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ASSORTIVE MATCHING OF BORROWERS AND LENDERS:
EVIDENCE FROM RURAL MEXICO

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

By
Susana Sanchez-Schwarz, Lic., M.A.

* * * * *

The Ohio State University
1996

Dissertation Committee:
Claudio Gonzalez-Vega, Adviser
Douglas H. Graham
Scott Irwin
Ian Sheldon

Approved by
Adviser
Graduate Program of Agricultural Economics
and Rural Sociology
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ABSTRACT

There is evidence that the rural credit markets of developing countries exhibit assortive matching patterns that sort and link borrowing entrepreneurs and lenders according to classes. This dissertation provides an explanation for this empirical regularity. Assortive matching patterns result from cost complementarities between lending technologies and borrower abilities to convey information about their risk type to lenders.

Lenders use either standard or idiosyncratic information to support screening, monitoring, and enforcement activities. The value of standard information is not affected by the distance between borrowers and lenders; thus, other lenders can read this information at comparable costs. In contrast, idiosyncratic information is generated at low marginal cost by interactions among local residents, or among agents in the same market. Consequently, the cost of gathering idiosyncratic information is affected by the identity and location of the lender.

The data set comes from a survey of rural entrepreneurs and a series of case studies about non-bank and informal lending technologies in three rural areas of Mexico. Rural entrepreneurs exhibit low participation rates in credit markets and are rather monogamous debtors.

A benchmark model for a pairwise analysis of entrepreneur and lender interactions is developed to demonstrate the effects on equilibrium interest rates and loan size of: (i) fixed and proportional costs of borrowing and lending; and (ii) the information acquisition behavior of lenders.

The benchmark model is extended to derive conditions for assortive matching. It is shown that an assortive matching pattern results in which formal lenders specialize in serving rural entrepreneurs with high endowments of standard information.
Assortive matching patterns are associated with market segmentation, with degrees of market power, and with interest rate differentials between formal and informal lenders.

A multinomial logit model is fitted to test for the matching hypothesis that entrepreneurs with greater endowments of standard information are more likely to be matched with formal lenders who specialize in interpreting standard information. The dissertation found that rural entrepreneurs with formal accounting practices, with higher endowments of collateralizable real estate assets, and with a history of prior access to credit are more likely to obtain loans from formal lenders.
To my parents for their love and support.
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VITA

April 10, 1968 ......................... Born - Santiago, Dominican Republic


1990 ......................................... Assistant to the Dean of the Department of Economics, Pontificia Universidad Católica Madre y Maestra, Santo Domingo, Dominican Republic.

1990 ......................................... Licenciatura, Pontificia Universidad Católica Madre y Maestra, Santo Domingo, Dominican Republic.

1991 ......................................... M.A. Economics, The Ohio State University

1990-1995 ............................. Graduate Research Associate in the Department of Agricultural Economics and Rural Sociology, The Ohio State University


PUBLICATIONS


FIELDS OF STUDY

Major Field: Agricultural Economics and Rural Sociology

Other Fields: Applied Economics and Econometrics
Wen S. Chern
Alan Randall
Mario Miranda
Cameron S. Thraen
Randall J. Olsen
Gary D. Schnitkey

Economic Development
Claudio Gonzalez-Vega
Douglas H. Graham

Financial Economics
Claudio Gonzalez-Vega
David Cole
Ralph A. Walking
Margaret Foster

Microeconomics and Industrial Organization
Hayime Miyazaki
Patricia Reagan
Masanori Hashimoto
Tatsuro Ichiishi

Macroeconomics
Robert Driskill
Stephen McCafferty
P. S. Lam
Paul Evans
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CHAPTER I
INTRODUCTION

The efficient operation of rural financial markets in developing countries has long been the object of academic and official concern. This preoccupation stems from the realization, particularly since the mid-1970s, that the services provided by financial markets and intermediaries are important—if not essential—for economic development [McKinnon, 1973; Shaw, 1973; Fry, 1988]. The contributions of financial intermediaries to economic development arise from the selection of investment projects, monitoring of firm managers, assistance in risk management, and transferring of resources from depositors to borrowers performed by them, thus facilitating capital accumulation and the intertemporal allocation of resources [Long, 1983]. These services reduce the overall costs of transacting in an economy, help resources to flow to their best alternative uses, and integrate and so enlarge markets. These beneficial effects of financial markets are crucial ingredients for economic development processes. Understanding the operation and performance of financial markets is thus important.

1.1 Statement of the Problem

The participation of heterogeneous lenders and borrowing entrepreneurs characterizes rural credit markets (RCMs). On the supply side, both formal and informal lenders are important sources of rural credit, although their relative importance varies across countries [Hoff and Stiglitz, 1990; Kochar, 1993]. On the demand side, entrepreneurs are heterogeneous in their comparative cost advantage of signaling creditworthiness to lenders. The total gains of intertemporal trade of

---

1 See Chapter 3 for a definition of formal and informal lenders.
borrowing and lending are affected by the matching or sorting of lenders and borrowing entrepreneurs. Thus, matching is an important aspect of an analysis of RCMs.

There is enough evidence that the RCMs of developing countries exhibit an assortive matching pattern [Hoff and Stiglitz, 1993; Esguerra, Nagarajan and Meyer, 1993; Muñoz, 1994; Conning, 1995]. An assortive matching pattern is defined as a matching that arranges entrepreneurs and lenders according to different classes. Matching is a function that assigns entrepreneurs to lenders, taking into account their participation constraints. When the participation constraint of the rural entrepreneur (RE) is binding, he is matched with himself.

There are two dimensions of matching in RCMs: single-period or a repeated-period framework. Within the first one, entrepreneurs are assigned only to lenders of the same type —formal or informal— or to just one lender. When an entrepreneur is matched with various lenders, he can be matched with one or various types of lenders. If the entrepreneur is matched with lenders of the same type, this is called matching with a sector. For example, in selected rural areas of The Philippines, Thailand, Bolivia, Costa Rica, Honduras, and Mexico, most households or entrepreneurs get credit from only one type of lender. A matching with a lender occurs when entrepreneurs receive loans from only one lender. In The Philippines, Nagarajan (1992) shows that little more than 50 percent of farmers interviewed received credit from only one lender in each growing season. In three selected rural areas of Mexico, three rural areas of Honduras, in the Cochabamba valleys of Bolivia, and in the Zona Urbana del Valle Central of Costa Rica, at least 70 percent of those entrepreneurs who obtained any type of loan service, received it from only one lender —either formal or informal.

The second dimension of matching occurs in a repeated-period framework. A monogamous matching describes a situation where entrepreneurs are always matched with a lender or with a sector.2 Regarding informal lenders, Siamwalla et al. (1990) report that most “borrowers were unable to use multiple sources of informal loans” and the average period of contact involving

---

2 In general, credit markets are characterized by exclusive relationships between borrowers and lenders [Jaffee and Stiglitz, 1990] which results from costs of information.
credit transactions with informal lenders was close to seven years. Entrepreneurs may also change the type of lenders over time due to changes in their demand for credit services.

The existence of an assortive matching system in credit markets raises two sets of issues. First, what determines the observed matching patterns? Second, what are the equity and efficiency effects of the observed matching outcomes? The first question relates to the underlying factors that affect the behavior of borrowers and lenders and that explain assortive matching patterns and the characteristics of credit contracts. The literature has focused on: (a) the determinants of sorting behavior in informal credit markets [Esguerra, 1993; Nagarajan, 1992; Floro and Yotopoulos, 1991] or in rural credit markets [Conning, 1995; Kochar, 1993] and (b) the interaction between two different segments of credit markets: formal and informal [Bell, Srinivasan, and Udry, 1990; Jain, 1993; Floro and Ray, 1992; Bell, 1990].

The second question is associated with the distributional effects of credit allocation mechanisms. If credit is allocated on the basis of endowments of resources, then a low initial endowment in a given locality would have a long-lived effect on wealth accumulation and, on poverty. Therefore, the allocation of credit can exacerbate income and wealth inequalities in rural areas. This question can be analyzed in a dynamic framework.

Assortive matching patterns in RCMs result from the individually rational behavior of heterogeneous agents engaged in credit transactions. The heterogeneity of lenders is due to the different types of information available to support their screening, monitoring, and enforcement activities. There are two types of information that can be used to support lending activities: standard and idiosyncratic. The main difference of standard information is that other lenders can easily read standard information at comparable costs and its value is not affected by the distance between borrowers and lenders.

The heterogeneity of borrowers emanates from their particular comparative advantages in generating (or having endowments of) standard information. The main hypothesis of this

---

Customer relationship models provide a theoretical framework to analyze matching with a lender in a repeated-period framework.
dissertation is that the observed assortive matching patterns arise mainly because of the associated costs of borrowers and lenders in producing and interpreting these two types of information. Research on these issues can make a significant contribution in assessing the most effective approach to promote the development of rural financial markets.

This dissertation contributes to the rural financial markets literature in several ways. First, it sheds light over key features of RCMs by arguing that the assortive matching of rural entrepreneurs and lenders is an equilibrium phenomenon. It answers questions such as: who is more likely to be matched with banks, moneylenders, or friends and relatives? Does the sorting of borrowers and lenders permit the prediction of who is more likely to be a non-borrower (i.e., a match with herself)? The theoretical model incorporates the comparative cost advantages of some lenders in screening different classes of borrowers and in monitoring and enforcing contracts with them, and the comparative advantages of some potential borrowers in signaling creditworthiness to certain types of lenders. Previous studies have focused only on the cost advantages of lenders in serving particular clientele [Esguerra, 1993; Conning, 1995; Nagarajan, 1992].

Second, formal and informal lenders are integrated here in a general model of sectoral choice. Previous work has analyzed matching patterns within informal credit markets only [Esguerra, 1993; Nagarajan, 1992; Floro and Yotopoulos, 1991]. Third, the dissertation provides an explanation for the phenomenon of self-selection of many individuals out of credit markets due to high borrowing transaction costs or to the riskiness of borrowing. This goes beyond the one-sided view of credit rationing based on asymmetric information [Stiglitz and Weiss, 1981]. It is important to allow for the possibility that for some loan demanders not borrowing from any source at all may be optimal, given their specific supply schedule of loans. McLeod (1992) presents evidence that many small firms in Indonesia rely on self-finance by choice and not because of credit constraints.
1.2 Why Study Rural Credit Markets in Mexico?

The dissertation is relevant for Mexican rural credit markets because of the paucity of research in this country. The performance of RCMs in Mexico has acquired particular importance because of the structural changes experienced by the rural economy in recent years. Since 1988, Mexico has undergone well-known macroeconomic reforms and fiscal stabilization measures, including the Program of Rural Modernization. The principal reforms affecting the rural areas have been those in the agricultural and financial sectors. These changes (e.g., changes in land ownership, removal of price controls, and increased international competition) will require farmers and other rural entrepreneurs to adjust factor proportions, modify output mixes, change their scale of operations, and invest in new technologies. The ability of rural entrepreneurs to adjust will depend on the performance of factor and financial markets. The efficient operation of rural financial markets is crucial for this process of adjustment and reallocation of resources to new economic activities. A study of RCMs is thus relevant given the present situation of the Mexican rural economy.

Furthermore, rural credit markets have been the center of policy interventions in Mexico. Examples of government interventions in Mexico are: specialized credit institutions (e.g., BANRURAL and FIRA), targeted credit programs, interest rate subsidies, and transaction cost subsidies for traditional banking technologies. However, these programs have failed to significantly reach rural clientele and have proven to be expensive. Because these interventions are unsustainable, the Mexican authorities are looking for new ways to promote rural financial intermediation.

1.3 Policy Implications

An understanding of the behavior of economic agents in RCMs has several implications for successful government intervention. The appropriate tools for intervention should arise from a *Key (1995a-c) and Staton (1995) look at agricultural credit markets and ejidatarios. In this dissertation the focus is on the rural economy.*
correct diagnosis of the operations of RCMs. For example, some theoretical models of the agricultural sector trace agricultural inefficiencies, income inequality, and poverty to credit constraints [Eswaran and Kotwal, 1989; Braverman and Stiglitz, 1989]. Those studies argue that policy reforms should start in the credit sector. However, government interventions should be directed to the factors responsible for a weak supply of and demand for credit.

Overall, actual government interventions in RCMs have been directed at destroying the status quo of assortive matching patterns [Gonzalez-Vega, 1993]. Different types of interventions, such as the creation of development banks, interest rate restrictions, and targeted credit, have been used for this purpose. However, the effects of these interventions has been abysmal as reflected by the poor performance of development banks [Adams, 1984] and the regressive effects of interest-rate restrictions [Gonzalez-Vega, 1976]. Recently, governments have shifted attention to the discovery of new mechanisms to break existing matching patterns through alternative viable lending technologies that allow formal institutions to reach marginal clientele [Chaves and Gonzalez-Vega, 1996; Stiglitz, 1990; Fuentes, 1994]. Recent studies are comparing the advantages of different lending technologies, such as group versus individual lending, in reaching marginal clientele [Gonzalez-Vega et al., 1996]

1.4 Objectives and Hypotheses

This dissertation has both theoretical and empirical objectives. Most models of matching that have been designed to explain the functioning of labor and marriage markets take preferences as given and assume a perfect information structure [Becker, 1976; Roth and Sotomayor, 1990; Simon and Warner, 1992; Crawford and Knoer, 1981; Kelso and Crawford, 1982]. The approach taken in this dissertation is to model the preferences of rural entrepreneurs (REs) and of lenders under different information structures and lending technologies. Then, equilibrium conditions for

---

5 Government interventions have focused on reaching marginal clientele to reduce income inequality and employment generation.
market outcomes are developed. This approach makes it possible to model the behavior of both REs and lenders in RCMs.

The second objective of this dissertation is the empirical identification of the determinants of the assortive matching of borrowers and lenders. An econometric model is fitted to test for the assortive matching hypothesis and the observable variables that affect the sorting.

The main hypothesis to be tested is:

Lenders and borrowers are sorted according to screening technologies and endowments of standard information. Entrepreneurs with a comparative advantage in producing standard information are more likely to engage in credit transactions with formal lenders.

Lacking direct measurements of the cost of producing standard information, variables associated with the ability of having a low marginal cost of generating standard information will be used.

1.5 Organization

This dissertation is organized as follows. Chapter 2 describes the Mexican setting. This chapter begins with a description of the methodology used for data collection in three selected rural areas of Mexico. Next, a description of rural entrepreneurs and lenders is provided. Chapter 3 starts with a review of the literature related to this dissertation. It first examines the problems encountered in RCMs such as adverse selection and moral hazard, and the different technologies available to lenders for overcoming these problems. A description of the lending technologies and information used by Mexican lenders is provided next. The chapter concludes with a presentation of a benchmark model to examine the effects of lending technologies and signaling abilities on the gains from a match. Chapter 4 extends the benchmark model to account for heterogeneous lenders and borrowers simultaneously. The chapter concludes with the derivation of the conditions for participation and choice of lender(s). The following chapter presents an empirical estimation of the
determinants of assortive matching conditions derived in Chapter 4. Finally, conclusions and policy implications are discussed in Chapter 6.
CHAPTER 2
RURAL CREDIT MARKETS IN MEXICO

2.1 Introduction

This chapter presents empirical evidence of matching patterns in rural credit markets (RCMs) in Mexico. To accomplish this goal, descriptive statistics on rural entrepreneurs (REs) and loan contracts are presented. The data set comes from a survey of REs and a series of case studies in three selected rural areas of Mexico.

Since 1988, Mexico has undergone well-known macroeconomic reforms and fiscal stabilization measures, including the Program of Rural Modernization. These reforms are characterized by a movement from direct state intervention toward a greater role of the market in the allocation of resources and toward privatization of the economy. The main reforms affecting the rural areas have been those in the agricultural and financial sectors. These have included broadening price and trade liberalization, privatization of agricultural-related parastatals, the reduction or elimination of agricultural input and price subsidies, constitutional changes to allow the privatization of ejido land, and downsizing and reorganization of development banks.

The financial reforms carried out by the Mexican government have resulted in a decline of the volumes of formal credit channeled to the rural sector [Swaminathan, 1991]. Furthermore, the relative shares of government financial institutions in formal credit flows have diminished because of the reforms. The main reforms affecting rural credit have been the reorganization and size reduction of the rural development bank (BANRURAL) and the creation of a new institution, Solidarity Funds (SOLIDARIDAD), to compensate peasants excluded from the outreach of
development banks. Those reforms were proposed because government involvement in the provision of credit to the rural population has clearly been an expensive presence in Mexico's RCMs and has mainly benefitted a few, among the better-off segments of the rural population.

This chapter is organized as follows. The next section provides a profile of the data set used in this dissertation. A general description of rural entrepreneurs in the selected rural areas is provided to put in perspective the demand side of RCMs. The third section compares the attributes of borrowers and non-borrowers in the areas of study. The fourth section presents a general description of the lenders in the Mexican credit markets. Next, the distinguished features of Mexican RCMs are discussed. The statistical evidence of the different dimensions of matching is displayed. This provides the framework for the theoretical models of Chapters 3 and 4. The characteristics of credit contracts are summarized in the sixth section. The chapter concludes with a summary of findings.

2.2 The Data Set

The data set used in this dissertation comes from two primary sources of data collected during the Spring and Summer of 1994 in certain areas of the following Mexican states: Guanajuato, Puebla, and Veracruz. These regions were selected due to the diversity in terms of economic activities, ethnicity, geography, and communication roads. The first source consists of a series of case studies about informal lending technologies. A total of 96 interviews were administered to pure moneylenders, trader-lenders, corporate agribusinesses, sharecroppers, and non-bank chartered financial intermediaries.

The main objective of the case studies was to gather information regarding the operational and information component of the technology of granting credit of non-bank lenders. A summary of the results of the case studies will be presented in Chapter 3. A flexible questionnaire was used to address the following issues: screening of loan applicants, mechanisms to monitor borrowers, and instruments for credit contract enforcement. In the absence of a list of all non-bank lenders, ad hoc methods were used to select lenders to interview. References from local residents,
government officials, and moneylenders were utilized to approach these informal lenders. As a result, no statistical inferences about the population of non-bank lenders can be made with these case studies.

The second primary source is a survey of rural entrepreneurs in the same areas where the case studies were undertaken. The universe for the survey was defined as the set of REs residing in localities with a population between 1,000 and 20,000 (according to the 1990 census) in the three selected areas. The survey's universe has 2.2 million inhabitants (33 percent of the total population of the three regions) distributed in 847 localities (6.2 percent of the total number of localities in the same areas).

Due to the lack of a list of rural entrepreneurs, the sampling unit chosen was the household. Although the sampling units were households, the focus of the study was on individuals engaged in some economic activity as independent entrepreneurs. To identify the REs—within each sampled household—all members of the household were registered in a household identification card (*Tarjeta de Registro de Hogares*) together with their basic demographic and economic characteristics. A questionnaire was employed to interview those household members identified as REs. Table 1 provides a breakdown of the sample by region.

### 2.3 Sampling Design

The households were selected through a multistage cluster random sampling. The first stage consisted of selecting 18 localities per basic region, for a total of 54 localities. Each locality's probability of being selected was proportional to the number of inhabitants (self-weighted). The second sampling stage was the selection of a census enumeration district (*Area Geoestadística Básica, AGEB*) within each locality previously chosen. The size of its population also weighted each district's probability to be selected.

The third stage was to select three blocks (*manzanas*) within each district. All blocks within a given census district had equal probability of being selected. Finally, the last stage in the sampling process was the systematic selection of 12 households for each block. The total number
of households incorporated in the sample design was, therefore, 1,944. Table 1 presents the sampling information for the rural entrepreneurs survey.

<table>
<thead>
<tr>
<th></th>
<th>Total in Selected Areas</th>
<th>Guanajuato</th>
<th>Puebla</th>
<th>Veracruz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Households Surveyed</td>
<td>1,683</td>
<td>557</td>
<td>549</td>
<td>577</td>
</tr>
<tr>
<td>Non-response for</td>
<td>261</td>
<td>91</td>
<td>99</td>
<td>71</td>
</tr>
<tr>
<td>Households Sampled</td>
<td>1,944</td>
<td>648</td>
<td>648</td>
<td>648</td>
</tr>
<tr>
<td>Rural Entrepreneurs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveyed</td>
<td>799</td>
<td>204</td>
<td>301</td>
<td>294</td>
</tr>
<tr>
<td>Farm REs</td>
<td>295</td>
<td>82</td>
<td>110</td>
<td>103</td>
</tr>
<tr>
<td>Non-farm REs</td>
<td>444</td>
<td>110</td>
<td>165</td>
<td>169</td>
</tr>
<tr>
<td>Both Activities</td>
<td>60</td>
<td>12</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Non-response for REs</td>
<td>53</td>
<td>18</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>852</td>
<td>222</td>
<td>316</td>
<td>314</td>
</tr>
</tbody>
</table>

Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural.

Table 1 Sampling Information for Rural Entrepreneurs Survey

2.4 The Questionnaire

The period of reference of the questionnaire was from July, 1993 to June, 1994. The questionnaire contains five sets of questions. The first one is directed to farm entrepreneurs in order to characterize their productive activities during the year prior to the survey. It contains questions regarding land tenure, crop production, livestock, technology, and sharecropping. The second set of questions is specific for non-farm entrepreneurs, to measure their place of activity, number of employees, technology, revenues, and costs. The third set of questions explores the formality of entrepreneurs—their participation in groups, their accounting methods, and their registration with the Department of the Treasury—and their marketing techniques. The fourth set of questions relates to RE participation in rural financial markets. Entrepreneurs were asked whether they have

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6 Replacement of no-responses was not explicitly included in the design.
engaged in any type credit transactions during the two years prior to the survey. Three types of credit transactions were considered: cash-loans, commercial credit, and forward sales. Several questions were asked to characterize credit contracts and customer relations. REs were asked whether they experienced a negative income shock during the 1989-1994 period. The last set of questions examines the sources of realized negative income shocks suffered by REs and the ex post strategies they use to cope with the crisis.

2.5 Strengths and Weaknesses of the Data

The survey data have the advantage that they are not limited to agricultural producers. Many empirical studies in Mexico have concentrated their attention on the agricultural sector (Key, 1995a-c; Staton, 1995). The survey data have, however, some weaknesses. First, the data on credit transaction characteristics have the limitation that borrowers supplied them. Hence, from this information one can make only indirect inferences about lenders. Second, data on the total lending portfolios of specific lenders are not available, since those informal lenders interviewed for the case studies provided only general information about their lending portfolio and the characteristics of their credit contracts.

Third, the cross-sectional nature of the data implies that income and production information are limited to the survey reference period. However, some information regarding the length of borrower-lender relationships is available. Fourth, the survey has data only on realized credit transactions. As a result, some variables are unobserved, such as the characteristics of credit contracts of alternative sources available to REs, with which contracts where not completed.

2.6 Rural Entrepreneurs in Three Areas of Mexico

The focus of this dissertation is on rural entrepreneurs, namely individuals who worked as self-employed or who hired workers for their own firm in any type of economic activity during the period under study. This section presents comparative statistics on selected variables for 799
interviewed rural entrepreneurs in three selected rural areas of Mexico. Throughout this discussion, all indicators correspond to the specific population estimates.

Rural entrepreneurs represent 16 percent of the labor force in the three selected rural areas. They comprise 29 percent of the economically active population of these areas. Rural entrepreneurs engage in various types of economic activities. About 55 percent are involved in non-farm ventures, 37 percent in farm enterprises, and 8 percent in both. The most important non-farm activities are trade, services, and manufacturing, as shown in Table 2. The importance of non-farm activities in the rural economy is not limited to REs. For example, 78 percent of workers (remunerated or unremunerated) are employed in non-agricultural enterprises.

Rural entrepreneurs are diversified in terms of ethnicity and gender. For example, non-indigenous and male REs represent 76 and 73 percent of REs, respectively. Gender and ethnicity are associated with distinct patterns of occupation among REs. Males, for example, account for 93 percent of the REs in farming, while females make up 39 percent of those in non-farm businesses.

The formality of REs can be assessed from two indicators: registration with the Department of the Treasury and accounting practices. There is a statistical significant positive association between these two indicators. Notice that 96 percent of REs with formal accounting practices are registered with the Department of the Treasury. Most REs do not use formal business records. It seems that their enterprises are simple enough or small enough not to require formal accounting records. For example, only 16 percent of REs keep such records. In view of the size of RE ventures, it is not surprising that 65 percent of REs keep no written records at all and that 17 percent of them keep only informal personal notes.

The majority of REs operate small businesses. This is evident from the small numbers of employees they hire and their general lack of business records. Indeed, 85 percent of all non-farm REs and 93 percent of farm REs run their operations by themselves, without the help of permanent employees. Fifty-two percent of farm REs do not even use seasonal workers. Only 6 percent of

\[ \chi^2 \text{-test rejects the null hypothesis of not association between accounting practices and registration with the Department of the Treasury at the 1 percent level.} \]
all non-farm REs have more than one employee, while only 2 percent of farm REs have more than one permanent employee. REs are relatively young people, 60 percent of them are less than 50 years of old.

<table>
<thead>
<tr>
<th>ECONOMIC ACTIVITY</th>
<th>EDUCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Entrepreneur</td>
<td>Illiterate</td>
</tr>
<tr>
<td>Non-farm Entrepreneur</td>
<td>Self-taught</td>
</tr>
<tr>
<td>Manufacture</td>
<td>Incomplete Primary</td>
</tr>
<tr>
<td>Trade</td>
<td>Primary School</td>
</tr>
<tr>
<td>Service</td>
<td>High School or College</td>
</tr>
<tr>
<td>Other</td>
<td>GENDER</td>
</tr>
<tr>
<td>Both Activities</td>
<td>Male</td>
</tr>
<tr>
<td>REGISTERED WITH SHCP*</td>
<td>Female</td>
</tr>
<tr>
<td>ACCOUNTING PRACTICES</td>
<td>ETHNICITY</td>
</tr>
<tr>
<td>Formal Accounting</td>
<td>Indigenous</td>
</tr>
<tr>
<td>SHCP* Book</td>
<td>Non-indigenous</td>
</tr>
<tr>
<td>Personal Notes</td>
<td>AGE</td>
</tr>
<tr>
<td>None</td>
<td>16 - 29</td>
</tr>
<tr>
<td>EMPLOYEES</td>
<td>30 - 49</td>
</tr>
<tr>
<td>Farm Entrepreneurs</td>
<td>50 - 70</td>
</tr>
<tr>
<td>Zero Permanent Employees</td>
<td>Over 70</td>
</tr>
<tr>
<td>Zero Seasonal Employees</td>
<td>7.0</td>
</tr>
<tr>
<td>Non-farm Entrepreneurs</td>
<td>85.4</td>
</tr>
<tr>
<td>Zero Salaried Workers</td>
<td></td>
</tr>
</tbody>
</table>

Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural.  
* Secretaría de Hacienda y Crédito Público (Department of the Treasury)

Table 2 Summary of Rural Entrepreneurs Characteristics  
(Percentage of Rural Entrepreneurs)

Rural entrepreneurs also vary greatly in the income from productive activities and collaterizable assets. For farm entrepreneurs, annual productive income was calculated as the monetary value of sales (crop and/or cattle) plus the imputed value of household consumption. In the case of non-farm entrepreneurs, productive income corresponds to the annualized value of gross

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* The average sale price in the RE’s locality of residence was used to impute the value of household consumption. This price was calculated as the average of prices of the crop in question that all REs of the locality reported. If this price was not available, then the average price of the corresponding region was used.
revenues. The value of real estate is used as a proxy of collaterizable assets. In order to get a good estimate of the value of real estate, REs were asked how much they would pay for the property if they were to buy it.

<table>
<thead>
<tr>
<th>Annual Enterprise Income*</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All entrepreneurs</td>
<td>34,506</td>
<td>113,497</td>
</tr>
<tr>
<td>1st quartile</td>
<td>410</td>
<td>380</td>
</tr>
<tr>
<td>2nd quartile</td>
<td>3,855</td>
<td>1,781</td>
</tr>
<tr>
<td>3rd quartile</td>
<td>13,364</td>
<td>4,132</td>
</tr>
<tr>
<td>4th quartile</td>
<td>115,103</td>
<td>201,302</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Real Estate Assets (Collaterizable)*</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All entrepreneurs</td>
<td>75,468</td>
<td>300,492</td>
</tr>
<tr>
<td>1st and 2nd quartiles</td>
<td>1,056</td>
<td>2,209</td>
</tr>
<tr>
<td>3rd quartile</td>
<td>20,738</td>
<td>7,896</td>
</tr>
<tr>
<td>4th quartile</td>
<td>259,937</td>
<td>531,885</td>
</tr>
</tbody>
</table>

Source: *Encuesta Regional de Servicios Financieros a Unidades de Producción Rural.
* Includes household consumption of goods produced.
* Value of real estate.
* At the time of the Survey, the exchange rate was N$3.3 to US$ 1.

Table 3 annual enterprise income and value of real estate assets of rural entrepreneurs (New Pesos, N$)

Table 3 presents the quartile distribution of the gross annual income that REs earn from their enterprises. The table also shows a highly skewed distribution of enterprise income and of collaterizable assets: the average income within the fourth income quartile, for example, is 280 times larger than the average income within the first income quartile. The average value of collaterizable assets within the fourth quartile is 240 times larger than the average for the first and second quartiles combined.

9 The questionnaire reported the typical monthly gross revenue. Since the number of worked months during the reference period was not available, it was assumed that they worked 12 months.
2.7 **Borrowers versus Non-Borrowers**

This section provides comparative statistics on selected variables for REs classified by their borrowing status at the time of the survey. Borrowing REs comprise those entrepreneurs who engaged in any type of credit transaction during the two years prior to the survey.\(^\text{10}\)

Borrowing REs reported a productive income over two times higher than non-borrowers (Table 4). The average productive income of REs who received loans from any possible source fall into the highest quartiles with respect to income. On the contrary, those REs who did not receive loans have an average productive income below the population average. This does not tell anything about the direction of causality between productive income and borrowing status. If lenders use collaterizable assets and productive income as proxies of repayment capacity, then REs with higher levels of income and real estate assets are more likely to be borrowers. Furthermore, if ownership of real estate assets and income are associated with the age of the enterprise — and therefore its size — then it is more likely for small REs to be non-borrowers [McLeod, 1992].\(^\text{11}\)

Pairwise comparisons of average productive income among the three borrowing categories (e.g., matching with a sector: formal or informal, and matching with formal and informal) are statistically different at the 5 percent level. However, as expected, the average productive income of REs matched with the formal sector and the average productive income of REs matched with both formal and informal lenders borrowers are not statistically different.

The difference between the age and size of locality of residence of borrowers and non-borrowers is statistically significant at the 5 percent level. Borrowing REs are younger than non-borrowing REs. On average, non-borrowers live in smaller localities than borrowers. Among borrowers, borrowers from both sectors live in localities with the highest average population of ten thousands.

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\(^{10}\) See page 20 for the type of credit transactions considered in the survey.

