MICROFINANCE, INCENTIVES TO REPAY, AND OVERINDEBTEDNESS: EVIDENCE FROM A HOUSEHOLD SURVEY IN BOLIVIA

DISSERTATION

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ABSTRACT

The superior repayment performance of the clients of microfinance institutions —when contrasted with banks— and the robustness of this repayment behavior during periods of severe systemic shocks have attracted much speculation. This dissertation formally addresses these issues, by exploring the relationships between overindebtedness and alternative lending technologies and contract designs. Data for 1997-2001, from a household survey taken during the overindebtedness episode of the Bolivian financial sector, are used to test the hypotheses.

Overindebtedness is an outcome of a loan contract that does not correspond to the original expectations of the borrower, the lender, or both. Repayment difficulties may result from unwillingness to repay, inability to repay, or actual repayment only after *extraordinary capacity* is generated through costly actions. *Costly actions* reflect efforts or outcomes beyond what the borrower had planned at the time of contract. Any credit relationship characterized by willingness and ability to repay without exceptional cost implies the absence of overindebtedness. Overindebtedness may result from the opportunistic behavior of lenders, the opportunistic behavior of borrowers, unexpected adverse systemic shocks, or limitations of the lending technologies in forecasting *ordinary* repayment capacity.

The dissertation builds a conceptual framework for the analysis of overindebtedness among microfinance borrowers. The model considers the intertemporal choices of different types of borrowers —when faced with unexpected adverse shocks and the need to reassess their repayment options— guided by the value of relationships characterized by different contract terms and the opportunity costs of the extra efforts required. The dissertation establishes a previously unidentified link between a high degree of *extraordinary* repayment capacity (both extraordinary willingness and extraordinary ability to repay) and the high repayment rates observed among MFIs. These rates are explained both by the ability to elicit strong incentives to repay and the opportunities these households have to generate *extraordinary* ability to repay. Thus, given similar ability across lenders to induce ordinary repayment capacity, the strength of microfinance lending technologies comes from their ability to create incentives for the borrower to engage in extraordinary costly actions and their capacity to identify households with a high probability of success at generating extraordinary ability to repay.

Dedicated to my parents Imelda and Claudio,
my wife Sandra,
and my daughter Valeria.

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FIELDS OF STUDY

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ACRONYMS

CGAP:	Consultative Group to Assist the Poor
FI:	Financial intermediary
FOC:	First-order condition(s)
GEV:	Generalized extreme-value models
iid:	Identically and independently distributed
KT:	Kuhn-Tucker
MFI:	Microfinance institution
MIX:	The Microfinance Information Exchange, Inc.
NBFI:	Nonbank financial institution
NGO:	Nongovernmental organization
FFP:	*Fondo financiero privado* (private financial fund)
RUM:	Random utility model
SBEF:	Superintendence of Banks and Financial Entities

CHAPTER 1

INTRODUCTION

1.1 Microfinance

Microfinance is important. It is the provision of a number of financial services, such as deposit instruments and credit, to those economic agents without access to traditional banks, when the use of innovative financial technologies makes this access possible. Typically, groups of potential microfinance clients include poor urban and rural households, microentrepreneurs, and low-income self-employed individuals worldwide.

Different types of organizations provide microfinance services, including self-help groups, non-government organizations, credit unions and cooperatives, non-bank financial institutions, and banks. Most microfinance institutions (MFIs) use lending technologies that differ from those of traditional commercial and state-owned banks. In particular, MFIs lend without requiring the pledge of traditional collateral. This particularity of their lending technology forces MFIs to use alternative terms and conditions to create incentive-compatible contracts.

Further, some MFIs operate based on property rights structures that differ from those of traditional banks, often resulting in an unclear or attenuated ownership of the

organization and in objective functions with multiple dimensions. If a party interested in maximizing outreach and another one with a concern for sustainability share ownership, the MFI's objective function is a weighted average of outreach and sustainability, whose specific structure depends on the relative power of each owner in the decision-making process (Hartarska, 2002).

The environment where MFIs operate also differs from the environment where traditional banks operate. In general, MFIs operate in developing countries characterized by high levels of poverty and risk, deficient physical and institutional infrastructures, and missing or incomplete markets. This dissertation addresses the issues of overindebtedness, contract design, and incentives to repay with special reference to developing countries and the performance of the loan portfolios of MFIs.

The desire to understand better the 1999-2002 overindebtedness episode experienced by the Bolivian financial sector, in general, and the microfinance sector, in particular, is one the motivations for the dissertation. During this episode, MFIs went through a reduction in both portfolio size and the number of clients as well as increasing rates of arrears and default. All three features were part of a generalized trend experienced by the Bolivian financial sector from 1998 to 2002 (Gonzalez-Vega and Rodriguez-Meza, 2002; Navajas, Conning and Gonzalez-Vega, 2003; and Economist Intelligence Unit, 2003). Since then, MFIs have swiftly and successfully reacted to the "crisis", have shown an outstanding performance (in contrast to banks, which are only slowly recovering), and have evolved to become a major component of the Bolivian financial system (Gonzalez-Vega and Villafani-Ibarnegaray, 2007).

MFIs have to solve information and incentive problems similar to those faced by banks, in order to determine and encourage the creditworthiness of potential borrowers. Both types of lenders have to design incentive-compatible contracts and, if necessary, require access to contract enforcement mechanisms in order to increase the likelihood of loan repayment.

MFIs in developing countries, however, have to solve these problems under more difficult circumstances than those faced by traditional banks in developed countries, due to particular features of the environment and of their clienteles. For instance, MFIs in countries like Bolivia do not have access to the vast institutional infrastructure of developed countries. Some pieces of the institutional infrastructure that have been missing or do not work properly in Bolivian credit markets are credit bureaus, legal mechanisms for secured transactions involving movable goods, collateral registries, arbitration, bankruptcy procedures, and cost-effective judicial processes for contract enforcement. One of the outcomes of the episode under consideration was precisely a renewed interest in these instruments and the emergence of credit bureaus. Much else must still be accomplished in order to complete this institutional infrastructure in Bolivia.

The clients of MFIs are households whose common characteristic is to have at least one independent activity, namely some source of non-wage, self-employed income, usually generated through informal activities or the household's microenterprise. Typically, the clients of MFIs are at the same time a household and a business, simultaneously engaged in production and consumption decisions.

1.2 Bolivia

Bolivia is one of the countries where microfinance has reached higher levels of outreach and sustainability (Gonzalez-Vega and Rodriguez-Meza, 2002; Gonzalez and Rosenberg, 2006). Microfinance emerged in Bolivia in the late 1980s and, since then, this country has been a center of attention for worldwide practitioners and researchers. One reason for this has been the successful development and implementation of new lending technologies, capable of reaching populations previously excluded from access to formal finance. The lending technology used by commercial banks usually requires specific types of assets to be pledged as collateral (mortgages on real estate or liens on cars), which excludes poor households without these assets from these credit transactions. In contrast, MFIs do not require these types of collateral, but they may still exclude some households because, for example, their lending technology requires road access to the farm for a creditworthiness evaluation *in situ*. A direct evaluation of the applicant's ability and willingness to repay substitutes, in turn, for audited financial statements and court enforcement.

In the earlier days, the development of microfinance was limited to non-profit, non-governmental organizations (NGOs), highly dependent on donor funding. Due in part, however, to the development of more efficient lending technologies, microfinance has become increasingly commercialized (Christen and Drake, 2002) and sustainable (Gonzalez and Rosenberg, 2006). Several NGOs have transformed into licensed banks or regulated non-bank financial institutions (NBFIs). In turn, some banks and finance companies have included microfinance services as part of their menu of products.

There are strong links between commercialization and increasing competition in microfinance (Christen and Drake, 2002). In most cases, competition among microfinance institutions has resulted in improvements in the quality of services and in declining costs (Porteous, 2006; Villafani-Ibarnegaray and Gonzalez-Vega, 2007). In other cases, nevertheless, competition has also resulted in the overindebtedness of some clients (Christen and Drake, 2002; Lascelles, 2008).

In Bolivia, consumer credit organizations became one important source of competition for MFIs at the turn of the century. They imported their lending technology —credit scoring— from "the developed world of salaried workers and consumer durables" to Bolivia from Chile (Rhyne, 2001: 141). While, in theory, the consumer credit market differs from the microcredit market, in the Bolivian reality there was a high degree of overlapping between the two segments of the market.

This convergence created substantial negative externalities from consumer credit lenders to MFIs, as the repayment environment worsened because of some of the practices of consumer lending. While MFIs had followed a policy of zero tolerance of arrears, some of the consumer credit organizations actually welcomed the fees generated by clients in arrears (in a business model similar to that of most credit card companies worldwide and recently highlighted by the subprime crisis in the United States).

Hellmann, Murdock and Stiglitz (2000) link increasing competition to opportunistic behavior by lenders. Their argument is that competition reduces profits, lower profits imply lower franchise or charter values (namely, the capitalized value of expected future profits), and lower franchise values reduce the incentives for making good loans, as bank owners would have a lower stake in the outcome.

Competition is more likely to saturate a market and result in moral hazard problems when financial markets are small, and Bolivian markets are small. According to the 2001 Census, the Bolivian population was only 8.3 million people, distributed in two million households, of whom 59 percent were poor according to a basic needs fulfillment index (Instituto Nacional de Estadística, 2002). Further, for the 1990-1993 period, a big proportion of all economic transactions, 67 percent of the GDP on average, took place in informal markets, and this has continued to be the case (Schneider and Enste, 2000).

Markets become smaller with a recession and, from 1999 onward, the Bolivian economy was thrown into a severe economic slowdown. The average per capita GDP for the 1998-2002 period was US$996, real per capita GDP decreased, and domestic investment experienced negative rates of growth in real terms (Gonzalez-Vega and Rodriguez-Meza, 2003).

Macroeconomic instability accentuates moral hazard problems (McKinnon, 1989). In Bolivia, the 1998-2003 period was characterized by economic instability and increasing uncertainty. Several unexpected adverse income shocks affected the distribution of the expected returns of microentrepreneurs and the correlations across their projects.

In addition, specific regional (department) and sector-of-activity shocks aggravated the deterioration of the general economic situation in Bolivia. Regional economic shocks, such as the fall of soybean prices, riots, coca eradication campaigns, and changes in customs regulations with adverse impacts on border areas were frequent

in the period. Furthermore, households also experienced the usual idiosyncratic shocks, such as sickness, funeral expenses, or unemployment, just to mention a few.

1.3 Overindebtedness

In Bolivia and for the 1998-2002 period, many circumstances suggest that some lenders might have behaved opportunistically. The lenders' opportunistic behavior may have been at the roots of the overindebtedness episode, since opportunistic lenders are willing to take more risks —when evaluating potential borrowers— during times when competition increases or when the expectation of a bailout emerges.

Three additional, complementary explanations for the Bolivian overindebtedness episode are likely, however. These include: (a) the borrowers' own opportunistic behavior, in the presence of growing competition in an environment with incomplete institutions, (b) the role of unexpected adverse systemic income shocks (combined with the fact that ability to repay is a random variable for both borrowers and lenders, in a world with uncertainty), and (c) the differential ability of various lending technologies in evaluating ability to repay under the changing circumstances or in encouraging willingness to repay under a broader range of opportunities for the borrowers.

In contrast to the role of the lender's opportunistic behavior under growing competition, the roles of incentives to repay and of opportunistic borrower behavior, as sources of overindebtedness, constitute less explored dimensions of this literature. This dissertation focuses, therefore, on these two additional channels as determinants of overindebtedness outcomes.

Credit transactions can be characterized as a principal-agent relationship, where the lender (principal) disburses a loan to the borrower (agent) and the borrower promises to repay after some time. There are circumstances, however, under which the borrower may decide not to repay, even though she can repay. In this case, the borrower has the *ability* to repay but she does not have the *willingness* to repay.

The decision to strategically default depends on the difference between the net benefits of defaulting and the net benefits of repaying. This difference depends, among other things, on the costs of defaulting (loss of reputation, collateral, or future access to credit) and the gains of not repaying (keeping the principal of the loan plus interest). In turn, lending technologies cannot perfectly: (a) screen and separate opportunistic from non-opportunistic borrowers or (b) design contracts that either fully reduce the extent of the borrowers' opportunistic behavior or protect the lender from its consequences.

Finally, recession, macroeconomic instability, and other unexpected adverse systemic income shocks may either result in actual unpredicted reductions of the borrowers' repayment capacity, in honest miscalculations by the lenders of the borrowers' ability to repay, or both. The lending technologies of most MFIs are designed to address these unexpected outcomes when they are idiosyncratic, but there is much less that they can do when the shocks are systemic (Gonzalez-Vega, 2003a).

To engage fully in the productive activities that maximize their utility, households require sufficient command over resources. The returns to these activities are not certain, however, and unexpected adverse income shocks may result in bad realizations of returns. Under these circumstances, the regular household returns, or *ordinary repayment capacity*, may not be enough to repay the loan, and the household may have no other

choice than to default. Other households may decide, for example, to sell productive assets or engage in other costly activities in order to repay their current loans, thereby exercising their *extraordinary* repayment capacity, even though the sale of productive assets implies a reduction of their future income-generating capacity and access to credit.

1.4 The Problem

Why does overindebtedness occur? The basic question of the existence of overindebtedness matters because, in perfect markets with no frictions and without uncertainty, one should not observe overindebtedness. This general question has been studied somewhat in developed country environments and for traditional banks (Kempson, 2002; Baum and Schwartz, 2005).

This dissertation is concerned, however, with the existence of overindebtedness in other types of environments, such as those characteristic of developing countries and for the portfolios of MFIs. Credit relationships in developing country environments and between poor borrowers and MFIs are considerably different from credit relationships in developed countries or with traditional banks. Differences in environments may result in differences in borrower and lender outcomes that may exacerbate the problem.

Thus, this dissertation focuses on the overindebtedness problem in the portfolios of MFIs in developing countries. Lessons from these experiences, where the determinants of overindebtedness may be more salient, may be valuable, however, for understanding overindebtedness in alternative scenarios.

1.5 General and Specific Objectives

This dissertation has two general, closely related objectives. One is to identify the causes and consequences of overindebtedness among the clients of MFIs in developing countries. The other is to understand better the repayment process of borrowers of microfinance institutions during periods of distress.

The specific objectives are the following:

- To explain why overindebtedness occurs in these environments (that is, to identify the types and sources of overindebtedness) and provide a conceptual framework for the analysis.
- To identify particular features of developing countries and of MFIs that may increase the likelihood of overindebtedness or induce different outcomes from the lenders' and borrowers' behavior.
- To distinguish the effects of overindebtedness on borrowers, lenders, depositors, and the government/regulators.
- To empirically test for these relationships, using data from the overindebtedness episode in the financial system and for the borrowers of Bolivian MFIs.

1.6 Hypotheses

Overindebtedness may be due to any one of several different causes, such as the lenders' opportunistic behavior, the borrowers' opportunistic behavior, or unexpected

adverse shocks. In a particular episode, most likely overindebtedness is the result of the interaction of more than one of these causes.

Features of developing country environments that make overindebtedness more likely are small market size, a higher degree of economic instability, limited opportunities for diversification, high transaction costs, and incomplete institutional frameworks. Features of MFIs that may lead to overindebtedness are unclear or attenuated property rights structures in the organization, governance structures that lead to insufficient internal control, objective functions that differ from the maximization of expected profits, and non-traditional incentive schemes for all stakeholders.

Given these characteristics and the complications that they create, it is remarkable that, during this episode, MFIs experienced much smaller losses from arrears and default than banks and other financial intermediaries in Bolivia (Gonzalez-Vega and Villafani-Ibarnegaray, 2007). As will be shown below, however, these lower rates of arrears do not necessarily mean that there was not overindebtedness.

Finally, financial services (payments instruments, money transfers, loans, and deposit facilities) are important for households in developing countries, where credit constraints and imperfect financial and insurance markets are common. In these countries, financial transactions are important tools for consumption smoothing, but they are not available to all households (Gomez-Soto, 2007).

Then, depending on the value of credit relationships with different lenders, households might be willing to undertake costly and extraordinary actions in order to keep a valuable relationship and the reputation upon which it is based. From a social perspective, overindebtedness is particularly costly because it jeopardizes lender

performance, reduces household welfare and, in extreme circumstances, it may hurt depositors, regulators and/or taxpayers.

1.7 Contents

This dissertation contains eight additional chapters. The second chapter analyzes distinctions between low-income economies and developed countries and between MFIs and traditional banks, relevant for understanding the nature and extent of the problem. In particular, these distinctions matter in understanding differences in behavior and in contractual outcomes for microfinance borrowers and lenders in developing countries, in comparison to their equivalents in developed countries.

The third chapter defines overindebtedness. It considers three different situations as cases of overindebtedness. These situations reflect: (a) the borrowers' *pure unwillingness* to repay (because ability to repay does exist), (b) the borrowers' *costly ability* to repay, due to extraordinary actions, and (c) the borrowers' *unavoidable inability* to repay. Thus, the absence of overindebtedness is defined as a situation where there is willingness to repay and where the ability to repay is sufficient and not costly (beyond the initial contractual expectations).

The fourth chapter analyzes the complex relationships that emerge among lenders, borrowers, depositors, and regulators. Based on this analysis, this chapter identifies three possible causes of overindebtedness. They are: (a) the borrowers' opportunistic behavior, (b) the lenders' opportunistic behavior, and (c) unexpected adverse income shocks. This

chapter examines particular circumstances that contribute to either the borrowers' or the lenders' opportunistic behavior or both.

The fifth chapter discusses the reasons why Bolivia has been chosen for the empirical application of this dissertation. Among them are the fact that microfinance has been significant in Bolivia and that the microfinance sector experienced a clearly identifiable overindebtedness episode in the 1998-2002 period. Additionally, an extremely rich database is available for testing some of the hypotheses. The Rural Finance Program at The Ohio State University (OSU) compiled this database, with support from the Agency for International Development (USAID). Further, this chapter describes some of the most important events of the 1997-2001 period relevant for the analysis of the overindebtedness episode.

The sixth chapter reviews the literature on credit relationships, incentives to repay, and reputation. At the end of this chapter, there is a discussion of the three most important lending technologies used by MFIs.

The seventh chapter reviews in detail three theoretical models of special relevance for this dissertation. These models have been used to analyze issues like repayment when there are no contract enforcement institutions and lending to borrowers with different abilities to repay. At the end of this chapter, different elements of these models are combined into a general model, to illustrate the most important concepts related to incentives to repay and extraordinary repayment capacity.

The eighth chapter describes the survey of households, discusses the econometric strategy, and interprets the results. The ninth chapter presents the conclusions and policy implications of this dissertation.

1.8 Contributions

Based on different strands of the literature and on actual experience, this dissertation makes two main contributions. First, it builds a conceptual framework for the analysis of overindebtedness among microfinance borrowers in developing countries. This has been uncharted territory. It matters, because since the time of the overindebtedness episode in Bolivia, there have been reports of new episodes in other countries, including Bangladesh, Ecuador, India and Peru.

The second contribution is to establish a previously unidentified link between *extraordinary* repayment capacity and the high repayment rates observed among MFIs. In particular, this dissertation shows that the high repayment rates obtained by MFIs are explained not only by strong incentives to repay but also by the *extraordinary* repayment capacity of the borrowers, which allows them to accomplish this goal.

This result is important, because it suggests that one of the strengths of microfinance lending technologies is the ability to screen borrowers that have a high probability of success at generating not only ordinary repayment capacity but in particular *extraordinary* repayment capacity. Since this strength was indeed tested in Bolivia for periods with a high incidence of unexpected adverse shocks for the borrowers, it would be, *a fortiori*, a pillar for good repayment outcomes in situations where there is a lower incidence of unexpected adverse shocks.

The lives of poor borrowers in developing countries are plagued with frequent unexpected adverse events. Microfinance institutions have developed lending technologies that allow them to operate profitably in these environments, while at the

same time offering high quality services to their clients. This dissertation adds a critical piece to the explanation of this success.

The results of this dissertation are particularly relevant to the discussion of whether microfinance is an investable asset class into which investors can put their savings with a reasonable hope for a decent return (Gonzalez, 2007; Krauss and Walter, 2008; Lascelles, 2008).

CHAPTER 2

THE ENVIRONMENT FOR MICROFINANCE INSTITUTIONS IN DEVELOPING COUNTRIES

Environments in developing countries differ from developed country environments with respect to several dimensions. These differences are important in any attempt to understand the peculiarities of overindebtedness in developing countries. Moreover, microfinance institutions (MFIs) differ from traditional commercial banks. These differences are also important in understanding overindebtedness episodes involving MFIs. This chapter discusses these differences and their relationship to overindebtedness.

2.1 Fragmentation, Transaction Costs, and Market Failure

Microfinance is most frequently found in developing countries, where it responds to features of their markets and institutional structures. First, several markets do not exist, and many of the existing ones work imperfectly (Morduch, 1995). Information asymmetries, incentive incompatibilities, and limited mechanisms for contract enforcement may often result in market failure, because of adverse selection and moral

hazard (Conning and Udry, 2007). In numerous instances, the institutional infrastructure required for the smooth operation of markets is incomplete, and markets fail to emerge.

Second, different types of isolation increase transaction costs for both borrowers and lenders (Gonzalez-Vega, 2003b). Several dimensions of distance separate potential parties in a transaction: geographic, cultural, ethnic, and language barriers limit trade. In addition, the costs of the physical and technological inputs used in financial organizations are high in contrast to developed countries, where progress in telecommunications and information management tools has lowered these components of transaction costs. Thus, fragmentation and high transaction costs are characteristics of these economies.

The existence and performance of insurance and financial markets are of particular relevance for overindebtedness episodes. These two markets play an important role in facilitating household risk management. When they are missing, households have to adopt alternative risk-management strategies. In general, these strategies are limited to less efficient and more costly mechanisms than those available through financial and insurance markets (Gomez-Soto and Gonzalez-Vega, 2007b).

Moreover, because many households are credit-constrained, in poor economies the value of credit relationships is higher than in developed countries. When credit relationships are extremely valuable, households are willing to undertake costly and extraordinary actions in order to preserve them. Furthermore, if creating new relationships is costly, when households are not able to preserve an already established client relationship they incur in substantial losses and they may find it very costly to replace it.

Further, developing countries have incomplete institutional infrastructures. Property rights are not well defined or protected, mechanisms to facilitate transactions are expensive, and contracts are difficult to enforce (World Bank, 2005). The framework for prudential regulation and supervision is often weak. This may result in distorting restrictions, insufficient monitoring, or both which, instead of reducing overindebtedness, may exacerbate it. Finally, corruption and macroeconomic instability are common. These features, combined with inadequate regulatory frameworks, may increase the expectations of bailout that opportunistic lenders and borrowers may develop.

A number of behavioral responses often emerge to fill in the gaps left by market failure and by the missing institutional infrastructure (Morduch, 1995). Households implement alternative risk-management strategies, such as various forms of diversification, migration, and the development of social safety nets. Lenders must compensate for institutional gaps, for instance with the development of new lending technologies, while corruption and systemic instability exacerbate both the lenders' and the borrowers' imprudent and opportunistic behavior.

2.2 Peculiarities of Microfinance Institutions

Microfinance institutions differ from traditional banks. The most important differences relate to the efficacy of lending technologies in marginal market segments, the structure of property rights in the organization, and the incentive structures for all stakeholders.

As organizations, MFIs are more complex than banks owned by profit-maximizing shareholders. Some MFIs are owned by donors or by groups of donors, such as some of the international development banks, or are owned by altruistic groups, such as churches and other non-government organizations (NGOs). Donors and private profit-seeking investors jointly own others. Different donors may have different objective functions.

The specific behavior and performance of each MFI depend on its particular property rights and governance structure. Some MFIs behave like profit-maximizers. Others are organized around more complex objective functions, which combine goals such as increasing outreach toward particular clienteles and the sustainability of the organization (Hartarska, 2002). Complex objective functions result in different structures of incentives for each MFI, while attenuated ownership increases the likelihood of the opportunistic behavior of some of the actors involved in the organization.

Similar to banks, MFIs have to determine the creditworthiness of potential borrowers and have to design incentive-compatible contracts to encourage repayment. However, microfinance clienteles differ from bank clienteles, and these differences require that MFIs implement other types of lending technologies and design alternative loan contracts.

These differences must be recognized in order to understand better the connection between overindebtedness and its determinants, such as increased competition, the introduction of new, alternative lending technologies (as was the case with the emergence of consumer credit in Bolivia), and the overlapping of the clienteles of MFIs and

consumer lenders. The available institutional infrastructure, including mechanisms for information sharing, shapes the consequences of competition (Pearson, 2008).

In contrast both to traditional bank lending technologies, which rely on collateral, and consumption credit technologies, which rely mainly on credit scoring and stable employment, microfinance is mostly about trust and reputation. Credit relationships are extremely valuable for microfinance clients, who typically are self-employed. There are two main reasons for the loyalty of these clients. First, credit relationships are important for household welfare, in particular for consumption smoothing and for taking advantage of unexploited productive opportunities. Second, credit relationships are costly to replace, and this difficulty increases the value of any existing relationship.

Microfinance institutions take advantage of these two motivations as an additional dimension of an incentive-compatible contract and, sometimes, as the most important determinant of repayment. In this sense, MFIs often insist with their clients that repayment on time will guarantee future access to loans. Further, lenders insist that arrears or default not only will force them to reject any future credit application, but that this behavior may also prevent delinquent borrowers from creating new credit relationships with other lenders. While these considerations also matter in developed country financial markets, they are in great contrast with the tradition of state-owned development banks and similar credit programs in developing countries.

When the value of borrower-lender relationships provides strong incentives for the clients of MFIs, a particular culture of repayment emerges. On-schedule repayment becomes a requirement for new loan contracts, granted under better conditions (interest rates, terms to maturity, frequency of payments), and only under extreme circumstances

are repayment delays permitted. Within this culture, the rescheduling of loans can be justified only in exceptional cases.

In contrast, traditional lending technologies mostly rely on collateral for creating incentive-compatible contracts and, in order to influence repayment, they threaten clients with foreclosing and the seizing of collateral. In the absence of contract enforcement institutions in developing countries, this threat may not be credible, because the probability of collateral being seized or the contract being enforced is very low and the exercise, particularly if the loan amount is small, is very costly. Moreover, given a high covariance of outcomes in local markets, there may be few mechanisms to diversify away from systemic risk.

Given the value of long-term credit relationships, MFIs disburse loans based on the acceptance of non-traditional assets, including intangible assets, as collateral or collateral substitutes. These alternative tools to encourage loan repayment include various types of group joint-liability contracts, compulsory savings that are accumulated into a common repayment fund, informal pledges of unregistered personal property (*e.g.*, TVs, radios, machinery) that cannot be enforced in courts, or documents left in custody with the MFI. Usually, after considering transaction and liquidity costs, the auction value of non-traditional assets pledged as collateral is lower for the MFI than the amount of the debt due. However, for the borrower, the value (in use) or the cost of replacement of the asset is higher than the value of not repaying the debt (Navajas and Gonzalez-Vega, 2003). Collateral substitutes thus work as incentive-compatible mechanisms.

Finally, when lenders share information about the borrowers through a credit bureau, default has a reputation cost, which reduces future access to credit from all the

sources that have access to the information (Luoto, McIntosh and Wydick, 2005). In these circumstances, the costs of defaulting for the household are higher than when lenders do not share information. The evolution of these information-sharing arrangements influences overindebtedness in developing countries. Moreover, default may induce losses of reputation in the community that can be quite costly (Beasley and Coate, 1995).

Two of the problems that lenders face in developing countries are that credit bureaus keep track only of particular segments of credit markets and that tarnished reputations do not induce the same behavior from all types of lenders. The partial data possessed by credit bureaus creates the possibility for borrowers with a bad record with a given lender to receive a new loan from another type of lender. This possibility exists: (a) because it is difficult for lenders in the new sector to assess the reputation type of the applicant or (b) because the alternative lender is not sufficiently interested in collecting all loans, as may be the case with some MFIs not interested in sustainability.

Moreover, borrowers may incur larger amounts of debt than a given lender may be aware of, including those cases when they actually borrow from other sources to repay current loans. When this happens, lenders that rely on the timeliness of frequent repayments for monitoring the borrowers' performance can no longer infer that repayment problems do not exist, by simply observing the periodic repayment behavior of their clients. Lack of shared information in turn increases the market power of lenders over those borrowers with a good reputation, who cannot communicate their true type to other lenders, in order to obtain better contracts. In this sense, reputation is not fully portable (Banerjee, 2007).

The different institutional environment and client characteristics faced by MFIs in developing countries requires the adoption of lending technologies different from those used by banks, tailored to these conditions. In the past three decades, MFIs have successfully developed new lending technologies to address these challenges. Systemic adverse shocks still represent, however, a formidable difficulty for them. In the case of Bolivia, the *extraordinary* repayment capacity of MFI borrowers and the ability of MFIs to indentify and induce extraordinary willingness and ability to repay allowed these organizations to overcome this challenge

CHAPTER 3

DEFINING OVERINDEBTEDNESS

A precise definition of overindebtedness is not available in the literature. In the British context, for example, the definition of overindebtedness has been based on measures of the extent of current financial difficulties, including arrears. These measures have used fixed thresholds on the ratios of debt service to income (Kempson, 2002). In Germany, overindebtedness has been defined as the inability of households to repay all debts fully and on time (Haas, 2006).

This dissertation identifies three different situations considered here as overindebtedness. One situation occurs when the borrower is not willing to repay the loan, even if she has the ability to do so, and default occurs. Another situation occurs when the borrower has to undertake costly extraordinary actions in order to repay the loan, beyond those anticipated at the time when agreement for the transaction was completed. The last situation occurs when the borrower is willing to repay the loan, but he does not have the ability to do so in full and when agreed, and arrears, partial repayment, or full default are observed.

In general, *overindebtedness* occurs when the repayment outcome of a loan contract does not correspond to the original expectations of either the borrower or the lender or both. As defined here, overindebtedness is the emergence of payments difficulties that may result from unwillingness to repay, complete or partial inability to repay, or costly actions for the borrower in order to repay. In contrast, any credit relationship characterized by willingness to repay and ability to repay without exceptional cost implies the absence of overindebtedness.

Exceptional cost is an effort or an outcome for the borrower beyond what had been planned at the time when the contract was agreed upon, which allows the household to generate *extraordinary* repayment capacity.

Moreover, default is not a necessary condition for overindebtedness (it is only a special case of it), and observed actual repayment is not a sufficient condition for the absence of overindebtedness. Figure 3.1 illustrates these situations, and they are discussed in the following chapters.

