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UMI®
THREE ESSAYS ON FINANCE FOR THE POOR

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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*****

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ABSTRACT

The dissertation contains three essays on unexplored dimensions of finance for the poor: microfinance governance, the efficacy of counseling for low-income mortgage borrowers, and the limitations of traditional banking in lending to young small firms in transition economies.

The first essay develops a model of information flows between managers and boards of microfinance organizations, with emphasis on the dual objectives of outreach and sustainability. It explores the board's optimal composition, appropriate for given economic environments, so managers are induced to reveal information about the microfinance technology and board decisions are efficient. Unlike models with single objectives, the duality of objectives makes managers reveal uniformly good sustainability and outreach signals but not reveal uniformly bad signals.

In slow growth environments, smarter boards induce less revelation. The duality of objectives improves the chances of revelation, even with smart boards. In uniformly fast growth environments, smart boards are optimal. For slow finance, fast outreach environments, dumb, business-dominated boards are preferable; for slow-outreach, fast finance environments, dumb, altruist-oriented boards are preferable.
The second essay evaluates the efficacy of cash flow-based credit counseling, by using competing risks (option-based) and choice theoretic approaches to modeling mortgage termination. Results suggest that low-income households exercise both put and call options. Both approaches produce mixed results about the influence of counseling on default, but show that counseling influences prepayment. Counseling lowers default hazards and helps borrowers prepay more often.

The third essay adapts the financing constraints approach to the circumstances of small firms in Russia and studies how investment in firms of different age is affected by the availability of internal funds and security of property rights. The empirical analysis shows that young firms face higher financing constraints, as a result of higher information costs.

Overall, formal financial intermediaries do not fund small firms, but banks grant loans to firms with transparent transactions. The security of property rights influences investment only in mature firms. Extralegal relationships in older firms, secured through extralegal payments, increase investment. Potential entrepreneurs are discouraged by high entry costs and only the most profitable firms, whose investment is unaffected by extralegal payments, enter the market.
DEDICATED TO DENIS
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CHAPTER 1

INTRODUCTION

One does not become a development economist —wrote Abhijit Banerjee at MIT earlier this year— if one believes that the world’s poorest are doing as well as they possibly could.\(^1\) A development economist, therefore, seeks to understand what economic policies and tools can help the poor improve their lives and the welfare of society. Finance has been viewed by many as a powerful tool to alleviate poverty.

Financial services do indeed have a role in indirectly improving the situation of the poor; however, they can achieve this result only when these services do what finance is supposed to do: facilitate payments and liquidity management, intermediate funds, in order to allow intertemporal reallocations of resources and bridge differences in marginal rates of return among deficit and surplus units, and offer instruments to deal with risk (Gonzalez-Vega, 1994). This dissertation addresses several issues associated with recent initiatives to extend the frontier of formal finance to the poor.

During its evolution, the Ohio State University’s approach to finance for the poor has emphasized the importance of different dimensions of the provision of financial

services, from policies, to financial technologies, to organizations (Gonzalez-Vega, 1994). The three essays of this dissertation are inspired by these three stages of evolution of the Ohio State University's perspective on development finance.

The focus of this dissertation is on three less frequently studied aspects of financial services for the poor: microfinance governance, credit counseling for low-income housing mortgage borrowers, and the limitations of traditional banking in offering loans for relatively young micro and very small firms in transition economies. The essays in the dissertation vary in research methodology—one essay is theoretical and two are empirical. Moreover, the data come from diverse economic environments—from U.S. low-income households who hold mortgage loans and from micro and very small entrepreneurs in Russia.

In the first essay, the focus is on the microfinance organization. The objective is to discover what composition of the board of directors will induce the manager of the microfinance organization to fully disclose all the information he possesses, so that the board's decision to implement or not implement a new financial technology is based on full information; i.e., it is efficient. An important issue in this model is how the duality of the organization's objectives—outreach and sustainability—affects the optimal composition of the board, under different growth environments and with different characteristics of board members.

The second essay is about financial technologies. It compares the effectiveness of the traditional screening technology used by banks in granting mortgage loans to the effectiveness of the screening technology based on credit counseling implemented by a third party. The goal is to establish whether credit counseling leads to lower rates of
mortgage termination. The challenge of this study comes from the disagreement among researchers on what conceptual approach (option-based or consumer choice approaches) better captures mortgage termination behavior. Additionally, there is even less clarity as to what determines the mortgage termination behavior of low-income households. The essay uses both methods and shows that, depending on the model, results on the effectiveness of credit counseling vary.

The third essay is about the consequences of economic policies that directly or indirectly affect small businesses. It attempts to identify what impedes the growth of micro and small firms in Russia—financing constraints or the insecurity of property rights. Credit services can benefit the poor only if the poor have productive opportunities that generate repayment capacity (Gonzalez-Vega, 1994). However, when productive opportunities exist but microentrepreneurs do not feel that their property rights are well protected, the provision of financial services will not help the poor (Johnson, 2002b).

The objective of the third essay is to study how the economic transition and the policies implemented by the Russian government have affected the security of the entrepreneurs' property rights and, consequently, their investment behavior. Moreover, the essay explores the consequences, on the small firms' ability to grow, of burdensome regulations on the financial sector and of the lack of competition from foreign financial institutions, which are better suited to provide cost-efficient financial services to microentrepreneurs. An important issue in this essay is to identify what types of firms—younger or more established firms—are most affected by often faulty government policies.
Research on financial services for the poor must address important tradeoffs, and this dissertation is not an exception. First, theoretical work must be grounded in well-documented stylized facts. Facts about the internal governance mechanism of any firm are hard to come by, because board members and managers do not want to expose themselves to extra scrutiny. Board members and managers of microfinance organizations are not an exception. This is why the theoretical model in the first essay takes a conservative approach and uses as general assumptions as possible, such as the duality of the organization's objectives, a higher quality of signals for the manager than for board members, and different types of environment—high and low growth in terms of both outreach and profitability.

Empirical work on financial services for the poor suffers from the lack of data and the poor quality of the little data available. In this respect, this dissertation is also not an exception. The second essay uses data collected and assembled by the author, as part of the Rural Finance Program team at The Ohio State University, from the loan application forms held at Huntington Bank. Data collection took more than four months, as the bank did not keep records about low-income borrowers in electronic form. The spreadsheet was created manually from paper or the paper image of loan applications. Furthermore, data on house prices volatility for less expensive houses could not be found for local, state or federal levels. As a result, the essay uses house prices volatilities estimated on the basis of a wider range of house prices, which leads to overestimation of the volatility of the houses purchased by low-income households.

The tradeoff in this second essay was to study mortgage termination by low-income households using either the latest developments in theory and methodology, such
as the competing risks models, and accommodating the potential problem with the put option, or to engage in simple descriptive comparisons. The choice was made in favor of the former.

Observing and documenting the economic transactions of low-income households in countries in transition is even more challenging. The data for the third essay come from a survey created and administered under the supervision of a team from the Rural Finance Program at The Ohio State University, in which I also participated. Creating and implementing a survey that would produce reliable information, especially if the questions relate to income, is a challenge in any environment. A survey asking Russian small entrepreneurs, many of whom operate in the gray economy, about their financial transactions turned almost impossible. The tradeoff was to ask questions that would be easily used in econometric analysis and obtain only few answers, most of which would be inaccurate, or to ask more general questions and receive more and more honest answers but be able to implement less precise econometric specifications. The choice was made in favor of the latter.

The three essays confirm lessons learned by the Rural Finance Program at The Ohio State University. Innovations in both lending technologies and organizational design may be more promising mechanisms to expand the frontier of finance to include the poor than repressive regulation has been.
CHAPTER 2

DUAL MISSION AND THE TRANSMISSION OF INFORMATION BETWEEN THE MANAGER AND THE BOARD OF MICROFINANCE ORGANIZATIONS

2.1 Introduction

The microfinance organization (MFO) has evolved as a result of the efforts of committed individuals and assistance agencies to promote economic development and reduce poverty. The MFO is a unique enterprise because of its dual objectives—it must provide financial services to the poor and it must cover its costs. In the professional jargon of microfinance (Yaron, 1994), the MFO must achieve substantial outreach goals while remaining financially sustainable (profitable).

In particular, the MFO must operate as any sustainable financial firm, lending to creditworthy clients, protecting its portfolio, and earning profits in order to expand its operations and broaden the scope of its services. At the same time, since its mission is to provide financial services to the poor, the MFO is expected to implement lending technologies that improve outreach, i.e., technologies that increase the number of poor people who use the services of the organization.¹

¹ This definition of outreach is a simplification because outreach has many dimensions—quality of outreach, cost of outreach, depth of outreach, breadth of outreach, length of outreach, and variety of outreach (Gonzalez-Vega, 1998b).
In the past decade, there has been an explosion of microfinance activities throughout the world. The academic interest in microfinance has also been on the rise. The existing literature has attempted to explain the success and failure of different microfinance initiatives by examining the merits and shortcomings of different lending technologies. Most of the academic microfinance literature consists of studies on joint-liability lending (Journal of Development Economics, Vol. 60 (1), October 1999). Another area of interest has been the selection of specific target groups among the poor in order to maximize social and economic gains (Morduch, 1999).

Practitioners have recognized that another dimension of microfinance is the limited potential of the organizational structure and governance practices of a typical microfinance organization (Campion, 1998; Campion and White, 1999; Rock et al., 1998). Case studies of individual MFOs and countrywide studies of microfinance also recognize the important role that managers and boards of directors play in making the organizations respond to the demands of local markets and thus improve both outreach and sustainability (Rhyne, 2001; Schmidt and Zeitinger, 1998). Very few academic studies have acknowledged, however, the importance of organizations and governance mechanisms in microfinance (Chaves, 1994; Gonzalez-Vega, 1993 and 1994; Krahnen and Schmidt, 1994; Schmidt and Gonzalez-Vega, 2000).

This absence of research on governance in microfinance is not surprising. Theoretical economists have only recently turned their attention to the corporate board, and most of the contributions to the understanding of the internal corporate governance mechanism were developed in the second half of the 1990s (John and Senbet, 1998; Hermalin and Weisbach, 2000). The focus of this research has been on the board’s role in
the modern corporation. The governance problems of privately-held firms and non-governmental organizations (NGOs) differ, however, from the problems of the corporation. This is why existing studies are of only limited help in the understanding of the role of the board of directors in microfinance.

The corporate board functions as a mechanism of oversight and control. The board, however, is not able to play this role by itself. External markets reinforce the internal governance mechanism and discipline both managers and directors. For example, both corporate managers and directors are motivated to perform well because the labor market for their services is strong. Managers must deliver because only good performance guarantees access to capital markets and thus the survival of the firm. Moreover, product market competition also forces managers to perform well in order to preserve their own reputation and earning potential.

Microfinance organizations, however, cannot fully benefit from the disciplining effects of various markets. Labor markets for MFO managers are weak, and many MFOs do not face competitors. Board members are rarely paid, and there is no market for such services. Instead, the board members' reputation in the community is the main mechanism that is expected to ensure diligent board performance. Reputation concerns may not be strong enough, however, to secure success in the achievement of the dual objectives of the MFO.

Providers of funds could reinforce the internal governance mechanism of MFOs, but there are few guarantees that good managers will be rewarded through improved access to funds. Moreover, donor funds, provided through non-market mechanisms and
sometimes without hard budget constraints, may create perverse incentives. In the absence of hard budget constraints, the incentives to pursue sustainability will be weak.

Moreover, MFOs are very heterogeneous, and their missions emphasize different levels and aspects of outreach and profitability. Furthermore, specific outreach and sustainability goals may be relatively easy to meet in one market and impossible to meet in another. Therefore, the donors’ evaluation of MFO performance cannot correctly capture the actual extent of the individual contributions of the manager or the board, and donors and investors cannot easily play the usual role that providers of finance play in the market for corporate control. That is, access to external funds may be arbitrary and not necessarily conditional on good governance.

The weak disciplining role of external markets shifts the focus of MFO governance back to the board. Very limited data on existing governance practices in microfinance are available, however. Neither board members nor managers have incentives to subject themselves to unnecessary scrutiny unless such scrutiny can benefit them. Campion (1998) argues that one of the ways to improve the performance of microfinance boards would be to pay board members for their services. Such a remedy could be costly, however, and currently most of the MFOs that do pay their board members only pay a symbolic remuneration.²

Board members of non-profit MFOs, furthermore, typically serve as volunteers. There is a legitimate concern that board members of NGOs may not perform their duties well either because they have the wrong reasons to participate or because they are not sufficiently diligent (Bowen, 1994). To address some specific topics, to be discussed

² Several MFOs have been transformed into regulated financial intermediaries. Paid board members are usual in this case.
below, this chapter makes the strong assumption that written guidance of the board members' rights and obligations, as well as peer policing, would decrease, although not eliminate, the incidence of inappropriate (non-diligent) behavior. As long as MFOs cannot afford to pay competitive salaries to their board members and as long as non-profit MFOs prefer to use volunteers, other methods to improve their internal governance mechanisms must be sought.

This chapter focuses on the characteristics of the board and on the dual nature of the MFO's objectives. It argues that different market conditions require a different composition of the board, in order to make the best use of its efforts. The logic of the model presented here is that the key for effective decision-making is good information. Even the most qualified board can make bad decisions, if the information it uses is of poor quality. Significant differences in the demand for financial services across regions, countries, and continents create different information requirements in different environments. This is particularly the case as, with growing competition, microfinance has become increasingly market-driven and not product-driven (Cohen et al., 2001). Having information on what technology may best serve the demands of a particular MFO market is a prerequisite for success.

In general, board members must approve the adoption and implementation of the financial technology that the MFO uses. Boards possess their own information about the chances that a given technology will achieve the target levels of outreach and sustainability. The managers' information, however, is always superior, as the managers know the market and the MFO resources better. Therefore, the board will approve a
technology that is most appropriate for a given market only when the board has all the information available—it's own and that of the managers.

This chapter develops a model of information exchange between the managers and the board. As a simplification, the board consists of two types of members: altruists, who care about outreach and are not interested in financial results, and business-oriented members (professionals), who care only about financial results but not about outreach. Moreover, the board is smart when board members receive high quality signals about the proposed financial technology or, equivalently, when the difference between the quality of the signals they receive and those received by the managers is small. The board is dumb if the signals are of low quality or if the difference between the quality of the managers' signals and the board’s signals is large.

The goal of the exercise is to design a board that would induce the managers to reveal their signals about the financial technology. Since the managers’ signals are of higher quality than those of the board, revelation of higher quality signals contributes to better decision-making.

The model permits characterization of an optimal board composition for each type of environment (i.e., for each type of market for microfinance services). Four types of environments are specified: high outreach–high profitability, low outreach–low profitability, low outreach–high profitability, and high outreach–low profitability potential. This chapter shows that different board characteristics are optimal in different environments. In each environment, and depending on the goals of the MFO, the board’s optimal composition varies in terms of dominance by altruistic or business-oriented members.
Part 2 summarizes the theoretical literature on board-management interaction. Part 3 describes the theoretical model and its solution. Part 4 discusses the results. Part 5 concludes.

2.2 The literature on the board of directors

Managerial motivation has been modeled by using agency theory (Grossman and Hart, 1983; Eisenhardt, 1989; Holmstrom and Milgrom, 1991; Milgrom and Roberts, 1992; Murphy, 1999; Salanie, 1997). The agency approach, however, treats the manager as a passive player in a game while, in practice, and especially in MFOs, managers control the organization. Moreover, in the agency approach, shareholders are the principal, but in many MFOs there are no shareholders. Rather, the providers of funds are private donors, government agencies and, only to a limited extend, private investors. Fama and Jensen (1983a and 1983b) argue that, in such circumstances, the board of directors will be an effective monitor, because reputation costs to board members will ensure that they perform their supervisory duties well.

A modeling approach that explicitly focuses on board-management interactions is better suited to explain the complex exchanges that characterize the internal governance mechanisms of MFOs. John and Senbet (1998) and Hermelin and Weisbach (2000) attempt to survey recent contributions to this analysis and conclude that, while there are important empirical studies, the theoretical literature on this subject is still in its infancy.

The empirical literature reveals that board composition, according to the board members’ association—outsiders or insiders, is not correlated to company performance. It also reveals that board size is negatively related to performance, and that both
composition and size are related to the quality of board decisions regarding CEO replacement and compensation. In turn, ownership structure, CEO turnover, and firm performance often lead to changes in the composition of the board.

Several new studies have attempted to explain the internal mechanism of governance and how it ameliorates various classes of agency problems arising from the conflict of interests among different stakeholders. Understanding whether the internal governance mechanisms help resolve management-shareholder problems is important. On the one hand, Fama and Jensen (1983a and 1983b) have argued that the board is an important institution that resolves management-shareholder problems. On the other hand, Mace (1986) argues that boards show little dissent and, therefore, perform little monitoring. If the latter view is correct, then governance must be redesigned and a new management disciplining mechanisms should be sought.

Warther (1998) is able to show that strong monitoring can coexist with passive dissent. In his model, the board has a utility function different from the utility functions of managers and of shareholders. Warther argues that, in practice, managers choose the board and not the other way around. He shows that the manager’s power to select and eject a board member influences board behavior, by constraining the frequency of open dissent. Board members do not exercise their power to fire managers frequently because of the threat that they may be ejected. However, this off-equilibrium threat to fire the manager is sufficient to induce good management.

The Warther model also suggests that monitoring improves when the board members’ incentives are aligned with the interests of shareholders, either by using options to compensate board members for performance or by using golden parachutes to
decrease the ejection penalty. Another result of the model that may be useful in the design of microfinance boards is that concentrating the information gathering tasks in a few board members may improve effectiveness, in much the same way as concentrated shareholding does (Shleifer and Vishny, 1997). Concentrated ownership, furthermore, has significantly improved corporate governance practices in Eastern Europe (Estrin, 2002).

Hermalin and Weisbach (1998) study how a board chosen through a process controlled by the CEO can be an efficient monitor. They model the negotiation process between the CEO and the board over the CEO's compensation and over the identity of new directors. The board's bargaining power comes from its ability to accept or refuse the new directors proposed by the manager. The bargaining power of the manager comes from his perceived ability relative to that of a replacement. These negotiations determine the degree of independence of the board and thus its willingness to monitor the manager. In this model, both the manager's activity and board structure are endogenously determined.

The predictions of the Hermalin and Weisbach (1998) model reflect empirical evidence that good CEO performance decreases the likelihood of replacement, that CEO turnover is sensitive to board independence, that more independent directors are added to the board following poor performance, and that accounting measures of performance predict better CEO turnover than stock market prices. The governance practices of financial firms, however, are not well explained by this model, as management markets are thin, managers are rarely replaced, and the governance mechanism is ex ante (Skeel, 1999). MFOs are not different in this respect; these features are likely magnified in this
case. Moreover, in the model of Hermelin and Weisbach, performance is evaluated in terms of profitability, while in MFOs both outreach and profitability matter.

In the model of Noe and Rebello (1997), the focus is on the presence of both outsiders and insiders in the board. Insiders are privately informed and they receive benefits if a project is accepted. Outsiders are uninformed; they care about reputation, as good reputation increases their value in the labor market. Outsiders may also own shares. The presence of outsiders who could coordinate their actions and fire a manager (or, equivalently, block his actions) results in efficient bargaining. Board members care about reputation, but the model predicts that only very strong reputation concerns can align the boards' incentives with the interests of the owners of capital (shareholders). If reputation concerns are weak, the compensation of board members matters. Noe and Rebello also find that when outsiders dominate, boards are more effective in crisis situations.

Almazan and Suarez (2000) do not explicitly consider the role of independent directors but concentrate on the allocation of control between the board and the CEO. They attempt to answer the question of how to induce a manager who is prone to entrenchment to improve the effectiveness of the firm's organization and, at the same time, preserve the degree of governance flexibility that would allow the board to take advantage of a potentially valuable replacement of CEO. This is achieved by using a compensation policy that includes not only an expensive performance-based compensation but also by letting the manager negotiate a severance pay when a replacement is desirable.

The Almazan and Suarez model suggests that shareholders might find it ex ante optimal to elect a CEO-dominated board, despite the possibility of entrenchment. Since
severance pay is part of the compensation package, only CEOs who have previously taken actions that have improved the organization are able to negotiate a substantial part of their compensation as severance. Thus, compensation is directly linked to past actions.

Other predictions of the Almazan and Suarez model include the observation that CEO-dominated boards (as is frequently the case with MFO boards) are optimal when the standard performance-based compensation is not very effective, due to a noisy link between managerial decisions and the organization’s performance, and when entrenchment temptations are not strong, due to small control rents. This could help explain the behavior of MFO boards, but this knowledge would be mostly useful if indeed MFO boards offered the managers severance pay. Campion (1998) finds, however, that MFOs do not offer severance pay to managers. Therefore, the MFO’s internal governance may have to rely on other mechanisms to align the incentives of the parties with the objectives of the organization. The model of Almazan and Suarez also suggests that takeovers are redundant when there are independent boards, but that the performance of CEO-controlled boards is improved under the threat of takeover.

Maug (1997) focuses on the interaction of the internal and external mechanisms of control. His goal is to contrast the effectiveness of independent directors in inducing corporate restructuring with that of alternative mechanisms, specifically the market for corporate control and the control exercised by creditors. In the model, the manager invests in his own firm-specific human capital and, if restructuring occurs, part of this capital will be lost. If the manager relies on an implicit contract that may be breached, the managers who anticipate restructuring will underinvest in their own human capital. As in previous models, high-powered compensation plans and control rights can alleviate this
problem, but this is expensive. The presence of independent directors, creditors and
takeover raiders can also alleviate this problem, but this requires costly information.

Maug also shows that the directors’ ability to negotiate and enforce implicit
contracts induces optimal use of company resources. The model yields a ranking of the
effectiveness of alternative control mechanisms, under the condition that acquiring
information through outsiders is not too costly. If the directors fail to exercise control, the
second-best solution is takeover control or creditor control. Strong directors and friendly
takeovers are the best control mechanisms, followed by hostile takeovers and debt. Next
in the ranking are managerial control (dominance) and, last, weak directors. If the cost of
acquiring information by outsiders is high and the expected restructuring potential is low,
unchecked management control is the dominant strategy. This result is close to the result
obtained in this chapter.

Hirshleifer and Thakor (1994) also study the interactions between internal and
external control mechanisms. They specifically look at the implications of takeover
threats on the effectiveness of the board of directors in monitoring the manager.
Berkovitch and Israel (1996) study how optimal management replacement can be
implemented by balancing the composition of the board. They show that when
management replacement involves increased risks, aggressive replacement is not optimal
and can be fine-tuned by leverage and the inclusion of conservative debt holders on the
board.

Nippel (1999) and Adams (2001) concentrate on the dual role of the board as a
monitor and an advisor. In Nippel’s model, the manager’s decision to undertake a project
is based on his private information of the NPV of the project, his management rents, and
the value of his share in the firm. In this model, an imperfect monitor always increases shareholders’ value if the probability of approving good projects is higher than the probability of approving bad projects (monitoring quality is high). An imperfect consultant can increase the firm’s value if the benefits of good advice outweigh the negative influence on the manager’s incentives to search for good projects. An interesting conclusion of this work is that board members should not try to stop investment projects but should, instead, reward managers for good projects.

Information plays an important role in the Adams (2001) model. In this model, there exists a trade-off between the board’s function as a monitor and its function as an advisor. When the manager’s incentives to share information are low, the board may pre-commit to less monitoring, in order to encourage the manager to share more information. Adams derives the conditions under which a management-friendly board is optimal, by explicitly modeling the manager’s career concerns in a three-period, dynamic game.

The Adams model predicts that the board’s monitoring intensity first falls and then rises, as the manager’s incentives become less aligned with the interests of shareholders and the manager’s career concerns increase. When the conflict of interests is large, it is optimal that the board be more management friendly, provided that the value of communication is extremely high. The model also shows that, in some circumstances, the German model of corporate governance, where the two board functions are separate, may be optimal. Adams also suggests that when boards are management friendly, the external governance mechanisms are expected to pick up the internal mechanism’s slack.

Information transmission is central to the model developed by Gutierrez-Urtiaga (2000), where board members are modeled as advisors. This model serves as a basis for
the model developed in this chapter. It assumes that the board cares only about shareholder value and has a sufficient number of outside directors to perform its duties well. The choice by the manager is to reveal or not to reveal all the information about the quality of a project. An important part of the model is its emphasis on the environment, which can be fast or slow growth. Gutierrez-Urtiaga shows that the board will make more efficient policy decisions if there is a balance between the decision power of the CEO (determined by expertise and knowledge) and that of the directors (determined by the proportion of independent directors and by the expertise they bring in).

2.3 The model

Consider a manager and a board. The board consists of two types of directors. **Altruists** care about outreach, *i.e.*, the number of (additional) poor people who gain access to financial services. **Business-oriented** board members care about the financial results of the microfinance organization. Board composition is exogenous and reflects the preferences of the founders/providers of finance.

As in Gutierrez-Urtiaga (2000), without a loss of generality, it is assumed that the manager is risk neutral. The manager maximizes his pecuniary and non-pecuniary remuneration from running the firm. The manager has no wealth and has a zero reservation utility. Changing these assumptions would only change the results found. Moreover, the manager has no preferences over the goals of the organization, *i.e.*, he does not care if the organization achieves better outreach or better financial results, as long as the organization continues its work —new projects are implemented, and the manager
receives his private benefit \(B\). This benefit is proportionately related to the number of projects implemented. If no projects are approved, there is no private benefit.

2.3.1 Description of the technology

The manager and the board consider a new project. The board must decide whether the new project will be undertaken and if it will ask the manager to implement it. In the most general terms, the new project is the implementation of a new financial technology. The new technology is expected to help the organization achieve good financial results and attain a desired level of outreach.

A technology requires an initial investment \(I\) and it yields \(R>I\) if it is \(r^g\) or zero if it is \(r^b\). The \textit{ex ante} probability that any technology in the pool of technologies achieves good financial results is \(p\), and this probability is common knowledge to the manager and the board members. The expected return of a financial technology that produces good financial results is \(pR>I\). The environment will be referred to here as fast financial growth when \(p \geq I/R\) and slow financial growth when \(p<I/R\), i.e., when projects are not \textit{ex ante} profitable.