\(^{11}\) Unfortunately the experience of the RE is only available for non-farm REs. Among borrowing non-farm REs, productive income and the value of real estate assets increase with the experience of the RE.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Non-borrowers</th>
<th>Borrowers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formal Only</td>
<td>Informal Only</td>
</tr>
<tr>
<td>Annual Productive Income *</td>
<td>22.478</td>
<td>96.812</td>
</tr>
<tr>
<td></td>
<td>(92.750)</td>
<td>(244.330)</td>
</tr>
<tr>
<td>Real Estate and Financial</td>
<td>67.915</td>
<td>56.650</td>
</tr>
<tr>
<td>Deposits</td>
<td>(239.133)</td>
<td>(76.060)</td>
</tr>
<tr>
<td>Dummy: Formal Accounting</td>
<td>10.9</td>
<td>22.7</td>
</tr>
<tr>
<td></td>
<td>(31.1)</td>
<td>(41.9)</td>
</tr>
<tr>
<td>RE's Age</td>
<td>48</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>(17)</td>
<td>(14)</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>0.12</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>(0.48)</td>
<td>(1.2)</td>
</tr>
<tr>
<td>Number of Dependents</td>
<td>3.5</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>(2.3)</td>
<td>(3.5)</td>
</tr>
<tr>
<td>Household Size</td>
<td>5.3</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>(2.6)</td>
<td>(3.4)</td>
</tr>
<tr>
<td>Population of RE in</td>
<td>7.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Locality of Residence b</td>
<td>(5.2)</td>
<td>(6.0)</td>
</tr>
<tr>
<td>Minimum Daily Wage in</td>
<td>14.3</td>
<td>15.6</td>
</tr>
<tr>
<td>RE's Locality</td>
<td>(3.7)</td>
<td>(4.8)</td>
</tr>
<tr>
<td>Dummy: Economic Crisis</td>
<td>54.3</td>
<td>51.1</td>
</tr>
<tr>
<td></td>
<td>(49.8)</td>
<td>(50.0)</td>
</tr>
<tr>
<td>Years of Experience in their</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic Activity for Non-Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Observations c</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>439</td>
<td>32</td>
</tr>
</tbody>
</table>

* Includes household consumption of goods produced.

b In thousand of inhabitants.

c Due to missing values not all calculations included the total number of observations.

* Comparisons between borrowers and non-borrowers means are significant at the 5 percent level.

Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural.

Table 4 Borrowers versus Non-borrowers in Three Selected Rural Areas of Mexico (Standard Errors in Parentheses)
Most non-borrowers run enterprises that are simpler than those of borrowers. For example, 21 percent of borrowers use formal accounting methods while only 11 percent of non-borrowers do. Thirty-six percent of REs borrowing from formal and informal sources use formal accounting, the highest value among all categories. This proportion is statistically significant at the 5 percent level from the other categories: non-borrowers, formal only, and informal only.

Rural entrepreneurs were asked whether they had experienced an economic crisis during the past five years. As Table 4 shows, 54 percent of non-borrowers declared having experienced an economic crisis, while 65 percent of borrowers did. The REs have two different strategies to deal with risk: risk management and risk coping [Alderman and Paxson, 1992]. The choice between these two alternative mechanisms depends on risk preferences, the cost of risk management, and the mechanisms available to cope with risk in case an individual crisis occurs. The probability of having a crisis is conditional on the \( \text{ex ante} \) activities undertaken by REs to manage risk (e.g., diversification). Then, the difference on the incidence of an economic crisis between borrowers and non-borrowers may be the result of borrowers having less incentives to reduce risk \( \text{ex ante} \) because they are more able to cope with risk than non-borrowers.

2.8 Lenders

Rural Credit Markets are generally subdivided into the formal and informal sectors. These lenders offer different credit contracts and their lending technologies imply different cost structures. The formal sector in Mexico includes: (i) government institutions; (ii) commercial banks; (iii) chartered non-bank financial intermediaries; and (iv) other registered institutions. The informal sector encompasses a great variety of lenders. These include: (i) moneylenders, who are individuals who provide cash loans in exchange for explicit interest payments; (ii) friends and relatives, who are individuals who provide cash loans without explicit pecuniary compensation; and

---

12 The description of their respective lending technologies is presented in Chapter 3.

13 In this dissertation lenders are classified according to the relative intensity in using standard or idiosyncratic information to screen and monitor borrowers and to enforce credit contracts. Standard and idiosyncratic information are defined in Chapter 3.
(iii) traders, merchants, and processors, who are individuals or commercial establishments who engage in various types of credit transactions (i.e., cash loans, commercial credit and interlinked credit contracts).

The survey considered three types of credit transactions: cash loans, commercial credit, and sales with downpayments. Cash loans are defined as credit disbursed and repaid in cash. Commercial credit is defined as credit received in kind but required to be repaid in cash. Finally, sales with downpayments are transactions in which REs received cash payments in exchange for future delivery of products or services.\footnote{Interlinked credit contracts are considered in this category.}

In Mexico, the government's key rural finance institutions are the Banco Nacional de Crédito Rural (BANRURAL), the Fideicomisos Instituidos en Relación con la Agricultura (FIRA),\footnote{Trust Funds related with Agriculture.} and the Programa Nacional de Solidaridad (PRONASOL). Each of these lenders targets credit to different clientele [Swaminathan, 1991]. For example, PRONASOL targets low income farm producers, while FIRA lends primarily to middle-large size farmers. Recent financial policies have been directed at reducing interest rate subsidies and fiscal transfers to these institutions. For example, BANRURAL reduced the numbers of its branches and of its employees in about one-half in 1992. BANRURAL and FIRA have been reaching fewer low-income farmers. Loans discounted by FIRA for low-income farmers decreased to 18 percent of total annual lending 1992, from about 50 percent in 1988 [Chaves and Sanchez, 1995]. These lenders are not relevant for the purposes of this dissertation because the survey reported that only 0.1 percent of all rural entrepreneurs received loans from them.

The private side of lending is composed of commercial banks, non-bank chartered intermediaries, other registered institutions, moneylenders, traders, agribusinesses, and friends and relatives. Commercial banks operate in the same manner as in other countries. At the end of 1994, Mexico had 32 licensed commercial banks, which operate as members of holding companies (Grupos Financieros) also engaged in providing non-bank financial services. However, the
geographical coverage of the commercial banking system is limited, because less than a third of the country's municipalities have bank offices, including those of development banks [World Bank, 1994].

Chartered non-bank intermediaries are financial institutions that have been granted an operation license by the Superintendency of Banks (Comisión Nacional Bancaria, CNB) or by the Department of the Treasury (Secretaría de Hacienda y Crédito Público, SHCP) or that operate without license but under the auspices of a particular piece of legislation. The most important examples are Uniones de Crédito (UCs), Sociedades de Ahorro y Préstamo (SAPs), and Cajas Populares (CPs). These institutions are client-owned organizations that engage in financial intermediation. However, UCs engage also in industrial and commercial activities. The UCs and SAPs operate under the Ley de Organizaciones Auxiliares de Crédito and the CPs operate under the Ley de Sociedades Cooperativas. At the end of 1994, there were 366 UCs and 15 SAPs operating in the country. Other registered institutions are organizations that provide credit but are not financial intermediaries. Examples of this category are the Instituto Nacional Indigenista (INI) and SOLIDARIDAD.

Moneylenders are individuals who provide credit with a profit motive. Overall, moneylenders have other careers, such as farmers, lawyers, politicians, traders, and merchants. They offer a variety of credit contracts: cash loans and interlinked transactions. Commercial Credit Providers are organizations or individuals who sell durables, inputs, and other products on credit.¹⁶

Trader-lenders and agribusinesses provide REs with interlinked credit transactions.¹⁷ In this case, rural entrepreneurs receive credit from agents who are interested in acquiring the output of their production. These lenders provide REs with three types of credit or insurance

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¹⁶ Even though commercial credit providers are business run companies, they are classified as part of the informal sector because of the technology used to screen borrowers.

¹⁷ These lenders are not relevant for this dissertation because the incidence of interlinked transactions among farm REs is minimum. However, the case studies provide very interesting findings.
services interlinked with input and output transactions: pure credit, rental contracts, and price hedging contracts.

**Pure Credit** is a credit transaction that is disbursed in-kind or in-cash and that borrowers agree to repay with the future delivery of production. The actual unit price paid on the borrower's production is determined at the time of delivery of the output and is usually calculated as the ongoing spot price minus a percentage agreed upon at disbursal. These transactions are *pure* credit because borrowers conserve all price and production risks.

**Rental Contracts** also involve disbursements to REs in exchange for the future delivery of production. However, the unit price on the borrower's production is specified at the time of disbursement, and it is independent of the ongoing spot price at the time of delivery. Rental transactions occur when traders pay for the production of a plot of land prior to harvest. The trader assumes all price, yield, and fraud risks.

**Price-Hedging Contracts.** This contract is similar to the rental contract, with the difference that in price-hedging contracts the producer assumes yield risks and agrees to future delivery of production to the lender at a fixed contracted price. This transaction has a price risk insurance component.

### 2.9 Credit Markets in Three Selected Rural Areas of Mexico.

This section presents the main characteristics of Mexican RCMs. First, the relative importance of interlinked credit transactions is minimal, compared to other countries. Second, the participation rates of REs are much lower than in other LDCs. Finally, there is a clear assortive matching system in which REs are matched with a type of credit services.

#### 2.9.1 Market Shares of Formal and Informal Lenders

The relative market shares of different credit products used by REs (e.g., cash loans, trade credit) and types of lenders (e.g., formal, informal) are measured in terms of the total number of individual transactions and in terms of the total volume of transactions.
The most commonly observed credit services in terms of the number of transactions are — in order of importance: (i) commercial credit; (ii) cash-loans from the informal sector; (iii) cash-loans from the formal sector; and (iv) sales with downpayment or forward sales (Table 5). In terms of the total volume of credit, the formal sector has the largest share of the market, with 61 percent of the amount of credit received by REs. The informal sector accounts for the remaining 39 percent. Cash loans are — by far — the most important credit service — almost by a three-to-one margin over the combined volume of commercial credit and sales with downpayments.

In some countries such as India and China, the informal sector is characterized by zero interest rate transactions from friends and relatives [Kochar, 1993; Feder et al. 1994]. This contrasts with the Mexican setting in which friends and relatives are not the most important source of informal finance in terms of the number of transactions.

<table>
<thead>
<tr>
<th></th>
<th>Cash Loans</th>
<th>Commercial Credit</th>
<th>Sales with Downpayment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formal</td>
<td>Moneylender</td>
<td>Friends and Relatives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total in Selected</td>
<td>% Trans</td>
<td>13.5</td>
<td>9.6</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>% N$</td>
<td>61.1</td>
<td>8.3</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Guanajuato</td>
<td>% Trans</td>
<td>19.1</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% N$</td>
<td>57.8</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>Puebla</td>
<td>% Trans</td>
<td>11.0</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% N$</td>
<td>68.4</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Veracruz</td>
<td>% Trans</td>
<td>10.4</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% N$</td>
<td>53.4</td>
<td>11.5</td>
</tr>
</tbody>
</table>

Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural

Table 5 Relative Importance of Formal and Informal Sector

Among the three types of credit services included, sales with downpayment are the least significant source of funding for REs in the regions studied. The overall scarcity of agricultural forward sales or interlinked transactions in the regions studied contrasts with the stylized facts that
characterize RCMs in other developing countries, particularly in Asia [Esguerra, 1993]. The
massive intervention of the government in the rural economy has been a likely contributing factor
in the scarcity of interlinked contracts. For example, the government monopoly, FERTIMEX,
supplied fertilizer, while agricultural output was marketed through agencies such as the Instituto
Mexicano del Café (INMECAFE) and the Compañía Nacional de Subsistencias Populares (National
Food Supplies Company, CONASUPO). Such interventions weakened the development of
interlinked credit contracts. The continued reform of the agricultural marketing system should
allow for a private market to develop. However, markets and institutions take time to evolve.

There are no statistically significant regional differences in the market shares (in terms of
number of transactions) of the different types of lenders (Table 5). However, the $\chi^2$ test yields
regional differences in the market shares when the various categories of the informal sector are
lumped together. For example, the formal sector has its largest share of the number of individual
transactions in Guanajuato — almost twice as much as in Veracruz and Puebla. This is because of
the significant market presence of chartered non-banks in the former state.

Puebla is the region where the formal sector supplies the largest share of the amount of
credit received by REs — 68 percent. This is because informal loans are — on the average — much
smaller than in other regions. The informal sector shows its largest participation in the number and
volume of credit transactions in Veracruz — 90 percent of transactions and 47 percent of the amount
of credit. This is because REs use commercial credit more frequently in Veracruz than in the other
two regions.

2.9.2 Participation and Matching in Credit Markets

The credit market in the three selected rural areas of Mexico differs in two aspects from
those of the rural areas of other developing countries. First, as shown in Table 6, the observed
credit market participation in Mexico is significantly lower as compared to that reported in the rural areas of other countries such as Bolivia, Costa Rica, Honduras, Nigeria, The Philippines, and Thailand. In rural Mexico, the majority of REs—55 percent—had not used any type of loans in the past two years prior to the survey—whether from the formal or informal sector. That is, only 45 percent received cash loans, and/or commercial credit, and/or payments for forward sales. In contrast, the reported proportion of borrowers in those other countries varies from 52 percent to 96 percent.

Second, Mexico not only has the lowest participation rate, but also the lowest proportion of rural entrepreneurs (REs) who reported credit contracts with different types of lenders (e.g., formal and informal) among those countries. The proportion of borrowing entrepreneurs reporting multiple types of sources ranges from 9 percent in Mexico to 28 percent in The Philippines. Thus, Mexico has the highest level of matching with a sector, since 91 percent of borrowing REs are matched with a sector. In Mexico, the evidence of matching with a lender is high. For example, 70 percent of borrowing entrepreneurs reported having just one lender as source of external funds. On average, borrowing REs received loans from 1.4 lenders. The high proportion of borrowing REs that are matched with a lender is not exclusive of Mexican RCMs. In three rural areas of Honduras, in the Cochabamba valleys of Bolivia, and in the Zona Urbana del Valle Central of Costa Rica, at least 70 percent of borrowing farmers or microenterprises obtained credit services from one lender.

Another interesting type of matching that is matching with a type of credit transaction. Figure 1 shows that among all REs: (i) 13 percent received cash loans only; (ii) 19 percent utilized commercial credit only; and (iii) 3 percent obtained advances on the future delivery of their production and/or services. A low proportion of REs had access to more than one type of credit service in the two years before the survey—as follows: (i) 8 percent received cash loans and commercial credit, and (ii) 2 percent obtained other combinations of credit services.
It seems that sector of economic activity and gender influence the type of credit services—cash loans, commercial credit, or sales with downpayment—that REs use. Borrowing patterns of male and female entrepreneurs, and of farm and non-farm entrepreneurs are statistically different at the 1 percent level. For example, 24 percent of female REs used only commercial credit, as compared to 17 percent of males. Sixteen percent of farm REs reported using cash-loan transactions only, as compared to 10 percent of non-farm entrepreneurs.

Thus, the general view, formulated primarily in Asian countries, of rural and other small entrepreneurs having a portfolio of different credit services from alternate sources is inconsistent with the findings of this survey. The data show that, in the regions studied, the comparatively few REs who did receive credit services tended to be rather monogamous debtors, as most of them used only one type of service, were matched with a sector, and with a lender.

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The Pearson chi-square statistic was computed to test for the difference in the borrowing patterns between male and female entrepreneurs, and between farm and non-farm entrepreneurs. Five categories were used for borrowing patterns: cash-loan only, commercial credit only, forward sales only, any combination of credit transactions, and no borrowing. The test yielded $\chi^2$ values of 12.9 and 68.3, respectively, and the alternative hypotheses of association between gender and borrowing patterns, and between economic activity and borrowing patterns are accepted at the 1 percent level.
## Table 6  Cross-Countries Comparison of the Participation of Rural Entrepreneurs in Credit Markets

<table>
<thead>
<tr>
<th>BORROWERS</th>
<th>NO LOANS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formal</td>
<td>Informat</td>
</tr>
<tr>
<td></td>
<td>only</td>
<td>only</td>
</tr>
</tbody>
</table>

### Rural surveys of farmers

<table>
<thead>
<tr>
<th>Location</th>
<th>Loans</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nueva Ecija Province, The Philippines, 1988-1989</td>
<td>3.9 63.0</td>
<td>96.1 3.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Cochabamba Valley, Bolivia, 1990</td>
<td>- - 52.2</td>
<td>47.8 100.0</td>
<td></td>
</tr>
<tr>
<td>Zaria, Nigeria, 1987-1988</td>
<td>- - 65.0</td>
<td>35.0 100.0</td>
<td></td>
</tr>
<tr>
<td>Nakhon Rachasima Province, Thailand, 1984-1985</td>
<td>15.9 32.0</td>
<td>57.6 42.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Various Regions, Honduras 1994</td>
<td>12.2 34.6</td>
<td>64.5 35.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Various Regions, Costa Rica, 1987</td>
<td>28.0 16.7</td>
<td>57.1 42.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Guanajuato, Puebla and Veracruz States, Mexico, 1994</td>
<td>6.7 25.8</td>
<td>38.1 61.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### Surveys of non-farm ventures

<table>
<thead>
<tr>
<th>Location</th>
<th>Loans</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iloilo, Negros Occidental, Cebu, and Bohol Provinces (Rural), The Philippines, 1991-1992</td>
<td>13.8 28.0</td>
<td>54.3 45.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Zona Urbana del Valle Central, Costa Rica (Urban), 1993</td>
<td>4.0 49.9</td>
<td>32.5 67.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Guanajuato, Puebla and Veracruz States, Mexico, 1994</td>
<td>2.9 45.6</td>
<td>51.7 48.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### Rural Entrepreneurs

<table>
<thead>
<tr>
<th>Location</th>
<th>Loans</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico, 1994</td>
<td>22.9 9.65</td>
<td>- - 9.65</td>
<td>-</td>
</tr>
<tr>
<td>Guanajuato, Puebla and Veracruz States, Mexico, 1994</td>
<td>4.2 36.4</td>
<td>44.8 55.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Sources: The Philippines: Nagarajan, 1992 (Table 8, p. 90); Lapar, 1994 (Table 3.7, p. 60). Bolivia: Muñoz, 1994 (Figure 7-1, p. 97); Nigeria: Udry, 1990 (Table 2, p.255); Thailand: Siamwalla et al., 1990 (Table 3, p. 277); Costa Rica: Villalobos, 1994 (Table 14, p.63), Quiroz, 1991 (Table 22, p.86 and Table 25 p.97); Honduras: Gonzalez-Vega and Torrico, 1995 (Table 24, p.A-25); Mexico: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural, 1994, Encuesta sobre Sistemas Financieros en Poblaciones Semi-urbanas y Rurales, 1994.

* This information does not include households with only land-pawing contracts (2.4 percent).

* Refers to households that received formal or informal loans.

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2.9.3 Cash-Loans Market: Reasons for not Requesting Loans

The survey data contain information regarding the reason for not requesting cash loans. As shown in Figure 2, the large majority of REs—more than three quarters—did not request cash loans during the two years prior to the survey. These entrepreneurs were asked why they had not attempted to obtain cash loans. On the basis of their answers, these REs were classified in one of three major groups: REs who did not need a cash loan (22 percent of all REs), REs who considered borrowing to be too risky (20 percent of REs), and REs who self-selected out of credit markets because of the process involved in obtaining loans (27 percent of REs). This last group combines those REs who answered that they had not applied for loans because of their belief that their loan applications would be rejected (8 percent of REs), their perception that transaction costs of borrowing are too high (9 percent), and their uneasiness about dealing with financial institutions (9 percent). Another 6 percent of REs gave other answers.

Due to low participation rates in RCMs, a theoretical model should be able to explain the decision of REs to request credit transactions. Previous studies on assortive matching [Esguerra, 1993; Nagarajan, 1992] ignored this aspect because in their country setting almost all farmers received loans from some source. Recent empirical studies of formal credit rationing have tried to account for the participation decision of REs to calculate the extent of quantity rationing [Kochar, 1993; Aguilera, 1990; Hunte, 1992].

The informal sector plays a significant role in the rural economy. The proportion of REs that reported using informal credit was 40.6 percent. Swaminathan (1991) summarizes that previous studies of RCMs in Mexico and the proportions of producers using informal credit ranged from 4.5 percent to 75 percent. The author argues that for some of those studies this proportion may be underestimated.

For REs without commercial credit or forward sales, there is not information about reasons for not requesting them.
2.10 Credit Contracts: The Supply Side

The main objective of this section is to show the characteristics of credit contracts in Mexico. These characteristics are the result of the interaction between loan applicants and lenders, and of lending technologies. Five elements of the credit contract are considered: loan amount, collateral and guarantees, maturity, interest rates, and borrower transaction costs.

2.10.1 Maturity.

Most of the credit transactions are of short duration. There are differences in terms to maturity among contracts provided by formal and informal lenders (see Table 7). Bank loans have the longest repayment terms; the average is 21 months, almost twice the average repayment term that chartered non-bank intermediaries require of REs.

Loans from the informal sector (i.e., moneylenders and friends and relatives) have much shorter repayment periods and quite flexible repayment schedules. Loans with a flexible repayment schedule are those whose maturity is contingent on the borrower's ability and willingness to pay, because a schedule is not established at disbursement. About one-half of the loans by informal lenders have flexible repayment schedules (see Table 7). Flexibility is more common for loans from friends and relatives—59 percent of transactions. Flexibility does not mean long repayment

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Figure 2 Participation and Reasons for not Participating in the Market for Cash Loans.
periods. In fact, flexible-term loans from moneylenders and friends tend to be paid back within about 4.5 months.

The limited access to long-term debt by only a few larger borrowers is probably due to a strong demand for short-term loans and a weak supply of long-term loans. The demand for short-term credit is high because rural incomes are very variable, resulting from unexpected consumption demands (e.g., sickness of family members), the seasonal nature of farm activities, and price uncertainties. Thus, short-term financial services are vital to help rural households to sustain consumption levels across income cycles, particularly among the poorest households, whose average consumption levels are low to begin with.

Long-term credit is rather limited because of inadequacies of the legal infrastructure to support the use of real state and movables as collateral, because of attenuated property rights, and because of the uncertainty that characterize rural areas. These factors, together with the country's history of price instability, no doubt deter most lenders from entering into long-term loans with fixed nominal values. Only banks and a few sophisticated borrowers can engage in loan contracts with adjustable interest rates.

2.10.2 Interest Rates

Transactions in RCMs are characterized by a wide range of interest rates (see Table 7). Interest rates are generally quoted on a monthly basis. Rates range from an average 2.2 percent per month in the case of chartered non-bank financial intermediaries, to an average of 16.3 percent in the case of commercial credit transactions that reported a positive rate.22

The effective rates of interest used for the analysis correspond to the internal rate of return on observed loans. The calculations consider all relevant attributes of loan contracts, such as the frequency of payments and whether interest charges are based on a flat or a declining balance.

22 The effective rate charged by formal sector intermediaries may be underestimated. This is because of the common practice of demanding compensatory balances from borrowers to increase the effective rate loans.
Effective rates are required in order to compare the rates of various kinds of credit contracts made in the study areas.\textsuperscript{23}

Loans from informal lenders are generally more expensive than those of formal intermediaries. The very high financial cost of informal cash-loans and commercial credit may be explained by the short term and small amounts of the transactions. However, the question that remains is why the excessive interest rates are not bid down by other merchants-lenders, including potential entrants.

There are three explanations for the high effective informal interest rate in the literature: monopoly power, high lending costs, and high risk premia. Hoff and Stiglitz (1990) support the idea that problems of imperfect information and enforcement are to blame for interest-rate differentials between the formal and informal sectors and that monopoly power or high credit risk explanations are not sufficient to account for the phenomenon. Aleem (1990) argues that high informal interest rates arise because informal lenders spend resources to screen applicants and pass on to them the costs associated with screening (i.e., adverse selection is to blame). On the other hand, Conning (1995) claims that lenders incur monitoring costs to reduce moral hazard behavior and pass those costs on to borrowers.

Another explanation of high informal interest rates is that they reflect a high \textit{ex ante} risk premium [Long, 1983; Bottomley, 1975]. However, the survey data on cash loan default rates and the anecdotal evidence from interviews with moneylenders and trader-lenders suggest that \textit{ex post} credit losses are not likely candidates to explain such high costs. As Table 7 shows, 26 percent of formal loans experienced repayment problems, while only 7 percent of informal cash loans did.\textsuperscript{24}

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\textsuperscript{23} Nominal as opposed to real rates were used because the loans observed were disbursed at different points over the period from June 1992 to June 1994 and their maturities vary. Hence, the calculation of \textit{ex post} real rates would be cumbersome and would add little to the analysis because the rates of inflation were low and stable in the period. The changes in the consumer price index for 1992, 1993, and 1994 were 11.9 percent, 8 percent, and 7 percent, respectively.

\textsuperscript{24} It should be pointed out that this information was collected from the borrowers themselves, who for various reasons may underreport delinquency.
2.10.3 Loan Amount

As shown in Table 7, banks provide the largest loans in rural credit markets. The average bank loan (N$36,411) is almost nine times larger than the average loan granted by chartered non­bank intermediaries (N$4,166). Moneylender loans run at N$3,170 and thus place third in rank. For commercial credit, the average amount is N$1,880, while other institutions offer the smallest loans, which average N$869.

The average amount provided to different groups of REs also varies considerably: for example, REs devoted exclusively to agricultural activities received cash-loans averaging N$10,800, which is twice the average received by REs focusing on nonagricultural activities (N$4,000).

The differences in the average size of the loans granted by each type of lender are consistent with the distribution of their transactions when judged by loan amount. Banks, for example, have a clear preference for comparatively large transactions: 85 percent of their loans were for N$10,000 or more. Loans of this size category accounted for 98 percent of bank disbursements.

2.10.4 Collateral and Guarantees

There are three types of collateral and guarantees used in the three regions studied: real collateral, fiduciary guarantees (borrower or cosigner) and verbal promises. Real collateral corresponds to tangible assets—real estate or movable goods— that borrowers pledge to get the loan. When a loan is granted on verbal promises, it means that nothing was offered to secure the transaction.

Instead of using such tangible assets as real estate and movable goods as collateral, lenders in the regions studied rely heavily on fiduciary contracts and informal agreements to guarantee repayment of the loans they grant. Banks have the strictest collateral requirements. As shown in Table 7, 41 percent of individual loans disbursed by banks required tangible assets such as mortgages on land and movable goods as collateral. Even so, the remaining 59 percent of bank loans were granted on fiduciary contracts.
Chartered non-bank intermediaries also count heavily on fiduciary guarantees for their loans, which were used in 86 percent of their transactions, for the equivalent of 69 percent of their disbursements. Moneylenders rely primarily on promises from their borrowers rather than on tangible collateral to enforce credit contracts. Fifty-five percent of the moneylender loans granted were based on the fiduciary responsibility of the borrower (e.g., pagare). The second most common guarantee accepted by moneylenders is a verbal promise.

<table>
<thead>
<tr>
<th>Type of Lender</th>
<th>Loan Amount (N$)</th>
<th>Repayment Terms (Months)*</th>
<th>Monthly Effective Interest Rate (%)</th>
<th>Flexible Terms</th>
<th>Real Collateral</th>
<th>Verbal Promises</th>
<th>Repayment Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CASH-LOANS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal Sector</td>
<td>16,736</td>
<td>14.1</td>
<td>2.2</td>
<td>2.5</td>
<td>40.7</td>
<td>-</td>
<td>28.7</td>
</tr>
<tr>
<td>Banks</td>
<td>4,166</td>
<td>10.4</td>
<td>2.7</td>
<td>-</td>
<td>7.2</td>
<td>7.2</td>
<td>30.1</td>
</tr>
<tr>
<td>Other Registered Institutions</td>
<td>869</td>
<td>6.4</td>
<td>0.1</td>
<td>6.6</td>
<td>-</td>
<td>8.9</td>
<td>17.0</td>
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<tr>
<td><strong>Informal Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Moneyminder</td>
<td>3,170</td>
<td>4.1</td>
<td>10.7</td>
<td>47.8</td>
<td>14.2</td>
<td>25.7</td>
<td>11.5</td>
</tr>
<tr>
<td>Friends and Relatives</td>
<td>878</td>
<td>2.6</td>
<td>0.0</td>
<td>58.7</td>
<td>1.4</td>
<td>90.3</td>
<td>4.3</td>
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<td><strong>COMMERCIAL CREDIT</strong></td>
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<tr>
<td><strong>FORWARD SALES</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural. Transactions with flexible contractual repayment terms were excluded from calculations.

Table 7 Characteristics of Credit Transactions: Amount, Repayment Terms, and Interest Rate in Three Selected Rural Areas of Mexico: Supply Side.

As might be expected, friends and relatives require the least stringent collateral requirements. Ninety percent of loans disbursed by this group are based on verbal promises, which also account for 86 percent of the amount disbursed.

Commercial credit, like cash loans, is granted on the creditor's trust; 95 percent of commercial credit transactions were not supported by any form of collateral, including 40 percent...
of the transactions based solely on the verbal promise of the debtor. The generalized lack of collateral and legal instruments is both a reflection and a cause of highly personal relationships between debtors and creditors. This contrasts sharply with developed financial markets in which transactions are mostly impersonal.

Forward sales fit the pattern of informality observed for most financial transactions in the regions surveyed. The vast majority of forward-sale contracts are rather informal and built around the trust of the parties involved, as indicated by the fact that 79 percent of them were based on verbal promises. In 8 percent of the transactions, the sellers were required to sign a promissory note (pagare) for the amount received in advance, and only 2 percent of the transactions were formalized by a legal contract (contrato privado) establishing the commitments and responsibilities of the parties involved (e.g., date of delivery of the goods, quality requirements).

The introduction of collateral requirements increases the riskiness of borrowing —risk averse farmers may drop out of the market. For example, 20 percent of rural entrepreneurs in Mexico declared that they did not borrow because it was too risky. Gonzalez-Vega and Torrico (1995) found in Honduras that among 115 farmers who did not apply for credit, 50 had decided not to because of the riskiness involved.

2.10.5 Borrower Transaction Costs and Timeliness of Loans

When choosing among potential lenders, borrowers pay close attention to the speed and timeliness of the disbursement, especially when cash needs are urgent or unexpected.25 Borrowers tend to be more concerned with other variables (e.g., interest rates) when deciding about the sources of funding for, say, capital investments. For the most part, however, the speed and timeliness of disbursement together with the transaction costs of borrowing greatly affect RE decisions regarding whether to participate in credit markets. Thus, 13 percent of REs who did not request cash loans said they considered the process too lengthy and costly.

25 The survey questionnaire was designed to obtain rough estimates of borrowers' transaction costs. Nonetheless, estimated transaction costs for different types of lenders are consistent with studies elsewhere and with expected results—as reported. Note also that the calculation of transaction costs do not take into account the maturity of loans (i.e., not annualized).
The speed of cash loan disbursement, measured as the time elapsed between the loan application and actual disbursement, varies with the size of the loans. That is to say, those lenders who provide the smaller loans are also the ones who disburse cash loans faster. Figure 3 shows that friends and relatives disburse their loans faster than any other group of lenders: they take three days on average. Next, moneylenders take about 10 days to disburse. Formal institutions, chartered non-banks and banks, take an average of four and 14 weeks, respectively.

