finance*, 25, pp. 2127-2167.

Berger, A. & Udell, G. (1995). Relationship Lending and Lines of Credit in Small Firm Finance. *Journal of Business*, 68(3), pp. 351-381.

Berle, A. A. & Means, G. C. (1923). The Modern Corporation and Private Property. New York.

Berlin, M. & Mester, L. (1998). On the Profitability and Cost of Relationship Lending. *Journal of Banking and Finance*, 22(6-8), pp. 873-897.

Berlin, M. & Mester, L. (1999). Deposits and Relationship Lending. *Review of Financial Studies*, 12(3), pp. 579-607.

Besley, T., Coate, S. & Loury, G. (1993). The Economics of Rotating Savings and Credit Associations. *The American Economic Review*, 83(4) (September), pp. 792-810.

Bonus, H. & Schmidt, G. (1990). The Cooperative Banking Group of the Federal Republic of Germany: Aspects of Institutional Change. *Journal of Institutional and Theoretical Economics*, 146, pp. 180-207.

Boot, A. (2000). Relationship Banking. What do we know?. *Journal of Financial Intermediation*, 9, pp. 7-25.

Boot, A., Greenbaum, S. & Thakor, A. (1993). Reputation and Discretion in Financial Contracting. *American Economic Review*, 83(5), pp. 1165-83.

Boot, A. & Thakor, A. (1994). Moral Hazard and Secured Lending in an Infinitely Repeated Credit Market Game. *International Economic Review*, 35(4), pp. 899-920.

Boot, A. W. A. & Thakor, A. V. (2000). Can Relationship Banking Survive Competition?. *The Journal of Finance*, 55, pp. 679-713.

Bouman, F. (1995). Rotating and Accumulating Savings and Credit Associations: A Development Perspective. *World Development*, 23(3), pp. 371-384.

Brunner, A., Decressin, J., Hardy, D. & Kudela, B. (2005). Germany's Three-Pillar Banking System. Cross - Country Perspectives in Europe. IMF Occasional Paper 233.

Carter, M. & Maluccio, J. (2003). Social Capital and Coping with Economic Shocks: An Analysis of Stunting of South African Children. *World Development*, 31(7), pp. 1147-1163.

Cetorelli, N. & Peretto, P. (2000). Oligopoly Banking and Capital Accumulation. Federal Reserve Bank of Chicago. Working Paper No. 12.

Charvériat, C. (2000). Natural Disasters in Latin America and the Caribbean: An Overview of Risk. Inter-American Development Bank Working Paper 434.

Chaudhury, I. A. & Matin, I. (2002). Dimensions and Dynamics of Microfinance Membership Overlap. A Micro Study from Bangladesh. *Small Enterprise Development*, 13(2), pp. 46-55.

Cole, R. (1998). The Importance of Relationships to the Availability of Credit. *The Journal of Banking and Finance*, 22, pp. 959-77.

Davis, K. (2001). Credit Union Governance and the Survival of the Cooperative Form. *Journal of Financial Service Research*, 19, pp. 197-210.

Deaton, A. (1991). Saving and Liquidity Constraints. *Econometrica*, 59(5) (September), pp. 1221-1248.

Deaton, A. (1992). Understanding Consumption. Clarendon Press: Oxford.

Deaton, A. (1997). The Analysis of Household Surveys. The John Hopkins University Press: Baltimore.

Degryse, H. & Ongena, S. (2001). Bank Relationships and Firm Profitability. *Financial Management*, 30, pp. 9-34.

Degryse, H. & Van Cayseele, P. (2000). Relationship Lending within a Bank-Based System: Evidence from European Small Business Data. *Journal of Financial Intermediation*, 9(1), pp. 90-109.

del Ninno, C., Dorosh, P. & Smith, L. (2003). Social Capital and Coping with Economic Shocks: Public Policy, Markets and Household Coping Strategies in Bangladesh: Avoiding a Food Security Crisis Following the 1998 Floods. *World Development*, 31(7), pp. 1221-1238.

Dercon, S. (2002). Income Risk, Coping Strategies, and Safety Nets. *The World Bank Research Observer*, 17(2), pp. 141-166.

Diamond, D. (1991). Monitoring and Reputation: The Choice between Bank Loans and Privately Placed Debt. *Journal of Political Economy*, 99(4), pp. 689-721.