The technology has a second dimension, related to outreach. Let \(TB\) be the number of target borrowers and \(AB\) be the number of actual new borrowers who are reached if the technology is successful. A technology can either succeed or fail. A good technology in terms of outreach \((t_g)\) is a technology that produces \(AB>TB\), i.e, the number of actual new borrowers is higher than the number of target borrowers. A technology is a bad technology \((t_b)\) if it fails, i.e., \(AB=0\). The \textit{ex ante} probability that any technology in

\[3\] Superscripts denote characteristics relevant to financial results, and subscripts denote characteristics relevant to outreach results, where \(g\) stands for good and \(b\) stands for bad.
the pool of technologies is good for outreach is $q$. The expected outcome from the technology in terms of outreach is $q_{AB}$. The environment is called a fast outreach environment if $q \geq TB/AB$. Similarly, it is called a slow outreach environment if $q < TB/AB$.

When both outreach and sustainability are taken into consideration, the technology can be of four types: $t^e$, $t^b$, $t^b$, $t^b$. Altruistic board members care only about outreach; for them $t^e = t^b = t^b$ and $t^b = t^b = t_b$. Business-oriented board members, in turn, care only about financial results and for them $t^e = t^e = t^e$, $t^b = t^b = t^b$.

The board will decide whether to implement the new financial technology, based on the expected results of this technology, conditional on the board information set $\Omega_{board}$. That is, the board will accept the new project when the conditional probability that the technology is acceptable, namely, if $\Pr(t=\text{good}|\Omega_{board})$, is greater than or equal to the targets of the organization.

Specifically, altruists would accept the new technology if $\Pr(t_{ab}|\Omega_{ab}) \geq TB/AB$, where $\Omega_{ab}$ is the information set of altruists. Business-oriented board members would accept the new technology if $\Pr(t_{bb}|\Omega_{bb}) \geq I/R$, where $\Omega_{bb}$ is their information set.

The manager obtains private benefits $B > 0$ if the project is undertaken and zero if the project is not undertaken. Given that the manager does not care what type of projects in terms of outreach and sustainability will be undertaken, $B$ does not depend on the project characteristics/type.
2.3.2 Players' signals

The manager receives signals about the quality of the project. These signals are $m^g_s$ if the technology yields good outreach and sustainability results, $m^f_s$ if the technology yields good financial results but does not attain the outreach level required, $m^b_s$ if the technology attains the target outreach level but does not yield good financial results, and $m^b_b$ if the technology fails to achieve both sustainability and outreach targets.

The altruistic board members receive one of two signals —either a signal $ab_g$, meaning that the technology is good in terms of outreach, or a signal $ab_b$, meaning that the technology is bad in terms of outreach. The professional board members also receive one of two signals —either a signal $bb^P$, indicating that the technology is financially good, or a signal $bb^b$, indicating that the technology is bad in terms of sustainability.

**Assumption 1:** The signals received by the board members and by the manager are independent, conditional on the technology. The signals are, moreover, informative.

Namely, the precision of the signal that the altruistic board members receive is denoted by

\[ \alpha = \Pr(ab_g | r_g) = \Pr(ab_b | r_b) > \frac{1}{2} \]  

(1a)

The precision of the signal that business-oriented board members receive is denoted by

\[ \beta = \Pr(bb^P | r^P) = \Pr(bb^b | r^b) > \frac{1}{2} \]  

(1b)

The precision of the manager's signals is:

\[ \gamma^a = \Pr(m^g | r^g) = \Pr(m^b | r_b) > \alpha > \frac{1}{2} \]  

(2a)

\[ \gamma^b = \Pr(m^f | r^f) = \Pr(m^b | r^b) > \beta > \frac{1}{2} \]  

(2b)
These assumptions mean that, first, when the manager or the board members receive signals, these signals are useful for the decision-making process and, second, that the manager receives more informative signals than the board does. The signals are private to the parties that observe them.

2.3.3 Information sets

The decisions of the board are based on the information that board members have, weighed by the proportion of member types. The manager receives private signals and can either reveal all the information he has or not reveal this information. That is, the action space of the manager consists of two actions: "reveal the signal" and "do not reveal the signal". The manager either discloses his full signals, $m^s_m$, $m^s_b$, $m^b_m$ and $m^b_b$ or does not disclose the signals at all. Partial disclosure is not considered here. From these signals, altruistic board members extract only one-sided signals, i.e., $m^b_b = m^s_b = m^s$ and $m^b_b = m^b = m_b$, since they do not care about financial results. Business-oriented board members extract only $m^b$, where $m^b = m^s_b = m^b$, and $m^b$, where $m^b = m^b_b = m^b_b$, since they do not care about outreach.

If the manager does not reveal his signals, the information set of the altruistic board members is defined by $\Omega^0_{ab} \in \{ab_b, ab_b\}$ and that of the business-oriented board members is defined by $\Omega^0_{bo} \in \{bb^b, bb^b\}$. 

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If the manager reveals his information, the information set of the altruistic board members is $\Omega_{\text{ab}}^1 \in \{(ab_g, m_g), (ab_b, m_b), (ab_b, m_g), (ab_b, m_b)\}$ and the information set of business-oriented members is $\Omega_{\text{bb}}^1 \in \{(bb^b, m^b), (bb^b, m^g), (bb^b, m^b), (bb^b, m^b)\}$.

After observing the signals of the manager, the board updates its beliefs about the quality of the project using Bayes’ rule. These updated probabilities are shown in the Appendix to this chapter.

**Lemma 1.** The ex post probabilities, after the signals are received, that the project is good in terms of outreach and good in terms of financial results can be ranked as follows:

\[
\begin{align*}
\Pr(t_g | ab_b, m_b) &< \Pr(t_g | ab_g, m_b) < q < \Pr(t_g | ab_b, m_g) < \Pr(t_g | ab_g, m_g) \quad (3a) \\
\Pr(t_g | ab_b, m_b) &< \Pr(t_g | ab_b) < q < \Pr(t_g | ab_g) < \Pr(t_g | ab_g, m_g) \quad (4a)
\end{align*}
\]

Similarly,

\[
\begin{align*}
\Pr(t^f | bb^b, m_b) &< \Pr(t^f | bb^b, m_g) < p < \Pr(t^f | bb^b, m^g) \quad (3b) \\
\Pr(t^f | bb^b, m_b) &< \Pr(t^f | bb^b) < p < \Pr(t^f | bb^b) < \Pr(t^f | bb^b, m^g) \quad (4b)
\end{align*}
\]

**Proof:** The proof is in the Appendix to this chapter.

There is, however, ambiguity regarding

\[
\begin{align*}
\Pr(t_g | ab_b) &\geq \Pr(t_g | ab_g, m_b), \text{ and} \\
\Pr(t_g | ab_b) &\geq \Pr(t_g | ab_b, m_g).
\end{align*}
\]

And

\[
\begin{align*}
\Pr(t^f | bb^b) &\geq \Pr(t^f | bb^b, m_b), \text{ and} \\
\Pr(t^f | bb^b) &\geq \Pr(t^f | bb^b, m^g).
\end{align*}
\]
2.3.4 The decision making process

The manager learns about the technology and observes signals regarding this technology. Then he submits the project to the board for approval. During the board meeting, board members extract their own signals regarding the technology. Board members can also ask additional questions and the manager can answer by either revealing his signal or by not revealing it. The manager cannot lie. The sequence of the events is the following:

1. Nature decides technology type and signals are observed.
2. The manager decides to disclose or not to disclose his signal.
3. The board decides on undertaking a project or not undertaking it.
4. Payoffs are obtained.

The action space of board members consists of two actions, \( AP \) “accept a project” and \( RP \) “reject a project”. The decision rule depends on the probability that the project reaches the target. Altruists will accept if \( \Pr(t_{d|f_{ab}} | \Omega_{ab}^d) > TB/AB \) and business-oriented board members will accept if \( \Pr(t_{d|f_{g}} | \Omega_{g}^d) > I/R \), where \( d=0,1 \) and 0 means the manager does not reveal and 1 means the manager reveals his signal.

The important ranges to consider are:

\[
\begin{align*}
\Pr(t_{d|f_{bb}} | b^b, m^b) &< I/R < \Pr(t_{d|f_{bb}} | b^b, m^B) \quad \text{and} \quad (7a) \\
\Pr(t_{d|f_{ab}} | a^b, m_b) &< TB/AB < \Pr(t_{d|f_{ab}} | a^b, m^B) \quad (7b)
\end{align*}
\]

It is not necessary to consider ranges outside these regions, because projects will be rejected/approved irrespective of the signals received. For example, if \( \Pr(t_{d|f_{bb}} | b^b, m^b) > I/R \), that is, if the ex post probability that the project is good, given that both the manager and board members received bad signals, is greater than the investment to
return ratio, then these signals do not influence the accept/reject decision. Clearly, the project will be accepted with certainty. Similarly, if \( \Pr(r|ab, m) < I/R \), that is, if the probability that the project is good, given that both the manager and board members receive good signals, is less than the investment to return ratio, then such project will never be accepted.

The efficiency of the decision by the board will depend on how informative board member signals are. This, in turn, depends on the difference between \( \gamma^a - \alpha \), and \( \gamma^b - \beta \). If \( \gamma^a - \alpha \) and \( \gamma^b - \beta \) are large, the board is *dumb*; if the difference is small, then the board is *smart*.

The environment adds another dimension to the game. There can be two types of environments for each objective: high growth and slow growth. Recall that an environment is *fast financial growth* when \( p \geq I/R \) and *slow financial growth* when \( p < I/R \). The environment is a *fast outreach* environment if \( q \geq TB/AB \) and a *slow-outreach environment* if \( q < TB/AB \). The possible combinations are illustrated in Figure 1 and Table 1.
Figure 1. Illustration of the possible combinations of environment and board quality.
<table>
<thead>
<tr>
<th>Dumb board</th>
<th>Smart board</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fast profitability</strong></td>
<td><strong>Fast profitability</strong></td>
</tr>
<tr>
<td>Large $\gamma^\alpha - \alpha$, $\gamma^\beta - \beta$</td>
<td>Small $\gamma^\alpha - \alpha$, $\gamma^\beta - \beta$</td>
</tr>
<tr>
<td><strong>Fast outreach</strong></td>
<td><strong>Fast outreach</strong></td>
</tr>
<tr>
<td>$I/R \in { Pr(f^a</td>
<td>b^a, m^a), \ p }$</td>
</tr>
<tr>
<td>$TB/AB \in { Pr(t_{a</td>
<td>ab, m_b}), \ q }$</td>
</tr>
<tr>
<td><strong>Slow profitability</strong></td>
<td><strong>Slow profitability</strong></td>
</tr>
<tr>
<td><strong>Slow outreach</strong></td>
<td><strong>Slow outreach</strong></td>
</tr>
<tr>
<td>$I/R \in { p, \ Pr(f^a</td>
<td>b^a, m^a) }$</td>
</tr>
<tr>
<td>$TB/AB \in { q, \ Pr(t_{a</td>
<td>ab, m_b}), \ q }$</td>
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<tr>
<td><strong>Slow profitability</strong></td>
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<td>$TB/AB \in { q, \ Pr(t_{a</td>
<td>ab, m_b}), \ q }$</td>
</tr>
</tbody>
</table>

Table 1. Possible combinations of board quality and environment

2.3.5 The information disclosure game

The manager receives his signal $m_i^z$. Let $M: \{ m^a, m^b, m^b \} \rightarrow \{0,1\}$ be an indicator function that takes the value of 1 if the manager reveals his signal (plays RS), and 0 if he does not reveal it (plays NR). The manager’s payoff is $\Pi_m (M, m_i^z)$.  

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Let \( B_a: \Omega^M_{ab} \rightarrow \{0,1\} \) be an indicator function for the altruistic board members that takes the value of 1 if they approve the new technology (AP) and 0 if they reject the new technology (RT). Similarly, let \( B_b: \Omega^M_{ab} \rightarrow \{0,1\} \) be an indicator function for the business-oriented board members that takes the value of 1 if they approve the new technology (AP) and 0 if they reject it (RT).

The payoff to the altruistic board members is \( \Pi_{ab}(M, B_a, ab^*_i) \), where \( ab^*_i \) is the signal that the altruistic board members get, and the payoff to the business-oriented board members is \( \Pi_{bb}(M, B_b, bb^*_i) \), where \( bb^*_i \) denotes the signal that these board members receive.

The rules that the board uses to accept/reject a project are derived from the board's objective function shown in (10). If the project is accepted, the payoffs are:

\[
\Pi_{ab}(M, B_a, ab^*_i) = \Pr(t_g|\ldots)(AB - TB) + [1-\Pr(t_g|\ldots)](-TB) \tag{8a}
\]

\[
\Pi_{bb}(M, B_b, bb^*_i) = \Pr(t^b|\ldots)(R - I)+ [1-\Pr(t^b|\ldots)](-I) \tag{8b}
\]

Altruists maximize:

\[
\text{Max} \{ \Pr(t_g|\ldots)(AB - TB) + [1-\Pr(t_g|\ldots)](-TB), 0 \} \tag{9a}
\]

Business-oriented members maximize:

\[
\text{Max} \{ \Pr(t^b|\ldots)(R - I)+ [1-\Pr(t^b|\ldots)](-I), 0 \} \tag{9b}
\]

A board, whose composition is determined by the relative weight of members who prefer sustainability to outreach, has the following choice

\[
\text{Max} \{ \rho \left[ \Pr(t^b|\ldots)(R - I)+ [1-\Pr(t^b|\ldots)](-I) \right] + (1 - \rho) \left[ \Pr(t_g|\ldots)(AB - TB) + [1-\Pr(t_g|\ldots)](-TB) \right], 0 \} \tag{10}
\]
where $\rho$ is the relative weight of business-oriented board members. If the project is rejected, the payoff $\Pi_{ab}(M, B_a, ab^*) = \Pi_{ab}(M, B_b, bb^*) = 0$.

Decisions are made with simple majority voting. The specific rules for accepting a project are, accept a project if

$$Pr(f|\ldots) > I/R \text{ and } Pr(t_g|\ldots) > TB/AB \text{ with probability } 1$$  \hspace{1cm} (11)

$$Pr(f|\ldots) > I/R \text{ and } Pr(t_g|\ldots) < TB/AB \text{ with probability } \rho$$  \hspace{1cm} (12)

$$Pr(f|\ldots) < I/R \text{ and } Pr(t_g|\ldots) > TB/AB \text{ with probability } 1 - \rho$$  \hspace{1cm} (13)

$$Pr(f|\ldots) < I/R \text{ and } Pr(t_g|\ldots) < TB/AB \text{ with probability } 0$$  \hspace{1cm} (14)

where $\rho$ represents the relative weight of the preferences of business-oriented board members, and the probabilities are *ex post* probabilities based on Bayes' updating rule.

### 2.4. Analysis of the game

The main research question is, under what circumstances will the manager reveal his signal so that the decisions of the board are efficient, in the sense that all the information is taken into consideration. This problem can be represented as a game with incomplete information, and a Perfect Bayesian solution will be sought.

The *bad* outcomes of this game are circumstances under which the expected payoffs to the manager from not revealing his signal are higher or equal than his expected payoffs from revealing the signal. If the manager does not reveal his signal, then the acceptance/rejection of the new technology will be based only on signals received by the board members. Since the board members' signals are less informative than the signals of the manager, decisions taken without the input from managers will not be efficient.

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Using the notation developed here, a good outcome occurs when
\( \Pi_M(1, m^r) > \Pi_M(0, m^s) \), and a bad outcome occurs when \( \Pi_M(1, m^r) \leq \Pi_M(0, m^s) \),
given revelation is otherwise costless. The purpose is to find out the possibility of not
revealing being a dominant strategy; namely, the possibility that \( \Pi_M(1, m^r) \leq \Pi_M(0, m^s) \)
for all types of environments (fast/slow growth in terms of both outreach and
sustainability) and for all types of boards (altruists/business-oriented boards, as well as
smart boards, who receive high quality signals, and dumb boards, who receive poor
quality signals). The case with no revelation costs will be examined first. The case with
revelation costs follows.

**Proposition 1:** The manager will always reveal his signal if it is costless to him to
reveal it. That is, \( \Pi_M(1, m^r) > \Pi_M(0, m^s) \) in the absence of revelation costs.
Table 2. Probabilities that the board will accept a project, by revealed managerial signal, by environment, and board type.

<table>
<thead>
<tr>
<th></th>
<th>Slow profitability</th>
<th>Fast profitability</th>
<th>Slow profitability</th>
<th>Fast profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slow outreach</td>
<td>Fast outreach</td>
<td>Slow outreach</td>
<td>Fast outreach</td>
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<tr>
<td>$m^b_s$</td>
<td></td>
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<tr>
<td>D</td>
<td>$\rho$</td>
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</tr>
<tr>
<td>S</td>
<td>$\rho\Pr(ab</td>
<td>m^s)+$</td>
<td>$\rho(1-\rho)$</td>
<td>$\rho\Pr(ab</td>
</tr>
<tr>
<td>$m^b_s$</td>
<td>(1-\rho)</td>
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<tr>
<td>D</td>
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<td>S</td>
<td>(1-\rho)\Pr(ab</td>
<td>m_s)</td>
<td>(1-\rho)</td>
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<td>$m^b_s$</td>
<td>(1-\rho)\Pr(ab</td>
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<tr>
<td>D</td>
<td>1</td>
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<tr>
<td>S</td>
<td>$\rho\Pr(ab</td>
<td>m^s)+$</td>
<td>1</td>
<td>$\rho\Pr(ab</td>
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<tr>
<td>$m^b_s$</td>
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<tr>
<td>S</td>
<td>$\rho\Pr(ab</td>
<td>m^s)+$</td>
<td>(1-\rho)\Pr(ab</td>
<td>m_s)</td>
</tr>
</tbody>
</table>

Note: $D$ stands for dumb board, $S$ stands for smart board.
Analysis: The expected payoffs that the manager gets are obtained by multiplying the probabilities that the project will be accepted (Table 2) times the private benefit $B$ that the manager receives if the project is accepted.

For example, let the manager receive a signal $m_s$; let $I/R$ and $TB/AB$ be in the slow financial results, slow outreach environment (which is common knowledge), and let the board be a smart board, as shown in Figure 2 (small differences $\gamma^\alpha - \alpha$ and $\gamma^\beta - \beta$).

Figure 2. Illustration of a smart board in a slow growth environment.
If the manager reveals $m^b$, the project will be approved if the business-oriented board members also receive a good signal, i.e., the business-oriented members will approve with probability $\Pr(bb^b|m^b)>0$. Given that $m^b$ is a bad signal in terms of the outreach aspect of the technology, the proposed technology will not pass the outreach test $TB/AB<\Pr(t_g|m^b)$ since, in a slow outreach growth environment, $TB/AB>\Pr(t_g,m^b)$. Therefore, we are in a situation where the board approves a project with acceptable profitability $\Pr(|.,..)>IR$ and unacceptable outreach $\Pr(t_g|m^b)<TB/AB$, with probability $\rho$. Thus, if a manager receives and reveals a signal $m^b$, the probability that the board will approve this project is $\rho \Pr(bb^b|m^b)$.

Now, let the manager receive a signal $m^b$, and let the environment consist of fast business/slow outreach and let the board be a dumb board (Figure 3). By Lemma 1, these assumptions mean that $IR$ is lower than $p$ and $TB/AB$ is higher than $q$, where $p$ and $q$ are known. If the manager reveals his signal $m^b$, the board’s updated probability of success for the business-oriented members will never be higher than $IR$. That is, whether these members receive a good or a bad signal does not matter, since the key signal comes from the manager, and a dumb business-oriented board approves this project only if it receives a good signal.

In this situation, the financial aspect of the project will not be approved, because $\Pr(t^b|m^b)<IR$. Therefore, the project will be approved with probability $1-\rho$, if it passes the test of the altruists, namely if $\Pr(t_g|m^b)>TB/AB$. Since the outreach environment is one of slow growth, altruistic board members will approve the project as long as the
manager's signal is good, since the altruists' own signal does not matter. That is, given that the manager reveals $m^*_e$, the test that the board members perform leads to a situation where $\Pr(t^*|.,.)<I/R$ and $\Pr(t^*|.,.)>TB/AB$, namely rule (13), and the project will be approved with probability $1-\rho$. In this situation, if the manager reveals his signal, his expected payoff is $(1-\rho)B$.

Figure 3. Illustration of a dumb board in a mixed environment.
If revealing information is costless, a manager will reveal his information whenever his payoff after revealing it is higher than his payoff if he does not reveal the signal. Given that information revelation is costless, any time a manager does not reveal his information, the board will assume that the signal is $m^b_b$. Therefore, the board will update its probabilities that the project will succeed given signal $m^b_b$. These probabilities are also shown in Table 2. To find out whether the manager will reveal his signals or not, the probabilities that the project will be accepted given that the manager reveals his signal are compared to the probabilities that the project will be accepted given $m^b_b$, by environment type and by board type.

Clearly, not revealing a signal and letting a dumb board infer that the signal is $m^b_b$, when it is not, will lead to the project not being accepted and the manager will lose from not revealing his signal, because the probability of the project being accepted given the assumption of $m^b_b$ and a dull board is always zero. The probabilities that the project will be approved in each case are presented in Table 2. A simple comparison shows that, even with a smart board, revealing the true signal to a smart board pays off, because the probabilities of the project being approved are always higher under $m^b_s$, $m^b_b$, or $m^b_x$, than under $m^b_b$.

By revealing his signal, however, the manager incurs disclosure costs. These costs arise because the board’s role is not only to accept or reject a technology but also to evaluate the manager and ask him to implement the project. By revealing more about the technology, the manager also reveals more about his abilities and exposes his potential weaknesses (Adams, 2001). In the presence of disclosure costs, bad equilibria, where bad
projects are approved or good projects are rejected, may exist. This will happen, as the board members are not sure whether the manager does not reveal his signal because he got a bad signal or because it is costly to reveal it.

**Proposition 2.** In the presence of positive disclosure costs, the board will rely on its own signals. Bad equilibria will occur when either $\Pr(t|bb^b) \geq I/R$ or $\Pr(t|ab_b) \geq TB/AB$. This will happen in slow growth environments, because $\Pr(t|bb^b) \geq I/R$ or $\Pr(t|ab_b) \geq TB/AB$ are to the right of $p$ and $q$, respectively. Bad equilibria will also occur when either $\Pr(t|bb^b) \geq I/R$ or $\Pr(t|ab_b) \geq TB/AB$. This will happen in fast growth environments, because $\Pr(t|bb^b) \geq I/R$ and $\Pr(t|ab_b) \geq TB/AB$ are to the left of $p$ and $q$ respectively.

**Proof:** The proof of this proposition consists of comparing the expected payoff to the manager when he does not reveal his signal to the expected payoff when he reveals the signal. The cases where a bad equilibrium will not exist are first eliminated.

Consider a dumb board (in both types of environment), where the difference between the quality of the board members' signals and the quality of the manager's signals is large. For a bad equilibrium to occur, we must have $\Pr(t|bb^b) \geq I/R$ or $\Pr(t|ab_b) \geq TB/AB$. That is, for the business-oriented members we must have

$$\Pr(t|bb^b) = \frac{p(1-\beta)}{p(1-\beta) + (1-p)\beta} \geq I/R.$$ This is equivalent to $\beta \leq \frac{p(R-I)}{p(R-I) + (1-p)I}$ and, since $1/2 \leq \beta \leq \frac{p(R-I)}{p(R-I) + (1-p)I}$ then this condition can only hold for $p > I/R$. 

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That is, for a dumb board, a bad equilibrium may exists only in a fast growth environment, and it does not exist in a slow growth environment. The updated probability of the business-oriented board members \( \Pr(r^e | bb^b) \) decreases when the difference with the greater quality of the manager’s signals \( \gamma^e - \phi \) decreases. Smarter boards may break the inequality above, but a dumb board may bring a bad equilibrium to a fast growing environment. The same interpretation holds for the case of outreach and for the mixed environment cases, when the board is dumb. In these cases, the manager reveals his signal in order to improve the chances that the project is accepted.

2.4.1 Slow finance, slow outreach environment

Consider a slow growth environment, both in financial and outreach potential. As mentioned earlier, with a dumb board, bad equilibria do not exist in a slow growth environment. For a smart board, however, both conditions for bad equilibria will exist; that is, \( \Pr(r^e | bb^b) \geq L/R \) and \( \Pr(t^g | ab^g) \geq TB/AB \). In other words, after receiving good signals, the board members updated probabilities that the project is successful will be high. Recall that the criteria (rules) for acceptance of a project are (11), (12), (13), and (14).

The probability of outcome (11) is \( \Pr(bb^f | m^f) \cdot \Pr(ab^g | m_u) \). That is, this probability is equal to the probability that the board gets the same signals as the manager. The probability of outcome (12) is \( \Pr(bb^f | m^f) \cdot [1 - \Pr(ab^g | m_u)] \), and the probability of outcome (13) is \( [1 - \Pr(bb^f | m^f)] \cdot \Pr(ab^g | m_u) \). The probability that the technology is approved if the manager does not reveal his signal is the sum of the relevant probabilities (11), (12), (13) and (14), weighted by the probabilities of acceptance in each of these cases:
\[ \text{Pr}(bb^s|m^s) \times \text{Pr}(ab^s|m_s) + \rho \text{Pr}(bb^s|m^s) \times [1 - \text{Pr}(ab^s|m_s)] + \\
(1 - \rho) \times [1 - \text{Pr}(bb^s|m^s)] \times \text{Pr}(ab^s|m_s) \]  

This expression (15) reduces to \( \rho \times \text{Pr}(bb^s|m^s) + (1 - \rho) \times \text{Pr}(ab^s|m_s) \) and the expected payoff from not revealing the signal is \( \Pi_m(0, m_s^*) = B \{ \rho \times \text{Pr}(bb^s|m^s) + (1 - \rho) \times \text{Pr}(ab^s|m_s) \} \).

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
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<td>bb^s)) (&gt;l/R)</td>
<td>Pr((t^s</td>
<td>bb^s)) (&gt;l/R)</td>
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<tr>
<td>Pr((t^s</td>
<td>ab^s)) (&gt;TB/AB)</td>
<td>Pr((t^s</td>
<td>ab^s)) (&lt;TB/AB)</td>
</tr>
<tr>
<td>(\Pi_m(0, m^*_s)).</td>
<td>{(\rho \times \text{Pr}(bb^s</td>
<td>m^s))} + {(1 - \rho) \times \text{Pr}(ab^s</td>
<td>m_s)} \times B</td>
</tr>
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</table>

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<th>Smart</th>
<th>Smart</th>
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<td>NR&gt;RS</td>
<td>NR&gt;RS</td>
</tr>
<tr>
<td>(m_s^g)</td>
<td>NR=RS</td>
<td>RS&gt;NR</td>
<td>RS&gt;NR</td>
</tr>
<tr>
<td>(m_s^b)</td>
<td>NR&gt;RS</td>
<td>RS&gt;NR if (\rho&lt;1/2)</td>
<td>NR=RS</td>
</tr>
<tr>
<td>(m_b^g)</td>
<td>NR&gt;RS</td>
<td>NR=RS</td>
<td>RS&gt;NR if (\rho&gt;1/2)</td>
</tr>
</tbody>
</table>

Table 3. Comparison between the manager's expected payoffs if he reveals and if he does not reveal the signal, for a slow finance, slow outreach environment.
For each type of signal that the manager receives, the expected payoffs from revealing the signal are compared to the expected payoffs from not revealing it (the comparison is in the Appendix). The results are presented in Table 3.