Those lenders who are slower to disburse also impose higher transaction costs on the borrowers. Those costs are usually highest with banks, where costs are on average N$710 per loan and three percent of the amount borrowed, as shown in Table 8. Borrowers transaction costs were measured as the expenses incurred by the borrower for each trip to the lender plus the opportunity cost of travel time. The minimum daily salary of the RE’s locality of residence was used as a proxy to the opportunity cost of time.\footnote{Borrower transaction costs may be underestimated because expenses related with the production of financial statements or getting references are not included in the calculations.}

Transaction costs are much lower for loans from chartered non-bank intermediaries. These costs average about N$40 and represent 1 percent of the amount borrowed. The informal sector (\textit{i.e.}, moneylenders, friends, and relatives) offers borrowers the lowest transaction costs, about N$12 on average. The costs average about 0.7 percent of the amount lent from moneylenders, and
I percent of loans from friends and relatives. The latter are slightly higher than the former because friends and relatives provide smaller loans than moneylenders.

The costs of borrowing vary greatly in part because of the geographic distance between borrowers and lenders. As shown in Table 8, the average distance between REs and the moneylenders and friends and relatives from whom they borrow are 4 kilometers, whereas in the case of bank loans the corresponding distance is 31 kilometers. In the former case, creditworthiness can be established and acquired through local information about the applicant's character and reputation at a low marginal cost.

Perhaps more importantly, lending technologies used to screen loan applicants and the abilities of REs to convey creditworthiness information to lenders govern transaction costs for both borrowers and lenders. The cost for lenders of producing sufficient information to support a credit contract (e.g., cost of screening, monitoring and enforcement) can be substantial and it is normally the main component of their costs.° For example, loans with non-possessory pledges (e.g., pawning) imply low information costs to lenders because the value of the pledged good provides all the information required to assess the probability of repayment. In order to minimize valuation costs, lenders use movable goods such as jewelry that have a well established secondary market.

Transaction costs for informal sector loans suggest that in these cases borrowers do not have to incur significant expenses such as lengthy trips and hence sizable amounts of foregone income to establish their creditworthiness. In contrast, formal bank technologies imply that REs do have to make many trips to get a loan. As shown in Table 8, banks' borrowers reported an average of six trips, while moneylenders' borrowers reported an average of one trip. A theoretical model of Mexican RCMs should analyze the effects of borrower and lender transaction costs on the gains of a match. Loan demand also governs the matching of borrowers and lenders from a given source,

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27 The elements of lending technology are analyzed in detail in Chapter 3. Particular attention is given to the information component of such technology (borrower screening, monitoring of projects, and enforcement of contracts).
because REs (with small or large credit demands) care about the magnitude of transaction costs relative to loan size.

<table>
<thead>
<tr>
<th>LENDER</th>
<th>Borrower Transaction Costa (%)</th>
<th>Number of Trips</th>
<th>Timelinessb (Months)</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASH LOANS</td>
<td>120.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal Sector</td>
<td>3.3</td>
<td>315.8</td>
<td>3.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Banks</td>
<td>3.0</td>
<td>710.4</td>
<td>6.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Chartered non-banks</td>
<td>0.9</td>
<td>38.8</td>
<td>1.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Other Register Institutions</td>
<td>8.0</td>
<td>40.5</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Informal Sector</td>
<td>1.0</td>
<td>11.6</td>
<td>1.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Moneylender</td>
<td>0.7</td>
<td>12.2</td>
<td>1.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Friends and Relatives</td>
<td>1.3</td>
<td>11.8</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Trader</td>
<td>0.0</td>
<td>0.2</td>
<td>1.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Positive Interest Rate</td>
<td>1.5</td>
<td>223.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Interest Rate</td>
<td>2.4</td>
<td>15.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMERCIAL CREDIT</td>
<td>2.0</td>
<td>17.0</td>
<td>0.6</td>
<td>-</td>
</tr>
<tr>
<td>Positive Interest Rate</td>
<td>2.4</td>
<td>28.7</td>
<td>0.8</td>
<td>-</td>
</tr>
<tr>
<td>Zero Interest Rate</td>
<td>1.8</td>
<td>8.6</td>
<td>0.5</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: *Encuesta Regional de Servicios Financieros a Unidades de Producción Rural.*

*a* Borrower transaction costs are defined as the expenses incurred by the borrower for each trip to the lender plus the opportunity cost of the travel time measured by the minimum daily wage locality.

*b* Timeliness is defined as the time elapsed between loan application and loan disbursement.

Note: Borrower transaction costs for sales with a downpayment are not available from the questionnaire. These costs should be smaller than for cash-loans or commercial credit. Ladman, de la Viña, and Liz reported that in the Dominican Republic borrower transaction costs of engaging in contract farming represented 0.25 percent of the average loan size.

Table 8 Borrower Transaction Costs by Type Lender and Credit Transaction
2.11 Summary

This chapter described rural credit markets in Mexico. The data set comes from a survey of rural entrepreneurs and a series of case studies in three selected rural areas. Rural entrepreneurs are diverse in terms of their economic activities, gender, formality, and ethnicity.

Mexican rural credit markets are different from those in other countries in various aspects. First, interlinked credit transactions (forward sales) represent 8 percent of the total number of transactions and only 3 percent of REs engaged in these transactions. The limited frequency of agricultural forward sales or interlinked transactions in the regions studied contrasts with the stylized facts that characterize RCMs in other developing countries, particularly in Asia. The massive intervention of the government in the rural economy has been a likely contributing factor in the absence of interlinked contracts.

Second, participation rates in credit markets in Mexico are much lower than those reported in the rural areas of other countries such as Bolivia, Costa Rica, Honduras, Nigeria, The Philippines, and Thailand. These low participation rates may be determined by weak supply of and demand for credit in the regions studied.

A combination of factors hinder the supply of credit: (i) attenuated property rights which increase the riskiness of borrowing and lending; (ii) traditional banking technologies entail a large fixed cost which is incompatible with small markets; (iii) government intervention in output and input markets have hampered the development of informal sources of finance, such as supplier and crop purchaser credits; (iv) high information and contract enforcement costs due to changing market relationships during a period of structural transformation; and (v) government debt-forgiveness programs have had a negative spillover effect by promoting strategic default. Traditional banking technologies push up borrower transaction costs in absolute terms, while in average REs required small loans. For example, the average TCs of a bank loan was N$700 while the average loan amount of loans from friends and relatives was of N$875.

The weak demand for credit is affected by two main factors. The first one refers to the inadequacies of the legal framework for creating, perfecting, and enforcing security interest result
in high ratios of collateral value to loan size and in the absence of opportunities to offer movable goods as collateral. The second one is related to high transaction cost of borrowing that induce entrepreneurs to self-select themselves out of the market. Both the supply of and demand for credit have been weakened by the difficulties of using movable goods as collateral. Owing to the inadequacies of the legal framework and enforcement mechanisms, movable goods are rarely used as collateral in the regions studied.

Third, the data show that Mexican rural credit markets have the highest level of matching with a sector among those countries, as 91 percent of borrowing REs engage in credit transactions with only formal or only informal lenders. Furthermore, REs tend to be rather monogamous debtors, as most of them use only one type of credit transaction, are matched with only one sector, and are matched with only one lender. It seems that lenders specialize in serving different clienteles, and that entrepreneurs have a comparative cost advantage in borrowing from certain lenders.

Fourth, the informal credit market sector plays an important role in the rural economy. This is shown by 41 percent of REs who reported borrowing from informal lenders. In contrast, 8 percent of REs engaged in credit transactions with formal lenders.

The characteristics of the credit services provided by formal and informal lenders are different in terms of interest rates, repayment terms, loan size, and borrower transaction costs. The interest rate charged by moneylenders is about five times higher than interest rates charged by formal lenders. In addition, the variation of interest rates is greater for the informal sector. For example, commercial credit transactions carry an average monthly interest rate of 16 percent, while moneylenders charge an average rate of 10.7 percent.

The objective of the next two chapters is to model the economic behavior of entrepreneurs and lenders to take into account differences in technologies and information structures. The main objective is to model the empirical regularities presented in this chapter.
3.1 Introduction

This chapter develops a theoretical model to examine how the transaction costs associated with efforts to modify information structures, the nature of lending technologies as well as the entrepreneur's signaling abilities affect the gains from a match between a lender and an entrepreneur. This pairwise analysis allows for an evaluation of the conditions that affect the entrepreneur's decision to participate in credit markets—request a loan—and his choice of lender(s)—formal or informal.\(^{28}\)

Two types of lender and borrower transaction costs are analyzed with the theoretical model: fixed and proportional costs of engaging in a credit transaction. Changes in these costs modify the total surplus of a match, due to the resulting changes in equilibrium interest rates and loan amounts.\(^{29}\) Under some circumstances, entrepreneurs may choose not to participate in credit markets, due to high \textit{ex ante} transaction costs, in which case their participation constraint is not satisfied. In other cases, high lending costs result in high interest rates, and again there is not gain from trade. Furthermore, the lack of an adequate economic infrastructure increases the transaction costs of lending and borrowing. These costs arise from the absence of institutions that define and

\(^{28}\) The gains of each match are specific to any borrower-lender combination.

\(^{29}\) The total surplus of a match is defined as the sum of the borrower's and the lender's expected profits.
enforce contracts. These two situations have implications for policy interventions in rural credit markets.

Besides considering different specifications of transaction costs, the theoretical model is extended to allow for divergences in the information structure of entrepreneurs and of lenders. The model focuses on the direct screening activities of lenders, which are an important component of lending costs for Mexican informal lenders.\textsuperscript{30}

This chapter begins with a description of lending technologies. A review of the literature on the problems of contractual relations between borrowers and lenders is presented. The chapter next develops a benchmark model of a lender and an entrepreneur that interact under different information structures and specifications of screening and borrowing costs. Two types of screening technologies will be analyzed: perfect and imperfect screening. The resources spend gathering and analyzing information about potential borrowers yield an unbiased estimator of the RE’s true risk type. Information is symmetric and lenders do not make errors when classifying potential borrowers.\textsuperscript{31} However, in some cases the acquisition of symmetric information is too costly and lenders choose to make errors when evaluating the credit risk of a loan applicant. These errors have an opportunity cost for lenders and increase total lending costs. Finally, changes in contractual equilibria are compared across the different scenarios described above.

3.2 Lending Technologies

Anyone involved in providing credit services — be it an individual or an organization — must employ a systematic method to do so. Such a method may be regarded as a technology of granting credit. Two components may be distinguished in the technology: operational tasks and information management.

\textsuperscript{30} The relative importance of screening, monitoring, and enforcement costs depends on the lending technology and the characteristics of credit contracts.

\textsuperscript{31} Information is symmetric when both agents — borrowers and lenders — have access to the same information set.
3.2.1 Operational Component

The operational component of the technology is related to the organizational structure, management information systems, physical infrastructure, financial management techniques, and internal control mechanisms of lenders. It is closely associated with fixed costs. The importance of the operational component of the technology increases with the existence of delegation of lending decisions to employees and with the size of the organization.

Traditional banking organizations may not be competitive in lending in small rural localities because of the relative importance of the operational management component in their lending technology. These markets are too small to sustain large fixed-cost structures.

3.2.2 Information Component

The information component of the technology reflects a particular solution to the problems that characterize RCMs. The problems of RCMs arise from differences in information between borrowers and lenders and the separation of disbursement and repayment over time. First, borrowers have private information about their probability of repayment or risk type. Lenders may face an adverse selection problem because the terms of the credit contract may influence the quality of their loan portfolio and the distribution of returns.\textsuperscript{32} Second, after disbursement occurs, borrowers can change the probability of repayment by engaging in certain actions, such as diverting borrowed funds to other activities, changing investment projects, or exerting a sub-optimal level of effort. There is then a moral hazard problem, because borrowers do not face all the consequences of their actions in case of default, due to limited liability, and because lenders are not able to perfectly monitor the use of the funds. Third, lenders face an enforcement problem, because borrowers can willingly default on their loans.

\textsuperscript{32} A market outcome will exhibit adverse selection when there is asymmetric information and the quality (riskiness) of the good traded depends on the price (interest rate) [Akerlof, 1970]. In other words, adverse selection arises because lenders are forced to treat heterogeneous borrowers as identical. Adverse selection results in inefficiency, because some Pareto optimal transactions do not occur. It should be pointed out that models of adverse selection do not take into account that agents can refine their information set acquiring information.
Lenders can use two alternative methodologies to deal with the information problem: direct and indirect (incentive) methods [Hoff and Stiglitz, 1990; Devinney, 1986]. The information technology chosen determines the cost structure of producing financial services.

3 Indirect or Incentive Method

Theoretical studies of the behavior of lenders and borrowers under asymmetric information involve the strategic interaction of agents resulting from the problems of adverse selection, moral hazard, and enforcement. The approach used to review this literature is based on each of these problems.

Most models that analyze the indirect mechanisms to allocate credit use the principal-agent framework to obtain the optimal set of credit contracts offered to potential borrowers. This framework is in the spirit of mechanism design. The lender chooses a game to motivate borrowers to self-select themselves into their corresponding risk categories, to take actions that reduce the probability of default, and/or to provoke them to willingly repay their loans. Credit contracts are usually modeled as debt contracts with a vector of characteristics such as interest rates, loan size, collateral requirements, borrower transaction costs, the threat of terminating relationships, monitoring activities, and the like. Thus, lenders can modified these characteristics to induce self-selection.

Adverse selection models assume that borrowers have private information about their risk type, and that lenders know borrower preferences over credit contract characteristics and the population distribution of borrower types. These models derive the characteristics of an optimal set of contracts that induces borrower self-selection. Self-selection is possible because the borrower's marginal rate of substitution between each pair of entry of the vector of characteristics of the credit contracts (e.g., loan size, interest rate, etc.) depends on his risk type. For example, Milde and Riley (1988) analyzed the case in which separation of borrowers into risk classes is obtained because of different marginal rates of substitution between loan size and interest rates. Loan size signals the borrower's risk type. The authors obtain the standard result that bad-risk

53 Those models assume that borrower preferences are characterized by the single crossing property.
borrowers exert a negative externality on good-risk debtors. This externality occurs because the separating equilibrium set of contracts consists of the symmetric information contract for the bad type, and a suboptimal contract for the good-risk (i.e., lower expected profits).

Collateral may be used as a signaling device to convey information to lenders about borrower risk type. Bester (1985), for example, shows that when collateral is used as a signaling device, good-risk borrowers will signal their creditworthiness by pledging more collateral in order to get lower interest rates. This is so, because good-risk borrowers (i.e., higher probability of success) exhibit a higher marginal rate of substitution between interest rates and collateral requirements.

Wang and Williamson (1993) allowed lenders to have access to a perfect screening technology. Lenders can incorporate as an element of loan contracts the probability of screening activities. The authors analyzed the characteristics of the optimal set of contracts that induce potential borrowers to tell the truth about their risk type. They reach a very intuitive result that good-risk borrowers would be those accepting a loan contract with a positive probability of screening, to get a lower interest rates.

Various indirect mechanisms can be used to solve the moral hazard problem, depending on the contractual relationship lasting one or more periods. If the agency relation lasts only one period, lenders can require borrowers to pledge hostages (collateral) or monitor their actions. However, if the credit relationship lasts more than one period, lenders can resort to the threat of terminating the relationship or use reputation effects.

The role of collateral has been analyzed as an incentive instrument to induce borrowers not to default or not to undertake riskier projects than originally proposed. Bester (1987) has shown, that borrowers that have stipulated in their contract lower collateral and higher interest rates, will prefer investment projects with a lower probability of success. In contrast, Chan and Kanatas (1985) argue that when collateral is used as an incentive device, lower-quality borrowers, will required to pledge higher levels of collateral. Berger and Udell (1990) present empirical evidence suggesting that collateral use is associated with riskier borrowers, rather than with safer ones.
Monitoring of borrower actions is another mechanism to deal with the problem of moral hazard. However, costly information acquisition about borrower actions makes sense if the lender is able to modify the behavior of the borrower when she finds out that the borrower has engaged in activities that worsen the probability of repayment and/or if the threat of monitoring induces borrowers to exert the right amount of effort. Therefore, it matters if lenders (principals) can credibly commit to carry out the monitoring activity. The literature emphasizes delegated monitoring. Consequently, the question of who is doing the monitoring is important. Stiglitz (1990) studies the case of peer monitoring and Conning (1995) looks at traders as performing monitoring activities for banks (uninformed lenders).

Stiglitz and Weiss (1983) studied the question of why banks refuse to lend to defaulters. Rationing is examined as an incentive device to avoid moral hazard problems. In a two-period model, the vector of characteristics of loan contracts includes contingent interest rates and probability of receiving a loan in the second period. Therefore, banks can link the availability of credit and the terms of credit in the second period to the performance of the first period. The authors determine the equilibrium loan contract to show that it may be optimal for banks to refuse lending to defaulters.

Models studying the enforcement problem deal with the issue of the threat of intentional default by borrowers. Jaffe and Rusell (1976) and Blackman (1995) are representative examples of models looking at borrower’s honesty and credit fungibility. Blackman (1995) argues that credit fungibility and unobservable borrower’s time preferences determine why lenders refuse to finance investments in technological change.

In summary, indirect mechanisms solve the adverse selection, moral hazard and enforcement problem throughout the design of incentive compatible credit contracts. The main drawback of the literature on indirect mechanism is that lenders, in practice, do not have perfect information concerning the preferences of borrowers over credit contract characteristics. Furthermore, borrowers are heterogeneous in more than one dimension (say wealth). The literature ignores how lenders gather information about the general characteristics of the population.
Consequently, several authors have emphasized the use of direct mechanisms to screen potential borrowers in developing countries or by informal lenders [Aleem, 1990; Siamwalla, 1990; Bell, 1990; Udry, 1990].

3 Direct Methodology

The direct method consists of spending resources to acquire information. The refinement of the information partition of the lenders allows them to separate borrowers into risk classes, monitor their activities and enforce loan collection. In other words, buying or acquiring information is a feasible strategy for lenders to reduce the degree of asymmetric information. Information costs depend on the nature of the information gathering technology, the heterogeneity of REs and the lender’s a priori stock of knowledge.

The rationale for the emergence of financial intermediaries is based on their comparative advantage in screening and monitoring investment projects and in enforcing loan collection. The approach taken by the literature is to model cost or production functions of those activities directed at reducing information asymmetries. The information gathering technology consists of three parts: screening and monitoring of borrowers and enforcement of loan contracts. The associated costs are closely related to variable costs of lending and are an important element of total lending costs.

Screening or borrower classification refers to actions by which a lender gathers information about the probability that a borrower will repay the loan (risk type). All lenders acquire information about their potential clients. Screening deals with the ex ante estimation of the ability of the borrower to repay and/or with the appraisal of the loan collateral. Consequently, the screening process allows lenders to reduce risk ex ante. This activity is based on the assumption that borrowers differ in their probability of repayment or risk type. The screening technology determines the efficiency of lenders in classifying potential borrowers into their corresponding risk categories. More will be said about the screening technology when it is modeled in the following sections.

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Hume (1992) related screening criteria to repayment rates by borrower classes, in order to evaluate the efficiency of screening.
The advantage of screening activities depends on the value of alternative mechanisms to
grant loans. If lenders can do better through random selection, then screening is unnecessary.
Aigner and Sprenkle (1968) examine the effect of information acquisition on lender behavior. By
spending resources on information gathering, lenders can reduce the expected \textit{ex ante} default costs,
thus earning a return on their information collection activity. Gonzalez-Vega (1976) and Devinney
(1986) also recognize that the screening technology affects the behavior of lenders.

An alternative mechanism used by lenders in developed countries to economize on
screening cost is information sharing among lenders. Nevertheless, as Pagano and Japelli (1993)
explain, the formation of credit bureaus is a recent phenomenon in those countries. The authors
present a theoretical model to explain the endogenous formation of credit bureaus and their natural
tendency toward a monopoly.

Monitoring of the borrower's behavior and investment projects is the second element of the
information component of the lending technology. Monitoring relates to the resources spent by
lenders in the oversight of the borrower's actions —after disbursement— that may affect the
previously estimated probability of repayment. Examples of monitoring are oversight of loan funds
uses, visits to places of business, disbursement of loans in-kind, evaluation of financial reports, and
disbursement of loans in installments, to match liquidity needs at every stage of the production
process, contingent upon the verification of specific actions that affect the probability of default.
In a sense, monitoring provides early warnings of potential default. It is obvious, therefore, that
monitoring is valuable only if the lender is able to induce the borrower to modify his behavior when
he has engaged (or may otherwise engage) in actions that may worsen the probability of repayment
or when the lender can proceed to early foreclosure due to violation of contract terms.

Finally, enforcement refers to actions undertaken by a lender to increase the borrower's
penalties in case of default. Examples of enforcement actions are foreclosing on collateral,
termination of relations, and reputation damage. The enforcement mechanisms available to lenders
—and their associate costs— depend on the character of the legal infrastructure and of the network
of social interactions.
Several authors have emphasized that costly screening, monitoring, and enforcement affect interest rates and how much competition exists in credit markets. Hoff and Stiglitz (1990) and Aleem (1990) argue that such costly activities raise competitive interest rates above the level that would exist under symmetric information. The degree of market competition may be affected by these activities because information costs create relation-specific capital between a borrower and a lender. For this reason, Aleem (1990) suggests that informal credit markets are characterized by monopolistic competition.

The theoretical model presented in the following sections focuses on the different costs faced by lenders when screening potential borrowers. These differences may determine the matching of borrowers and lenders. This chapter centers on costly information acquisition and specifically, on the *ex ante* screening of loan applicants.

### 3.3 Information

There are two alternative types of information used to support the screening and monitoring of borrowers and enforcement of credit contracts: standard and idiosyncratic information. Standard information consists of information generated by borrowers and/or lenders whose value is not affected by the distance between borrowers and lenders. Once standard information is generated, a set of potential lenders may use this information regardless of their identity or location. Examples of standard information are audited financial statements, real estate property appraisals, credit reports, and stock price quotations.

The alternative type of information used to support the screening and monitoring of borrowers and the enforcement of credit contracts is idiosyncratic information. The value of idiosyncratic information is affected by the distance between borrowers and lenders. This type of information can be generated at low marginal cost due to, for example, the ordinary daily interactions among residents of the same locality, agents interacting in the same markets, or due to geographical proximity or kinship. In other words, idiosyncratic information may be a by-product

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of location and proximity between lenders and borrowers. Consequently, the cost of gathering/analyzing idiosyncratic information is affected by the identity and location of the lender. Furthermore, the quality (noisiness) of idiosyncratic information declines with distance. Examples of idiosyncratic information are reputation, character, working habits, patterns of family expenditures, past performance, and rumors.

The value of information (standard or idiosyncratic) is affected by its quality, timeliness, context, and cost of acquisition. The quality of information is measured by its accuracy as a proxy for repayment capacity and willingness to repay. The context of information is the background that allows its correct interpretation. In the case of idiosyncratic information, knowledge of this background cannot be easily transmitted across distance. Consequently, the location of lenders does matter.

The choice of a predominant type of information within a lender’s technology influences the transaction costs of lending and borrowing. The latter is so because, for a given lender, potential borrowers have different costs to convey information about their creditworthiness. On the other hand, for a given potential borrower, some lenders may have a comparative advantage in gathering the required information. Such transaction and information cost differentials lead to assortive matching system in RCMs.

3.3.1 Availability and Quality of Standard Information about Borrowers

Borrower stocks of available standard information and their quality depend on the nature of their economic activities. For example, the availability and quality of financial statements depend on the size of operations of the enterprise. REs with small businesses, who hire few or no employees outside their family circle, can store all information about prices, costs, and debts in their heads. They do not need complicated internal control mechanisms because they make all decisions and control all assets. Keeping simple financial records of their businesses is rational for them. In addition, the size of the economic activity also affects the degree of jointness of consumption and production decisions. If consumption and production decisions are not separable, the entrepreneurs’ willingness to repay a loan may be affected by the very inelastic priorities
regarding the allocation of available cash at any point in time. Hence, records of RE economic activities would provide—even if they were maintained—little information regarding the ability and willingness to repay a loan.

The small size of economic activity and jointness of consumption and production decisions increase the relative quality of idiosyncratic information as a proxy for the ability and willingness to repay. Vigano (1992) argues that informal lenders evaluate credit risk using "symptomatic information" which can be interpreted as "symptoms of customers' economic and financial conditions and of their ability to repay, with a reasonably low error margin."

Entrepreneurs' investment in acquiring standard information can be modeled as a signal. It is assumed that the entrepreneurs' decision regarding the amount of standard information to have readily available is independent of their decision to apply for a credit contract.

3.3.2 Lender Endowments of Idiosyncratic Information

As explained in a previous section, the lenders' identity and location affect their available stock of idiosyncratic information about a potential or existing client. Lenders vary in terms in their available stock of idiosyncratic information regarding a potential pool of borrowers. It must be noted that idiosyncratic information is a by-product of the proximity with the borrower. This proximity may be due to physical distance and to contact in other markets or social groups.

3.4 Non-bank Lender Technologies in Mexico

This section presents the findings of the case studies of non-bank lenders who provide credit services in three selected areas of Mexico. The main objective is to describe their lending technology and the associated cost structure.

3.4.1 Moneylenders

Moneylenders were defined as those individuals who provide credit contracts with a profit motive. Fourteen moneylenders were interviewed in three selected rural areas of Mexico. The case studies established that moneylenders are typically devoted to other economic activities beside lending. Moneylenders are also traders, politicians, lawyers. The diversification of activities is
the result of a limited number of clients and is a means of reducing business risk due to systematic correlation of clients' income. Because moneylenders operate in a small geographical ratio, their clients are usually devoted to the same economic activities. The reported number of borrowers range from 25 to 100.36

The majority of the moneylenders interviewed operate with low fixed costs. This is because moneylenders run their lending-related activities—screening, loan disbursement, and loan collection—by themselves. Low fixed costs are consistent with the comparatively reduced volume of their operations; i.e., few borrowers and small-size loans. Mexican moneylenders use their own resources or borrow from formal lenders to maintain their lending activities. This is consistent with the findings of other studies [Aleem, 1990; Bell, 1990].

Moneylenders can be classified depending on the methods they use to screen borrowers and enforce credit contracts: (a) those who rely solely on collateral, mainly real estate and (b) those who rely on the applicant's personal attributes and local reputation. Collateral-based moneylenders use the value of the pledged asset as the indicator of the probability of repayment of the loan or the riskiness of the loan. As a result, their information technology is similar to that used by banks. The most interesting findings about this group of moneylenders were the use of other repayment assurances that expose borrowers to opportunistic behavior, in addition to high ratios of loan to collateral value. Some lenders, for example, do not require a mortgage but will ask for the actual transfer of the title on the real estate pledged as collateral. Other moneylenders also require their borrowers to sign blank or partly blank legal documents. Under such circumstances, the credibility problem surrounding credit contracts shifts from borrowers to lenders, who have to promise the return of pledged assets when loans are repaid and not to take undue advantage of signed blank documents.

In contrast, character-based moneylenders grant loans either on a verbal promise or on the fiduciary responsibility of the applicants (e.g., pagaré). Such credit contracts are based almost on

36 Sianwala et al. (1990) reported that the number of clients of Thailand moneylenders range from one to forty-five.
pure trust and therefore require close, almost personal, relationships between borrowers and lenders. These moneylenders screen borrowers by using idiosyncratic information on the borrower's character. This includes variables such as work habits, patterns of household expenditures, and the applicant's involvement in economic transactions that require an honest reputation in the market. Character-based moneylenders normally know their applicants who come from the same location, but in many cases additional information is acquired through references of political authorities or of another borrower trusted by the lender. In some cases moneylenders declared that they investigate the ability and character of their potential clients.

Significant monitoring activities were observed in the absence of enforceable collateral. Moneylenders reported monitoring to verify that the investment plan is actually carried out and to avoid a diversion of funds to other uses. A mechanism used to verify investment plans is the sequential disbursement of loan installments, conditional on certain actions being carried out. Lenders declared to obtain information about borrowers' actions through surprise visits and comments from neighbors and other borrowers.

Character-based moneylenders solve the pure enforcement problem (willingness to pay) by relying on references and informal credit bureaus in which individual credit histories are assembled. If a borrower defaults on a lender and such lender is trustworthy to other lenders, the other lenders may deny future credit. This form of collusion among character-based moneylenders exists only among very small groups of moneylenders who live close to each other. Credit bureaus can be classified by the type of information shared. Formal credit bureaus share standard information and as a result there is a tendency towards a natural monopoly as Pagano and Japelli (1993) have shown. In contrast, informal credit bureaus are a mechanism used by character-based moneylenders to screen borrowers and enforce contracts. The information shared is idiosyncratic information and this enforces the local character of these informal credit bureaus.

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37 The monitoring activities also depend on how movable the collateral is. In Mexico, movable assets are rarely used as collateral. Conning (1995) developed a principal-agent model to find an inverse relationship between collateral pledged and monitoring activities.
The number of individuals who belong to the group or network over which any lender has a cost comparative advantage is limited. This implies that the number of loans that a lender can efficiently evaluate is also limited, because assessing personal behavior and collecting nonstandard information about individuals who do not belong to the network is very costly. This limits the potential growth of a lender's business or forces him to rely on the information possessed by other members of the group.

The lending technology used by moneylenders does not totally eliminate loan defaults. Moneylenders declared that loan obligations are renegotiated if factors outside the control of the borrowers threaten loan default. In cases of intentional default, moneylenders reported that credit relations are terminated. On the other hand, collateral-based moneylenders would start a legal process to transfer collateral ownership.

Moneylenders declared that they do not expand their volume of operations because of the lack of "already known" creditworthy individuals at a given time. Furthermore, they reported that the lack of capital was not the cause for not expanding their lending operations.\footnote{Sivanwala et al. reported that there is little evidence that moneylenders in Thailand are constrained by the availability of loanable funds.}

3.4.2 Trader-Lenders and Agribusinesses

Trader-lenders and agribusinesses are individuals or companies that provide interlinked credit transactions to agricultural producers. These lenders reported three types of contracts: credit, rental, and price-hedging. The successful provision of these contracts requires also the solution of adverse selection, moral hazard, and enforcement problems through an information technology. The screening and monitoring technologies used by traders-lenders are similar to that used by character-based moneylenders. However, the main difference between them depends on the enforcement mechanisms used to assure repayment.

It was found in the case studies that two factors determine the ability to enforce contracts: (i) the agronomical characteristics of the goods produced, and (ii) the market structure for selling these goods. Agronomical properties make some crops more enforcement friendly than others and
hence more likely to be financed. For example, all three types of interlinked contracts—credit, rental, and price-hedging contracts—are available for the production of citrus but not for various other vegetables and fruits. In the case of citrus, once small fruits have bloomed, the borrower’s negligence does not affect yields. In contrast, the successful production of other fruits and vegetables depends on the borrower’s diligence up to the last moment.

The market structure of products also influences how easy it is to enforce interlinked credit contracts. Products whose markets are more competitive present more difficulties for enforcement than those that are less competitive. For example, the monopsonistic structure in the market for brewing malts facilitates the enforcement of interlinked contracts for barley. Mexico’s beer brewing companies have established a cartel (Impulsora Comercial S.A. de C.V.) for the collective purchase of their inputs, which allocates barley production quotas to individual producers. Barley to be used in the production of brewing malts commands a price at least twice that of barley to be used as forage. Trader-lenders lend to those producers who obtained production quotas with no apprehension because defaulting on a loan implies having to sell their production as forage at half price.