Diamond, D. W. & Dybwig, P. (1983). Bank Runs, Deposit Insurance and Liquidity. *Journal of Political Economy*, 91, pp. 401-419.

Economic Commission for Latin America and the Caribbean (ECLAC) (2003). *Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters,* United Nations, ECLAC and International Bank for Reconstruction and Development.

Elsas, R. & Krahnen, J. (1998). Is Relationship Banking Special? Evidence from Creditfile Data in Germany. *Journal of Banking and Finance*, 22, pp. 1283-1316.

Elsas, R. & Krahnen, J. (2004). Universal Banks and Relationships with Firms. In Krahnen, J. and Schmidt, R. (eds). *The German Financial System.* Oxford University Press, Oxford, pp. 197-233.

Eswaran, M. & Kotwal, A. (1989). Credit as Insurance in Agrarian Economies. *Journal of Development Economics*, 31, pp. 37-53.

Fama, E. & Jensen, M. (1983a). Agency Problems and Residual Claims. *Journal of Law and Economics*, 26, pp. 327-349.

Fama, E. & Jensen, M. (1983b). Separation of Ownership and Control. *Journal of Law and Economics*, 26, pp. 301-325.

Ferri, G., Kang, T. & Kim, I. (2001). The Value of Relationship Banking During Financial Crises: Evidence from the Republic of Korea. World Bank Policy Research Working Paper No. 2553.

Fonteyne, W. (2007). Cooperative Banks in Europe - Policy Issues. International Monetary Fund (IMF), Working Paper WP 07/159.

Foster, A. (1995). Prices, Credit Markets and Child Growth in Low-Income Rural Areas. *The Economic Journal*, 105(430) (May), pp. 551-570.

Freixas, X. (2005). Deconstructing Relationship Banking. *Investigaciones Económicas*, XXIX(1), pp. 3-31.

Gertler, P. & Gruber, J. (2002). Insuring Consumption Against Illness. *The American Economic Review*, 92(1) (March), pp. 51-70.

Gertler, P., Levine, D. & Moretti, E. (2002). Do Microfinance Programs Help Families Insure Consumption Against Illness? Working Paper No. CCPR-011-02, University of California, Los Angeles, California Center for Population Research.

Gitter, S. & Barham, B. (2007). Credit, Natural Disasters, Coffee, and Educational Attainment in Rural Honduras. *World Development*, 35(3), pp. 498-511.

Gorton, G. & Schmid, F. (1999). Corporate Governance, Dispersion and Efficiency: Empirical Evidence from Austrian Cooperative Banking. *Journal of Corporate Finance*, 5, pp. 119-140.

Greenbaum, S., Kanatas, G. & Venezia, I. (1989). Equilibrium Loan Pricing under the Bank-Client Relationship. *Journal of Banking and Finance*, 13(2), pp. 221-235.

Greene, W. H. (2003). Econometric Analysis. Prentice Hall International.

Grimard, F. (1997). Household Consumption Smoothing through Ethnic Ties: Evidence from Côte d'Ivoire. *Journal of Development Economics*, 53, pp. 391-422.

Guinnane, T. & Henriksen, I. (1997). Why Danish Credit Co-operatives were so unimportant. *Scandinavian Economic Historic Review*, 46, pp. 32-54.

Guinnane, T. W. (1994). A Failed Institutional Transplant: Raiffeisen's Credit Cooperatives in Ireland, 1894-1914. *Explorations in Economic History*, 31, pp. 38-61.

Guinnane, T. W. (2002). Delegated Monitors, Large and Small: Germany's Banking System, 1800-1914. *The Journal of Economic Literature*, 40, pp. 73-124.

Gurtner, E., J. M. & Ory, J. N. (2002). Le statut de coopérative est-il source d'efficacité dans le secteur Bancaire?. *Revue d'Economie Financiere*, 67, pp. 133-164.

Hansmann, H. (2000). The Ownership of Enterprise. The Belknap Press of Harvard University Press: Cambridge.

Hart, O. & Moore, J. (1998). Cooperatives versus Outside Ownership. National Bureau of Economic Research Working Paper No. 6421.

Hermalin, B. & Wallace, N. (1994). The Determinants of Efficiency and Solvency in Savings and Loans. *Rand Journal of Economics*, 10, pp. 361-381.