Consider a smart board. Let \( \Pr(t^*|bb^g) > I/R \) but \( \Pr(t|ab_g) < TB/AB \). That is, if the altruists receive a bad or a good signal, they will still not like the project, because even with a good signal \( TB/AB \) will be to the right of the updated probability. Business-oriented board members will like the project if they receive a good signal, because then \( I/R \) is to the left of the updated probability, as \( \Pr(t^*|bb^g) > I/R \), but they will not accept the project if \( \Pr(t|bb^g) < I/R \), i.e., if \( I/R \) is to the right of the updated probability. Therefore, only two outcomes are relevant here, namely rule (12) applies, \( \Pr(t|...) > I/R \) and \( \Pr(t|...) < TB/AB \), and the project will be accepted with probability \( \rho \), and rule (14) applies, \( \Pr(t^*|...) < I/R \) and \( \Pr(t|...) < TB/AB \), under which the project will be accepted with probability zero. The latter case is irrelevant because, when the business-oriented members receive \( bb^g \), and that will happen with probability \( [1-\Pr(bb^g|m')] \), then \( \Pr(t^*|bb^g) < I/R \) and the technology will be accepted with zero probability. Therefore, the focus is on the former outcome only.

The manager receives his signal and estimates that the technology will be accepted with probability \( \rho \), given that board members receive a good signal. That is, the manager’s expected payoff of not revealing the signal is \( \Pi_M(0, m_i') = B\{\rho \Pr(bb^g|m')\} \). These payoffs are presented in Table 3, column three.

If the board members’ updated probabilities are \( \Pr(t^*|bb^g) < I/R \) and \( \Pr(t|ab_g) > TB/AB \), then the expected payoff of not revealing is
\( \Pi_M(0, m_i^t) = B*\{(1-p)*Pr(bb|m_e)\} \). In this case, the financial aspect of the project will never be approved, and we can have it only approved under rule (13), with probability \((1-p)\), and under rule (14), when the project is never approved. The manager infers that case (13) will happen when the altruists’ signals are good, namely \(Pr(abg|m_e)\).

After calculating his expected payoffs if he reveals his signal, \( \Pi_M(0, m_i^t) \), the manager compares \( \Pi_M(0, m_i^t) \) to \( \Pi_M(1, m_i^t) \) for each \( m_i^t \). When \( \Pi_M(0, m_i^t) \geq \Pi_M(1, m_i^t) \), the manager will not reveal his signal.

The results of these comparisons are also presented in Table 3. The manager will not reveal his signal if he calculates that the board’s updated probabilities, when the board members receive good signals, are sufficient to approve the project, because he does not need to incur the costs of revelation. Revelation will not change the outcome. This conclusion applies only to smart boards, however, when the difference between the signal of the manager and the signals of the board is small, because here the board’s and not the manager’s decision is decisive for acceptance of the technology. In a slow growth environment, instead, and when the difference in signals is high, because the board is dumber, then the board’s signals are not decisive and there are not bad equilibria, because the manager reveals his signal. This result is similar to the result of Gutierrez-Urtiaga (2000). The result differs, nevertheless, when the updated probabilities of the altruists and business-oriented members of the board differ, because of their exclusive focus on one of the two goals of the organization.

Unlike in Gutierrez-Urtiaga (2000) where, in a slow environment, good signals are never released to a smart board, here, when the manager’s signal is double good \( m_i^g \),
namely, when there are good financial and outreach prospects for the technology, \( m_g^g \) is almost always released. Similarly, \( m_b^b \) is never released. Additionally, when the altruists’ updated probabilities make them believe that the proposed technology will not satisfy the target for outreach (column 3 of Table 3), the board will never learn from the manager if the manager’s signal is \( m_b^g \); it will only learn \( m_g^b \) when the board is dominated by altruists. However, when the board is dominated by business-oriented members (\( p > 1/2 \)), the board may or may not learn the manager’s signal \( m_g^b \). Nevertheless, when the business-oriented members’ updated probabilities tell them that the investment will not be recovered (column 4 of Table 3), altruist-dominated boards may or may not learn \( m_g^b \).

Therefore, in general, the duality of objectives of the MFO improves the chances that more manager information will be released, even when the board is smart.

Overall, in a slow finance, slow outreach environment, dumb boards will still induce full information disclosure, since there are no bad equilibria with dumb boards. However, a dumb board is less likely to be able to give good advice or evaluate the manager. Smart boards do have some value here, because good signals are always released, and business oriented boards may learn \( m_g^b \) and altruist-dominated boards may learn \( m_b^g \). In these cases, excessive optimism may be prevented, without the loss of the valuable advice and guidance of a smart board. This result also suggests that, if the poor quality of the dumb board’s signals is compensated by the high quality of the manager’s signals, a dumb board may be optimal.
2.4.2 *Fast finance, fast outreach environment*

Comparisons of the expected payoffs for a fast finance, fast outreach environment are presented in Table 4. In this environment, bad outcomes \{NR is dominant, \textit{i.e.,} \(\Pi_M(1, m^1_s) \leq \Pi_M(0, m^0_s)\)\} exist with both smart and dumb boards. Uniformly (double) bad signals are never revealed, and double good signals are generally revealed. Non-revelation of uniformly good signals occurs when board members, after receiving bad signals, still believe that the technology is worth adopting. That is, for very good board signals, the manager’s information is not important. This conclusion applies to both smart and dumb boards.

The second column of Table 4 shows that when, after a bad signal, the board still believes that the proposed project is good, the manager will never reveal his signal. While not revealing a good signal will not change the outcome of the board’s decision, revealing mixed and bad signals may change this outcome. Therefore, in these cases, represented by columns 2 and 3, we have bad equilibria.

Column 9 in Table 4 shows the opposite case. When the updated probabilities of the board lead them to believe that the proposed technology is bad, a smart board is beneficial because it will be informed by the manager about the technology; \textit{i.e.,} the manager will reveal all his signals, except for bad signals that will not change the board’s decision in this situation.
Consider column 5. The altruists in a smart board do not believe that the technology will satisfy the outreach target if they receive a signal $ab_b$ and the professionals would accept the technology after receiving a signal $bb^b$. An altruists-dominated board may or may not learn a signal $m^b_g$ (good outreach, bad finance), but business-oriented boards will never learn this $m^b_g$ signal.

This result is different from the result for a slow growth environment. In a slow growth environment, when the altruists’ updated probabilities dictate rejection of the
technology, an altruist-dominated board will always learn from the manager the signal about \( m_g^b \), while in a fast growth environment, an altruist-dominated board may or may not learn about \( m_g^b \). This is important, because in a fast growth environment, a manager's signal \( m_g^b \) is different from the board's signal \( ab_b \), and the mistake that the board may make if it does not learn about \( m_g \) is greater.

Now consider column 4, where everything is the same except that the board is dumb. The altruists of a dumb board again have updated probabilities that indicate that the proposed technology will not achieve the target outreach. A board dominated by business-oriented members will never learn \( m_g^b \). Moreover, since \( p > 1/3 \), which is equivalent to \((1-p) < 2/3\), even some altruist-dominated boards, where altruists are less than 2/3 of the voting rights, will not learn the good outreach signal, because \( 1/2 < (1-p) < 2/3 \). In other words, when altruists are a majority but by less than 2/3, \( \prod_m (1, m_i^o) < \prod_m (0, m_i^o) \). Therefore, a dumb board in this environment leads to less information being released to an altruist-dominated board.

Similarly, let the board be business-oriented and its updated probabilities indicate that the expected returns will be lower than the required investment. Altruists are satisfied with the prospect for outreach (column 7 in Table 4), but the board will never learn the \( m_g^b \) signal; that is, good finance, bad outreach, and may or may not learn about \( m_b^f \). The signal that the board may not learn here (the signal that the manager gets \( m^b \)) is the opposite to the signal that the business-oriented members receive, namely \( bb^b \), and the chances for missing out on a good technology are higher. Under the same conditions, a dumb board dominated by altruists will never learn \( m_b^f \). Moreover, even business-dominated boards, where business-oriented members are the majority but by less than
2/3, will not learn \( m_b^x \), because \( \Pi_M(1, m^t_1) < \Pi_M(0, m^t_1) \). Again, dumber boards lead to bigger mistakes in a fast growth environment.

Finally, consider column 8 of Table 4. The board’s updated probabilities do not permit acceptance of the technology. A smart board will always learn the manager’s signals. For a dumb board, however, both \( \Pi_M(1, m^t_1) < \Pi_M(0, m^t_1) \) and \( \Pi_M(1, m^t_1) > \Pi_M(0, m^t_1) \) are possible, and for mixed signals, a risk averse manager will most likely reveal the signal.

### 2.4.3 Mixed Environments

In a mixed environment, dumb boards are not considered here for the slow types of environment, when the manager has received a good signal, since bad equilibria do not exist in this case.

#### 2.4.3.1 Slow finance, fast outreach environment

In this fast outreach environment, altruists will accept the technology if, after receiving a bad signal, they still believe that the technology will reach the outreach target. Business-oriented board members will accept the project in this slow finance environment only if, after receiving a good signal, their updated probability of success is higher than \( l/R \). Let these \( bb^x \) and \( ab_b \) signals be called the critical signals.

Here again, uniformly bad signals are never revealed and uniformly good signals are revealed, except for the case where the board will accept the technology anyway (column 2 of Table 5).
Table 5. Comparison between the manager’s payoffs if he reveals and if he does not reveal the signal, for a mixed, slow finance, fast outreach environment.

<table>
<thead>
<tr>
<th>Board</th>
<th>m^b</th>
<th>m^g</th>
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<tr>
<td>m_b</td>
<td>NR</td>
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<td>NR</td>
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<td>m_g^g</td>
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</tr>
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</table>

In a mixed environment, using dumb boards will eliminate the bad equilibria in columns 2 and 3 of Table 5. If this recommendation to use dumb boards is carried through, the rest of the analysis focuses on the dumb board represented in the columns 4 and 6 of Table 5. Consider column 4 of Table 5. Business-oriented members will not accept the technology, while altruists will accept it. If the manager’s signal is the opposite of the board’s critical signals, i.e., if the manager gets m_g^b, when ab_b and bb^g have been received, then the manager will not reveal his signals. However, if his signal is m_b^g, that

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is, if the manager's signal is the same as the signal of the board, then the manager will not reveal his signal \( m_b \) to an altruist-dominated board but he will reveal it to a board dominated by professionals.

Therefore, in a slow finance, fast outreach environment, with dumb boards, professionally-dominated boards will induce more information revelation than altruist-dominated boards. This result carries on for column 6 of Table 5, where a professionally-dominated board will induce revelation of information because the requirement is even weaker, namely \( p > 1/3 \). Of course, if altruists dominate but they are not too many, i.e., the composition is such that \( 1/2 < (1-p) < 2/3 \), there still can be better information revelation, but this result would not carry through for column 4. Therefore, business-dominated boards will induce the most information revelation in this environment.

2.4.3.2 Fast finance, slow outreach environment

By symmetry, the same results hold true for a fast finance, slow outreach environment. The best recommendation is to use less sophisticated boards, dominated by altruists.
Table 6. Comparison between the manager’s payoffs if he reveals and if he does not reveal the signal, for a mixed, fast finance, slow outreach environment.

2.5. Conclusion

Microfinance organizations must mainly rely on their internal governance mechanism to ensure that the organization fulfills its objectives because, in the case of microfinance, the external governance mechanisms are not sufficient for this task. In particular, MFOs rely on their boards to ensure the proper functioning of the organization. One of the most important roles of the microfinance board is to decide what
financial technology the organization should adopt and have implemented by the manager. The board will make the best decision only if it uses all the information available about the potential technology and about the manager.

This chapter develops a model of information flows between the microfinance manager and the microfinance board. A distinctive feature of this model is that it emphasizes the dual objectives of the microfinance organization: outreach and profitability. Moreover, the model is specified for four types of environments - slow-growth finance and slow-growth outreach, fast-growth finance and fast-growth outreach, fast-growth finance and slow-growth outreach, and slow-growth finance and fast-growth outreach. The goal of the exercise is to describe the optimal composition of the board (in terms of altruistic and business-oriented members, as well as smart and dumb boards) that corresponds to each type of environment, so that the manager is induced to reveal his signals about the technology and the board's decisions are efficient.

The results show that the duality of objectives has positive and negative consequences for efficient decision-making. When the manager learns that the technology is likely to be uniformly good in terms of both finance and outreach, the manager almost always reveals his information. However, independently of the environment, the manager never reveals uniformly bad information. This result is different from the result by Gutierrez-Urtiaga (2000), where the manager does not reveal good and bad signals in a slow growth environment if he interacts with a board dominated by smart directors.

In the model of this dissertation, given a slow growth environment, there is a tradeoff between having a smart board and information revelation by the manager.
Namely, in a uniformly slow growth environment, as the quality of board signals improve (i.e., the board becomes smarter), the probability that the manager will reveal his information decreases. In order for the manager to reveal his information, the board must be less smart. Dumb boards, however, are less able to make good decisions. An important result here is that the duality of the organization's objectives improves the chances that more information will be revealed even when the board is smart. This is good news, since smarter boards are able to make a better use of the information that they receive.

In fast growth environments, smarter boards lead to more information revelation. Dumb boards may achieve the same result, but only by being able to guess the manager's signal, and therefore his bias, and only if the board composition consists of at least 2/3 of the dominant type.

The model of this chapter also suggests that dumb boards may be sometimes optimal in mixed environments. If the environment is slow finance and fast outreach, a dumb, business-dominated board will induce most information revelation, while if the environment is fast finance and slow outreach, a dumb, altruist-dominated board will lead to most information revelation by the manager.

Innovations in organizational designs that reduce the manager's revelation costs or reward the manager for using information efficiently will reduce the possibility of bad equilibria.
CHAPTER 3

A COMPARISON OF OPTION-BASED AND CONSUMER CHOICE APPROACHES TO EVALUATING COUNSELING FOR MORTGAGE LOANS TO LOW-INCOME HOUSEHOLDS IN THE U.S.

3.1 Introduction

The prolonged economic expansion of the past decade, several government support efforts, and some innovations in lending technologies, including credit counseling, have led to substantial growth in the provision of mortgage loans to low-income households in the United States. Indeed, both lenders and borrowers have benefited from new cost-efficient lending technologies that better address the challenges of low-income housing finance. This chapter provides empirical evidence that an alternative screening mechanism—credit counseling—may reduce the incidence of default on low-income mortgage loans, thereby reducing risks for banks, and may improve the borrowers’ ability to prepay their loans, thereby allowing them to take advantage of more favorable market conditions, when these conditions emerge.

Banks recognize loans to low-income households as riskier and costlier than housing loans to wealthier clients. The challenges for banks are how to address these higher risks and costs and still reach low-income clients in a profitable manner.
Typically, banks and other financial institutions attempt to assess the risks of housing loans by using a traditional lending technology, based on a consideration of loan features (namely, term to maturity, interest rate, downpayment), some financial characteristics of the borrower (income level, total debt), and the value of the property pledged as collateral.

The term *lending technology* is used to denote the set of criteria, steps and procedures used by a lender to overcome the typical information, incentive, and contract enforcement problems that constrain the emergence of credit transactions. The elements of the technology allow the lender to assess the probability of default and to include incentives (such as collateral), among the terms and conditions of the loan contract, in order to encourage repayment. When the lending technology does not closely match the features of a particular set of potential clients, these clients may be excluded from access to loans, despite their underlying creditworthiness (Navajas and Gonzalez-Vega, 2002). Traditional lending technologies may not be appropriate for low-income households and may, therefore, exclude too many potentially creditworthy borrowers.

Banks, furthermore, seek to attract low-income borrowers by reducing downpayment and other cash-contribution requirements, by extending closing cost assistance, and by accepting lower qualifying incomes and non-traditional credit histories. These actions, usually in response to regulatory requirements that marginal populations be included in credit portfolios, do not address the higher risks of low-income mortgages and do not reduce much a generalized reluctance to lend to this segment of the population. Dealing with these risks requires, instead, innovative screening and monitoring tools.
In recent years, financial institutions have begun to collaborate with third parties in their attempts to design a better screening mechanism for low-income mortgage loans. This collaboration involves the third party in providing homeownership and credit counseling. Although numerous programs offer homeownership counseling, however, little is known about their effectiveness. Further understanding of what works and what does not work in this area could help focus additional attention on promising practices that increase access to mortgage loans by low-income households.

Credit counseling is an innovation designed to help low-income households, and the banks that lend to them, to estimate the amount of debt they can afford and thereby prevent default. By learning more about mortgage loans and personal finance, however, low-income borrowers may also learn to behave strategically and may prepay (refinance) their mortgages more often, in response to a fall in interest rates. If this is the case, counseling may be more beneficial to the borrowers than previously thought.

This dissertation claims that costly practices, such as a lower downpayment, higher housing expense to income ratios, higher total monthly obligations to income ratios, and other subsidies designed to attract low-income borrowers, may be less appropriate than innovations such as credit counseling and lower prepayment penalties in expanding the supply of financial services to this segment of the population.

An important challenge in the evaluation of the effectiveness of alternative lending practices is the lack of agreement among researches on how to study mortgage termination by low-income households. The option theoretic and choice theoretic approaches are two alternative approaches to the analysis of mortgage termination. While the option theoretic approach has dominated the research on mortgage termination
over the past two decades, very few empirical studies have been successful in
demonstrating that low-income households do behave strategically when acting on their
mortgage obligations. In turn, the choice theoretic approach has dealt primarily with
explaining default as a result of borrower heterogeneity and insolvency, but it has not
explicitly addressed prepayment behavior.

This chapter empirically evaluates possible determinants of low-income household's mortgage termination and compares the effectiveness of traditional banking screening mechanisms and the non-traditional screening associated with a particular credit counseling program. Part 2 briefly reviews the relevant literature and describes the competing-risks (option-based) and choice-theoretic approaches to mortgage termination. Part 3 presents an overview of the U.S. counseling industry and of studies of the effectiveness of counseling. Part 4 describes the lending technology examined in this chapter. Part 5 presents the empirical analysis. Conclusions are offered in Part 6.

3.2 Discussion of the literature

3.2.1 The option-based theory of mortgage termination

Mortgages are among the most complex financial contracts ever created. Their valuation has been rooted in option-based pricing models. In effect, the literature on pricing mortgages as derivative instruments can be traced back to the seminal work of Black and Scholes (1973). These authors showed that, for short-term scenarios, in which the interest rate can be regarded as fixed, there is a closed form solution to the problem of valuing a call option on the underlying asset. Simply put, this means that, by using a few parameters, namely a stock’s current price and its volatility, an investor can find the value
of an option on that stock. Since the value of the option can be estimated, a borrower will exercise the option when it has value.

Mortgage termination, according to this option-based theory, is a purely financial decision, independent of the housing decision. The value of a mortgage consists of the present value of scheduled payments by a borrower and the value of the options granted to the borrower to terminate the mortgage either by prepayment or default. When deciding on how to act on the loan obligation, a borrower faces several choices. The borrower has the choice to (1) make the payment on the loan and continue in good standing as a debtor, (2) pay in full the remaining balance on the loan, by refinancing (prepayment, or call option), or (3) surrender the house to the lender in exchange for cancellation of the debt (put, or default option). Prepayment and default are just two actions that borrowers undertake in order to increase their wealth. These actions are driven by the value of the underlying prepayment (call) and default (put) options (Foster and Van Order, 1984).

In simpler terms, the call option is in-the-money (prepayment is profitable) when the net present value of the outstanding loan balance is lower at current market interest rates than at contract interest rates. In turn, the put option is in-the-money (default is wealth increasing) when the borrower could have lower monthly payments on a new zero-downpayment loan used to purchase the same house, for the same remaining term as the old loan (Quigley and Van Order, 1991). Default and prepayment, from this theoretical perspective, are purely financial decisions.

Most option-based models of mortgage termination study prepayment and default separately (Quigley and Van Order, 1992 and 1995; Capozza et al., 1998; Kau and...
Keenan, 1999). There is some debate about these contributions. Observed termination rates differ from those predicted by option-based models (Foster and Van Order, 1985; Vandell and Thibodeau, 1985; Vandell, 1992; Riddiough and Vandell, 1993; Lekkas et al., 1993). To correct for the observed overestimation, some option-based studies incorporate transaction costs into the specification of the contingent claims model. The need to explicitly consider transaction costs has been questioned, nevertheless, by proponents of the pure option-theoretic model (Kau et al., 1993 and 1994; Capozza et al., 1998). The rationale for underexercising the option, these authors argue, is that the borrower will not necessarily default when the equity in the house becomes negative, because by doing so the borrower would sacrifice subsequent default options, which also have value.

In contrast, a series of recent papers, by Kau et al. (1995) and Kau and Keenan (1996), develop theoretical arguments that emphasize the importance of the jointness of prepayment and default options. More generally, this recent framework accounts for the fact that, by exercising the option to default today, a borrower gives up not only the option to default in the future but also the option to prepay in the future. Deng et al. (1996) and Deng (1997) empirically estimate the joint default and prepayment choices of individuals by using a competing-risks model. Deng et al. (2000) also estimate a competing-risks model of mortgage termination by accounting for borrower heterogeneity. This empirical approach estimates prepayment and default as competing risks, by accounting for the fact that these risks may be correlated.

More formally, this option-based model specifies the underlying state variables and deduces the rule that determines when the options should be exercised in order to
maximize the borrower’s wealth. From this perspective, the value of the mortgage $M(c,r,H,B,k)$ depends on the coupon rate $c$, a vector of relevant interest rates $r$, the property value $H$, the outstanding balance $B$, and the age of the loan $k$. In continuous time, the equilibrium condition for $M$ can be derived by the standard arbitrage argument and is a second-order partial differential equation such that the value of the option is the risk-adjusted expected present value of its net cash flow.

Let house price changes be continuous with an instantaneous mean $\mu$ and a standard deviation $\sigma_h$. The return to owning the house consists of a price appreciation and of a service flow $d$ (an imputed rent payout “dividend” rate), assumed to be proportional to the value of the house. Assume that there is only one short-term interest rate $r$ and that it determines the yield curve. Let $\theta$ be the mean value of the short-term rate, $\gamma$ be the rate of convergence for the short rate, $\sigma_r$ be the volatility of the short rate, and $\rho$ be the correlation between interest rate changes and house price changes. It has been shown (Kau et al., 1995) that the value of the mortgage $M$ satisfies

$$
\frac{1}{2} r \sigma_r^2 \frac{\partial^2 M}{\partial r^2} + \rho \sqrt{r} \sigma_r \sigma_h \frac{\partial^2 M}{\partial r \partial h} + \frac{1}{2} H^2 \sigma_h^2 \frac{\partial^2 M}{\partial H^2} + \gamma (\theta - r) \frac{\partial M}{\partial r} \\
+ (r - d) H \frac{\partial M}{\partial H} + \frac{\partial M}{\partial \tau} - rM = 0
$$

(16)

In this model, the value of $M(.)$ and the optimal default and prepayment are determined *simultaneously*. This equation is consistent with an infinite number of

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1 The description of the theoretical model used here follows Deng et al.(2000) and Kau et al.(1995).
functions $M(\cdot)$. The appropriate function is determined by choosing the level for $r$, $r^*$, and the level for $H$, $H^*$, at which to terminate the mortgage through default or prepayment, that is, by choosing the $r$ and $H$ that minimize $M$, given equation (16) (Kau et al., 1995).

The levels of $r$ and $H$ are functions of $c$, $d$, $B$, $k$ and the parameters governing the stochastic process for $r$ and $H$. Two pairs of $r$ and $H$ trigger termination due to the jointness of the options. Some levels of $r$ trigger prepayment or default, and some levels of $H$ trigger prepayment or default. For example, at a low enough level of $r$, a borrower may default if the house value is very low, or a borrower may prepay when the equity value has risen, because the loan now is safer and would carry a lower interest rate. Conditional on the information set of actors in the market and the research objective, the estimated probability of default or prepayment is the probability that these specific levels of $r$ and $H$ occur.

In order to know when to exercise the option, a borrower only needs to know market prices. For example, the prepayment option can be exercised when the borrower can refinance the loan for the same remaining term at a par at a mortgage interest rate less than the coupon on the current loan or, alternatively, when the market value of the house is greater or equal to the mortgage balance. Default can be exercised when the borrower payment would be lower on a new, zero downpayment loan for the same remaining term, if this loan is used to purchase the same house.

3.2.2 Option-based models of mortgage termination by low-income households

The option-based approach, sometimes modified to include variables other than those prescribed by the theoretical foundations, has been used in several studies to
examine mortgage termination by low-income borrowers. Deng et al. (1996) develop an empirical, option-based model of homeowner's default behavior in a proportional hazards framework. These authors simulate probabilities of default and default costs on zero downpayment loans and then compare the results with conventional underwriting standards. They estimate that, if low-income borrowers are enticed by banks that offer zero downpayment requirements and if no adjustment for the higher default rates is made, the cost of the implicit subsidy would amount from $74,000 to $87,000 per million dollars of lending.

Quercia et al. (1995) show that a lower loan-to-value (LTV) ratio at the time of origination (i.e., a higher downpayment) leads to lower default rates for rural, low-income borrowers. These authors focus on the 1981 Farmers Home Administration Section 502 program and show that, while contemporaneous equity value in rural low-income mortgage loans is not associated with default, crisis events are.

Van Order et al. (2000) find, however, that the default behavior of both low-income and average-income groups is responsive to negative contemporaneous equity, while default rates and default losses are higher for low-income borrowers. Moreover, the influence on credit risk of individual and neighborhood income is small for LTV less than 80 percent, but it ranges from 15 up to 50 basis points for very high LTV ratios. Enticing low-income mortgage borrowers with lower downpayment requirements thus increases the risk of default.