3.1 Unwillingness to Repay

Credit relationships are valuable to borrowers. The value of a credit relationship depends, among other things, on how costly it would be to replace it, on the long-term horizon of the relationship, and on the value of the future transactions that the household may undertake with a particular lender. The household expects to preserve these benefits when protecting a credit relationship.

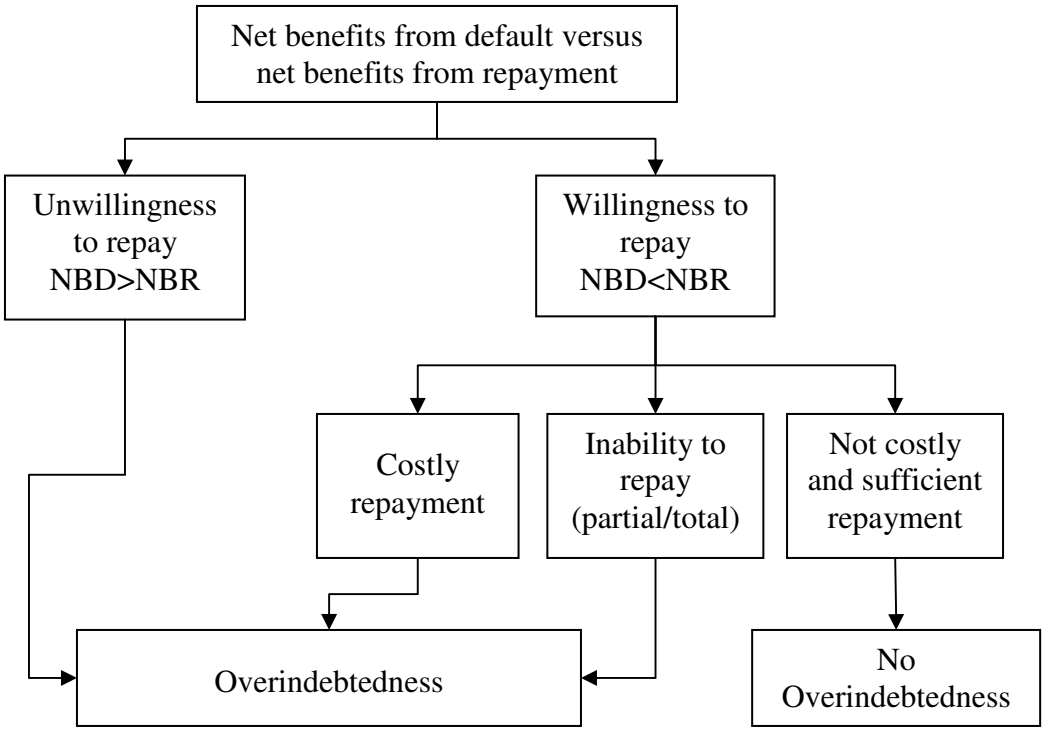


Figure 3.1: General Overindebtedness Situations.

Default has negative consequences on the household, such as the loss of future relationship benefits, loss of assets pledged as collateral, and the penalties from bad reputation. However, if the household defaults, it keeps the unpaid principal of the loan and any interest due. Thus, in order to decide if the protection of a credit relationship is optimal, rational utility-maximizing households will compare the net benefit of defaulting with the net benefit of repaying. If the former is lower than the latter, the household will try to preserve the credit relationship. If not, the household will default.

Moreover, the balance between the costs and benefits of default and the incentives to repay influence other borrower decisions. If the credit relationship is valuable, borrowers will behave more prudently in their production efforts (they will use more caution and diligence) than when they are engaged in less valuable relationships. They will also demand smaller loans, in order to increase the probability of repayment.

Lending technologies assess household and business characteristics and use this information to design incentive-compatible contracts. Inadequate contracts result in unwillingness to repay. Attractive terms and conditions make a contract more valuable and increase the borrower's willingness to repay.

Several elements of the lending technology influence this decision. For example, more demanding collateral requirements increase the cost of default and reduce the borrowers' opportunistic behavior. Reputation penalties also increase the cost of default. Loan size, term to maturity, the interest rate charged and the accompanying transaction costs influence the costs and benefits of default. The present value of the relationship depends on the overall quality of the services provided by the intermediary and on the set

of opportunities available to the borrower in the future, among other variables (Rodriguez-Meza, 2001).

Up to this point, unwillingness to repay may occur because the lending technology is not successful in designing attractive loan contracts, given the borrowers' characteristics, or because the lender is not successful in *signaling* its commitment to enforcing contracts and to sustainability, thereby shortening the expected horizon of the relationship.

In addition, exogenous events may result in *ex post* unwillingness to repay even though, *ex ante*, there is willingness to repay. Two possible examples are: (a) greater competition in financial markets with incomplete institutions (Navajas, Conning and Gonzalez-Vega, 2003; McIntosh and Wydick, 2005), and (b) unexpected adverse income shocks.

Competition reduces the value of lending relationships with incumbent lenders and thereby reduces willingness to repay. Unexpected adverse shocks may also reduce willingness to repay. Shocks may reduce the value of collateral, such as when there is a drop in real estate prices, thereby encouraging moral hazard, or permanent shocks may reduce the net present value of a stream of loans in the future and therefore the value of the credit relationship. In the Bolivian microfinance sector, competition substantially increased just before a succession of major adverse systemic shocks. Increased competition and a recession jointly decreased the value of credit relationships.

Households unwilling to repay are classified here, according to their ability to repay, into three groups: those with full ability to repay, those with partial ability to repay, and those without any ability to repay. This distinction is important because the

absence of overindebtedness depends on both willingness and ability to repay. In order to avoid the overindebtedness of the first group, it would only be necessary to change their willingness to repay. For the other two groups, however, changes in their willingness to repay are not sufficient to prevent overindebtedness because, even if they were willing to repay, they would not have the ability to do so. This argument ignores the possibility that a higher cost of default may induce borrowers to be more prudent and to take smaller loans, for which the ability to repay is preserved. In this case, there is a strong ex ante willingness to repay as well.

3.2 Costly Ability to Repay

There are situations when borrowers repay the loan but when, in order to do so, they have to undertake extraordinary costly actions. Because credit relationships are valuable, in order to repay households in developing countries are willing to work additional hours, reduce their consumption, sell assets (productive assets or those simply held as precautionary reserves), or reduce human capital investments, beyond their expectations at the time when they engaged in the loan contract. Under certainty about the need of the costly actions needed to make repayment possible, the household might not have engaged in the current credit contract.

These actions are costly for the household because they imply less leisure, less consumption, less access to credit and a lower income-generating capacity in the future, less educated children and, generally, less household welfare. Under these circumstances, the household is successful in repaying the loan and default does not

occur. However, in order to avoid default, the household must undertake costly actions that might not have been necessary if a different loan contract would have been designed.

3.3 Inability to Repay

Finally, there is inability to repay when a borrower, even if she has willingness to repay, cannot repay. In this case, the loan principal plus interest L(1+r) is greater than the total repayment capacity of the household. As in the previous cases, inability to repay and overindebtedness might have not emerged if the loan contract would have been different.

Some of the dimensions of the loan contract that may result in greater ability to repay are lower interest rates, smaller loan sizes, repayment schedules better adjusted to the borrower's cash flows, longer terms to maturity and, in general, lower lender expectations about the borrowers' repayment capacity. Borrowers with access to several types of lenders may or may not be less likely to have repayment problems. While short-term access to informal lenders may allow a household to keep current in its payments with a formal lender (Gonzalez-Vega and Maldonado, 2008), a multiplicity of loans from lenders who are not aware of these multiple commitments and their amount may increase overindebtedness.

CHAPTER 4

CAUSES AND CONSEQUENCES OF OVERINDEBTEDNESS

Different types of actors interact in credit markets: borrowers, lenders, regulators, and depositors. Achievement of the goals implied by their respective objective functions is affected by the actions taken by others. What is good for one actor may be bad for another one, and their objective functions may not always be compatible. Thus, in order to define overindebtedness and to examine its consequences, it is necessary to identify the objective functions of these actors and to examine their behavior under the existing structures of incentives.

4.1 Actors and Interactions

Financial markets result from the interaction of several types of actors: borrowers, depositors, lenders, and regulators. Each type of actor pursues a different objective function. Most MFIs are profit maximizers, while borrowers and depositors are utility maximizers. Regulators ostensibly protect depositors and taxpayers. In Bolivia, prudential regulation and supervision are the responsibility of the Superintendence of Banks and Financial Entities (SBEF).

It is possible to identify additional actors, but they will be ignored here in order to keep the analysis simple. For example, MFIs involve owners, managers, and loan officers. Thus, property rights and incentive-compatible governance structures play a decisive role in ultimately determining their performance (Chaves, 1994). In turn, regulators are agents of the government, which, itself, is an agent of the people. Each one of these actors may choose to behave opportunistically. The analysis will focus, however, on the opportunistic behavior of borrower and lenders.

4.2 The Lender's Opportunistic Behavior

Overindebtedness may result from the opportunistic behavior of lenders. This behavior may have negative consequences for other (non-opportunistic) lenders, depositors-regulator, and the borrowers themselves.

Depositors (principals) trust banks (agents) with their savings. Banks may have, however, incentives to invest in too risky a portfolio of loans because, in the case of failure, their high leverage and limited liability allow them to transfer most of the losses to depositors (Chaves and Gonzalez-Vega, 1994). In the case of success, nevertheless, the banks keep most of the earnings, because the interest rate paid on deposits is fixed. Alternatively, if deposit insurance exists, or if the lenders' subjective beliefs indicate that the authorities will intervene, any losses will be transferred to the insurer or the taxpayers.

If new credit relationships are costly to establish, borrowers who are not overindebted may also incur costs when banks fail. Access to credit markets matters for

consumption smoothing. Research has found that the inability to smooth consumption deteriorates child health, especially for girls, in South Indian households (Behrman and Deolalikar, 1987). The survival rate of girls relative to boys increases when there are positive shocks during the early years of their lives. For Bangladeshi households, body size suffers notably after major flooding (Foster, 1995). Finally, South Indian households often take children out of school in response to adverse income shocks (Jacoby and Skoufias, 1997). Maldonado, Gonzalez-Vega and Romero (2003) found that access to microfinance reduces these effects of shocks in Bolivia.

Several circumstances induce lenders to behave opportunistically. The value of bank charters declines when increasing competition erodes expected monopoly rents or when changes in the environment, such as a recession or other systemic shocks, reduce expected future profits.

Opportunistic behavior also increases if there are expectations of bailout or a weak or inefficient framework of prudential regulation and supervision, which does not sufficiently constrain this behavior. In a general study about subprime lending, Ioannidou, Ongena and Peydró (2007) analyze the case of opportunistic traditional banks in Bolivia, based on information from the public credit bureau located at the SBEF. However, they do not analyze regulated MFIs as a separate category. Jimenez, Ongena, and Peydro-Alcalde (2008) do a similar analysis for Spanish banks. Both papers offer good literature reviews.

4.2.1 Prudential Regulation and Supervision

Prudential regulation and supervision attempt to protect banking systems from the risky behavior of deposit-taking organizations. Traditionally, regulation has included the establishment of compatible incentives for prudent portfolio management (such as capital adequacy requirements), regulations concerning inside loans, rules on reserves and loan loss provisions, and entry restrictions, while supervision has been in charge of monitoring portfolio quality (McKinnon, 1989; Kane, 1989; Dewatripont and Tirole, 1994).

Since the 1990s, three major changes in prudential regulation and supervision have occurred (Hellmann, Murdock, and Stiglitz, 2000). First, there has been greater emphasis on monitoring the banks' risk-management systems and less emphasis on monitoring individual transactions. Second, interest rates have been deregulated and restrictions on the asset choices of banks have been lifted. Third, greater emphasis has been place on capital adequacy requirements, following the standards of the Basle Accord. These authors argue that financial crises have become more frequent as these changes in prudential regulation and, in particular, the liberalization of interest rates has occurred. However, many others do not share their opinion and this dissertation is not the place to resolve this controversy (Demirgüç-Kunt and Detragiache, 1998).

Several researchers have suggested, however, that moral hazard plays an important role in explaining these failures. One example is *gambling on resurrection*, where banks already in difficulties choose a risky asset portfolio that pays out high profits or bonuses if the gamble succeeds but leaves depositors, or their insurers, with the losses if the gamble fails (Kane, 1989; Cole, Mackenzie and White, 1995).

Others have elaborated further on moral hazard, arguing that banks may use fraudulent practices, such as insider lending, to "loot" the banks (Akerlof and Romer, 1993). In this case, bank managers extract value from the bank, even if this leads to insolvency. In contrast, when gambling on resurrection, when the outcome is insolvency bank managers cannot extract any value from their actions.

When the regulatory framework is weak, inadequate regulation may exacerbate these problems instead of reducing them. This may be the case in developing countries, where regulatory frameworks are not efficient and it is often difficult to penalize fraud or incompetence.

4.2.2 Deposit Insurance and Expectations of Bailout

Deposit insurance may be a source of moral hazard, as it reduces the incentives for depositors to monitor banks and lowers the concerns of bankers to manage their loan portfolios cautiously (Kane, 1989). However, some have argued that it makes little difference whether countries have a formal system of deposit insurance since, in the event of a financial crisis, there will always be a bailout. As one comment remarks "there are two kinds of countries: those that have deposit insurance, and those that don't yet know that they have it" (Hellmann, Murdock and Stiglitz, 2000: 148). McKinnon (1989) shares a similar idea: "individual savers perceive that the government is responsible for the safety of the financial (monetary) assets they own, whether or not there is some formal deposit insurance in place" (p. 101).

Either explicit or implicit, both deposit insurance and expectations of bailout increase the opportunistic behavior of financial intermediaries and may contribute to overindebtedness. There is no deposit insurance in Bolivia, but regulated financial intermediaries, particularly the banks, have held such expectations, given numerous instances of bailout. These expectations do not necessarily carry over to MFIs, which may not qualify for the "too large to fail" rule and which do not have the political connections that banks enjoy.

Several types of circumstances may increase expectations of bailout. These expectations are more likely when political attention focuses on the financial sector. For instance, when governments announce programs to save banks, these organizations are likely to behave even more opportunistically. Expectations of bailout may also influence the opportunistic behavior of borrowers. This may have been the case in Bolivia, with the creation of debtor associations and announcements of legislated debt forgiveness.

4.2.3 Financial Liberalization

Recent empirical studies have suggested that the significant interest rate increases associated with financial liberalization in the 1990s coincided with a greater incidence of financial crises. These authors also find, however, that financial crises have been as frequent in countries that have not liberalized as in countries that have gone through liberalization (Demirgüç-Kunt and Detragiache, 1998). Moreover, crises are more likely when the legal system is weak, the bureaucracy is inefficient, difficulties to enforce contracts are hard to overcome, and corruption is widespread.

4.2.4 Competition

Hellmann, Murdock and Stiglitz (2000) argue that "financial market liberalization increases competition; competition erodes profits; lower profits imply lower franchise values (*i.e.*, the capitalized value of expected future profits); and lower franchise values lower incentives for making good loans, increasing the moral-hazard problem" (p. 148). According to these authors, in the presence of competition, banks may gamble more often. If banks are required to hold sufficient equity capital, they have to internalize the consequences of gambling, thereby increasing the likelihood that banks will chose to lend prudently.

While the implementation of minimum capital requirements, adjusted for risk, can thus reduce moral hazard, these requirements sometimes must be set at inefficiently high levels in order to achieve this purpose. In particular, banks may have incentives to compete by offering high interest rates on deposits, which translate into high loan rates, which may accentuate adverse selection problems. Therefore, it may not be possible to implement any Pareto-efficient reduction of moral hazard when capital requirements are the only tool of prudential regulation and interest rates are liberalized.

There is much debate in the literature about the right combination of regulation tools that would be appropriate in different environments. In the case of Bolivia, increased competition resulted in declining interest rates, which makes adverse selection effects a la Stiglitz and Weiss (1981) unlikely (Villafani-Ibarnegaray and Gonzalez-Vega, 2007). As examined next, competition does influence the behavior of both borrowers and lenders in ways that may lead to overindebtedness. Moreover, the value of bank charters

declined with the recession, although this was not likely the case for MFIs, which continued to grow over this period (Gonzalez-Vega and Villafani-Ibarnegaray, 2007). What the appropriate regulatory framework should be also depends on the extent of competition and the evolution of macroeconomic conditions. Worldwide, a recent survey of microfinance practitioners, analysts, investors, and observers found that competition was the seventh more important risk for MFIs and the fastest rising, at the same time (Lascelles, 2008).

4.2.5 Competition and Recession

In effect, either an increase in competition or a recession reduce the net present value of the franchise of a financial intermediary and may induce some opportunistic behavior. This behavior may take several forms, including a loosening of creditworthiness requirements and the possibility that loan sizes may increase beyond those suggested by the original lending technology. Lenders attempt to retain good borrowers by granting larger loans and competitors attempt to attract them by offering even larger loans or lending despite the existing debt levels of applicants. If lenders do not share information about debt levels, overindebtedness may follow.

Macroeconomic instability further induces lenders to behave opportunistically, because their expectations of bailout will increase the more systemic the adverse shocks are (McKinnon, 1989). Furthermore, lenders and borrowers may argue that since "the financial crisis was caused by the economic recession, and the economic recession was caused by the government," the government has an obligation to bail them out.

4.3 The Borrower's Opportunistic Behavior

The borrowers' opportunistic behavior can cause overindebtedness. There are circumstances when borrowers are not prudent, take actions against bank profits, or simply prefer to default. With limited liability and weak mechanisms for contract enforcement or without reputation effects, dishonest borrowers will default every time there is a private benefit to do so. The information asymmetry and incentive incompatibility problems that make opportunistic behavior possible have been widely studied in the literature (Stiglitz and Weiss, 1981; Varian, 1992).

Many circumstances may thus induce borrowers to behave opportunistically. These include greater competition among lenders, particularly if the lenders do not share information about their clients, a recession and other unexpected adverse income shocks, and expectations of debt forgiveness, as already discussed.

4.4 Unexpected Adverse Income Shocks (Nature)

Overindebtedness may be either lender-originated, borrower-originated, or both. In addition, overindebtedness may be nature-originated. This is the case when unexpected states of nature reduce the borrower's ability to repay, even if neither the borrower nor the lender behave opportunistically, as households in developing countries must cope both with severe poverty and extremely variable incomes (Glewwe and Hall, 1998; Bardhan and Udry, 1999).

From a borrower's perspective, the purpose of a loan is to increase her household's utility, independently of the specific use of the funds (consumption smoothing, purchase of productive assets or inputs, or repayment of previous loans, for example). Borrowers apply for loans because their expected utility with loans is greater than their expected utility without loans. Under uncertainty, borrower and lender choose loan contracts based on their best imperfect information about the future state of nature and, therefore, about the borrower's repayment capacity. Ex post, after the uncertainty about the actual state of nature has been resolved, unfavorable *forecast errors* (differences between expected and actual states of nature) may result in a lower repayment capacity than was expected at contract time.

Faced with adverse shocks, it is likely that borrowers will experience repayment difficulties, given their budget constraints and limited wealth. These problems may result in default or in situations where, in order to repay, there will be lower levels of household leisure, consumption, holdings of productive assets and precautionary reserves, or human capital investment, or where there will be a loss of the assets that had been pledged as collateral. Further, several of these outcomes may reduce the household's future demand of financial services or its future ability to demonstrate creditworthiness.

Once the state of nature is known, households revise their optimal, *ex ante*, plans by incorporating the newly available information. In other words, based on the new information, households engage in a new optimization process, reallocating resources across available alternatives and revising their consumption choices. These actions are not costless, however. Furthermore, resource reallocations may not be feasible if irreversibilities and indivisibilities exist, as is the case with specific or illiquid assets.

The revisions may include reallocations of labor between the household's own productive activities and the labor market. The household may stop producing certain goods and services and may switch to new activities. Current consumption levels (including leisure) may decline.

The specific new resource allocation depends, among other variables, on the particular impact of the shock and on the new expectations about the future, including those about the persistence of the shock. If the shock is permanent, the household may need to abandon the productive activities directly affected by it. However, if the shock is transitory, the household may resume those activities once the shock is over. Moreover, this distinction will influence savings behavior, depending on the changes in permanent income or in transitory income (Deaton, 1990).

In very bad instances, the household may not be able to adjust income flows sufficiently. Then, other dimensions of the household's endeavors will have to be adjusted. In some instances, the household may decide to use child labor as a factor of production or it may not be able to afford the costs of sending children to school anymore, thereby interrupting the process of human capital formation (Maldonado and Gonzalez-Vega, 2008). In other cases, sales of productive assets may be necessary, thereby reducing future income-generating capacity and access to credit. In many cases, the household may not be able to repay the loan at all.

In summary, overindebtedness caused by inability to repay directly reduces the lender's profits through its incidence on losses from arrears and default. Future lender profits may also decline even when the household repays after undertaking costly extraordinary actions, because of the associated reduction in the size or the quality of the

future pool of clients. After incorporating the consequences of the shock, some households may be afraid to engage in new credit transactions, and others may not need them anymore because their productive opportunities have disappeared. In addition, some households will not be able to apply for new loans because they have lost their collateral or because the bad reputation effects originated by the earlier overindebtedness would have reduced their creditworthiness.

Among all of these determinants, this dissertation focuses on competition and recession, the borrower's opportunistic behavior, unexpected adverse income shocks, and the lenders' opportunistic behavior.

CHAPTER 5

BOLIVIA

This dissertation focuses on overindebtedness in Bolivia. There are several reasons for this. One is that microfinance is important in Bolivia. In comparison to other countries, relatively large portfolios and numbers of clients characterize the sector (Gonzalez and Rosenberg, 2006). MFIs have become a substantial component of the financial system, holding over 20 percent of the assets of the regulated financial intermediaries and reaching close to 70 percent of all clients of financial institutions in this country (Gonzalez-Vega and Villafani-Ibarnegaray, 2007). The performance of Bolivian MFIs in the mobilization of deposits, even during periods of political instability and runs on deposits has been outstanding, as well. The quality of their services to depositors has been identified as a source of client loyalty and as an explanation of the lower volatility of deposits at MFIs compared to other intermediaries (Gomez-Soto and Gonzalez-Vega, 2007a).

For the rapid pace of innovation and the success of its regulatory framework, Bolivia has been the learning ground for many microfinance practitioners from around the world, and some of the most important microfinance networks, like ACCION

International, Freedom from Hunger, PROCREDIT, and Pro Mujer, in addition to some outstanding locally grounded programs, like FIE, were operating in the country in the 1997-2001 period.

In addition, a significant overindebtedness episode took place in Bolivia. The fact that this episode lasted several years has important implications. Since households and financial intermediaries prepare for these adverse events by holding reserves, which are costly, lenders and borrowers may not have held sufficient reserves for a multi-year overindebtedness episode. Their reserves might have been depleted early in the episode, leaving them vulnerable to additional shocks.

Actually, overindebtedness had multiple and cumulative causes. This makes the analysis extremely rich and, at the same time, complex. This chapter describes relevant circumstances for the 1997-2001 period, which corresponds to the time frame for the information in the household survey used for the empirical analysis.

In effect, the Rural Finance Program at The Ohio State University collected an extremely rich database through a household survey, which contains detailed information relevant for the study of overindebtedness and the empirical test of the hypotheses of this dissertation. This database is described below.

5.1 Increased Competition

Many types of lenders have competed in the Bolivian microfinance sector, each one of them using different lending technologies. The actual market segment where lenders operate is a function of their lending technology. Expansions into other segments

cannot be implemented without the development of innovations suited to the new clienteles (Navajas, Conning, and Gonzalez-Vega, 2003). Otherwise, overindebtedness follows and the quality of loan portfolios declines.

Although competition increased with the entry of consumer lenders, it had grown even before the consumer credit organizations entered the market. By 1996, a little less than a decade since the creation of the first microfinance program, there were almost a quarter million clients of microfinance institutions in Bolivia. These numbers reached almost half-a-million by 1999, and over 400 thousand clients had loans by the end of 2003. By now, this number is approaching 800 thousand (Gonzalez-Vega and Villafani-Ibarnegaray, 2007).

Competition, the recession, and reductions in market size motivated many lenders to compete in similar market segments. Numerous clients received multiple offers from several lenders, and one of the new ways to compete was through a relaxation of creditworthiness requirements. The probability that actual lending would go beyond repayment ability and, thereby, the chances of default increased (Drake and Rhyne, 2002). Households combined loans from several regulated lenders or from regulated and unregulated lenders.

5.2 Recession

The 1998-2001 period was characterized by slow GDP growth and declining per capita GDP (Figure 5.1). Urban unemployment was high, and the rates of domestic

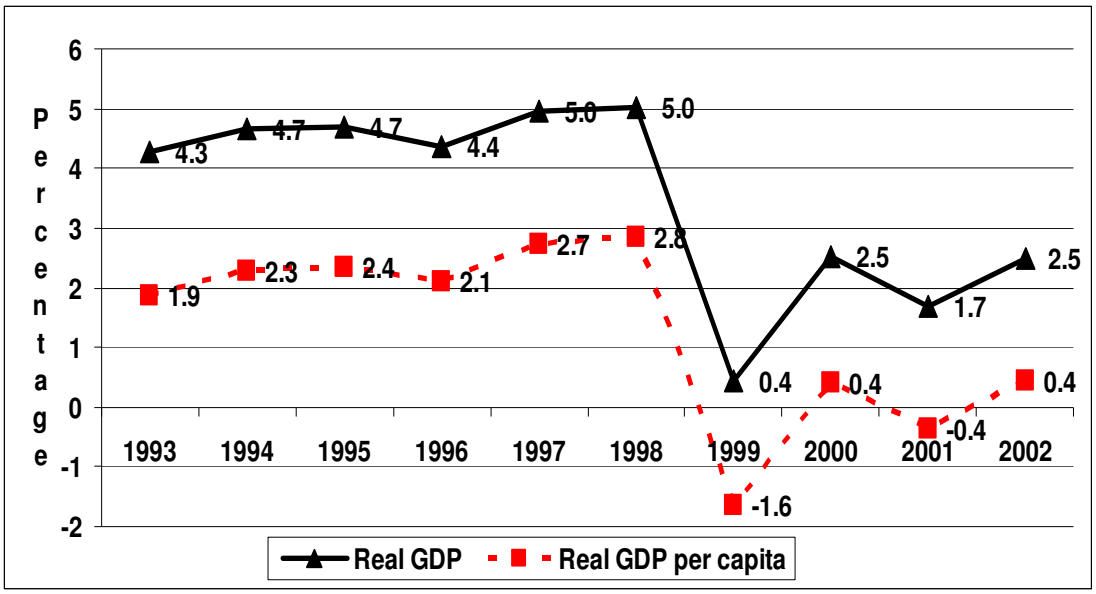
investment low. A recession reduces market size and increases incentives for financial intermediaries and their clients to behave opportunistically.

5.3 Idiosyncratic and Systemic Shocks

The recession (a systemic shock) does not affect all households the same way. Moreover, the recession is not the only adverse shock that may reduce a household's repayment capacity or affect its valuation of a credit relationship. For the 1997-2001 period, 86 percent of the 959 households in the sample analyzed in this dissertation reported to have experienced at least one adverse shock.[1] In 2001, this proportion was 73 percent. Among all the households that experienced shocks during 2001, a drop in sales of more than 25 percent was the most common shock (77 percent of the cases), followed by unemployment for at least two weeks (19 percent), and a productive activity that became unprofitable (13 percent).

Finally, for all the loans received by these households in the 1997-2001 period, in only 24 percent of the cases the household had enough resources to repay the loan without having to undertake costly actions. Actually, in most of the cases, the households had to work more than their ordinary schedule, in order to repay (66 percent). It was also common to repay using financial savings (47 percent) and with remittances specially sent for that purpose (29 percent). In some cases, it was necessary to sell productive assets (23 percent) and, occasionally, to get a new loan in order to repay another one (10 percent).

[1] All sample related issues are discussed in chapter 8. See Gonzalez and Gonzalez-Vega (2003) for additional results, and a detailed description of the sample.



Source: World Development Indicators, Online Version, updated on April 2008.

Figure 5.1.

Bolivia: Annual Rates of Growth of Total and Per Capita Real GDP

Deterioration of the Culture of Repayment

Before the emergence of consumer credit, MFIs never allowed any arrears without discontinuing the relationship, and loan rescheduling was not common. One of the most important changes introduced by consumer lenders in this market was the implicit option for rescheduling that was included in most of the loan contracts. Moreover, arrears were profitable for consumer lenders, because of the additional fees that they charged. Microfinance clients became confused about the nature of their contractual obligations. Some borrowers might have felt that the repayment discipline had become less strict.

Some of the households in repayment trouble were honest non-opportunistic households, while others were opportunistic borrowers who had applied for loans with only a low expectation that repayment would occur. As all types of borrowers (opportunistic and non-opportunistic) started to experience repayment problems, the borrowers organized themselves into debtor associations, whose goal was to release debtors from their financial obligations with MFIs. The actions of these organizations induced additional borrowers to behave opportunistically.

CHAPTER 6

CREDIT RELATIONSHIPS, INCENTIVES TO REPAY, AND REPUTATION

The literature on the theoretical aspects of the behavior of financial intermediaries (FIs) is extremely rich. Researchers have worked on areas such as the functions of FIs, the reasons for their existence, competition, asymmetric information problems and contract design, equilibrium and credit rationing, the welfare effects of financial systems, risk management, and prudential regulation and supervision (Freixas and Rochet, 1997). This chapter focuses on the literature related to borrower-lender relationships, incentives to repay, reputation effects, and the lending technologies used by microfinance institutions.

6.1 Credit Relationships

Fried and Howitt (1980) claimed that credit rationing exists as part of an equilibrium risk-sharing arrangement between a bank and its customers. According to these authors, a borrower and a lender can benefit not only from loan contracts now but also from an "understanding" or "implicit contract" concerning future loan contracts. Specifically, Fried and Howitt assume that there are two types of borrowers: old

borrowers (with long-established relationships with the bank) and new borrowers. From the bank's perspective, the only difference between the two types is that lending to an old customer is less costly than lending to a new one.

First, there are some economies in administering loans to old customers (because they already have an account with the particular bank). Second, the screening of customers to ensure that they are a "good risk" is facilitated by the existence of a relationship. Credit relationships emerge between banks and borrowers as a beneficial agreement, where both parties share the risks associated with an uncertain cost of funds. In this agreement, the interest rate charged by the bank is fixed, thereby protecting both parties from unexpected changes in rates. To deal with credit risk in the resulting pooling equilibrium, the bank engages in credit rationing.