Sugar cane mills have similar enforcement advantages, as transportation costs of bulk sugar cane are very high and mills are located sparsely throughout rural areas. This makes the enforcement of interlinked credit contracts comparatively easier, as fraudulent borrowers would have to pay high transportation costs to sell their production to other mills. In any event, given the reduced number of regional mills, they collude in order to enforce contracts.

The trader-lenders and agribusinesses interviewed serve significantly larger numbers of borrowers than the moneylenders interviewed. They reported having hundreds of borrowers, up

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39 The case studies reveal that within citrus there are differences in terms of the types of contract offered. For example, only rental contracts were observed for lime orchards because those orchards are harvested all year round. In contrast, oranges have a comparatively short and fixed harvesting period which aids in enforcement as lenders know with precision the time at which harvesting will take place. Siamwalla et al. (1990) and Conning (1995) also present evidence that agronomical properties of the crop affect the type of credit services offered.
to 1,500 in one case. The geographic coverage of trader-lenders also seems more extended than that of moneylenders, but their transactions are narrowly focused on one crop.

3.5 Basic Model: Symmetric Information and Zero Transaction Costs

The model of Milde and Riley (1988) is modified in order to allow for heterogeneous lenders and entrepreneurs. More recently, Bell (1990) used a modification of these models to analyze the interaction between institutional lenders (credit cooperatives) and moneylenders in rural India. Esguerra (1993) used a similar model to analyze credit-linked transactions and the pattern of credit allocation in informal credit markets.

Entrepreneurs are assumed to borrow for productive purposes. The main objective of the model is to capture the fact that the surplus of a particular borrower-lender combination varies for two reasons. First, as reported above, Mexican lenders use different lending technologies that are reflected in their cost structures and financial products. Second, entrepreneurs have different ex ante transaction costs in dealing with different lenders.

3.5.1 Assumptions of the Model

i. REs and lenders live in a risk neutral world. They are assumed to be risk neutral agents and to maximize expected profits.

ii. Information is symmetric. REs and lenders have the same beliefs about the distribution of returns from the investment project to be financed with the loan.

iii. Pure enforcement and moral hazard problems are ignored.

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40 Due to interlinkages between production and consumption decisions of many rural entrepreneurs, the demand schedules of REs do not take into account the fungibility of credit. However, the model can be extended to allow for fungibility by adopting Blackman's (1995) approach.

41 In this manner the model is simplified, because we are abstracting from the effects of risk aversion on lender and borrower behavior. Risk-averse entrepreneurs are more likely not to participate in credit markets, because the cost of risk increases with the degree of risk aversion.
iv. **Lenders offer fixed-debt contracts.** That is, lenders require a fixed repayment amount despite the project's outcome. Contracts cannot be contingent upon the final project or the type of agent because monitoring is costly.

v. **One-period model.** This assumption disregards the analysis of repeated dealings and pure enforcement problems. However, the analysis is simplified without altering the results. Dynamic issues are relevant to study the persistence of matching patterns over time or the establishment of lending relationships. Several authors have used one-period models to explain the related issues of credit rationing and redlining.\(^\text{43}\)

vi. **Entrepreneurs agree to invest the borrowed funds on a specific investment project.** Borrowers do not change investment projects after the loan is granted. This rules out the problem of moral hazard or incentive problems explained in the literature, that arise when loan contract characteristics may influence the choice of investment projects.

vii. **Minimum consumption requirements are ignored.**

viii. **Limited liability.**

3.5.2 **Modeling Rural Entrepreneur Demand for Loans**

Consider an entrepreneur who seeks finance for an investment project. Initially, the RE does not differentiate between formal and informal lenders, treating both loan sources equally. The borrower-specific aggregate supply schedule determines the RE position in the market (borrower or non-borrower). The entrepreneur determines working capital requirements, taking into consideration interest rates, fixed factors of production, risk type, and endowments of standard information.\(^\text{44}\)

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\(^{42}\) This assumption may not be valid if credit contracts have an insurance component, as is likely for informal loans [Udry, 1990]. However, this type of risk-sharing arrangement looks more like an equity contract than a debt contract. Therefore, risk-trading considerations are ignored and the model focuses on debt contracts only.

\(^{43}\) See Stiglitz and Weiss (1981), and Hodgman (1960).

\(^{44}\) The equity contribution, \(E\), can be introduced by defining working capital requirements as the sum of borrowed funds and equity contribution, \(B + E\).
The entrepreneur borrows $B$ at an interest rate $r$ at the beginning of the production period. At the end of the production period, the entrepreneur sells the goods produced $Q$ at a price $P$ and repays the lender $RB$ from his productive income, $y$. Let $y = PQ$, where $P$ is a nonnegative random variable and $R = 1 + r$ is the interest-rate factor.

The entrepreneur produces $Q$ according to a production function $Q = Q(B, A, \theta; \phi)$ where $B$ is the amount borrowed, $A$ is the set of fixed factors of production, $\theta$ is an uncertainty parameter representing those exogenous variables affecting production, and $\phi$ is a set of variables representing the size and nature of the RE's operations (i.e., endowment and quality of standard information). The production function, $Q(B, A, \theta; \phi)$, is assumed to be strictly increasing in all its arguments and strictly concave with respect to the amount borrowed, $B$.

There are two sources of income risk: production and price risk $(\Theta, P)$. Price risk arises from supply or demand shifts. Production risk arises from variations in production conditions (e.g., weather, sickness of the entrepreneur) and input prices. Entrepreneurs are mainly concerned with income uncertainties rather than just production risk [Newbery and Stiglitz, 1981]. It is assumed that production and price risk are multiplicative. It is possible to define a random variable $\theta = (\Theta * P)$ that encompasses production and price risk. This random variable has a cumulative density function $F_\theta(\theta)$ defined on some finite interval, $[\underline{\theta}, \overline{\theta}]$, where $\delta$ is the entrepreneur's risk type. An increase in $\delta$ shifts the distribution downward so that the mean value of $\theta$ increases. Each

The effect of a greater $\delta$ is illustrated in Figure 4, where $\delta_2 > \delta_1$ and $F_{\delta_1}(\theta) < F_{\delta_2}(\theta)$ for all $\theta$. It is assumed that an increase in $\delta$ leads to first-order stochastic dominance, which requires that $\partial F_\delta(\theta)/\partial \delta < 0$ for all $\theta$. Furthermore, $F_\delta(\theta)$ is assumed to be bounded between $H(\theta)$ and $J(\theta)$ as shown in the following equation:

$$F_\delta(\theta) = \delta H(\theta) + (1 - \delta)J(\theta)$$  \hspace{1cm} (1)

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45 Risk is sometimes defined by the second order stochastic dominance.

46 Stiglitz and Weiss (1981) used second-order stochastic dominance to define risk type.
Production and price uncertainties imply that there is a positive probability of default. Although there are a number of ways to define default, it is assumed that the borrower defaults if the project outcome is not enough to meet loan obligations. The borrower receives $\theta Y(B, A; \phi) - RB$ whenever the outcome of $\theta$ enables the RE to repay the agreed amount, otherwise he receives nothing. It is assumed that the contracted repayment amount is bounded between the worst and the best project outcome, that is, $\bar{\theta} Y(B, A; \phi) > RB > \underline{\theta} Y(B, A; \phi)$. Therefore, there is a critical level of $\theta$ that equates the project outcome with loan obligations. Let $\hat{\theta} = \frac{RB}{Y(B, A, \phi)}$ be that critical value. Then, the probability of default is given by $F_{\hat{\theta}}(\theta)$, that is the probability that $\theta$ is less than $\hat{\theta}$.

![Figure 4: Cumulative Distribution Functions: $J(\theta)$ and $H(\theta)$](image)

The entrepreneur maximizes his expected profit from productive activities by choosing a level a level of $B$ to finance variable inputs, given fixed factors of production. It is assumed that all investment is financed by borrowing. The entrepreneur’s optimization problem is written as:

$$max_B \pi = \int_\theta^\bar{\theta} \theta Y(B, A; \phi) dF_{\hat{\theta}}(\theta) + RB[1 - F_{\hat{\theta}}(\theta)]$$

s.t. \hspace{1cm} \pi \geq \pi_0 \hspace{1cm} (2)
The first term represents the RE's receipts if the contracted amount can be repaid in full. The second term denotes loan obligations if the outcome of $\theta$ is favorable enough to enable the RE to meet the contracted amount. The entrepreneur's acceptance of a particular loan contract requires that the expected profits of the project financed with the loan exceed some minimum level, $\pi_0$. The corresponding Lagragian yields the first-order conditions:

$$\mathcal{L}_B = \pi_B = \frac{\partial \pi}{\partial B} = \int_{\delta}^{\bar{\delta}} \left[ \Theta Y_B(B, A; \phi) - R \right] dF_\delta(\Theta) \leq 0$$

$$\mathcal{L}_\lambda = \pi - \pi_0 \geq 0 \quad (3)$$

When the first equation of (3) is binding, the notional demand schedule $B^d(\lambda, A, \delta, \theta; \phi)$ is implicitly defined as a function of the interest rate factor, RE's characteristics, and other exogenous variables. The optimal loan size, $B^\star$, equates the expected marginal return—given that the realized value of $\theta$ is favorable to enable repayment ($\theta \geq \hat{\theta}$) —with the marginal cost of borrowing.

To unambiguously derive second-order conditions, equation (3) is simplified by using integration by parts and the definition of $\hat{\theta}$ as:

$$\pi_B = \left[ 1 - F_\delta(\hat{\theta}) \right] \left[ Y_B N(\hat{\theta}; \delta) + R (\epsilon - 1) \right] \leq 0 \quad (4)$$

where,

$$N(\hat{\theta}; \delta) = \frac{\int_{\delta}^{\bar{\delta}} [1 - F_\delta(\Theta)] d(\Theta)}{[1 - F_\delta(\hat{\theta})]} \quad (5)$$

and $\epsilon = (\partial Y/\partial B) (B/Y)$ is the loan elasticity of output.

Hence, the resulting second-order condition for a maximum is given by:

$$\pi_{BB} = \left[ 1 - F_\delta(\hat{\theta}) \right] \left[ Y_{BB} N(\hat{\theta}; \delta) + N_\delta \hat{\theta}_B Y_B + R \epsilon_B \right] - \frac{\pi_B f_\delta(\hat{\theta}) \hat{\theta}_B}{1 - F_\delta(\hat{\theta})} < 0 \quad (6)$$

59
As Milde and Riley (1988) show, the following conditions are necessary to satisfy the second-order conditions for expected profit maximization: (i) the elasticity of output is non-increasing in $B$; and (ii) $N$ is decreasing in $\theta$.

In describing the behavior of rural entrepreneurs, it is useful to consider his loan demand function and his isoprofit curve. The demand for loans gives the loan size that maximizes the entrepreneur expected profits at a given interest rate, and is implicitly defined by the first-order condition. The isoprofit curve is derived from the RE's expected profit function, and it gives the combination of loan size and interest rates that maintain the RE with a constant level of expected profits. Using the assumptions of the model, the following proposition characterizes the comparative static of the demand for loans:

**Proposition 1: Characteristics of Loan Demand**

(i) The optimal loan size is inversely related to the interest rate, $dB^d/dR < 0$. This is a standard result, since credit is assumed to be a normal good.

(ii) The loan demand $B^d (\cdot)$ increases with fixed factors of production. This implies that variations in loan demand occur due to differences in fixed-factor endowments. Fixed-factor endowments affect investment amounts and production techniques (see Figure 5).

(iii) The loan demand $B^d (\cdot)$ shifts to the right due to an increase in $\phi$. A rural entrepreneur endowment of standard information is associated with better production-enhancing capability and it is expected that REs with high values of $\phi$ demand more credit for a given interest rate.

[47] In the interest of expositional clarity, proofs of all propositions are presented in the appendix.
The properties of the RE's iso-expected profit curve are given by the following proposition.

**Proposition 2: Characteristics of the Iso-expected Profit Curves of Rural Entrepreneurs.**

(I) Lower isoprofit curves correspond to higher levels of profit.

(II) Iso-expected profit curves are concave around $B^d$. The isoprofit curves are positively sloped for $B < B^d$, reach a maximum for $B = B^d$, and are negatively sloped for $B > B^d$. A horizontal movement from $B^d$ implies a decrease in expected profits, so that to keep the same level of profits, the interest rate factor must decrease.

The slope of the entrepreneurs' isoprofit, $dR/dB|_n$, represents the marginal rate of substitution between the cost of credit, $R$, and the loan amount, $B$, or the marginal willingness to pay for additional credit. For $B < B^d$ the expected marginal product of credit is greater than its expected marginal cost and consequently, $dR/dB|_n$ is positive. However, for $B > B^d$ the converse is true. Figure 6 shows the relationship between an entrepreneur's loan demand and his isoprofit curves.
3.5.3 Modeling Lender Supply Schedules

As reported previously, in Mexico there are a wide range of lenders operating with different lending technologies and objective functions. Maybe no single model can capture in detail each type of lender; however, the formulation presented below extracts the essence, by connecting entrepreneur and lender characteristics into the lender’s decision.

The lender offers the entrepreneurs a menu of loan contracts maturing in one period. The loan contract consists of a loan amount \( B \) and interest rate factor \( R = 1 + r \). A profit maximizer lender chooses the optimal loan size for a given interest factor by taking into account the available information about the entrepreneur’s characteristics and the opportunity cost of funds.\(^{48}\) The cost of obtaining funds may vary across lenders of different types. This reflects the fact that lenders may have access to different sources of funds. Also, lenders differ in their scale of operations (number of clients, number of active months) so that their opportunity cost of money is different. Let \( I(\omega) = 1 + i(\omega) \) denote the opportunity cost of funds, where \( \omega \) is a vector of variables that reflect the

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\(^{48}\) It will be assumed that lenders—either banks or moneylenders—are profit maximizers. Agency problems between lenders and their employees are ignored because the added complexity will not shed light for the purposes of the model.
lender's technology. This rate is assumed to be constant, on the premise that the opportunity cost of the lender's pool of loanable funds is the same in granting individual loans.**

In the case of symmetric information, the lender observes all relevant characteristics of the RE. Then, his optimization problem is related to the entrepreneur's problem, because the lender gets the borrower's project returns whenever gross income is less than the loan obligation (limited liability). In this setting, the loan offer curve varies with the RE's characteristics and the lending technology. The optimization problem is represented by:

$$\max_B g = \int_0^\delta [\Theta Y(B, A; \phi) dF_\delta(\Theta) + RB[1 - F_\delta(\Theta)] - I(\omega)B$$

s.t. \( g \geq 0 \) \hspace{0.5cm} (7)

The first term represents what the lender receives if the RE's productive income falls short of the loan obligations. The second term denotes the gross receipts of the lender if the outcome of \( \Theta \) is sufficiently favorable to allow repayment. Finally, the last term corresponds to the opportunity cost of loanable funds.

A more intuitive way to write the lender's expected profit is:

$$g = RB - \int_0^\delta [RB - \Theta Y(B, A; \phi)] dF_\delta(\Theta) - I(\omega)B$$

because expected profits are equal to total revenues, RB, minus expected default costs (second term) and the opportunity cost of funds (third term).

The optimization program yields the first-order condition:

$$g_B = R - \int_0^\delta (R - \Theta Y_B) dF_\delta(\Theta) + I(\omega) \leq 0$$

\hspace{0.5cm} (9)

The first term is marginal revenue, R. Each unit of B earns the lender the amount of the interest rate factor, R. This reflects the positive impact of loan size on profits. The second term

**Operational costs can be modeled as fixed or proportional to loan size. Then, the specification for screening costs can be easily interpreted as operational costs.
represents the reservation cost of lending. It has two components: marginal risk cost and the marginal opportunity cost of funds.\textsuperscript{50} The marginal risk cost is the expected marginal loss in income if the borrower defaults. When (9) is met as equality, the notional supply schedule $B'(\cdot)$ equates expected marginal revenue on the loan with the marginal cost of lending.

Using the assumptions of the model, the following proposition characterizes the comparative statics of the notional supply of loans.

**Proposition 3:** The notional supply of loans $B'(\cdot)$ has the following characteristics:

(i) The loan offer curve is positively sloped. The larger the loan size, the greater the probability of default and therefore the higher the interest rate charged on that loan.

(ii) The notional supply schedule of loans shifts to the right with an increase in the borrowers' fixed factors of production. The productivity of credit increases with fixed factors of production. Consequently, the lender has more incentive to grant larger loans.

(iii) The loan offer curve shifts to the right with an improvement of the RE's risk type; \textit{i.e.}, an increase of $\delta$.

(iv) An increase in the opportunity cost of funds decreases the optimal loan size.

For the lender, contours indicating constant expected profits generated by loans made to a type $\delta$ entrepreneurs are shown in Figure 7. Each contour identifies combinations of $B$ and $R$ that yield the same value of expected profits. The characteristics of these contours are indicated in the following proposition.

\textsuperscript{50} In the model the marginal and the average opportunity cost of funds are the same.
**Proposition 4:** The lender's isoprofit curves have the following characteristics:

(I) Higher isoprofit curves correspond to higher levels of profit. Lenders prefer higher interest rates because of the positive impact of profits, for a given loan size.

(II) Iso-expected profit curves are convex around $B^*$ ($\cdot$). The isoprofits are negatively sloped for $B < B^*$, reach a maximum for $B = B^*$, and are positively sloped for $B > B^*$. A horizontal movement away from the optimal loan size implies a decrease of expected profits. Then, the interest rate factor must be increased to keep the same level of profits.

(III) The zero isoprofit curve is everywhere increasing. This follows from the assumption that $Y(B, A; \phi)$ is a concave function of $B$. An increase in $B$ thus increases returns in case of default less than proportionately, so that the cost of lending $(I'B)$ increases relative to expected income.

The slope of the lender's isoprofit, $\frac{dR}{dB}|_t$, represents the marginal rate of substitution between the interest rate factor, $R$, and the loan amount, $B$ or the marginal willingness to lend an additional unit of credit.
3.5.4 Contractual Equilibria

In the context of this model, the socially optimal set of contracts is determined by the maximization of both lender and entrepreneur's expected profits, subject to their participation constraints. The optimization problem is written as:

\[
\max_B \pi + g = Y(\cdot) \int_B^\theta \theta F_\theta(\theta) - I(\omega)B
\]
\[
\text{s.t. } \pi \geq \pi_0 \quad g \geq 0
\]

The first-order conditions for the corresponding Lagrangian are:

\[
\frac{\partial L_B}{\partial B} = \frac{Y_B(\cdot)}{\theta} \int_B^\theta \theta \delta F_\theta(\theta) - I(\omega) + \lambda g_B - \mu \pi_B = 0
\]

\[
\frac{\partial L_\lambda}{\partial \lambda} = g \geq 0
\]

\[
\frac{\partial L_\mu}{\partial \mu} = \pi - \pi_0 \geq 0
\]

From the above equations there is a unique optimal loan size, \( B^* \), when an interior solution exists. The locus of tangency points of the borrower's and lender's isoprofit curves determines the contract curve — combination of loan size and interest rate factor that satisfy the first-order conditions for the maximization of both lender and entrepreneur profits. The distribution of the surplus depends upon the bargaining power of borrowers and lenders to agree on an interest rate factor or on the degree of competition in credit markets. In this model, the contract curve is a vertical line, because the interest rate does not enter the first-order condition.

The main difference between the monopolistic and competitive solutions is how the interest rate factor is determined. In the competitive solution, the interest rate factor is determined by the zero profit condition of lenders. The lenders' expected profit will be driven down to zero, due to free entry into lending activities. As a result, the optimization program is equivalent to the maximization of the entrepreneur's expected profit, subject to the lender earning zero expected profits. In Figure 8 this is shown as point C and the interest rate factor corresponds to \( R^{\text{min}} \). The magnitude of loan-size rationing is measured as \( B^d(R^{\text{min}}) - B^* \). At point C, there is loan-size
rationing — the borrower receives a loan amount smaller than the one that maximizes his expected profits for the interest rate factor, $R_{\min}$. Uncertainties in the RE’s investment project induce an increase in the probability of total repayment because changes due to an increase of the loan size. The lender finds it optimal not to increase the loan amount because he is constrained to earn zero profits.

In the monopoly case, the interest rate factor is chosen to make the RE indifferent between borrowing and not borrowing. In other words, the lender extracts all borrower surplus and the entrepreneur’s constrained participation is binding. Consequently, the lender maximizes his profits, subject to the constraint that the entrepreneur earns his reservation level of profits. In this case, the monopolist will offer the optimal loan size $B^*$ at an interest rate of $R_{\max}$. This is shown as point M in Figure 8. In this situation the entrepreneur is getting a loan amount greater than the one demanded at that interest rate factor. The lender is making a take-it or leave-it offer.

In some cases, it may be the case that there is not an interior solution because the optimal contract curve has collapsed to the null space. It may be the case that the opportunity cost of the

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Jaffe (1971) explains the degree of competition determines the existence of loan-size rationing.
lender, $I(\omega)$, is higher than the reservation interest rate of the entrepreneur. The following proposition characterizes the comparative statics of the optimal loan size.

**Proposition 5:** The Pareto optimal loan size $B^*(\delta, I, A; \omega, \phi)$:

(i) increases with the RE’s fixed factors of production,

(ii) is positively related to the RE’s risk type, and

(iii) decreases with the opportunity cost of funds of the lender.

![Symmetric Information: Absences of Equilibria](image)

**Figure 9** Symmetric Information: Absences of Equilibria

3.6 **Asymmetric Information**

The information structure is asymmetric if some agents have information that other agents do not have. There are two dimensions of information asymmetries. One dimension of information asymmetries is related to the differences in the information partition between borrowers and lenders regarding the true riskiness of the borrowers’ investment projects. Another way to model asymmetric information is by assuming that lenders have a different assessment of the entrepreneur’s productivity, and endowment of fixed factors of production ($A$), reflecting their
limited information on borrowing entrepreneurs. The justification of the existence of financial intermediaries relies on their function of resolving information asymmetries.

Another dimension of asymmetric information between borrowers and lenders is the ignorance of borrowers about the credit contract conditions offered by lenders [Aleem, 1990]. Consequently, borrowers have to incur in search costs to investigate not only loan contract characteristics, but also the screening criteria used by potential lenders. In short, borrowers have imperfect information about the characteristics of individual lenders. This dimension of informational asymmetry is ignored in this dissertation.52

3.7 Screening Technology: Information Acquisition

The screening technology determines the efficiency of lenders in classifying potential borrowers into their corresponding risk categories. Two types of screening technologies can be distinguished: perfect and imperfect. Under a perfect screening technology, lenders do not make errors when classifying potential borrowers. In this sense information is symmetric after the lender spends resources gathering and analyzing information about potential borrowers. Several authors have modeled the screening technology as perfect [Stiglitz, 1975; Bell, 1990; Esguerra, 1993; Devinney, 1986; Bardham, Boucher and Carter, 1995].

Potential lenders differ in their cost of direct screening of potential borrowers. For lenders using idiosyncratic information, these costs may be low because idiosyncratic information is generated at a low cost through interaction with the borrower in other markets. Consequently, these differences of costs among lenders may lead to some lenders having a comparative advantage in offering credit services to some clientele.

The theoretical model analyzes the perfect screening technology under two different cost structures:

52 This introduces product differentiation. The entrepreneur must determine his optimal search rule, in order to get the best credit contract. See Philips (1988), McMillan and Rothschild (1994) for a review of the literature on consumer research.
(a) **Fixed Cost.** The lender pays a fixed amount to obtain a perfect estimator of the entrepreneur's risk type, $\delta$.

(b) **Proportional Cost.** The lender pays an amount proportional to loan size to obtain a perfect estimator of the entrepreneur's risk type, $\delta$.

The assumption of a perfect screening technology may not be feasible in the real world. As a result, lenders chose how much error to make because it is costly to avoid errors [Aigner and Sprenkle, 1968; Gonzalez-Vega, 1976]. Lenders rely on an imperfect screening technology and errors are made when classifying potential borrowers. These errors have an opportunity cost for the lender and affect his competitiveness in the market. The theoretical model is modified to analyze the lender's information acquisition process to obtain an estimator of $\delta$.

### 3.8 Perfect Screening: Fixed Costs of Information Acquisition and Signaling.

The main objective of this section is to show how the equilibrium loan amount and interest rate change as the result of fixed costs of information acquisition. In addition, the effect of fixed borrowers' transaction costs of borrowing will be analyzed. These issues are important because some authors have explained that the limited access to formal lenders by some borrowers is due to high costs of lending [Gonzalez-Vega, 1976] and high borrowers' transaction costs [Adams and Nehman, 1979; Gonzalez-Vega and Gonzalez-Garita, 1987].

It is assumed that before dealing with a new client a lender has to incur in a fixed cost of $S(\omega, \phi)$. This expenditure represents the time spent on search talking to informants about the character of the potential borrowers or evaluating collateral assets. More importantly, these costs can be interpreted as the cost of verifying that the entrepreneur does not have other loan contracts; *i.e.*, ensuring exclusive credit contracts. These costs vary with the information technology, $\omega$, and the entrepreneurs' ability to provide the information requirements of lenders, $\phi$. This reflects the fact that for a given lender, his cost of assessing the risk type of an entrepreneur depends on his information management technology and on the nature and size of the entrepreneur's activities.
Borrower transaction costs are defined as noninterest costs incurred by the borrower. These costs can be explicit and implicit [Adams and Nehman 1979]. Explicit costs are travel expenditure, entertainment, bribes and gratuities, forced purchase of other lender services and/or products, production of information requested by lenders and other expenses. Implicit costs are the opportunity costs of time spent searching and negotiating to obtain a loan and borrower's losses due to disbursement delays. The borrower incurs in these costs regardless of the loan size. These costs depend on the information technology of the lender and on the RE's endowments of the lender's information requirements.

The modeling of borrower transaction costs as fixed has certain similarities with nonlinear pricing because these costs can be interpreted as an entry fee. As different from nonlinear pricing, the lender does not get the "entry fee" paid by the borrowers. Consequently, lenders may behave opportunistically with respect to the borrowers after the entry fee is paid. However, because lenders also pay an entry fee, a relation specific-capital is created. This may lead to market segmentation and lenders' specialization into certain borrower categories.

Another interpretation of the borrowers' transaction cost is provided by Devinney (1986). The author argues that when loan applicants pay for their screening (i.e., they get an exogenous certification of their risk type), they are buying a lottery. Then the loan applicant cares whether the expected value of the lottery is positive. Loan applicants get a good draw when they receive a good contract and the bad draw is when they receive a bad contract or are rejected.

3.8.1 The Entrepreneur's Optimization Problem.

The existence of fixed borrowing costs changes the borrower's participation constraint or reservation level of expected profits. The potential borrower's decision is to apply for a loan only if the expected profits are greater than or equal to the fixed cost or entry fee. There is an endogenous self-selection of entrepreneurs into the credit market because the proportion of the fixed costs of borrowing with respect to expected profits change with fixed factors of production and endowments of standard information.
Let \( K = K(\omega, \phi) \) denote the entrepreneur's fixed costs of borrowing. These costs depend both on the lender's technology, \( \omega \), and on the entrepreneur's endowment of standard information, \( \phi \).^33 Now, the borrower optimization problem can be rewritten as:

\[
\text{Max } \pi^* = \pi - K(\omega, \phi) = \int_0^\theta [\theta Y(B, A) - RB] dF_\theta(\theta) - K(\omega, \phi)
\]

\[
\text{s.t. } \pi^* \geq \pi_0
\]

(12)

Because of the fixed nature of \( K \), the first-order condition is the same as in equation (3). In the present case, entrepreneurs require a larger minimum loan size to start demanding loans, \( B^{\text{max}} \). This minimum is that loan size that solves the participation constraint and the first-order conditions simultaneously.

**3.8.2 The Lender's Optimization Problem.**

As presented above, \( S(\omega, \phi) \) denotes the lenders' fixed cost of screening. The incorporation of fixed screening costs changes the participation constraint of the lender. The lender requires expected profits to be greater than or equal to the fixed cost of lending. Therefore, his optimization problem can be rewritten as:

\[
\text{Max } g^N = \int_0^\theta [\theta Y(\cdot) dF_\theta(\theta) + RB[1 - F_\theta(\theta)]) - l(\omega)B - S(\omega, \phi)
\]

\[
\text{s.t. } g^N \geq 0
\]

(13)

Because of the fixed nature of \( S \), the first-order condition is the same as in equation (9). However, Proposition 4 is modified as follows:

**Proposition 6:** The lender's zero isoprofit curve is convex on the \((R, B)\) space.

As shown in Figure 10, the lender's participation constraint shifts upward with the incorporation of fixed screening costs. For values of \( B < B' \), an increase of loan size for a given

---

^33 The entrepreneur transaction costs of borrowing are modeled explicitly in Chapter 4 as a function of the lending technology, \( \omega \), and the entrepreneur's endowment of standard information, \( \phi \).
R increases the expected level of profits, due to a decrease in average screening costs. Hence, the interest rate factor must decrease, to keep profits equal to zero. For values of $B > B^*$, an increase in loan size decreases the level of profits because of higher expected default costs than the reduction in average screening costs. Therefore, to keep the lender at the same level of profits, the interest rate factor has to increase.

### 3.8.3 Contractual Equilibria.

The socially optimal set of contracts is derived from the following optimization program:

$$
\begin{align*}
\max_B \pi^N + g^N &= \pi + g - K(w, \phi) - S(w, \phi) \\
\text{s.t.} \quad \pi^N &\geq \pi_0 \\
&\quad g^N \geq 0
\end{align*}
$$

The first-order condition remains the same because of the fixed nature of lending and borrowing costs, as shown by equation (11). However, the inclusion of fixed costs changes the participation constraints of borrowers and lenders. This is shown in Figure 10. Fixed costs of screening and signaling affect the decision of whether to request or grant a loan, but not the marginal conditions determining the equilibrium loan size and interest rate. Therefore, the optimal loan amount, $B^*$ is the same.

![Figure 10 Fixed Costs: Contractual Equilibria](image)

Figure 10 Fixed Costs: Contractual Equilibria

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Proposition 7  The new contractual equilibria are characterized by:

(i) A reduction of the length of the contract curve. Hence, it can be the case that the contract curve collapses to the null space as the sum of $S(\omega, \phi)$ and $K(\omega, \phi)$ become high enough. The length of the contract curve is given by \( \max \left\{ R^{\text{min}} - R^{\text{max}}, 0 \right\} \), where $R^{\text{min}}$ solves $\pi^N (B^*, R^{\text{min}}) = 0$ and $R^{\text{max}}$ solves $g_N (B^*, R^{\text{max}}) = 0$. Figure 10 shows that the length of the contract curve is reduced from MC to M'C'.

(ii) If credit markets are competitive (i.e., the lenders' expected profits are zero), then we can expect that the competitive interest rate factor will rise due to the lenders' screening costs. Investment in information raises the interest rate above the level achieved under perfect information, because lender costs are increased [Aleem, 1990; Hoff and Stiglitz, 1990]. However, borrowers' costs do not affect that rate.

(iii) If monopoly characterizes credit markets, then an inverse relationship between entrepreneurs' transaction costs of borrowing and the monopoly interest rate factor, $R^{\text{max}}$, can be expected.