All these studies of low-income borrower behavior do not explicitly account, nevertheless, for the jointness of the prepayment and default options and, as Deng et al. (2000) show, the results may be biased as a result of this omission.
3.2.3 The choice theoretic approach

The choice theoretic approach is concerned with the ability of the consumer to repay the loan. Empirically, many studies show that factors other than those prescribed by pure option-based theory may influence mortgage termination, primarily default. Most studies find evidence that transaction costs may influence default (Cunningham and Hendershott, 1984; Foster and Van Order, 1984; Quigley and Van Order, 1995; Vandell, 1998). Yang et al. (1998) find evidence about the presence of consumer choice determinants of mortgage termination, mainly through the influence of household income. LaCour-Little (1999) shows that borrower characteristics influence mortgage termination, especially when the option is at-the-money (i.e., when it does not have a value).

The empirical studies following this approach use the flexibility of the Cox proportional hazards empirical model to extend the option-based model and to include additional variables that may also influence default. The choice-theoretic approach incorporates the option values usually emphasized by the option-based model, but it does so in a more general, consumer choice framework. In fact, adherents to this approach argue that the option-based model can be viewed as a nested model within the broader consumer choice model and can be qualified by the consumer choice paradigm. That is, the option-based model would still be part of the consumer choice paradigm. In general, this approach integrates all wealth-related variables in the analysis. Insolvency, in particular, is recognized as a motivation for default.

Elmer and Seelig (1999) develop a theoretical model that focuses on insolvency as the main reason for mortgage default. In this model, a consumer with uncertain
income $y_i$ finances her home purchase with a fixed interest rate mortgage $m_i$ in an environment of volatile housing prices $p_i$ and interest rates $i_i$. Consumption can be smoothed over time with unsecured borrowing ($b_i > 0$) and lending ($b_i < 0$). Given initial prices and expectations about all future periods, the individual determines an optimal life-cycle consumption pattern by solving the following maximization problem:

$$\text{Max } U (c_0, c_1, c_2)$$
$$c_0, c_1, c_2 > 0$$

Such that
$$c_0 = y_0 - (p_0 - m_0) + b_0$$
$$c_1 = y_0 - m_0 + b_0 i_0 + b_1$$
$$c_2 = y_0 + (p_0 - m_0 (1 + i_0)) - (b_0 + b_1) (1 + i_0)$$
where $c_0, c_1, c_2 > 0$

The authors interpret interior solutions (under standard conditions for optimization) as conditions for solvency, since consumption occurs in all periods. Consumers try to avoid corner solutions, thus eliminating expectations of insolvency. Instead of focusing on consumption decisions, the authors explore conditions for the exercise of mortgage termination (default and refinancing) in response to exogenous shocks to income, prices, or interest rates.

The consumer could refinance the mortgage when interest rates fall, which is equivalent to obtaining a present value interest savings of $V_1 [m_0 (i_0 - i_1)]$. This option is exercised only if the value of the interest savings exceeds transaction costs ($RT$), so that the refinance option value is represented as $R' = \max (0, V_1 - RT)$. 

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The strategic ability to default delivers a gain $D_t$. The value of this option is explored for both recourse and non-recourse legal environments.\(^2\) As interest rates fall, the value of the strategic default option increases in a non-recourse environment, and strategic default yields a gain equal to the difference between the amount of the mortgage (including any unpaid interest) and the current market value of the home:

$$D_t^* = \max[0, m_0(1 + i_0) - p_t] .$$

In case of recourse, borrowers are liable for the full mortgage debt, so strategic default is not feasible. The value of the strategic default option is

$$D_t^* = \max\{0, V_t^* [m_0(i_o - i_t^*)] - DT + N \max[0, m_0(1 + i_0) - p_t] \},$$

where $DT$ are the default transaction costs, which are assumed to be higher than the cost of refinancing, and $N$ is a dummy variable for a non-recourse legal environment. Default is also recognized as a hedge against the reduction in wealth due to falling house prices.

There is a difference between this strategic default (unwillingness to pay) and default by insolvency (inability to pay). Insolvency results when the borrower's wealth declines to the point where consumption is no longer feasible if mortgage and other debt obligations are honored.

Figure 1 illustrates the roles of different options under a threat of insolvency in a Fisherian framework. The horizontal and vertical axes represent first and second-period income, respectively. The outer quadrant reflects gross income, with interest payments required on the initial debt represented by the shaded region at the origin. Consumption, a part of gross income, is nested within this outer quadrant. The budget constraint $A$

\(^2\) In a recourse environment, in case of default, the lender has the right to go after all personal property of the borrower in order to collect its debt.
reflects the possible anticipated consumption choices, with positive borrowing \((b_i > 0)\), based on the initial prices and income. Constraints \(B\) and \(C\) result from unanticipated negative shocks to income or to other forms of wealth. While \(B\) represents a condition of solvency, \(C\) implies insolvency, because the budget constraint falls outside the feasible consumption region.

The prospect of insolvency gives rise to the role of the consumer risk posture. The feasible consumption region in Figure 1 is inversely related to the size of the shaded region that represents the interest burden. A higher leverage limits the consumer choice set in subsequent periods, as previous financial commitments directly interact with the size of unexpected shocks to determine the likelihood of insolvency. Higher debt service obligations increase this likelihood.

The main shocks that may affect the consumer are shocks to income, shocks to housing prices, and shocks to interest rates. *Income shocks* play a central role in single-family mortgage default, as adverse (idiosyncratic) income shocks are related to insolvency by reducing wealth (*i.e.*, by shifting the budget constraint towards the insolvency region). Consumers with different borrowing and savings positions will be affected differently by the same income shock. The magnitude of the trigger event sufficient for insolvency is inversely related to the consumer's leverage and to income volatility and it is positively related to savings.
Figure 4. Put and call options under threat of insolvency.

Adverse shocks to housing prices erode the value of home equity in any legal environment (that is, the budget constraint in Figure 1 shifts to the left). Such a shift may be sufficient to invoke insolvency default, but some authors argue that it is unlikely under the standard underwriting practices. In a recourse environment, the value of the strategic
default option is always less than the value of the refinance option, so strategic default never occurs. Insolvency may occur when income is insufficient to meet debt obligations, including the negative equity implied by the mortgage liability. Thus, in a recourse environment, consumer leverage interacts with shocks to wealth to determine the likelihood of insolvency as a sole motivation for mortgage default. Unlike what option-based theory suggests, negative equity by itself is neither a necessary nor a sufficient condition for default.

In a non-recourse environment, the strategic default option has value and this value exceeds the value of refinancing, because it hedges the consumer against the erosion of wealth due to falling housing prices. The likelihood of strategic default is always higher and default is independent of changes in income. Only prohibitively high transaction costs associated with default may prevent it.

Interest rate shocks change the slope of the budget constraint in Figure 1, but do not move the borrower to the insolvency region. Higher interest rates reduce utility from intertemporal consumption smoothing, however. Moreover, a decline in interest rates increases the value of refinancing and of strategic default options, but as the transaction costs of refinancing are lower than those associated with default (reputation, or credit impairment costs are high), the refinance option always has a higher net value. The rise in the option value shifts the budget constraint outward, which means that insolvency default cannot result from a decline in interest rates.

Elmer and Seelig (1999) show that a rise in interest rates changes the slope of the budget constraint and the optimal level of borrowing but that it fails to motivate either strategic or insolvency default. Thus, unlike in the option theory of default, interest rates
do not influence default, as they cannot independently motivate insolvency and are more likely to motivate the exercise of the prepayment option.

The greater importance of the ability to pay, particularly for poorer households with volatile incomes, provides additional reasons to examine how income levels and volatility, as well as borrower leverage, influence mortgage termination. Critics of the option-based theory of mortgage default also argue that borrowers may not understand how mortgage markets function and cannot properly "price" their mortgage options. However, credit counseling introduces concepts such as the present value of money, annualized interest rates, and the true value of a mortgage loan. As interest rates and property values change, borrowers who have undergone counseling may have a better understanding of how these changes affect the value of their loan obligations. This greater knowledge may improve the borrowers' ability to "price" their options. Therefore, it is important to use both the option-based and the consumer choice approaches to identify what determines mortgage termination by low-income households and to study the effectiveness of the alternative lending technologies.

3.3 Overview of credit counseling

3.3.1 Historical background

Credit counseling emerged in the United States as a result of the passing of the 1968 Housing and Urban Development Act. Under this act, the U.S. Department of Housing and Urban Development (HUD) was allowed to authorize public and private organizations to provide counseling to mortgagors in the Sections 235 and 237 programs.
The resulting services and infrastructure to provide them led to the development of the credit counseling industry (Quercia et al., 1996).

In 1969, the Housing and Urban Development Act was amended, and additional entities were allowed to enter the credit counseling market. The amendment also broadened the scope of the counseling process itself, to include additional topics such as childcare and money management. In the following years, single-family homeowners, emergency homeownership, and home equity conversions were added to the counseling services covered by the HUD legislation.

A big boost to the industry was the passing of the 1974 Housing and Community Development Act, which allowed HUD to grant funding to counseling agencies. The Federal Housing Enterprise Financial Safety and Soundness Act of 1992 and the 1989 amendments to the Community Reinvestment Act (CRA) provided additional support to counseling programs (Schill and Watcher, 1995).

The credit counseling services that emerged under these programs involve several entities. First, the financial institution that grants the loan typically works with community groups, often non-profit organizations. For-profit financial organizations find it attractive to team up with non-profit organizations because the latter have developed an expertise in counseling low-income households on a variety of issues. Their comparative advantages reflect their proximity to the target clientele and cost savings resulting from their broader contacts with the potential borrowers. For example, GE Mortgage and Capital Corporation and Fannie Mae worked with Housing Opportunities, Inc., a Pennsylvania-based non-profit organization, to develop the Community Homebuyers program (Quercia and Watcher, 1996).
Although the credit counseling industry has been around for at least three decades, it still remains fragmented, and sharp variations across programs can be observed. These program differences offer an opportunity to learn about the strengths and weaknesses of alternative approaches.

3.3.2 Types of credit counseling and credit counseling programs

There are two types of homeowners counseling: pre-purchase and post-purchase counseling. *Pre-purchase* counseling helps families to decide whether they should become homeowners. More precisely, pre-purchase counseling advises them under what circumstances they should consider becoming homeowners.

For many counseling program participants, this decision is linked to actions that they would need to undertake in order to buy a home, given requirements set by the program developed by the specific unit that conducts the counseling. The goal of pre-purchase counseling is mostly to influence the stability of the homeowners' flow of income and expenses, thus decreasing the probability of default.

The actual counseling includes topics such as the home buying process, life-long money management, financing the purchase of a home, qualifying for a mortgage, shopping for a home, steps of the loan application process, the closing process, life as a homeowner, taking care of the home, and foreclosure prevention. Some counsel providers add topics about parenting and family life skills, building self-esteem, fostering civic responsibility, and encouraging community involvement.

*Post-purchase* counseling, or delinquency counseling, is usually provided after a crisis event, when the borrower has already missed one or several payments. The
The purpose of post-purchase counseling is to prevent default and foreclosure. This type of counseling is relatively new and its use has been growing, as many financial institutions now require low-income borrowers to sign up for five years of post-purchase counseling in case they should become delinquent.

Despite its growing popularity, post-purchase counseling is still rarely used, however, mainly because it is costly. It often involves one-on-one meetings, allowing the counselor to observe the level of maintenance of the property and other issues relevant to the stability of the homeowner's situation. Post-purchase counseling includes various topics on crisis management, budgeting, advocacy, obtaining financial assistance, and using various networks that provide assistance (Mallach, 2001).

An effective counseling program must include consideration of both the tenure choice and the default decision. The tenure choice is the choice to buy or to rent, and it is traditionally determined by the level of income of the family and by the relative costs of owning and renting (Turner and O’Neal, 1986).

Some authors distinguish between homeownership education and homeownership counseling, with education addressing the tenure choice and counseling addressing everything else. A successful housing program must rely, however, on an appropriate tenure choice. Borrowing or lending when the tenure decision is based on incorrect assumptions become riskier. This is the reason why the tenure choice (homeownership education) is often the first step in counseling.

The default decision is the choice of continuing with repayment of the mortgage or accepting the consequences of loan delinquency. The literature discusses the importance of several variables that influence these choices. It seems that wealth

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constraints are more important than income constraints in limiting a household's ability to purchase a home. Both characteristics seem to influence, however, the decision to default (Linneman and Watcher, 1989). That is, default may result either from illiquidity (insufficient income flows) or from insolvency (negative net worth). Because of the greater potential incidence of illiquidity among low-income households, greater attention to income and cash flows may be needed.

Credit histories seem to be important in obtaining funding for home purchases, although families with a less sound credit history can work to improve it and still qualify for a mortgage loan. Life-cycle considerations determine preferences for different types of housing (namely, households may prefer to buy single-family houses, as such properties are less available for renting). Expectations about moving costs also influence the tenure choice, as these vary largely, depending on family type and household size and age structure (Linneman and Watcher, 1989).

The choice to own, if based on an incorrect evaluation of repayment capacity, increases the incidence of default. In addition to household characteristics, the price and location of the property are important for the default decision, and they must be, therefore, considered in the counseling process. For example, higher prices make houses less affordable, compared to a given level of household income. Higher prices also require longer periods to accumulate the necessary downpayment.

When the house is too expensive, the probability of an adverse shock seriously jeopardizing the probability of repayment is greater. Good location, however, may lead to significant appreciation of the value of the house. The amount of equity invested in
the house will create compatible incentives for the owner to be more careful about servicing the mortgage, in fear of the loss of equity in case of foreclosure.

The overall economic development of the local community also affects default behavior, as a downturn in the local market may cause additional defaults (Quercia and Watcher, 1996). Indeed, deterioration of the local environment may not only lower the value of the equity in the home but it may also reduce the economic opportunities that support the income flows from which repayment is made by the family.

3.3.3 Previous studies of the effectiveness of credit counseling

Although credit counseling is a growing industry, little is known about its effectiveness. An evaluation of this effectiveness is difficult, however, because the programs vary in desired outcomes (goals), characteristics of the counselors (their stake in the transaction and their qualifications), program content, focus and duration of the sessions, depth of counseling, and quality of the materials used.

Comparisons across programs are difficult, moreover, because housing markets and participants differ across communities and because programs use numerous mechanisms to attract clients, such as radio, television, newspaper ads and fliers, and workshops and seminars on real estate. The wide variety of counseling programs, participants, and market conditions make it difficult, therefore, to select an appropriate methodology to evaluate the overall efficiency of counseling.

Furthermore, a recent Price Waterhouse Coopers feasibility study on counseling effectiveness found that: (a) lenders do not collect adequate and specific data on counseling, (b) loan performance data are uneven, unavailable or impossible to link to
origination data, and (c) little or no demographic data are available from the lenders. As a result of these findings, a project for a comprehensive evaluation of counseling was abandoned by the consulting firm (Mallach, 2001).

There are only a few studies that attempt to evaluate specific counseling programs and the results from these studies vary substantially.³ Studies on pre-purchase counseling are especially limited in number and value. For instance, the effect of pre-purchase counseling was found to be positive in terms of homeownership rates, according to a 1970 San Francisco study, but it was found to be negative in a study by Abt (1981)⁴. According to Fresno study, the link between pre-purchase counseling and subsequent ownership performance was positive. A Housing Assistance Council study (1994) found that pre-purchase counseling is effective in increasing home ownership, while the evidence about the effect of post-purchase counseling did not allow clear conclusions.

Wilder (1995) found that households that had received post-purchase counseling and financial aid through the Mortgage Foreclosure Prevention program were more likely to avoid foreclosure than those who had not. In the absence of a proper control group, however, these results are not surprising. Moreover, most of the studies cited above are based on limited sample sizes and suffer from sample design problems.

The influence of counseling on delinquency and default is also unclear. Some studies, such as those by OSTI in 1974 and HUD in 1975, found that counseling decreased delinquency and default rates but others, such as Fresno (1974), HUD (1977),

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³ This section is based on Quercia and Watcher (1996) and Mallach (2001). These references provide additional details on the studies briefly surveyed here.
⁴ These results are reported in Mallach (2001) but the references on the original paper were not provided by the author.
and Detroit (1980), found no significant relationship. Moreover, the Detroit study found a negative long-term relationship between counseling and default.

Mills and Lubuele (1994) compared the aggregate incidence of delinquency among low-income borrowers, who received their loans through community reinvestment activities, with the delinquency rates shown by conventional borrowers. Low-income participants were found to show repayment performances similar or better than those of conventional borrowers.

Using a similar simple comparison of default experiences, however, Steinbach (1995) found evidence that loosening the underwriting standards in order to expand ownership does result in high default and foreclosure rates. These two studies use simple comparisons and there is no matching, in the design, between treatment and control groups.

Hirad and Zone (2001) used a large database of 40,000 Freddie Mac Affordable Gold Loans, to study how counseling influences delinquency and what kinds of counseling are most effective. The authors found that delinquency rates are lowest in individual counseling programs, followed by classroom counseling, with telephone counseling being least effective. The study used a reliable database, but the logit model employed does not account for the duration nature of the data. That is, in assessing repayment, the authors did not consider the time elapsed since the establishment of the mortgage.

In the Hirad and Zone (2001) study, delinquency was defined as being delinquent at the time when the sample was drawn. Unfortunately, the sample consists of loans with

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5 These results are also based on Mallach (2001) and again references of the original papers were not provided.
huge variations in the age of the loans. One should not expect the same probability of having defaulted in the case of one-year-old loans than in the case of ten-year-old loans. Only a method that considers duration can address this issue.

Many studies of counseling suffer from other shortcomings in the design of the treatment and control groups. More importantly, most studies cannot properly evaluate default, as they do not account for the duration features of the data.

An innovative methodology to study the effectiveness of counseling comes from recent developments in the literature on default, used as background for this chapter (Quercia and Watcher, 1996). In this chapter, an option-based model of mortgage termination and an econometric technique that accounts for the time-censored nature of the data are used. This approach has not been previously used to study the effectiveness of counseling.

3.4 The cash-flow based credit counseling

Traditional banking technologies rely mainly on underwriting standards to determine whether a potential borrower will be able to service a mortgage loan. These underwriting standards require that the ratio of total (monthly) housing expense to pre-tax income does not exceed 28 percent and that the ratio of total (monthly) debt obligations to income does not exceed 36 percent. To estimate these ratios, banks engage in expensive and time consuming collection and verification of data on household income, liabilities and assets. Most of the information in the loan application form is verifiable but some (for example, the value of miscellaneous assets) is not. The lack of knowledge
on low-income household circumstances reduces the banks’ abilities to screen good
borrowers and to precisely determine the optimal level of sustainable debt.6

The Community Mortgage Loan Program studied in this dissertation was initiated
by Paul Taylor and Associates Community Development Consulting, Huntington Bank,
and Fannie Mae in 1992. The broader objectives were to improve the integration of the
financial products offered in a community and to enhance opportunities for home
ownership. The specific purpose of the program was to provide cost efficient mortgage
loans to low-income households, in a fashion profitable to the bank.

Prior to 1995, only the bank was involved in the screening of potential borrowers.
At that time, the decision to lend was based on standard banking practices. In the
absence of credit scoring methods, the estimation of standard debt ratios was among the
most important determinants of creditworthiness, as perceived by the bank. In 1995, PT
and Associates were brought in as a counsel provider. PT and Associates then introduced
their own counseling program, taking advantage of their links to communities, in several
cases through churches.

PT and Associates offered the bank a product based on their proximity to and
knowledge of the potential clientele. The program requires that all potential low-income
borrowers go through a counseling process. To address the specific needs of each
borrower, the amount of counseling needed is individually determined. Each potential
borrower provides preliminary information, on the basis of which a counselor determines
how many classes each person must attend. Potential borrowers participate in group

6 Credit scoring, considered by many to be the most important innovation in mortgage lending, was not
used for the whole period for which we have data, and, given the small size sample of the data, can not be
use to evaluate its effectiveness.
sessions, where they learn how to keep track of their living expenses, measure their level of debt, and calculate whether the expected mortgage loan can be sustainable.

*Graduation* is granted only to those participants who, given an interest rate and a loan amount, can generate zero or *positive cash flow*, based on a thorough verification and calculation of their actual living expenses and debt. Loan amounts adjusted by these criteria do not always correspond to those resulting from the standard financial ratios that banks use as a screening device. This is the essence of the innovation: the determination of the loan amount through a different screening tool.

Granting a loan, furthermore, requires that the borrower contribute a five-percent downpayment. To address this potential obstacle, the program combines counseling with some financial assistance. If the borrower cannot provide the five-percent downpayment, she is granted a consumer loan to make this possible. Thus, the counseling program may, by its design, control for the influence of downpayment on default and may prevent a useful analysis of this influence.

A major advantage of the Community Mortgage Loan program is that the counsel provider is a third party, with superior knowledge of the circumstances of urban, low-income households; that is, the provider of counseling possesses information advantages over the bank. This expertise, combined with a conservative approach to maximum sustainable debt estimation, improves the chances of success of the loan.

An additional important consequence of the counseling process may be that, as potential borrowers learn more about the way financial markets function, they may learn to behave more strategically and to prepay more often when interest rates fall. If such behavior is confirmed by the empirical analysis, together with a positive effect of
counseling on default, it may be an additional argument that counseling helps low-income borrowers.

3.5 Empirical analysis

3.5.1 The data

The data consist of information from a random sample of 394 loan folders, drawn from the database of 1,338 mortgage loans, originated between 1992 and 2000, under the auspices of the program. Counseled loans represent 63 percent (294 loans) and non-counseled loans 37 percent (100 loans) of the total number of loans in the sample.

The population includes mortgages from Florida, Indiana, Kentucky, Michigan, Ohio, and West Virginia but about 85 percent are loans from Ohio. A possible problem with the selection of the control and treatment group is that loans from the control group have a longer period of observation – they were initiated between 1992 and 1995, while loans from the treatment group have a shorter period of observation, as they were initiated between 1995 and 2000. Moreover, it may be that low-income people who wanted to buy houses in the early 1990s differ from low-income people who wanted to buy a house after 1995, although both groups were recruited using the same method.

To study differences between counseled and non-counseled borrowers, in terms of continuous variables, a mean difference test is performed (Table 7). All values are calculated in 1992 price equivalents, so that the influence of inflation is eliminated. The first column of Table 1 describes each variable; the second column shows the average value for non-counseled borrowers; the third column shows the average value for
counseled borrowers, while the fourth column shows the statistics determining significance.

Counseled and non-counseled borrowers differ in income and net assets. Primary borrower monthly income and household monthly income are significantly higher for the counseled borrowers ($1,928 and $2,339, respectively) than for the non-counseled borrowers ($1,756 and $2,030, respectively). Counseled borrowers also paid a higher rent prior to the purchase of the house and now have higher housing expenses, after the purchase, compared to non-counseled borrowers. The relative increase in housing expenses is not significantly different across groups, however.

Non-counseled borrowers report miscellaneous assets ($18,008) that are almost twice the miscellaneous assets reported by counseled borrowers ($10,979). Since the value of most other itemized assets (i.e., bank deposits, car, real estate owned, savings for retirement) must be confirmed, declaring a higher value of miscellaneous assets, which can not be confirmed by the bank, increases net worth and therefore the chances of getting the loan. Savings for retirement, in contrast, are three times higher for counseled borrowers than for non-counseled borrowers. The higher amount of unconfirmed miscellaneous assets and the lower level of saving for retirement for non-counseled borrowers may suggest that before counseling was introduced, banks wanted to see more assets in order for the borrowers to qualify for a particular loan.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Counseled (Mean/$a)</th>
<th>Counseled (Mean/$a)</th>
<th>Z-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borrower's age</td>
<td>37.4</td>
<td>35.4</td>
<td>0.68</td>
</tr>
<tr>
<td>Monthly income (borrower)</td>
<td>1,756</td>
<td>1,928</td>
<td>-2.04**</td>
</tr>
<tr>
<td>Monthly income (household)</td>
<td>2,030</td>
<td>2,339</td>
<td>-3.07***</td>
</tr>
<tr>
<td>Income previous year</td>
<td>17,576</td>
<td>23,818</td>
<td>-4.22***</td>
</tr>
<tr>
<td>Monthly housing expense to income</td>
<td>0.21</td>
<td>0.23</td>
<td>-1.33</td>
</tr>
<tr>
<td>Monthly total obligations to income</td>
<td>0.33</td>
<td>0.33</td>
<td>-0.25</td>
</tr>
<tr>
<td>Rent payment prior to loan</td>
<td>269</td>
<td>309</td>
<td>-1.79*</td>
</tr>
<tr>
<td>Housing expense after mortgage</td>
<td>375</td>
<td>458</td>
<td>-6.64***</td>
</tr>
<tr>
<td>Increase in housing costs (%)</td>
<td>80</td>
<td>50</td>
<td>1.10</td>
</tr>
<tr>
<td>Total declared assets</td>
<td>28,221</td>
<td>19,988</td>
<td>2.97***</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>18,008</td>
<td>10,979</td>
<td>3.97***</td>
</tr>
<tr>
<td>Savings for retirement</td>
<td>2,060</td>
<td>6,939</td>
<td>-2.17***</td>
</tr>
<tr>
<td>Total liability</td>
<td>8,240</td>
<td>11,333</td>
<td>-2.48***</td>
</tr>
<tr>
<td>Downpayment</td>
<td>2,553</td>
<td>1,561</td>
<td>-3.58***</td>
</tr>
<tr>
<td>Consumer loans</td>
<td>1,040</td>
<td>3,231</td>
<td>-3.24***</td>
</tr>
<tr>
<td>Loan amount</td>
<td>40,880</td>
<td>43,061</td>
<td>-1.73*</td>
</tr>
<tr>
<td>Loan to value</td>
<td>0.94</td>
<td>0.95</td>
<td>3.23***</td>
</tr>
<tr>
<td>Property value</td>
<td>44,914</td>
<td>47,538</td>
<td>-2.00**</td>
</tr>
<tr>
<td>Purchasing price</td>
<td>43,840</td>
<td>45,834</td>
<td>1.55</td>
</tr>
</tbody>
</table>

* In 1992 price equivalent, when relevant, * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 7. Borrower and financial contract characteristics
The ratios of prime housing expenses to income and of total monthly obligations to income are important because financial institutions heavily use them to screen potential borrowers. Statistically, these ratios do not differ for counseled and non-counseled borrowers. This is important and it indicates that, for the bank, both counseled and non-counseled borrowers look the same. However, if counseled borrowers default less often, this would indicate that the counseling process helps in picking up better borrowers, who will not be distinguished by the traditional banking technology.