Hetherington, A. (1991). Mutual and Cooperative Enterprises. An Analysis of Customer-owned Firms in the United States. University Press of Virginia, Charlottesville and London.

Hoff, K. & Stiglitz, J. (1998). Moneylenders and Bankers: Price-Increasing Subsidies in a Monopolistically Competitive Market. *Journal of Development Economics*, 55, pp. 485-518.

Holmstroem, B. & Tirole, J. (1997). Financial Intermediation, Loanable Funds and the Real Sector. *The Quarterly Journal of Economics*, 112(3) (August), pp. 663-691.

Höser, R. (1989). Konkurrenzfähigkeit der Rechtsform Genossenschaft. Schulz-Kirchner: Idstein.

Höser, R. (1990). Der Förderungsauftrag moderner Genossenschaftsbanken und seine Umsetzung in die Praxis. Fritz Knapp Verlag: Frankfurt a.M.

Hoshi, T. (1993). The Choice Between Public and Private Debt: An Analysis of Post-Deregulation Corporate Financing in Japan. NBER Working Paper No. 4421.

Hossain, M. (1988). Credit for Alleviation of Rural Poverty: The Grameen Bank of Bangladesh, Research Report 65, International Food Policy Research Institute, Washington, DC.

Howitt, P. & Fried, J. (1980). Credit Rationing and Implicit Contract Theory. *Journal of Money, Credit and Banking*, 12(3), pp. 471-487.

Hubbard, R., K. K. & Palia, D. (2002). Are There Bank Effects in Borrowers' Cost of Funds? Evidence from a Matched Sample of Borrowers and Banks. *Journal of Business*, 75(4), pp. 559-581.

Hulme, D. (1991). The Malawi Mundi Fund: Daughter of Grameen. *Journal of International Development*, 3(4), pp. 427-431.

Interamerican Development Bank (2006). La Microempresa en Ecuador: Perspektivas, Desafios y Lineamiento de Apoyo, Interamerican Development Bank, Quito.

Jacoby, H. & Skoufias, E. (1997). Risk, Financial Markets, and Human Capital in a Developing Country. *The Review of Economic Studies*, 64(3) (July), pp. 311-335.

Jalan, J. & Ravallion, M. (1999). Are the Poor Less Well Insured? Evidence on Vulnerability to Income Risk in Rural China. *Journal of Development Economics*, 58, pp. 61-81.

Jensen, M. & Meckling, W. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics*, 3, pp. 305-360.

Jensen, R. (2000). Agricultural Volatility and Investments in Children. *AEA Papers and Proceedings*, 90(2) (May), pp. 399-404.

Kochar, A. (1995). Explaining Household Vulnerability to Idiosyncratic Income Shocks. *AEA Papers and Proceedings*, 85(2) (May), pp. 159-164.

Kochar, A. (1999). Smoothing Consumption by Smoothing Income: Hours-of-Work Responses to Idiosyncratic Agricultural Shocks in Rural India. *The Review of Economics and Statistics*, 81(1) (February), pp. 50-61.

Kotz, H. & Nagel, J. (2002). Les banques du secteur coopératif allemand sont-elles construites sur un avantage comparatif déclinant?. *Revue d'Economie Financiére*, 67, pp. 57-72.

Lamm-Tennant, J. & Starks, T. (1993). Stock Versus Mutual Ownership Structures: The Risk Implications. *Journal of Business*, 66, pp. 29-46.

Levine, R. (2004). Finance and Growth. Theory and Evidence. *Journal of Money, Credit and Banking*, 37(2), pp. 191-222.

McIntosh, C., de Janvry, A. & Sadoulet, E. (2005). How Rising Competition Among Microfinance Institutions Affects Incumbent Lenders. *The Economic Journal*, 115, pp. 987-1004.

Mester, L. (1993a). Agency Costs among Savings and Loans. *Journal of Banking and Finance*, 1, pp. 257-278.

Mester, L. (1993b). Efficiency in the Savings and Loan Industry. *Journal of Financial Intermediation*, 17, pp. 267-286.

Miamidian, E., Arnold, M., Burritt, K. & Jacquand, M. (2005). Surviving Disasters and Supporting Recovery: A Guidebook for Microfinance Institutions. World Bank Disaster Risk Management Research Working Paper Series No. 10.