Sharpe (1990) derives a theory of "customer relationships" in bank loan markets, based on a traditional view of bank lending behavior. From this view, an essential factor underlying a bank's loan pricing policy is its impact on the bank's stock of loyal customers as well as on those customers' deposits. In this model, customer relationships arise endogenously because of "inside information" generated by the history of bank-firm interactions. Sharpe focuses on the fact that banks that actually lend to a firm learn more about that borrower's characteristics than other banks. This private information creates temporary monopoly power. Thus, firms stay with the same bank not simply because the bank treats them well but because high-quality firms are informationally captured, as they will find it harder to convey information about their superior performance to other banks.

6.2 Incentives to Repay

In Jaffee and Russell (1976), borrowers have exogenously specified, unobservable, fixed costs of default that differ across individuals, and borrowers default if these costs are less than the expected repayment. According to Allen (1983), one limitation of this model is the exogeneity of the costs of default. In modern capital markets, however, penalties for default are imposed by the market itself, such that borrowers who do not make payments on their loans are excluded from the market.

Eaton and Gersovitz (1981) develop a model with endogenous default costs in the context of international credit markets, where countries borrow to smooth consumption. They assume that default leads to an embargo on future borrowing, so that defaulting cost depends on the penalty of not being able to smooth consumption. One of their arguments is that even without legal or coercive methods of enforcing repayment, lenders can take retaliatory actions to penalize defaulting borrowers; in particular, they can resort to exclusion from future borrowing. Additionally, these authors emphasize that the threat of future exclusion from credit markets will not deter a country from defaulting if it plans to borrow on an uninterrupted basis for a period, with no further intention of borrowing thereafter.

In Eaton and Gersovitz (1981), lenders are assumed to know all relevant characteristics of individual borrowers. In addition, borrowers are assumed to be "inherently dishonest," in that they will default if it is in their benefit. One important result of their model is that lending is possible even without exogenous defaulting costs, because borrowers optimize over an infinite horizon in which repayment is a condition

for borrowing in subsequent periods. Additionally, in their model the benefits of default grow with the size of the outstanding debt, while the costs are determined endogenously by the variability and growth rate of the borrower's income and several other characteristics affecting its future demand for debt. This model will be discussed in detail in chapter 7, as it reflects circumstances similar to those found among clients of MFIs.

Bulow and Rogoff (1989) argue that reputation alone is not enough to ensure debt repayment, and their argument can be adapted to complement Eaton and Gersovitz (1981). In their work, two types of contracts are available to the country for consumption smoothing. In the "reputation contract," the country can receive new loans in exchange for a state contingent repayment. In the "cash-in-advance" contract, a foreign third party acts as an insurer vis-à-vis the country's risk. The authors show that if the country's future repayment has a positive expected present discounted value, the country will be better off by ceasing payment on its reputation contract and starting the lower cost insurance contract. Therefore, the threat of exclusion from future borrowing loses its strength when the country has an alternative mechanism (insurance) to achieve consumption smoothing.

Three key assumptions guarantee the results in Bulow and Rogoff (1989). First, access to credit markets matters only for consumption smoothing. Second, there are (at least) two types of substitute contracts. Third, the only punishment to a defaulting borrower is exclusion from future reputation contracts, but not from the substitute contract. The first assumption guarantees that credit contracts and insurance contracts are substitutes. Once credit is used for other purposes, such as investing, the substitution

with non-credit contracts disappears. The second assumption guarantees that at least one substitute for the reputation contract exists. The third assumption guarantees that default does not stop access to non-reputation types of contracts. Mutatis mutandis, these results suggest different repayment behavior by borrowing households, depending on the urgency of consumption smoothing (e.g., poverty) and their access to alternative mechanisms for risk coping.

Allen (1983) develops a model of borrowing where default leads to exclusion from access to new loans in the future (endogenous cost). In his model, contracts are enforceable provided the current repayment due is less than or equal to the value of future access to credit markets. The author assumes that interest on old debt must be paid before new debt can be serviced. This implies that borrowers contract with one lender at a time. Inputs are supplied at the beginning of discrete production periods, and outputs are produced at the end. At the end of each period, only the borrower initially observes output. One important result is that, if the termination threat is credible, a contract is enforceable provided each payment is less than the value of future access to the market. Microfinance institutions create these conditions by requiring frequent repayment of small installments and by immediately reacting to any arrears.

Bolton and Scharfstein (1990) are interested in agency problems in financial contracts. These authors argue that, "the commitment to terminate a firm's funding if its performance is poor ensures that the firm does not divert resources to itself at the expense of investors" (p. 93). The threat of termination of the credit relationship thus provides incentives for managers to be diligent and not opportunistic. The agency problems emerge from the impossibility of making financial contracts explicitly contingent on

realized profits. With asymmetric information, the lender may refuse to grant the loan, because the borrower may report that the effective profits were lower than the loan, and this will result in a loss for the bank. However, in a two-period credit relationship, the lender can commit to disburse a new loan in the second period if the borrower repays the loan of the first period.

In Bolton and Scharfstein (1990), the agency problem is related to the one-period models of Townsend (1979), and Gale and Hellwig (1985). In these models, the use of a costly verification technology allows the lender to contract payments contingent on profits. Thus, inspection (monitoring) plays a similar role in these models as the termination threat in Bolton and Scharfstein (1990) in increasing the probability of repayment.

Gonzalez-Vega (1993) has argued that the perception of lender permanence is the most important determinant of lender credibility and repayment behavior in environments where there are unsustainable organizations.

Armendáriz de Aghion and Morduch (2000) analyze a debt contract between an individual lender and a borrower and assume that the bank has all the bargaining power. In their model, the threat not to refinance a borrower who defaults on her debt obligation is the main dynamic incentive for repayment. This threat is enhanced by promising to extend steadily larger loans to good customers over time. The formalization of their model follows Bolton and Scharfstein (1990).

Because theirs is a limited horizon model (only two periods), one of their results is that, once the borrower obtains her second-period return, she will default on her second-period debt obligation with certainty, since the bank cannot reward the borrower

with a new loan anymore. However, the model is still useful in showing the improvements in first-period performance. The limitation of this approach is that the lender may not have incentives to lend in the first period (by backward induction, it can be shown that if the borrower believes that, for this reason, the lender will not make loans in the second period, she will not repay in the first period) and the market collapses (Pearson, 2008). Nevertheless, in an infinite horizon model with a sufficiently large discount factor, strategic default will never be observed in equilibrium, as given by the folk theorem in Fundenberg and Maskin (1986).

Indeed, Fundenberg and Maskin (1986) establish that the payoff vector of a one-shot game of complete information can arise in perfect equilibrium of the infinitely repeated game if players are sufficiently patient. In addition, any individually rational payoffs of a one-shot game can be approximated by sequential equilibrium payoffs of a long but finite game of incomplete information, where the players' payoffs are almost certain as in the one-shot game.

Egli (2004) analyzes progressive lending as an enforcement mechanism for individual MFIs. Progressive lending refers to the practice that borrowers initially get small loans, which increase over time. The motivation for her model is that, in many MFIs, the borrower at first gets very small loans, which increase with good repayment. She shows that splitting up projects enables lending even without collateral and with high uncertainty about the enforceability of repayment.

Under her assumptions, including the assumption that borrowers do not have any collateral, the splitting up of large projects into sub-projects as well as the "starting small" effect arise endogenously in Egli (2004). Finally, the splitting into subprojects is

the main dynamic incentive for repayment without collateral, because it allows pressure to be kept on the borrower, since she would be able to fund her second-period project only when she repays at the end of the first period. One important result is that, to further deter any opportunistic behavior, the lender can postpone the funding of the most profitable subprojects until later periods. Under such an arrangement, an adverse shock that reduces the profitability of the second project will increase the likelihood of default on the first loan.

In the words Yunus, "It's not just one loan, it's a door that opened for you. You can proceed as far as you can go" (Adams, 2008: 52).

6.3 Reputation Effects

In Kreps and Wilson (1982) and Milgrom and Roberts (1982), reputation arises from learning about particular characteristics of agents over time based on observed behavior. Reputation effects arise when an agent adjusts his behavior to influence data others use in learning about him (Diamond, 1989). In credit markets, reputation is important because there is a diverse pool of unobservable borrower characteristics in an observationally equivalent group of agents.

In particular, Diamond (1989) analyzes incentive problems between borrowers and lenders. Specifically, the author focuses on reputation formation and the evolution of the incentive effects of reputation over time to mitigate these conflicts. The main result is that reputation incentives are not strong for borrowers with short credit histories and they become stronger for borrowers who manage to acquire a good reputation. In particular,

with sufficient adverse selection, reputation will not initially provide improved incentives to newer borrowers (those with shorter credit histories).

In Vercammen (1995), borrowers ignore some of the short-run incentives to choose risky projects or lower effort because of their concern about their credit histories. In his model, reputation effects in credit markets are welfare improving because they offset some of the losses from moral hazard, by moving the equilibrium closer to the first-best solution.

6.4 Microfinance Lending Technologies

A lending technology is a structured method of lending through the systematic use of information and incentives (Gonzalez-Vega, 2003b, Navajas and Gonzalez-Vega, 2003). It is the production function of loans, considering all the steps, procedures, and criteria used in the credit process. The key elements of a lending technology are signaling, screening, contract design, monitoring, and contract enforcement (Besley, 1994).

Signaling, allows the lender the possibility of establishing its credibility in the enforcement of contracts and in the promises about the future of the relationship. This is critical in a political economy environment where traditionally credit has not been defined as a contractual obligation but rather as a political handout.

Based on screening, the lender decides whether to lend to a particular borrower and under what conditions. In its screening efforts, the lender determines the ability and willingness to repay of the potential borrower and, thereby, decides on a loan amount.

The design of the contract has to be incentive compatible, as the lender creates conditions such that the borrower is willing to repay the loan. This is necessary because it may not always be in the borrower's interest to fulfill her contract obligations. Three usual variations in the design of contract incentives include the fear of loss of the asset pledged as collateral, the promise of new loans, or the fear of social sanctions. During monitoring, the lender learns if the ordinary capacity to repay will be enough or if the initial willingness to repay has changed in order to take additional steps in guaranteeing repayment. Finally, contract enforcement mechanisms seek to make the borrower liable in case of default.

According to their lending technology, MFIs can be classified into three groups: village banks, solidarity group lenders, and individual lenders. A general description of each technology is presented next.

6.4.1 Village Banks

The lending technology of village banks was developed in the 1980s in Bolivia (Hatch, 1987). However, since its inception, this technology has evolved a lot. In general, the process starts with a loan from the village bank institution, the MFI, to a group of approximately 20-60 individuals. Other members must approve a particular applicant's membership in the bank. This is one component of the delegated screening that takes place within the village bank. Village bank members are then trained in collecting and disbursing money and in keeping records of these transactions. The first loan, usually for less than $100 per borrower, has to be repaid in 16 weekly installments.

Members usually hold weekly meetings, to collect payments and take savings. These meetings are a component of the delegated monitoring implicit in this lending technology.

Once all the members of the village bank repay their loans, they become eligible for a new loan of a larger size. For this to happen, the previous loan must be repaid in full to the MFI. Usually, the new loan from the MFI is equivalent to the previous loan plus the amount of the savings of all the members in the group. Loan sizes per borrower also increase after every cycle, until they reach a ceiling of $300, on average, three years after the first loan. Each member's loan size has to be approved by the other members, and through their joint liability, incentives for member monitoring are created.

In addition to financial services, sometimes members of village banks receive other services from the MFI, including education and health training. These services are an extra incentive to repay, because when the members of the village bank are not able to repay the full loan to the MFI, all members of the bank are cut-off from access to the additional services as well. This works as an additional strong incentive to repay (Holt, 1993; Outtara, Gonzalez-Vega and Graham, 1999; Wesley, 2004).

One additional incentive to repay among members of village banks is preserving access to the internal account. The *internal account* is built from the member savings, interest from loans made from these savings, fines charged to members, and member installment payments before the full amount owed to the MFI becomes due (the external account). Emergency loans to members are granted with funds from the internal account, and this is a valuable service for borrowers, specially in risky environments (Maldonado and Gonzalez-Vega, 2008). A more detailed description of the lending technology of

CRECER, an outstanding village banking program in Bolivia, can be found in Quirós-Rodríguez, Rodriguez-Meza and Gonzalez-Vega (2003).

6.4.2 Solidarity Groups

Solidarity groups started with the creation of Grameen Bank in Bangladesh. Similar to village banks, this technology has evolved a lot from its original characteristics, and it has been adopted effectively in many countries worldwide. It is based on the concept of joint liability, which has received a lot of theoretical attention over the last twenty years. Under joint liability, access to credit for each borrower in the group is made conditional on group repayment. Joint liability may induce borrowers in a group to monitor each other, thereby alleviating moral hazard problems (Stiglitz, 1990; Varian, 1990; Matin, 1997; Ghatak and Guinnane, 1999; Ahlin and Townsend, 2007).

The introduction of group lending contracts may mitigate adverse selection problems (Ghatak, 1999). Group members tend to have good information about each other's projects and risk, and this local information allows the external MFI to operate with lower screening and monitoring costs. Models of group lenders usually assume that the returns of the group members are uncorrelated, and this allows one member to cover the repayment of other members in case of idiosyncratic shocks. However, this mechanism may not work in the presence of systemic shocks (Gonzalez-Vega, 2003b).

Besley and Coate (1995) establish that if social penalties are sufficiently severe, higher repayment rates can be achieved through group rather than individual lending. However, recent evidence from many countries suggests that high repayment rates can be

achieved as well with individual lending. According to Gonzalez-Vega (2003b), individual lenders are more robust along the business cycle and lead to better long-term repayment records, because they can avoid better the covariance of the members' returns. Moreover, lenders can adjust loan sizes and other contract terms to match each individual borrower's adjustment during the cycle.

The typical solidarity group has between 3-7 members, who decide how much each one will receive, while the MFI must approve the total amount. While screening and monitoring are also delegated to group members, the loan officer plays an important role in evaluating the group's credit worthiness. Similar to village banks, access to subsequent loans depends on successful repayment by all members or, alternatively, the total amount owed by the group.

Two of the best-known examples of MFIs using solidarity groups have been Grameen Bank in Bangladesh and BancoSol in Bolivia, although BancoSol essentially abandoned this lending technology after the crisis. Both organizations follow the same basic model of group lending, but implement it differently. The following description of solidarity groups will be based on BancoSol's approach at the time of the survey.

BancoSol started operations as PRODEM, an NGO, in 1987 and it transformed into a bank in 1992. PRODEM transformed into a FFP in 2000. Members self-select into groups, and they do screening and monitoring for the lender. Collateral is not a requirement for receiving a loan. Loan sizes are small and terms to maturity are short, with loans repaid in multiple installments. Since joint liability is strictly enforced, failure to repay implies a loss of future access for all group members. Loan officers play an important role in the success of solidarity groups, as they learn about old and potential

new borrowers. As part of the incentives to repay, substantial improvements in the terms and conditions of loans are made contingent on the repayment of previous loans (Gonzalez-Vega *et al.,* 1997). A more detailed description of the lending technology of PRODEM, can be found in Rodriguez-Meza, Gonzalez-Vega, and Gonzalez (2003).

6.4.3 Individual Lenders

Individual lenders make loans to households with a diversified portfolio of income generating activities, with loans tailored to specific individual demands. Credit officers do all the screening, mainly through referrals and personal visits to the borrower's residence and business or farm. In order to assess ability to repay, loan officers estimate cash flows for the household unit. Individual lenders belonging to the Procredit network usually accept collateral substitutes, such as TVs or household appliances, which are seized and sold if the loan is not repaid (Navajas and Gonzalez-Vega, 2003). The expectation that loan size will increase over time is stronger among individual borrowers and it represent a strong incentive to repay. A more detailed description of the lending technology of Caja Los Andes, now Banco Los Andes, can be found in Rodriguez-Meza, and Gonzalez-Vega (2003).

CHAPTER 7

MODELS OF REPAYMENT

Over the past few decades, several theoretical models have been developed to explain the most important dimensions of credit relationships. A combination of some of these elements is necessary in order to understand better the screening and dynamic incentives to repay of microfinance clients, especially during periods of recession and frequent and unexpected adverse shocks. In this chapter, I review in detail three of these models, given their particular relevance. At the end of the chapter, I consolidate the various elements into a single model.

7.1 Relevant Models of Repayment

7.1.1 Eaton and Gersovitz (1981)

Eaton and Gersovitz (1981) analyze financial transactions between countries when default is a possible strategy for sovereign nations. The possibility of default arises because there are no international mechanisms for contract enforcement across countries. Their general conclusions can be extended to MFIs and borrowers in developing

countries, where contract enforcement is not available and where borrowers can default on microfinance loans without risking legal penalties. Thus, although the original paper is presented in terms of countries (the borrowers) and private international lenders (the lenders), their results can be generalized to microfinance borrowers and lenders (MFIs).

Even without legal or coercive methods of enforcing repayment, MFIs can take a number of retaliatory actions to penalize defaulting debtors. One of the most important of these penalties is exclusion from future borrowing. According to these authors, "the threat of future exclusion will not deter a country from defaulting if it plans to borrow on an uninterrupted basis for a period of time with no further intention of borrowing thereafter" (Eaton and Gersovitz, 1981: 289).

In their model, the only reason for borrowing is consumption smoothing. They assume that if the borrower refuses to repay, it faces a permanent embargo on future loans by lenders. This assumption captures the fact that default makes re-entry into financial markets difficult.

Specifically, the authors characterize the borrower with three assumptions. First, the net output in period t, y_t, is a random variable with a distribution function $g_t(y_t)$, for which there exists a maximum output $y_t^{max} < \infty$ such that $\int_0^{y_t^{max}} g_t(y_t)dy_t = 1$.

Second, output is not storable, such that $c_t = y_t + b_t - p_t$, where c_t is consumption, b_t is borrowing, and p_t is debt-service payments, all in period t. Third, the borrower's objective function, with U bounded from above, is $E\left[\sum_{t=0}^{\infty} \beta^t U(c_t - P_t)\right]$ where $U'>0$, $U''<0$, and $0 < \beta < 1$ is the discount factor. Here, P_t is a penalty imposed for defaulting, in addition to the embargo on future borrowing.

Borrowing opportunities are characterized with two assumptions. One is that debt matures in one period. The repayment function is then given by $d_{t+1} = R(Bt)$, where d_{t+1} is debt service obligations in period $t+1$. Usually, this obligation is $(1+r_t)b_t$, where r_t is the interest rate at which b_t is contracted.

The other assumption is that, in each period, the borrower chooses b_t from B_t: the set of loan amounts available in period t. If $p_t < d_t$ such that debt payments fall short of debt obligations, $B_\tau = \{0\}$ for $\tau \geq t$. In other words, the debtor is no longer allowed to borrow. Otherwise, if $p_t = d_t$, then $B_t = B(y_t, d_t)$. That is, the set of borrowing opportunities is a function of repayment capacity. Under this assumption, the borrower will choose either $p_t = 0$ or $p_t = d_t$.

Under these assumptions, the value of the objective function of a borrower in period t, given a decision to default in period t, is defined as

$$V^D(y_t) \equiv E\left[\sum_{\tau=t}^{\infty} \beta^{\tau-t} U(y_t - P_t)\right].$$

In turn, the value of the objective function in period t, given a decision not to default in period t, is defined as:

$$V^R(y_t, d_t) \equiv \sup_{b_t \in B_t} \left\{U(y_t + b_t - d_t) + \beta E \max\left[V^R(y_{t+1}, d_{t+1}), V^D(y_{t+1})\right]\right\}.$$

In addition, the authors assume that this objective function exists and is unique.

In this model, opportunistic default is optimal in period t if and only if $V^D(y_t) > V^R(y_t, d_t)$. In turn, the probability of default in period t as it is anticipated in period $t-1$ is a function of the amount to be repaid, d_t, such that $\lambda(d_t) = \Pr\left[V^D(y_t) > V^R(y_t, d_t)\right]$.

Additional assumptions of the model include that lenders can make loans to alternative borrowers at a given market interest rate, lenders know the function defining the probability of default, and there is a maximum amount of loanable funds in any period *t*. In this model, a competitive borrowing equilibrium is characterized by the functions $V^*(y_t, d_t)$, $B^*(y_t, d_t)$, and $R^*(b_t)$, defined by the b_t from B^* which maximizes $V^*(y_t, d_t)$ subject to the constraint $\left\{1-\lambda[R^*(b_t)]\right\} R^*(b_t) = (1+r)b_t, \ \vee b_t \in B^*$.

This condition establishes that lenders will only make those loans that guarantee them an expected rate of return at least as high as the market interest rate. Competition among lenders will ensure that the terms on which these loans are offered maximize the borrower's utility.

The paper develops several theorems. First, the probability of default in period *t* increases monotonically with debt service obligations d_t. Second, $R^*(b_t)$ is increasing and convex over the set of available loans in period *t*, $[0, b_t^{max}]$. This theorem establishes that, in equilibrium, borrowing will be characterized by an upward-sloping supply curve for credit, since $R^*(b_t)$ increases monotonically in this range.

The demand for credit is defined as the level of borrowing b_t^* that the borrower would choose if he could borrow any positive amount. Formally, with a loan b_t^*, the borrower attains the value function $V^U(y_t, d_t)$, where

$$V^U \equiv \sup_{b_t \in R+} \left\{U(yt + bt - dt) + \beta E \max\left[V^R(y_{t+1}, R^*(b_t)), V^D(y_{t+1})\right]\right\}.$$

For this definition of demand, the assumption is that the borrower behaves as if the rate of interest is given for any b_t, and that rationing occurs if $b_t^* > b_t^{max}$. Since the objective function is increasing in b_t, if the borrower cannot borrow b_t^*, he will borrow

the largest amount available, b_t^{max}. Actual borrowing b_t is therefore determined by the rationing rule $b_t = min(b_t^*, b_t^{max})$.

The explicit solution of the value of the borrower's objective function, given a decision not to default, requires that $V^R(y_{t+1}, d_{t+1})$ be a simple function of $V^R(y_t, d_t)$ such that $V^R(y_t, d_t)$ can be expressed in terms of $sup\{U(y_t + b_t - d_t)\}$. However, one difficulty in the application of this solution technique is the $E(max[\bullet])$ operator, which arises because a decision not to default this period is not a decision never to default, but it is only a decision to wait one period in order to reconsider whether default is optimal or not.

Therefore, in order to solve the model, the authors assume that the borrower's income alternates between a value that is high relative to trend and a value that is low relative to trend. Further, they assume that borrowing occurs in periods of relatively low income (for the purposes of consumption smoothing) and loans must be fully repaid in the succeeding period. Failure to repay prevents borrowing in subsequent periods and thus reduces the value of the objective function in the future. An additional simplification is that the authors assume that the objective function in each period is given by a constant-relative-risk-aversion utility function:

$$U(X) = \begin{cases} \dfrac{X^{1-\gamma}}{1-\gamma} & \text{if } \lambda > 0 \text{ and } \lambda \neq 1 \\ \ln X & \text{if } \gamma = 1 \end{cases}$$

Under these simplifying assumptions, the authors analyze a two-period model without uncertainty, in which equilibrium is characterized by the absence of default. In this case, unless lenders err by making loans in excess of b^{max}, all debt will always be repaid in full, because there is no income uncertainty and the probability of default is known to the lender. However, misperception by the lenders of the borrowers'

characteristics may lead to default and may actually pose a threat to the stability of the market.

Next, the authors introduce uncertainty about the borrower's situation in the period when loans come due. In order to analyze this more complex model, they use a Taylor-series approximation of a general utility function. One additional simplification is that they assume that the borrowers' income in any future period takes on only one of two values, high and low, with equal probabilities, regardless of income in the previous period.

The most important result from this paper is that even without legal or coercive methods of enforcing repayment, lenders can take a number of retaliatory actions to penalize defaulting borrowers. The most important of these penalties is exclusion from future borrowing, which is critical for consumption smoothing. However, if the borrower has no further intention of borrowing after a given period, the threat of future exclusion will not deter default. This condition is very similar to the environment for microfinance borrowers, who have limited access to tools for consumption smoothing and who face much uncertainty about the future.

7.1.2 Armendariz de Aghion and Morduch (2000)

Armendariz de Aghion and Morduch (2000) model dynamic incentive problems in microfinance. In particular, these authors analyze the case of an individual debt contract between a bank and a borrower, and they assume that the bank has all the bargaining power. Their formalization follows Bolton and Scharfstein (1990). The

authors define a dynamic incentive as the threat not to refinance a borrower who defaults on her debt obligation, and the threat is enhanced by promising to extend steadily larger loans over time to good customers. Because many borrowers have been severely credit constrained, they typically desire larger and larger loans. Thus the promised growth in loan size enhances the borrowers' loss from being cut off, as long as they remained credit constrained, as in Egli (2004).

From these assumptions, Armendariz de Aghion and Morduch (2000) develop a two-period model, to capture the non-refinancing threat. In this model, a loan of size *d* can be extended by the bank to the borrower at the beginning of each period, and the borrower has no other source of funding. In each period, the borrower uses the current loan to invest in a project that yields a total return π with probability *p* and zero with probability *1-p*.

Initially, they assume that there is no moral hazard with respect to the borrower's effort in undertaking the project. This implies that *p* is exogenous. The only moral hazard threat emerges at the repayment stage. Specifically, the authors assume that the borrower can take the money and run after the investment returns have been realized. In order to discourage the borrower from taking the money and running in period one, the bank can threaten not to extend a new loan in period two. In this case, the borrower cannot finance her second-period investment.

In their model, the sequence of events is as follows. In period one, a loan of size *d* is extended to the borrower. The borrower invests *d* and obtains a first-period investment return π. The borrower then decides whether to default on her first-period debt obligation. In period two, the bank decides whether to refinance the borrower. If

the bank does extend a new loan *d*, the borrower invests and obtains a second-period return.

Under the threat of not being refinanced, if the borrower defaults she gets $\pi + \delta v\pi$, where δ is the discount factor and *v* is the probability of being refinanced by the bank ($0 \leq v \leq 1$). In this model, the borrower will only default when her return realization is high. Assuming that the return realization is high both in the first and in the second period, the maximum the borrower can pocket is π in the first period and $\delta\pi$ in the second period, conditional upon the lender extending a new loan (which occurs with probability *v*). The authors assume that the borrower cannot self-finance a second-period project in the event of default in the first period.

If the borrower decides to repay, she gets $\pi - r + \delta\pi$, where *r* is the borrowers' debt obligation. When the borrower decides to repay in the first period, the bank will in turn automatically decide to extend a second-period loan ($v = 1$), in order reward the borrower for her good behavior. Subsequently, the authors show that this is an equilibrium strategy for the bank.

Once the borrower obtains her second-period return, she will default on her second-period debt obligation with certainty, since the bank cannot, in this limited-horizon model, reward the borrower with a new loan anymore. This implies that the borrower's second-period return is simply $\delta\pi$. The authors recognize that this limited-horizon world may be unrealistic in practice, but they argue that the model is still useful in showing the repayment incentive in the first period.

The model rests on the assumption that the bank can credibly commit to provide the second-period loan, even though it anticipates default. However, in an infinite-

horizon model with a sufficiently large discount factor δ, strategic default will never be observed in equilibrium, according to the folk theorem (Fundenberg and Maskin, 1986).

The borrower decides to repay if $\pi + \delta v\pi \leq \pi - r + \delta\pi$. This incentive-compatibility constraint implies that the borrower's payoff is at least as large when she does default as when she defaults. If the bank can credibly carry out its threat not to refinance in case of default ($v = 0$), the borrower will fear losing access to a second-period return realization, thereby preventing strategic default in the first period.

MFIs can do better by imposing quasi-collateral requirements for individual loans and inducing social sanctions, as in the cases of group lending and village banks (Beasley and Coate, 1995; Navajas and Gonzalez-Vega, 2003). Armendariz de Aghion and Morduch (2000) capture these sanctions through a variable *w*. Some examples of these sanctions include loss of reputation and exclusion from the village community as well as reports to a credit bureau. In the presence of additional sanctions *w*, the borrower's incentive compatibility constraint becomes $\pi - w \leq \pi - r + \delta\pi$.

This model further allows these authors to re-interpret the variable *w* as a positive incentive for repayment. This is the case when the MFIs can establish their reputation for providing loans of increasing size, over time, to those borrowers who meet their debt repayment obligations. In this case, the incentive-compatibility constraint then becomes $\pi \leq \pi - r + \delta\pi_2$, where π_2 are the returns from a larger project in period two. The implicit assumption is that the borrower remains credit constrained in period two.

Another variation of their model is to think of *w* as a proxy for the probability of being re-financed by a rival lender. This would be the case if borrowers can secure refinancing by a second lender with probability v_2. In this case, the incentive-

compatibility constraint becomes $\pi + \delta v_2 \pi_2 \leq \pi - r + \delta\pi$. This equation establishes that, the greater the probability v_2 of refinancing by a second lender, the weaker will be the incentives to repay the first lender, and the lower the maximum repayment *r* that can be extracted by the first lender. This outcome describes an environment of increasing competition without information sharing.

7.1.3 Navajas, Conning and Gonzalez-Vega (2003)

Navajas, Conning, and Gonzalez-Vega (2003) develop a simple canonical model of moral hazard to analyze competition and the design of lending technologies among individual and solidarity group lenders, such as those observed in Bolivia. In their model, lenders are assumed to be able to choose between two broad types of lending technologies. One technology involves offering a standardized loan contract, without screening, to all borrowers who apply (group lending). The other technology uses costly screening to generate a more precise estimate of the productivity type of each borrower that applies (individual lender).

In their model, a risk neutral entrepreneur has access to a project with stochastic returns. The project requires three inputs: a tradable input *I*, a non-tradable input *z*, and diligence or effort, *p* or *q*. They interpret the tradable input as the money value of purchased intermediate inputs, while *z* is a productivity parameter determined, for example, by the entrepreneur's skill, ability or entrepreneurial drive (Conning, 1999; Navajas, 1999). In addition, project returns are stochastic because random events such as bad weather, theft or merchandise spoilage can suddenly render the project a failure.

Similar to Armendariz de Aghion and Morduch (2000), these authors consider just two possible project outcomes, for any given level of investment, and two possible levels of diligence. When the project succeeds, returns are assumed to be $zf(I)$, where $f(I)$ is a standard concave production function with $f' > 0$ and $f'' < 0$. When the project fails, the returns are zero. When the entrepreneur is diligent, the probability of success is p and the probability of failure is $1-p$, for an expected project return $pzf(I)$. When the entrepreneur is not diligent, the associated probability of success is q, where $p > q > 0$.