Counseling seems to improve the chances of people with past financial problems in obtaining mortgage loans. The rate of declared personal bankruptcy during the previous seven years is twice as high for counseled (14 percent) than for non-counseled borrowers (7 percent), and the difference is statistically significant.

Data associated with the financial contract show that there is no statistically significant difference in the purchasing price of the house for the two groups ($43,840 and $45,834, respectively). Counseled borrowers received a higher loan amount than non-counseled borrowers ($43,061 and $40,880, respectively) and higher amounts of consumer credit to finance the downpayment ($3,231 and $1,040, respectively). The amount of the actual downpayment—cash from the borrower—was practically the same, however, for the two groups.

This dissertation uses the most restrictive definition of default possible. Loans in default are those loans for which foreclosing actually took place, loans that were terminated due to borrower delinquency, or loans for which a loss was realized. These are the cases when the bank can clearly identify that default has indeed occurred.
There are other loans with problems, which for the current purposes are not classified as being in default but as truncated observations. These include a few loans that have been in arrears for over three months and loans for which the bank has initiated foreclosing procedures. Despite these repayment difficulties, however, these loans were not defined here as loans in default. One of the reasons was insufficient information in the borrower folders about their status. Moreover, often the bank, after some negotiations, reinstates a number of these loans in current standing. In another case, a loan that had been in arrears for five to six months was eventually prepaid (paid in full in advance). Loans sold to investors are also classified as truncated observations.

Repayment records in the sample expand up to nine years, with most loans still outstanding (Table 8). Loans in default represent 9 percent of the number of loans in the portfolio, while only 5 percent of the loans were paid in full in advance (prepaid). Sixteen of the borrowers who had received counseling were in default at the time of the data collection, while 12 had prepaid their loan. Of the non-counseled borrowers, 18 of were in default and only 5 had prepaid.

The data are observed at specific points in time, and since 98 percent of the loans are 30-years loans, all observations are truncated. It is not appropriate, therefore, to estimate from these figures the true proportion of the portfolio in default, for comparisons across the two groups, because the loans were disbursed at different points in time. For example, loans to counseled borrowers show a lower percentage of defaults, but there are fewer time periods for the actual observations of repayment, since the time of disbursement of these loans, as well. As a result, one cannot compare this default ratio to a ratio computed for non-counseled borrowers, for whom the repayment history is longer.
<table>
<thead>
<tr>
<th>Loan Status</th>
<th>Non-Counseled</th>
<th></th>
<th>Counseled</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Total</td>
<td>37.3</td>
<td>100</td>
<td>63.3</td>
<td>294</td>
<td>100</td>
<td>394</td>
</tr>
<tr>
<td>In Default</td>
<td>18</td>
<td>18</td>
<td>5</td>
<td>16</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td>Prepaid</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>12</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Current</td>
<td>77</td>
<td>77</td>
<td>91</td>
<td>266</td>
<td>86</td>
<td>343</td>
</tr>
</tbody>
</table>

Table 8. Portfolio status.

An estimate of two indicators, time at risk and incidence rate of default, provides more relevant information, as these indicators account for the number of days that each loan has been in the portfolio (Table 9). In time at risk, one takes into account the age of the loan. This indicator measures the number of days that the loan has been in the portfolio. For each loan, each day in the portfolio counts as one unit of time at risk. For example, if the loan has been in the portfolio for four years, it has 1,460 days at risk (4*365).

Time at risk takes into account, therefore, the duration feature of loans. It does not tell us, however, how the probability of default and prepayment change as the loan ages. The incidence rate of default and of prepayment measures the chances that default and prepayment will occur per portfolio-day. Time at risk multiplied by the total incidence rate gives the number of defaults and prepayment. These measures thus neutralize...
observed differences in default and prepayment rates due to the different lengths of the repayment history of each loan in the sample. When the defaults are weighted to represent the true proportion of counseled and non-counseled borrowers in the portfolio, the incidence rate of default among non-counseled borrowers is almost twice as high as that for counseled borrowers.

<table>
<thead>
<tr>
<th>Type of Loans</th>
<th>Time at Risk (portfolio days)</th>
<th>Incidence Rate (chances per portfolio days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default (Portfolio)</td>
<td>604,246</td>
<td>0.000056</td>
</tr>
<tr>
<td>Counseled</td>
<td>312,921</td>
<td>0.000051</td>
</tr>
<tr>
<td>Non-Counseled</td>
<td>291,324</td>
<td>0.000062</td>
</tr>
<tr>
<td>Prepayment (Portfolio)</td>
<td>637,115</td>
<td>0.000027</td>
</tr>
<tr>
<td>Counseled</td>
<td>312,388</td>
<td>0.000038</td>
</tr>
<tr>
<td>Non-Counseled</td>
<td>324,727</td>
<td>0.000015</td>
</tr>
</tbody>
</table>

Table 9. Portfolio characteristics – non-parametric duration analysis

Duration or survival analysis is concerned with the time that it takes a certain outcome, such as default or prepayment, to occur. It is important to examine not only
how many people have defaulted or prepaid, but also how things that happen over time influence the probability of default or prepayment. From this perspective, important information on the differences in repayment patterns between counseled and non-counseled borrowers comes from the estimation of Nelson-Aalen cumulative hazard and survivor functions.

The cumulative hazard function is similar to a cumulative distribution function. The cumulative hazard function records the proportion of the portfolio that we would expect to be in default or prepayment over the period of time considered. The default cumulative hazard functions for counseled and non-counseled borrowers are shown in Figure 5.

A higher cumulative default hazard rate is observed for non-counseled borrowers from the very beginning of the loan cycle. Eventually, by the sixth year (2,244th day), the corresponding cumulative hazard rate is 20 percent. That is, after six years, 20 percent of the non-counseled borrowers would have defaulted. Figure 5 also shows that the default hazard rate for non-counseled borrowers is always higher than the default hazard rate for counseled borrowers. To ensure that the differences in incidence rates of default are statistically significant, a non-parametric duration analysis is implemented. The results show that the difference in the incidence rates of default between the two groups are statistically significant, at the five-percent level of significance \( \text{Chi}^2(1) = 4.14 \).
Figure 5. Nelson-Aalen cumulative default hazard with and without counseling.

Figure 6 depicts the prepayment hazard rates for the counseled borrowers with dotted line and that of non-counseled with solid line. It shows that there is no significant difference in the pattern of the prepayment hazard for the two groups.
Figure 6. Nelson-Aalen cumulative prepayment hazard with and without counseling.

3.5.2 Empirical specifications

The proportional hazards model introduced by Cox and Oakes (1984) provides a convenient framework for empirically testing both the option-based and consumer choice theories of default and prepayment. Moreover, the approach is ideal for dealing with time censored data, as the repayment data are available for only several years since loan origination, for loans still outstanding.

Recall that a hazard in duration models is defined as a chance event. The hazard rate is the probability that this event will occur in a particular period, conditional on the event not occurring at (surviving until) the beginning of the period. The general
proportional hazards model assumes that, at each point of time during the mortgage contract period, the mortgage has a certain probability of termination (a separate probability for default or for prepayment), conditional on the survival of the mortgage.

In the general model, the hazard function is defined as a baseline hazard and a set of time-varying covariates. The hazard rate for the $j$-th subject in the dataset is then:

$$ h(t|x_j) = h_0 \exp(x_j b) $$

(19)

where $h_0$ is the baseline hazard, $b = (b_1, b_2, ..., b_k)$ is to be estimated, and $x_j$ is a vector of covariates that may be time variant or time invariant.

The baseline hazard $h_0$ can decrease or increase over time or take any functional form. This approach does not require any assumptions regarding the change of the default rate over time. Actually, the baseline hazard is not even estimated. In the Cox proportional hazards model, the focus is on the relative hazard of the time-varying covariates. Time plays no role in this framework; it merely serves to align time-varying contemporaneous values.

The empirical analysis of mortgage termination is complicated because the critical values of individual house prices and mortgage interest rates that trigger default cannot be observed, neither can be the extent to which the option is in the money. However, the probability that the option is in the money can be estimated given the initial loan-to-value ratio and the stochastic process for housing prices. The probability of exercising the option should increase as the option moves further into the money. Moreover, since by exercising one option the borrower gives up the other option, the extent to which one option is in the money affects the exercise of the other. For instance, the probability of
prepayment is a function of the extent to which the default option is in the money. This jointness of the two options is captured well in the competing risks framework.

Following Deng et al. (2000), let $T_p$ and $T_d$ be the discrete random variables representing the duration of a mortgage until it is terminated by the mortgage holder in the form of prepayment or default. There is no restriction on the functional form of the baseline hazard. The joint survivor function conditional on $n_p, n_d, r, H, Y$ and $X$ can be expressed in the following form:

$$S(t_p, t_d | r, H, Y, X, n_p, n_d) = \exp \left( -n_p \sum_{k=1}^{K} \exp(\gamma_{pk} + g_{pk}(r, H, Y) + \beta' X) \right)$$

$$-n_d \sum_{k=1}^{K} \exp(\gamma_{dk} + g_{dk}(r, H, Y) + \beta' X)$$

where $g_{pk}(r, H, Y)$ and $g_{dk}(r, H, Y)$ are the time-varying functions of option-related variables; $r$ and $H$ are the relevant interest rates and property values, respectively; $Y$ is a vector of other variables that will be used together with $r$ and $H$ to estimate the market values of the options empirically; $X$ is a vector of non-option related variables that indicate borrower financial strength or financial risk, as well as trigger events, such as unemployment and divorce; $\gamma_{pk}, \gamma_{dk}$ are parameters of the baseline function that are not estimated empirically (nonrestricted baseline hazard), and $n_p$ and $n_d$ are unobserved heterogeneity associated with the hazard functions for prepayment and default. The model is estimated by the Maximum Likelihood Method.\footnote{Estimation is performed with STATA. The MLE for the competing risks model is estimated using a program developed by Mario Cleves, STATA Corporation, based on Lin and Wei (1989) and Lin (1994).}

The key variables, according to the option theoretic approach, are those measuring the extent to which the put and call options are in-the-money. To establish the
effect of counseling on default, the current mortgage (Fannie Mae 30-years) interest rate and the initial contract terms are sufficient. The "Call_Option" variable measures the ratio of the present discounted value of the unpaid mortgage balance at the current quarterly mortgage interest rate relative to the value discounted at the contract interest rate.

The variables measuring the value of the put and call options are defined by the initial terms of the mortgage and current conditions. For fixed-rate mortgage \( i \), at each month \( k \) after origination at time \( \tau_i \), with local market interest rate \( m_{j,\tau_i+k} \), where \( j \) indexes the local region, with a mortgage rate of \( r_i \), with a monthly payment of \( P_i \), in principal and interest, and mortgage term in months \( TM_i \), the call option is

\[
Call_{-Option}_{i,k} = \frac{\sum_{t=1}^{TM_i-k} \frac{P_i}{(1 + m_{j,\tau_i+k})^t} - \sum_{t=1}^{TM_i-k} \frac{P_i}{(1 + r_i)^t}}{\sum_{t=1}^{TM_i-k} \frac{P_i}{(1 + m_{j,\tau_i+k})^t}}
\]

\[
= \frac{V_{i,m_{j,\tau_i+k}} - V^*_{i,r_i}}{V_{i,m_{j,\tau_i+k}}}
\]

(21)

The market value \( M_i \) of property \( i \), purchased at cost \( C_i \) at time \( \tau_i \) and evaluated \( k_i \) months thereafter is

\[
M_{i,k_i} = C_i \left( \frac{I_{j,\tau_i+k_i}}{I_{j,\tau_i}} \right)
\]

(22)

where the term in parenthesis follows a log-normal distribution.
To value the put option, it is necessary to measure the monthly market value of each house and to compute homeowner equity for each month. Individual variations in house prices in the sample cannot be observed. However, as in Deng et al. (2000), the value of the individual house prices is imputed from the monthly index of mean price changes by county for the period of study. The variances used to compute the probability of default (Put\_Option) are the estimates from repeat (paired) sales, by state, provided by the Office of Federal Housing Oversight (OFHEO). The variable “Put\_Option” measures the probability that homeowner equity is negative; i.e., it measures the probability that the put option is in-the-money.

The ratio of equity to market value, $E$, of the property $i$ is

$$E_{i,k} = \frac{M_{i,k} - V_{i,m_t+k_t}}{M_{i,k}}$$

(23)

The “Put\_Option” variable is defined as the probability that equity is negative:

$$Put\_Option_{i,k} = \text{prob}(E_{i,k} < 0) = \Phi\left(\frac{\log V_{i,m_t+k_t} - \log M_{i,k}}{\sqrt{w^2}}\right)$$

(24)

where $\Phi(.)$ is a cumulative standard normal distribution function, and $w^2$ is the estimated variance of the OHEO housing prices volatility.

Testing the consumer choice model is a challenge. The ideal dataset would have information on borrower wealth, savings, and consumption patterns at the time of loan origination, data on borrower income, marital status and other variables that may induce a shock to consumption and spending throughout the mortgage period. Data on individual
housing equity, as well as on the movement of interest rates, would complete the ideal dataset.

In reality, lenders do not observe changes in borrower income nor do they record circumstances that may trigger default. From the consumer choice point of view, only changes in interest rates are fully observable. Thus, only inferences regarding prepayment can be made. As noted earlier, prepayment is not treated differently by the two theoretical approaches, except that recent option-based models have developed an empirical methodology to test the jointness of the two options. Thus, if the value of the prepayment option is related to the value of the default option, and the latter depends on shock events, then indeed the Cox proportional hazards model is ideal for testing the applicability of both approaches, provided variables that measure trigger events, income and wealth are identified.

Elmer and Seeling (1999) test their insolvency-driven model on an aggregate level by regressing aggregate mortgage default rates on aggregate movements in interest rates, house appreciation indexes, personal savings, household liabilities divided by household assets, business failure rates, and consumption of casino gambling divided by disposable income, but the results are somewhat mixed. This approach is inappropriate for our purposes, as aggregate variables may not reflect the circumstances of low-income borrowers and disaggregate data that could better capture the economic circumstances of this segment of the population are not available.

The choice theoretic approach is tested, instead, by considering income, wealth, and leverage at the time of mortgage origination. Proxies for trigger events for the
duration of the repayment record are monthly unemployment rates by counties (MSA) and the annual divorce rate by state.\textsuperscript{8}

To measure risk exposure, \textit{Income} (total household monthly income), monthly \textit{Housing Expense to Income Ratio}, and savings proxies - \textit{Net Wealth} (the difference between total assets and total liabilities) and \textit{Downpayment} – are used.

\subsection*{3.5.3 Empirical results}

The results regarding the effectiveness of alternative lending mechanisms vary depending on the approach. Default and prepayment hazard rates, estimated in a competing risks framework, for a model with option values only, are shown in Table 10, Model 1. According to these results, mortgage termination by low-income households is driven by the values of the put and call options. Moreover, counseling decreases the hazard rate of default and, therefore, may be an improvement in the screening mechanism compared to traditional mortgage lending; the coefficient of counseling is significant at the 10 percent level.

\textsuperscript{8} State divorce rates are reported in various issues of U.S. National Center for Health Statistics, \textit{"Vital Statistics of the United States, Volume III, Marriage and Divorce,"} and in \textit{"Statistical Abstract of the U.S."} Divorce rates for Ohio counties (90 percent of the data) are obtained by the Center for Public Health Data and Statistics, Ohio Department of Health. State unemployment rates are reported in various issues of U.S Department of Labor, \textit{"Employment and Unemployment in States and Local Areas (Monthly)"} and in \textit{"Monthly Labor Review"}.  

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<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
<th>Model 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Default</td>
<td>Prepayment</td>
<td>Default</td>
<td>Prepayment</td>
<td>Default</td>
<td>Prepayment</td>
</tr>
<tr>
<td>Put Option</td>
<td>1.240*</td>
<td>0.308</td>
<td>1.035</td>
<td>0.409</td>
<td>1.038*</td>
<td>0.393</td>
</tr>
<tr>
<td></td>
<td>(1.89)</td>
<td>(0.57)</td>
<td>(1.67)</td>
<td>(0.81)</td>
<td>(1.68)</td>
<td>(0.78)</td>
</tr>
<tr>
<td>Call Option</td>
<td>1.789</td>
<td>3.224***</td>
<td>1.123</td>
<td>4.095***</td>
<td>1.997</td>
<td>4.257***</td>
</tr>
<tr>
<td></td>
<td>(0.94)</td>
<td>(2.98)</td>
<td>(0.54)</td>
<td>(3.16)</td>
<td>(0.94)</td>
<td>(3.18)</td>
</tr>
<tr>
<td>Unemployment</td>
<td>-0.157</td>
<td>0.237</td>
<td>-0.156</td>
<td>0.257</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.75)</td>
<td>(1.67)</td>
<td>(0.73)</td>
<td>(1.55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorce</td>
<td>-0.571</td>
<td>0.091</td>
<td>-0.532*</td>
<td>0.753</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.75)</td>
<td>(0.39)</td>
<td>(1.69)</td>
<td>(0.34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>-0.0003</td>
<td>-0.0003**</td>
<td>0.0004*</td>
<td>-0.0003*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.49)</td>
<td>(2.03)</td>
<td>(1.75)</td>
<td>(1.89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing expense</td>
<td>2.950*</td>
<td>-4.533*</td>
<td>3.273**</td>
<td>-3.977*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to income</td>
<td>(1.91)</td>
<td>(1.82)</td>
<td>(2.01)</td>
<td>(1.80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downpayment</td>
<td></td>
<td>0.0002</td>
<td></td>
<td>0.00008</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.60</td>
<td></td>
<td>(0.83)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counseling</td>
<td>-0.656</td>
<td>0.217</td>
<td>-0.426</td>
<td>0.548**</td>
<td>-0.575</td>
<td>0.515**</td>
</tr>
<tr>
<td></td>
<td>(1.67)</td>
<td>(0.81)</td>
<td>(1.51)</td>
<td>(2.16)</td>
<td>(1.50)</td>
<td>(2.03)</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-282</td>
<td>-270</td>
<td></td>
<td>-269</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P&gt;</td>
<td>z</td>
<td></td>
<td>0.01</td>
<td>0.001</td>
<td></td>
<td>0.001</td>
</tr>
</tbody>
</table>

**t** values are in parenthesis
* *significant at 10 percent level
** **significant at 5 percent level
*** ***significant at 1 percent level

Table 10. Estimates of the competing risk model.
When the competing risks framework is extended to include variables that capture borrower heterogeneity at time of loan origination (Model 2 and Model 3), the explanatory power of the model increases. Default hazard is affected by the value of the put option, by the divorce rate, and by income and housing expense to income ratios. Counseling does not affect default in this specification but the influence of counseling on prepayment is strong. If default and prepayment are interdependent risks, counseling seems to influences prepayment to a greater extend while the influence on default is close to being but is not significant at the 10 percent level. This specification may be the one that best captures both option theory considerations and consumer choice concerns.

Estimates from consumer choice specifications, when the default hazard is estimated independently, are shown in Table 11. The predictive power of the model decreases significantly if default hazard is estimated as an independent hazard, where default is specified to be driven only by insolvency (Model 1, Table 11). Contrary to the prediction of the consumer choice model, net wealth at time of origination does not affect the default hazard in both of the default specifications (Models 1 and 2 in Table 11). The predictive power improves when the value of the put option is included in the regression but, according to this specification, counseling does not influence the default hazard (Model 2 in Table 11). Overall, in the consumer choice specifications, counseling is only marginally effective, at the 10 percent level of significance. Moreover, this result is not robust to different model specifications. Counseling does, however, influence prepayment even within this consumer choice specifications.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1 (Default a)</th>
<th>Model 2 (Default b)</th>
<th>Model 3 (Prepayment)</th>
<th>Model 4 (Prepayment)</th>
<th>Model 5 (Prepayment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Put Option</td>
<td>3.146*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Call Option</td>
<td></td>
<td>14.109***</td>
<td>17.298***</td>
<td>15.205***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.74)</td>
<td>(2.85)</td>
<td>(2.92)</td>
<td></td>
</tr>
<tr>
<td>Net Worth</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>(0.92)</td>
<td>(0.94)</td>
<td>(0.94)</td>
<td>(0.94)</td>
<td>(0.94)</td>
</tr>
<tr>
<td>Unemployment</td>
<td>0.835</td>
<td>0.845</td>
<td>0.580**</td>
<td>0.574*</td>
<td>0.621**</td>
</tr>
<tr>
<td></td>
<td>(0.85)</td>
<td>(0.67)</td>
<td>(1.97)</td>
<td>(1.84)</td>
<td>(2.02)</td>
</tr>
<tr>
<td>Divorce</td>
<td>0.543**</td>
<td>0.545**</td>
<td>0.181</td>
<td>0.238</td>
<td>0.156</td>
</tr>
<tr>
<td></td>
<td>(2.30)</td>
<td>(2.22)</td>
<td>(0.45)</td>
<td>(0.55)</td>
<td>(0.39)</td>
</tr>
<tr>
<td>Income</td>
<td>0.996**</td>
<td>0.986*</td>
<td></td>
<td>0.0004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.02)</td>
<td>(1.80)</td>
<td></td>
<td>(-1.58)</td>
<td></td>
</tr>
<tr>
<td>Housing Expense to</td>
<td>28.66**</td>
<td>27.7**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income Ratio</td>
<td>(2.12)</td>
<td>(2.08)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downpayment</td>
<td>1.001**</td>
<td>1.001**</td>
<td>-0.0004*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.09)</td>
<td>(2.06)</td>
<td>(-1.75)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counseling</td>
<td>0.533*</td>
<td>0.618</td>
<td>1.19</td>
<td>1.377*</td>
<td>1.377**</td>
</tr>
<tr>
<td></td>
<td>(1.68)</td>
<td>(1.22)</td>
<td>(1.71)</td>
<td>(1.86)</td>
<td>(1.96)</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-174</td>
<td>-169</td>
<td>-100</td>
<td>-77</td>
<td>-99</td>
</tr>
<tr>
<td>P&gt;</td>
<td>z</td>
<td></td>
<td>0.01</td>
<td>0.008</td>
<td>0.02</td>
</tr>
</tbody>
</table>

a Insolvency default only
b Strategic and insolvency default
t values are in parenthesis
* significant at 10 percent level
** significant at 5 percent level
*** significant at 1 percent level

Table 11. Default and prepayment as independent hazards

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When estimated separately, prepayment hazard is influenced by the value of the call option and thus, as expected, is affected by changes in interest rates (Model 3, Table 11). In this specification, unemployment also affects prepayment positively while the divorce rate does not. A link test for model specification confirms that the model is specified properly (Stata Manual).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Magnitude of Change</th>
<th>Competing Risks</th>
<th>Default</th>
<th>Prepayment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put Option</td>
<td>0.01 point</td>
<td>1.01</td>
<td>1.03</td>
<td></td>
</tr>
<tr>
<td>Call Option</td>
<td>0.01 point</td>
<td>1.04</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Net Worth $1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment 0.001 point</td>
<td></td>
<td>1.0001</td>
<td>1.0009</td>
<td>1.0003</td>
</tr>
<tr>
<td>Divorce 0.001 point</td>
<td></td>
<td>0.999</td>
<td></td>
<td>1.0006</td>
</tr>
<tr>
<td>Income $100</td>
<td></td>
<td>0.96</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>Housing Expense to Income Ratio 0.01</td>
<td></td>
<td>1.03</td>
<td>0.96</td>
<td>1.32</td>
</tr>
<tr>
<td>Downpayment $1000</td>
<td></td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counseling $1000</td>
<td></td>
<td>0.56</td>
<td>1.67</td>
<td>0.54</td>
</tr>
</tbody>
</table>

*Estimation based on Model 3, Table 4. Coefficients close to but not significant at the 10 percent level are in italic.

*b Estimation based on Model 2, Table 5.

*c Estimation based on Model 3, Table 5.

Table 12. Magnitude of the influence of the covariates
Table 12 presents the magnitude of influence of the covariates. Default hazard is affected by the put option, divorce rate, income, the income to housing expense ratio, downpayment and, to some extent, by counseling. The magnitude of the change is interpreted in the following manner. According to the competing risks approach, a 0.01 increase in the probability that the equity is negative increases the probability of default by 1 percent. An increase in the pre-tax monthly income at the time of mortgage origination by $100 decreases the default hazard by 4 percent. An increase of the monthly housing expense to income ratio by 0.01 increases the probability of default by 3 percent. An increase of the downpayment by $1000 decreases the default hazard by 56 percent. Finally, although counseling is significant at only the 12 percent level, counseled borrowers have a default hazard rate that is only 56 percent of the default hazard of non-counseled borrowers.

According to the competing risks approach, an increase in the option value by 0.01 points (as a result of a decrease in the market interest rate) increases the prepayment hazard by 4 percent. Higher income and a housing expense to income ratio at the time of mortgage origination decrease the prepayment hazard by 3 and 4 percent, respectively. Counseled borrowers are 67 percent more likely to prepay than are non-counseled borrowers. Therefore, according to the competing risks approach with borrower heterogeneity, counseled borrowers are more likely to prepay and there is some evidence that they are less likely to default, but the latter result is not robust to model specifications.

The consumer choice specification renders interesting results. If it is assumed that low-income borrowers default only when insolvent and that they never default
strategically, then counseling decreases the default hazard. However, if it is assumed that low-income borrowers default both strategically and when insolvent, as the consumer choice model for a non-recourse environment suggests, then counseling does not significantly influence the default hazard. Moreover, Models 1 and 2 in Table 11 predict that an increase in the monthly housing expense to income ratio increases the chances of default ten times more than what the competing risks model suggests. Namely, an increase by 0.01 points of this ratio increases the default hazard by 32 percent.

Models 3, 4 and 5 in Table 11 show that an increase in the option ratio by 0.01 (as a result of a decrease in the market interest rates) increases the chances of prepayment 20 times. The unemployment rate also has a positive, albeit miniscule, influence on the prepayment hazard. Most importantly, counseled borrowers are four times more likely to prepay than are non-counseled borrowers.

Overall, the results show that counseling influences the prepayment hazard. It may be that counseled borrowers prepay more often because those who have graduated from the program and, therefore, qualify to get a loan from the bank, are consumers with a better overall credit history and repayment capacity. These clients could afford to prepay when the market conditions allow it. As prepayment penalties are priced in the loan, the bank will not incur serious losses. However, if the higher prepayment rates by the counseled borrowers capture improvement of their understanding of the mortgage market and, even more importantly, they capture their chances to get another loan with better interest rates as a result of the positive credit history they were able to build, then counseling indeed may be beneficial. In other words, counseling may decrease the default
hazard and improve the chances that low-income borrowers build a healthy credit history, which these borrowers can later use to get better mortgage loan terms.