(iv) For a given increase in the lenders' screening costs under a competitive market structure, the change in the interest rate for an entrepreneur with low fixed factors of production or worse risk type is bigger than for an entrepreneur with high fixed factors of production or better risk type.

3.9 Perfect Screening: Proportional Costs

The main objective of this section is to show how the equilibrium loan amount and interest rate change as a result of proportional costs of information acquisition. In addition, the effect of proportional transaction costs of borrowing will be analyzed.

3.9.1 The Entrepreneur's Optimization Problem.

It is assumed that the entrepreneur's total transaction costs are proportional to loan size. Let $\alpha(\omega, \phi)$ denote the factor of proportionality; i.e., the cost per dollar borrowed. An example of proportional transaction costs is the commission fee. As before, these costs depend on the lenders'
information technology and the borrowers' ability to signal creditworthiness. The optimization problem is rewritten as:

$$\max_B \pi^N = \pi - \alpha(\omega, \phi)B = \int_0^\delta [\theta Y(\cdot) - RB] dF_\delta(\theta) - \alpha(\omega, \phi)B$$

s.t. \( \pi - \alpha(\omega, \phi)B \geq \pi_0 \) \hspace{1cm} (15)

which yields the first-order condition:

$$\pi^N_B = \pi_B - \alpha(\omega, \phi) = \int_0^\delta [\theta Y_B(\cdot) - R] dF_\delta(\theta) - \alpha(\omega, \phi)$$ \hspace{1cm} (16)

There is a reduction in the marginal rate of substitution between the interest rate factor and the loan size as shown by the following equation:

$$\frac{\partial}{\partial \alpha} \frac{dR}{dB} = - \frac{1}{B[1 - F(\hat{\theta})]} < 0$$ \hspace{1cm} (17)

The decrease in \( R \) that the loan applicant requires in order to accept a larger loan is smaller for \( \alpha \) with higher values of \( \alpha \).

**Proposition 9:** The loan demand \( B^*(R,A,\theta, \alpha, \phi) \) decreases with the proportional cost of borrowing.

### 3.9.2 The Lender's Optimization Problem.

It is assumed that before dealing with a new client a lender has to incur in a proportional cost of \( \beta(\omega, \phi) \) per unit of amount loaned. Those costs vary with the information technology and the entrepreneurs' ability to provide the information requirements of lenders.\(^{34}\) The lender's optimization problem can be rewritten as:

$$\max_B g^N = g - \beta(\omega, \phi)B = \int_0^\delta [\theta YdF(\theta, \delta) + RB[1 - F(\hat{\theta})] - IB - \beta(\omega, \phi)B$$ \hspace{1cm} (18)

\(^{34}\) These costs are assumed to be independent of interest rates. In the section of imperfect screening, it is shown that information acquisition expenditures depend on interest rates.

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which yields the first-order condition:

\[ g_B^N = g_B - \beta(\omega, \phi) = \int_0^\delta \left[ \theta Y_\delta dF(\theta, \delta) + R[1 - F(\delta)] - I - \beta(\omega, \phi) \right] \]  \hspace{1cm} (19)

There is an increase in the marginal rate of substitution between interest rate and loan size for a given level of profits. The marginal increase in the interest rate that the lender is willing to accept in order to grant a larger loan is greater for lenders with higher values of \( \beta \) as shown by the following equation:

\[ \frac{d}{dB} \frac{dR}{dB_{g}} = \frac{1}{B[1 - F(\delta)]} > 0 \]  \hspace{1cm} (20)

**Proposition 10:** The loan offer curve \( B(\cdot) \) shifts to the left with an increase of the proportional cost of screening, \( \beta \).

### 3.9.3 Contractual Equilibria

As before, the optimal set of contracts is derived from the maximization of the sum of the borrower’s and the lender’s expected profits. The optimization program is written as follows:

\[
\begin{align*}
\text{MAX} & \quad \pi - \alpha(\omega, \phi)B + g - \beta(\omega, \phi)B \\
\text{s.t.} & \quad \pi \geq \pi_0 + \alpha(\omega, \phi)B \quad g \geq \beta(\omega, \phi)B
\end{align*}
\]  \hspace{1cm} (21)

which yields the first-order conditions:

\[
\begin{align*}
\mathcal{L}_B = Y_\delta & \int_0^\delta \theta dF(\theta) - I(\omega) - \beta(\omega, \phi) - \alpha(\omega, \phi) \leq 0 \\
\mathcal{L}_\lambda = g - \beta(\omega, \phi)B \geq 0 \\
\mathcal{L}_\mu = \pi - \pi_0 - \alpha(\omega, \phi)B \geq 0
\end{align*}
\]  \hspace{1cm} (22)

Proportional screening and borrowers’ transaction costs affect the marginal conditions for equilibrium loan size which changes with the borrower’s and lender’s proportional costs.
**Proposition 11:** The new Pareto optimal loan size $B^*(a, \delta, \beta, \theta, I; \phi, \omega)$:

(i) decreases with $\alpha (\phi, \omega)$ and

(ii) decreases with $\beta (\phi, \omega)$.

The effect of borrower and lender proportional screening and signaling costs on the competitive and monopolistic interest rate factor has two components. The first element is the loan-size effect, and the second element is the transaction cost effect.

**Proposition 12:**

(i) The effect of $\beta (\phi, \omega)$ and $\alpha (\phi, \omega)$ on the monopolistic interest rate factor, $R^{\text{max}}$, is undetermined. An increase of the lender proportional cost may lead to an increase or decrease of $R^{\text{max}}$ depending on the shape of the borrower's reservation profit level and the new loan size.

The effect of an increase of the borrower's proportional cost has two components. The first component consists of the substitution between transaction costs and interest rates. The transaction cost effect is equal to the inverse of the probability of repayment. The second component is the loan size effect which is equal to the change of the slope of the new isoprofit curve times the change of the optimal loan size.
The competitive interest rate factor, $R^{\text{min}}$, is inversely related to $\alpha(\phi, \omega)$. However, the effect of $\beta(\phi, \omega)$ is undetermined.

3.10 Comparison of Fixed and Proportional Costs

This section compares the results of fixed and proportional screening and signaling costs on the equilibrium loan size and interest rates. The following issues are contrasted:

Effect on the Optimal Loan Size. Fixed screening and borrowing costs and the fixed nature of lender and borrower costs modify the participation constraint of borrowers and lenders but not the marginal conditions determining the equilibrium loan size. In contrast, proportional borrowing and screening costs reduce the optimal loan size.

Effect on the Competitive Interest Rate. An increase of lenders’ fixed screening costs increases the competitive interest rates charged by lenders. Investments in information acquisition by lenders, raises the interest rate above the level achieved under symmetric information because lender costs are increased.

Competitive interest rates are not affected by fixed borrower transaction costs. In contrast, an increase in the borrower’s proportional transaction costs induces a reduction of the competitive interest rate, with a positively-sloped competitive supply schedule, as loan size declines. An increase of the lender’s proportional transaction costs, reduces the competitive interest rates, if the elasticity of the equilibrium loan size with respect to these costs is less than one.

Effect on the Monopolistic Interest Rate. The monopolistic interest rate is inversely related to the entrepreneur fixed borrowing costs. Higher fixed borrowing costs change increases the reservation level of expected profits of the RE, and in order to compensate the borrower for those costs, the monopolist must reduce the interest rate. However, if borrower costs are proportional to loan size, the monopolist may either reduce or increase the interest rate depending on the curvature of the new RE’s isoprofit and the effect on the equilibrium loan size.
An increase in the proportional cost of lending, may either reduce or increase the monopolistic rate because of induced changes in the equilibrium loan size and because of the concavity of the participation constraint of the entrepreneur.

Effect on the Length of the Contract Curve. Both fixed and proportional borrower and lender costs reduce the distance between the reservation rate of borrower and lender for a given loan size. However, because proportional borrower and lender costs change the equilibrium loan size, the length of the new contract curve can be larger or smaller.

3.11 Imperfect Screening

The objective of this section is to modify the assumption of a perfect screening technology, which may not be a realistic one because lenders (formal or informal) do make errors when classifying potential borrowers according to their risk characteristics.

The model of the previous sections is modified here to allow for the endogenous (and costly) collection of information on repayment-relevant variables. The endogenous determination of information collection has been analyzed by Aigner and Sprenkle (1968). The authors conjecture that lenders can reduce expected default costs by spending resources on the collection of information about their customers. Their method has been used by Gonzalez-Vega (1976) and Nagarajan (1992). The following section resembles Aigner and Sprenkle's model.

Lenders are concerned with the distribution frequency of expected profits from a loan. Entrepreneurs are endowed with a distinct attribute that affects their probability of repayment, known to themselves, but unknown to lenders. This attribute is represented by $\delta$, which summarizes all the variables affecting the profitability of the entrepreneur's economic activities. As in Akerlof (1970), lenders are assumed to know the distribution of $\delta$ in the population, but as different from that model, each loan applicant is valued as if his risk type (attribute) were the lower bound of the distribution of $\delta$.

---

55 This assumption is necessary to create a monotonic relationship between information acquisition and the estimator of the entrepreneur's risk type.
3.11.1 Information Acquisition Technology

The information function is a production function that relates information acquisition to an estimate of entrepreneur type. Lenders acquire and process new information to generate an estimator of the entrepreneur's risk type. The output of the information gathering process is an intangible service whose reliability is observable ex post.

The reliability of the estimator depends on the information technology and the loan applicant's characteristics affecting information quality. Of course, the distance between lenders and loan applicants is an important factor.

Each lender uses available private information to estimate the entrepreneur's risk type, \( \delta \), with a twice-continuously differentiable information function \( \delta(q; \omega) \). The following restrictions are imposed on the information production function:

\[
\begin{align*}
\delta(q; \omega) &= \delta - \epsilon(q; \omega) \\
\delta_q(q; \omega) &> 0 \quad \delta_{qq}(q; \omega) < 0 \\
\delta_q(0; \omega) &= \infty \quad \delta_q(\infty; \omega) = 0
\end{align*}
\] (23)

where \( q \) is the total information gathered by the lender and \( \epsilon \) is the amount of error the lender makes when estimating \( \delta \). The distribution of the error term over the interval \([0, \delta]\) changes as the lenders acquire more information about the entrepreneur. In the case of perfect screening technology, the error term is equal to zero and the probability that \( \delta(q; \omega) = \delta \) is one.

The information production function is assumed to show diminishing returns to information acquisition. As shown in Figure 12, as the lender uses more information to evaluate the riskiness of the loan, the estimate, \( \delta(q; \omega) \), is closer to the true value.
The information acquisition function is affected by technological factors, stock of available information, and the true risk type of the entrepreneur. The fact that two lenders may require different amounts of additional information to come up with the same point estimator of $\delta$ reflects technological differences or different stocks of information. As shown in Figure 13 (a) and (b) the lender with technology $\omega_i$ have a technological advantage in using standard rather than idiosyncratic information. This comparative advantage is determined by the choice of the information management technology of the lenders. For example, lenders with a technology closer to informal lenders are more efficient in processing idiosyncratic information, because of their proximity to borrowers.

In certain situations the lender may already have a stock of available information about the applicant. Let $s$ denote the stock of information available about the loan applicant. In these cases, each loan applicant is valued as the estimator given by the stock of information available, $\delta(s; \omega)$ [see Figure 13 (d)]. Differences in the stock of available information about an entrepreneur may give some lenders a comparative advantage in estimating the entrepreneur’s true risk type. For example, lender $\omega_j$ has an initial endowment of information, and this gives him an advantage with respect to lender $\omega_k$. An interesting extension of the model is a time dimension to investigate the
following hypothesis: (i) repeated dealings may lead to better contractual terms for the borrower because of declining information cost for the lender; and (ii) lenders may behave opportunistically with respect to borrowers because the cost of switching to other lenders may be high.

Finally, the true risk type of the entrepreneur also affects the shape of the information production function. As shown in Figure 13 (c) the true risk type of the entrepreneur changes the information function's plateau.

![Figure 13 Information Production Function](image)

### 3.11.2 The Lender's Supply Schedule.

The appropriate decision-making variable for the lender is the acquisition of additional information, $z$, to estimate the entrepreneur's risk type, $\delta$. Let $b(\omega, \phi)$ denote the per unit cost of information. This per unit cost of information (standard or idiosyncratic) varies with the lending technology, $\omega$, and the RE’s endowment of standard information, $\phi$. To simplify the exposition,
the lender's optimization program is solved recursively. In the first stage, the optimal amount of additional information, \( z'(B,R,A,b, \phi, \omega, \delta) \), is determined by comparing the marginal return of information acquisition with the marginal cost. In the second stage, \( z'(B,R,A,b, \phi, \omega, \delta) \) is substituted in the expected profit function of the lender.

The optimal amount of additional information is derived from the following optimization program:

\[
\begin{align*}
\text{MAX } & g = \delta(q; \omega) X'' + [1 - \delta(q; \omega)] X^J - I(\omega)B - b(\omega, \phi) z \\
\text{s.t. } & g \geq 0
\end{align*}
\]

where,

\[
X^D = \int_0^b \theta Y D(\theta) + [1 - D(\theta)] RB \quad \text{for } D = H, J
\]

The first-order condition is given by:

\[
g_z = \delta_4(q; \omega) [X'' - X^J] - b(\omega, \phi) \leq 0
\]

The first term represents the marginal return of information acquisition. This is equal to the marginal change in the estimator of risk type times the difference between the expected revenue from the better and worse risk types. The second term denotes the marginal cost of information which is assumed to be constant. When condition (26) is met as an equality, the demand for additional information, \( z'(B,R,A,b, \phi, \omega, \delta) \), is implicitly defined as a function of the marginal cost of information, loan size, the interest rate factor, borrower characteristics, and other exogenous variables. Using the assumptions of the model, the following proposition characterizes the comparative statics of the demand for information.

**Proposition 13:** The lender's demand for additional information has the following characteristics:

(I) The optimal amount of additional information is inversely related to its cost.

(II) The demand for information is positively related to the interest rate factor and loan size (\( \partial z' / \partial B > 0 \) and \( \partial z' / \partial R > 0 \)). Lenders are willing to spend more time in evaluating larger loans.
because average information costs declines with loan size. Furthermore, an increase of loan size has a positive impact on the expected profit of the lender.

(iii) The amount of additional information demanded increases with the fixed factors of production of the entrepreneur. A greater amount of fixed factors increases the productivity of credit and investing more resources to acquire information is more profitable for lenders.

In the second stage, the supply schedule of the lender is derived by taking into account the optimal amount of information obtained from the previous stage. The optimization program is written as:

\[ \text{MAX } \quad \hat{g} = \delta(q^*; \omega)X^H + [1 - \delta(q^*; \omega)]X^J - I(\omega)B - b(\omega, \phi)z^* \]  

which yields the first-order condition:

\[ \hat{g}_B = \delta(q^*; \omega)X^H_B + [1 - \delta(q^*; \omega)]X^J_B - I(\omega, \phi) \leq 0 \]  

This condition is obtained by using equation (26).

Equation (28) is identical to the first-order condition in the case of symmetric information, with the difference that it depends on the estimated risk type, \( \delta(q) \), rather than on the true \( \delta \).

The second-order condition requires that:

\[ \hat{g}_{BB} = \delta(q^*; \omega)X^H_{BB} + [1 - \delta(q^*; \omega)]X^J_{BB} - \frac{\delta^2 q(X^H_B - X^J_B)^2}{\delta q q^2(X^H - X^J)} < 0 \]  

\textit{Proposition 14:} The zero isoprofit curve of the lender is convex. Positive information cost changes the participation constraint of the lender.

The information acquisition process has two effects on the participation constraint of lenders. First, costly information acquisition increases the reservation level of expected profits that the lender needs in order to break even. Hence, the participation constraint moves upward. Second, the map of isoprofit curves based on \( \delta(q^*; \omega, \phi) \) collapses into the map of isoprofit curves based on the true risk type.
Proposition 15: The loan offer curve:

(i) shifts to the left with an increase of the per-unit cost of information.

3.11.3 Contractual Equilibria

Adding the borrower's and the lender's expected profit and differentiating this sum with respect to loan size indicates that the Pareto optimal set of contracts is given by the following optimization program:

$$\begin{align*}
\max_{B} & \quad \pi + g = \\
& \delta Z^H + [1 - \delta]Z^J + \delta (q') X^H + [1 - \delta (q')] X^J - I(\omega)B - b z' \\
& \text{s.t.} \quad \pi \geq \pi_0 \quad \hat{g} \geq b z'
\end{align*}$$

(30)

where,

$$Z^D = \int_{\theta}^{\bar{\theta}} \theta Y D(\theta) - [1 - D(\hat{\theta})] R B \quad \text{for} \quad D = H, J$$

(31)

After some manipulations, the first-order condition is given by:

$$\hat{\xi}_B = Y \theta E[\Theta | F_{\theta}(\theta)] - [\int_{\bar{\theta}}^{\delta} (R - \theta) \gamma_d(\theta) - \int_{\theta}^{\delta} (R - \theta) \gamma_d(\theta)] - I(\omega) \leq 0$$

(32)

In equilibrium, the expected marginal product of the loan is equal to its marginal cost. The marginal cost has two components: (i) the overestimation of the expected marginal risk cost and (ii) the opportunity cost of lending.

As is evident from the first-order condition, the contract curve is no longer independent of the interest rate due to imperfect screening. The following proposition presents the comparative statics of the Pareto optimal loan size.

Proposition 16 The Pareto optimal loan size $B(R, A, b)$ with imperfect screening:

(i) increases with the interest rate factor under certain conditions.

(ii) decreases with the per-unit cost of information.
3.12 Summary and Scope for Future Research

This chapter presented a benchmark model of the interaction between a lender and an entrepreneur under different structures of cost and information. The case of symmetric information was analyzed first. This is followed by the case of perfect screening technologies with fixed and proportional signaling and screening costs. The main objective of the perfect screening setting was to show the effect of these costs on the equilibrium loan size, and the competitive and monopolistic interest rates. The comparison between fixed and proportional costs were provided in a previous section.

<table>
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<th>B*</th>
<th>R*</th>
<th>R**</th>
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Table 9 Summary Perfect and Imperfect Screening Models

In the imperfect screening setting, screening costs are a function of loan size and interest rate. This makes the slope of the contract curve positively related to the interest rate under certain conditions. The main drawback of the imperfect screening setting is that it assumes the lender to have pessimistic beliefs about the risk type of the entrepreneur. The information function gives a
lower bound of the entrepreneur's risk type. A straightforward extension of the model is to introduce an additional information function that gives an upper bound of the risk type which decreases with information acquisition. It would be interesting to analyze information acquisition of lenders in a dynamic setting with repeated interactions between a lender and a borrower.
CHAPTER 4
A MODEL OF ASSORTIVE MATCHING IN RURAL CREDIT MARKETS

4.1 Introduction

The main objective of this chapter is to extend the theoretical model of Chapter 3 to allow for the introduction of heterogeneous lenders with different lending technologies and borrowers with different possibilities of signaling creditworthiness. As examined in Chapter 2, Mexican credit markets are characterized by their dual nature, in which both formal and informal lenders are important sources of credit for rural entrepreneurs. Furthermore, the data show that, in the regions studied, the comparatively few REs who did receive credit services tend to be rather monogamous debtors, as most of them received only one type of service from only one sector, and from a single source in the corresponding sector. The REs must not only decide whether to request a loan, but must also choose among the different types of lenders — formal and informal lenders. The question of choice of lender type is important.

This chapter is organized as follows. First, the literature on assortive matching in credit markets is reviewed. This is followed by a review of the literature on two-sided matching games. Then the perfect screening model with fixed signaling and screening costs of Chapter 3 is extended to allow for variations of the lender technology and the entrepreneur type — in terms of endowment of standard information — and to derive the expected assortive matching of lenders and entrepreneurs. Next, the previous model of assortive matching is reinterpreted as an assignment game between borrowers and lenders. Finally, general conclusions and future extensions of the models are presented.
4.2 Assortive Matching in the Credit Market Literature

The assortive matching of borrowers and lenders has been addressed in the literature from different perspectives: lender costs, formal rationing constraints, collateral endowments, capital structure, interaction between formal and informal lenders, and interlinked credit contracts.

Several authors have emphasized the role of lender costs or comparative advantages as the main determinant of lender specialization serving specific market niches [Gonzalez-Vega, 1976; Aigner and Sprenkle, 1968; Hoff and Stiglitz, 1993; Conning, 1993; Esguerra, 1993; Nagarajan, 1992; Muñoz, 1994]. Most studies ignore that matching is a mechanism that pairs loan demanders with lenders. Both demand and supply issues are relevant.

An important area of the rural finance literature has been devoted to explaining the poor outreach of formal lenders toward marginal clienteles and the poor financial performance of state-owned development banks in developing countries [Adams, 1984]. Essentially, two views explain the lack of access to formal credit by marginal clientele. The first one argues that formal lenders deny credit to small producers because of the riskiness of their activities and of asymmetric information. All credit transactions are characterized, however, by an asymmetry of information between the lender and the borrower. Marginal clienteles are classified by formal lenders as too risky. This may be the result of an inadequate screening technology. Informal lenders do find it profitable to lend to small REs and their default rates—as reported by borrowers—were lower for informal lenders than for formal intermediaries in the surveyed areas. The second explanation is a fixed-cost argument. Formal lenders are generally characterized for a high fixed cost structure of lending, and, as shown in Chapter 3, this reduces the gain of a credit transaction and increases interest rates.

In many developing countries, rural formal intermediaries are state-owned banks that operate under interest rate ceilings. Empirical studies that focus on analyzing formal rationing constraints generally assume that all rural households demand formal credit. Kochar (1993)

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54 Indicators of repayment problems are the amount and number of loans that experienced repayment problems as a percentage of the total amount of loans and the total number of loans disbursed, respectively.
presents a sectoral choice model of financial markets with two sectors (formal and informal), to explain the equilibrium position of a household in those markets, given formal sector distortions (e.g., interest rate ceilings). The model examines how interest rate ceilings affect the borrower's choice of lenders. The rationale behind sectoral choice is cost: borrowers would choose the least expensive source first. However, the theoretical model does not consider borrower transaction costs and the heterogeneity of borrowers in their signaling capacity with respect to different types of lenders. The model assumes that informal lenders have a comparative advantage in their screening activities over all types of borrowers. In other words, it completely ignores that formal lenders do have a cost advantage in screening certain types of borrowers.

The question that arises is, what are the underlying reasons for the lack of formal financial services in RCMs for a group of REs, when it is profitable for informal lenders to offer them? In other words, what is the driving force of the observed assortive matching system?

An interesting approach to explaining matching is offered by Calomiris and Hubbard (1990). They argue that there are different markets for external finance (e.g., symmetric and asymmetric markets). These markets then sort entrepreneurs that are heterogeneous in terms of the degree of asymmetric information (information intensity) and risk. Entrepreneurs have differential access to these markets according to their net worth position (collateral endowments). Consequently, market segmentation results.

The capital structure literature indirectly addresses the issues of choice of lender or sources of funds by posing the question of how do firms choose their capital structure. Myers (1984) presents two different views of how firms make financing choices. The static framework views the entrepreneur (firm) as setting a target debt-to-value ratio that is determined by the costs and benefits of borrowing. In contrast, the pecking order theory considers costs of asymmetric information and financial distress as determinants of a preference ordering in the sources of finance. As Myers (1984) points out, firms prefer those sources of finance that represent the least loss of ownership control for them. Under this "safety first" principle, firms prefer internal versus external sources of funds to finance investment. If external finance is needed, firms draw upon the safest type first.
Firms or entrepreneurs can draw upon internal finance (retained earnings) or external finance (loans, trade credit, interlinked transactions). The relative composition of each equity and liabilities sources determines the capital structure of the firm. Self-finance is the most commonly used form of finance for small and medium scale enterprises and farmers [Baydas and Graham, 1995; Key 1995a].

The matching of borrowers and lenders has been analyzed indirectly, through the interaction of formal and informal lenders. Hoff and Stiglitz (1993) assume the existence of a matching system in credit markets to study the effects of government funds on market interest rates and the advantages of group lending over vertical flows of funds. The model presented is about the interaction of formal and informal lenders through the vertical integration of financial markets. They argue that matching exists because the modus operandi of trader-lenders allows them to solve the screening and enforcement problem of a loan contract with small producers. Their model assumes that traders have an enforcement advantage due to these linked transactions. They fail to explain that the matching system may not only exist because of the ability of lenders to screen different types of prospective borrowers, but also because of the ability of those prospective borrowers to convey to lenders information about their repayment capacity. Other sources of finance such as the pure moneylender are ignored in their analysis.

Conning (1995) presents a mechanism-design model that focuses on the moral hazard problem of the loan contract. He argues that lenders have two mechanisms to restrain borrowers from undertaking actions that reduce the likelihood of repayment: (i) use of collateral and (ii) monitoring of borrower actions. In this model there is an inverse relationship between the value of collateral and monitoring activities. The variety of loan contracts observed shows this relationship and borrowers would choose the optimal contract given their collateral endowments. In order to monitor borrowers that have low collateralizable asset endowments, banks (uninformed lenders) would use traders—informed agents—as monitoring agents. The problem for the bank is to provide traders with the appropriate incentives to monitor borrowers.
This review of the literature concludes with a discussion of three papers on interlinked credit contracts and matching patterns in informal credit markets. The common ground of the studies of Floro and Yotopoulos (1991), Nagarajan (1992), and Esguerra (1993) is that they stress the interlocker comparative advantage on screening and enforcement. Their studies are limited to interlinked credit contracts offered by trader-lenders and farmer-lenders in the Philippines. Each of them provides different explanations to the matching of trader-lenders and farmer-lenders to farm producers.

Nagarajan (1992) argues that what really exists is a matching by occupational specialization of both lenders and borrowers. These occupational specialization results in different abilities of lenders to satisfy borrower-specific credit needs and the different endowments of collateral substitutes (e.g., output, cultivation rights, or labor services). Differential access to specialized informal lenders is observed.

In turn, Esguerra (1993) argues that lender specialization is based on collateral substitutes. Sorting of borrowers and lenders occurs because trader-lenders and farmer-lenders have different costs of screening different types of borrowers. As a result, lenders specialize in that type of borrower over which they have a comparative advantage in screening (borrowers) and enforcing loan contracts. Borrowers choose the loan contract with better terms. As in Nagarajan (1992), borrowers and lenders are classified according to their occupations.

Floro and Yotopoulos (1991) argue that divergences of objective functions of trader-lenders and farmer-lenders result in different preferences over borrower characteristics. Moreover, borrowers differ in their willingness to offer different types of output or usufruct land as collateral. Trader-lenders specialize in larger farmers because larger farmers are more likely to produce a marketable surplus of goods. On the other hand, farmer-lenders prefer small farmers, who are likely to default, in order to gain access to usufruct land. Their model demonstrated the sorting of borrowers by showing that the partial derivatives of expected profit functions of trader-lenders and farmer-lenders with respect to farm size have opposite signs.
The research of Nagarajan, Esguerra, and Floro and Yotopoulos suffers from some drawbacks. First, they look only at the informal sector, even though 31 percent of households borrowed from the formal sector [Nagarajan, 1992]. In addition, their analysis focuses on interlinked transactions, ignoring other credit services. In many cases, interlinked transactions are not only used as a source of finance, but also as price-risk insurance mechanism for farmers. As presented in Chapter 2, the use of interlinked transactions by rural entrepreneurs is very limited in rural Mexico. Furthermore, even though these authors propose that interlinked contracts act as collateral substitutes, it is very hard to believe that a promise to deliver the harvest is more credible than a promise to pay a loan back. This is only true if there is a sole buyer of the product in the market or if buyers are perfectly colluded. Finally, there is a matching of borrowers and lenders because of their occupation in the product or labor market. This result does not allow for generalizations to other countries where there is not an infrastructure of traders and landlords.

In summary, both supply and demand issues must be considered in the theoretical modeling of matching. Lending and signaling technologies and their associated transaction costs are the main determinants of matching patterns in rural credit markets. The theoretical model developed in this chapter incorporates lenders with different lending technologies. Lending and signaling technologies and their associated transaction costs are the main determinants of matching patterns in RCMs.

4.3 Two-sided Matching Games

The theoretical literature on matching games has two streams: centralized and decentralized games. One side of the literature has focused on the study of procedures used by a central organization (i.e., a clearing house), to generate matching outcomes in certain markets, such as the labor market for medical interns [Roth and Sotomayor, 1990] and sororities rush [Mongell and Roth, 1991]. In centralized matching procedures, participants do not sort themselves out

Data from Esguerra (1993), and Floro and Yotopoulos (1991) about the relative importance of formal lenders is not available.
individually to other participants, but rather present their ranking of choices to the central organization which then generates a matching with the help of an algorithm. The questions are: do players have incentives to reveal their true preferences? Is the matching outcome stable? Roth (1991) sensed that a centralized mechanism to solve the matching game may have appeared in markets such as medical interns and sororities because there is a tendency for one set of agents (e.g., hospital and/or sororities) to make offers very early in order to guarantee quality members. This type of behavior turns out to be detrimental for both sets of agents and a centralized procedure appears to eliminate these perverse behaviors.

The decentralized side of the literature studies markets such as those for labor and marriages. In the labor market literature, Crawford and Knoer (1981) and Kelso and Crawford (1982) study sorting processes in competitive labor markets with heterogeneous firms and workers. They create an artificial salary adjustment process, algorithm, that mimics the adjustment process that takes in labor markets. The authors show that the algorithm may converge to an equilibrium and that the observed matching depends on who makes the initial offer in the market: firms or workers. As will be presented later, these articles can be reinterpreted straightforward in light of credit markets.

Labor economists have applied job matching theory to explain unemployment rates and the relationship between wages and tenure. The job matching hypothesis predicts that wages and tenure should be positively related. Workers in a good match are more likely to stay in their jobs for longer periods. This implies that the gains of the match are maximized. Then they would not receive an alternative wage offer that exceeds their current wages. Chapman and Southwick (1991) estimated the matching hypothesis in the setting of major-league baseball.

The matching model has also been applied to marriage markets [Becker, 1976; Boulier and Rosenzweig, 1984]. Becker (1976) used an economic approach to explain why most adults are married and the sorting of mates by wealth, education, and other characteristics of males and females. The rationale behind Becker's model can be translated into credit markets. Borrowers and lenders match in order to maximize their net gains of engaging in loan transactions. Each match
can be considered as a two-person firm in which borrowers hire lenders at a cost and receive residual income. The assortive matching of borrowers and lenders can be explained as the result of the effects of borrower and lender characteristics on the net gains of credit transactions.

4.4 Assortive Matching in Rural Credit Markets: A Theoretical Model

This section studies the sorting process in rural credit markets using Becker's analysis for marriage markets. It is natural to assume that lenders grant credit to many entrepreneurs while entrepreneurs borrow only from one lender.

The assumption of exclusive credit contracts seems plausible in the Mexican setting. In Chapter 2, it was shown that in the selected regions, 41 percent of REs borrowed from either formal or informal lenders and four percent received loans from both types of lenders. Furthermore, among borrowing REs, 70 percent dealt with only one lender and 78 percent contracted one type of credit transaction (i.e., cash loan, commercial credit, or sales with downpayment).

The remainder of this chapter is concerned with the derivation of a theory of matching in credit markets. This section derives the basic theoretical propositions concerning expected matching patterns. The implications of the model are then presented. Before analyzing credit market outcomes, some comments regarding the heterogeneity of borrowers and lenders are needed.