These authors also assume that all entrepreneurs need to borrow to be able to engage in the project (they are credit constrained). Even wealthy entrepreneurs will choose to borrow, if their existing assets are illiquid and/or can earn a higher rate of return at the margin.

Based on this model, the authors state four hypotheses. These hypotheses are that borrowers of the solidarity group lender will be on average (i) poorer and (ii) less productive than borrowers from the individual lender, that (iii) a borrower who switches to the individual lender will also be less poor and more productive, and (iv) that the individual lender will offer a greater variety of loan contracts.

In a dynamic extension, Katchova, Miranda, and Gonzalez-Vega (2006) show that interest rates are dynamically determined by information on the productivity and diligence characteristics of borrowers, investment opportunities, correlation of business activities, peer monitoring costs and social sanctions.

7.2 Consolidated Model

The following model combines key elements from Eaton and Gersovitz (1981), Allen (1983), Conning (1999), Armendáriz de Aghion and Morduch (2000), and Navajas, Conning, and Gonzalez-Vega (2003), in order to present a theoretical framework that allows for the discussion of overindebtedness, dynamic incentives to repay, and extraordinary repayment capacity.

In this model, households live for only two periods, have an initial endowment of labor and capital (assets), and there is no depreciation. In addition, households can store output (save) from period one to be used as capital (and later consumed) in period two. Assets are assumed to have a high degree of illiquidity in period one, so there is an extra incentive to consume them in period two rather than period one or an extra penalty if they are consumed or sold in period one. Additionally, the household does not have enough resources of its own to take full advantage of its investment opportunities, so that borrowing is welfare-improving.

In the model, all funds from borrowing are invested (used to purchase capital) at the beginning of each period. Households have a dynamic incentive to repay and preserve access to credit (by repaying the loan) because of the high probability that they will get a new loan for period two. The specific assumptions of the model are discussed in the following sections.

7.2.1 Characterization of the Borrower

The household has an initial endowment of assets (capital) a_0, which can be accumulated or liquidated under special rules. In particular, there are two different sets of prices at which assets can be sold, in order to transform them into consumption, in periods one and two, L_1 and L_2. In real life, the microentrepreneurs' productive assets are not fully liquid and, under emergency, a quick sale can be achieved only after accepting a loss. Therefore, it will be assumed that $L_1 < L_2 \leq 1$. During bad years, when everybody is affected by unexpected adverse systemic shocks, the value of productive assets will be lower than during regular years, both because the expected returns will be lower and because everyone is attempting to sell at the same time (Gomez-Soto and Gonzalez-Vega, 2007b).

The household has a maximum initial endowment of labor e^{max}. This implies that the number of potential workers is constant, under the assumption of zero migration, marriages or divorces, for example.

In each period t, net output y_t is a stochastic function such that:

$$y_t = \left\{ \begin{array}{cc} z_t Y(k_t, e_t) & \text{with probability } p \\ 0 & \text{with probability } (1-p) \end{array} \right\} \; for \; t = 1, 2 \qquad (7.1)$$

The first component of net output, z_t, is a non-tradable factor input, and it is interpreted as the entrepreneur's skill or ability in production. This ability is assumed to be unevenly distributed in the population, similar to Conning (1999), Navajas (1999), and Navajas, Conning and Gonzalez-Vega (2003). Later on, it will be assumed that the distribution of z_t depends on the state of nature and on the type of lender. In particular, it will be assumed that the implementation of better lending technologies allows some

lenders to screen and accept borrowers with greater skills. The second component of output corresponds to a production function with two inputs, capital, k_t, and effort (labor), e_t. Decreasing marginal productivity is assumed for both inputs, such that $Y_k > 0$, $Y_{kk} < 0$, $Y_e > 0$, and $Y_{ee} < 0$. In addition, the second component is assumed to become zero with a probability *(1-p),* when the project fails.

In this economy, output can be stored (asset accumulation), such that:

$$c_t = y_t - p_t - (a_t - a_{t-1})L_t \qquad (7.2)$$

where c_t is consumption, p_t is debt service, and $a_t - a_{t-1}$ is asset accumulation (savings), all variables at the end of period t. This equation represents the budget constraint that must be satisfied in every period. As discussed, the price of assets in period one is less than in period two, $L_1 < L_2$, if there are assets to draw down ($a_1 - a_0 < 0$), and equal to L_2 otherwise. In addition, there is a minimum level of consumption below which the household does not survive, $c^{Min} > 0$.

In this model, the household maximizes expected utility W, where

$$W = E_0[U_1 + \beta U_2] \qquad (7.3)$$

and $0 < \beta < 1$, where β is a discount factor equal to $1/(1+\rho)$, and ρ is the rate of time preference. The household is assumed to be risk averse. In turn, the utility function satisfies $U_c > 0$, $U_{cc} < 0$, and $U_e < 0$, $U_{ee} < 0$. In other words, $U_t(\bullet)$ is a twice-differentiable concave function, increasing in c_t and decreasing in e_t, and $E_t[\bullet]$ defines the expectations operator conditional on the information/expectations available to the individual as of time t. For simplicity, it will be assumed that output is not equal to zero and the expectations operator will be removed.

7.2.2 Borrowing Opportunities

There are many lenders in this economy (individual, solidarity groups, village banks, consumption lenders, traditional banks), but it will be initially assumed that each borrower can establish a credit relationship with only one particular type (perfect matching), which charges an interest rate r_t.

Debt matures in one period, and the repayment function is given by

$$d_t = (1 + r_t) b_t \qquad (7.4)$$

where d_t is the debt service obligation at the end of period t, and r_t is the interest rate at which debt b_t is contracted. This amount is what the household should repay every period. In the end, however, the household may decide to default and repay nothing.

The household owns some assets, which are available for production, such that in each period

$$k_t = b_t + a_{t-1} \qquad (7.5)$$

In each period, the household chooses a loan b_t, where $b_t \in \{0, B_t\}$, and B_t represents the maximum loan size available to the household in each period. In general, B_t corresponds to a rationing rule that may be lender-specific and household-specific.

In general, the rationing rule depends on the lending technology. Village banks use a standard rationing rule $B_t = b^{Max} > 0$, independent of household characteristics, such that B_t is the same for all households. For individual lenders, the maximum loan size in period one is a function of the household's expected repayment capacity (ordinary), usually forecasted on the basis of household characteristics such as the household's endowment of assets and labor and skills, such that $B_1 = B_1(a_0, e^{max}, z_1)$. For traditional

banks, the most important component of the rationing rule is the value of traditional collateral, such that $B_1 = B_1(a_0)$. Differences in the rationing rule reflect differences between asset-based lending (traditional banks) and relationship lending (microfinance).

The maximum loan size in period two is a function of the maximum loan size in period one and of the reputation of the household (type), gained from period one, such that $B_2 = B_2(B_1, T)$, where $T \in$ {Default, Repayment}, and $B_2(B_1, D) = 0$ when there is default, for any level of B_1. Alternatively, the maximum loan size in period two is a function of household assets, labor, skills, and reputation (type) gained in period one, such that $B_2 = B_2(a_1, e_1, z_2, T)$, where $T \in$ {Default, Repayment}, and $B_2(a_1, e_1, z_2, D) = 0$ when there is default, for any levels of a_1, e_1, and z_2.

Default is defined as any situation where $p_t < b_t$. In other words, in this model partial repayment is not enough for keeping a good reputation. This is consistent with practices adopted by MFIs in Bolivia. Therefore, in each period, the borrower chooses p_t and b_t, and, under the full repayment assumption (all-or-nothing), the household will choose either $p_1 = 0$ or $p_1 = d_1$.

7.2.3 Borrower Behavior: Solving the Model

The problem for the household is to maximize its intertemporal utility by finding the optimal amounts of effort, consumption, savings, and borrowing/capital in periods one and two. Following Armendariz de Aghion and Morduch (2000), in this two-period model default is always observed in the second period, since the borrower does not have any incentive to repay. This implies that the household will always take the maximum

loan available in period two, regardless of the interest rate ($b_2=B_2$ and $k_2=a_1+b_2$). This optimization problem can then be expressed as:

$$\underset{c_1,c_2,e_1,e_2,k_1,a_1}{\text{Max}} \; W = U(c_1, e_1) + \beta U(c_2, e_2) \tag{7.6}$$

where $U_c > 0$, $U_{cc} < 0$, $U_e < 0$, $U_{ee} > 0$, $Y_k > 0$, $Y_{kk} < 0$, $Y_e > 0$, $Y_{ee} < 0$,

$$0 < \beta < 1, \text{ and } \beta = 1/(1+\rho)$$

subject to:

$$a_0 = \bar{a} \geq 0 \tag{7.7}$$

$$e_t \leq e^{Max} \tag{7.8}$$

$$c_t \geq c^{Min} \tag{7.9}$$

$$c_t = y_t - (a_t - a_{t-1})L_t - p_t \tag{7.10}$$

$$y_t = z_t Y(k_t, e_t) \tag{7.11}$$

$$k_t = b_t + a_{t-1}. \tag{7.12}$$

$$d_t = (1 + r_t) b_t \tag{7.13}$$

$$a_1 \geq 0 \text{ (maximum asset drawdown in period one)} \tag{7.14}$$

$$a_2 = 0 \text{ (no bequest motive)} \tag{7.15}$$

$$0 \leq b_1 \leq B_1(a_0, e^{Max}, z_1) \tag{7.16}$$

$$b_2 = B_2(B_1, T), \text{ and } \begin{cases} B_2(B_1, D) = 0 \text{ if default} \\ B_2(B_1, R) > B_1 \text{ if repayment} \end{cases} \tag{7.17}$$

$$W \geq W^0 = \sup W(b_1 = b_2 = 0) \tag{7.18}$$

Making some substitutions and assuming full repayment of debt in each period, the Kuhn-Tucker Lagrangian associated with the household optimization problem is:[2]

$$\Gamma = \begin{bmatrix} U(c_1,\ e_1)+\beta U(c_2\ ,\ e_2) \\ +\lambda_1\{z_1 Y(k_1,\ e_1)\ -(a_1-a_0)L_1-c_1\ -\ (1+r_1)(k_1\ -a_0)\} \\ +\lambda_2\{z_2 Y(a_1+b_2,e_2)\ +a_1L_2-c_2\} \\ -\mu(e_1)\cdot(e_1-e^{Max})-\mu(e_2)\cdot(e_2-e^{Max}) \\ +\mu(c_1)\cdot(c_1-c^{Min})+\mu(c_2)\cdot(c_2-c^{Min}) \\ -\mu(B_1)\cdot(b_1-B_1)+\mu(b_1)\cdot b_1+\mu(a_1)\cdot a_1 \end{bmatrix} \tag{7.19}$$

The first-order conditions (FOC) for the intertemporal maximization of utility are:

$$\frac{\partial\Gamma}{\partial c_1} = \frac{\partial U(c_1,e_1)}{\partial c_1}-\lambda_1+\mu(c_1)=0 \tag{7.20}$$

$$\frac{\partial\Gamma}{\partial c_2} = \beta\cdot\frac{\partial U(c_2,e_2)}{\partial c_2}-\lambda_2+\mu(c_2)=0 \tag{7.21}$$

$$\frac{\partial\Gamma}{\partial e_1} = \frac{\partial U(c_1,e_1)}{\partial e_1}+\lambda_1 z_1\frac{\partial Y(k_1,e_1)}{\partial e_1}-\mu(e_1)=0 \tag{7.22}$$

$$\frac{\partial\Gamma}{\partial e_2} = \beta\frac{\partial U(c_2,e_2)}{\partial e_2}+\lambda_2 z_2\frac{\partial Y(k_2,e_2)}{\partial e_2}-\mu(e_2)=0 \tag{7.23}$$

$$\frac{\partial\Gamma}{\partial k_1} = \lambda_1\left[z_1\frac{\partial Y(k_1,e_1)}{\partial k_1}-(1+r_1)\right]-\mu(B_1)+\mu(b_1)=0 \tag{7.24}$$

$$\frac{\partial\Gamma}{\partial a_1} = -\lambda_1 L_1+\lambda_2\left(z_2\frac{\partial Y(k_2,e_2)}{\partial k_2}+L_2\right)+\mu(a_1)=0 \tag{7.25}$$

$$\frac{\partial\Gamma}{\partial\lambda_1} = z_1 Y(k_1,e_1)\ -\ (1+r_1)(k_1\ -a_0)-(a_1-a_0)L_1-c_1=0 \tag{7.26}$$

[2] See Simon and Blume (1994) for details.

$$\frac{\partial \Gamma}{\partial \lambda_2} = \ z_2 Y(a_1 + b_2, e_2) \ + a_1 L_2 - c_2 = 0 \tag{7.27}$$

$$\mu(e_1) \cdot (e_1 - e^{Max}) = 0, \ \ \mu(e_2) \cdot (e_2 - e^{Max}) = 0 \tag{7.28}$$

$$\mu(c_1) \cdot (c_1 - c^{Min}) = 0, \ \ \mu(c_2) \cdot (c_2 - c^{Min}) = 0 \tag{7.29}$$

$$\mu(B_1) \cdot (b_1 - B_1) = 0 \tag{7.30}$$

$$\mu(b_1) \cdot b_1 = 0 \tag{7.31}$$

$$\mu(a_1) \cdot a_1 = 0 \tag{7.32}$$

$$\mu(e_1), \mu(e_2), \mu(c_1), \mu(c_2), \mu(B_1), \mu(b_1), \mu(a_1) \geq 0 \tag{7.33}$$

$$e_1 \leq e^{Max}, \ \ e_2 \leq e^{Max} \tag{7.34}$$

$$c_1 \geq c^{Min}, \ \ c_2 \geq c^{Min} \tag{7.35}$$

$$b_1 \leq B_1, \ \ b_2 = B_2 \tag{7.36}$$

$$b_1 \geq 0 \tag{7.37}$$

$$a_1 \geq 0 \tag{7.38}$$

It will be assumed that a solution exists and that this solution is:

$$\psi^* = (c_1^*, c_2^*, e_1^*, e_2^*, k_1^*, a_1^*)$$

Additionally, this solution defines the optimal levels of utility in period one and two, U_1^* and U_2^*, and the maximum level of utility (value function) W^*.

In the previous FOC, λ_t is the Lagrangian multiplier and it represents the impact on the expected utility of the household of having one extra unit of consumption in period t (shadow price of consumption). In addition, all $\mu(\bullet)s$ are the Kuhn-Tucker multipliers, and they represent the impact on the expected utility of the household of relaxing in one unit the respective inequality constraints. For instance, $\mu(a_1)$ represents the impact on the

expected utility of the household of relaxing the non-negativity of savings constraint in one unit. If $\mu(a_1) = 0$, this means that the respective constraint is not binding and, therefore, that the change in the expected utility of the household of relaxing this constraint is zero.

As shown by the first two FOC, in equilibrium the shadow price of consumption has to be equal to the discounted marginal utilities of consumption plus the shadow price of relaxing the minimum consumption constraints, such that:

$$\lambda_1 = \frac{\partial U\left(c_1^*, e_1^*\right)}{\partial c_1} + \mu(c_1) \tag{7.39}$$

$$\lambda_2 = \beta \cdot \frac{\partial U\left(c_2^*, e_2^*\right)}{\partial c_2} + \mu(c_2) \tag{7.40}$$

Therefore, the shadow price of consumption is equal to the discounted marginal utility of consumption only when the minimum consumption constraint is not binding [$\mu(c_t) = 0$]. When the minimum consumption constraint is binding, the shadow price of consumption is higher than the marginal utility of consumption and $\mu(c_t) > 0$.

In order to simplify notation, variables such as $c_t^{\Diamond}$ or $e_t^{\Diamond}$ will represent the optimal solution to the maximization problem of the household when the respective inequality constraints associated with the KT multipliers are not binding [$\mu(\bullet)s=0$]. For example, $c_t^{\Diamond}$ represents the optimal level of consumption independent of the existence of a minimum level of consumption, and $e_t^{\Diamond}$ represents the optimal level of effort independent of the existence of a maximum level of effort.

In Figure 7.1, the shadow price of consumption is represented in the vertical axis for different levels of consumption, given c^{Min}. If the optimal solution is less than c^{Min},

then the shadow price of consumption is higher than the marginal utility of consumption in that period, because the minimum consumption constraint is binding. However, if the optimal consumption is higher than c^{Min}, then the shadow price of consumption is equal to the marginal utility of consumption in that period.

The third and fourth FOC characterize the optimal levels of effort in periods one and two, respectively. Substituting the optimal values of λ_t from the first two FOC, the third and fourth FOC are:

$$-\frac{\partial U\left(\mathrm{c}_{\mathrm{t}}^{*},\mathrm{e}_{\mathrm{t}}^{*}\right)}{\partial e_t}=\beta^{1-t}\left(\lambda_t z_t \frac{\partial Y(\mathrm{k}_{\mathrm{t}}^{*},\mathrm{e}_{\mathrm{t}}^{*})}{\partial e_t}-\mu\left(e_t\right)\right) \tag{7.41}$$

$$-\frac{\partial U\left(\mathrm{c}_{\mathrm{t}}^{*},\mathrm{e}_{\mathrm{t}}^{*}\right)}{\partial e_t}=\beta^{1-t}\left\{\left(\beta^{t-1}\frac{\partial U\left(\mathrm{c}_{\mathrm{t}}^{*},\mathrm{e}_{\mathrm{t}}^{*}\right)}{\partial c_t}+\mu\left(c_t\right)\right)z_t \frac{\partial Y(\mathrm{k}_{\mathrm{t}}^{*},\mathrm{e}_{\mathrm{t}}^{*})}{\partial e_t}-\mu\left(e_t\right)\right\} \tag{7.42}$$

These FOC establish that, when the maximum effort constraints are not binding [$\mu\left(e_t\right)=0$], at the optimum level of effort e_t*, the marginal (des)utility of working one extra unit of time (the LHS in 7.41) has to be equal to the marginal utility of the extra consumption generated by one extra unit of effort (RHS). When the maximum effort constraints are binding [$\mu\left(e_t\right)>0$], the marginal (des)utility of working one extra unit of time is lower than the marginal utility generated by the extra consumption produced by that extra unit of effort.

In Figure 7.2, two maximum levels of effort are represented: e^{Max1} and e^{Max2}. If $e^{Max}=e^{Max1}$, e_t has to be equal to e^{Max1} and the marginal utility of the extra consumption generated by one extra unit of effort is higher than the marginal disutility of working that extra unit. If $e^{Max}=e^{Max2}$, then the marginal utility of the extra consumption generated by one extra unit of effort is equal to the marginal disutility of working that extra unit.

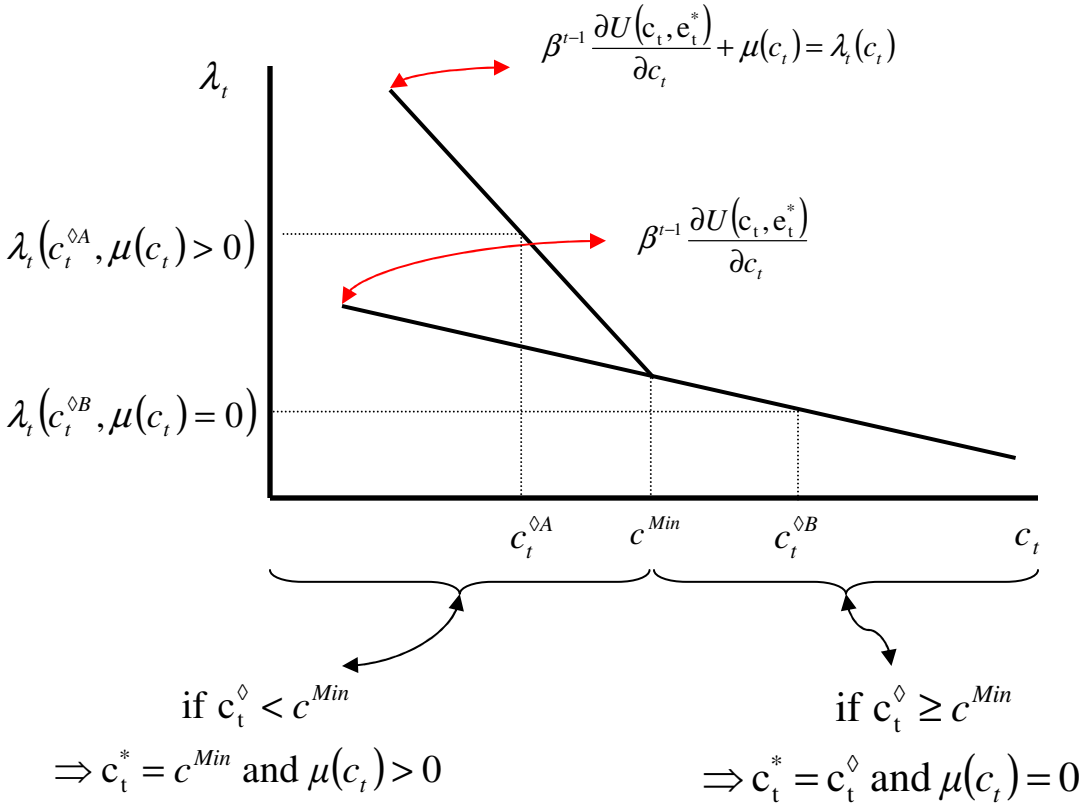


Figure 7.1.

Shadow Price of Consumption.

If the rationing rules on loan sizes are not binding in period one, [$\mu(B_1) = 0$], and the nonnegative loan constraints are not binding [$\mu(b_1) = 0$], the fifth FOC establishes that, at the optimal solution ($k_1^{\Diamond}$ in Figure 7.3), the marginal product of capital in period one has to be equal to the marginal cost of capital, ($1+r_1$), such that:

$$z_1 \frac{\partial Y(\mathrm{k}_1^*, \mathrm{e}_1^*)}{\partial k_1} = (1 + \mathrm{r}_1) \tag{7.43}$$

In contrast, if the period one rationing rule is binding [$\mu(B_1) > 0$], at the optimum solution ($b_1 = B_1$), the marginal product of capital in each period is higher than the marginal cost of capital, and this difference is equal to $\mu(B_1)/\lambda_1$, such that:

$$z_1 \frac{\partial Y(\mathrm{k}_1^*, \mathrm{e}_1^*)}{\partial k_1} - (1 + \mathrm{r}_1) = \frac{\mu(B_1)}{\lambda_1} \tag{7.44}$$

This situation typically describes a credit-constrained household. Attractive productive opportunities are not funded because of credit rationing. In Figure 7.3, these are the cases when $k_1 < k_1^{\Diamond}$. Borrowers of village banks are the most likely to be credit constrained, given the small amounts granted according to the rationing rule associated with this technology and the given rigid schedules for the growth of loan sizes.

Individual borrowers are expected to be the least credit constrained among microfinance clients, specially if they have some credit history that guarantees them access to larger loans, if they keep an excellent repayment history.

Borrowers of solidarity groups would be somewhere in between. The borrowers from consumption lenders may expect to be fully credit constrained in period two, even after repayment, if they expect their lender to be in bankruptcy by period two (as was the case in the Bolivian experience).

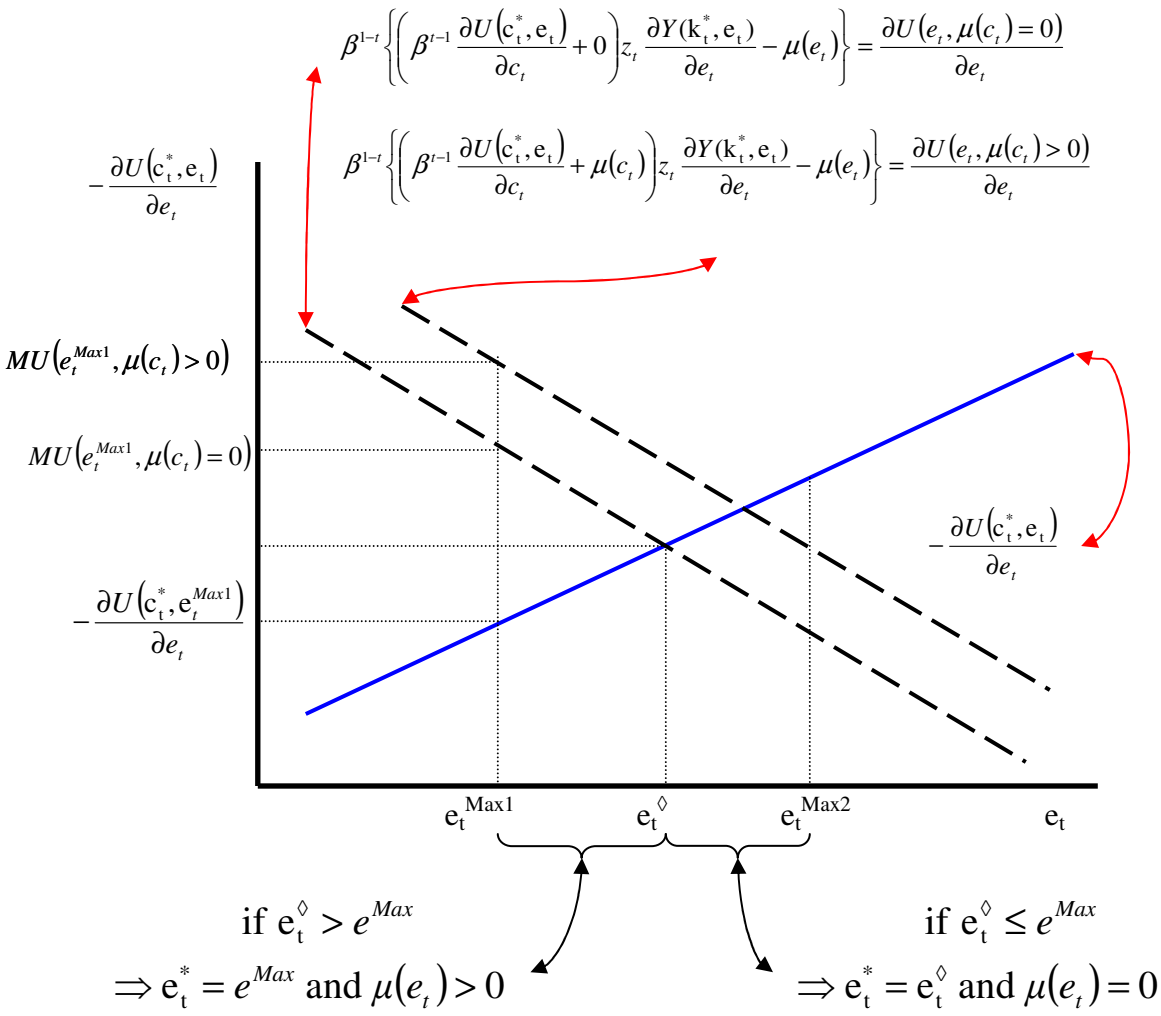


Figure 7.2.

Optimal Level of Effort, e_t*.

When the investment opportunities offer low returns ($Y^L(\bullet)$), the nonnegative loan constraints are binding [$\mu(b_1) > 0$] at the optimum solution ($b_1 = 0$), and the marginal product of capital in each period is lower than the marginal cost of capital. This is the case of a household without sufficiently attractive productive opportunities, given the interest rate on loans, and therefore no legitimate demand for credit, such that:

$$(1+r_1) - z_1 \frac{\partial Y^L(k_1^*, e_1^*)}{\partial k_1} = \frac{\mu(b_1)}{\lambda_1} \qquad (7.45)$$

Under these circumstances, if deposit facilities were available, this *surplus* unit would choose to hold additional financial assets as part of its wealth. This is the household participation constraint in credit markets. It establishes that, for a household to take a loan, it must expect that the returns from the loan will be higher than the interest rate paid.

These cases are represented in Figure 7.3. In addition, note that the nonnegative loan size and the rationing rule cannot be both binding at the same time. In other words, when the nonnegative loan size constraint is binding, this implies that the rationing rule is not binding, and vice versa.

The sixth FOC represents the intertemporal equilibrium condition. In equilibrium, if the minimum subsistence constraints are not binding [$\mu(c_1) = 0$ and $\mu(c_2) = 0$] and the nonnegative savings constraint is not binding [$\mu(a_1) = 0$], the marginal utility of one extra unit of consumption in period one has to be equal to the discounted marginal utility of L_2 units of consumption in period two.

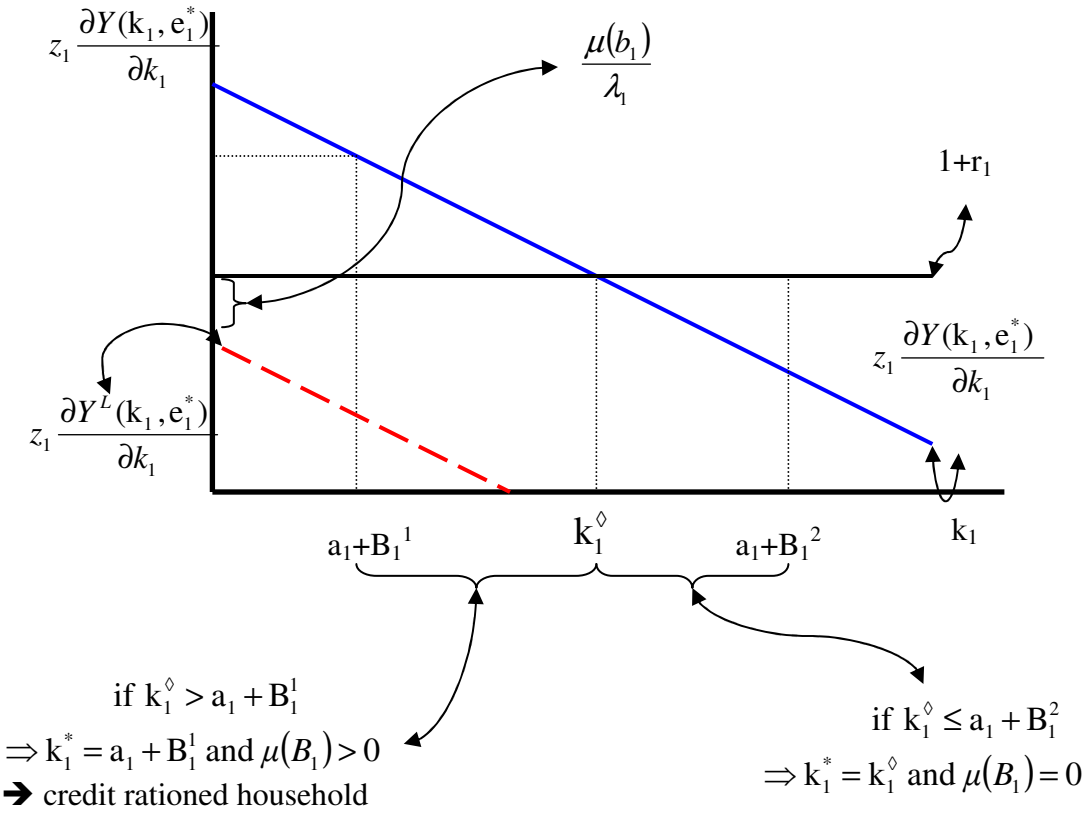


Figure 7.3.