Morduch, J. (1995). Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives*, 9(3) (Summer), pp. 103-114.

Morduch, J. (1999a). Between the State and the Market: Can Informal Insurance Patch the Safety Net?. *The World Bank Research Observer*, 14(2) (August), pp. 187-207.

Morduch, J. (1999b). The Microfinance Promise. *Journal of Economic Literature*, 37 (December), pp. 1569-1614.

Nakamura, L. (1991). Commercial Bank Information: Implications for the Structure of Banking. Working Paper. Federal Reserve Bank of Philadelphia.

Navajas, S., Conning, J. & Gonzalez-Vega, C. (2003). Lending Technologies, Competition and Consolidation in the Market for Microfinance in Bolivia. *Journal of International Development*, 15, pp. 747-770.

Ongena, S. & Smith, D. (2000). What Determines The Number of Bank Relationships? Cross-Country Evidence. *Journal of Financial Intermediation*, 9, pp. 26-56.

Padilla, A. & Pagano, M. (2000). Sharing Default Information as a Disciplining Device. *European Economic Review*, 44, pp. 1951-1980.

Pantoja, E. (2002). Microfinance and Disaster Risk Management. Experiences and Lessons Learned. Final Report, Provention Consortium, World Bank, UNDP, UNCDF.

Petersen, M. & Rajan, R. G. (1994). The Benefits of Lending Relationships: Evidence from Small Business Data. *The Journal of Finance*, 49 (1), pp. 3-37.

Petersen, M. & Rajan, R. G. (1995). The Effect of Credit Market Competition on Lending Relationships. *The Quarterly Journal of Economics*, 110(2) (May), pp. 407-43.

Rahman, A. (1999). Micro-Credit Initiatives for Equitable and Sustainable Development: Who pays?. *World Development*, 26(12), pp. 67-82.

Rajan, R. G. (1992). Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt. *Journal of Finance*, 47(4), pp. 1367-1400.

Rajan, R. G. & Zingales, L. (1998). Which Capitalism? Lessons from the East Asian Crisis. *Journal of Applied Corporate Finance*, 11(3), pp. 40-48.

Ranjan, P. (2001). Credit Constraints and the Phenomenon of Child Labor. *Journal of Development Economics*, 64, pp. 81-102.

Rasmusen, E. (1988). Mutual Banks and Stock Banks. *Journal of Law and Economics*, 31, pp. 395-421.

Rhyne, E. N. (2002). Mainstreaming Microfinance. How Lending to the Poor Began, Grew and Came of Age in Bolivia. Kumarian Press: Sterling.

Rose, E. (1999). Consumption Smoothing and Excess Female Mortality in Rural India. *The Review of Economics and Statistics*, 81(1) (February), pp. 41-49.

Rosenzweig, M. (1988). Risk, Implicit Contracts and the Family in Rural Areas of Low-Income Countries. *The Economic Journal*, 98(393) (December), pp. 1148-1170.

Rosenzweig, M. & Wolpin, K. (1993). Credit Market Constraints, Consumption Smoothing, and the Accumulation of Durable Production Assets in Low-Income Countries: Investments in Bullocks in India. *Journal of Political Economy*, 101(2), pp. 223-244.

Schaefer, D., Siliverstovs, B. & Terberger, E. (2009). Banking Competition, Good or Bad? The Case of Promoting Micro and Small Enterprise Finance in Kazakhstan. *Applied Economics*, forthcoming.

Schrader, J. (2009). The Competition between Relationship-Based Microfinance and Transaction Lending. Working Paper. University of Heidelberg.

Sharpe, S. (1990). Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships. *The Journal of Finance*, 45(4), pp. 1069-1087.

Steffen, S. & Wagenburg, M. (2008). Syndicated Loans, Lending Relationships and the Business Cycle. Working Paper.

Sties, A. (2005). Ein Beitrag zur ökonomischen Theorie der Kreditgenossenschaft: Die Ausgestaltung von Genossenschaftsanteilen. PhD Thesis, Chair of Banking and Finance, Heidelberg University.

Stiglitz, J. & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *American Economic Review*, 71, pp. 393-410.

Superintendencia de Bancos del Ecuador (2006). Memorandum 2006. Quito.

Tadesse, S. (2002). Financial Architecture and Economic Performance: International Evidence. *Journal of Financial Intermediation*, 11, pp. 429-454.