4.4.1 Lender Heterogeneity

The screening technology, $\omega$, is associated with the information inputs that lenders use to determine the repayment capacity of potential clients. It is related to the relative importance of standard information as a means to classify loan applicants into their corresponding risk categories. A point of departure of this model is that the efficacy of a screening technology varies with some observable characteristics of loan applicants such as the initial endowment of standard and/or idiosyncratic information. This occurs because the quality of standard information changes with the nature and size of the RE's activities (see Chapter 3).

Lenders are classified in terms of their screening technology, $\omega$. Define $\omega \in [0, 1]$. There is a continuum of screening technologies ranging from a technology completely specialized in
idiosyncratic information to a technology completely specialized in standard information. At the
beginning of the continuum are informal lenders \((ω = 0)\) and at the other end are formal lenders
\((ω = 1)\). It is important to highlight the differences between these two types of lenders.

As explained before, the main difference between formal and informal lenders is the type
of information used to support loan contracts. This is so because the distinct nature of standard and
idiosyncratic information has implications for the number of clients, monitoring and enforcement
mechanism, and market structure.

The institutional arrangements (e.g., legal institutions, social sanctions) used by lenders also
vary with the relative importance of idiosyncratic versus standard information. Informal lenders
rely on social sanctions for contract enforcement, while formal lenders use the formal legal
infrastructure more frequently.

Another factor that differentiates formal and informal lenders is the operational component
of their technologies. Formal lenders have complex organizations that need to solve problems of
internal control and staff monitoring. Informal lenders tend to operate by themselves and when
they hire employees, these are merely for secretarial purposes.

The taxonomy of lenders adopted for this dissertation differs from that based on regulation,
as used by Adams and Fichett (1992), or the definition of Krahnen and Schmidt (1994), based on
the use of the legal. The information costs of lending and borrowing are affected by the choice of
a predominant type of information within a lender's technology.

4.4.2 The Heterogeneity of Rural Entrepreneurs

Rural entrepreneurs are classified in terms of their endowments of standard information,
\(ϕ\). Define \(ϕ \in [0, 1]\). There is a continuum of entrepreneur types that ranges from entrepreneurs
with an empty endowment of standard information to entrepreneurs with high endowments. At the
beginning of the continuum are small entrepreneurs \((ϕ = 0)\) and at the other end are big
entrepreneurs \((ϕ = 1)\). It is important to highlight the differences between these two types of
entrepreneurs. As explained in Chapter 3, the smallness of operation makes other variables, not
captured by standard information, more relevant in terms of predicting the probability that a loan will be repaid.

The heterogeneity of borrowers in terms of the available stock of standard information implies that they have different costs to supply lenders with information regarding their ability and willingness to pay back their loans. Hence, a given borrower will face different costs of convincing—signaling creditworthiness—alternative potential lenders—formal or informal. Consequently, borrower characteristics that reduce information costs would increase their access to external sources of finance—formal or informal.

4.4.3 The Entrepreneur's Equilibrium Position

A rural credit market consists of a set of \( n \) lenders and \( m \) entrepreneurs, indexed \( j = 1, \ldots, n \) and \( i = 1, \ldots, m \) respectively. An entrepreneur's expected profits or utility of receiving a loan contract—specified by \( B \) and \( R \)—from lender \( j \) is given by \( \pi^j(B^j, R^j) \). A lender's expected profits or utility of granting a loan contract to entrepreneur \( i \) is given by \( g^i(B^i, R(B^i)) \). Where \( R(B^i) \) is a function that solves for the interest rate factor charged by lenders given a loan size. The gain of a loan contract, \( x^i \), is defined as the sum of the lender's and the borrower's expected profits. Then \( x^i = \pi^i + g^i \), where \( \pi \) and \( g \) are defined as in Chapter 3.

A rural entrepreneur chooses the least expensive source for every loan amount taking into consideration transaction costs of borrowing. Because the RE's transaction costs of borrowing change with the identity of the lender, each individual lender's supply schedule must be adjusted to reflect this cost. Total borrowing cost has two components: the financial or interest rate cost defined by \( R \), and the transaction cost of borrowing. Transaction cost of borrowing introduces a wedge between lending rates \( R \) and total borrowing cost, \( R^i \). The total borrowing cost of the \( ith \) entrepreneur borrowing from lender \( j \) is defined as the equivalent interest rate that makes the difference between expected profits with and without transaction costs, equal to the entrepreneur transaction costs of borrowing, \( K^i(\omega, \phi) \).
For a given $B^0$, total borrowing cost is then equal to:

$$R'' = R(B'') + \frac{K''(\omega, \phi)}{B''[1 - F(\bar{\theta})]}$$  \hspace{1cm} (33)$$

where $R(B^0)$ is the combination of $R$ and $B$ defined by $g^{ii}(B,R | \cdot ) = 0$. Equation (33) shows that fixed transaction costs of borrowing results in a wedge (a price band) between borrowing and lending rates.

The sequence of events is as follows. Each lender offers the entrepreneur a menu of loan contracts defined by the zero isoprofit contour because competition constrains lenders. Entry into lending may be costly if screening costs are high. Remember that idiosyncratic information is generated as a by-product of interactions in other markets between borrowers and lenders. A new entrant must be familiarized with the pool of potential loan applicants to compete with existing lenders. Otherwise, the incumbent has an informational or cost advantage in lending to that pool.
Because the credit market comprises a set of heterogeneous lenders, the relevant menu of loan contracts for an entrepreneur is his aggregate perceived supply schedule. This perceived supply schedule is the union of the least cost part of each segment of the market. It is assumed that lenders can enforce exclusive dealings. This curve is continuous, but not everywhere differentiable and is given by:

$$ R^i = R^i(B) = \min_j R^i[B_j, A_j, \delta_j, \phi_j, I(\omega_j), S^j(\omega_j, \phi_j), K^j(\omega_j, \phi_j)] $$

(34)

Examples of aggregate supply schedules, $R^i = R^i(B)$ are portrayed in Figure 14, as the dark line. The heterogeneity of lenders and entrepreneurs explains the variations of perceived supply schedules. Figure 14 (a) shows the case of lenders that differ in their opportunity cost of funds. As shown in Chapter 3, an increase of the opportunity cost of funds lead to an increase in the marginal rate of substitution between loan size and interest rate. Figure 14 (b) shows how
differences in fixed lending cost reduces the competitiveness of some lenders with regards to a specific entrepreneur. Figure 14(c) exemplifies the combine effect of opportunity cost of funds and lender's transaction costs. Figure 14 (d) shows the combined effect of difference of the opportunity cost of lending and of the transaction cost of borrowing of entrepreneurs for each lender type. It is shown that for loan sizes smaller than \( B^* \) the lender with the higher opportunity cost is the least cost source, but for loan sizes larger than \( B^* \) the lender with the lower \( I(.) \) offers the least cost contract source.

The entrepreneur optimization program in this market is given by:

\[
\begin{align*}
\max_{B} \pi^u = & \int_0^\infty \theta y dF_\delta(\theta) - RB[1 - F_\delta(\theta)] \\
\text{s.t.} \quad R = R^1(B) \\
& B^u \geq 0
\end{align*}
\]  

(35)

where \( R^1 \) is defined as equation (34).

The entrepreneur is choosing the lender that maximizes his expected profits. Then, the problem may also be formulated as:

\[
\begin{align*}
\max_{j, B} \left[ \max_{B^u} \pi^u(B^u, R | K^u(\omega, \phi)) \right] \\
\text{s.t.} \quad g^u(B^u, R) = 0 \\
\text{s.t.} \quad \pi^u(B^u, R) \geq 0 \\
& B^u \geq 0
\end{align*}
\]  

(36)

The perfect screening technology with fixed costs is used to derive expected assortive matching patterns. The imperfect screening technology presented in Chapter 3 can be easily extended by incorporating the lender's costs of misclassification together with information costs. Hence, lenders possess comparative advantage in screening a pool of potential borrowers, if they are better in evaluating the credit risk of those borrowers.
In the previous optimization program, the entrepreneur chooses the lender who offers the most attractive loan contract which results in a choice of lender of type $\omega_j$. The question that follows is how the optimal type of lender $\omega_j$ changes due to variations of the entrepreneur's type $\phi$.

### 4.4.4 Screening and Borrowing Costs functions

In this section, the screening cost, $S(\omega, \phi)$ and borrowing cost, $K(\omega, \phi)$ are explicitly modeled. The entrepreneur's transaction costs of borrowing are the weighted cost of borrowing from a formal and from an informal lender. The weights correspond to the relative importance of standard information in the technology of the lender, $\omega$. The cost of borrowing from a formal lender, $K^F(\phi)$ and the cost of borrowing from an informal lender, $K^I(\phi)$ are the two components of the RE borrowing costs.

The following equation shows the characteristics of the borrowing fixed transaction cost function:

$$K(\omega, \phi) = \omega K^F(\phi) + (1 - \omega) K^I(\phi)$$

$$K^F(\phi) - K^I(\phi) \geq 0$$

$$\omega[K^F(\phi) - K^I(\phi)] \leq 0$$

The previous equations show that: (i) as the technology of the lender approaches the formal, the entrepreneur borrowing cost increases; (ii) as the endowment of standard information increases for an entrepreneur, his cost of borrowing decline.

The lender screening cost also has two components, the cost of lending to a big entrepreneur, $S^g(\omega)$ and the cost of lending to a small entrepreneur, $S^p(\omega)$ for a given lending technology. These two costs are weighted by the type of the entrepreneur served, as shown in the following equation:
The function $S^p(\omega)$ is positively related to $\omega$. As shown in Figure 15, $S^p(\omega)$ increases as the information technology moves toward a complete specialization in standard information. These lenders would face increasing screening costs, because for them the quality of standard information of small entrepreneurs declines. On the other hand, the function $S^o(\omega)$ is negatively related to $\omega$. It is more costly to screen big entrepreneurs than small entrepreneurs for informal lenders. Big entrepreneurs may not have an opportunity to generate idiosyncratic information with informal lenders because there is not opportunity for daily interactions with them. Furthermore, informal lenders may face a capacity constraint in the number of clients that they can handle, resulting in the specialization in the most profitable clientele for them, small entrepreneurs.

\[
S(\omega, \phi) = \phi S^G(\omega) + (1 - \phi) S^P(\omega)
\]

\[
S^G(\omega) < 0 \quad S^P(\omega) > 0
\]

\[
S^{G\omega}(\omega) > 0 \quad S^{P\omega}(\omega) < 0
\]

Figure 15  Screening and Signaling Costs
The entrepreneur chooses the type of lender, \( \omega \), who maximizes his expected profits. If there is free entry into lending activities, lenders are constrained to earn zero profits, and the total surplus of a match corresponds to the RE's profits. Then, the optimization program can be written as:

\[
\hspace{1cm} \max_{\omega} x^*(\omega, \phi) = x^*(B^*(\omega), R^*(\omega, \phi), \cdot) \tag{39}
\]

which yields the first-order condition:

\[
x^*_\omega = Y_\theta E(\theta) \frac{\partial B^*}{\partial \omega} \frac{dl}{d\omega} - B^* \frac{dl}{d\omega} [1 + \frac{\partial B^* L}{\partial B^*}] - \Phi[S^G_{\omega} - S^L_{\omega}] - [K^R(\phi) - K^L(\phi)] < 0 \tag{40}
\]

The second-order condition for a maximum requires:

\[
x^*_{\omega \phi} = Y_\theta E(\theta) B^*_{l(\omega)} l_{\omega \phi} + Y_{\theta \theta} E(\theta) [B^*_{l(\omega)} l_{\omega \phi}]^2 - B^*_{l(\omega)} l_{\omega \phi} [1 + \frac{\partial B^* L}{\partial B^*}] - \Phi[S^G_{\omega \phi} - S^L_{\omega \phi}] - 2B^*_{l(\omega)} l_{\omega \phi}^2 < 0 \tag{41}
\]

The question that follows is, how does the optimal choice of lenders' technology change with RE type? The first-order condition for choice of lender type implicitly defines the optimal value of \( \omega \), as a function of \( \phi \).

**Proposition 17**: The optimal level of \( \omega \) is positively related to \( \phi \). A positive assortive matching occurs between lender and entrepreneur types.

**Proof**: \( \frac{d\omega}{d\phi} = -\frac{x^*_{\omega \phi}}{x^*_{\omega \omega}} \). From the second-order condition, the denominator is negative. The numerator is positive, as the following equation shows:

\[
x^*_{\omega \phi} = Y_\theta E(\theta) B^*_{l(\omega)} l_{\omega \phi} - B^*_{l(\omega)} l_{\omega \phi} - [S^G_{\omega \phi} - S^L_{\omega \phi}] - [K^R_{\phi} - K^L_{\phi}] > 0 \tag{42}
\]

Hence, a positive assortive matching occurs between lender and entrepreneur types.
4.5 Assignment of Borrowers and Lenders

The purpose of this section is to interpret the results of the previous section as part of a more general model of market games. In the market game presented below (borrow from Crawford and Knoer, 1981), entrepreneurs and lenders negotiate endogenous characteristics of loan contracts that affect expected profits.

As explained before, a rural credit market consists of a set of $n$ lenders and $m$ entrepreneurs, indexed $j = 1, ..., n$ and $i = 1, ..., m$ respectively. To simplify the analysis, consider the case when $m=n$. This does not imply that each entrepreneur would receive a loan contract, because it may be optimal for a lender and an entrepreneur to be matched to themselves.

Matching is defined as a function that assigns entrepreneurs to lenders together with a schedule of expected profits for borrowers and lenders, and their corresponding loan contract characteristics. Let $f: \{1, \ldots, n\} \rightarrow \{1, \ldots, n\}$ be a one-to-one function that represents the assignment of borrowers to lenders. The $i$th entrepreneur is assigned a lender represented by $f(i)$, and the $j$th lender is assigned an entrepreneur represented by $h(j) = f^{-1}(j)$. A matching must also satisfy the participation constraint of entrepreneurs and lenders to be consistent with the notion that credit transactions are voluntary. The participation constraints are represented by the following equations:

$$\pi^{\text{f}^{-1}(j)}(B^{\text{f}^{-1}(j)}, R^{\text{f}^{-1}(j)}) \geq \underline{\pi}$$

$$g^{h(j)}(B^{h(j)}, R^{h(j)}) \geq \underline{g} = 0$$

A stable matching—besides satisfying the participation constraint of the agents—must also have the property that a borrower and a lender not matched to each other could increase their expected profits without someone worse off. The following equation expresses this condition:

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59 The specification of the model can be further elaborated to allow a capacity constraint regarding the number of borrowers lenders can handle, and to incorporate a fixed volume of loanable funds at a given time. A model that incorporates these two constraints is interesting per se; however, the added complexity of the model confuses the objectives of this dissertation.

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The simultaneous satisfaction of conditions (43) and (44) imply that a stable matching maximizes, over all possible matches, the sum of entrepreneurs and lenders expected profits (See Crawford and Knoer, 1981). Therefore, a stable matching must solve the following optimization program:

\[
\max \quad Z' = \sum_{i,j} x_{ij}^u = \pi^u + g^u \quad \forall \text{ matching } f
\]

s.t. \[ \pi^{h(0)}(B^{h(0)}, R^{h(0)}) > \bar{\pi} \quad i = 1, \ldots, m \]
\[
g^{h(0)}(B^{h(0)}, R^{h(0)}) > 0 \quad j = 1, \ldots, n
\]
\[
x^{h(0)}(B^{h(0)}, R^{h(0)}) > x^u(B^u, R^u) \quad \forall \ i, j
\]

where \( Z' \) is the total gain over all credit transactions.

The solution of the previous maximization problem implies certain regularities regarding the sorting of borrowers and lenders in terms of signaling and screening technologies. Becker (1976) argues, in the setting of marriage markets, that the complementarity of male and female traits on the production of household goods implies a positive sorting of traits. Furthermore, the author shows that if the traits of males and females are complementary, then positive sorting of traits maximizes the production of household goods over all marriages. In the setting of this model, the complementary condition is given by \( x_{ij} > 0 \). It is important to note that this is the same condition obtained in Proposition 17.

As presented in that Proposition, the traits of \( \omega \) and \( \phi \) are complementary for the gain of a match. This proposition shows that a movement toward a more formal lending technology (increasing \( \omega \)) adds more to the gain of a match when the RE has a greater endowment of standard information. The complementarity of \( \omega \) and \( \phi \) implies a positive assortive sorting of high values of \( \omega \), with high value \( \phi \), in this manner, the gains over all credit transactions, \( Z' \), is maximized.
4.6 Consequences of Assortive Matching

The clear pattern of assortive matching has several implications for the functioning of rural credit markets such as market segmentation, competition, and pricing behavior. These implications can be easily derived from the model by adding some additional features such as limiting the size of clients a lender can deal with, and introducing strategic pricing behavior of lenders.

4.6.1 Market Segmentation

As a result of assortive matching, RCMs are broken down into small clusters or segments in which each type of lender serves a particular clientele. The survey data presents evidence that suggests that borrowers and lenders are segmented into small clusters, the lack of collateral use among informal lenders results in highly personal relationships that have developed due to the lack of an adequate legal infrastructure and the lack of collateral. Then, for informal lenders personal knowledge and contact with entrepreneurs become an important mechanism to gather idiosyncratic information to screen and enforce contracts. In addition, the use of idiosyncratic information also limits the size of the market (number of already known creditworthy entrepreneurs), and reduces the degree of competition among informal lenders.

4.6.2 Competition

The degree of market competition is affected by assortive matching and the information technology of informal lenders. The assortive matching results were derived under the assumption that free entry into lending activities constraint lenders' expected profits to zero. This assumption may be relaxed because certain segments or clusters of RCMs may not be subject to competition from potential entrants because of the use of idiosyncratic information to support the information component of the technology. Only those who already know borrowers can provide credit services effectively—given the generalized lack and effectiveness of collateral in the three selected rural areas of Mexico.

Competition among incumbent lenders and across segments over a given pool of borrowers is not necessarily strong because: for any given potential borrower, some lenders have an advantage regarding what it costs for borrowers to prove their creditworthiness and the costs for other lenders
to screen them.\textsuperscript{49} The assumption of zero expected profits may not be reasonable for informal lenders.

The screening process used in the informal segments of rural financial markets creates relationship-specific capital between borrower and lender that is likely to exist with only one lender at any given point in time. Under such circumstances, informal lenders may behave like "location" monopolists over a pool of borrowers and may then profitably arbitrage on their cost advantages.\textsuperscript{51} During the two years of the survey, 70 percent of REs who received any form of credit had only one lender, while an additional 22 percent had only two sources.

Another factor limiting the entry of informal lenders deals with the techniques adopted by collateral moneylenders to enhance the enforcement of credit contracts. Many collateral lenders require the actual transfer of mortgages and the sign of blank documents. Hence, a reputation of not taking advantage of borrowers becomes for the lender a condition to enter certain market segments. This reduces the pool of potential entrants, and incumbent lenders may earn rents on their reputation.

4.6.3 Interest Rates Differential between Sectors

The question of pricing is related to the negotiability of the division of the gain of the match. As presented in the previous section, it is not credible that the informal lender would stick to the zero profit supply schedule due to limited competition.

Assortive matching implies that a lender has a comparative advantage over other lenders in offering loan contracts to a given pool of borrowers. This gives him the ability to raise interest rates up to the next lower level of perceived interest rate of the closest competitor. It is optimal for lenders to arbitrage on borrowers' transaction costs of going to other sources. Arbitrage on

\textsuperscript{49} This is equivalent to saying that there are significant sunk costs and strong "learning-by-doing" effects in an informal lender's credit allocation technology. The summary of non-bank case studies presented in Chapter 3 strongly suggests that such is the case. In fact, a portion of the cost differential between two potential lenders is due to plain serendipity in that it results from such factors as living close to the borrower and, in the words of an interviewed lender, "having friends in common."

\textsuperscript{51} The model of chapter 3 and 4, can be easily modified to include distance between borrowers and lenders by modeling fixed costs of borrowing and lending as a function of distance.
borrowers' transaction costs may explain the gap between formal and informal interest rates and the high dispersion of interest rates in informal credit markets.

4.7 Summary of Results and Future Scope of Research

This chapter extended the model of Chapter 3 to derive the expected assortive matching of borrowers and lenders. It was shown that the driving force behind a positive sorting of borrowers and lenders is the complementarity of lending technologies and endowments of standard information to reduce lending and transaction costs of borrowing.

Assortive matching results in market segmentation because borrowers and lenders can be seen as being grouped into small clusters. Informal credit markets may be characterized by limited competition arising from assortive matching and the nature of the lending technology of informal lenders. The interest rate differential between formal and informal sectors, and the high variation of informal interest rates can be explained by the strategic pricing of informal lenders. Assortive matching implies that a lender has a comparative advantage over other lenders in offering loan contracts to a specific pool of clients. This gives him the ability to raise interest rates up to the next lower level of the perceived interest rate of the closest competitor.

The model presented in this chapter of assortive matching can be extended in several directions to explain other phenomena of RCMs. Matching game theory can be used to explain credit market outcomes with an endogenization of loan contract characteristics. Crawford and Knoer (1981) and Kelso and Crawford (1982) present a matching game between firms and workers with heterogeneous characteristics and endogenous negotiation of salaries. An interesting application of their model is to simulate the interaction of borrowers and lenders to derive the relative shares of formal and informal lenders and to determine the risk portfolio of lenders.

Interesting extensions of the model are: (i) the introduction of dynamic features to analyze the persistence of assortive matching patterns over time; (ii) the investigation of the effects of repeated dealings in credit markets; and (iii) the introduction of the search behavior of borrowers.
CHAPTER 5

EMPIRICAL ESTIMATION OF ASSORTIVE MATCHING IN MEXICO

5.1 Introduction

This chapter presents an empirical estimation of the determinants of assortive matching in rural credit markets (RCMs) in Mexico. These determinants reflect the differential ability of entrepreneurs to signal creditworthiness to alternative lenders and the comparative advantages of different lenders in interpreting those signals. A theoretical model of the determinants of assortive matching in RCMs was presented, in Chapters 3 and 4. The theoretical model predicts that REs with a high endowment of standard information—with a comparative advantage in signaling creditworthiness by means of standard information—will get loans from lenders who rely on technologies that are closer to those of formal lenders—those with full specialization in interpreting standard information.

The empirical estimation tests if the observed sorting of entrepreneurs and lenders is due to differences in the lending technologies of creditors. This is accomplished by using a multinomial logit model. If the hypotheses are not rejected by the data, then the behavior of lenders and of entrepreneurs is consistent with the predictions of the theoretical model.

This chapter is organized as follows. First, a review of related empirical studies is presented in the next section. Then, the advantages and drawbacks of the multinomial logit model are described. Third, the econometric model is fitted to the survey data and the interpretation of results is provided.
5.2 Review of Previous Studies

There are three types of econometric models that can be used to test the hypotheses of this dissertation. First, empirical models of the formal credit sector that deal with credit rationing under interest rate ceilings can be adapted to estimate which lenders will be chosen by the borrowers. These econometric models measure the extent of credit rationing by estimating demand and supply functions. Bell, Srinivasan and Udry (1992) and Kochar (1993) examine the effect of formal sector restrictions (interest rate ceilings) on the extent of formal sector rationing in credit markets with both formal and informal lenders. Households are classified into various categories depending on their participation in credit markets as borrowers of formal lenders or of informal lenders, or as non-borrowers. These studies estimate the extent of credit rationing in the formal sector by estimating the probability that a household falls into that group. Kochar (1993) argues that the formal sector is not always the low cost sector and that some households make constrained choices because of formal sector rationing. Staton (1995) uses a switching regression model to determine overall credit rationing using a market disequilibrium framework, where the loan size observed is the minimum of the amount supplied or the amount demanded.

Another approach to estimate the relative importance of the formal and informal sectors is to fit a structural model of the behavior of rural entrepreneurs. Key (1995) derives a structural model of household behavior allowing for a dual credit sector and for borrower transaction costs. The parameters of this model were estimated by the method of simulated moments. The main advantage of a structural model is that it allows for a simulation of the effect of policy changes on the total volume of formal and informal credit.

In addition, discrete regression models, such as multinomial and nested logit models, can be used to estimate the probability that the decisions of entrepreneurs and lenders coincide. In other words, these models provide information about the variables that affect the observed assignment of credit between entrepreneurs and lenders. They provide a mechanism for predicting the

---

Kochar (1993) defines credit rationing as quantity rationing, while Bell et al. use both loan-size and quantity rationing.
probability that a RE with given characteristics obtains a particular type of credit transaction (e.g., cash loans, commercial credit, and sales with downpayments) from a particular source. The main advantage of this type of model is that it focuses on the decisions about participation in the market, independently of the characteristics of credit contracts.

Discrete response models have been used to estimate the sorting of borrowers and lenders. For example, Esguerra (1993) and Nagarajan (1992) used the multinomial logit to evaluate the matching between households and trader-lenders and between households and farmer-lenders. MacKie-Mason (1990) uses a nested logit model to estimate the hypothesis that firms do care about who provides their financing. Muñoz (1994) used a mixed logit model that includes characteristics of the loan transaction.

This dissertation utilizes discrete regression models to test for the hypothesis of assortive matching between borrowers and lenders. Specifically, the econometric estimation of matching borrowers and lenders tests whether entrepreneurs with a comparative advantage in producing standard information are more likely to engage in credit transactions with lenders that specialize in interpreting this type of information. In the absence of direct measures of the cost of producing standard information, variables associated with the ability of having a low marginal cost of generating standard information are used.

5.3 Econometric Model of Matching in Rural Credit Markets: Multinomial Logit

The multinomial logit model is a discrete regression model in which the dependent variable is classified into \( m \) categories. This model is derived from the maximization of random utility, assuming that the error term is distributed with a standard gamma distribution. Hence, the multinomial logit predicts the preferences of REs for each category specified. Let \( P_1, P_2, \ldots, P_m \) be the probabilities associated with each category. By definition, \( P_m \geq 0 \) and \( \sum_m P = 1 \). Therefore, to estimate the model, these probabilities must be expressed in binary form with one category as a reference state.

\(^{63}\) This model is also known as a McFadden conditional logit model.
For the multinomial logit those probabilities can be written as:

$$P_j = \frac{e^{\beta_j x}}{\sum_{j=1}^{m} e^{\beta_j x}} \quad (j = 1, 2, \ldots, m)$$ (46)

where the vector $\beta_j$ for the reference category, $m$, is normalized to zero. Furthermore, $x_i$ is a vector of RE characteristics observable to all lenders.

The parameters of the model are estimated by maximum likelihood estimation. The logarithm of the likelihood function for the multinomial logit model can be written as

$$\log L = \sum_{i=1}^{n} \sum_{j=1}^{n} y_{ij} \log P_{ij}$$ (47)

where $y_{ij} = 1$, if the $i$th individual falls in the $j$th category and $y_{ij} = 0$ otherwise. The maximization of the logarithm of the likelihood function yields the first-order conditions:

$$\frac{\partial \log L}{\partial \beta_k} = \sum_{i=1}^{n} (y_{ik} - P_{ik}) x_i = 0$$ (48)

which are nonlinear in $\beta_k$, because $P_k$ is a nonlinear function of all $\beta$'s. Hence, an iterative procedure is needed to estimate the parameters.

The equations fitted by the model are:

$$\ln \left( \frac{P_j}{P_m} \right) = \beta_j x_i \quad (j = 1, 2, \ldots, m - 1)$$ (49)

The diagonal and off-diagonal elements of the matrix of second derivatives are:

$$\frac{\partial^2 \log L}{\partial \beta_k \beta'_l} = - \sum_{i=1}^{n} P_{ik} (1 - P_{ik}) x_i x'_l$$ (50)

$$\frac{\partial^2 \log L}{\partial \beta_k \beta'_l} = - \sum_{i=1}^{n} P_{ik} P_{il} x_i x'_l$$ (51)

There is a unique maximum and any iterative procedure converges to the maximum, because the matrix of second derivatives is negative definite. The asymptotic covariance matrix of the coefficient estimates is given by the inverse of the information matrix that corresponds to the
matrix of second derivatives. A measure of the goodness-of-fit for the multinomial logit model is based on the likelihood-ratio test statistic.

The main limitation of the multinomial logit model is the "Independence of Irrelevant Alternatives (IIA)." In simple words, IIA means that the ratio of the probabilities of two choices (or states) is independent of the number of choices considered. In addition, the model does not permit the separation of demand and supply coefficients and it implicitly assumes that every entrepreneur had potential access to all the categories specified for the model.

5.4 Empirical Estimation of the Multinomial Logit Model

The theoretical model of Chapter 4 predicts a pattern of positive sorting of borrower and lender technologies. It was implicitly assumed there that there is an infinite number of types of lenders and entrepreneurs. However, for the empirical estimation, lenders are classified according to the type of credit services provided (e.g., cash loans versus commercial credit) and according to the relative importance of idiosyncratic information used to support credit transactions—screening, monitoring, and enforcement.

The borrowing status of entrepreneurs is classified into six categories indexed by $j$. These categories are: $j=1$ for entrepreneurs receiving commercial credit; $j=2$ for entrepreneurs with sales with downpayments; $j=3$ for RE borrowing from formal lenders; $j=4$ for RE borrowing from moneylenders; $j=5$ for RE borrowing from friends and relatives; and $j=6$ for non-borrowers.

The multinomial logit can be interpreted as a model that predicts entrepreneur preferences for different types of creditors, because it is derived from the random utility choice models. Therefore, it could answer questions such as what is the probability that an entrepreneur with a given profile falls into one of the categories of the model. However, the borrowing status of entrepreneurs receiving commercial credit; $j=2$ for entrepreneurs with sales with downpayments; $j=3$ for RE borrowing from formal lenders; $j=4$ for RE borrowing from moneylenders; $j=5$ for RE borrowing from friends and relatives; and $j=6$ for non-borrowers.

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54 See Maddala (1983) and Cramer (1991) for a summary of the specification of the multinomial and nested logit models.

55 This interpretation implicitly assumes that all entrepreneurs have potential access to all types of lenders.
entrepreneurs is the result of the interaction of supply and demand factors. Therefore, lender technologies should also be reflected in observed credit market transactions.

The evidence in Mexico is that REs know the screening requirements, the loan contract characteristics, and the probability of receiving a loan transaction from alternative sources. For example, in the market for cash-loans, 3 percent of REs reported having a loan application rejected. Then, REs incorporate the lender's behavior into their decision of whether to apply for a loan or not. It seems logical to interpret predicted probabilities from the multinomial model as the probability of a RE receiving a loan from a specific type of lender. Although elements of demand and supply are simultaneously involved, the results shed light on what makes entrepreneurs request credit from a given source, and on what makes lenders grant credit. Thus, the empirical estimation of the model provides evidence of the assortive matching of borrowers and lenders in RCMs.

Estimation of the multinomial logit uses the survey data on 799 REs. The unit of observation is the RE instead of the credit transaction. In fact, even if a RE matched with a sector or with a lender received multiple loans, it is treated as a single observation. The specification of the multinomial logit requires the classification of REs into the six mutually exclusive categories as specified previously.