Optimal Level of Capital, k_t*.

$$L_1 \frac{\partial U(c_1^*, e_1^*)}{\partial c_1} = \beta(L_2) \frac{\partial U(c_2^*, e_2^*)}{\partial c_2} \tag{7.46}$$

Alternatively, the condition in (7.46) can be represented as the equality of the marginal rate of substitution of intertemporal consumption with the slope of the intertemporal budget constraint, such that:

$$MRS_{c_2,c_1} = -\frac{dc_2}{dc_1} = \frac{\partial U(c_1^*, e_1^*)}{\partial c_1} \Big/ \beta \cdot \frac{\partial U(c_2^*, e_2^*)}{\partial c_2} = \left(\frac{L_2}{L_1}\right) > 0 \tag{7.47}$$

In this model, households are assumed to own an initial endowment of assets, a_0. Additionally, it has been assumed that households can store extra output from period one toward period two, such that $a_1 \geq 0$.

In order to represent in a graph the sixth and seventh FOC, each period's budget constraint can be rewritten in the following way:

$$\begin{aligned} c_1 &= z_1 Y(k_1, e_1) - (1 + r_1)(k_1 - a_0) - (a_1 - a_0)L_1 = H_1 - a_1 \\ c_2 &= z_2 Y(a_1 + b_2, e_2) + a_1 L_2 = H_2 + a_1 L_2 \end{aligned} \tag{7.48}$$

where a_1 represents the stored output (savings) from period one to period two, and H_t represents cash-in-hand available for consumption or saving. This case is presented in Figure 7.4.

If the minimum subsistence constraints are binding [$\mu(c_1) > 0$ and $\mu(c_2) > 0$] or the nonnegative savings constraint is binding [$\mu(a_1) > 0$], the seventh FOC becomes a more general expression. In this case, it establishes that, at the optimal solution, the shadow price of one extra unit of consumption in period one has to be equal to L_2 times the shadow price of one extra unit of consumption in period two, such that:

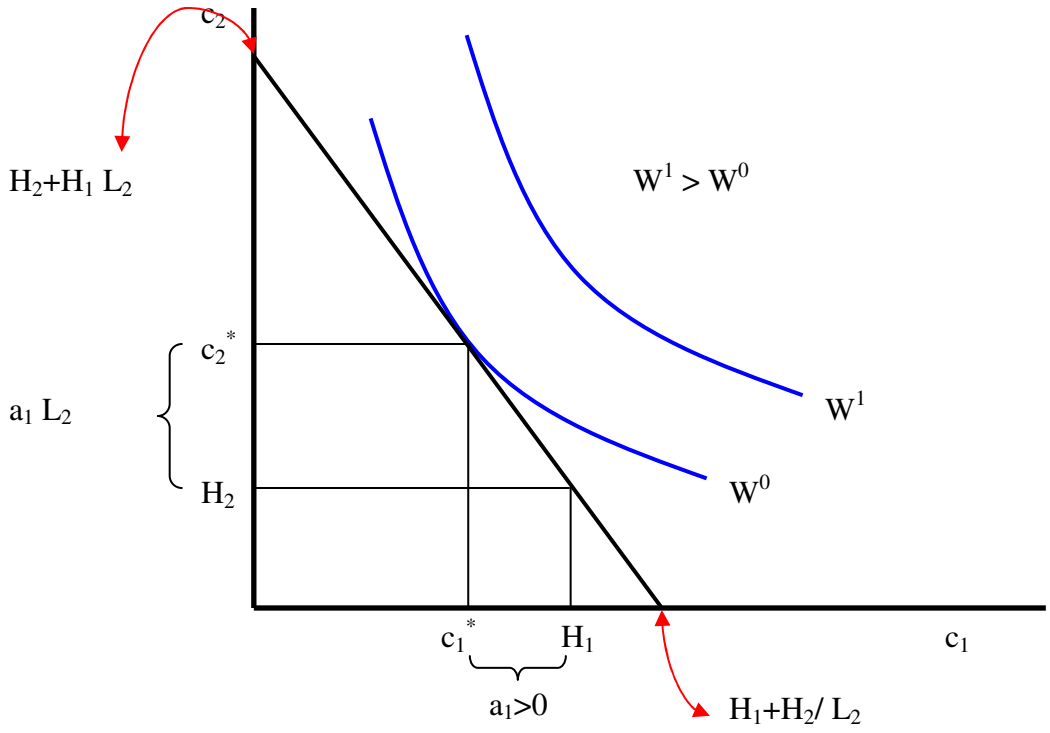


Figure 7.4.

Optimal Levels of c_1* and c_2*.

$$L_1 \frac{\partial U(c_1^*, e_1^*)}{\partial c_1} + \mu(c_1) = \left(\beta \cdot \frac{\partial U(c_2^*, e_2^*)}{\partial c_2} + \mu(c_2) \right) L_2 + \mu(a_1) = 0 \qquad (7.49)$$

In addition, when the minimum consumption constraints are binding, the marginal rate of substitution of intertemporal consumption will not be equal to the slope of the intertemporal budget constraint. Thus,

$$\begin{aligned} MRS_{c_2,c_1} &= -\frac{dc_2}{dc_1} \\ &= \frac{\frac{\partial U(c_1^*, e_1^*)}{\partial c_1}}{\beta \cdot \frac{\partial U(c_2^*, e_2^*)}{\partial c_2}} \neq \frac{\frac{\partial U(c_1^*, e_1^*)}{\partial c_1} + \mu(c_1) - \mu(a_1)}{\beta \cdot \frac{\partial U(c_2^*, e_2^*)}{\partial c_2} + \mu(c_2)} = \left(\frac{L_2}{L_1} \right) > 0 \end{aligned} \qquad (7.50)$$

In order to analyze production decisions, combining the third and fifth FOC defines the conditions that must be satisfied by the optimal combination of inputs in period one. Specifically, from the third or fourth FOC, the marginal product of effort is:

$$z_1 \frac{\partial Y(k_1, e_1)}{\partial e_1} = \frac{\mu(e_1) - \frac{\partial U(c_1, e_1)}{\partial e_1}}{\lambda_1} \qquad (7.51)$$

In turn, from the fifth FOC, the marginal product of capital is:

$$z_1 \frac{\partial Y(k_1, e_1)}{\partial k_1} = \frac{\mu(B_1) - \mu(b_1)}{\lambda_1} + (1 + r_1) \qquad (7.52)$$

Therefore, the marginal rate of technical substitution of capital for effort with positive KT multipliers is defined as:

$$MRTS_{k_1,e_1} = -\frac{dk}{de} = \frac{\frac{\partial Y(k_1, e_1)}{\partial e_1}}{\frac{\partial Y(k_1, e_1)}{\partial k_1}} = \frac{\left(\mu(e_1) - \frac{\partial U(c_t, e_t)}{\partial e_t} \right) \Big/ \lambda_1}{\frac{\mu(B_1) - \mu(b_1)}{\lambda_1} + (1 + r_1)} > 0 \qquad (7.53)$$

In turn, the marginal rate of technical substitution of capital for effort with zero KT multipliers (non-binding constraints) is defined as:

$$MRTS_{k_t,e_t} = -\frac{dk}{de} = \frac{\dfrac{\partial Y(\mathrm{k_t},\mathrm{e_t})}{\partial e_t}}{\dfrac{\partial Y(\mathrm{k_t},\mathrm{e_t})}{\partial k_t}} = -\frac{\dfrac{\partial U(\mathrm{c_t},\mathrm{e_t})}{\partial e_t} \Big/ \dfrac{\partial U(\mathrm{c_t},\mathrm{e_t})}{\partial c_t}}{1+\mathrm{r_t}} > 0 \quad (7.54)$$

7.3 Opportunistic Default without Unexpected Adverse Shocks

If, in period one, the household defaults on the loan, it loses access to credit in period two. When the household has sufficient ability to repay the loan in period one, the decision to default will depend on the relative levels of utility in both scenarios. If the total utility of the household under default is higher than the total utility of the household under repayment, the household will decide to default, even when there is sufficient ability to repay.

To default on the loan of period one implies not repaying any loan amount in that period, given the repay all-or-nothing rule, and therefore not having access to credit in period two. This also implies having to decide on the optimal level of the decision variables, constrained by a fixed level of capital in period one, namely k_1*, equal to the initial level of assets plus the loan from period one. The optimization problem of the household under default in the first period is:

$$\Gamma_{k_1=k_1^*} = \begin{bmatrix} U(c_1,\ e_1)+\beta U(c_2\ ,\ e_2) \\ +\lambda_1\{z_1 Y(k_1^*,\ e_1)\ -(a_1-a_0)L_1-c_1\} \\ +\lambda_2\{z_2 Y(a_1,e_2)\ +a_1 L_2-c_2\} \\ -\mu(e_1)\cdot(e_1-e^{Max})-\mu(e_2)\cdot(e_2-e^{Max}) \\ +\mu(c_1)\cdot(c_1-c^{Min})+\mu(c_2)\cdot(c_2-c^{Min}) \\ -\mu(B_1)\cdot(b_1-B_1)+\mu(b_1)\cdot b_1+\mu(a_1)\cdot a_1 \end{bmatrix} \tag{7.55}$$

The first-order conditions (FOC) in this case are:

$$\frac{\partial\Gamma}{\partial c_1} = \frac{\partial U(c_1,e_1)}{\partial c_1}-\lambda_1+\mu(c_1)=0 \tag{7.56}$$

$$\frac{\partial\Gamma}{\partial c_2} = \beta\cdot\frac{\partial U(c_2,e_2)}{\partial c_2}-\lambda_2+\mu(c_2)=0 \tag{7.57}$$

$$\frac{\partial\Gamma}{\partial e_1} = \frac{\partial U(c_1,e_1)}{\partial e_1}+\lambda_1 z_1\frac{\partial Y(k_1^*,e_1)}{\partial e_1}-\mu(e_1)=0 \tag{7.58}$$

$$\frac{\partial\Gamma}{\partial e_2} = \beta\cdot\frac{\partial U(c_2,e_2)}{\partial e_2}+\lambda_2 z_2\frac{\partial Y(k_2,e_2)}{\partial e_2}-\mu(e_2)=0 \tag{7.59}$$

$$\frac{\partial\Gamma}{\partial a_1} = -\lambda_1 L_1+\lambda_2\left(z_2\frac{\partial Y(k_2,e_2)}{\partial k_2}+L_2\right)+\mu(a_1)=0 \tag{7.60}$$

$$\frac{\partial\Gamma}{\partial\lambda_1} = z_1 Y(k_1^*,e_1)-(a_1-a_0)L_1-c_1=0 \tag{7.61}$$

$$\frac{\partial\Gamma}{\partial\lambda_2} = z_2 Y(a_1,e_2)+a_1 L_2-c_2=0 \tag{7.62}$$

$$\mu(e_1)\cdot(e_1-e^{Max})=0,\quad \mu(e_2)\cdot(e_2-e^{Max})=0 \tag{7.63}$$

$$\mu(c_1)\cdot(c_1-c^{Min})=0,\quad \mu(c_2)\cdot(c_2-c^{Min})=0 \tag{7.64}$$

$$\mu(a_1)\cdot a_1=0 \tag{7.65}$$

$$\mu(e_1),\mu(e_2),\mu(c_1),\mu(c_2),\mu(a_1)\geq 0 \tag{7.66}$$

$$e_1 \le e^{Max}, \quad e_2 \le e^{Max} \tag{7.67}$$

$$c_1 \ge c^{Min}, \quad c_2 \ge c^{Min} \tag{7.68}$$

$$a_1 \ge 0 \tag{7.69}$$

It will be assumed that a solution exists and that this solution is:

$$\psi^D = (c_1^D, c_2^D, e_1^D, e_2^D, a_1^D)$$

Additionally, this solution defines the optimal levels of utility in period one and two, U_1^D, and U_2^D, and the maximum value of utility W^D.

The maximum value of the objective function, given a decision to repay the loan of period one, is:

$$W^R(b) = \sup_{b_1 \le B_1} \begin{bmatrix} U(z_1 Y(b_1 + a_0, e_1) - (a_1 - a_0)L_1 - b_1(1+r_1),\ e_1) \\ +\beta U(z_2 Y(b_2 + a_1, e_2) + a_1 L_2,\ e_2) \end{bmatrix} \tag{7.70}$$

The maximum value of the objective function, given a decision to default on the loan of period one, is:

$$W^D(b) = \sup_{b_1 \le B_1} E_0 \begin{bmatrix} U(z_1 Y(b_1 + a_0, e_1) - (a_1 - a_0)L_1,\ e_1) \\ +\beta U(z_2 Y(a_1, e_2) - a_1 L_2,\ e_2) \end{bmatrix} \tag{7.71}$$

For notational purposes, b_1^R will represent the maximum amount of capital, made possible by the loan, below which the utility of the household under repayment is equal to the utility of the household under default, such that:

$$W^R(b_1^R) = W^D(b_1^R) \tag{7.72}$$

As will be shown later, b_1^R may not exist under the current debt contract. However, when it exists (when $b_1^R > 0$), for any loan below b_1^R there are incentives to repay, and for any loan larger that b_1^R any opportunistic household will default.

By the envelope theorem, the slope of $W^R(b)$ with respect to b_1 is given by:

$$\frac{\partial W^{R}(b)}{\partial b_1} = \frac{\partial \mathrm{U}\left[\mathrm{c}_1^{\mathrm{R}}(b),\ \mathrm{e}_1^{\mathrm{R}}(b)\right]}{\partial c_1}\left(\frac{\partial \mathrm{Y}\left[\mathrm{b}_1 + \mathrm{a}_1, \mathrm{e}_1^{\mathrm{R}}(b)\right]}{\partial b_1} - \left(1 + \mathrm{r}_1\right)\right) \qquad (7.73)$$

This slope will be positive as long as the marginal product of capital is higher than $1+r_1$, will be zero when these two variables are equated, and it will be negative when the marginal product of capital is lower than $1+r_1$. In other words, this function has a global maximum where $b_1 = b_1^*$, such that $k_1 = k_1^*$. Additionally, the higher (lower) the interest rate is, the lower (higher) is the loan amount where W^R reaches its maximum (b_1^*), given a decreasing marginal productivity of capital. Furthermore, W^R is decreasing in r_1, so that the higher the interest rate is, the lower W^R will be for any positive size of loan. These cases are represented in Figure 7.5.

The slope of $W^D(b)$ with respect to b is always positive, as long as the marginal utility of consumption and the marginal productivity of capital are positive, and is given by

$$\frac{\partial W^{D}(b)}{\partial b_1} = \frac{\partial \mathrm{U}\left[\mathrm{c}_1^{\mathrm{D}}(b),\ \mathrm{e}_1^{\mathrm{D}}(b)\right]}{\partial c_1}\left(\frac{\partial \mathrm{Y}\left[\mathrm{b}_1 + \mathrm{a}_1, \mathrm{e}_1^{\mathrm{D}}(b)\right]}{\partial b_1}\right) > 0 \qquad (7.74)$$

If $b_1 = 0$, then $W^R(0) = W^D(0)$ if $k_2 = a_2$. In other words, both functions intersect at the vertical axis when the household does not find any debt in period two to be welfare-improving. When this is the case, there will be default for any positive size of loan in period one. This is the case of a household that will not demand credit in period two and, therefore, does not have any incentives to preserve the credit relationship with the lender.

Additionally, when $b_1 = 0$ and $k_2 = a_2$, this implies that $c_1^D(0) = c_1^R(0)$ and $e_1^D(0) = e_1^R(0)$. Therefore, at this point, the slope with respect to b is higher for $W^D(0)$ than for $W^R(0)$. This is the case of $W^D(b)$, shown in Figure 7.6

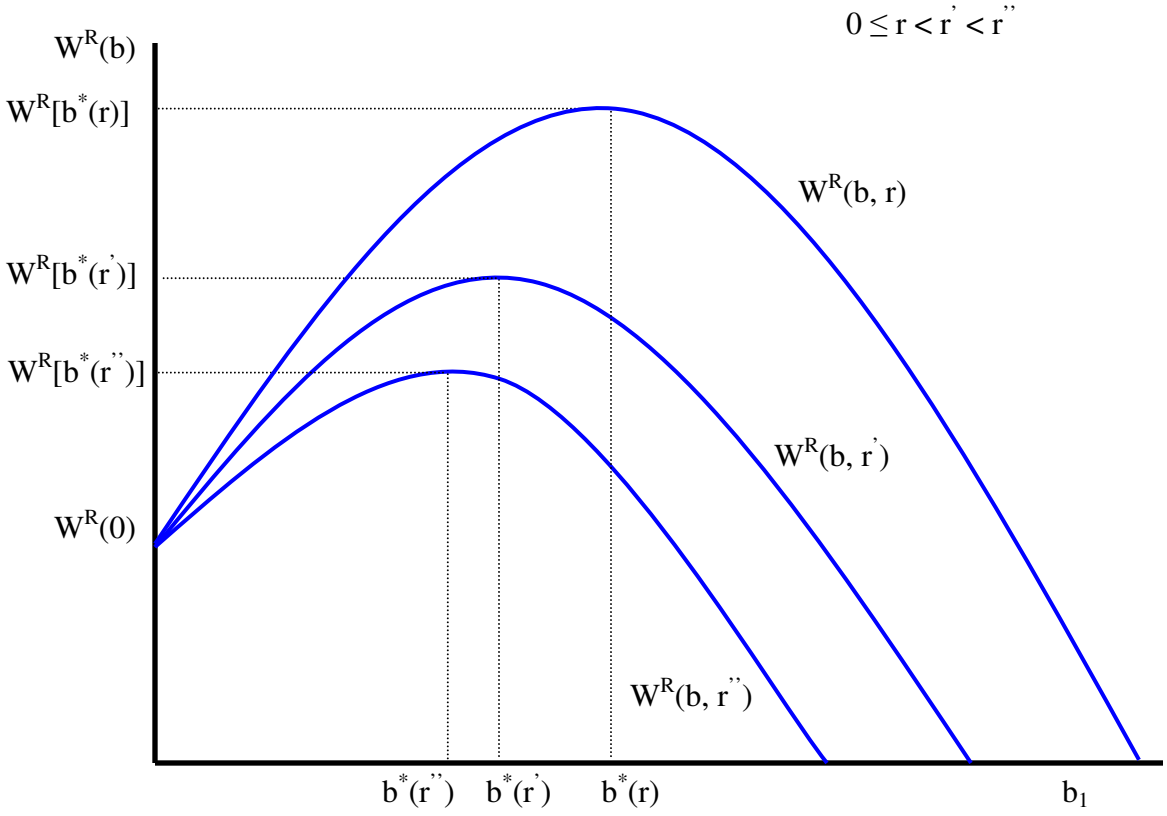


Figure 7.5.

***$W^R(b_1,r_1)$* and *b_1* for Different Levels of *r_1*.**

However, if there is no borrowing in period one, and the household demands a loan in period two, then $W^R(0) > W^D(0)$. This is the case of a household that demands a loan in period two, because the optimal level of investment in that period is higher than its accumulated assets. For this type of household, there exists a positive interval of debt amounts, such that for any $b^R \in \{0, b_1^R\}$, the value of the objective function will be:

$$W^R(b^R) \geq W^D(b^R) \tag{7.75}$$

These cases are depicted in Figure 7.6. Note that, for the existence of b_1^R, the following condition is not a necessary condition

$$\frac{\partial W^D(b)}{\partial b_1} > \frac{\partial W^R(b)}{\partial b_1} \tag{7.76}$$

Changes in the parameters of $W(b)^R$ and $W(b)^D$ have an impact on b_1^R, where b_1^R satisfies $W(b_1^R)^R = W(b_1^R)^D$. The impact of changes in $d_1 = (1+r_1)(k_1-a_1)$ on b_1^R is given by:

$$\begin{aligned} &\frac{\partial W^D(b)}{\partial d_1} = 0 \\ &\frac{\partial W^R(b)}{\partial d_1} = -\frac{\partial U(c_1, e_1)}{\partial c_1} < 0 \end{aligned} \tag{7.77}$$

In other words, the higher the debt obligations of the household in period one, the smaller the loan size above which the household does not have incentives to repay, even when there is sufficient repayment capacity, such that

$$\frac{\partial b_1^R(d_1)}{\partial d_1} =< 0 \tag{7.78}$$

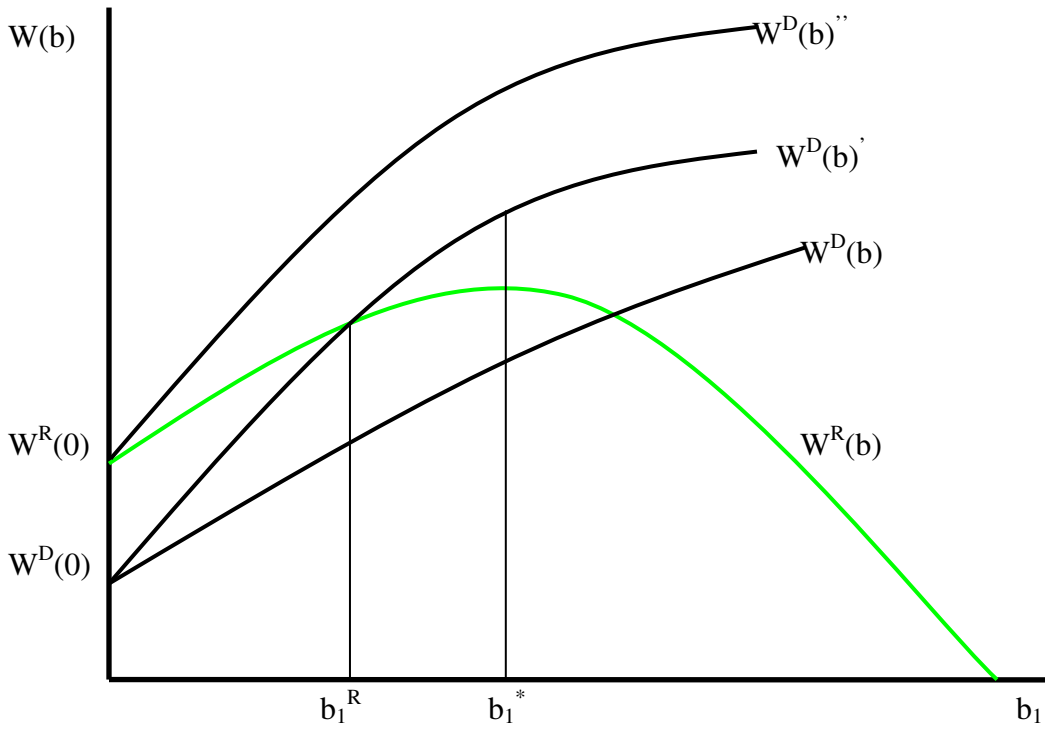


Figure 7.6.

***W^R(b_1)* and *b_1* for Different Levels of *r_1*.**

As previously shown, default may be caused by lack of willingness to repay, not just by insufficient ability to repay. In the current model, when households receive loans larger that b_1^R, they are better off under default than under repayment. This is one type of overindebtedness, when there is sufficient repayment capacity but there is no willingness to repay. In this model, as long as $W^R > W^D$, the household will always choose to repay the loan in the first period.

7.4 Unexpected Adverse Shocks

Risk is particularly important for households in countries where incomes are low and volatile. Households are vulnerable to risk from business failures, deteriorated macroeconomic conditions, and illness (Murdoch, 1995). The previous analysis has ignored the impact of adverse unexpected income shocks over the effective repayment capacity of the household and over the decision to repay.

However, microfinance borrowers face uncertainty about the future, and they must make decisions based on the best imperfect information they have available. Shocks may affect household welfare in many ways. Worsened economic conditions may result in unemployment or drops in sales, while accidents and illness may reduce the effective labor endowment of households in any given period or may destroy some assets.

In this section, it will be assumed that, given some unexpected adverse shock, the household becomes certain that, at the end of period one, the effective level of output $z_1^E Y_1^E(k_1^*, e_1^*)$ will be lower than the planned level of output, $z_1 Y(k_1^*, e_1^*)$, given the optimal amount of capital k_1* and the planned levels of effort e_1*, such that

$$(1+r_1)(k_1^* - a_0) > z_1^E Y_1^E(k_1^*, e_1^*) - c_1^* - (a_1^* - a_0)L_1 \qquad (7.79)$$

Once the household learns about the shock, there is no longer uncertainty about the production function of period one. This means that, after the shock, the only source of uncertainty is the outcome of the production function in period two.

Additionally, I assume that the household learns about the adverse shock early in the period, just after fixed assets have been bough with the loan, and that this investment is not reversible (*i.e.*, the household cannot disinvest and return the loan funds to the lender). Therefore, the household has only two options, either to default on the loan or to repay by undertaking costly actions.

In the model adopted here, the household can undertake any of the following three types of costly actions: (i) reduce consumption, (ii) increase effort, and (iii) reduce savings, all with respect to planned levels. The first two costly actions imply a reduction in the effective level of utility of period one, while the later implies a reduction in the level of utility of period two. In addition, it is possible that the shock may change the production function of period two. Under these circumstances, the household has two broad options, to repay or to default.

7.4.1 Analysis of the Repayment Scenario

Remember that this model assumes that households cannot get new loans unless they have repaid all previous ones. Let G_t represent the gap between effective available resources (gross income) minus current claims on funds (consumption + debt service) and accumulation of assets, such that

$$G_1 = \left\{z_1^E Y_1^E\left(k_1^*, e_1^*\right)\right\} - \left\{c_1^* + \left(1 + r_1\right)\left(k_1^* - a_0\right) - \left(a_1 - a_0\right)L_1\right\} < 0 \qquad (7.80)$$

After the adverse shock, unless something else changes, there is not enough ability to repay the loan. Note that G_t is the additional repayment capacity necessary to repay the loan. The larger G_t, the greater the reduction in consumption and asset drawdown and the larger the increase in effort necessary to repay the loan. Additionally, note that in order to generate extra repayment capacity, the household is constrained by the level of assets available. In other words, the household has to generate extra repayment capacity while keeping this variable fixed.

After the shock, the new problem for the household is to generate the extra repayment capacity necessary to repay the loan at a minimum loss of utility. This is equivalent to a new optimization problem, where the objective function is similar to the previous one, but subject to the constraint $G_t = 0$, and with fixed levels of $k_1 = k_1^*$ and $b_1 = b_1^*$. The Kuhn-Tucker Lagrangian for this problem is:

$$\Gamma_{k_1 = k_1^*} = \begin{bmatrix} U\left(c_1,\ e_1\right) + \beta U\left(c_2\ ,\ e_2\right) \\ + \lambda_1\left\{z_1^E Y^E\left(k_1^*,\ e_1\right) - \left(a_1 - a_0\right)L_1 - c_1 - \left(1 + r_1\right)\left(k_1^* - a_0\right)\right\} \\ + \lambda_2\left\{z_2\ Y\left(a_1 + b_2, e_2\right) + a_1 L_2 - c_2\right\} \\ - \mu\left(e_1\right)\cdot\left(e_1 - e^{Max}\right) - \mu\left(e_2\right)\cdot\left(e_2 - e^{Max}\right) \\ + \mu\left(c_1\right)\cdot\left(c_1 - c^{Min}\right) + \mu\left(c_2\right)\cdot\left(c_2 - c^{Min}\right) \\ - \mu\left(B_2\right)\cdot\left(b_2 - B_2\right) + \mu\left(b_2\right)\cdot b_2 + \mu\left(a_1\right)\cdot a_1 \end{bmatrix} \qquad (7.81)$$

The first-order conditions (FOC) for optimization are:

$$\frac{\partial \Gamma}{\partial c_1} = \frac{\partial U\left(c_1, e_1\right)}{\partial c_1} - \lambda_1 + \mu\left(c_1\right) = 0 \qquad (7.82)$$

$$\frac{\partial \Gamma}{\partial c_2} = \beta \cdot \frac{\partial U\left(c_2, e_2\right)}{\partial c_2} - \lambda_2 + \mu\left(c_2\right) = 0 \qquad (7.83)$$

$$\frac{\partial \Gamma}{\partial e_1} = \frac{\partial U(c_1, e_1)}{\partial e_1} + \lambda_1 z_1^E \frac{\partial Y^E(k_1^*, e_1)}{\partial e_1} - \mu(e_1) = 0 \tag{7.84}$$

$$\frac{\partial \Gamma}{\partial e_2} = \beta \frac{\partial U(c_2, e_2)}{\partial e_2} + \lambda_2 z_2 \frac{\partial Y(k_2, e_2)}{\partial e_2} - \mu(e_2) = 0 \tag{7.85}$$

$$\frac{\partial \Gamma}{\partial a_1} = -\lambda_1 L_1 + \lambda_2 \left(z_2 \frac{\partial Y(k_2, e_2)}{\partial e_2} + L_2 \right) + \mu(a_1) = 0 \tag{7.86}$$

$$\frac{\partial \Gamma}{\partial \lambda_1} = z_1^E Y^E(k_1^*, e_1) - (1 + r_1)(k_1^* - a_0) - (a_1 - a_0) L_1 - c_1 = 0 \tag{7.87}$$

$$\frac{\partial \Gamma}{\partial \lambda_2} = z_2 Y(a_1 + b_2, e_2) + a_1 L_2 - c_2 = 0 \tag{7.88}$$

$$\mu(e_1) \cdot (e_1 - e^{Max}) = 0, \quad \mu(e_2) \cdot (e_2 - e^{Max}) = 0 \tag{7.89}$$

$$\mu(c_1) \cdot (c_1 - c^{Min}) = 0, \quad \mu(c_2) \cdot (c_2 - c^{Min}) = 0 \tag{7.90}$$

$$\mu(B_1) \cdot (b_1 - B_1) = 0, \quad \mu(B_2) \cdot (b_2 - B_2) = 0 \tag{7.91}$$

$$\mu(b_1) \cdot b_1 = 0, \ \mu(b_2) \cdot b_2 = 0 \tag{7.92}$$

$$\mu(a_1) \cdot a_1 = 0 \tag{7.93}$$

$$\mu(e_1), \mu(e_2), \mu(c_1), \mu(c_2), \mu(B_2), \mu(b_2), \mu(a_1) \geq 0 \tag{7.94}$$

$$e_1 \leq e^{Max}, \quad e_2 \leq e^{Max} \tag{7.95}$$

$$c_1 \geq c^{Min}, \quad c_2 \geq c^{Min} \tag{7.96}$$

$$b_2 \leq B_2 \tag{7.97}$$

$$b_2 \geq 0 \tag{7.98}$$

$$a_1 \geq 0 \tag{7.99}$$

where λ_1 represents the impact on the expected utility of the household (at the optimal solution) of having to cover one extra unit of gap in period one. This is the shadow price

of consumption in period one, which is equal to the shadow price of the gap. In other words, λ_1 is the impact on the expected utility (at the optimal solution) of having a reduction on income due to the impact of the unexpected adverse shock in period one, while λ_2 is the shadow price of consumption in period two.