Tedeschi, G. A. (2003). Here Today, Gone Tomorrow: Can Dynamic Incentives Make Microfinance More Flexible?. *Journal of Development Economics*, 80(1), pp. 84-105.

Terberger, E. (1993). Agency-Theorie. in: Corsten, Hans (Hrsg.): *Lexikon der Betriebswirtschaftlehre,* 2. Aufl., München, pp. 29-34.

Terberger, E. (2005). Die Struktur des Finanzsystems und der Finanzierungszugang fuer kleine Unternehmen. *Vierteljahrshefte zur Wirtschaftsforschung*, 74(4), pp. 75-91.

Terberger, E. & Schrader, J. (2008). Credit Cooperatives and the Incentive Effect of Reserves on Management Behavior. Working Paper. University of Heidelberg.

Townsend, R. (1994). Risk and Insurance in Village India. *Econometrica*, 62(3) (May), pp. 539-591.

Townsend, R. (1995). Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies. *The Journal of Economic Perspectives*, 9(3) (Summer), pp. 83-102.

Verbeek, M. (2003). A Guide to Modern Econometrics. John Wiley and Sons.

Vogelgesang, U. (2003). Microfinance in Times of Crisis: The Effects of Competition, Rising Indebtedness, and Economic Crisis on Repayment Behavior. *World Development*, 31, pp. 2085-2114.

von Pischke, J. (2002). Innovation in Finance and Movement to Client-Centered Credit. *Journal of International Development*, 14, pp. 369-380.

Wooldridge, J. M. (2001). Econometric Analysis of Cross Section and Panel Data. The MIT Press: Cambridge.

6 Appendix

6.1 Microcredit, Natural Disasters, and Relationship Lending

Table A1: Summary Statistics of Credit Approvals

	Ambato & Riobamba	All Branches
Demographic Characteristics		
Male (%)	68.15	64.81
Average Age (years)	39.4	38.6
Married (%)	78.86	77.81
Destination of loan		
Agriculture (%)	33.31	20.36
Business/Trade (%)	26.25	33.27
Livestock/Fish Breeding (%)	4.16	7.19
Production/Construction (%)	15.51	19.73
Transportation (%)	10.31	8.00
Observations	35,543	79,989

Table A2: Probit Regression for Credit Approval - incl. Lags

Variable	Coefficient	(Std. Error)
Volcanic Activity		
Explosions	-0.0021^{***}	(0.0003)
L1.	-0.0013^{***}	(0.0003)
L2.	-0.0012^{***}	(0.0003)
L3.	-0.0013^{***}	(0.0002)
L4.	-0.0020^{***}	(0.0002)
L5.	-0.0030^{***}	(0.0003)
L6.	0.0013^{***}	(0.0002)
Demographic Characteristics		
Age	-0.0045^{***}	(0.0012)
$(\text{Age})^2$	0.0001^{***}	(0.0000)
Married	0.0389^{***}	(0.0052)
Male	-0.0314^{***}	(0.0045)
Loan Characteristics		
Amount Applied For	$-1.46e-06^{***}$	$(2.44e-07)$
Old Client	0.2448^{***}	(0.0042)
Observations	47,477	

Notes: [1] Probit regressions for Ambato & Riobamba reporting marginal effects. [2] ***denotes significant at the 1 percent level, **at the 5 percent level, and *at the 10 percent level. [3] Region, year, and destination of loan dummies included.

6.2 Cooperatives and the Incentive Effects of Retained Earnings

Derivation of multi period setting result

In a multi period setting, it holds that

$$E(\pi) = (1 - y^*)y^* e(N + R) = dN \tag{47}$$

Applying the quadratic formula, and defining the dividend gap $G = \frac{d}{\frac{R}{N}+1}$, we receive two solutions:

$$y_1^* = \frac{1}{2} - \sqrt{1 - \frac{4G}{e}} \tag{48}$$

$$y_2^* = \frac{1}{2} + \sqrt{1 - \frac{4G}{e}} \tag{49}$$

The relation between expected profits and the target return consists in an inverted U-shaped curve. Consequently, for every expected return, if $1 - \frac{4G}{e} > 0$, there exists one risky target return and one safe target return. Since the manager's utility depends on the probability of reaching the dividend target, it will always choose the solution with the lowest risk level, y_1^*. Inserting y_1^* in the utility function, we get:

$$E(U) = w + 1 - [\frac{1}{2} - \sqrt{1 - \frac{4G}{e}}] - e^2 \tag{50}$$

Maximising $E(U)$ with respect to management effort e yields to:

$$(1 - \frac{4G}{e^*})^{-\frac{1}{2}} G - 2e^{*3} = 0 \tag{51}$$

Applying the implicit function theorem and deriving e^* with respect to R, we get:

$$\frac{\delta e^*}{\delta R} = -\frac{-\frac{1}{2}(1 - \frac{4G}{e^*})^{-\frac{3}{2}} G(-\frac{4}{e})\frac{\delta G}{\delta R} + (1 - \frac{4G}{e^*})^{-\frac{1}{2}}\frac{\delta G}{\delta R}}{-\frac{1}{2}(1 - \frac{4G}{e^*})^{-\frac{3}{2}} G(\frac{4}{e^{*2}}) - 6e^2} \tag{52}$$

Since $\frac{\delta G}{\delta R} < 0$, it holds that

$$\frac{\delta e^*}{\delta R} < 0 \tag{53}$$

This result corresponds to the result in the one period setting. Turning now the effect of a change of R on y^*, we calculate $\frac{\delta y_1^*}{\delta R}$:

$$\frac{\delta y_1^*}{\delta R} = \frac{1}{4}(1 - \frac{4G}{e^*(R)})^{-\frac{1}{2}} \frac{4\frac{\delta G}{\delta R}e^* - \frac{\delta e^*}{\delta R}G}{[e(R)]^2} \tag{54}$$

It can be seen that the algebraic sign of $\frac{\delta y_1^*}{\delta R}$ is determined by $4\frac{\delta G}{\delta R}e^* - \frac{\delta e^*}{\delta R}G$. Inserting $\frac{\delta G}{\delta R}$ and $\frac{\delta e^*}{\delta R}$ in $4\frac{\delta G}{\delta R}e^* - \frac{\delta e^*}{\delta R}G$ yields to:

$$4\frac{\delta G}{\delta R}e^* + G\frac{-\frac{1}{2}(1 - \frac{4G}{e^*})^{-\frac{3}{2}}G(-\frac{4}{e})\frac{\delta G}{\delta R} + (1 - \frac{4G}{e^*})^{-\frac{1}{2}}\frac{\delta G}{\delta R}}{-\frac{1}{2}(1 - \frac{4G}{e^*})^{-\frac{3}{2}}G(\frac{4}{e^{*2}}) - 6e^2} \tag{55}$$

Simplifying this expression yields to:

$$\frac{\frac{\delta G}{\delta R}[(1 - \frac{4G}{e^*})^{-\frac{3}{2}}(\frac{2G}{e}(-5 + G - 24e^3(1 - \frac{4G}{e^*})^{\frac{3}{2}})}{-\frac{1}{2}(1 - \frac{4G}{e^*})^{-\frac{3}{2}}G(\frac{4}{e^{*2}}) - 6e^2} \tag{56}$$

Since it holds that $\frac{\delta G}{\delta R} < 0$, $1 - \frac{4G}{e^*} > 0$, $G < 1$, it is equivalent to:

$$\frac{\delta y^*}{\delta R} < 0 \tag{57}$$

This result also corresponds to the result in the one period setting. Since the manager will always use the less risky result, the expected return on equity will always fall with an increase in retained earnings. This is a small difference in comparison to the one period setting, where it is also theoretically possible that return on equity rises with higher reserves.

Table A3: Summary Statistic

Variable	Mean	Std. Dev.	Min.	Max.
Cooperative Characteristics				
Reserves/Subscribed Capital	58%	14%	11	97
Total Assets (1000)	653	690	23	1005
Liabilities/Equity	21	4.4	8.4	57.2
Performance Measures				
Ad. expenses/ Total Assets	2.3%	0.5%	0.5%	5.0%
Dividends/Profits	15.4%	8.9%	-7000%	1100%
Annual Net Profit/Total Equity	5.3%	3.2%	-28.8%	22.4%
Operative Result/Total Equity	13.2%	9.6%	-149%	41.7%
Total dividend/Subscribed Capital	5.5%	1.6%	1.3%	10.4%
Variance of operating profits (1000)	1.8	2.6	0.018	38.8