<table>
<thead>
<tr>
<th>Multinomial Categories</th>
<th>Survey Classification</th>
<th>Mutually Exclusive Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-borrowers</td>
<td>439</td>
<td>439</td>
</tr>
<tr>
<td>Commercial Credit</td>
<td>159</td>
<td>182</td>
</tr>
<tr>
<td>Forward Sales</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>Formal Lenders</td>
<td>32</td>
<td>55</td>
</tr>
<tr>
<td>Moneylenders</td>
<td>23</td>
<td>39</td>
</tr>
<tr>
<td>Friends and Relatives</td>
<td>41</td>
<td>55</td>
</tr>
<tr>
<td>Multiple Sources</td>
<td>82</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural

Table 10 Classification of Rural Entrepreneurs for the Estimation of the Multinomial Logit

**Information regarding rejections for commercial credit and forward sales transactions is not available from the survey. Baydas and Graham (1995) also reported low rejection of loan applicants in The Gambia.**
As shown in Table 10, eighty-two REs can be classified into more than one of the categories specified for the multinomial logit. In order to ensure the mutual exclusivity required by the model, the classification can be carried out by different methods: (i) to classify REs with the category of lender providing the largest transactions in terms of size, because it is expected that borrowers preferences are tied to loan size; (ii) to classify REs on the basis of total borrowing cost or marginal loan; (iii) to duplicate those REs that can be classified in various categories for each class attaching weights according to loan size; (iv) to classify REs according to frequency or length of the credit relationship. The first approach is used to classify REs into the corresponding categories of the multinomial logit.

5.5 Explanatory Variables

The vector $x_i$ of explanatory variables consists of: (i) RE characteristics affecting the demand for credit, such as the riskiness and profitability of enterprises; (ii) proxies related to the availability and quality of standard information; and (iii) locality characteristics associated with the size of the market. Table 11 provides some summary statistics of the explanatory variables used in the estimation.

5.5.1 Demand for Credit: Riskiness and Profitability of Enterprises

The variables that affect the demand for loans also provide the lender with information about the riskiness and profitability of investment projects because they indicate the repayment capacity of loan applicants. The variables included in this category are:

Entrepreneur's Age. The age of the entrepreneur measures his stage in the life cycle. The sign of the parameter for this variable is expected to be ambiguous, depending on the strength of supply and demand forces. It can be argued that age captures attitudes toward risk, since younger REs can be expected to be more risk loving than older ones. However, from the point of view of lenders, a positive effect is expected. Older entrepreneurs may have more experience and a different set of values than younger entrepreneurs, which in turn could affect creditworthiness.
Furthermore, older REs may be more educated and have more knowledge about the screening criteria of formal lenders.

**Previous Borrowing Experience.** This is a dummy variable that takes the value of 1 if the RE had any financing six years before the survey and zero otherwise. Presumably, obtaining a loan should be less costly or less difficult for those individuals who have already established their creditworthiness and know the screening techniques used by lenders. This is consistent with what lenders report about a good reputation and about availability of references being important conditions to grant loans.

**Value of Productive Income.** The repayment capacity of REs is captured by the annualized value of entrepreneurial activities. This variable measures cash flows of the enterprise, and serves as a proxy for the ability to draw from internal sources of finance.67

**Agricultural Activity.** This is a dummy variable that takes the value of 1 if the entrepreneur has only one enterprise that is farm-related and zero otherwise. This variable would capture differences in access due to the economic activity of the entrepreneur. Bank loans are the single most important source of credit for farm REs, as they accounted for 70 percent of the total amount of credit—from all sources—received by the group. On the other hand, 70 percent of the individual transactions and 85 percent of the amount of credit granted by banks to REs were given to individuals who had agricultural ventures.

**Gender and Ethnicity.** These are dummy variables that take the value of 1 for male and indigenous entrepreneurs, and zero otherwise. It captures any differences in the choice of lenders by REs or in the screening process of lenders.

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67 There is a difference regarding the period of reference of borrowing activities and productive income. The survey asked REs for their sources of credit services for two years prior to the survey, while productive income is measured for the year prior to the survey.
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy: Agricultural Venture only</td>
<td>0.37437</td>
<td>.48427</td>
</tr>
<tr>
<td>Dummy: Gender of RE</td>
<td>0.73731</td>
<td>.44038</td>
</tr>
<tr>
<td>Dummy: Ethnicity of RE</td>
<td>0.27665</td>
<td>.44763</td>
</tr>
<tr>
<td>Log of RE'S Productive income*</td>
<td>8.4396</td>
<td>2.4318</td>
</tr>
<tr>
<td>Log of Real Estate and Financial Saving *</td>
<td>6.6010</td>
<td>5.0461</td>
</tr>
<tr>
<td>Age of RE</td>
<td>45.9</td>
<td>15.717</td>
</tr>
<tr>
<td>Household Size</td>
<td>5.43</td>
<td>2.6774</td>
</tr>
<tr>
<td>Dummy: Economic Crisis</td>
<td>0.59391</td>
<td>.49141</td>
</tr>
<tr>
<td>Dummy: Accounting</td>
<td>0.15102</td>
<td>.35829</td>
</tr>
<tr>
<td>Dummy: Credit history of RE</td>
<td>0.25254</td>
<td>.43474</td>
</tr>
<tr>
<td>Percentage of Population Working in the Primary Sector in RE’s Locality</td>
<td>0.10288</td>
<td>.06267</td>
</tr>
<tr>
<td>Population in RE’s Locality of Residence</td>
<td>7.3301</td>
<td>5.1892</td>
</tr>
<tr>
<td>Minimum Daily Wage in RE’s Locality of Residence</td>
<td>14.176</td>
<td>3.5862</td>
</tr>
</tbody>
</table>

Source: Encuesta Regional de Servicios Financieros a Unidades de Producción Rural
* Geometric mean.

Table 11 Mean Values of Independent Variables of the Multinomial Logit Model

5.5.2 Availability and Quality of Standard Information:

Stocks of available standard information on borrowers and their quality depend on the nature of the economic activities of borrowers. Variables related to the endowment and noisiness of standard information are important screening criteria for formal lenders. The variables included in this category are:

Value of Real Estate Assets and Financial Assets (Wealth). This variable measures collateral availability of the entrepreneur in the form of real estate assets and financial assets. Lenders use collateral as a signaling device to separate borrowers according to risk [Bester, 1987]. The collateral is the hostage that the borrower offers to the lender to signal his commitment to repay the loan. Lender heterogeneity implies that this variable should be relevant for formal lenders.

Accounting Practices. This is a dummy variable that takes the value of 1 if the entrepreneur uses formal accounting methods and zero otherwise. Accounting records are an important ingredient in traditional technologies used to screen borrowers by formal lenders.
specially banks). Hence, REs who already have formal accounting records of their venture reduce the cost for formal lenders to establish their creditworthiness, which makes them more attractive clients. Once a business has kept accounting records for its own purposes, the marginal cost of using them to signal creditworthiness to a lender should be very low, if not zero. Reduced marginal cost for the applicant makes bank loans attractive for potential borrowers when choosing their sources of credit.

**Household Size.** Household size is taken as a proxy for the consumption needs that REs need to satisfy and for jointness in production and consumption decisions. In general, for those households with at least one RE, the RE’s economic activity is the only source of income for the household. It is posited that the larger the household, the larger the probability of having emergency needs and of having an inelastic demand for credit.

**Economic Crisis.** This is a dummy variable that takes the value of 1 if the RE had experienced an economic crisis during the five years before the survey and zero otherwise. This variable tries to capture an intertemporal consumption smoothing strategy through financial markets and risk sharing arrangements among friends and relatives. The ability of lenders to observe an economic crisis depends on their proximity to entrepreneurs. Yet altruistic lenders are most likely to lend to individuals who may not have yet established a credit history.

### 5.5.3 Locality Characteristics

Variables that describe locality determine the willingness of lenders to serve a particular location based on diversification and economic development. Three variables are included in this category:

**Population.** This variable measures the level of development of the locality where the entrepreneur lives. Smaller towns are also less likely to have a bank, which —*ceteris paribus*— makes bank loans more expensive for REs (*i.e.*, traveling required). At the same time, residents of small localities may also signal their creditworthiness to their money-lending neighbors at a relatively lower cost than to a bank. In general, formal lenders are located in larger towns, where they can exploit economies of scale that allow them to cover their high fixed costs. During the past
three years, the Mexican commercial bank system has been reallocating its offices to municipalities with bigger populations. Screening borrowers on the basis of their character and enforcing contracts locally may be cheaper for a moneylender who lends in a small locality. This is because the costs of gathering information about loan applicants may be a by-product of geographical proximity.

Proportion of the Population Working in the Primary Sector. This variable attempts to measure the extent of economic diversification of the locality. Agrarian economies are expected to have very correlated cash flows, which hinders, local financial intermediation of any kind.

Minimum Daily Wage. This variable corresponds to the ongoing daily wage for an unskilled worker (i.e., jornal) at the time of the survey. It can be used as a proxy for local wealth (e.g., capital-labor ratio).

5.6 Empirical Results

This section presents the empirical estimation of the multinomial logit model using the survey data. The analysis is divided into two main parts: (i) determinants of access to credit services (i.e., what variables affect the choice between categories of non-borrowing and borrowing from the five choices specified in the model and (ii) factors affecting the choice of lenders or/and of assortive matching.

5.6.1 Determinants of Access to Credit Services

Table 12 shows the coefficients for the multinomial logit with non-borrowers as the reference category. The model has a good goodness of fit as presented by the likelihood ratio test. Different specifications of the model were fitted including other explanatory variables such as an education index, number of dependents, among others. The specification of the model presented below was chosen by examining the significance of these additional explanatory variables, and by

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* In 1991, the commercial banking system had 278 offices in municipalities with less than 20,000 inhabitants. In 1993, only 219 offices remained in the same municipalities.
using the Schwarz-Criterion to adjust for different degree of freedom. Furthermore, the number of observations limits the number of explanatory variables that can be included.

As indicated by equation (49), the coefficients show the effect of independent variables on the logarithm of \( P_j / P_m \). Hence, the coefficients clearly do not measure the effect on the probability of receiving credit from a specific type of lender.\(^9\)

Significant coefficients, except for agricultural ventures with respect to all the alternative sources of credit, suggest that the variable is an important determinant of receiving credit services in the three selected rural areas of Mexico. It is important to note that agricultural ventures have a positive effect on the ratio of \( P_{\text{Formal}} / P_{\text{N.B.}} \). The effect is negative, however for the other categories. It may be the case that REs engaged in agricultural ventures are more likely to receive credit from formal sources than from other sources.

The logarithm of productive income is significant in explaining the choice of formal lenders and commercial credit with respect to the non-borrowing category. This may imply that formal lenders and commercial credit providers do use this variable to screen potential borrowers. Real estate assets and deposits in financial institutions also affect the choice between borrowing from formal lenders and non-borrowing. REs with higher endowments of collateral assets may demand a larger loan size, generally provided by formal lenders. Moreover, formal lenders required real collateral in 41 percent of their transactions.

The age of the RE captures determinants of both the demand for and the supply of loans: however, as explained before, there are competing effects. The significant negative signs of this variable for \( P_{\text{CCC}} / P_{\text{N.B.}} \) and \( P_{\text{Flend}} / P_{\text{N.B.}} \) suggest that older entrepreneurs are less likely to receive a loan from friends and relatives and from commercial credit providers. These two categories of lenders support the activities of younger entrepreneurs because they may have a comparative advantage in screening them, relative to other types of lenders.

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\(^9\) See Cramer (1991) for a more detailed explanation of how to interpret the coefficients of the multinomial logit.
## Dependent Variables (in natural logarithm)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>( P_{CC} / P_{NR} )</th>
<th>( P_{Male} / P_{NR} )</th>
<th>( P_{Formal} / P_{NR} )</th>
<th>( P_{Informal} / P_{NR} )</th>
<th>( P_{Bank} / P_{NR} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.6741</td>
<td>-1.0974</td>
<td>-8.3670 ***</td>
<td>-2.7273 *</td>
<td>-0.34494</td>
</tr>
<tr>
<td></td>
<td>(0.8544)</td>
<td>(1.9220)</td>
<td>(1.5370)</td>
<td>(1.6906)</td>
<td>(1.3619)</td>
</tr>
<tr>
<td>Dummy: Only Agricultural Venture (1 = Farm-RE, 0 = Otherwise)</td>
<td>-1.0362 ***</td>
<td>-2.1512 ***</td>
<td>1.1995 ***</td>
<td>-1.4689 ***</td>
<td>-0.3442</td>
</tr>
<tr>
<td></td>
<td>(0.3181)</td>
<td>(0.7733)</td>
<td>(0.4442)</td>
<td>(0.5160)</td>
<td>(0.4851)</td>
</tr>
<tr>
<td>Dummy: Gender of RE (1 = Male, 0 = Female)</td>
<td>-0.0185</td>
<td>0.7051</td>
<td>0.7058</td>
<td>0.6917</td>
<td>0.4543</td>
</tr>
<tr>
<td></td>
<td>(0.2206)</td>
<td>(0.4944)</td>
<td>(0.5473)</td>
<td>(0.5097)</td>
<td>(0.3925)</td>
</tr>
<tr>
<td>Dummy: Ethnicity of RE (1 = Indigenous, 0 = Non-indigenous)</td>
<td>-0.1425</td>
<td>0.3645</td>
<td>-0.0086</td>
<td>-0.7531</td>
<td>0.0204</td>
</tr>
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<td></td>
<td>(0.2895)</td>
<td>(0.5063)</td>
<td>(0.5072)</td>
<td>(0.4912)</td>
<td>(0.4112)</td>
</tr>
<tr>
<td>Log of RE's Productive Income (includes imputed value of on-farm consumption)</td>
<td>0.1234 **</td>
<td>-0.0316</td>
<td>0.1724 **</td>
<td>-0.0574 **</td>
<td>-0.0390</td>
</tr>
<tr>
<td></td>
<td>(0.0613)</td>
<td>(0.1201)</td>
<td>(0.0857)</td>
<td>(0.0929)</td>
<td>(0.0795)</td>
</tr>
<tr>
<td>Log of Wealth (Real Estate and Bank Deposits)</td>
<td>0.0214</td>
<td>0.0116</td>
<td>0.1040 **</td>
<td>0.0344</td>
<td>-0.0170</td>
</tr>
<tr>
<td></td>
<td>(0.0213)</td>
<td>(0.0450)</td>
<td>(0.0469)</td>
<td>(0.0420)</td>
<td>(0.0357)</td>
</tr>
<tr>
<td>Age of RE</td>
<td>-0.0164 **</td>
<td>-0.0089</td>
<td>-0.0152</td>
<td>0.0033</td>
<td>-0.0388 ***</td>
</tr>
<tr>
<td></td>
<td>(0.0070)</td>
<td>(0.0142)</td>
<td>(0.0125)</td>
<td>(0.0125)</td>
<td>(0.0129)</td>
</tr>
<tr>
<td>Household Size</td>
<td>0.0243</td>
<td>0.0422</td>
<td>0.0661</td>
<td>0.1751 ***</td>
<td>0.0306</td>
</tr>
<tr>
<td></td>
<td>(0.0385)</td>
<td>(0.0797)</td>
<td>(0.0580)</td>
<td>(0.0589)</td>
<td>(0.0579)</td>
</tr>
<tr>
<td>Dummy: Economic Crisis (1 = Experienced Crisis, 0 = Otherwise)</td>
<td>0.2401</td>
<td>0.4224</td>
<td>-0.2600</td>
<td>0.2262</td>
<td>0.8327 ***</td>
</tr>
<tr>
<td></td>
<td>(0.2008)</td>
<td>(0.4223)</td>
<td>(0.3494)</td>
<td>(0.3899)</td>
<td>(0.3402)</td>
</tr>
<tr>
<td>Dummy: Accounting (1 = Yes, 0 = No)</td>
<td>0.4740 *</td>
<td>-0.0111</td>
<td>1.2069 **</td>
<td>-0.1294</td>
<td>-0.2234</td>
</tr>
<tr>
<td></td>
<td>(0.2666)</td>
<td>(0.6023)</td>
<td>(0.4445)</td>
<td>(0.5965)</td>
<td>(0.5299)</td>
</tr>
<tr>
<td>Dummy: Credit History of RE (1 = Credit History in Last Six Years, 0 = Otherwise)</td>
<td>1.4433 ***</td>
<td>1.3834 ***</td>
<td>2.4335 ***</td>
<td>1.7029 ***</td>
<td>1.8114 ***</td>
</tr>
<tr>
<td></td>
<td>(0.2383)</td>
<td>(0.4402)</td>
<td>(0.3488)</td>
<td>(0.3846)</td>
<td>(0.3372)</td>
</tr>
<tr>
<td>Percentage of Population Working in Primary Sector in RE's Locality</td>
<td>-4.9496 **</td>
<td>0.2646</td>
<td>2.0837</td>
<td>3.3444</td>
<td>-4.7224</td>
</tr>
<tr>
<td></td>
<td>(2.5369)</td>
<td>(4.5100)</td>
<td>(4.1910)</td>
<td>(1.8903)</td>
<td>(3.8750)</td>
</tr>
<tr>
<td>Population in RE's Locality of Residence</td>
<td>-0.0097</td>
<td>-0.0440</td>
<td>0.0756 **</td>
<td>-0.0888</td>
<td>-0.0140</td>
</tr>
<tr>
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<td>(0.0223)</td>
<td>(0.0521)</td>
<td>(0.0393)</td>
<td>(0.0371)</td>
<td>(0.0373)</td>
</tr>
<tr>
<td>Minimum Daily Wage in RE's Locality</td>
<td>-0.0249</td>
<td>-0.0694</td>
<td>0.0928 **</td>
<td>-0.0436</td>
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<td>(0.0298)</td>
<td>(0.0776)</td>
<td>(0.0853)</td>
<td>(0.0592)</td>
<td>(0.0490)</td>
</tr>
</tbody>
</table>

Log-Likelihood: -862.816  
Likelihood Ratio Test \( \chi^2 \) (65): 326.3941  
Number of Observations: 788  

Source: Multinomial Logit Estimation  
* / ** / *** significant at the 90 % / 95 % / 99 % confidence interval respectively  
N.B. = Non-borrowers, C.C. = Commercial Credit

Table 12  Estimated Coefficients for the General Multinomial Logit Model  (Number in Parentheses Corresponds to Standard Errors)
The size of the household indicates the propensity of cyclical and unexpected consumption needs and the jointness in consumption and production decisions. As explained in chapter 3, the jointness in consumption and production decisions makes idiosyncratic information a better estimator of the probability of repayment. Hence, lenders who specialize in the use of idiosyncratic information may have a comparative advantage in screening those entrepreneurs. The coefficient of household size is significant for moneylenders who use idiosyncratic information to support their lending activities. Furthermore, larger households may have a higher propensity for short-term consumption (or emergency) loans that moneylenders easily supply.

The incidence of having experienced an economic crisis is related to risk-management techniques. In many cases the causes of an economic crisis are known only by family and friends circles. The positive and significant sign of the dummy variable of an economic crisis reflects that: (i) altruistic lenders, such as friends and family, are more likely to lend to individuals who experience an economic crisis; and/or that (ii) it reduces the probability of the RE being a borrower. Twenty-one percent of the REs who borrowed from the informal sector only and who had experienced an economic crisis during the past five years, reported that getting loans or donations from friends and relatives was the most important measure against the crisis.

The use of formal accounting by REs has a significant effect on the categories of commercial credit, and specially formal lenders. This variable may be related to the demand for loans, since availability of financial statements depends on the size of operation of the enterprise. It is expected to find formal lenders having a comparative advantage in screening entrepreneurs with higher endowment of standard information, as reflected by the availability of financial statements. It is surprising that this variable was significant for the category of commercial credit providers because their lending technology is based on standard information.

Having participated in credit markets six years ago is an important determinant between the different categories of borrowers and non-borrowers in Mexican RCMs. This variable is statistically significant for all the categories of the model. Obtaining a loan may be less difficult for those REs that had already established a credit-relationship and that already knew the screening
requirements or criteria used by lenders. The effect of this variable is particularly important for
formal lenders, because the absolute effect is higher for this category. It may be the case that
customer relationships are specially important for formal lenders. Borrowers reported an average
of five years since the date of receiving their first loan from formal lenders to the date of getting
the most recent, the highest among all sources.  

The percentage of the population working in the primary sector of the locality of residence
of the RE affects the choice between commercial credit and non-borrowing. This effect is consistent
with either a positive effect on the probability of being a non-borrower or a negative effect on
receiving commercial credit. It may be the case, that the larger the degree of agrarian development
in the community, the more correlated are the cash-flows of potential borrowers and the more
hindered is the development of credit markets.

The degree of development of the locality of residence of REs is proxied by two variables:
population size and minimum daily wage. These variables turned out to be important in
determining the choice between formal lenders and non-borrowing.

5.6.2 Determinants of Assertive Matching

A pattern of assortive matching is derived from the significance of the variables affecting
the choice between different credit sources and non-borrowing. However, to investigate the
empirical validation of the expected assortive matching, marginal effects are calculated. Marginal
effects give the direction and magnitude of the change in the probability of the average RE falling
into one of the categories. The marginal effects are given by the following set of equations:

\[ \frac{\delta P_j}{\delta x_i} = P_j (\beta_j - \lambda) \quad j = 1, \ldots, m \quad i = 1, \ldots, T \]  

(52)

where

\[ \lambda = \sum_{j = 1}^{m} P_j \beta_j \]  

(53)

For moneylender, friends and relatives, commercial credit, and forward sales the corresponding
average for length of relationship are: 46, 46, 42, and 53 months.
As is evident from equation (52), the marginal effects are evaluated at the value of each observation. In this dissertation, the approach taken is to estimate the value of the marginal effects evaluated at the mean value of the explanatory variables. Marginal effects are interpreted as the change in the probability of getting a loan from lender $j$, for the average RE of the three selected rural areas. In the case of dummy variables, the mean value is the sample proportion. Hence, marginal effects of dummy variables are interpreted as the change in the probability of receiving a loan from lender $j$, by changing the sample proportion of agricultural producers.

![Graph showing predicted probabilities of various credit services](image)

**Figure 16** Predicted Probabilities of Having Received Various Credit Services for an Otherwise Average Rural Entrepreneur as the Value of Real Estate Assets and Financial Savings Increases

The model predicts that variables associated with a higher endowment of standard information lead to a higher probability of receiving a loan from formal lenders. For example, increasing the logarithm of the real estate assets of the average RE has a positive significant effect on the probability of the average RE getting a loan from formal lenders. This effect can be easily demonstrated by examining what happens to the predicted probability that the average RE will get...
a given type of credit service as his endowments of real estate assets increase, if everything else remains constant. As Figure 16 shows, increases in the value of real estate assets of the average RE appear to be associated with a higher probability of receiving loans from formal lenders. The logarithm of productive income does not have a statistically significant marginal effect; however, it has a positive sign.\(^7\)

The availability of financial statements turns out to be significant only for the category of formal lenders. Accounting practices by the RE have a negative but not significant sign for the other categories, with the exception of commercial credit. An otherwise average RE with a complex and large enough business to keep accounting records has a higher probability of receiving loans from formal lenders, as shown by the sign of this variable. This is because a RE that already has financial records has a low marginal cost of borrowing from lenders that require financial statements.

![Figure 17 Predicted Probabilities of Having Received Various Credit Services for an Otherwise Average, Rural Entrepreneur as Her Accounting Practices Changes.](image)

\(^7\) When the model was run for the subsector of cash-loan borrowers, the productive income had a significant positive effect on the probability of getting a loan from formal lenders and a negative effect on the probability of receiving a loan from moneylenders.
Rural entrepreneurs that had borrowed six years before the survey had better chances of being a borrower at the survey time. The dummy variable on credit history is statistically significant for all categories of the model. This means that obtaining loans should be less costly for REs with an established credit history. Those REs may have better information regarding the screening criteria of lenders and the characteristics of credit contracts offered. Not being a borrower six years before the survey increases the probability of being a non-borrower at the time of the survey.

The significance of the dummy variable of agricultural activities confirms the expectations raised in the previous section. The formal sector is most likely to have lent to REs in the agricultural sector. It may be the case that the characteristics of the loan contracts offered by formal lenders are more consistent with the preferences of agricultural producers. For agricultural producers, bank loans are the single most important source of credit, as they accounted for 70 percent of the total amount of credit received by that group.

The probability of having borrowed from moneylenders and forward sales providers is inversely related to agricultural activities. Moneylenders may choose to lend to non-agricultural producers in the absence of geographical diversification. For example, 92 percent of moneylenders' borrowers lived within a 10-kilometer ratio. It is not surprising to find that the probability of getting a forward sale is inversely related to agricultural activities, since only 2 percent of agricultural producers received forward sales.

The size of the locality has a negative effect on the probability that the average RE borrowed from moneylenders. The screening of borrowers by using idiosyncratic information may be cheaper for moneylenders who lived in small localities. As explained in Chapter 3, acquisition of idiosyncratic information about loan applicants may only be a by-product of geographical proximity. Furthermore, the opportunity cost of lending for moneylenders may increase with the size of the locality and with more attractive larger investment opportunities for the lender.72

72 None of the moneylenders interviewed in the survey areas were devoted exclusively to lending activities.
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>( P_{\text{NR}} )</th>
<th>( P_{\text{GC}} )</th>
<th>( P_{\text{Sales}} )</th>
<th>( P_{\text{ Formal}} )</th>
<th>( P_{\text{ Informal}} )</th>
<th>( P_{\text{ Friends}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy: Only Agricultural venture</td>
<td>0.2132</td>
<td>-0.1509</td>
<td>-0.0727 **</td>
<td>0.0540 **</td>
<td>-0.0439 **</td>
<td>0.0003</td>
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<td>(0.1217)</td>
<td>(0.0261)</td>
<td>(0.0269)</td>
<td>(0.0190)</td>
<td>(0.0185)</td>
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<td>Dummy: Gender of RE</td>
<td>-0.0600</td>
<td>-0.0256</td>
<td>0.0179</td>
<td>0.0212</td>
<td>0.0233</td>
<td>0.0232 *</td>
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<td>(0.0794)</td>
<td>(0.0854)</td>
<td>(0.0156)</td>
<td>(0.0175)</td>
<td>(0.0154)</td>
<td>(0.0139)</td>
</tr>
<tr>
<td>Dummy: Ethnicity of RE</td>
<td>0.0318</td>
<td>-0.0199</td>
<td>0.0093</td>
<td>0.0015</td>
<td>-0.0275</td>
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<td>(0.0871)</td>
<td>(0.0883)</td>
<td>(0.0152)</td>
<td>(0.0171)</td>
<td>(0.0173)</td>
<td>(0.0155)</td>
</tr>
<tr>
<td>Log of RE's Productive Income *</td>
<td>-0.0154</td>
<td>0.0220</td>
<td>-0.0031</td>
<td>0.0051</td>
<td>-0.0043</td>
<td>-0.0042</td>
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<td>(0.0028)</td>
<td>(0.0037)</td>
<td>(0.0033)</td>
<td>(0.0034)</td>
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<td>Log of Wealth *</td>
<td>-0.0028</td>
<td>-0.0007</td>
<td>0.0002</td>
<td>0.0035 **</td>
<td>0.0012</td>
<td>-0.0014</td>
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<td>(0.0013)</td>
<td>(0.0017)</td>
<td>(0.0013)</td>
<td>(0.0012)</td>
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<td>Age of RE</td>
<td>0.0042 *</td>
<td>-0.0021</td>
<td>-0.0001</td>
<td>-0.0003</td>
<td>0.0004</td>
<td>-0.0021 ***</td>
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<tr>
<td></td>
<td>(0.0024)</td>
<td>(0.0025)</td>
<td>(0.0004)</td>
<td>(0.0004)</td>
<td>(0.0005)</td>
<td>(0.0006)</td>
</tr>
<tr>
<td>Household Size</td>
<td>-0.0109</td>
<td>0.0014</td>
<td>0.0007</td>
<td>0.0017</td>
<td>0.0062 **</td>
<td>0.0008</td>
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<td>(0.0017)</td>
<td>(0.0020)</td>
<td>(0.0027)</td>
<td>(0.0022)</td>
</tr>
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<td>Dummy: Economic Crisis</td>
<td>-0.0729</td>
<td>0.0265</td>
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<td>0.0042</td>
<td>0.0465 ***</td>
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<td>(0.0130)</td>
<td>(0.0144)</td>
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<td>Dummy: Accounting</td>
<td>-0.0772</td>
<td>0.0763</td>
<td>-0.0040</td>
<td>0.0377 *</td>
<td>-0.0100</td>
<td>-0.0228</td>
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<td>(0.1030)</td>
<td>(0.0129)</td>
<td>(0.0231)</td>
<td>(0.0158)</td>
<td>(0.0165)</td>
</tr>
<tr>
<td>Dummy: Credit History of RE</td>
<td>-0.3844 ***</td>
<td>0.1793 ***</td>
<td>0.0223 **</td>
<td>0.0637 ***</td>
<td>0.0421 ***</td>
<td>0.0771 ***</td>
</tr>
<tr>
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<td>(0.0774)</td>
<td>(0.0098)</td>
<td>(0.0192)</td>
<td>(0.0139)</td>
<td>(0.0207)</td>
</tr>
<tr>
<td>Percentage of Population Working in Primary Sector in RE's Locality</td>
<td>0.7234</td>
<td>-0.8268</td>
<td>0.0426</td>
<td>0.1139</td>
<td>0.1774</td>
<td>-0.2306 **</td>
</tr>
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<td>(0.8018)</td>
<td>(0.1238)</td>
<td>(0.1372)</td>
<td>(0.1604)</td>
<td>(0.1409)</td>
</tr>
<tr>
<td>Population in RE's Locality of Residence</td>
<td>0.0032</td>
<td>-0.0010</td>
<td>-0.0011</td>
<td>0.0028</td>
<td>-0.0033 **</td>
<td>-0.0006</td>
</tr>
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<td>(0.0081)</td>
<td>(0.0089)</td>
<td>(0.0012)</td>
<td>(0.0023)</td>
<td>(0.0016)</td>
<td>(0.0013)</td>
</tr>
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<td>Minimum Daily Wage in RE's Locality</td>
<td>0.0047</td>
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<td>-0.0018</td>
<td>0.0035</td>
<td>-0.0014</td>
<td>-0.0012</td>
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<td>(0.0126)</td>
<td>(0.0015)</td>
<td>(0.0023)</td>
<td>(0.0019)</td>
<td>(0.0018)</td>
</tr>
</tbody>
</table>

* / ** / *** significant at the 90% / 95% / 99% confidence intervals, respectively

* Derivatives at the sample mean

Table 13 Marginal Effects of Independent Variables on Probabilities
The positive marginal effect of household size on the probability of getting a loan from moneylenders suggests that moneylenders are more able to satisfy the demand for credit of larger families. It is reasonable to argue that larger families are more likely to have unexpected consumption requirements, which triggers the demand for loans with short term and rapid disbursement to be used for consumption. Moneylenders are likely to provide loans with those characteristics. Furthermore, the larger the household, the easier it is to generate idiosyncratic information with moneylenders.

The younger the average RE, the more likely he is of receiving loans from friends and relatives. Younger REs may only be able to convey their creditworthiness accurately to the circle of friends and relatives who lend for reciprocity purposes. By living in less agrarian localities, REs increase their chances of getting loans from friends and relatives. The correlation of cash flows among residents of more agrarian localities is expected to be higher. This may be specially true in Mexico, where crop diversification of agricultural producers in the surveyed areas is limited. The correlation of cash flows hinders the development of informal credit markets.