It will be assumed that an internal solution to the previous maximization problem exists and that this solution is:

$$\psi^{RS} = (c_1^{RS}, c_2^{RS}, e_1^{RS}, e_2^{RS}, k_2^{RS}, a_1^{RS}, M_1^{RS})$$

7.4.2 Analysis of the Default Scenario

To default on the loan implies loosing access to credit in period two, while not having to incur any costly action in period one (such as reduced consumption or increased effort). Under default, the problem for the household is:

$$\Gamma_{k_1=k_1^*} = \begin{bmatrix} U(c_1,\ e_1)+\beta U(c_2\ ,\ e_2) \\ +\lambda_1\left\{z_1^E Y^E(k_1^*, e_1)\ -(a_1-a_0)L_1-c_1\right\} \\ +\lambda_2\left\{z_2 Y^E(k_2, e_2)\ - a_1 L_2 - c_2\right\} \\ -\mu(e_1)\cdot(e_1-e^{Max})-\mu(e_2)\cdot(e_2-e^{Max}) \\ +\mu(c_1)\cdot(c_1-c^{Min})+\mu(c_2)\cdot(c_2-c^{Min}) \\ -\mu(B_2)\cdot(b_2 - B_2)+\mu(b_2)\cdot b_2+\mu(a_1)\cdot a_1 \end{bmatrix} \quad (7.100)$$

The first-order conditions (FOC) for optimization are:

$$\frac{\partial\Gamma}{\partial c_1} = \frac{\partial U(c_1, e_1)}{\partial c_1} - \lambda_1 + \mu(c_1) = 0 \quad (7.101)$$

$$\frac{\partial\Gamma}{\partial c_2} = \beta\cdot\frac{\partial U(c_2, e_2)}{\partial c_2} - \lambda_2 + \mu(c_2) = 0 \quad (7.102)$$

$$\frac{\partial \Gamma}{\partial e_1} = \frac{\partial U(\mathrm{c}_1, \mathrm{e}_1)}{\partial e_1} + \lambda_1 z_1^E \frac{\partial Y^{\mathrm{E}}(\mathrm{k}_1^*, \mathrm{e}_1)}{\partial e_1} - \mu(e_1) = 0 \tag{7.103}$$

$$\frac{\partial \Gamma}{\partial e_2} = \beta \cdot \frac{\partial U(\mathrm{c}_2, \mathrm{e}_2)}{\partial e_2} + \lambda_2 z_2 \frac{\partial Y(\mathrm{k}_2, \mathrm{e}_2)}{\partial e_2} - \mu(e_2) = 0 \tag{7.104}$$

$$\frac{\partial \Gamma}{\partial a_1} = -\lambda_1 L_1 + \lambda_2 \left(\mathrm{z}_2 \frac{\partial Y(\mathrm{k}_2, \mathrm{e}_2)}{\partial e_2} + \mathrm{L}_2 \right) + \mu(a_1) = 0 \tag{7.105}$$

$$\frac{\partial \Gamma}{\partial \lambda_1} = \mathrm{z}_1^{\mathrm{E}} \mathrm{Y}^E(\mathrm{k}_1^*, \mathrm{e}_1) - (\mathrm{a}_1 - \mathrm{a}_0)\mathrm{L}_1 - c_1 = 0 \tag{7.106}$$

$$\frac{\partial \Gamma}{\partial \lambda_2} = \mathrm{z}_2 \mathrm{Y}(\mathrm{a}_1 + \mathrm{b}_2, \mathrm{e}_2) + \mathrm{a}_1 \mathrm{L}_2 - c_2 = 0 \tag{7.107}$$

$$\mu(\mathrm{e}_1) \cdot (\mathrm{e}_1 - e^{Max}) = 0, \quad \mu(\mathrm{e}_2) \cdot (\mathrm{e}_2 - e^{Max}) = 0 \tag{7.108}$$

$$\mu(\mathrm{c}_1) \cdot (\mathrm{c}_1 - c^{Min}) = 0, \quad \mu(\mathrm{c}_2) \cdot (\mathrm{c}_2 - c^{Min}) = 0 \tag{7.109}$$

$$\mu(\mathrm{B}_2) \cdot (\mathrm{b}_2 - \mathrm{B}_2) = 0 \tag{7.110}$$

$$\mu(\mathrm{b}_2) \cdot \mathrm{b}_2 = 0 \tag{7.111}$$

$$\mu(\mathrm{a}_1) \cdot \mathrm{a}_1 = 0 \tag{7.112}$$

$$\mu(\mathrm{e}_1), \mu(\mathrm{e}_2), \mu(\mathrm{c}_1), \mu(\mathrm{c}_2), \mu(\mathrm{B}_2), \mu(\mathrm{b}_2), \mu(\mathrm{a}_1) \geq 0 \tag{7.113}$$

$$\mathrm{e}_1 \leq e^{Max}, \quad \mathrm{e}_2 \leq e^{Max} \tag{7.114}$$

$$\mathrm{c}_1 \geq c^{Min}, \quad \mathrm{c}_2 \geq c^{Min} \tag{7.115}$$

$$\mathrm{b}_2 \leq \mathrm{B}_2 \tag{7.116}$$

$$\mathrm{b}_2 \geq 0 \tag{7.117}$$

$$\mathrm{a}_1 \geq 0 \tag{7.118}$$

It will be assumed that a solution to the previous maximization problem for the household exists and that this solution is:

$$\psi^{DS} = (c_1^{DS}, c_2^{DS}, e_1^{DS}, e_2^{DS}, k_2^{DS}, a_1^{DS})$$

Additionally, the previous solution defines the optimal levels of utility in period one and two, U_1^{DS}, and U_2^{DS}, and the maximum level of utility W^{DS}.

7.4.3 Extraordinary Repayment Capacity

The larger the gap that the household needs to cover with extraordinary repayment capacity, the most likely that the household will default, specially if the consumption levels are very close to the subsistence level or if the effort levels are very close to the maximum capacity of the household.

The main impact of the shock is through changes in the ability level in production z_t. In particular, there can be either a mean shift of the distribution of income earned, a larger deviation from the mean for all households, or both, due to the unexpected adverse shocks. However, the shifts in the distribution and deviations from the mean do not have to be uniform over different types of lenders and over the borrowers that are matched by their respective lending technologies. These differences across lender types are important in understanding why the borrowers associated with some types of lenders are more likely to generate extraordinary repayment capacity than households matched with other types of lenders.

CHAPTER 8

SAMPLE DESCRIPTION, ECONOMETRIC APPROACH AND RESULTS

8.1 Sampling and Sample Description

The Rural Finance Program at The Ohio State University implemented the data collection effort between October and December of 2001. The sample was designed to be representative of the 1999 departmental distribution of the urban clients of Bolivian MFIs. The sampling framework was a distribution of clients by location, from the data available at the SBEF.

The sample was randomly selected using a two-stage process. The units for this sampling procedure were the zones and segments defined for the implementation of the 2001 Bolivian Census by the *Instituto Nacional de Estadística* (INE). In the first stage, zones were selected for each one of the locations to be studied (La Paz, El Alto, Oruro, Cochabamba, and Santa Cruz). In the second stage, segments were randomly selected in each zone, and every household in the segment was approached.

Since the goal of the survey was to obtain information representative of the Bolivian microfinance sector, three requirements were imposed on households in order to be interviewed (filters). First, at least one member of the household should have

undertaken at least one independent activity during the 1997-2001 period. Second, the number of employees in the independent activity should have been at most 15 employees. Third, at least one member of the household should have received at least one loan from any one of a specific group of lenders over the 1997-2001 period. Lenders in this group included all MFIs (regulated and non-regulated), consumption lenders, the "microfinance" or consumption programs of commercial banks, and cooperatives.

In the end, after screening 3,607 households, it was possible to find 959 that satisfied all three requirements. Surprisingly, even though it would seem likely that an important proportion of Bolivians would have refused to be interviewed by a stranger about their experience with credit (rejections), only 247 households (6.9 percent) of those approached before the filter was applied refused to participate in the interview at all. The detail of the rejections by department is presented in Table 8.1. For the households that refused to participate, it was impossible to know if they did have any independent activity or had received any qualifying loan in the 1997-2001 period.

For the households that agreed to participate in the screening process, 27 percent of them did not qualify for the interview because they did not have an independent activity during the 1997-2001 period, while 14 households employed more than 15 persons in their independent activities. The highest proportions without independent activity were among the households of La Paz (39 percent), followed by Oruro (30 percent), Cochabamba (25 percent), El Alto (23 percent), and Santa Cruz (21 percent).

Department	Rejections	Without Independent Activity [a/]	With Independent Activity		Total	Total Without Rejections
			Without Qualifying Loan	With Qualifying Loan		
Cochabamba	108	125	192	177	602	494
El Alto	43	231	475	281	1,030	987
La Paz	40	290	298	160	788	748
Oruro	39	50	57	58	204	165
Santa Cruz	17	203	480	283	983	966
Total	**247**	**899**	**1,502**	**959**	**3,607**	**3,360**

a/ Including 14 households that employed more than 15 people in their independent activity.

Source: Overindebtedness Survey – OSU, 2001.

Table 8.1. Sampling Filters by Department: Number of Households.

The results for La Paz are consistent with a greater availability of salaried sources of income, specially in the public and the services sectors. The case of Oruro reflects the fact that there are not many choices for independent activities in that region, with the exception of the smuggling of goods across the international borders with Chile and Argentina.

Finally, 61 percent of the households with independent activity did not receive any eligible loan in the 1997-2001 period. This finding is important, because it means that only 39 percent of the households that at least had one independent activity did receive at least one qualifying loan in the period. Thus, despite the impressive improvements in microfinance, well beyond the breadth of outreach achieved in other

countries, there were still many microentrepreneurs who had not been reached by these services in Bolivia. The causes for this outreach challenge are many and are beyond the scope of this dissertation. Maybe some of these households do not demand credit all of the time, or the existing lending technologies still exclude them. Furthermore, the time frame for this outcome was the "crisis" period, while the breadth of outreach seems to have doubled in Bolivia (in terms of the numbers of clients reached) since that time.

Finally, out of the 3,607 households screened, almost 27 percent satisfied the three requirements and the full survey was implemented to them. Table 8.2 presents the final sample distribution by department and municipality type. The sample is distributed in four departments and five major cities: Cochabamba, El Alto, La Paz, Oruro, and Santa Cruz. Across municipalities, 61 percent of the sample is located in capital cities, 36 percent in urban locations, and only 3 percent in rural municipalities. Even though El Alto (a large urban area of recent development, through massive rural-urban migration) is part of the department of La Paz and in a close location to the city of La Paz, for analytical purposes I will treat these two cities as separate geographical areas in the discussion of the data and econometric analysis, in recognition of key cultural and economic differences.

Beyond the department capitals, the urban municipalities in Cochabamba are Colcapirua, Punata, Quillacollo, and Sacaba; El Alto is the municipality with the same name; and the urban municipalities in Santa Cruz are Mineros and Montero. The rural municipalities are Laja and Viacha in El Alto, and Cotoca in Santa Cruz. Based on this, the sample is mostly urban and concentrated in municipality capitals. Hereafter, I will refer to the sample collected by this survey as the Overindebtedness Survey – OSU, 2001.

Department	Municipality Type			Total	% [a/]
	Capital	Urban	Rural		
Cochabamba	108	69	0	177	18
% [b/]	61	39	0	100	
El Alto [c/]	0	265	16	281	29
% [b/]	0	94	6	100	
La Paz [c/]	160	0	0	160	17
% [b/]	100	0	0	100	
Oruro	58	0	0	58	6
% [b/]	100	0	0	100	
Santa Cruz	258	14	11	283	30
% [b/]	91	5	4	100	
Total	584	348	27	959	100
% [b/]	61	36	3	100	

a/ Percentages by department with respect to the total sample of 959 households.
b/ Percentages by city type with respect to departmental subsamples and total.
c/ The city of El Alto is part of the department of La Paz; however, it will be treated independently for analytical purposes.

Source: Overindebtedness Survey – OSU, 2001.

Table 8.2. Sample Distribution by Department and Municipality Type:

Number of Households and Percentages.

8.2 Opening the Black Box of Repayment Capacity

In this section, I will describe the main results from the survey, focusing on the research questions and the conceptual framework about overindebtedness discussed in chapter 3. Gonzalez and Gonzalez-Vega (2003) contribute a rich discussion of additional survey results.

For analytical purposes, I will classify all potentials lenders available to a Bolivian household in the 1997-2001 period into nine categories, according to their lending technology, regulatory status, and legal form: groups, individual, consumption, village banks, cooperatives, NGOs, banks, commercial, and informal. In addition, I will consider lenders in the first seven groups as formal lenders, and lenders in the last two groups as informal lenders.

- **Group lenders**: This category includes the only two regulated MFIs with group lending in the 1997-2001 period: BancoSol and PRODEM.
- **Individual lenders:** This category includes the four regulated MFIs without a banking license (*fondos financieros privados* or FFPs) that operate on the basis of individual lending technologies (as opposed to solidarity groups or consumption lending): Caja Los Andes (now Banco Procredit), EcoFuturo, FIE, and Fondo de la Comunidad.
- **Consumption lenders**: This category is a combination of the so-called "microfinance programs" of traditional banks (like Presto in Banco Económico, CrediAgil in Banco de la Unión, Solución in Banco Santa Cruz,

and Superfácil in Banco Mercantil), the other FFPs focused on consumption lending (FASSIL and ACCESO), and the credit cards from traditional banks.

- **Village banks:** This category includes only CRECER and Pro Mujer, both of them unregulated NGOs whose lending technologies and performance were similar during the 1997-2001 period.
- **Cooperatives**: This category groups all credit cooperatives, such as Jesús Nazareno, San Martín de Porres, FINANCIACOOP, La Merced, Pío X, or Fátima.
- **NGOs**: This category includes all other non-regulated MFIs, such as CIDRE, IDEPRO, Diaconía-FRIF, SARTAWI, Agrocapital, FADES, and Funbodem.
- **Banks**: This category includes all traditional banks and *mutuales* (savings and loans associations), characterized by fully collateralized loans, with traditional collateral.
- **Commercial sources**: This category includes all lines of credit to finance purchases of goods at particular stores, like hardware stores, warehouses, intermediaries, wholesale sellers or convenience stores.
- **Informal sources**: This category includes moneylenders, friends, relatives, pasanaku (a type of ROSCA)[3], employers, pawnshops, and the like.

Overall, the 959 households in the survey were engaged in 1,282 lending relationships with formal lenders during the 1997-2001 period. This means that the households in the sample on average developed relationships with 1.3 different formal

[3] In a random selection, pasanaku members contribute a fixed sum to a pot at regularly scheduled meetings, and then take turns in receiving loans from the common pool of funds (Besley, Coate and Loury, 1993; Bouman, 1995).

lenders. Let me emphasize that this is 1.3 lenders, not loans, because the households in the sample received several loans from some of these sources of credit during the 1997-2001 period. That is, borrowers may have received multiple loans over time in connection with a given relationship. Based on the survey, however, I do not know the details about each particular loan.

It is possible to classify each lending relationship into one of three mutually exclusive categories, according to the level of arrears. Note that since many households had more than one lending relationship in the 1997-2001 period, the description of the sample results related to credit transactions is presented in terms of lending relationships rather than in terms of households, in order to gain insights about the composition of the global portfolio of different types of MFIs.

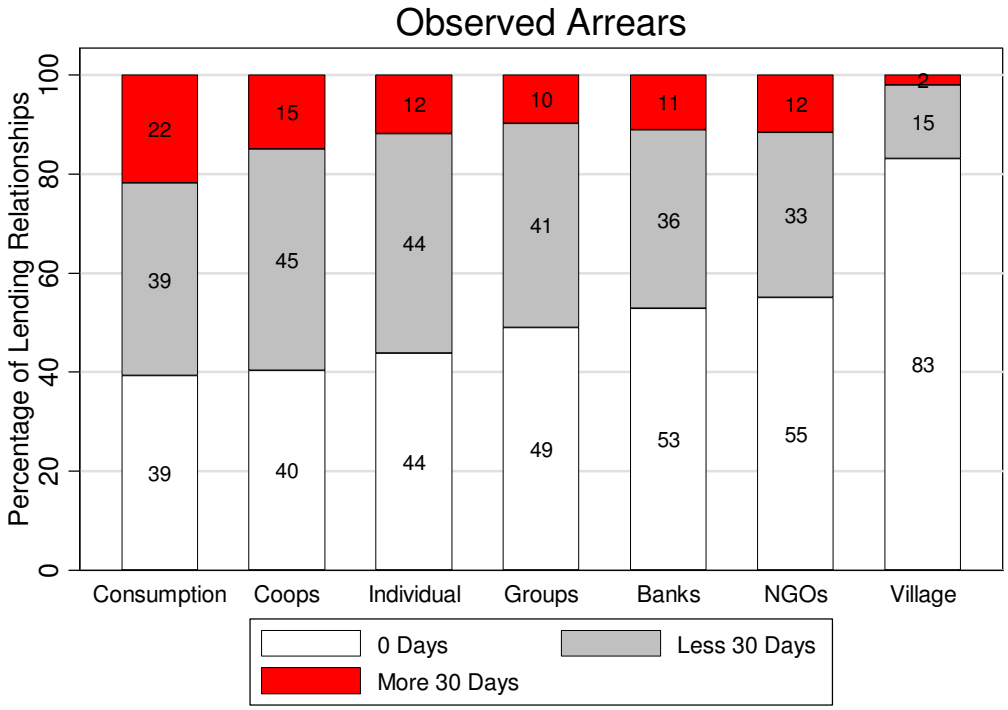
In particular, for the whole sample, 630 lending relationships (49 percent of the total number of relationships) presented a perfect repayment record, with 0 days of arrears for all loans in the 1997-2001 period. In turn, 492 lending relationships (38 percent) experienced arrears of less than 30 days at least once in the period, and 160 relationships (12 percent) experienced arrears of more than 30 days at least once in the period. Arrears are basic financial indicators that most MFIs analyze using their internal information systems. For example, today close to 1,200 MFIs worldwide disclose their detailed financial information in the MIX Market (www.mixmarket.org), including indicators of portfolio quality like portfolio at risk over 30 days, loan loss reserve ratios, risk coverage ratios and write-off ratios.

A breakdown of arrears by type of lender is presented in Figure 8.1. For the 1997-2001 period, village banks are the MFIs with the lowest levels of arrears (with only

17 percent of their borrowers experiencing some). Village banks are followed by NGOs (35 percent), banks (37 percent), group lenders (51 percent), individual lenders (56 percent), cooperatives (60 percent), and consumption lenders (61 percent).

The results shown in Figure 8.1 may be surprising for observers not familiar with microfinance. One reason for this surprise may be that the best repayment rates are achieved by village banks, both unregulated NGOs, with a 100 percent of uncollateralized loans (from the traditional perspective), and not allowed to report defaulters to the public-sector (SBEF) credit bureau during the 1997-2001 period (so that this type of reputation effect was not an incentive to repay). Then, the question of how do village banks design loan contracts that keep incentives to repay so high and arrears so low in comparison to other types of lenders, which employ more explicit incentive schemes (like traditional collateral or reputations effects), is at the heart of this dissertation.

What makes this survey unique is the possibility to identify all the costly actions taken by the households in order to repay each loan over the 1997-2001 period and classify these actions and outcomes in ways more consistent with the different overindebtedness situations previously discussed. In chapter 3, I defined as *non-overindebted* households those that are both willing to repay the loan and can repay it on time, without incurring costly actions. In contrast, *overindebted* households are those that either are not willing to repay, cannot generate sufficient repayment capacity without engaging in costly actions, repay only partially, or are in arrears.



Based on 1,282 lending relationships in the 1997-2001 period. Figures are percentages based on the total number of credit relationships by type of lender.

Source: Overindebtedness Survey – OSU, 2001.

Figure 8.1.

Arrears Levels by Type of Lender in the 1997-2001 Period.

Based on this definition, one important distinction between overindebted and non-overindebted households is that non-overindebted households are the only ones that do not need to engage in any costly actions in order to repay on time, even after unexpected adverse shocks. In other words, non-overindebted lending relationships are the only ones where the forecasted or *ordinary* repayment capacity (without engaging in costly actions) was sufficient to make all the payments on time. An analysis of non-overindebted households can then help identify which types of MFIs have the best lending technologies in terms of the most accurate prediction of the ordinary repayment capacity of a household.

Based on the information collected in the survey, it is possible to classify households into six categories, by combining the level of arrears (zero days, less than 30 days, 30 days or more) and the two categories of costly actions: *active* (the household engaged in some costly actions at least once in the period) and *inactive* (the household did not engage in any costly actions). Therefore, the final six mutually exclusive categories of observed outcomes are: (A) non-overindebted, (B) active - zero days of arrears, (C) active - less than 30 days of arrears, (D) active - 30 days or more of arrears, (E) inactive - less than 30 days of arrears, and (F) inactive - 30 days or more of arrears. These categories are represented at the bottom of the tree in Figure 8.2. The numbers in parenthesis show the number of lending relationships for each case, according to the sample. These observed outcomes are the consequence of different combinations of ordinary and extraordinary willingness and ability to repay. These possible combinations are shown in Figure 8.2.

The top of Figure 8.2 is a tree representation of all repayment scenarios, under a framework that allows the analysis of costly actions, their effectiveness in achieving lower arrears, and their link with the observed outcomes in the survey (bottom of the tree). This tree is a more elaborate version of the one presented in Chapter 3. It shows the borrowers' choices after consideration of a random adverse event. The consequences of this shock may be decomposed into two dimensions: a mean shift of the distribution of production results (systemic shock) and a deviation for specific borrowers of the project outcomes from the mean of the new distribution (idiosyncratic outcomes). This random event may influence the decisions of the borrowers and the outcomes of the costly actions taken by the household in terms of a revised willingness to repay and of the effectiveness of the costly actions in actually generating extra repayment capacity.

The decision process is more complex than described here, and the household would have taken many decisions before having to take the decision to repay. For example, first the household must decide it to demand a loan or not. Second, the household must decide whether to apply for a loan, given what it knows about supply, and what size of loan to request. Next, the actual size of the loan is determined by the interaction of borrower characteristics and the lending technology. Finally, some applicants are rejected and others rationed, so they may get smaller loans than those demanded. Then, disbursement takes place. Here is where the decision process examined here starts. It refers only to households that have a loan and decide if to repay the loan in a given period or not. See Joshi (2005) for a discussion.

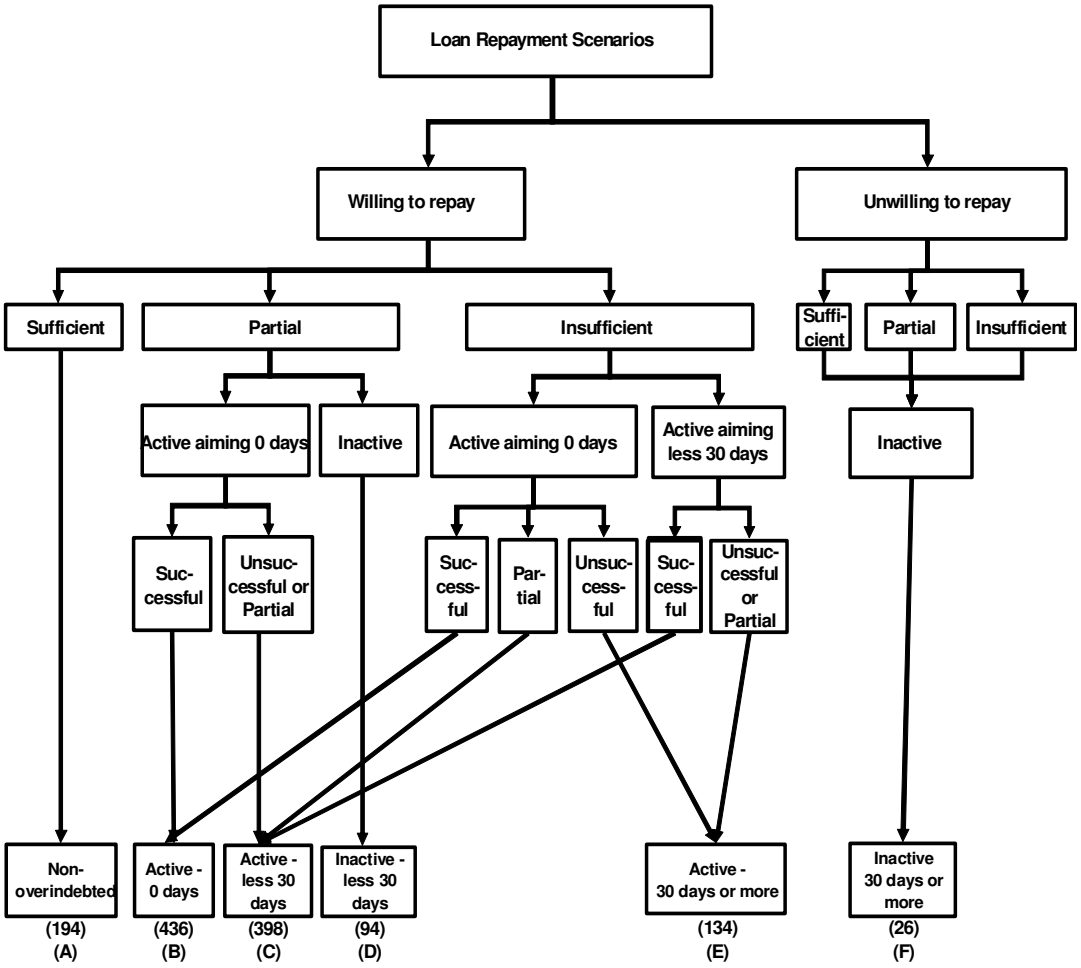


Figure 8.2.

Repayment Scenarios versus Observed Outcomes.

Before or even after the loan has been disbursed, however, one decision that the household must make is about willingness to repay. This decision was discussed in section 3.1. One possibility is that, even if before the household took the loan there was indeed (ex ante) willingness to repay, due to changes in the current and future states of nature (adverse shocks), a lower value of the lending relationship may result in (ex post) unwillingness to repay. Another possibility is that, even before the shocks materialized, the household was already planning to default, and the subsequent shocks just increased the net value of defaulting versus the value of repaying (opportunistic default).

If the household decides that repayment is better than default, then different paths may be followed, depending on the effective repayment capacity without costly actions (ordinary repayment capacity). If there is willingness to repay and the ordinary ability to repay is sufficient to repay with zero days of arrears, the household does not need to engage in any costly actions, and we observe non-overindebtedness. This is category (A) in the tree, where the incidence of this status reflects the survey results.

If, after the shock, the ordinary repayment capacity is not sufficient to repay on time and with no arrears (that is, the ordinary ability to repay is only partially sufficient) but it will be sufficient to repay within 30 days, then a household that is willing to repay has two options. It may do nothing (inactive) and then repay with arrears of less than 30 days, given its ability to do so (D), or it may engage in costly actions, in aiming to repay with zero days of arrears. However, even to engage in costly actions may not be enough for the household to be able to repay on time, for instance if the economic conditions are not favorable for the generation of the extra ability to repay which the household is expecting to generate when it decides to engage in the costly actions.

In this case, two additional scenarios emerge. One scenario is when the household succeeds in generating the extra repayment capacity and pays on time (B). This success depends on both the general economic conditions and the household's specific capacity to generate the extra ability to repay. The other scenario is when the household fails (partially or totally) to generate the extra ability to repay, a necessary condition to repay with zero days of arrears (C). Analytically, under the current tree structure and from the survey's perspective, partial failure and full failure are identical. The only case when the distinction is relevant is for insufficient ability plus aiming at repayment with zero days of arrears. This particular branch is considered explicitly in the tree.

Those households that do not generate sufficient ordinary repayment capacity, which would allow them repayment at least with under 30 days of arrears, account for the third type of households that are willing to repay (insufficient ordinary repayment capacity). Depending on the strength of the incentives, these households may then engage in costly actions, aiming to repay with zero days of arrears or with less than 30 days of arrears. Households aiming to repay with zero days of arrears can experience three different outcomes: full success (B), partial success (C), or failure (E). In addition, households aiming to repay with less than 30 days of arrears may experience two different outcomes: full success (C) or partial or total failure (E). Categories (B), (C), (D) and (E) thus result from an initial insufficient ordinary ability to repay followed by different degrees of extraordinary willingness and the capacity to generate additional ability to repay.

At the far right branch of the tree are the households that are not willing to repay. For these households, once the decision not to repay has been taken, inactivity becomes the default choice and, based on the survey, they will be the households in category (F).

8.3 Dependent Variables

As the choices and outcomes along the tree suggest, the categories observed with the survey instrument are the result of several potential causes and their combinations. The information from the survey does not allow, however, a distinction of the specific causes. This identification issue limits the nature of the comparisons that are possible in the empirical analysis. Further distinction across these cases would be valuable, but the current dataset does not allow it.

For example, among households that were willing to repay (for which there was ordinary willingness) and which did not have sufficient ordinary ability to repay on time, it is impossible to differentiate how large the partial or total initial lack of ability was, because the final outcomes were observed only after the extraordinary and costly actions had been taken. The intermediate step in the tree was not observed in the survey. For analytical purposes, however, this distinction might allow the researcher to identify the accuracy of alternative lending technologies in forecasting ordinary repayment capacity under uncertainty.