The results shed some light on the theoretical debate on how to study default by low-income households. The evidence suggests that low-income borrowers consider home ownership as a financial investment and that they act on it as predicted by the option-based theory of mortgage termination. However, other variables, such as income and personal circumstances, also affect the borrower's behavior, and render credibility to the consumer choice approach.

6. Conclusions

The purpose of this chapter has been to evaluate the efficacy a cash-flow based credit counseling program by using innovative competing risks (option-based) and choice theoretic approaches. If mortgage termination by low-income households is driven by consumer choice considerations, and if default is not strategic but is only driven by ability to pay, then the screening technology of the counsel provider is only marginally better than traditional banking practices. The results show that the pure option-based competing risks model of mortgage termination (where only option values are specified) does not explain well mortgage termination behavior by low-income households, although it does show that counseling influences default hazard. Limitations in data quality may be behind some of these results. The competing risks specification, which also accounts for borrower heterogeneity, performs best, but it provides ambiguous results in terms of the effectiveness of counseling in reducing default. Counseling seems
to influence the default hazard, but this result is not robust. However, counseling does affect prepayment and this result is robust to alternative model specifications.

Overall, the evidence suggests that low-income households possess some degree of financial sophistication, as they tend to exercise both their put and call options. There is evidence that counseled borrowers default less often than non-counseled borrowers. Moreover, through counseling, borrowers may be learning to behave more strategically and may be more inclined to prepay when the call options are in-the-money.
CHAPTER 4

INVESTMENT, FINANCING CONSTRAINTS, AND THE SECURITY OF PROPERTY RIGHTS: EMPIRICAL EVIDENCE FROM SMALL FIRMS IN RUSSIA

4.1 Introduction

Worldwide and particularly in transition economies, the entrepreneurial firm is perceived as an engine of economic growth (Kornai, 1991; Gomulka, 1994; McMillan 1995; Berkowitz and DeJong, 2002; McMillan and Woodruff, 2002). Across countries, entrepreneurs face various constraints and must overcome diverse challenges in order to sustain and expand their operations. This chapter presents evidence that imperfections in credit markets and the insecurity of property rights restrict small firms’ investment and growth in Russia.

The ability of entrepreneurs to continuously fund new projects is essential for growth. Small firms, however, often face financing constraints, because their internal funds are limited and, as small firms find it difficult to signal their quality to lenders and to investors, because external funds are not always available (Berger and Udell, 1998).
The supply of external finance for small firms is particularly limited in Russia, due to the absence of skilled bankers and of appropriate lending technologies (Roe et al., 1998). Under these circumstances, small firms’ investment is often limited to the amount of available internal funds.

In addition, Russia has undergone significant institutional reform in the process of transition to a market economy. The establishment of reasonable norms and laws to protect investors has been, however, difficult and slow (La Porta et al., 1999). During this process of transformation, poorly defined and badly protected private property rights as well as numerous legal and regulatory hurdles have additionally restricted the small enterprises’ ability to grow. For example, government officials have engaged in predatory behavior and have sought bribes in exchange for the provision of essential services to entrepreneurs (Shleifer and Vishny, 1993, 1994, and 1998; Frye and Shleifer, 1997; Johnson et al., 2002b). Moreover, small firms may have been discouraged from investing in new projects, as their future profits could have easily been subject to extortion by criminal gangs (Frye and Zhuravskaya, 2000; Johnson et al., 2002a).

Several recent studies argue that the investment and growth of small and medium-sized enterprises (SME) in Central and Eastern Europe and the Newly Independent States have been influenced by firm characteristics such as size and financial leverage. Specifically, these studies explore the extent to which SME’s investment has been influenced by the availability of internal funds. While the small firms’ investment can be related to the age of the firm (according to the financial growth cycle hypothesis), the investment decisions of firms of a given age have been largely unexplored (Burger and Udell, 1998). Moreover, young SMEs may have been even more dependent on internal
funds, as the supply of credit has been determined by existing lending technologies, while the standard banking technology is not friendly to young firms.

Research efforts, furthermore, have focused on SMEs, where small firms are defined as firms with less than 100 employees, while medium-sized firms are those with 100 to 500 employees (EBRD, 1999).\(^1\) Within the group of small firms, the focus has been on larger, established enterprises. The smallest firms within the group --self-employed individuals, individual private entrepreneurs, small family firms and partnerships, or simply micro-size legal entities-- have largely been ignored.\(^2,3\)

Not surprisingly, very small enterprises have been ignored by researchers, as data are rarely available, either because very small firms are not required to provide detailed reports to government officials or because they sometimes operate in the gray economy (Johnson \textit{et al.}, 2000). Moreover, it is difficult to observe and measure very small firms' transactions, because there is no clear distinction between assets that belong to the firm and assets that belong to the household.

This chapter uses data from a 1999 survey of very small firms (with up to 20 employees) from Samara, Russia. It studies the extent to which the decision to invest by small firms of different ages is influenced by the availability of internal funds and by the security of property rights. The research also sheds some light on the ability of providers

---

\(^{1}\) Djankov and Murrell (2000) survey the empirical literature on firms in transition economies but the focus of their survey is on medium size and large enterprises.

\(^{2}\) The multiplicity of legal forms among households with micro-firms in Russia has been mainly the result of household diversification, to avoid personal taxes by family members, and not necessarily the result of the entrepreneurs' desire to best protect their property rights (Nadolnyak and Hartarska, 1999).

\(^{3}\) Among the exception are Earle and Sakova (1999 and 2000), who analyze labor force survey data of self-employed individuals in Poland, and Djankov and Nenova (2001), who study employment in manufacturing firms with less than 50 employees.
of formal finance to resolve the problems of asymmetric information they encounter when lending to small firms.

The chapter is organized as follows. Part 2 reviews the research on investment under insecure property rights in transition economies. It also discusses the methods used and summarizes previous research on financing constraints. Part 3 describes the Russian financial system during the period of the study. The data and the empirical specifications are presented in Parts 4 and 5. Part 6 summarizes the results. Conclusions are offered in Part 7.

4.2 Previous studies and methods

4.2.1 The literature on financing constraints

In a perfect capital market, the investment decision of the firm is independent of the source of finance (Modigliani and Miller, 1958). In the presence of transaction costs and asymmetric information, however, external finance is either rationed or is available at a premium (Jensen and Meckling, 1976; Stiglitz and Weiss, 1981; Myers and Majluf, 1984). In such circumstances, external and internal finance are no longer perfect substitutes.

In firms facing high information costs (due to signaling, screening, monitoring as well as agency costs that exist due to asymmetric information and incentive problems between the firm and external capital providers), investment will be limited by the available internal funds (Fazzari et al., 1988). Firms that require external funds but face imperfections in the capital market are considered financially constrained. The constraint does not affect all firms uniformly, however, and the degree of effective financing
constraint that various firms face provides information on the ability of the financial system to fund the firms’ growth.

The specific literature on financing constraints reviewed here does not explicitly deal with the asymmetric information between a firm and the providers of external finance and does not study why there may be capital market imperfections and credit rationing. Instead, the literature on financing constraints focuses on the consequences of the high costs of raising external capital. Initially, the research efforts focused on the empirical relationship between financing constraints and the firms’ investment, but recent contributions have made much progress in explaining the theoretical underpinning of the observed results.

Fazzari, Hubbard and Peterson (1988) first adopted an empirical methodology to study the link between investment and cash flows in financially constrained and unconstrained firms. The methodology involves splitting the sample into sub-samples, according to suitable theoretical priors that characterize constrained and unconstrained firms (i.e., criteria that serve as proxies for capital market imperfections such as dividend policy, net worth, firm size and the like) and then estimating reduced-form investment equations.

The general statement of the reduced-form investment equation that these authors examine is

\[(I/K)_{it} = f(X/K)_{it} + g(CF/K)_{it} + u_{it}\]  

(25)

where \(I\) is the investment in plant and equipment for firm \(i\) at time \(t\); \(X\) represents a vector of variables that have been identified as determinants of investment from a variety of theoretical perspectives; and \(u\) is the error term. The function \(g(.)\) depends on the firm’s
internal funds or cash flow \((\text{CF})\); it represents the "sensitivity" of investment to available internal finance, after investment opportunities are controlled for through the variables in \(X\). All variables are divided by the beginning-of-period capital stock \(K\).

Cash flow is defined in this literature as current revenues minus expenses and taxes and is used as a proxy for changes in net worth. The most appropriate measure for investment opportunity \((\text{IO})\) is the expectation by the entrepreneur or firm manager of the present value of future profits from additional capital investment. In the neoclassical theory of the choice of capital stock, this expectation is measured by marginal \(q\), the shadow value to the firm of an additional unit of physical capital (Hubbard, 1998).

Thus, within each sub-sample, (fixed) investment is regressed on two groups of variables – investment opportunities and cash flow. A test is then performed to check whether the difference between the estimated cash flow coefficients in the sub-samples is statistically significant. In these models, a statistically significant difference is evidence that firms with a higher dependence on internal cash flow for investment face higher information costs and are most likely to be unable to obtain external funds or unwilling to pay an unacceptably high premium to obtain them.

In their paper, Fazzari et al. used a firm's payout policy as their constraint criterion, arguing that firms that pay low or no dividends can reasonably be thought to be financially constrained. The authors show that, independently of the specifications used to control for investment opportunity \((\text{i.e., the q-theory specification of investment or the Euler equation, and the specification based on the sales accelerator model})\), investment in financially constrained firms is more \text{\textit{sensitive}} to the level of available cash flow, \text{i.e.,}
depends to a greater extent on it. The results, according to the authors, suggest that capital market imperfections affect the firms' investment.

The Fazzari, Hubbard and Peterson paper has spurred a substantial empirical literature, which compares the investment-cash flow sensitivities of firms classified according to various "constraint" criteria and obtains results similar to those in the original paper. The criteria used in this literature are membership in an industrial or financial group, the relationship with an intermediary, a firm's size and age, financial leverage, the availability of collateralizable assets, the type of industry, stock market listing and the choice of stock market, the presence of bond rating or of a commercial paper program, use of trade credit, the concentration of ownership or the pattern of insider trading, and indexes of several variables.4

Many empirical papers have refined the concept of financing constraints. For example, Fazzari and Petersen (1993) provide a new test for financing constraints by accounting for the dual role of working capital as a source and a use of funds. Results show that, in the augmented fixed investment regression, the coefficient of endogenous working capital is negative; i.e., firms smooth fixed investment with working capital.

4 Povel and Raith (2001) provide a list of some of the studies. For example, they report that studies that use membership in an industrial or financial group are Hoshi et al. (1990 and 1991), Schaller (1993) and Chirinko and Schaller (1995). The relationship with an intermediary is used by Elston (1996) and Horiuchi and Okazaki (1994). Firm size is used by Deveraux and Schiantarelli (1990) and Oliner and Rudebusch (1992). Firm age is used by Oliner and Rudebusch (1992), Deveraux and Schiantarelli (1990), and Schaller (1993). Leverage and the coverage ratio are used by Whitted (1992). The availability of collateralizable assets is used by Schaller (1993), Hubbard and Kashyap (1992), and Ogawa et al. (1996). The type of industry is used by Deveraux and Schiantarelli (1990). Stock market listing and the choice of stock market are used by Oliner and Rudebusch (1992). The presence of bond rating or of a commercial paper program are used by Gilchrist and Himmelberg (1995 and 1999), Whitted (1992), and Erikson and Whitted (2000). The use of trade credit is a splitting criterion in Peterson and Rajan (1994). The concentration of ownership, or the pattern of insider trading are a splitting criterion in Oliner and Rudebusch (1992) and Schaller (1993). Indexes of several variables are used by Kaplan and Zingales (1997) and Cleary 1999.
Carpenter et al. (1994) provide evidence of a link between investment in inventories and fluctuations in internal finance. They reason that, given imperfect capital markets, during a downturn, financially constrained firms will reduce their inventories, because inventory investments have lower adjustment costs. That is, firms will decrease the rate at which they replenish inventories in order to absorb the shock to cash flows. The empirical results show that the inventory investments of small firms are more sensitive to cyclical shocks to cash flows than those of bigger firms. Carpenter et al. (1998) find similar results for different inventory cycles and for firms from different manufacturing sectors. Hubbard et al. (1995) refine the empirical model by accounting for firm specific cash flow as well as a measure of the tightness of the aggregate borrowing conditions for mature firms, and they find that both are significant.

The literature on financing constraints is not without its controversies. The numerous empirical results that investment in constrained firms is more sensitive to cash flow than investment in unconstrained firms are not disputed. Many have argued, however, that it is not clear whether this result truly captures structural conditions or, instead, simply reflects equation misspecifications. The answer has an important policy implication. If the shortage of internal capital and the high information cost of external finance reflect important impediments to capital formation, policies that decrease the cost of external capital might be appropriate (Chirinko, 1997). This policy recommendation should not be that credit should be subsidized (Gonzalez-Vega, 1998). Rather, for the case of small firms, these policies should be directed towards helping banks and other financial intermediaries to acquire the necessary information processing capability and
developing technologies that will make possible the provision of cost-effective financial services to small firms.

Chirinko (1997) studies financing constraints in a formal framework and explores their impact on the specification of the Q investment equation. He finds that the case for financing constraints can be made only if firms are classified by their susceptibility to information problems, determined by factors such as affiliation with a financial or industrial group, ownership concentration and bank ownership, as well as the firm's age. However, his framework shows that firm size and retained earnings policy are not appropriate separation criterion because the relationship between investment and cash flow may not be linear.

Chirinko's work first underscored the importance of separating criteria. There is hardly a doubt that smaller firms face higher information costs. However, it is not always clear what boundary separates smaller firms that face higher information costs from bigger firms that face lower information costs. If the separating threshold is arbitrary, it is unlikely that the approach would produce reliable results.

Kaplan and Zingales (1997) also use a formal framework that accounts for firm type (by using an exogenously determined indicator for the cost of internal capital) and argue that an investment-cash flow sensitivity measure of financing constraints may be flawed because there are levels of investment where this relationship is non-monotonic. Moreover, their empirical analysis shows that, when firms are split according to size and earnings retention policy, investment in firms that are expected to be more financially constrained is less sensitive to cash flow than in less constrained firms. Kaplan and Zingales (1997 and 2000) suggest that, if the relationship between investment and
internal finance is not monotonic, then the observed sensitivity may be due to non-optimizing management behavior or excessive managerial conservatism. Fazzari et al. (2000) use the Kaplan and Zingalez theoretical framework and show that monotonicity requirement holds when theoretical priors for firm classification are well defined. Therefore, firm size may not be a good splitting criterion because the cut-off line is often chosen arbitrarily.

Hubbard (1998) surveys the empirical literature on financing constraints and summarizes the theoretical underpinnings used to motivate the empirical work. He concludes that more research is needed to explain how imperfections in the credit market and the costs of internal funds affect investment. Povel and Raith (2001) were able to achieve exactly that. These authors endogenously derive the optimal financial contract between the firm and a provider of external capital. They emphasize that investment depends on both the extent of capital market imperfections and the firm's level of internal funds.

In a model where the cost of debt finance is endogenously determined, optimal investment varies with the level of internal funds and with the asymmetry of information between the firm and the outside investor's information about the firm's profitability. However, the marginal cost of debt finance and, therefore, of investment is affected in different ways by the two factors. Povel and Raith (2001) show that optimal investment is a U-shaped function of the firm's level of internal funds. With greater asymmetries of information, however, investment decreases and becomes more sensitive to changes in internal funds.
Pover and Raith (2001) consider a firm that invests $I$ and generates a stochastic revenue $F(I, \delta)$ one period later, where $\delta$ is a random variable distributed with density $w(\delta)$ and c.d.f. $\Omega(\delta)$ over some interval $(\underline{\delta}, \bar{\delta})$. Here, $W$ denotes the internal funds that a firm can contribute to its scalable investment. Internal funds are defined as the difference between current assets and current liabilities. For expositional clarity, only variable costs of investment are considered. The firm offers a financial contract to risk neutral investors that stipulates that the firm wants to obtain an amount $I - W$ to invest $I$. The revenue $F(I, \delta)$ is unobservable to investors. The firm then makes a payment to the
investor and depending on the size of this payment the firm is either liquidated or allowed to continue. The liquidation decision is stochastic. If the firm is allowed to continue, it earns a payoff $\pi_2$, and if it is terminated, the firm's assets are sold for a liquidation value of $L < \pi_2$. The model also assumes scalable investment—a change in the marginal cost of debt finance affects both the decision whether to invest and which investment to choose. Additionally, the model makes the empirically relevant assumption that some firms may have negative levels of internal funds. A firm with negative internal funds may still have positive net worth because net worth accounts for the firm marketable collateral $L$. Negative net worth, applicable to young firms with few tangible assets but valuable growth opportunities, is also allowed by this model.

The authors show that the firm's internal funds must be at least $W$, where

$$W = - \left[ \frac{\pi_2 - L}{\pi_2} \right] E[F(\bar{I}, \theta)] + \frac{L}{\pi_2} F(\bar{I}, \bar{\theta}) - I \right]$$

(26)

If the firm wants to invest $I$ and needs external funds, it will offer a contract where it borrows $I-W$ and promises a repayment $D$. If it repays $D$, the firm is allowed to continue; if it repays $r < D$ (i.e., if it defaults), it is allowed to continue with probability $\beta(r) = 1 - \frac{D-r}{\pi_2}$ and it is liquidated with probability $1 - \beta(r)$. The required repayment $D$ and the threshold between solvency and default is implicitly defined by

$$D = F(I, \delta)$$

(27)

and the investors' participation constraints is

$$\int \left( F(I, \theta) + \frac{D - F(I, \theta)}{\pi_2} L \right) w(\theta) d\theta + (1 - \Omega(\theta)) D = I - W$$

(28)
The firm specifies \( r \) and continuum of probabilities \( \beta (r) \) that satisfy the incentive constraint

\[
F(I, 6) - r + \beta (r) \pi_2 \geq F(I, 6) - \hat{r} + \beta (\hat{r}) \pi_2 \quad \text{for all feasible } \hat{r}.
\]

The firm investment choice is determined by choosing \( l \) and \( D \) (through equation 27) to maximize

\[
\int_{\theta} \beta (F(I, \theta)) \pi_2 w(\theta) d\theta + \int_{\theta} [F(I, \theta) - D + \pi_2] w(\theta) d\theta
\]

subject to the investor participation constraint (28). Through substitution, this equation reduces to

\[
E(F(I, 6)) - D + \pi_2
\]

The authors show that at \( W = \bar{I} \), and at \( W = \underline{W} \), the firm invests at the first-best level of \( \bar{I} \). On the interval \((\underline{W}, \bar{I})\), the optimal investment function \( l(W) \) is strictly lower than \( \underline{W} \), U-shaped and has a unique minimum at a negative level of internal funds \( \underline{W} \).

To account for the information asymmetry between the investors and the firm, uncertainty regarding the firm’s future profits is introduced. The firm’s expected future payoffs are still \( \pi_2 \) and \( L \), but the realized values are stochastic. These values are both zero with probability \( \alpha \), and \( \frac{\pi_2}{1 - \beta} \) and \( \frac{L}{1 - \alpha} \) with probability \( (1 - \alpha) \). Now the investors’ participation constraint is

\[
(1 - \alpha) \int_{\theta} \left[ F(I, \theta) + \frac{D - F(I, \theta)}{\pi_2} L \right] w(\theta) d\theta + (1 - \alpha)(1 - \Omega(\hat{\theta})) D - I + W = 0
\]

and the firm’s objective is

\[
E(F(I, 6)) - D + (1 - \alpha) \pi_2
\]
The authors prove that, given a fixed \( I \), an increase in \( \alpha \) increases the risk premium, and that, if \( W \) is sufficiently close to \( \bar{I} \), then \( \bar{I}_w\alpha > 0 \), i.e., the sensitivity of investment with respect to internal funds is increasing in \( \alpha \).

Figure 5 represents investment as a U-shaped function of internal funds. When \( \alpha=0 \) there is no asymmetric information. With asymmetric information (illustrated through a small change in \( \alpha \), for example \( \alpha =0.1 \)), the curve shifts downwards and investment moves further away from the first-best level for positive and slightly negative values of internal funds.

Thus, Povel and Raith show that, if the criteria to split the sample into constrained and unconstrained firms proxies the presence or absence of asymmetric information, and if the firm’s internal funds are positive or slightly negative, investment will be more sensitive to cash flows, the more severe the capital market imperfections. This relationship may not hold if the splitting criterion is correlated to net worth.

### 4.2.2 Financing constraints and small firms

Most of the research on financing constraints uses data from publicly traded companies, mainly because data for smaller firms are less available (Berger and Udell, 1998; Hubbard, 1998). In the non-transition context, only a few studies have employed the approach of Fazarri et al. (1988) and its modifications to study the financing constraints of small firms (Deveraux and Schiantarelli, 1990; Oliner and Rudebusch, 1992 and 1996). However, evidence that small firms’ investment depends both on the availability of internal funds and on their access to external funds abounds (Evans and Jovanovic, 1989; Berger and Udell, 1992; Storey, 1993; Holtz-Eakin et al., 1994; Binks

Banks are better monitors than private investors in funding small firms (Diamond, 1984). Therefore, the degree of capital market imperfections for small firms is mostly determined by the asymmetry of information between them and the banks. The ability of the banking system to provide adequate volumes of credit to privately held firms has been an important issue in post-communist countries. This is why a small body of research has used various databases and surveys and has employed the empirical methods described above to study how financing constraints influence investment in small firms in post-socialist economies.

4.2.3 Investment, financing constraints and the role of the transition process

In post-communist countries, small and medium-size enterprises face important financing constraints (sometimes loosely called “liquidity constraints”). In developed countries, due to asymmetric information, the investment of the most informationally opaque firms (that is, firms that face higher information costs, such as smaller and younger firms) is most sensitive to the availability of internal funds (Berger and Udell, 1998).

In Bulgaria, in addition to these reasons, Budina et al. (1999) argue that, prior to 1996, smaller firms were more liquidity constrained than larger firms, due to the then prevailing soft budget constraints that characterized bank lending. Investment in firms with a significant prior level of long-term debt (larger, mainly state-owned firms) was not constrained by the availability of their own internal funds, while the investment of firms
without debt, as were most of the smaller private firms, showed a higher sensitivity to internal funds. Banks lent to big state-owned firms not because these firms were better or because they offered good collateral, thus alleviating asymmetric information problems. Rather, banks simply gambled that, in the case of default by state-owned enterprises, the banks would be bailed out by the government. This would happen through the recapitalization of the banking system (Perotti, 1998).

In contrast, Chow and Fungk (2000) show that smaller firms in China are less financially constrained than larger, predominantly state-owned firms. The authors attribute this difference to the greater efficiency of smaller firms and to the fact that larger firms are heavily indebted, have been making losses, and do not have sufficient available cash to cover their investment demand. Moreover, the local and central government have problems in satisfying the large firms' liquidity demands.

Perotti and Gelfer (2001) find evidence that Russian firms with closer ties to industrial-financial groups face lower liquidity constraints. This reflects shortcomings of the regulatory framework, which should discontinue related lending, when the banks' risk management tools are not sufficiently developed and when opportunistic behavior cannot be discouraged.

Underdeveloped institutions in transition economies also affect the behavior of small firms. In a weak institutional environment, corrupt government officials and (semi) criminal organizations influence the security of property rights and thus the firms' investment and growth. Johnson et al. (2002a) argue that firms will undertake projects with positive net present value only if convinced that they can use the fruits of their investment. If the property rights of these firms are badly defined and poorly enforced,
they will be less willing to expand and will invest less. If the hypothesis of Johnson et al. is correct, then it may be that an unobserved number of firms are never created because of the lack of security of property rights.

Johnson et al. (2002a) develop a theoretical, pecking-order model of investment and incorporate the specific transition circumstances through an index that reflects the security of property rights. The specification of the empirical model is close to that of the empirical model of financing constraints. The empirical analysis uses a sample of small firms (the average number of employees is 55) operating in Poland, Romania, Slovakia, Ukraine, and Russia. Their results show that, prior to 1997, the investment of small firms was primarily determined by the security of property rights. The availability of internal funds and access to external funds become important only after property rights are secured. Johnson et al. admit, however, that access to external finance and, therefore, less dependence on internal funds for investment will become increasingly important as profit margins decline and retained earnings do not grow as fast as before.

Bratkowski et al. (2000) study investment in de novo firms in the Czech Republic, Hungary and Poland. The sample comes from a survey implemented in 1997 and consists of small firms, where the average number of employees is 47. The study finds that firms that did not apply for credit were less constrained by the availability of internal funds than were firms that applied and received credit. This result is interpreted to mean that These authors also study determinants of the supply of credit and claim that banks are able to mitigate problems of asymmetric information by requiring collateral. Others, like Pissarides et al. (2000) and Lizal and Svejnar (2001), however, provide evidence that the
lack of adequate access to external funds has significantly constrained investment in SMEs in Bulgaria and Russia and in the Czech Republic, respectively.

Studies of financing constraints of firms in transition countries and in Russia have not accounted for the influence of the firm’s financial growth cycle. Young firms may find it more difficult, however, to signal their quality to lenders and thus obtain external finance. Moreover, most of the research has been undertaken for SMEs, where small firms are those that hire up to 100 employees and medium firms hire up to 500 employees. Research on very small firms has been limited because it is difficult to observe and measure their transactions. This chapter adapts the financing constraints approach to study the investment plans of very small firms, with up to 20 employees.

Understanding what determines investment in micro and very small firms is important because new firms are rarely created large. Furthermore, very small firms investment patterns are the least studied patterns in both developed and developing countries (Berger and Udell, 1998; Mann, 1998). Moreover, in order to create better policies directed toward improving the business environment for small firms, it is important to identify the challenges and constraints that these firms face. The contribution of this chapter is to show how growth of small young and more established firms is affected by security of property rights and underdevelopment of the financial market. Results show that these two factors do not affected uniformly investment in firms of different age.

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5 The financial growth cycle refers to the varying financial requirements since time of creation through maturity. The approach has been criticized because it assumes that all firms have an equal desire to grow - life cycle trap (Berger and Udell, 1998).