A few variables have statistically significant coefficients for the marginal effects on the categories of commercial credit and forward sales. Forward sales are more likely to be received by individuals who work in non-agricultural activities and who have borrowed in the past.

### 5.7 Summary of Findings

In this chapter, a multinomial logit model was fitted to test for the hypotheses that: (i) REs with higher endowments of standard information are more likely to engage in financial transactions with formal lenders; and (ii) REs with low endowment of idiosyncratic information are more likely to receive loans from informal lenders. It was argued that variables related to the screening process:

73 Friends and relatives were the most important source of funds to start business for 12 percent of non-farm entrepreneurs. This is in contrast to banks and moneylenders who accounted together for 3 percent.
requirement of formal and informal lenders should be important determinants of the probability of REs obtaining loans from these types of lenders.

The econometric results support these hypotheses. Specifically, formal lenders lend based on the RE's ability to supply standard information. Higher probabilities of obtaining a loan from formal lenders are associated with: endowments of collateral assets, formal accounting practices, past credit history, and engagement in agricultural activities. However, the results do not provide strong evidence that informal lenders lend to REs with lower endowments of standard information, which is not a surprising result. The availability of idiosyncratic information is difficult to observe because it is specific to a borrower-lender pair. Furthermore, informal lenders have different motives to engage in lending activities. For example, moneylenders have a profit motive to provide loans, while friends and relatives have altruistic and reciprocity motives.

Moneylenders are more likely to grant loans to —otherwise average— REs who: have non-agricultural activities, have larger families, who live in smaller towns, and had borrowed six years before the survey. Friends and relatives are more likely to lend to REs who are: male, younger, have experienced an economic crisis, live in more agrarian towns, and had borrowed in the past. Thus based on the empirical results, the clienteles of formal and informal lenders are differentiated in terms of the availability of standard information and size of operation.
CHAPTER 6
CONCLUSIONS

6.1 Summary of Findings

In three regions of Mexico rural credit markets are characterized by: (i) shallowness, as only 45 percent of rural entrepreneurs (REs) engaged in credit transactions during the two years prior to the survey; (ii) assortive matching; (iii) a limited frequency of interlinked credit contracts, as only 2 percent of farm entrepreneurs engaged in interlinked transactions; and (iv) the predominance of commercial credit as the major source of finance.

In rural credit markets in Mexico, in general, REs have limited access to financial services. The observed credit market participation is lower compared to that reported in the rural areas of other countries such as Bolivia, Costa Rica, Honduras, Nigeria, The Philippines, and Thailand. These lower participation rates reflect weak supply of and demand for credit in the regions studied.

A combination of factors hinders the supply of credit: (i) attenuated property rights; (ii) lending technologies with high fixed cost structures; (iii) government intervention in output, input, and credit markets; and (iv) high information and contract enforcement costs due to changing market relationships during a period of structural transformation.

A weak demand for credit is the result of: (i) high borrowing costs; and (ii) inadequacies of the legal framework for creating, perfecting, and enforcing security interest which result in high ratios of collateral value to loan size and in the absence of opportunities to offer movable goods as collateral.

A benchmark model of a pairwise interaction between a borrower and a lender was presented in Chapter 3. In this model, income and production risk are incorporated in a
multiplicative way. The demand for and supply of loans were derived and the characteristics of a competitive and a monopolistic credit contract were discussed.

Next, two types of lending and borrowing costs were incorporated into the basic model: fixed and proportional costs. The introduction of fixed costs results in the same equilibrium loan size as in the case of the benchmark model. Moreover, investments in information acquisition by lenders raise the competitive interest rate above the level achieved under perfect information, because lender costs are increased. However, borrower costs do not affect this rate.

The monopolistic interest rate is inversely related to the entrepreneur’s fixed borrowing costs. Higher fixed borrowing costs increase the reservation level of expected profits of the RE and, in order to compensate the borrower for those costs, the monopolist must reduce the interest rate.

Proportional lending and borrowing costs affect the equilibrium loan contract differently than fixed costs. With the introduction of proportional transaction costs of borrowing and lending, the optimal loan size decreases with respect to the benchmark model. Therefore, an increase in the borrower’s proportional transaction costs induces a reduction of the competitive interest rates, with a positively-sloped competitive supply schedule, as loan size declines. An increase of the lender’s proportional transaction costs reduces however, the competitive interest rates if the elasticity of the equilibrium loan size with respect to these costs is less than one.

An increase in the proportional cost of lending may either reduce or increase the monopolistic interest rate because of induced changes in the equilibrium loan size and because of the concavity of the participation constraint of the entrepreneur.

The assumption of a perfect screening technology is relaxed by modeling the information acquisition process of lenders. The process of costly information acquisition reduces the gains of a match and the window of negotiation between a lender and a borrowing entrepreneur. Furthermore, lenders with better estimates of an entrepreneur’s risk type are in better position to offer loan contracts with more attractive terms.
Mexican credit markets exhibit an assortive matching pattern which sort and links entrepreneurs and lenders according to classes. Chapter 4 provides an explanation for this empirical regularity. It is argued that assortive matching patterns result from cost complementarities between lending technologies and the entrepreneurs' ability to convey their risk type to lenders.

Lenders use standard or idiosyncratic information to support their screening, monitoring, and enforcement activities. The value of standard information is not affected by the distance between borrowers and lenders, and other lenders can read this information at comparable costs. In contrast, **Idiosyncratic Information** is generated at low marginal cost by interactions among local residents or among agents interacting in the same markets. Consequently, the cost of gathering idiosyncratic information is affected by the identity and location of the lender.

Assortive matching patterns in rural credit markets are associated with monopolistic structures in informal markets and with interest rate differentials between formal and informal sectors. Competition among informal lenders may be limited because those lenders who already know creditworthy clients have an advantage over potential lenders without that information. New lenders, while competition among incumbent lenders is reduced by the advantages of their relationship with their own pool of borrowers.

Because assortive matching results from the comparative advantage of a particular lender over others in offering loan contracts to a given pool of borrowers, it is optimal for lenders to arbitrage on borrowers' transaction costs of seeking other sources of funds. This results in a wide variation of interest rates in the informal sector, and in a differential between the average interest rate of formal and informal lenders.

The econometric results of Chapter 5 support the evidence of assortive matching in the rural areas of the Mexican states of Guanajuato, Puebla, and Veracruz. A multinomial logit model is fitted to empirically test the hypothesis of assortive matching. Lenders are classified into five categories according to the type of credit services offered (e.g., cash-loans versus commercial credit) and their profit motive (e.g., friends and relatives lend for altruistic or reciprocity reasons).

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The hypothesis of assortive matching is divided into two components: (i) formal lenders are more likely to lend to entrepreneurs with a higher endowment of standard information; and (ii) informal lenders are more likely to lend to entrepreneurs with lower endowments of standard information.

The econometric findings show that certain lenders provide credit only to certain rural entrepreneurs depending on their economic activities, income levels, wealth endowments, characteristics of the locality where they reside, and other demographic variables.

6.2 Scope for Future Research

The models of Chapters 3 and 4 do not allow for the analysis of different enforcement mechanisms, such as the termination of relationships [Stiglitz and Weiss, 1983] and reputation effects. However, they can be extended to introduce a time dimension, since the expectation of repeated transactions creates important incentives in rural credit markets.

Furthermore, the model can be extended to address moral hazard from two different perspectives. The first one is based on the diversion of borrowed funds to other uses, such as household consumption, before investing money into their projects. The model of Chapter 3 can be easily adapted to introduce the choice of credit diversion for private consumption by using a two-period model, as Blackman (1995) does. However, moral hazard can also occur after the realized project outcome, when entrepreneurs do not reveal to lenders the true project return. Williamson's (1986) framework of the ex post monitoring activities of lenders can be incorporated in the model to deal with this type of moral hazard.

An interesting extension of the matching game model of Chapter 4 is to allow for the strategic interaction among formal and informal lenders to derive a pricing game. This type of modeling would provide an explanation of the interest rate differential between the two sectors. Another extension of the model is to link the entrepreneurs' participation constraint to labor market opportunities.
6.3 Policy Implications

The financial sector plays an important role in the economic development of the rural areas. This dissertation has several expected policy implications for government interventions in rural credit markets. The process of economic adjustment in Mexico calls for financial deepening in the rural areas, as financial services are necessary instruments for the changes that many rural entrepreneurs must carry out. As presented in Chapter 2, a large majority of REs operate under financial autarky and do not have financial savings.

The shallowness of rural credit markets in the regions studied will affect the easiness of REs to adjust to the macroeconomic reforms of recent years and to the exchange rate crisis of early 1995. RCMs may play an important role to help REs to adjust factor proportions, modify output mixes, change their scale of operations, and invest in new technologies. Unfortunately, the performance of these markets is likely to deteriorate in the short term. The informal sector is unlikely to expand because of: (i) the structural adjustment has weakened traditional enforcement mechanisms; and (ii) endogenous market organizations with an interest in promoting interlinked credit contracts may have not yet appeared.

Some type of government participation in rural financial markets may be desirable, given the beneficial effects of smoothly functioning markets. As shown, RCMs in Mexico are highly segmented. The formal sector's main advantage is its ability to intermediate funds over space, which is an important function in the rural areas because of covariant income [Besley, 1994]. In contrast, informal lenders who rely mainly on their own local resources cannot intermediate funds over large geographical areas. The informal sector's main advantage is its access to idiosyncratic (local) information about entrepreneur risk types. A combination of each sector's comparative advantage might be an appealing strategy to deepen and integrate RCMs.

Two alternative strategies can be used to combine the comparative advantages of formal and informal sectors: (i) use informal lenders as conduits for formal lenders; or (ii) induce formal lenders to behave like the informal sector or the downgrading of formal lenders. The use of

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informal lenders as agents of formal lenders creates an agency problem [Chaves and Gonzalez-Vega, 1996; Fuentes, 1994]. There are several documented cases of recruitment of informal lenders as agents [Bell, 1990]. In Mexico, FIRA has established a program aimed at using a variety of enterprises, such as, processors and input suppliers, as conduits to disburse formal credit to final users (Programa de Agro-Asociaciones).15

There are several problems in using informal lenders who provide interlinked credit contracts as conduits. First, savings mobilization in the rural areas is neglected. Second, the development of rural financial markets at large is ignored because interlinked credit contracts are contingent on the market of specific products. Credit market relationships would be destroyed as producers change crops or economic activity. Given the Mexican current environment of structural change, the best way to promote interlinked credit contracts is to increase the flow of capital to rural areas so that those contracts can arise endogenously. For example, the government can promote the development of private marketing channels for outputs and inputs. Pervasive government interventions in those markets through state-owned institutions (e.g., CONASUPO and FERTIMEX) have limited the development of interlinked transactions between output, input, and credit markets. Third, there are doubts of whether an increased supply of formal sector funds to trader-lenders would increase the volume of funds or reduce interest rates in the rural areas. There is at least anecdotal evidence from the case studies that informal lenders are not constrained by funds. Hoff and Stiglitz (1993) present a theoretical model that shows that informal interest rates may increase due to increased competition for borrowers among lenders via induced entry. Several authors present evidence that traditional credit interventions of injecting funds into the rural areas do not drive informal lenders out or reduce interest rates [Siamwella et al. 1990; Bell, 1990].

The main objective of government intervention in Mexican credit markets should be to increase the availability of formal finance in rural areas by inducing formal intermediaries to behave more like informal lenders. In this manner, formal lenders would be able to compete with informal

15 There is a lot of cross-countries evidence of contract lending or contract farming [See Conning, 1995; Ladman, de la Viña and Liz, 1992; Bell, 1990].
lenders in different segments of the market, leading to greater market integration. The development of a new lending technology—hybrid of formal and informal—takes a lot of experimentation. Besley (1994) argues that there is a role for government investment in research and development of new lending technologies. The appropriate form of government experimentation of new technologies is beyond the scope of this dissertation.

Since the driving forces behind the assortive matching hypothesis are information and transaction costs, government intervention in other markets may reduce the small entrepreneurs' cost of borrowing from formal lenders and increase their demand for formal credit. Moreover, given the importance of collateral and contract enforceability in financial intermediation, a government's key duty is to provide an environment in which property rights, contracts, and—hence—financial services can prosper. This entails—for example—improved legal frameworks for contract enforcement, collateral use, and information-sharing networks between lenders (e.g., credit checks). This type of intervention will have an effect only in the long term, because institutions and markets take time to evolve.

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76 There is a growing interest on the discussion of individual versus group lending.

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APPENDIX A

BENCHMARK MODEL

Proposition I: Characteristics of loan demand functions

(I) The loan demand function $B(R, A, \ldots)$ is implicitly defined from the first-order condition of the rural entrepreneur optimization problem. Using the implicit function rule, $\frac{dB}{dR} = -\frac{\pi_{BR}}{\pi_{BB}}$. From the second-order condition of profit maximization (see equation (6), (6)) the denominator is negative. The numerator is negative if the output elasticity is less than one ($\varepsilon < 1$) and the critical value of $\theta$ is increasing in the interest rate factor ($\dot{\theta}_R > 0$).

$$\pi_{BR} = [1 - F_\theta(\hat{\theta})] \left[ Y_B \frac{\partial N_\theta}{\partial \theta} \dot{\theta}_R + (\varepsilon - 1) \right] < 0 \quad (54)$$

Q.E.D.

(II) Again, from the implicit-function rule $\frac{dB}{dA} = -\frac{\pi_{BA}}{\pi_{BB}}$. Deriving the first-order condition for profit maximization with respect to $A$.

$$\pi_{BA} = \left[ 1 - F(\hat{\theta}) \right] \left[ Y_B N_\theta \dot{\theta}_A + Y_{BA} N(\hat{\theta}) + R \varepsilon_A \right] > 0 \quad (55)$$

If the following conditions are satisfied $\pi_{BA}$ is negative: (i) the elasticity of output is non-increasing in $A$, (ii) $N$ is decreasing in $\hat{\theta}$ and (iii) the critical value of $\theta$ is decreasing in fixed factors of production ($\dot{\theta}_A < 0$).

Q.E.D.
(iii) Using the implicit-function rule $d\Phi/d\phi = -\pi_{ne}/\pi_{na}$. Deriving the first-order condition for profit maximization with respect to $\Phi$,

$$\pi_{B\Phi} = \{ Y_B N_0 \hat{\theta} + Y_B N(\hat{\theta}) + R \epsilon_\theta \} > 0 \quad (56)$$

If the following conditions are satisfied $\pi_{ne}$ is negative: (i) the elasticity of output is non-increasing in $\phi$, (ii) $N$ is decreasing in $\hat{\theta}$ and (iii) the critical value of $\theta$ is decreasing in fixed factors of production ($\hat{\theta}_0 < 0$).

**Proposition 2 Characteristics of the entrepreneur's isoprofit curves.**

(i) Differentiating the entrepreneur's expected profits with respect to $R$ yields,

$$\pi_R = \frac{d\pi}{dR} = -B [1 - F_\delta(\hat{\theta})] < 0 \quad (57)$$

Q.E.D.

(ii) Implicit differentiation of expected profits yields $dR/dB = -\pi_n/\pi_R$.

$$\frac{dR}{dB} = \frac{\int_0^\delta [\Theta Y_B - R]dF_\delta(\Theta)}{B[1 - F_\delta(\hat{\theta})]} > 0 \quad (58)$$

Consequently, the sign of $dB/dR$ determines the sign of $\pi_n$. When an interior solution for $B$ is reached, the slope of the expected isoprofit is zero ( $\pi_n = 0$). This implies that the slope of the isoprofit is zero whenever it crosses the notional loan demand function. In order to show that
the isoprofit is concave around the notional loan demand function, it is necessarily that the second
derivative is negative. Totally differentiating, \( \frac{dR}{dB} = -\pi_B / \pi_R \) yields,

\[
\frac{\partial}{\partial B} \frac{dR}{dB} = \frac{-[\pi_R \pi_{BB} - \pi_B \pi_{RB}]}{\pi_R^2}
\]

which is negative when \( \pi_B = 0 \).

Q.E.D.

**Proposition 3: Characteristics of the notional supply of loans \( B^* \).**

(i) The notional supply of loans \( B^*(R, A, \ldots) \) is implicitly defined from the first-order
condition of the lender. Using the implicit function rule, \( \frac{dB^*}{dR} = -g_{BR} / g_{BB} \). The numerator is
positive because \( g_{BB} = -\pi_B \). The denominator is negative because the output elasticity is less than
one (\( e < 1 \)) and the critical value of \( \theta \) is increasing on \( B \) (\( \theta_B > 0 \)).

\[
g_{BB} = Y_{BB} \int_{\theta} F_\theta (\theta) + Rf_\theta (\theta) \theta_B (e - 1) < 0
\]

Q.E.D.

(ii) Using the implicit-function rule, \( \frac{dB^*}{dA} = -g_{BA} / g_{BB} \). From the second-order condition for
profit maximization the denominator is negative. In addition, \( g_{BA} \) is positive because of the critical
value of \( \theta \) is increasing on \( A \), and the elasticity of output is less than one.

\[
g_{BA} = \int_{\theta} \theta Y_{BA} dF(\theta) + Rf(\hat{\theta}) \theta_A (1 - e) > 0
\]

Since, \( dB^*/dA > 0 \), the lender' iso-profit map shift to the right when \( A \) is increased.

Q.E.D.
(iii) Using the implicit-function rule, \( \frac{dB^s}{d\theta} = -\frac{g_{s\theta}}{g_{ss}} \). From the SOC for profit maximization the denominator is negative. In addition, \( g_{s\theta} \) is positive because of the critical value of \( \theta \) is increasing on \( A \), and the elasticity of output is less than one.

\[
g_{s\theta} = Y_{s} \int_{\theta}^{1} [J(\theta) - H(\theta)] d\theta + R(1 - \varepsilon)[J(\hat{\theta}) - H(\hat{\theta})] > 0
\]  

(62)

(iv) Using the implicit-function rule, \( \frac{dB^v}{dI} = \frac{g_{sI}}{g_{ss}} = 1/g_{ss} < 0 \).

**Proposition 4: Characteristics of the lender’s isoprofit curves.**

(i) Higher isoprofit curves correspond to higher levels of profit.

\[
g_R = \frac{\partial g}{\partial R} = B[1 - F_\delta(\hat{\theta})] > 0
\]  

(63)

(ii) To show that the isoprofit is convex around the optimal loan amount it is necessarily that the second derivative is negative. Totally differentiating the slope of the isoprofit yields,

\[
\frac{\partial}{\partial R} \frac{dR}{dB} = \frac{-[g_R g_{BB} - g_B g_{RB}]}{g_R^2} > 0
\]  

(64)

which is positive when \( g_B = 0 \).

(iii) The slope of the zero isoprofit curve is everywhere increasing because the output-elasticity \( \varepsilon \) is less than unity. Implicitly differentiating the lender’s expected profit yields,

\[
\frac{dR}{dB}_{|R = R^*} = \frac{-g_B}{g_R} = \frac{-\{ \int_{\theta}^{1} \Theta Y_{\theta} dF_\delta(\theta) + R[1 - F_\delta(\hat{\theta})] - I \}}{B[1 - F_\delta(\hat{\theta})]}
\]  

(65)

\[
\frac{-[RB - IB + \int_{\theta}^{1} [\varepsilon \theta Y - RB] dF_\delta(\theta)]}{B^2[1 - F_\delta(\hat{\theta})]}]
\]  

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When \( g = 0 \) then

\[
IB = \int_0^\beta \left[ Y(B,A,\Theta) dF_\delta(\Theta) \right] + RB \left[ 1 - F_\delta(\hat{\Theta}) \right]
\] (66)

Substituting (66) into equation (65) yields.

\[
\frac{dR}{dB} \bigg|_{g \to 0} = \frac{-\int_0^\beta \left[ (\varepsilon - 1) \Theta Y dF_\delta(\Theta) \right]}{B^2 [1 - F_\delta(\hat{\Theta})]} > 0
\] (67)

\[
g(B,R) = 0 \rightarrow \frac{dR}{dB} \bigg|_{\pi \to 0} > 0.
\] (68)

Q.E.D.

**Proposition 5: Comparative Statics of the Pareto optimal loan size \( B^* (\delta, l, A; \omega, \phi) \):**

The first-order condition of the sum of the borrower and the lender expected profits implicitly defined the Pareto optimal loan size. Using the implicit function theorem:

(i)

\[
\frac{dB^*}{dA} = -\frac{\xi_{BA}}{\xi_{BB}} = -\frac{Y_{BA} \int_0^\beta \Theta dF_\delta(\Theta)}{Y_{BB} \int_0^\beta \Theta dF_\delta(\Theta)} > 0
\] (69)

(ii)

\[
\frac{dB^*}{dB} = -\frac{\xi_{BB}}{\xi_{BB}} = -\frac{\int_0^\delta \Theta dH(\Theta) - \int_0^\delta \Theta dJ(\Theta)}{Y_{BB} \int_0^\delta \Theta dF_\delta(\Theta)} > 0
\] (70)
\[ \frac{dB}{dI} = -\frac{\frac{\partial}{\partial \theta} \cdot}{\frac{\partial}{\partial \theta} \cdot \theta} = \frac{1}{Y_{BB} \int_{Q} \theta dF_{\theta}(\theta)} < 0 \]  

(71)
APPENDIX B
PERFECT SCREENING MODELS

Proposition 6: The lender's zero isoprofit curve is convex on the \((R,B)\) space.

Implicitly differentiating, the lender's expected profits when this is equal to zero yields,

\[
\frac{dR}{dB_{y=0}} = -\frac{g_B}{g_R} = -\frac{\int_\hat{\theta}^\theta \psi(\epsilon - 1) dF_\hat{\theta}(\theta) + S(\omega \phi)}{B^2 [1 - F_\hat{\theta}(\hat{\theta})]} \\
> 0 \quad \Rightarrow \quad g_B < 0
\]  

Q.E.D.

Proposition 7 Contractual Equilibria with Fixed Screening and Signaling Costs.

(i), (ii) and (iii) are expressed in the following equations,

\[
\frac{dR_{\text{max}}}{dK} = -\frac{1}{B [1 - F(\hat{\theta})]} < 0 \\
\frac{dR_{\text{min}}}{dS} = \frac{1}{B [1 - F(\hat{\theta})]} > 0
\]

Notice that increasing \(K\) or \(S\) move \(R_{\text{max}}\) and \(R_{\text{min}}\) closer to each other.
Let \( A_{0} \) and \( A_{s} \) denote fixed factor of production for big and small entrepreneurs, respectively. From the implicit-function rule, \( dR_{G}^{min} / dS = -g_{ss}^{N} / g_{s}^{N} \). Hence, for the same change on screening costs,

\[
dR_{G}^{min} = \frac{dS}{B^{*}(A_{G})[1 - F(\hat{\theta} | A_{G})]} < \frac{dS}{B^{*}(A_{S})[1 - F(\hat{\theta} | A_{S})]} = dR_{S}^{min}
\]  

(75)

because,

\[
\frac{B(A_{S})}{B(A_{G})} < \frac{1 - F(\hat{\theta} | A_{G})}{1 - F(\hat{\theta} | A_{S})}
\]  

(76)

This result, because equilibrium loan size is increasing on \( A \) and the critical level of \( \hat{\theta} = \hat{\theta} \) is decreasing in \( A \).

Q.E.D.

**Proposition 9:** Using the implicit function theorem,

\[
\frac{dB^{d}}{d\alpha} = -\frac{\pi_{N}^{N}}{\pi_{BB}^{N}} = \frac{1}{\pi_{BB}^{N}} < 0
\]  

(77)

**Proposition 10:** Using the implicit function theorem,

\[
\frac{dB^{i}}{d\bar{p}} = -\frac{\xi_{N}^{N}}{\xi_{BB}^{N}} = \frac{1}{\xi_{BB}^{N}} < 0
\]  

(78)
Proposition 11: The new Pareto optimal loan size $B^*(\alpha, \delta, \beta, \theta, I, A; \phi, \omega)$:

(i) This effect is shown by the following equations.

\[
\frac{d B^*}{d \alpha} = \frac{1}{Y_{BB} E(\Theta; \delta)} < 0
\]

(79)

\[
\frac{d B^*}{d \beta} = \frac{1}{Y_{BB} E(\Theta; \delta)} < 0
\]

(80)

Proposition 12:

(i)

\[
\frac{d R_{\text{max}}}{d \alpha} = -\frac{\pi_B}{\pi_R} \frac{\partial B^*}{\partial \alpha} - \frac{\pi_\alpha}{\pi_R} = \frac{[Y(e - 1) \int_0^\Theta \theta dF(\theta) + \pi_0]}{B^2[1 - F(\Theta)]} \frac{\partial B^*}{\partial \alpha} - \frac{1}{[1 - F(\Theta)]} \geq 0
\]

(81)

(ii)

\[
\frac{d R_{\text{max}}}{d \beta} = -\frac{\pi_B}{\pi_R} \frac{\partial B^*}{\partial \beta} = \frac{[Y(e - 1) \int_0^\Theta \theta dF(\theta) + \pi_0]}{B^2[1 - F(\Theta)]} \frac{\partial B^*}{\partial \beta} \geq 0
\]

(82)

(iii)

\[
\frac{d R_{\text{min}}}{d \beta} = -\frac{g_B}{g_R} \frac{\partial B^*}{\partial \beta} - \frac{g_\Theta}{g_R} = \frac{Y(1 - e) \int_0^\Theta \theta dF(\theta)}{B^2[1 - F(\Theta)]} \frac{\partial B^*}{\partial \beta} + \frac{1}{[1 - F(\Theta)]} \geq 0
\]

(83)
\[
\frac{dR^{\min}}{d\alpha} = -\frac{g_B}{g_R} \frac{\partial B^*}{\partial \alpha} = \frac{Y(1 - e) \int_{\theta}^{\theta} \Theta dF(\Theta)}{B^2[1 - F(\theta)]} \frac{\partial B^*}{\partial \alpha} < 0
\]
APPENDIX C
IMPERFECT SCREENING: CONSERVATIVE LENDER

Proposition 13: The lender demand for additional information has the following characteristics:

(i)

\[
\frac{dz^*(B,R,b)}{dB(\omega, \phi)} = -\frac{g_z}{g_{zb}} = \frac{1}{\delta_{qq}(X^H - X^J)} < 0
\]  

(85)

(ii)

\[
\frac{dz^*(B,R,b)}{dB} = -\frac{g_{zR}}{g_z} = \frac{-\delta_q(X^H - X^J)}{\delta_{qq}(X^H - X^J)} > 0
\]  

(86)

(iii)

\[
\frac{dz^*}{dA} = -\frac{g_{zA}}{g_z} = \frac{-\delta_q(X^H - X^J)}{\delta_{qq}(X^H - X^J)} > 0
\]  

(87)
Proposition 14 The zero isoprofit curve of the lender is convex.

\[
\frac{dR}{dB} \bigg|_{g=0} = -\int_{0}^{\hat{\theta}} Y(\epsilon - 1) dF_{\delta(q^*)}(\theta) + h(\omega, \phi)z^* \bigg] \bigg. \frac{B^2[1 - F_{\delta(q^*)}(\hat{\theta}; \cdot)]}{\delta_{qq} (X - X')^2} > 0 \tag{89}
\]

Proposition 15 Using the implicit function theorem,

\[
\frac{dB}{db} = -\frac{\hat{g}_{Bb}}{\hat{g}_{bb}} = -\frac{\delta_q (X_B - X_B^J)}{\delta_{qq} (X - X')} \frac{\hat{g}_{BB}}{\hat{g}_{BB}} < 0 \tag{90}
\]

Proposition 16 The Pareto optimal loan size \(B(R, A, b)\) with imperfect screening:

(i) The slope of the contract curve in the \(R-B\) space is given by \(dB^*/dR = -\frac{\delta_{BB}}{\delta_{BB}}\). Hence, the sign of \(dB^*/dR\) depends on the sign of \(\delta_{BB}\).

\[
\frac{\partial^2 \mathcal{L}_{BR}}{\partial R \partial b} = \left[ \delta - \delta(q^*) \right] [Z_{BR}^H - Z_{BR}^J] - \frac{\delta_q (X_B^H - X_B^J)}{\delta_{qq} (X^H - X^J)} > 0 \tag{91}
\]

\(\delta_{BB}\) is positive as long as,

\[
Z_{BR}^H - Z_{BR}^J > 0 \Rightarrow \frac{h(\hat{\theta})}{1 - \tilde{H}(\hat{\theta})} > \frac{j(\hat{\theta})}{1 - \tilde{J}(\hat{\theta})} \tag{92}
\]
\[
Z_{BR}^H - Z_{BR}^J = [1 - H(\hat{\theta})][R(1 - \epsilon)\hat{\theta}_R \frac{H(\hat{\theta})}{1 - H(\hat{\theta})} - 1]
- [1 - J(\hat{\theta})][R(1 - \epsilon)\hat{\theta}_R \frac{J(\hat{\theta})}{1 - J(\hat{\theta})} - 1]
\]

(93)

(II) decreases with the per unit cost of information.

\[
\frac{dB}{db} = - \frac{\xi_{BR}^B}{\xi_{BR}^B} = - \frac{\delta_q (X^{III}_B - X^{IV}_B)}{\delta_{qq} (X^{III}_B - X^{IV}_B) \xi_{BB}} < 0
\]

(94)
APPENDIX D

NOTATION AND VARIABLES

Basic Model

\(\pi\)  
Entrepreneur's expected profits

\(A\)  
Entrepreneur's fixed factor of production

\(B\)  
Loan size

\(\phi\)  
Set of variables that represent the endowment of standard information.

\(\Theta\)  
Random variable that represent production risk

\(P\)  
Random variable that represent price risk

\(\theta\)  
Random variable that encompasses production and price risk

\(y\)  
Random productive income

\(Q(B,A,\Theta;\phi)\)  
Production function

\(Y(B,A)\)  
Certain productive income

\(c\)  
Elasticity of output

\(\delta\)  
Entrepreneur's risk type

\(F_\delta(\theta)\)  
Cumulative distribution function of \(\theta\)

\(H(\theta)\)  
Cumulative distribution of \(\theta\) when \(\delta = 1\)

\(I(\theta)\)  
Cumulative distribution of \(\theta\) when \(\delta = 0\)

\(g\)  
Lender's expected profits

\(\omega\)  
Vector of variables that reflect the lender's technology

\(l(\omega)\)  
Opportunity cost of funds for lenders

\(r\)  
Interest rate

\(R = 1 + r\)  
Interest rate factor

\(R^{\text{max}}\)  
Monopolistic interest rate factor

\(R^{\text{min}}\)  
Competitive interest rate factor

Fixed Lending and Borrowing Costs

\(S(\phi, \omega)\)  
Fixed lending cost

\(K(\phi, \omega)\)  
Fixed borrowing cost

Proportional Lending and Borrowing Costs

\(\alpha(\phi, \omega)\)  
Per unit transaction cost of borrowing

\(\beta(\phi, \omega)\)  
Per unit lending cost
Imperfect Screening

\( b \)  Per unit cost of information
\( q \)  Total amount of information that the lender has
\( z \)  Amount of additional information
\( s \)  Initial endowment of information