Second, based on the survey, it is also impossible to distinguish between households aiming to repay with zero days of arrears versus households only aiming to repay with less than 30 days of arrears, because it is impossible to know if the

extraordinary and costly actions that they took were partially or completely successful, given their objectives. Does the final outcome reflect insufficient extraordinary willingness or insufficient extraordinary ability in the second stage? This analysis, however, may be useful for MFIs in evaluating how effective their incentive mechanisms are in inducing extraordinary willingness and, therefore, effort for the household to successfully achieve its expected (desired) levels of arrears, compatible with the MFI's goals.

Finally, it is impossible to separate households in terms of the cost effectiveness of generating extraordinary repayment capacity, because similar outcomes may have required larger efforts and sacrifice for some compared to others. This information may help the researcher in identifying which lending technologies are more accurate at identifying extraordinary repayment capacity as well as how costly this achievement is for the household. This information is important, because exceptionally high costs reduce the borrowers' probability of demanding and receiving new loans in the future. Thus, these are important questions that future research will need to answer, based on new surveys that solve the identification issues highlighted by these examples.

Nevertheless, the data from the survey can still be used to identify several important issues. Based on category (A), it is possible to identify which lending technologies forecasted better the ordinary repayment capacity of the households in the sample, conditional on the correct identification of willingness to repay, since this is the only group for which the ordinary ability to repay was enough to fulfill the obligation of the loan with zero days of arrears.

Since some of the households in category (F) also had enough ordinary ability to repay with zero days of arrears and others did not, this analysis should aim at differentiating households in category (A) versus households in categories (B+C+D+E), excluding those in (F). That is, the exercise will identify households with both willingness and ability to repay according to the contract terms. These are the only non-overindebted households in the sample. For easy reference, I will call this empirical model *Logit I*.

Next, I will focus on categories B, C, D and E. Households in these categories had indeed willingness to repay, but they needed to engage in costly actions in order to actually repay. For these households, ceteris paribus, the greater the incentives to repay with a lower level of arrears, the higher the level of effort that they would put into the costly actions and the higher the probability of success of these costly actions. In addition, for these households, ceteris paribus, the greater their ability to generate extraordinary repayment capacity, given their endowment and opportunities, the higher the success rate of their costly actions and the lower the level of arrears observed in the end.

For instance, all households in category (B) were aiming at repaying with zero days of arrears, and they were successful in generating the extra repayment capacity to do so. However, households in category (C) were either aiming at repaying but only with some level of arrears or they were less successful in generating the extra repayment capacity required, in comparison to households in category (B).

In turn, compared to category (C), households in category (E) score even lower (from the point of view of most MFIs) in terms of at least one of the dimensions under

analysis; either they were aiming at levels of arrears over zero days but could not generate sufficient ability to repay with less than 30 days of arrears or they were aiming at repaying within less than 30 days but failed in the attempt.

For instance, Gonzalez (2007) reports that, in a sample of over 700 MFIs, the average portfolio at risk over 30 days is 6 percent and the average write-off ratio is 3 percent. Thus, from the point of view of most MFIs, it is preferable to push as many households away from (E) and preferably into (B), and in order to do so they need a combination of better incentives —such that the households would aim at zero days of arrears— and a better screening of households —such that they select households that are more successful in generating extraordinary repayment capacity.

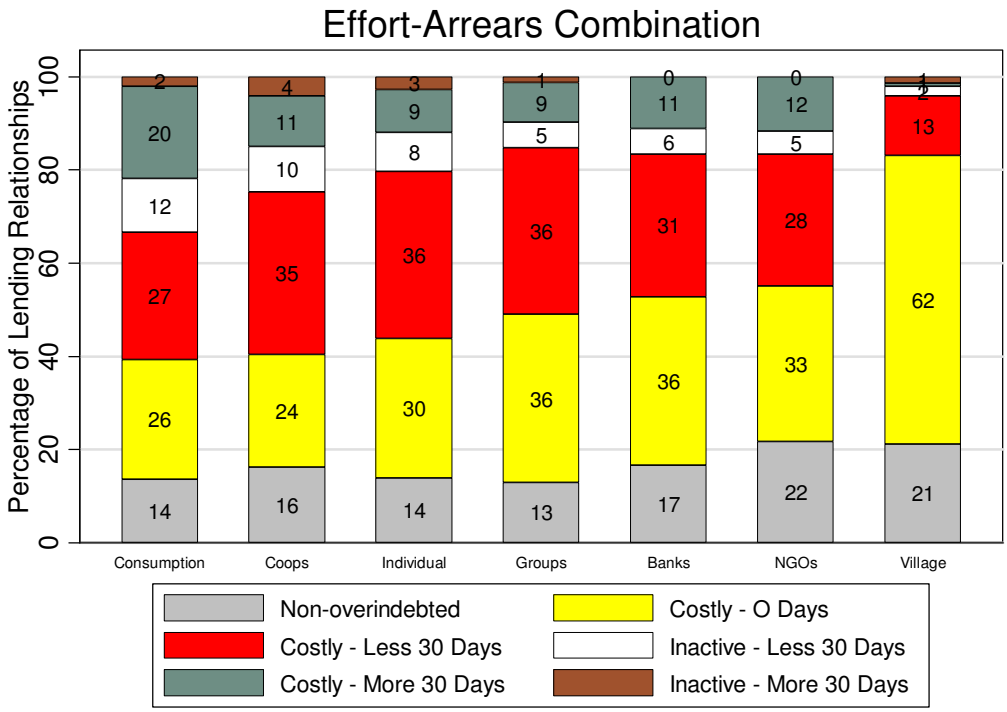
Following the same analysis, (D) is worse than (C) in terms of the revealed incentives, even if the arrears level is the same. Thus, each one of these four categories has different implications and, therefore, valuation from the perspective of the MFIs and suggest alternative corrective actions.

Thus, for the econometric estimations, I split these four categories into two groups: (B+C) versus (D+E). For easy reference, this will be called *logit II*. Note that there are two determinants of outcomes at play here and that this econometric estimation cannot distinguish between the effectiveness of incentives in inducing extraordinary willingness to repay versus the success of the households in generating extraordinary ability to repay. For the econometric analysis, there will be explicit controls for incentives —beyond the dummies for lending technologies— while the additional controls for ability to repay will be variables such as the number of workers, financial savings, assets, diversification, remittances and so on.

Overall, the survey suggests that overindebtedness was comparatively high in the 1997-2001 period, with 1,088 lending relationships (85 percent of all lending relationships) characterized by some level of arrears or by the households engaging in costly actions, at least once in the period, in order to repay the loan.

In addition, an analysis of the data by type of lender reveals that there is not a lot of variation among lenders in this respect, with village banks showing the lowest level of complications (79 percent of all lending relationships with village banks showed some level of arrears or, particularly, costly actions in order to repay at least once during the period under analysis), and group lenders showed the highest levels of complications (87 percent of these lending relationships showed some level of arrears or costly actions at least once during the period). From low to high, the percentages for the other types of lenders are NGOs (78 percent), banks (83 percent), cooperatives (84 percent), and for both consumption and individual lenders, 86 percent, as reflected in Figure 8.3.

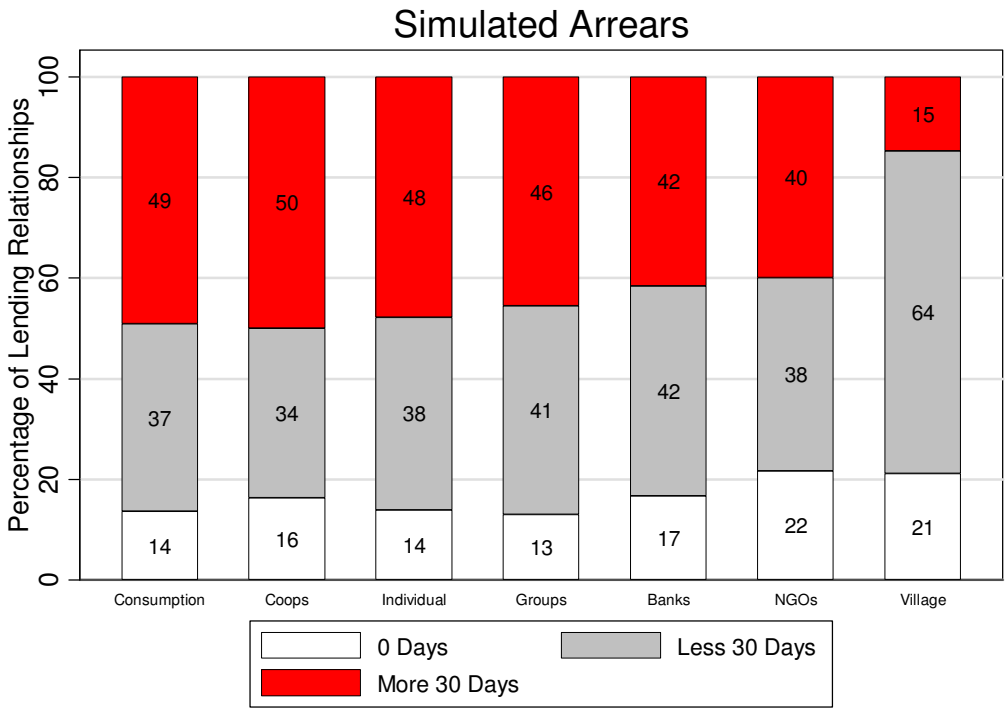
One way to illustrate the importance of costly actions in avoiding arrears is by simulating a passive scenario, where all active households are assumed inactive instead. Since costly actions were actually necessary for active households in order to achieve the observed level of arrears, in the simulation, the simulated level of arrears for each one is downgraded by one category with respect to the category actually observed. This is indeed a conservative simulation, compared to one where all active households would be downgraded to the worst level of arrears, in the assumption that default would follow in the absence of costly extraordinary actions. Simulated results by type of lender are presented in Figure 8.4.



Based on 1,282 lending relationships in the 1997-2001 period. Figures are percentages based on the total number of credit relationships, by type of lender. Source: Overindebtedness Survey – OSU, 2001.

Figure 8.3.

Effort Levels by Type of Lender, in the 1997-2001 Period.



Based on 1,282 lending relationships in the 1997-2001 period. Figures are percentages based on total number of credit relationships by type of lender.

Source: Overindebtedness Survey – OSU, 2001.

Figure 8.4.

Simulated Arrear Levels by Type of Lender in the 1997-2001 Period.

Under the simulated scenario, portfolio quality would be a lot worse than was actually observed. In particular, in the (mildly) passive scenario, the number of lending relationships with at least one instance of more than 30 days of arrears (44 percent of the total) would be 3.5 times higher than was actually observed (12 percent). Moreover, the number of relationships with perfect repayment records decreases dramatically, from 49 to 15 percent of all lending relationships, under the simulation. Because of the inflows and outflows, the number of lending relationships with at least one instance of less than 30 days of arrears does not change a lot under the simulation (from 38 to 41 percent of the total).

The previous analysis suggests that whether borrowers engage in costly actions or not in order to repay their loans is crucial in determining the final outcome of a loan contract, in terms of arrears. In addition, the effect of the simulation is not the same for all types of lenders. For instance, a comparison of Figure 8.3 versus Figure 8.1 reveals that, without active borrowers, village banks would experience a reduction in the number of lending relationships with perfect repayment records of 62 percentage points, while both consumption lenders and cooperatives would experience a reduction of at most 25 percentage points.

It has been argued for a while that MFIs perform better than traditional banks during times of crisis (Ahlin and Lin, 2006; Gonzalez-Vega and Villafani-Ibarnegaray, 2007; Gonzalez, 2007; Krauss and Walter, 2008). However, there has been mostly speculation about the reasons why. Building on Gonzalez and Gonzalez-Vega (2003), this dissertation is the first attempt to highlight and measure the link between the

borrowers' actions and better repayment rates and to identify differences in lending technologies that explain these outcomes.

Identifying some of the reasons why the repayment rates of the clients of some MFIs are better than others and why the repayment rates of the clients of MFIs are better than the repayment rates of the clients of other financial institutions has many important implications. In a recent survey by the Centre for the Study of Financial Innovation (CSFI), although credit risk was ranked as the tenth most important risk faced by microfinance worldwide, it was ranked, however, as a fast-rising risk, in the fifth place in terms of rate of increase (Lascelles, 2008).

Therefore, knowledge about these determinants of repayment can help financial regulators understand better the actual risk of MFI portfolios and design prudential regulation customized to the specific risk structure of microfinance (Villafani-Ibarnegaray, 2008). It can also help the microfinance community design better lending technologies and improve the current ones in terms of a better measure of extraordinary repayment capacity and the creation of better incentive mechanisms. This can further help the borrowers be less credit constrained, if MFIs can measure better the extraordinary repayment capacity of the households.

8.4 Other Survey Results

Based on the survey, it is possible to identify the main economic activity and the main person of the household in terms of income generation. Specifically, services were the main economic activity for most of the households in the sample (56 percent),

followed by commerce (24 percent) and manufacturing (13 percent). These results are consistent with the occupations of urban households, for whom agriculture or livestock activities are not very common.

In addition, 81 percent of the households had the same main economic activity along all of the 1997-2001 period, and 88 percent of the households had the same main income-generating person during the period. However, only for 74 percent of the households this main person was the head of the household; in 15 percent of the cases, the main income earner was the spouse of the head and, in 4 percent of the cases, a son or daughter played this role. For 29 percent of the households, the main person was a woman. Finally, the average schooling of the main person was 8.6 years (the median was 9 years), with the least educated households being in El Alto (average 7.6 years / median 7 years) and Cochabamba (8.2 years / 8 years), followed by La Paz (9.1 years/ 10 years), Santa Cruz (9.2 years / 10 years), and Oruro (9.8 years/ 11 years).

8.5 Explanatory Variables

Among all the data collected, there are some particular groups of variables that are of special importance for this dissertation, such as: (a) shocks, expectation and timing of events, (b) lenders and loan characteristics, (c) household experience with lenders, (d) household repayment capacity, and (e) transaction costs.

8.5.1 Shocks, Expectations and Timing of Events

Negative income shocks were common during the 1997-2001 period for Bolivian urban households. However, the impact of the shocks on different households, different regions or different economic activities was not uniform.

- **Regional dummies**: The sample covers five major Bolivian cities, and the unexpected adverse shocks affected these cities in different ways. The specific regional dummy variables are:
    - **Cochabamba**: This variable takes the value of 1 if the city is Cochabamba (18 percent of the households), 0 otherwise.
    - **El Alto**: It takes de value of 1 if the city is El Alto (29 percent), 0 otherwise.
    - **La Paz**: It takes de value of 1 if the city is La Paz (17 percent), 0 otherwise.
    - **Oruro**: It takes de value of 1 if the city is Oruro (6 percent), 0 otherwise.
    - **Santa Cruz**: It takes de value of 1 if the city is Santa Cruz (29 percent), 0 otherwise.
- **Household shocks**: The goal in using this variable is to capture the impact of any unexpected adverse event that might have reduced household repayment capacity while there were loans outstanding. Some examples of shocks considered here are death of a worker or family member, illness that made it impossible to work for at least two weeks, unemployment for at least two weeks, drop in sales of at least 25 percent, drop in the value of livestock of at least 25 percent, or

interruption in remittances. A detailed discussion of adverse shocks was presented in section 5.3.

- **Shocks 1997 – shocks 2001**: This dummy variable takes the value of 1 if the household both experienced at least one adverse shock in that year and had an outstanding loan with a formal lender, 0 otherwise. When a shock is experienced in a particular year, it may trigger costly actions if there is a loan outstanding. As shown in Table 8.3, only 5 percent of the households with outstanding loans in 1997 experienced an adverse shock in that year, but this proportion increased to 41 percent in 2001. This broader incidence is a reflection of the systemic nature of the shocks.
- **Shocks** (any year): This variable takes the value of 1 if both the household experienced an adverse shock and there was an outstanding formal loan for any year in the 1997-2001 period, 0 otherwise. In the 1997-2001 period, 69 percent of the households with outstanding loans experienced at least one adverse shock.
- **Number of years with shocks**: This variable is the total number of years when both the household suffered an adverse shock and there was an outstanding loan in that year. This variable captures the cumulative impact of shocks over time and the potential wear down of household strategies in facing new repayment problems. The range of this variable is 0-5, and the average is 1.2 years with both a shock and an outstanding loan per household. However, 27 percent of the households in the sample never suffered a single adverse shock while there was also an outstanding

loan, and 39 percent of the households suffered adverse shocks in only one of the year whiles at the same time they had an outstanding balance. The other 34 percent experienced adverse shocks in at least two years when they had an outstanding loan.

- **Number of shocks per year 1997 – 2001:** This variable measures the total number of adverse shocks by year experienced by the household if there was an outstanding formal loan in that year. As shown in Table 8.3, the households with outstanding loans in 1997 experienced an average of 1.3 shocks per household, while in 2001 the average was 1.6 shocks per household with outstanding loans.
- **Shocks before first loan 1998 – shocks before first loan 2001**: These variables are intended to control for whether the decision to engage in a new lending relationship was due to the experience of an adverse event in the previous year. Based on the survey, it is impossible to define this variable for those households whose first loan was received in 1997 and they will be excluded from the econometric analysis where this set of dummy variables is included. Percentages by year are presented in Table 8.3.
- **Shocks before first loan**: This dummy variable takes the value of 1 if the household suffered a adverse shock on the year before receiving the first loan from the lender, in the 1998-2001 period, and 0 otherwise. Only 25 percent of the households share this characteristic.

Variable	1997	1998	1999	2000	2001	Overall
Shocks	0.05	0.09	0.19	0.35	0.41	0.69
Number of shocks [a/]	1.29	1.33	1.37	1.54	1.61	1.64
Shocks before loan		0.05	0.04	0.06	0.09	0.25

a/ Only for households that both experienced an adverse shock and had at least one outstanding loan in the same year.

Source: Overindebtedness Survey – OSU, 2001.

Table 8.3. Shocks, Expectations and Timing of Events:

Descriptive Statistics.

- **Economic activity that generated most of household income, 1997-2001**: This information allows the identification of the main economic activity for the household, from an income generating perspective. This variable will capture the sensitivity of different economic activities to shocks. In particular, three dummy variables have been defined:
    - **Manufacturing**: This dummy variable takes the value of 1 if the main economic activity in the 1997-2001 period is manufacturing (11 percent of the households in the sample), 0 otherwise.
    - **Commerce**: This dummy variable takes the value of 1 if the main economic activity in the 1997-2001 period is commerce (20 percent), 0 otherwise.

- **Services**: This dummy variable takes the value of 1 if the main economic activity in the 1997-2001 period is services (47 percent), 0 otherwise.
- **Others**: This dummy variable takes the value of 1 if the main economic activity was different from manufacturing, commerce and services or if it was not stable in the 1997-2001 period (23 percent), 0 otherwise.

8.5.2 Lender and Loan Characteristics

The households' willingness to repay, whether or not they engaged in costly actions, and the observed level of arrears depend, among other things, on characteristics of the lending relationship and loan contract, like loan size, interest rate, term to maturity, collateral pledged, penalties for default —including a reputation effect, the opportunity cost of defaulting, and future access to loans and other services— as well the lending technologies and lender renegotiation efforts. This information was directly provided by each MFI. Since most of these variables were not collected in the survey, therefore, the following dummy variables will capture the average effect of all lender characteristics not explicitly included in the regressions:

- **Individual**: This dummy variable takes the value of 1 if the relationship is with an individual lender, (24 percent of the households in the sample), 0 otherwise.
- **Consumption**: This dummy variable takes the value of 1 if the relationship is with a consumption lender, (23 percent), 0 otherwise.
- **Groups**: This dummy variable takes the value of 1 if the relationship is with BancoSol or PRODEM (39 percent), 0 otherwise.

- **Village**: This dummy variable takes the value of 1 if the relationship is with CRECER or Pro Mujer (14 percent), 0 otherwise.
- **Others**: This dummy variable takes the value of 1 if the relationship is with cooperatives, NGOs or banks (25 percent), 0 otherwise.
- **Bureau**: This dummy variable takes the value of 1 if the lender reports to the credit bureau (76 percent), 0 otherwise. In Bolivia, all lenders that reported to the credit bureau in the 1997-2001 period were regulated intermediaries. However, for most of the econometric models discussed later, whatever effects are captured by this variable are more related with the reputation effect associated with the credit bureau than with the regulatory status of the MFIs in this category. When combined with types of lenders, this variable will capture the average reputation effect for all types of regulated MFIs.
- **Loan term**: Loan term to maturity is measured in years for the last loan by the particular lender. The longer the term, the longer the exposure of the loan to shocks and repayment problems. It is expected that more overindebtedness will be observed in this case. For the 1997-2001 period, the average term to maturity of the loan was 1.6 years.

8.5.3 Household Experience with Lenders and Incentives to Repay

Both the relative value of different lending relationships and the willingness to repay are associated with the borrowers' experience with different lenders. However, the relationship may not be linear.

- **Outstanding balances by year (outstanding 1997-outstanding 2001):** This dummy variable takes the value of 1 if there was an outstanding loan with a particular lender in that year, 0 otherwise. This variable will capture the timing of events; i.e., loans in some years were more likely to have created overindebtedness than in others, or households with loans in certain years were less likely to engage in costly actions, so that the results are not biased by unobservable time effects. Table 8.4 shows that 25 percent of all households in the sample had and outstanding loan in 1997 and 54 percent of all households in the sample had an outstanding loan in 2001.
- **Relationships 1997 – relationships 2001, or total number of lending relationships with outstanding balances by year:** Since data on the total amount of debt outstanding were not collected in the survey, the number of outstanding loans is the only proxy available. This variable will capture the average effect of adding one extra loan, while the variables *outstanding 1997 – outstanding 2001* just capture the effect of having at least one outstanding loan that year. In 1997, households with outstanding loans had on average 1.1 outstanding lending relationships, while in 2001 the average was 1.17 outstanding lending relationships (Table 8.4).
- **Relationships, or maximum number of lending relationships with outstanding balances in the 1997-2001 period:** In some econometric specifications, the maximum number of lending relationships was used instead of the breakdown by year. In the 1997-2001 period, households in the sample had

on average 1.24 outstanding lending relationships (one with each different lender).

- **Number of years when the borrower received new loans from each lender:** This variable measures the total number of years when the borrower received at least one new loan from each lender, in the 1997-2001 period. This variable is intended to capture (years) of experience of the household with the particular lender. More experience may be associated with more prudent borrowing and better knowledge of the borrower's ordinary repayment capacity. Nevertheless, more experience may be associated as well with larger loans sizes and potential repayment problems. Only 26 percent of the lending relationships received new loans in more than one of these years (from the same lender). Specifically, 13 percent of these borrowers received new loans in two of these years, 7 percent in three of these years, 3 percent in four of these years, and 3 percent in five of these years. The average for this variable is 1.5 years per lending relationship. Based on the survey, it was impossible to determine number of loans received from each lender, which would probably be a better control than this one.

- **First timer**: This dummy variable will take the value of 1 if the particular loan was the first one received in the 1997-2001 period, 0 otherwise. This variable is intended to capture the limited experience of first-time borrowers (37 percent of all households) versus borrowers with longer credit histories.

- **Cohort 1997 – cohort 2001**: These five dummy variables are defined based on the year that the household received its first formal loan in the 1997-2001 period. All households that received their first loan before 1997 are grouped in the 1997 cohort. The omitted variable is either cohort 1997 or cohort 2001, depending on the econometric model estimated. As long as controls for the period when there were outstanding debts and term to maturity are included in the econometric estimations, these dummy variables will capture whether less experienced borrowers (newer cohorts) where more likely to be in a situation of overindebtedness than older cohorts. The percentages of households by cohort are presented in Table 8.4.
- **Commercial**: This dummy variable will take the value of 1 if the household had outstanding loans with commercial lenders in the 1997-2001 period (22 percent of the households), 0 otherwise.
- **Shared borrowers or borrowers with outstanding balances with both consumption and microfinance lender:** This dummy variable will take the value of 1 if the household had an outstanding loan in the same year with a consumption lender and a microfinance lender (individual, groups, NGOs, and village banks), 0 otherwise. Since the goal of this variable is to evaluate the impact on microfinance clients of being shared with consumption lenders, this variable is 0 for all consumption lending relationships. Only 70 lending relationships were shared with consumption lenders: 26 with group lenders, 32 with individual lenders, 7 with NGOs, and 5 with village banks.

- **Common borrowers, or borrowers that received loans from both a consumption and a microfinance lender in the 1997-2001 period:** This dummy variable will take the value of 1 if the household received at least one loan in the 1997-2001 period from both a consumption lender and a microfinance lender (individual, groups, NGOs, village banks), even if that happened in different years, 0 otherwise. This variable is 0 for all consumption lending relationships. Only 90 lending relationships were ever shared: 30 with group lenders, 36 with individual lenders, 10 with NGOs, and 14 with village banks.
- **Default first:** This dummy variable measures the seniority of the debt (in what order loans would be repaid). It will take the value of 1 if the households indicated that, if in trouble, they would repay the particular lender last, 0 otherwise. This dummy variable is 0 for all lenders with only one active lending relationship in the 1997-2001 period or for households that indicated that they would give the same priority to repaying all of the lenders. In order to capture only the stronger cases, in the case of households with an even number of lending relationships, the dummy was set to 1 for half of them and 0 for the other half and, in the case of households with an odd number of lending relationships, the dummy was set to 1 for half of them and 0 for the other half, with the exception of the median lending relationship. Overall, for 8 percent of all lending relationships, the households indicated that they would repay the corresponding loan last, when facing repayment problems. Including this variable in the regressions makes it possible to isolate the incentive effect from the capacity to generate extra ability to repay.

Variable	1997	1998	1999	2000	2001
Outstanding balances by year	0.25	0.44	0.55	0.59	0.54
Number of relationships	1.11	1.18	1.19	1.19	1.17
Cohorts	0.25	0.25	0.21	0.18	0.12

Source: Overindebtedness Survey – OSU, 2001.

Table 8.4. Household Experience with Lenders: Descriptive Statistics.

8.5.4 Household Repayment Capacity

Different variables are related to the potential and effective ability to repay of the household but they are highly correlated, so they will be tested one at a time, in different econometric specifications. The average and median for these explanatory variables are presented in Table 8.5.

- **Household size**: Larger households may have more workers but also more dependents. The average household had 5.4 members.
- **Dependency ratio**: This variable is defined as the number of dependents over the number of workers in the household. All household members less than 10 years old or over 60 years old where considered as dependents, regardless of their actual participation in labor markets. For the households in the sample, the average dependency ratio was 0.96.

- **Number of workers in the household**: This variable measures the number of household members, 14 to 60 years old, who actually worked at least once in the 1997-2001 period. More workers imply more resources available for production, more repayment capacity, and more diversification opportunities. The number of workers is a proxy for ability to repay; however, it may reduce the value of any individual credit relationship, since other members of the household can create new ones. One limitation of this variable as a proxy for repayment capacity is that, when facing lending and repayment decisions, the number of workers is endogenous. Thus, one challenge is to isolate households with more workers before the risk of overindebtedness versus households that increased the number of workers after forecasting repayment problems that led to overindebtedness.
- **Salaried workers**: This variable measures the number of household members who worked for a salary outside the household. Potentially, salary income could be a stable flow of funds available to repay the loan, in case the household needs the extra liquidity.
- **Diversification index**: More diversified households are expected to have less repayment problems and be more successful in generating extraordinary repayment capacity. The diversification index used in this dissertation is based on the number of economic activities in which the household was engaged in the 1997-2001 period. First, economic activities were divided into six major categories: manufacturing, commerce, services, mining, public sector, and others. For the first three groups, a total for the number of subcategories was estimated. Examples of subcategories in manufacturing include handicrafts, shoes, clothes,

food, and so on. When there was more than one subcategory, additional subcategories where given a lower weight (1/4) inside each category. Finally, the individual scores for all the categories were added to create the aggregate diversification index.

- **Characteristics of the head of the household or worker that generated most of the household's income, 1997-2001:** These variables are age, gender, and education. For each household, it is possible to determine the worker that generated the largest share of income in each year. Information was also collected about whether this worker generated more that half of the household's income or more than a quarter.
    - **Age and gender:** These variables allow for the testing of hypotheses about gender differences (i.e., women are more vulnerable to shocks, or if they have stronger willingness to repay because they may have more to lose), or age differences (i.e., young households are more vulnerable than older ones).
    - **Human capital**: Borrowers that are more educated may cope better with shocks or be more prudent in their investment decisions. However, they could also be more risk takers than less educated households are.
- **Number of potential workers**: For a household with members in working ages who are not currently involved in productive activities, it is easier to engage them in order to repay the loan than for a household without any spare workers.
- **Poverty level**: This dummy variable takes the value of 1 if the household is poor at the threshold, 0 otherwise. This is not an explanatory variable per se, but some

interesting results emerge. This variable is based on the 2001 Basic Needs Fulfillment Poverty Index (INE, 2002). Based on this index, households can be classified into four categories of poverty: extreme, poor, poor at the threshold, and non poor. The general result is that households that were poor at the threshold at the end of 2001 were the most likely to engage in costly actions to repay. Access to MFIs according to poverty levels had been discussed in Navajas, et al. (2000).

- **Financial savings**: This dummy variable takes the value of 1 if the household had any type of savings account with a financial institution in the 1997-2001 period, 0 otherwise. According to the survey, 39 percent of the households had financial savings in the 1997-2001 period.
- **Migrants**: This dummy variable takes the value of 1 if the household received remittances from migrants, 0 otherwise. According to the survey, 14 percent of the households had migrants in the 1997-2001 period.
- **Informal**: This dummy variable takes the value of 1 if the household had access to loans from the informal sector (friends, family, moneylender), 0 otherwise.

	Average	Median
Household size	5.41	5.00
Dependency ratio	0.96	0.80
Workers 14-60 years old	2.55	2.00
Salaried workers	0.85	1.00
Diversification index	1.67	1.63
Age of main person	41.1	40.0
Male main person	0.66	1.00
Female main person	0.29	0.00
Education main person	8.98	9.00
Potential number of workers	3.45	3.00
Poor at the threshold	0.18	0.00
Financial savings	0.39	0.00
Migrants	0.14	0.00

Source: Overindebtedness Survey – OSU, 2001.

Table 8.5. Household Ability to Repay:

Descriptive Statistics.

8.6 Main Econometric Results

All dependent variables under analysis are dichotomous, and this characteristic restricts the models available for the econometric analysis to logit and probit models. The most important difference between these two models is that logit models assume that the unobserved portion of the utility of the household (the decision maker in this dissertation) is distributed *iid* extreme value, while the probit models assume that the unobserved portion is distributed following a normal distribution (Train, 2003). Even though the distribution in the case of the logit has heavier tails than the normal distribution, in most applications the distinction between the two models does not make much difference, according to Green (2000: 815). All econometric results presented in this dissertation are estimated using the logit model, because it is possible to estimate it while assuming both random effects (RE) and fixed effects (FE), while probit models cannot be estimated under fixed effects (Green, 2000; Train, 2003).