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4.3 Overview of the Russian banking sector

Banking and banks have had a very short history in Russia. The Soviet banking sector consisted of a mono-bank system, with a redistributive function—supplying the funds from depositors and the Government to enterprises and individuals, according to planning requirements. The banking reform of 1992 split the main sectoral banks (the savings Sberbank, the Vnesheconombank, and the Agroprombank) into smaller banks. In addition, unlike most transition countries, a very large number of new, private banks emerged shortly after the start of the reforms in Russia. Following the 1992 reform and up to 1995, GDP declined by 32 percent, while the assets of the banking sector grew by 43 percent, and the number of new banks picked at 2,500 in 1995 (Warner, 1998). Evidently, it was profitable to engage in banking activities, but lending was not necessarily the activity that banks pursued.

Post-soviet banking has been characterized by three distinctive periods—from 1992 to 1995, from 1995 to the summer of 1998, and post 1998. During the first period, banks were primarily engaged in channeling the direct lending of the Government to state-owned enterprises and made their profits by paying only a 10 percent annual interest rate for funds, at a time when inflation reached 800 percent. Moreover, more than 70 percent of the banks’ liabilities were from non-interest bearing deposits. At the beginning of this period, depositors kept their money in the banking system in spite of the high inflation. Cheap credit, however, did not flow to entrepreneurs. Banks rarely engaged in lending and they kept the spread between lending and deposit interest rates broad, because they had stronger incentives to engage in other profitable activities. For example, banks were allowed to hold foreign assets and profited from direct inflationary rents of
servicing foreign transactions as well as from the fees collected as a result of the high demand for foreign currency (Warner, 1998).

The banking reform of 1995 eliminated these sources of profits. Banks, however, found it difficult to mobilize deposits in the post-hyperinflationary environment. As a result, they lacked sufficient resources to acquire risk evaluation expertise and to develop new lending technologies. Moreover, the proliferation of barter rendered traditional banking services less appealing. Banks earned income through non-lending activities such as trading GKOs (a type of T-bills) and by organizing payment on veksels – financial instruments that enterprises used to extend credit to each other (Commander et al., 2002).

Poorly designed and badly enforced regulations also impeded the ability of banks to lend. Banks were required to block the clients’ accounts if any default on tax payments occurred (Hendley et al., 2000). To reduce both the visibility of their transactions and the banks’ access to their accounts, enterprises avoided payments through the banking system. The restrictions on the free transfer of the enterprises’ funds from non-cash into cash additionally prevented firms from opening and using bank accounts. These regulations made intermediation almost impossible, because banks could not collect information on their clients’ transactions and could not use such information when deciding to whom to lend.

At the same time, the Central Bank failed to curb activities that indeed jeopardized the safety of the banking system. Prudent lending requires that banks develop and use financial products that match their information processing capabilities, so that various risks can be properly handled. Regulators failed to prevent the development of too sophisticated products, such as the infamous forward contracts for foreign currency,
for which the banks did not have the information processing capability (Roe et al., 1998).

When the government defaulted on its GKOs in the summer of 1998 and the currency was devalued, many banks went bankrupt. The irony of the Russian crisis is that mainly smaller banks, engaged in prudent lending to small and medium-sized enterprises, were able to survive. Within a year following the August financial crisis, at the time that the OSU survey in Samara was implemented, lending was still stagnant (Business Central Europe, 2000, EBRD, 1999).

In an environment of a low-level of intermediation, lending to smaller enterprises was even less appealing. Many, especially the big banks, found it unprofitable to lend to small and newly established firms. Traditional bank technology requires that a potential borrower presents audited financial statements for the previous three years. Such lending technology is inappropriate, however, because banks do not trust financial statements in Russia. Moreover, young firms cannot satisfy the requirement of three years of financial statements.

In developed countries, the credit history of the owner is widely used as an indicator for borrower credibility and managerial skills (Berger and Udell, 1998). Russian bankers, however, find it difficult to evaluate the managerial ability of an entrepreneur. For example, if a firm uses the informal sector’s help to enforce its contracts with business partners, banks have no means to evaluate and monitor such “business contracts”. At the same time, anecdotal evidence suggests that both banks and small entrepreneurs use private protection because they do not believe that the formal legal system could enforce their contracts. The higher cost of servicing smaller firms and the absence of a technology to deal with the specific risks has kept the cost of bank credit in
Russia high (Roe et al., 1998).

There are not many alternative sources of formal loans for micro and small businesses in Russia. Government programs to support small businesses are few, and they often primarily provide non-financial services. For example, the Federal Fund for Small Business Support provides mainly technical assistance, as its employees have limited experience with credit evaluation. The Regional Enterprise Support Funds, including the one operating in Samara, provide funding for small entrepreneurs but mainly to entrepreneurs who can invest a significant amount of their own capital. These government programs are capital constrained, tend to fund “priority sectors/activities,” and often misallocate resources, as government officials grant loans to friends and relatives.

In the more rural areas, mutual credit associations and consumer cooperatives also provide some funds to their members.6 Innovative microfinance organizations (MFOs) that lend exclusively to micro and small businesses (Opportunity International, Women’s World Banking, FINCA, the EBRD Small Business Fund) emerged in the mid-1990s, but their influence is limited. MFO arrival in Russia is somewhat late because only recently have regulations changed to allow their operations (Safavian et al., 2000).

Overall, the high costs of raising capital that entrepreneurs face worldwide is accentuated in Russia by the lack of banking tradition and managerial skills and by the limited information processing capability of the system. Moreover, banks operate in a restrictive legal environment, which discourages transparency of entrepreneurial activity and makes the evaluation of credit risk even more difficult. Alternative formal lenders

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6 There are no credit unions in Russia.
have limited capacity to fund small firms' investment. As a consequence, Russian small businesses have been forced to rely even more on their internal funds for investment.

4.4 Empirical Specifications

4.4.1 The investment equation

The empirical model is constructed following Fazzari et al. (1988). The sample is split into two sub-samples - young firms (of age less than three years) and older firms (of age equal to or higher than three years). The exercise tests whether the availability of internal funds influences the firms' decision to invest in fixed capital. The classification according to age captures the influence of the financial growth cycle, and it allows to check whether the existing lending technology is biased against young firms.

An important challenge in studying micro and small entrepreneurs' investment is to distinguish between business and household assets. A measure of the level of investment may be incorrect because it is not always possible to separate the physical capital that entrepreneurs use for private purposes from that used for business purposes. Furthermore, Russian entrepreneurs do not have any incentives to correctly represent their assets and their level of investment. On the contrary, pilot tests for the OSU Samara survey revealed that even the most innocent questions about the level of investment were systematically not answered.

Johnson et al. (2002a) address this issue by constructing several categories for reinvestment level and use ordered probit regressions for investment against cash flow and property rights. They find that the results are robust under alternative specifications. This dissertation also uses a qualitative dependent variable and a probit regression model
of the form \( \Pr(y=1|x) = F(\alpha + x\beta ) \), where \( F(.) \) is a normal cumulative distribution function. More precisely, the probit model that is estimated is:

\[
\Pr(\text{IFC}=1) = F(\alpha + \beta_1 IO + \beta_2 CF + \beta_3 PR + \beta_4 Z)
\]

where IFC is the investment decision, IO is the investment opportunity variable, CF is the variable that measures cash flows, PR is an index of the security of property rights, and Z is a vector of dummy variables that capture various entrepreneurial characteristics as well as industry features.

The dependent variable IFC does not measure the level of (physical) investment; rather, it measures whether the entrepreneur has or does not have a specific plan to invest in physical capital. Ideally, the dependent variable would be the actual expected investment divided by the current stock of capital. However, as already mentioned, there is no way to find out what capital stock each firm possesses and any attempted measure will be biased, as enterprises in Russia use elaborate schemes to hide the actual assets of their businesses.

The theoretical model of Povel and Raith (2001) allows for scalable investment, i.e., the firm can choose both whether to undertake an investment and which level of investment to undertake. That is, the firm can vary the scale of production and invest less or more depending on the unobserved endogenously determined cost of capital. Here, the qualitative dependent variable IFC only measures whether investment will be undertaken or not. The hope is that this probability of investment approximates well the expected level of investment for each small firm, given that the capital stock is unobservable and given that the scalable optimal level of investment is also unobserved.
Employment growth and sales growth are the variables most often used to account for investment opportunity in transition economies. Change in sales, as in the sales accelerator models, was used by Budina et al. (2000) and Lizal and Svejnar (2002). Anderson and Kegels (1998) and Grosfeld and Nivet (1999) use employment growth. The latter authors argue that, in transition countries, sales follow more closely past investment, while employment growth is less related to past investment and more related to expectations about future profits. Bratkowski et al. (2000) and Johnson et al. (2002a) also use employment growth as a proxy for investment opportunity, arguing that sales growth is a less appropriate measure of investment opportunity for start-ups, because start-ups may have excellent investment prospects but an unimpressive sales record.

Investment opportunity (IO) is approximated here by the annualized average rate of employment growth since time of interception. This variable is believed to be a better approximation for business opportunity than the employment growth for the last 12 months. The latter variable has almost no variation. Only five firms indicated some change in employment growth for the last 12 months. One explanation for the lack of change in employment is that, in the post crisis environment, there were no opportunities. This idea is contradicted, however, by the fact that more than half the entrepreneurs reported that the August 1998 crisis had a positive effect on their business. The lack of variation of the data is more likely a consequence of poor question design. Entrepreneurs were asked to recall the employment level for each month of the last year. Such questions are known to lead to satisfactory answers on the part of the respondent, who in similar situations indicates that there was no change (Krosnick et. al, 1996; Krosnick and Fabrigar, 2003).

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The annualized employment growth may also overestimate growth in firms that start small and underestimate growth in firms that start bigger. However, according to Gibrat's law on proportionate effects, firm size and growth rates are not related (Gibrat, 1931). Numerous papers have tested the Gibrat's law, and although the evidence is somewhat ambiguous, there is general agreement that the law holds (Sutton, 1997). Moreover, if firm size at time of inception is included in the investment equation, the results do not change.

As an instrument to proxy for cash flow or change in net worth, the entrepreneurs' liquid reserves for business emergencies are used here. The variable is a dummy that takes the value of one if the entrepreneur indicated that he/she has positive reserves and zero otherwise. This variable is less related to employment growth (the proxy for investment opportunity) than a variable that would indicate that the entrepreneur has a positive cash flow within the enterprise. Thus, investment opportunity and cash flows are independent of each other, as required by the financing constraint methodology. This specification captures the fact that firms with unstable cash flows need liquid reserves because such firms have limited access to external funds. Lack of access to external liquidity, according to the approach employed, is the result of higher degree of asymmetric information between these firms and creditors.

The probit model of investment is augmented by a variable that represents the security of property rights. The index of property rights used mirrors the index used by Johnson et al. (2002a). It has a value of zero if the entrepreneur answered that he must pay extra legally for protection to informal groups and if he answered that other business people pay to government officials for permits and business protection. The index takes
the value of one if only two types of extra-legal payments are being made and the value
of two if only one type of extra-legal payment is being made. The index takes the highest
value of three if the entrepreneur does not pay for private protection and believes that other
businesses do not pay extra legally to government officials for permits and businesses
protection.

In Johnson et al. (2002), the value of zero stands for least secure property rights
while the value of 3 measures most secure property rights. In other words, property rights
are secure if the legal system and institutions function normally and protect the property
rights of the entrepreneurs.

In the empirical specification, a dummy variable TN controls for the discretionary
power of tax officials, as entrepreneurs indicated that taxes are the most burdensome for
the business. The variable takes the value of one if the entrepreneur has indicated that
he/she believes the tax authorities have discretionary power to change individual tax
obligations and zero otherwise. The variable Startup takes the value of one if the business
was a new business and zero if the firm is a spin-off from formerly state-owned
enterprises. It controls for potentially different investment needs of the two types of
organizations (Johnson et al., 2002b). Variables for Industry (occupation) controls are
also included to account for potential differences across firms.

4.4.2 The credit supply equation

To gain additional information on the possibility that young and smaller firms
face higher information costs in formal credit markets, and therefore may be rationed by
banks, following Bratkowski et al. (2000), a probit model of credit supply is estimated. The model if of the form:

$$\text{Pr}(CS=1) = F(\alpha + \beta_1 DP + \beta_2 UBS + \beta_3 EA + \beta_4 ID) \quad (34)$$

Here $CS$ stands for credit supply, $DP$ is a dummy for profitability, $UBS$ is a dummy for using the banking system/collateral, $EA$ is a vector of entrepreneurial ability, and $ID$ is a vector of industry dummies.

The qualitative dependent variable $CS$ equals one if the applicant received a formal loan and zero if the applicant was denied a formal loan prior to the summer of 1999. This variable includes not only bank loans, although these are the majority of the loans, but also loans from other formal sources, such as credit organizations and government programs, and leasing transactions.

The sample for this equation consists of only those firms that applied for formal credit, to avoid identification problems that arise when there is no information about which firms have actually asked for credit. This is done in order to avoid the danger of taking as a determinant of the supply of credit a variable that in fact captures demand. A self-selection bias may exist because entrepreneurs who believe they cannot obtain a formal loan simply do not apply. Due to bad data quality, the self-selection bias cannot be corrected for. It is also hard to imagine its accurate magnitude since there are no studies about small firms in Russia that would report such bias.\(^7\)

\(^7\) The self-selection bias for comparable firms in developed countries is very small. For example, Chittenden et al. (1996) use two databases for small firms in England and report that this bias is of the magnitude of two percent. Levenson and Willard (2000) report that for US firms of comparable size, only 4 were discouraged from applying for a loan because they did not believe they will get one.
Banks lend when they believe that the firm will repay the loan. This will happen when the expected profitability of the project is high, the probability that it will be successful is high, and the borrower is willing to repay. Since banks do not have perfect knowledge of the project’s quality and borrower’s credibility, banks require collateral to alleviate asymmetric information problems. A traditional lending technology, therefore, would require that banks fund profitable projects and guard against unexpected events by requiring collateral.

The dataset does not contain information on the availability of collateral, and the empirical model cannot capture the incentive to repay that collateral provides. However, collateral can alleviate asymmetric information problems only if the lender can promptly repossess and resell the asset to recuperate the loss. In Russia, however, very few physical assets can serve as collateral. For example, only in specific circumstances can apartments serve as collateral (Nadolnyak and Hartarska, 1999). Furthermore, since it is expensive and time consuming to seize collateral, and since reselling the assets in underdeveloped secondary markets is not always possible, banks in Russia are forced to use other methods to guard against losses. Banks, therefore, must find a good substitute for collateral or find a way to better measure profitable projects, and this is what is measured by the $DP$ variable.

To properly identify the effect of credit constraints on investment, some variables that affect credit supply but not investment should be included in the credit supply equation. This is why, to measure whether banks funded profitable projects, a dummy for profitability ($DP$) is included. This variable takes the value of one if the enterprise grew (experienced employment growth) and zero otherwise. The assumption is that the rate of
employment growth used in the investment equation captures investment opportunities, while the dummy variable used in the credit supply equation provides information only on whether growing firms were funded or not.

As Russian entrepreneurs often manipulate their financial statements, lending based only on financial statements would not be prudent. However, Russian firms that use the banking system to pay suppliers and to receive payments from clients have established a record that banks can use to evaluate the credibility of the borrower. Moreover, by using the banking system, firms signal that they are better quality clients, because such firms risk having their assets frozen if they are unable to meet tax obligations. Finally, firms that actively use the banking system are de facto providing some collateral, as the funds in their accounts will be seized in case of default. A dummy variable that takes the value of one if the firm is actively using the banking system (UBS) and zero otherwise is used to measure whether banks have used the firms’ payment records to screen applicants and guard against default.

In developed countries, banks often use the personal credit history of the owner of the business when deciding who gets credit (Berger and Udell, 1998; Mann 1998). In this empirical model, the entrepreneurs’ age and education are used as a proxy for entrepreneurial abilities (EA). Additionally, the ID dummies control for industry differences.
4.5 The data

The data come from a survey of 203 very small enterprises (with up to 20 employees) in Samara, Russia. The sample was drawn randomly using the database provided by the Statistical Department of Samara Oblast. The database of the Statistical Department is comprehensive, because all entrepreneurs (including the self-employed individual private entrepreneurs, or fizicheskye litsa, and private companies) are required by law to register in order to start operations. The sampling is subject to the usual bias that only surviving firms were surveyed. The survey was implemented in the summer of 1999, almost exactly a year after the 1998 financial and banking crisis.

The firms in the sample are very small, with 8 as their average number of employees. Table 13 presents some descriptive statistics for the variables used in the regression analysis. The sample is split into two sub-samples: young firms, with age less than three years, and older firms, with age three years or more. The group of young firms consists of 93 firms, with average age is 1.3 years. The group of older firms consists of 110 firms, with average age of 5.9 years. The two groups differ in terms of size but this difference is not very big. For example, the average number of employees at time of inception for the young firms was 6 and 9 for the older. At the time of the interview the average number of employees for the younger firms was 9 and for the older firms 10. The group of older firms is the group that would most likely qualify for a loan based on a traditional lending technology, which requires at least 3 years of financial statements.

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8 The survey was developed by a OSU Rural Finance Program research team led by Professor Gonzalez-Vega and Professor Graham. The survey was implemented in July and August of 1999 in Samara, Russia by a team of 10–15 students and sociologists form Samara State University.
Most of the firms are retail businesses, but approximately a quarter operate in manufacturing and a quarter operate in services. The occupation distribution of the two groups is not significantly different, except that, in the group of older firms, slightly more operate in manufacturing and slightly less operate in retail trade. Two thirds of the owners hold university degrees. The share of owners of young firms that hold a university degree is 0.61, slightly lower than 0.70 for the owners of more mature firms.

A third of the entrepreneurs, in both groups, indicate that they have specific plans to invest in physical capital in the coming year. The entrepreneurs were also asked to respond if they would be willing to return to their previous employment instead of continuing with the private business and a third in both groups answered that they would give up the private business. This question could be used to test for investment opportunities. However, willingness to return to salaried employment may also capture owner preferences rather than lack of opportunity.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Young (Mean)</th>
<th>Older (Mean)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFC</td>
<td>0.319</td>
<td>0.330</td>
<td>1 if investment in fixed capital, else 0;</td>
</tr>
<tr>
<td>IO</td>
<td>54.7</td>
<td>17.1</td>
<td>Investment opportunity, annual employment growth (percentage);</td>
</tr>
<tr>
<td>DP</td>
<td>0.323</td>
<td>0.427</td>
<td>1 if employment grew, else 0;</td>
</tr>
<tr>
<td>CF</td>
<td>0.677</td>
<td>0.618</td>
<td>1 if cash flow positive (saves for business emergencies), else 0;</td>
</tr>
<tr>
<td>ISPR</td>
<td>1.237</td>
<td>1.196</td>
<td>Index of security of property rights, 0 = least secure, 3 = most secure;</td>
</tr>
<tr>
<td>M</td>
<td>0.183</td>
<td>0.273</td>
<td>1 if manufacturing, else 0;</td>
</tr>
<tr>
<td>Trade</td>
<td>0.548</td>
<td>0.436</td>
<td>1 if trade, else 0;</td>
</tr>
<tr>
<td>Services</td>
<td>0.269</td>
<td>0.291</td>
<td>1 if service, else 0;</td>
</tr>
<tr>
<td>F_size</td>
<td>6.8</td>
<td>10.5</td>
<td>Number of employees;</td>
</tr>
<tr>
<td>CS</td>
<td>28.7</td>
<td></td>
<td>1 if received a formal loan, if rejected 0;</td>
</tr>
<tr>
<td>UBS</td>
<td>0.344</td>
<td>0.509</td>
<td>1 if use the banking system, else 0;</td>
</tr>
<tr>
<td>F_age</td>
<td>1.29</td>
<td>5.92</td>
<td>Number of years since operation;</td>
</tr>
<tr>
<td>M_edu</td>
<td>61.3</td>
<td>70.0</td>
<td>1 if manager has university degree, else 0;</td>
</tr>
<tr>
<td>M_age</td>
<td>37.5</td>
<td>41.8</td>
<td>Age of the entrepreneur-manager;</td>
</tr>
</tbody>
</table>

Table 13. Description of the variables from the Samara survey.
A higher proportion of the older firms grew, but the annual growth rate for this
group is much lower. Of the older firms, 43 percent grew while among the younger only
32 percent did. The annual rate of employment growth for the young firms is 55 percent,
while the annual rate of employment growth for the older firms is only 17 percent. In
other words, a smaller proportion of the young firms grew, but those that did grow
experienced very high growth rates. In contrast, a higher proportion of the older firms
grew, but the average growth rate for them is three times lower than for young firms.
These results should be regarded with caution however, because many of the older firms
are spin-offs from big industrial enterprises and some of these spin-offs have experienced
rapid decline in employment. Thus, the shrinking firms substantially worsen the result for
the growing de novo older firms.

Russian small entrepreneurs identify the lack of funds as the main constraint to
growth—46 percent reported financing as their most serious obstacle. This may be
deceiving, as entrepreneurs may believe that additional funds may cure problems that are
structural (Gonzalez-Vega, 1998). Limited markets are the main constraint to growth for
43 percent of the entrepreneurs while regulations rank third (9 percent). The answers to
the question what constraints growth is not used in the regression analysis because social
physiologists have argued that answers to “why” questions fail the test, re-test condition
and are unable to identify the correct reasons for human behavior (Krosinik, 2003).

On a scale of one to four (where 1 stands for not at all problematic, 2 stands for
somewhat problematic, 3 stands for problematic, and 4 stands for very problematic),
ten entrepreneurs rate only taxes (2.9) higher than financing (2.2), and there is no substantial
difference between the two groups by firm age. Corruption and private protection are
rated as less problematic (index of 2 and 1.3, respectively). It seems that financing constraints dominate property rights issues, although this does not mean that businesses do not participate in extra-legal exchanges with government officials or private protection companies. The econometric exercise addresses this problem and it also tests the possibility that those two variables are correlated, i.e., endogenously determined by a third variable.

The security of property rights is approximated by an index. As direct questions about the entrepreneurs’ transactions with government officials were unlikely to be answered, or answered truthfully, the entrepreneurs were asked if they thought that other businesses pay extra legally to government officials for various permits and for business protection. Within the group of young firms, about two-thirds of the entrepreneurs report that they believe government officials are being paid extra-legally to issue permits (67 percent) and to protect businesses (69 percent). The numbers are slightly higher for older firms, where 71 percent believe government officials are paid for permits and 76 percent believe that government officials are paid for business protection.

A third of the young firms, and 40 percent of the older firms report that they themselves pay for private protection (90 percent answered this question). Overall, the index of property rights is 1.24 for the young and 1.20 for the older firms. In both groups, two thirds report that taxes are negotiable; namely, that government officials can interpret taxes differently depending on the entrepreneur.
4.6 Results

4.6.1 Investment equation

Both investment opportunities and cash flow have a positive and significant effect on the probability that a firm will invest in fixed capital when the sample is split according to enterprise age. Models one and two show positive significant coefficients on the cash flow variable for both young and older firms (Table 14).

The null hypothesis that the cash flow coefficients are the same for the two groups is rejected at the 10 percent level of significance. Therefore, both young and older firms experience financing constraints but young firms are more constrained by the availability of internal funds and are more likely to face higher information costs in the market for external funds.

The model is not likely to be linear, since the highest and the lowest coefficients are outside the range 0.3 – 0.7 for both groups (Long, 1998). A good way to interpret the coefficients is to estimate the following change:

$$\Delta \Pr(IFC = 1 \mid \bar{x}) = \Delta \Pr(IFC = 1 \mid \bar{x}, x_k) - \Delta \Pr(IFC = 0 \mid \bar{x}, x_k)$$  (35)

where $x_k$ is the cash flow and $\bar{x}$ is the vector of independent variables estimated at the mean. This calculation shows that young firms that have internal funds are 32 percent more likely to invest than are young firms who do not have internal funds. Older firms with internal funds are 23 percent more likely to invest than are older firms without internal funds. The hypothesis that the coefficients for CF variable are the same is rejected at 10 percent level. These results suggest that, while both groups experience financing constraints, the severity of these constraints is higher for young firms.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1 Young</th>
<th>Model 1 Older</th>
<th>Model 2 Young</th>
<th>Model 2 Older</th>
<th>Model 3 Young</th>
<th>Model 3 Older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.554</td>
<td>0.655</td>
<td>-1.626</td>
<td>1.748</td>
<td>-0.688</td>
<td>-0.833</td>
</tr>
<tr>
<td></td>
<td>(0.348)</td>
<td>(0.510)</td>
<td>(0.374)</td>
<td>(523)</td>
<td>(0.346)</td>
<td>(483)</td>
</tr>
<tr>
<td>IO</td>
<td>0.745***</td>
<td>0.824***</td>
<td>0.644**</td>
<td>0.585**</td>
<td>0.662**</td>
<td>0.840***</td>
</tr>
<tr>
<td></td>
<td>(0.300)</td>
<td>(0.278)</td>
<td>(0.324)</td>
<td>(0.304)</td>
<td>(298)</td>
<td>(0.270)</td>
</tr>
<tr>
<td>CF</td>
<td>0.846***</td>
<td>0.639**</td>
<td>0.847***</td>
<td>0.682**</td>
<td>0.804***</td>
<td>0.680**</td>
</tr>
<tr>
<td></td>
<td>(0.313)</td>
<td>(0.291)</td>
<td>(0.331)</td>
<td>(0.316)</td>
<td>(0.308)</td>
<td>(0.256)</td>
</tr>
<tr>
<td>ISPR</td>
<td>-0.003</td>
<td>-0.298*</td>
<td>-0.058</td>
<td>-0.282*</td>
<td>0.026</td>
<td>0.287*</td>
</tr>
<tr>
<td></td>
<td>(0.175)</td>
<td>(0.169)</td>
<td>(0.175)</td>
<td>(0.171)</td>
<td>(0.171)</td>
<td>(0.170)</td>
</tr>
<tr>
<td>Service</td>
<td>-0.366</td>
<td>-0.014</td>
<td>0.199</td>
<td>0.478</td>
<td>-0.438</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>(0.419)</td>
<td>(0.334)</td>
<td>(0.343)</td>
<td>(0.320)</td>
<td>(0.415)</td>
<td>(0.334)</td>
</tr>
<tr>
<td>Trade</td>
<td>-0.503</td>
<td>-0.557*</td>
<td>-0.610*</td>
<td>-0.508</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.363)</td>
<td>(0.322)</td>
<td>(0.352)</td>
<td>(0.319)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prod.</td>
<td></td>
<td></td>
<td>0.657*</td>
<td>0.308</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(397)</td>
<td>(0.364)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start up</td>
<td>-0.341</td>
<td>-0.008</td>
<td>-0.020</td>
<td>0.343</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.321)</td>
<td>(0.293)</td>
<td>(0.348)</td>
<td>(0.322)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>0.028</td>
<td>0.039</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.122</td>
<td>0.117</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.287)</td>
<td>(0.228)</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>16</td>
<td>27.8</td>
<td>17</td>
<td>32.9</td>
<td>10.5</td>
<td>32.8</td>
</tr>
<tr>
<td>$P$</td>
<td>p&gt;0.01</td>
<td>p&gt;0.001</td>
<td>p&gt;0.0</td>
<td>p&gt;0.001</td>
<td>p&gt;0.005</td>
<td>p&gt;0.001</td>
</tr>
<tr>
<td>No.Obs.</td>
<td>106</td>
<td>93</td>
<td>106</td>
<td>93</td>
<td>106</td>
<td>106</td>
</tr>
</tbody>
</table>

* significant at 10 percent level  
** significant at 5 percent level  
*** significant at 1 percent level  

Table 14. Probit investment in fixed capital
The security of property rights has a non-uniform influence over the investment decision of small firms in Russia. The older firms' decision to invest is negatively affected by the security of property rights, but the coefficient for this index is insignificant in the investment equation for young firms. For one standard deviation from the mean value of the index, the probability that the firm will invest decreased by 10 percent.