Specifically, all econometric results were estimated using the panel logit specification implemented in Stata with the command *xtlogit* (StataCorp, 2005a). Random effects were tested with the Hausman specification test, and all the results suggest that the random effects hypothesis cannot be rejected. Therefore, all results reported are estimated assuming random effects. All marginal effects are estimated around the mean using the command *mfx* (StataCorp, 2005b).

Dichotomous dependent variable models are particular cases of multiple-choice models that are used to analyze decisions among two or more alternatives. They are divided in ordered and unordered models, depending on the type of dependent variable.

For example, a bond rating is an ordered dependent variable, and outcomes such as reduction in consumption, selling of productive assets, or withdrawal of kids from school are unordered alternatives (Train, 2003).

8.6.1 Logit I: Overindebted and Willing to Repay versus Non-Overindebted

The Logit I model tests for differences between households that were not overindebted and households that were overindebted but had willingness to repay. The main question addressed by inferences from this empirical model is if some MFIs are better than others at forecasting the ordinary repayment capacity of households. Surprisingly, this is an area where MFI types do not show statistically significant differences from one another and from other types of financial institutions. In addition, there is no significant relationship between the use of the credit bureau by the lender and the probability of overindebtedness and the null hypothesis cannot be rejected (Tables 8.6 and 8.7).

The relationship between longer terms to maturity and the probability of overindebtedness is statistically significant, but the overall effect is small, as the average marginal effect is an increase in overindebtedness of one percentage point for every additional year of loan term. Longer loan terms are correlated with certain lending technologies, but even when the former variable is removed from the analysis there is no statistically significant relationship, on the one hand, between lender technology and other lender characteristics and, on the other hand, overindebtedness.

In addition, households with more experience with particular lenders were less likely to be overindebted, the larger the number of new loans that they received. In particular, the probability of being overindebted drops almost 3 percentage points for every additional year that the household received a new loan from a particular lender.

The coefficients for most of the socioeconomic variables that may be associated with the household's ability to repay were not significant in all of the specifications (household size, number of salaried workers, diversification index, and dependency ratio). The only significant socioeconomic variable associated with the household's ability to repay is the level of education of the main person; however, the marginal effect is small. For instance, ceteris paribus, a difference of 10 years of education between two main persons will result in only a difference of four percentage points in their probability of being overindebted, with this probability being higher for the less educated household.

Households of El Alto, La Paz and Oruro show a probability of being overindebted 3-4 percentage points higher than households of Cochabamba and Santa Cruz, but this does not seem related to the main economic activity of the household, since the coefficients for the variables by activity were not statistically significant. These differences may reflect, however, regional specific shocks as well as different degrees of competition among MFIs in each location.

Households that experienced adverse shocks show a probability of being overindebted that is 7 percentage points higher than for other households. Overindebtedness is associated with the number of outstanding loans only in 2007, with the probability of being overindebted increasing 3.5 percentage points for every outstanding loan, but the effect is not significant for all other years or for the overall

period. Thus, the popular assumption that overindebtedness is associated with multiplicity of relationships does not find strong support in these results.

Finally, households with access to commercial lenders have a probability of being overindebted that is almost 6 percentage points higher than otherwise. Moreover, there is no high correlation between access to commercial lenders and any other explanatory variable considered in all of the econometric estimations. Different econometric specifications without this explanatory variable were estimated, but no gains in significance for the other explanatory variables or changes in the marginal effects were observed.

Explanatory Variables	Coefficient		Std. Err.	z	P>z	[95% Conf. Interval]	
Cochabamba	0.329		0.349	0.94	0.35	-0.355	1.012
El Alto	0.574	*	0.332	1.73	0.08	-0.076	1.225
La Paz	0.794	**	0.399	1.99	0.05	0.012	1.575
Oruro	0.987	*	0.546	1.81	0.07	-0.082	2.056
Shocks	0.962	***	0.253	3.80	0.00	0.466	1.459
Manufacture	-0.643		0.418	-1.54	0.12	-1.463	0.177
Commerce	0.003		0.368	0.01	0.99	-0.718	0.724
Services	-0.125		0.300	-0.42	0.68	-0.714	0.463
Individual	0.153		0.386	0.40	0.69	-0.604	0.910
Groups	0.246		0.346	0.71	0.48	-0.431	0.924
Village	-0.064		0.447	-0.14	0.89	-0.940	0.811
Others	-0.211		0.340	-0.62	0.54	-0.876	0.455
Loan term	0.159	**	0.076	2.09	0.04	0.010	0.308
Number of relationships	0.078		0.172	0.46	0.65	-0.259	0.415
Years with new loans	-0.437	***	0.137	-3.19	0.00	-0.705	-0.168
Cohort 1997	2.433	***	0.434	5.61	0.00	1.583	3.284
Cohort 1998	1.673	***	0.377	4.43	0.00	0.934	2.413
Cohort 1999	1.580	***	0.372	4.24	0.00	0.850	2.309
Cohort 2000	1.134	***	0.364	3.12	0.00	0.421	1.848
Commercial	1.082	***	0.320	3.38	0.00	0.454	1.710
Age main person	-0.011		0.011	-1.02	0.31	-0.033	0.010
Education main person	-0.067	**	0.035	-1.94	0.05	-0.135	0.001
Constant	1.151		0.767	1.50	0.13	-0.352	2.654
/lnsig2u	0.858		0.205			0.457	1.260
sigma_u	1.536		0.157			1.257	1.877
Rho	0.418		0.050			0.324	0.517

* significant at 10%; ** significant at 5%; *** significant at 1%

Random-effects logistic regression. Observations = 1,236. Households = 929.

Dependent variable = 1 if (B+C+D+E) and dependent variable = 0 if (A)

Log likelihood = -470.9303. Wald chi2(22) = 66.50. Prob. > chi2 = 0.000.

Likelihood-ratio test of rho = 0: chibar2(01) = =24.46. Prob. >= chibar2 = 0.000

Table 8.6. Logit I:

Random-Effects Logistic Regression Results.

Explanatory Variables	Marginal Effect			Std. Err.	z	P>z	[95% Conf. Interval]		Average
Cochabamba	0.019		a/	0.018	1.03	0.31	-0.017	0.055	0.17
El Alto	0.033	*	a/	0.018	1.87	0.06	-0.002	0.067	0.29
La Paz	0.041	**	a/	0.017	2.40	0.02	0.007	0.074	0.17
Oruro	0.044	***	a/	0.017	2.58	0.01	0.010	0.077	0.06
Shocks	0.072	***	a/	0.023	3.13	0.00	0.027	0.117	0.69
Manufacture	-0.051		a/	0.040	-1.26	0.21	-0.130	0.028	0.11
Commerce	0.000		a/	0.023	0.01	0.99	-0.045	0.046	0.19
Services	-0.008		a/	0.019	-0.42	0.68	-0.045	0.029	0.46
Individual	0.009		a/	0.022	0.41	0.68	-0.035	0.053	0.19
Groups	0.015		a/	0.020	0.74	0.46	-0.024	0.054	0.30
Village	-0.004		a/	0.029	-0.14	0.89	-0.062	0.053	0.11
Others	-0.014		a/	0.024	-0.59	0.56	-0.061	0.033	0.20
Loan term	0.010	**		0.005	2.09	0.04	0.001	0.019	1.60
Number of relationships	0.005			0.011	0.46	0.65	-0.016	0.026	1.46
Years with new loans	-0.027	***		0.009	-3.12	0.00	-0.045	-0.010	1.47
Cohort 1997	0.107	***	a/	0.018	5.89	0.00	0.071	0.142	0.25
Cohort 1998	0.078	***	a/	0.016	4.87	0.00	0.047	0.109	0.24
Cohort 1999	0.071	***	a/	0.015	4.87	0.00	0.043	0.100	0.21
Cohort 2000	0.053	***	a/	0.014	3.79	0.00	0.026	0.081	0.17
Commercial	0.055	***	a/	0.014	3.96	0.00	0.028	0.082	0.23
Age main person	-0.001			0.001	-1.02	0.31	-0.002	0.001	41.00
Education main person	-0.004	**	a/	0.002	-1.93	0.05	-0.009	0.000	9.10

* significant at 10%; ** significant at 5%; *** significant at 1%

a/ Marginal effect is for discrete change of dummy variable from 0 to 1.

Dependent variable = Pr(B+C+D+E) = 0.933

Table 8.7. Logit I:

Random-Effects Logistic Regression Marginal Effects.

8.6.2 Logit I: Robustness Checks and Other Results

The main tests of hypotheses in this dissertation are related to the difference across lending technologies, household characteristics that may be associated with ability to repay (ordinary and extraordinary), and lending experience with various lenders. Many alternative models were estimated, besides those discussed above, in order to consider the effect of different model specifications, and the main results were very similar to those discussed above, in terms of the magnitude of the marginal effects and their significance.

Specifically, instead of using one single dummy variable for shocks experienced for the whole period, I tried using *shocks 1997 – shocks 2001*, the *number of shocks per year*, and the *number of years with shocks*, as defined in section 8.5.1.

Since once plausible hypothesis regarding shocks is that the household received a loan as a consumption smoothing mechanism after experiencing an unexpected adverse shock, I tested for this hypothesis by including the variable *shocks before first loan*, but the coefficient was never statistically significant.

Another test explored whether there was any particular effect associated with sharing information with the credit bureau, but this dummy variable was not statistically significant in all the specifications that I tried. Regarding experience with lenders, the following alternatives to the number of relationships were tried as well: *outstanding balances by year* and *number of outstanding balances by year*.

One of the main claims in Bolivia during the overindebtedness episode was that the deterioration in loan portfolios had been caused by the entry of the consumption

lenders, which had overindebted the "good" borrowers who had so far worked only with the traditional microfinance sector. I tested for this relationship with two different controls, but neither one was statistically significant. One of this control variables is *shared borrowers between both consumption and microfinance lender*" and the other is *common borrowers*, but neither one was statistically significant.

8.6.3 Logit II: Costly Actions

This model is an attempt to determine which MFIs select those borrowers that are both more likely to engage in costly actions and more effective at generating extraordinary repayment capacity, by separating them into two groups according to their impact on portfolio quality, namely (B+C) versus (D+E).

Since one of the explanatory variables is a control for incentives to repay (*default first*), and since the results suggest that borrowers of MFIs with a weaker structure of incentives have a probability that is almost 11 percentage points higher of being in the lower quality group (D+E), it is possible to attribute the difference in probabilities to differences across the lending technologies in their ability to screen borrowers with a high effectiveness at generating extraordinary ability to repay.

In particular, the results suggest that village banks possess the best lending technology from this perspective. In comparison, the clients of group lenders have a probability 18 percentage points higher of being in (D+E), the clients of individual lenders have a probability 29 percentage points higher, and the clients of consumption lenders have a probability 48 percentage points higher of being in the lower quality

group. The significance and magnitude of these marginal effects is very robust to model specification. This is the most significant result from this dissertation, a dimension of repayment that so far had not been captured in the microfinance literature. One of the next steps is to test if these differences are statistically significant.

Similar to the previous results, the coefficients for the socioeconomic variables are not significant. This result is related to the fact that lending technologies and lending decisions are based on more complex rules and sets of tangible and intangible information than the observation of magnitudes such as those measured with the survey. For instance, it has been shown that credit scoring models may improve the screening of borrowers only after the credit officer has made an initial screening, but that scoring cannot replace the traditional screening of MFIs based on intangible characteristics (Schreiner, 2000 and 2003). Moreover, if these MFIs take these factors into account, the additional explanatory power of these variables should be low when the MFIs do a good job, because the MFI clients in the sample, have already been "selected" by the MFIs and may not be representative of the general population.

Another result is that households in Oruro have a probability around 6-9 percentage points higher of being in the lower quality group. This result is related to local economic conditions and the lack of opportunities to generate extra repayment capacity, even if the households try (i.e., someone can try to sell her goods 24/7 but, if nobody wants to buy, she cannot do more). Moreover, Oruro was subject to major adverse shocks related to the main economic activity in the area, with the adoption of more strict customs regulations.

Ability to repay has to do with both internal capacity (having the resources to accomplish this purpose) and the existence of external opportunities (for example, being in a market where, by working more, the household can generate additional revenue, to repay the loan). Since the Oruro effect is quite strong, I tried all specifications without the Oruro households, but no relevant changes were observed, especially in the results related to the socioeconomic variables.

The most important result from this analysis is the fact that the coefficients for the lending technologies are significant in this econometric model but not in the previous one, which suggests that the strength of microfinance lending technologies is not so much at forecasting ***ordinary*** repayment capacity but at forecasting the ability to generate ***extraordinary*** repayment capacity and that this is why their observed loan quality performance is better than the performance of consumption lenders and traditional banks.

8.6.4 Logit II: Robustness Checks and Other Results

There are other interesting results. Households that are poor at the threshold have a probability almost 4 percentage points higher of being in the better group compared to the rest of households.

The coefficients for shocks and for the number of lenders are not statistically significant. Neither is the coefficient for economic activity. Finally, the coefficients for access to informal sources of credit, the availability of savings (both non-financial assets and financial savings), and the presence of migrants were not statistically significant. Access to informal lenders did not improve the chances of being in the better group.

Explanatory Variables	Coefficient		Std. Err.	z	P>z	[95% Conf.	Interval]
Cochabamba	-2.015	***	0.451	-4.47	0.00	-2.898	-1.132
El Alto	-1.991	***	0.422	-4.72	0.00	-2.818	-1.165
La Paz	-1.605	***	0.429	-3.75	0.00	-2.445	-0.765
Santa Cruz	-1.331	***	0.407	-3.27	0.00	-2.129	-0.533
Shocks	0.084		0.232	0.36	0.72	-0.370	0.539
Manufacture	0.401		0.360	1.11	0.27	-0.304	1.106
Commerce	-0.036		0.310	-0.12	0.91	-0.643	0.571
Services	-0.045		0.258	-0.17	0.86	-0.550	0.461
Individual	1.720	***	0.619	2.78	0.01	0.507	2.934
Consumption	2.605	***	0.642	4.06	0.00	1.346	3.863
Groups	1.250	**	0.605	2.06	0.04	0.063	2.436
Others	1.754	***	0.642	2.73	0.01	0.497	3.012
Loan term	0.037		0.055	0.67	0.51	-0.071	0.144
Number of relationships	0.079		0.150	0.53	0.60	-0.215	0.373
First timer	-0.085		0.227	-0.37	0.71	-0.529	0.360
Cohort 1997	1.037	**	0.468	2.22	0.03	0.121	1.954
Cohort 1998	0.920	**	0.448	2.05	0.04	0.042	1.799
Cohort 1999	0.913	**	0.453	2.01	0.04	0.024	1.801
Cohort 2000	0.561		0.482	1.16	0.24	-0.383	1.506
Default first	0.761	***	0.264	2.88	0.00	0.243	1.279
Number of potential workers	0.027		0.064	0.42	0.67	-0.099	0.153
Age main person	0.005		0.011	0.50	0.62	-0.015	0.026
Education main person	0.022		0.030	0.72	0.47	-0.038	0.081
Diversification	-0.045		0.145	-0.31	0.75	-0.329	0.238
Savings	0.046		0.214	0.22	0.83	-0.373	0.465
Migrants	-0.013		0.291	-0.04	0.96	-0.583	0.557
Constant	-3.349	***	1.008	-3.32	0.00	-5.325	-1.373
/lnsig2u	0.168		0.396			-0.609	0.945
Sigma_u	1.088		0.216			0.738	1.604
Rho	0.265		0.077			0.142	0.439

* significant at 10%; ** significant at 5%; *** significant at 1%

Random-effects logistic regression. Observations = 1,048. Households = 806.

Dependent variable = 1 if (D+E) and dependent variable = 0 if (B+C)

Log likelihood = -481.66784 Wald chi2(26) = 75.52. Prob. > chi2 = 0.000.

Likelihood-ratio test of rho = 0: chibar2(01) = 5.82. Prob. >= chibar2 = 0.008

Table 8.8. Logit II:

Random-Effects Logistic Regression Results.

Explanatory Variables	Marginal Effect			Std. Err.	z	P>z	[95% Conf. Interval]		Average
Cochabamba	-0.154	***	a/	0.025	-6.17	0.00	-0.203	-0.105	0.17
El Alto	-0.186	***	a/	0.033	-5.55	0.00	-0.251	-0.120	0.29
La Paz	-0.135	***	a/	0.027	-5.00	0.00	-0.189	-0.082	0.18
Santa Cruz	-0.132	***	a/	0.035	-3.80	0.00	-0.199	-0.064	0.29
Shocks	0.010		a/	0.027	0.37	0.71	-0.043	0.063	0.71
Manufacture	0.053		a/	0.053	1.01	0.31	-0.050	0.157	0.10
Commerce	-0.004		a/	0.036	-0.12	0.91	-0.075	0.067	0.20
Services	-0.005		a/	0.031	-0.17	0.86	-0.065	0.055	0.46
Individual	0.287	**	a/	0.124	2.31	0.02	0.043	0.530	0.20
Consumption	0.478	***	a/	0.130	3.69	0.00	0.224	0.732	0.19
Groups	0.177	*	a/	0.096	1.83	0.07	-0.012	0.366	0.31
Others	0.294	**	a/	0.129	2.27	0.02	0.040	0.547	0.20
Loan term	0.004			0.007	0.67	0.51	-0.008	0.017	1.64
Number of relationships	0.009			0.018	0.53	0.60	-0.026	0.044	1.47
First timer	-0.010		a/	0.027	-0.37	0.71	-0.064	0.043	0.63
Cohort 1997	0.147	**	a/	0.076	1.93	0.05	-0.002	0.296	0.27
Cohort 1998	0.129	*	a/	0.072	1.79	0.07	-0.012	0.271	0.25
Cohort 1999	0.130	*	a/	0.075	1.74	0.08	-0.017	0.277	0.21
Cohort 2000	0.076		a/	0.073	1.04	0.30	-0.067	0.220	0.17
Default first	0.110	**	a/	0.045	2.43	0.02	0.021	0.199	0.13
Number of potential workers	0.003			0.008	0.42	0.67	-0.012	0.018	3.56
Age main person	-0.005			0.001	0.50	0.62	-0.002	0.003	40.84
Education main person	0.001			0.004	0.72	0.47	-0.004	0.010	9.04
Diversification	0.003			0.017	-0.31	0.75	-0.039	0.028	1.67
Savings	0.006		a/	0.026	0.22	0.83	-0.045	0.056	0.40
Migrants	-0.002			0.034	-0.04	0.96	-0.069	0.066	0.14

* significant at 10%; ** significant at 5%; *** significant at 1%

a/ Marginal effect is for discrete change of dummy variable from 0 to 1.

Dependent variable = Pr(D+E) = 0.138

Table 8.9. Logit II:

Random-Effects Logistic Regression Marginal Effects.

CHAPTER 9

CONCLUSIONS AND POLICY RECOMMENDATIONS

The environment for microfinance institutions in developing countries presents many characteristics that increase the probability of the upsurge of overindebtedness episodes. Some of these characteristics include the absence of credit bureaus and other information-sharing mechanisms, collateral registries, and appropriate mechanisms for contract enforcement.

In this dissertation, three different situations have been identified as overindebtedness. One is when the borrower has sufficient ability to repay the loan but is not willing to do it. The second one occurs when the borrower has to engage in extraordinary and costly actions in order to repay the loan. The third one occurs when the borrower fails to repay the loan. Under this definition, overindebtedness is more than just default, because it may exist even when default is not the final outcome observed by the lender.

Another claim of this dissertation is that overindebtedness is more than the multiplicity of credit sources used by a borrower. For instance, there can be overindebtedness even with just one loan. In fact, one of the empirical results of this dissertation is that overindebtedness in Bolivia was not associated with the multiplicity of loans per borrower.

Overindebtedness may have many causes, including the borrower's opportunistic behavior, the lender's opportunistic behavior, and unexpected adverse income shocks. The empirical results from this dissertation suggest that the latter two played an important role in the Bolivian overindebtedness episode, especially the last one. However, based on the information available from the survey, it is not possible to test for the extent of the borrower's opportunistic behavior.

The 1997-2001 period was particularly difficult for the Bolivian MFIs and their borrowers, especially for the economic recession and the high frequency of unexpected adverse shocks affecting particular geographic regions and economic activities. In the same period, there was also an increase in financial competition and a deterioration in the culture of repayment in different sectors of the financial system. This also contributed to the overindebtedness episode.

This dissertation is the first analysis ever of the borrowers' costly actions and extraordinary repayment capacity among MFIs in developing countries. This analysis highlights the importance of costly actions and extraordinary repayment capacity in understanding why the repayment rates of microfinance institutions are better than the repayment rates of other financial institutions. In particular, it has been claimed that MFIs are highly resilient to adverse shocks, and this dissertation matters in understanding why (Gonzalez, 2007). The strength of the lending technologies of MFIs is twofold. They posses comparative advantages both at (a) generating incentives for the households to engage in costly actions and at (b) identifying households that are more likely to succeed in generating the extra repayment capacity.

One policy implication of this dissertation is that, in order to have a full understanding of the performance and risk profile of microfinance institutions, it is necessary to have a good understanding of their clients, their environment, and their ability to generate extraordinary repayment capacity. In the end, Bolivian MFIs were able to ride this overindebtedness episode successfully, but they were already mature MFIs with some of the best managers in the sector.

The fact that most microfinance borrowers need to get loans from more than one MFI at the same time may be a sign of underindebtedness with each single lender —and, therefore, of credit rationing (Alpizar and Gonzalez-Vega, 2006). It is not necessarily a sign of overindebtedness, as is usually believed. Bolivian MFIs have shown that, using the right incentives and screening mechanisms, they are able to keep better repayment rates than the rest of the financial system.

Diversification, in all its dimensions, is important for MFIs, as highlighted by the case of Oruro. In addition, in many countries, local regulatory frameworks force MFIs to operate in narrow geographical markets, increasing the risk of their global portfolios in case of regional systemic shocks.

APPENDIX A

DISCRETE CHOICE MODELS: GENERAL DISCUSSION

Situations where the dependent variable is a discrete outcome are modeled with qualitative response models (Green, 2000; Pindyck and Rubinfeld, 1998), also known as discrete choice models (Train 2003) or categorical dependent variable models. In a discrete choice model, a decision maker faces a choice, or a series of choices, among a set of alternatives. Finally, the goal of the researcher is to understand the behavioral process that leads to the agent's choice, where the behavioral process is the function that relates the observed and unobserved factors with the agent's choice (Train, 2003).

Since the unobserved factors are part of the behavioral process, the agent's choice is not deterministic and cannot be predicted exactly. In its place, the probability of selecting any particular outcome is derived, where the unobserved factors are considered random (Train, 2003).

Some features are common to all discrete choice models. Some of these features are the choice set, the derivation of choice probabilities from utility-maximizing behavior, and the need to make assumptions about the distribution of the unobserved factors that affect utility (Train, 2003). These features are described next.

- **The Choice Set**

The choice set is the set of alternatives from which agents make a choice. The choice set needs to satisfy three requirements in order to fit within a discrete choice model. "First, the alternatives have to be *mutually exclusive* from the decision maker's perspective. … Second, the choice set has to be *exhaustive*, in that all possible alternatives are included. … Third, the number of alternatives must be finite" (Train, 2003: 15).

- **Derivation of Choice Probabilities from a Random Utility Model**

Discrete choice models are generally derived under the assumption of utility-maximizing behavior by the decision maker and, specifically, under the framework of a random utility model (RUM). The description here of RUMs follows very close Train (2003).[4]

In RUMs, a decision maker n faces a choice among J alternatives, and each alternative produces a certain level of utility for the decision maker. Following the common notation, the utility that decision maker n obtains from alternative j is U_{nj}, $j = 1, \ldots, J$. This utility is known to the decision maker but it is not completely observable to the researcher. Under RUMs, it is assumed that the decision maker chooses the alternative that provides the greatest utility, such that the behavioral model is to choose alternative i if and only if $U_{ni} > U_{nj}$ for all $j \neq i$.

[4] See Train (1999) or Green (2000) for additional details.

However, the researcher does not observe the decision maker's utility. In general, the researcher only observes some attributes of the alternatives as faced by the decision maker, x_{nj} , and some attributes of the decision maker s_n, and thereby can specify a function that relates these observed factors to the decision maker's utility. This function is denoted by $V_{nj} = V(x_{nj}, s)$. Usually, $V(\bullet)$ depends on parameters that are unknown to the researcher and therefore estimated statistically.

Note that $V_{nj} \neq U_{nj}$ because there are aspects of the utility function $U(\bullet)$ that the researcher does not or cannot observe. Under these circumstances, utility is decomposed as $U_{nj} = V_{nj} + \varepsilon_{nj}$, where ε_{nj} captures the factors that affect utility but are not included in V_{nj}.

The common modeling strategy is to threat all ε_{nj} as random elements, because they are not known to the researcher, where the joint density of the random vector $\varepsilon_n = (\varepsilon_{n1}, \ldots, \varepsilon_{nJ})$ is denoted by $f(\varepsilon_n)$. Based on this density, it is possible for the researcher to make probabilistic statements about the decision maker's choice. Following Train (2003), the probability that decision maker n chooses alternative i is:

$$\begin{aligned} P_{ni} &= \text{Prob}\left(U_{ni} > U_{nj} \;\forall\; j \neq i\right) \\ &= \text{Prob}\left(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \;\forall\; j \neq i\right) \\ &= \text{Prob}\left(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \;\forall\; j \neq i\right) \end{aligned}$$

Note that the probability that each random term $\varepsilon_{nj} - \varepsilon_{ni}$ is below the quantity $V_{ni} - V_{nj}$ is a cumulative distribution and that using the density $f(\varepsilon_n)$ this cumulative distribution can be rewritten as:

$$\begin{aligned} P_{ni} &= \text{Prob}\left(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \;\forall\; j \neq i\right) \\ &= \int_{\varepsilon} \text{I}\left(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \;\forall\; j \neq i\right) f(\varepsilon_n)\, d\varepsilon_n \end{aligned}$$

where $I(\bullet)$ is an indicator function, equal to 1 when the expression in parentheses is true and 0 otherwise. Imposing different specifications over the density of the unobserved portion of utility $f(\varepsilon_n)$ results in different discrete choice models. This is equivalent to assuming different distributions for the unobserved portion of the utility.

As different models assume different distributions for $f(\varepsilon_n)$, this has an impact on whether the previous integral has a close form solution. For example, assuming that the unobserved portion of utility is independent and identically distributed (*iid*) extreme values (logit) or certain generalized extreme value (nested logit) results in closed form solutions. Instead, assuming that $f(\varepsilon_n)$ is multivariate normal (Probit) or a mixing distribution plus an *iid* extreme value (mixed logit) results in non-closed form solutions, which must be evaluated numerically through simulation (Train, 2003).

- **Implications of the Distribution Assumptions**

Standard logit, or just logit, is the most widely used discrete choice model (Train, 2003). This model is derived under the assumption that ε_{ni} is *iid* extreme value for all alternatives *i*. According to Train, one of the critical parts of this assumption is that "the unobserved factors are uncorrelated over alternatives" (Train, 2003: 22).

Even though the *iid* assumption provides a convenient closed form solution to be estimated by most econometric packages, it might be a restrictive assumption under many circumstances (Train, 2003). For example, unobserved factors related to one alternative might be similar to those related to another alternative. When this is the case, the unobserved factors are correlated among alternatives rather than independent.

Additionally, the *iid* assumption has important implications when a logit is applied to sequences of choices over time. Specifically, because of the *iid* assumption, the logit model assumes that each choice is independent of the others. However, in many cases it is reasonable to assume that unobserved factors that affect the choice in one period would persist, at least somewhat, into the next period, therefore inducing dependence among the choices over time. Similar arguments can be generalized to agents that have the opportunity to make more than one decision (with different lenders, for example).

One effect of the *iid* assumption is that it implies the independence of irrelevant alternatives (IIA) property and very restrictive substitution patterns estimated by the standard logit model. These limitations are discussed in detail later.

According to Train (2003), the development of other discrete choice models happened mostly to avoid the *iid* assumption and its implications. For example, generalized extreme-value models (GEV) are based on distributions that allow correlation in unobserved factors over alternatives. The nested logit model is one of the simplest GEV models. Probit models are based on the assumption that the unobserved factors are distributed jointly normal, and with their more general forms, any pattern of correlation or heteroskedasticity can be accommodated. Additionally, probit models allow for any pattern of correlation over time or multiple decisions. According to Train (2003), the main advantage of the probit model is its flexibility in handling correlations over alternatives and time. However, its limitation arises from its reliance on the normal distribution, because in particular situations unobserved factors may not be normally distributed.

Finally, the mixed logit model allows the unobserved factors to follow any distribution. In a mixed logit model, the unobserved factors are decomposed into a part that contains all the correlation and heteroskedasticity and another part that is *iid* extreme value. Additionally, the first part can follow any distribution, including non-normal distributions like uniform, lognormal, or triangular. Additionally, McFadden and Train (2000) have shown that the mixed logit can approximate any discrete choice model and thus is fully general.

- **(Standard) Logit Model**

According to many, the logit model is the easiest and most widely used discrete choice model (Train, 2003). It was originally derived assuming IIA. McFadden (1974) has shown that if an only if the *J* disturbances are independent and identically distributed (*iid*), it is possible to obtain the logit model, such that[5]

$$\Pr ob\ (i = j) = \frac{e^{\beta' z_{ij}}}{\sum_1^J e^{\beta' z_{ij}}} \qquad (9.1)$$

this leads to what is called the conditional logit model, or the multinomial logit model, or just logit. According to Train (2003), the important assumption of this model is not so much the shape of the distribution as that the errors are independent of each other. This means that the unobserved portion of utility for one alternative is unrelated to the unobserved portion of utility for another alternative.

[5] The distribution of the errors is also called Gumbel. Maddala (2000) call it Weibull, but according to Train (2003) this is wrong.

In this model, utility depends on x_{ij}, which includes features specific to the individual as well as to the choices. The binomial logit model is a special case of the multinomial logit, when there are only two options. According to Green (2000), estimation of the multinomial logit models is straightforward. As with binary-choice model, after the estimation of the multinomial logit models it is necessary to compute marginal effects in order to determine the effect of changes in the independent variables over the expected probability of the event *j*.

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