These results, furthermore, contradict the findings of Johnson et al. (2002a), who found that the coefficient for the ISPR is positive. The discrepancy might be explained by the fact that these authors used data for the earlier stages of the economic transition, when profit margins were high and there was a lack of information regarding the bribing practices of various government officials and private "protection firms". Johnson et al. argue that the greater the number of officials (institutions) the entrepreneurs had to bribe, the more discouraged they became regarding the future of their businesses and the less they invested. This is well captured in their work by the security of property rights index, where more "secure" property rights means having to pay to a smaller number of officials.

The negative sign in front of the index of property rights in Table 2 suggests that the hypothesis of Johnson et al. did not hold for the reality of Samara, Russia in 1999. It seems that, unlike in 1996, in 1999 the older small businesses in Russia were well aware of the extra legal "fees" charged by various government officials and private protection people. The more extralegal "relationships" the older firms had secured through extra legal payments, the more likely they were to invest. In this sense, the results confirm the suggestion of Johnson et al. (2002a) that it is the insecurity regarding the incidence of
extra legal payments, not the need to pay extra legally, which affects the firms’
investment decisions.

The extra legal payments that the older firms pay to government officials may be
offering some security of property rights that allows businesses to function. Bad laws
serve a country best when badly enforced, because they allow the most efficient small
firms to pay the fee and conduct their business, as suggested by the theory of the second
best applied to small firms in Russia.

The insignificance of the index of security of property rights for young firms is
harder to interpret. Investment in young firms may be independent of the index of
property rights because of the firms’ insufficient information. Young firms may be less
aware about the extent of the need to pay extra-legally to various officials for services
and permits or for private protection. The security of property rights index consists of
answers to questions of whether entrepreneurs believe that other businesses pay extra-
legally for government services and permits. Thus, the index may reflect the young
entrepreneurs’ imperfect knowledge about the need to pay. However, young firms are
also more likely to remember their own registration process, which is quite burdensome
(Gonzalez-Vega et al., 1999) and, thus, it is perhaps unlikely that these firms do not
know that extra-legal payments exist.

An alternative interpretation of this result is that government officials deliberately
do not target young enterprises because the rents to be extracted are limited compared to
the transaction and information costs of extracting these rents and because officials
expect to target only survivors and extract even higher rents. It may also be that the
young firms in the sample can afford the extra-legal payment and their investment is not
affected by the extra legal “fees”. For these young firms, the need to grow may outweigh the concerns about the security of property rights. If that is the case, then an argument could be made that only extremely profitable firms that can overcome the high entry costs enter the market. The entrepreneurial potential of the population cannot be fully used, as many potentially viable firms will remain unborn.

Taxes rank highest among the set of current problems; 40 percent of the entrepreneurs believe that the tax authorities have the discretionary power to reinterpret individual tax obligations. Surprisingly, however, the dummy for the discretionary tax power of government officials is insignificant in the firms’ investment equations (Table 14, Model 3). Perhaps, firms know that their taxes will be changed and are prepared to negotiate with the tax officials so that mutually beneficial agreement is reached. This result only strengthens the conclusion that the necessity to bribe per se does not deter investment, at least not for the firms in the sample.

Industry controls show that, in both groups, retail businesses are 20 percent less likely to invest in fixed capital. This is an expected result, as retail businesses do not need much fixed capital to grow. Young firms operating in manufacturing, however, are about 70 percent more likely to invest than those that do not operate in manufacturing (Table 14 Model 2). This is consistent with the observed improvement conditions for domestic manufacturing that resulted from the devaluation of the rouble, which made imports extremely expensive and increased the demand for domestically manufactured products. Finally, start-up and spin-off businesses do not differ in their patterns of investment.
4.6.2 Credit supply equation

The results from the credit supply equation suggest that lenders may not have been successful in identifying the best investment projects. For example, if a firm employment grew, it is likely that it was engaged in profitable activity. The coefficient of employment growth, however, is not significant in the credit supply equation (Table 15).

Moreover, unlike lenders in developed countries, which extensively use the main owners' personal characteristics as a measure of borrower credibility, banks in Russia were unable to distinguish the entrepreneur's type, at least not if management abilities can be proxied by the managers' age and education. This result is consistent with Storey (1994), who also found that in relatively young businesses the personal characteristics of the borrower do not influence the banks' lending decision.

Banks, however, attempted to guard against default by lending to firms that actively used the banking system for their business transactions and that built a payments history. The upshot is that small businesses who did not want to have their activities transparent by using the official payment system had very limited access to formal loans and had to limit their investment to the amount of internal sources or informal loans.

Firm age is not significant in the credit supply equation. Nevertheless, it may only appear that banks did not discriminate on the basis of age, because this result may be due to a self-selection bias – young firms, aware that they can not get a formal loan did not even apply. Size also seems to not have played a role in the supply of credit but bigger firms had only a slight advantage. Finally, banks did not believe that the service industry offers good returns to investment, so projects in services were generally not funded.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
<td>Coef.</td>
</tr>
<tr>
<td></td>
<td>(SE)</td>
<td>(SE)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.497</td>
<td>0.505</td>
</tr>
<tr>
<td></td>
<td>(481)</td>
<td>(0.906)</td>
</tr>
<tr>
<td>DP</td>
<td>0.166</td>
<td>0.226</td>
</tr>
<tr>
<td></td>
<td>(0.194)</td>
<td>(0.197)</td>
</tr>
<tr>
<td>UBS</td>
<td>0.797***</td>
<td>0.930**</td>
</tr>
<tr>
<td></td>
<td>(0.325)</td>
<td>(0.305)</td>
</tr>
<tr>
<td>Service</td>
<td>-0.799*</td>
<td>-0.679*</td>
</tr>
<tr>
<td></td>
<td>(0.798)</td>
<td>(0.420)</td>
</tr>
<tr>
<td>Trade</td>
<td>-0.256</td>
<td>-0.161</td>
</tr>
<tr>
<td></td>
<td>(0.401)</td>
<td>(0.410)</td>
</tr>
<tr>
<td>F_age</td>
<td>0.078</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
<td>(0.061)</td>
</tr>
<tr>
<td>F_size</td>
<td>0.025</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td></td>
</tr>
<tr>
<td>M_edu</td>
<td></td>
<td>0.317</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.333)</td>
</tr>
<tr>
<td>M_age</td>
<td></td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.017)</td>
</tr>
<tr>
<td>Chi Squared</td>
<td>20.1</td>
<td>19.3</td>
</tr>
<tr>
<td>P</td>
<td>p&gt;0.001</td>
<td>p&gt;0.007</td>
</tr>
<tr>
<td>Observations</td>
<td>93</td>
<td>93</td>
</tr>
</tbody>
</table>

*The sample includes only those who applied for a formal loan.

* significant at 10 percent level
** significant at 5 percent level
*** significant at 1 percent level

Table 15. Credit supply. Probit received a formal loan
4.7 Conclusions

Research on financing constraints of very small firms is scarce because it is difficult to observe and measure their transactions. This chapter contributes to the literature by studying how investment in young and older very small firms in a post-transition environment is affected by financing constraints and the security of property rights. The approach proposed by Fazzari et al. is adapted to the specific circumstances of small firms in Russia, and the particularities of the economic transition process are added through an index of the security of property rights.

The empirical analysis suggests that investment in very small firms is strongly influenced by the availability of internal capital. Overall, the younger firms face higher information costs and their investment is more dependent on the availability of internal funds than is investment in older firms. The security of property rights influences investment only in more mature firms. The more extralegal relationships the older firms had secured through extra legal payments, the more likely they are to invest and expand the business. The upshot is that insecurity regarding the incidence of extra legal payments, not the need to pay extra legally, affects firms' investment decisions. Results also show that, for young firms, the need to grow the business outweighs property rights concerns. The formal financial sector did not channel funds to the most successful investment projects but there is evidence that loans were given to firms that had more transparent transactions, given their use of bank services.
REFERENCES


Gibrat, Robert (1931), "Les inégalités économiques; applications: aux inégalités des richesses, à la concentration des entreprises, aux populations des villes, aux statistiques des familles, etc., d'une loi nouvelle, la loi de l'effect proportionnel", Recueil Sirey, Paris.


Gonzalez-Vega, Claudio (1998a), "Do Financial Institutions Have a Role in Assisting the Poor?" in Mwangi S. Kimenyi, Robert S. Weiland and J.D Von Pischke (eds.), *Strategic Issues in Microfinance*, Aldershot: Ashgate.


Gonzalez-Vega, Claudio, Douglas H. Graham, Valentina Hartarska, Denis Nadolnyak and Mehnaz Safavian (1999), "The Financial Experience and Attitudes Toward Regulation of Micro and Small Enterprises in Russia: Preliminary Survey Results from Samara," Rural Finance Program, The Ohio State University, Columbus, Oh.


Hirad, Abdighani and Peter M. Zorn (2001), "A Little Knowledge Is a Good Thing: Empirical Evidence of the Effectiveness of Pre-Purchase Homeownership Counseling" Freddie Mac.

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APPENDIX

Proof of Lemma 1:

Lemma 1 comes from a simple comparison of the updated probabilities calculated using Bayes' rule. Inequality (3a) from the text can be rewritten as

\[
\Pr(t_s|a_{bh},m_b) = \frac{1}{1 + \frac{(1-q)\alpha}{q}(1-\gamma^a)} < \Pr(t_s|a_{bg},m_b) = \frac{1}{1 + \frac{(1-q)\alpha}{q}(1-\gamma^a)} < \frac{1}{q} \frac{(1-\gamma^a)}{\gamma^a}
\]

\[
\Pr(t_s|a_{bh},m_g) = \frac{1}{1 + \frac{(1-q)(1-\alpha)}{q}(1-\gamma^a)} < \Pr(t_s|a_{bg},m_g) = \frac{1}{1 + \frac{(1-q)(1-\alpha)}{q}(1-\gamma^a)} < \frac{1}{q} \frac{(1-\gamma^a)}{\gamma^a}
\]

and this inequality holds because \(\gamma^a > \alpha > \frac{1}{2}\).

Inequality (4a) from the text can be rewritten as

\[
\Pr(t_s|a_{bh},m_b) = \frac{1}{1 + \frac{(1-q)\alpha}{q}(1-\gamma^a)} < \Pr(t_s|a_{bh},m_g) = \frac{1}{1 + \frac{(1-q)(1-\alpha)(1-\gamma^a)}{q}(1-\gamma^a)} < \frac{1}{q} \frac{(1-\gamma^a)}{\gamma^a}
\]

\[
\Pr(t_s|a_{bg}) = \frac{1}{1 + \frac{(1-p)\alpha}{p}(1-\gamma^a)} < \Pr(t_s|a_{bg},m_g) = \frac{1}{1 + \frac{(1-q)(1-\alpha)(1-\gamma^a)}{q}(1-\gamma^a)} < \frac{1}{q} \frac{(1-\gamma^a)}{\gamma^a}
\]

and it holds because \(\gamma^a > \alpha > \frac{1}{2}\).
Similarly, for the case of business-oriented board members, inequality (3b) from the text can be rewritten as

\[
\Pr(t^b|bb^b, m^b) = \frac{1}{1 + \frac{(1-p)(1-\beta)}{p} \frac{\gamma^\beta}{(1-\gamma^\beta)}} < \Pr(t^b|bb^b, m^b) = \frac{1}{1 + \frac{(1-p)(1-\beta)}{p} \frac{\gamma^\beta}{(1-\gamma^\beta)}} < p
\]

This inequality holds because \(\gamma^\beta > \beta > 1/2\).

Inequality (4b) from the text also can be rewritten as

\[
\Pr(t^b|bb^b, m^b) = \frac{1}{1 + \frac{(1-p)(1-\beta)}{p} \frac{\gamma^\beta}{(1-\gamma^\beta)}} < \Pr(t^b|bb^b, m^b) = \frac{1}{1 + \frac{(1-p)(1-\beta)}{p} \frac{\gamma^\beta}{(1-\gamma^\beta)}} < p
\]

and it also holds because \(\gamma^\beta > \beta > 1/2\).

Proof of the inequalities in Table 3, for a slow finance, slow outreach environment.

For a situation where, \(\Pr(t^b|bb^b) > 1/R\) and \(\Pr(tg|ab^g) > TB/AB\) (column 2 in Table 3), the expected payoff for the manager was derived in the text to be

\[
\Pi_M(0, m^*_i) = \{p \Pr(bb^b|m^*i) + (1-p)\Pr(ab^g|m^*_i)\}^*B
\]
This payoff will differ, depending on the type of signal that the manager receives. For example, if the manager receives \( m^s_6 \), then \( \Pi_M(0, m^s_6) = (\rho \Pr(bb^s|m^s) + (1-\rho)\Pr(ab_s|m_s))B \) if he does not reveal the signal. The payoff from revealing it, for the same signal (from Table 2), is \( E \Pi_M(1, m^s_6) = (\rho \Pr(bb^s|m^s))B \). Since \( \rho \Pr(bb^s|m^s) + (1-\rho)\Pr(ab_s|m_s) \geq \rho \Pr(bb^s|m^s)B \), it follows that \( E \Pi_M(0, m^s_6) > E \Pi_M(1, m^s_6) \) or, in other words, that not revealing is preferred to revealing the signal.

Now let the manager's signal be \( m^b_s \). According to the equation (1) of this Appendix, the expected payoff from not revealing it, when the manager receives this signal is \( \Pi_M(0, m^b_s) = (\rho \Pr(bb^b|m^b) + (1-\rho)\Pr(ab_s|m_s))B \). This payoff must be compared to the expected payoff from revealing, \( \Pi_M(0, m^b_s) = (1-\rho)\Pr(ab_s|m_s)B \), namely the probability from Table 2, times \( B \). In this situation, the manager calculates that \( \rho \Pr(bb^b|m^b) + (1-\rho)\Pr(ab_s|m_s) \geq (1-\rho)\Pr(ab_s|m_s) \). It follows that not revealing the manager's signal is the dominant strategy.

For a uniformly good signal \( m^g_s \), the expected payoff from not revealing the signal, according to equation (1) of this appendix, becomes \( \Pi_M(0, m^g_s) = (\rho \Pr(bb^g|m^g) + (1-\rho)\Pr(ab_s|m_s))B \). This payoff must be compared to the relevant expression—the probabilities from Table 2 (column 3, row 7) times \( B \), which is exactly \( \rho \Pr(bb^g|m^g) + (1-\rho)\Pr(ab_s|m_s) \). Therefore, revealing and not revealing lead to the same expected payoffs. Thus, not revealing is the dominant strategy only if revelation is costly.
For \( m_s^b \), the comparison is trivial, because to reveal the signal would yield a zero payoff to the manager (last row of column three in Table 2) and not to reveal guarantees a positive probability of the technology being approved.

In summary, in a slow growth, slow finance environment, when \( \Pr(t|bb^s)>I/R \) and \( \Pr(t|ab_s)>TB/AB \), \( NR>RS \) and the manager will not reveal his signal. In this environment, it is possible that \( \Pr(t|bb^s)>I/R \) but \( \Pr(t|ab_s)<TB/AB \). The manager’s payoff of not revealing the signal is

\[
\rho \cdot \Pr(bb^s|m^s)
\]

When the manager receives \( m_s^b \), \( \Pi_M(0, m_s^b) = \rho \cdot \Pr(bb^s|m^s) = \Pi_M(1, m_s^b) = \{\rho \cdot \Pr(bb^s|m^s)\} \cdot B \); namely, \( NR=RS \). When the manager receives the signal \( m_s^b \), \( \Pi_M(0, m_s^b) = \{\rho \cdot \Pr(bb^s|m^b)\} \cdot B \) and \( \Pi_M(1, m_s^b) = \{(1 - \rho) \cdot \Pr(ab_s|m_s)\} \cdot B \). In this case, \( NR \) will dominate \( RS \) if \( \rho \cdot \Pr(bb^s|m^b) > (1 - \rho) \cdot \Pr(ab_s|m_s) \), and this will happen when \( \rho < 1/2 \).

For \( m_s^b \), \( \Pi_M(0, m_s^b) = \{\rho \cdot \Pr(bb^s|m^s)\} \cdot B \) and \( \Pi_M(1, m_s^b) = \{\rho \cdot \Pr(bb^s|m^s) + (1 - \rho) \cdot \Pr(ab_s|m_s)\} \cdot B \). Clearly, in this case \( \Pi_M(1, m_s^b) = \rho \cdot \Pr(bb^s|m^s) + (1 - \rho) \cdot \Pr(ab_s|m_s) \cdot B > \rho P(bb^s|m^s) \cdot B = \Pi_M(0, m_s^b) \) so revealing the signal always pays off for the manager.

By the same logic, in this environment and with a smart board, when \( \Pr(t|bb^s)<I/R \) and \( \Pr(t|ab_s)>TB/AB \), we obtain symmetric results, (the case is presented in the text, in column 4, Table 3).
Proof of the inequalities shown in Table 4, for a fast finance, fast outreach environment.

Consider a dumb board and a case when \( \Pr(t^a|bb^b) > I/R \) and \( \Pr(t^g|ab_g) < TB/AB < \Pr(t^g|ab_g) \). The test for the financial goal is satisfactory is \( \Pr(t^a|bb^b) > I/R \). Altruists will approve the project if they get a good signal since \( \Pr(t^g|ab_g) < TB/AB < \Pr(t^g|ab_g) \). Here, we can have two cases. In case (10) from the text, the board approves the technology with probability one, when the technology passes both financial and outreach tests. This will happen with probability \( \Pr(ab_g|m_t) \). Alternatively, case (11) from the text will happen with probability \( 1 - \Pr(ab_g|m_t) \), and the board will approve the technology with probability \( \rho \). The expected payoff from not revealing the manager's signal is thus:

\[
\Pi_M(0, m^*_g) = \{\Pr(ab_g|m_t) + \rho [1 - \Pr(ab_g|m_t)]\} * B = \{\rho + (1 - \rho) \Pr(ab_g|m_t)\} * B
\]  

(3)

If the manager gets a uniformly good signal, \( m^*_g \), \( \Pi_M(1, m^*_g) = B \) and it is greater than \( \Pi_M(0, m^*_g) = \{\rho + (1 - \rho) \Pr(ab_g|m_t)\} * B \). Thus, the manager will prefer to reveal. Suppose the manager gets \( m^b_g \). Then \( \Pi_M(0, m^b_g) = 0 \), so revealing is preferred. When the manager gets \( m^b_g \), then, from Table 2, \( \Pi_M(1, m^b_g) = (I - \rho)B \), and by applying equation (3) from this appendix, \( \Pi_M(0, m^b_g) = \{\rho + (1 - \rho) \Pr(ab_g|m_t)\} * B \). Comparing these two expressions,

\[
(I - \rho) > \rho + (1 - \rho) \Pr(ab_g|m_t) \quad \iff \quad \frac{1 - \Pr(ab_g|m_t)}{2 - \Pr(ab_g|m_t)} > \rho.
\]

The LHS of the inequality \( \in [0,1/3] \) and, therefore, NR is preferred to RS if \( \rho > \frac{1}{2} \).
Suppose the manager receives \( m_b^g \). According to equation 3 in the appendix, \( \Pi_M(0, m_b^g) = (\rho + (1 - \rho) \Pr(ab_g|m_b)) \cdot B \) and \( \Pi_M(0, m_b^e) = \rho \cdot B \). Thus, not revealing is always preferable.

Now consider a smart board. The manager’s expected payoff from not revealing his signals is still the same. However, the expected payoffs from revealing differ. These payoffs are also presented in Table 2. To illustrate, suppose the manager gets a uniformly good signal, \( m^g \). In this case, \( \Pi_M(0, m^g) = (\rho + (1 - \rho)\Pr(ab_g|m^g)) \cdot B < B = \Pi_M(1, m^g) \).

Clearly, the manager prefers to reveal his signal.

Now suppose the manager gets \( m^b \). From Table 2, we have \( \Pi_M(1, m^b) = (\rho \Pr(b^g|m^b) + (1 - \rho) \Pr(b^b|a^b)) \cdot B \) which, according to equation (3) of this appendix is the same payoff as from not revealing.

If the manager receives \( m^b \), \( \Pi_M(1, m^b) = (1 - \rho) + \rho \Pr(b^b|m^b) \cdot B \) according to Table 2, and \( \Pi_M(0, m^b) = (\rho + (1 - \rho) \Pr(ab_g|m^b)) \cdot B \). The relevant comparison is:

\[
(1 - \rho) + \rho \Pr(b^b|m^b) > < \rho + (1 - \rho) \Pr(ab_g|m_b)
\]

\[
1 + \rho \Pr(b^b|m^b) > < 2\rho + (1 - \rho) \Pr(ab_g|m^b)
\]

\[
\frac{1 - \Pr(ab_g|m^b)}{2 - \Pr(a^b|m^b) - \Pr(b^b|m^b)} > < \rho
\]

The LHS of the inequality \( \in [0, 1/2] \) and, therefore, NR is preferred if \( \rho > 1/2 \).

Now suppose that the manager gets \( m^g \). \( \Pi_M(0, m^g) = (\rho + (1 - \rho) \Pr(ab_g|m_b)) \cdot B \)

From Table 2, \( \Pi_M(1, m^g) = (\rho + (1 - \rho) \Pr(ab_g|m_b)) \cdot B \). These expressions are equivalent and not revealing yields the same expected payoff for the manager as revealing.

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Proof of the inequalities shown in Table 4, for a mixed slow finance-fast outreach environment.

Consider a dumb board. Let \( \Pr(t^e | b^e) < I/R \) and \( \Pr(t_b | ab_b) > TB/AB \). That is, altruists will approve even if they got a bad signal and hear nothing from the manager. However, business-oriented board members are not optimistic about the success of the financial technology—even receiving a good signal is not enough to make them accept the technology. In case the manager does not reveal his signal, the board will never approve the financial aspect of the technology, but will always approve the outreach. Therefore, the probability of acceptance depends only on the board composition, and is equal to \( 1 - \rho \).

The expected payoff from not revealing is \( \mathbb{E} \Pi_M (0, m^t) = (1 - \rho) B \).

Suppose the manager gets a uniformly good signal \( m^g \). Then \( \Pi_M (1, m^g) = B > (1 - \rho) B = \Pi_M (1, m^e) \). Therefore, revealing is the preferred strategy.

Suppose the manager gets \( m^b \). Then, from Table 2, \( \Pi_M (1, m^b) = 0 \) and since \( \Pi_M (0, m^b) = (1 - \rho) B \), not revealing is preferred to revealing.

Suppose the manager gets \( m^b \). Then, \( \Pi_M (1, m^b) = \Pi_M (0, m^b) = (1 - \rho) B \) and the manager is indifferent between the two strategies.

Now suppose that the manager gets \( m^t \). Then, from Table 2, \( \Pi_M (1, m^t) = \rho B \) and \( \Pi_M (0, m^t) = (1 - \rho) B \). As \( \rho < (1 - \rho) \), not revealing is the dominant strategy if \( \rho < \frac{1}{2} \) and revealing is the preferred strategy if \( \rho > \frac{1}{2} \).
Now suppose the board is smart. The payoff of not revealing is the same; however, it must be compared to different payoffs from not revealing, according to Table 2 in the article.

If the manager receives a uniformly good signal $m^*_g$, then

$$
\Pi_M(1, m^*_g) = \{p \Pr(bb^g|m^*_g) + (1- \rho)\}^*B
$$

and this is clearly greater than $\Pi_M(0, m^*_g) = (1-\rho)B$. Therefore, revealing the information is always preferred.

Suppose that the manager receives $m^*_b$. From Table 2, $\Pi_M(1, m^*_b) = [(1-\rho) \Pr(bb_b|m_b)B]$, which is smaller than $\Pi_M(0, m^*_b)$. Therefore, not revealing is preferred.

Let the manager get $m^*_g$. $\Pi_M(1, m^*_g) = \Pi_M(0, m^*_g) = (1-\rho)B$, and the manager is indifferent between the two strategies.

Finally, suppose the manager receives $m^*_l$. Then, from Table 2, $\Pi_M(1, m^*_l) = \{p \Pr(bb^g|m^*_l) + (1-\rho)\Pr(ab_g|m_b)\}^*B$. The payoff from not revealing is $\Pi_M(0, m^*_l) = (1-\rho)B$.

The comparison that the manager makes is thus

$$
\rho \Pr(bb^g|m^*_l) + (1-\rho) \Pr(ab_g|m_b) > (1-\rho)
$$

and

$$
\rho \left[ \Pr(bb^g|m^*_l) - \Pr(ab_g|m_b) + 1 \right] < 1 - \Pr(ab_g|m_b)
$$

$$
\rho < \frac{1 - \Pr(ab_g|m_b)}{1 - \Pr(ab_g|m_b) + \Pr(bb^g|m^*_l)}
$$

Given the reasonable assumptions that $\Pr(bb^g|m^*_l)$ and $\Pr(ab_g|m_b) \in [0.5,1]$ and that $\Pr(bb^g|m^*_l)$ and $\Pr(ab_g|m_b) \in [0,0.5]$ (both the manager's and the board's
signals are informative), the RHS of the above inequality is \((1/3, 2/3)\). Therefore, not revealing is preferred to revealing when \(p<1/3\) and revealing is preferred to not revealing when \(p>2/3\), i.e., the composition of the board determines the manager's strategy.