Heterogeneity, Matching, and the Hedonic Structure of the Credit Market*

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Abstract

This paper develops a matching model between entrepreneurs and financial intermediaries to explain the assortative organization of credit relationships and the heterogeneity in the equilibrium contracts. The diversity in credit sizes and interest rates is determined by the optimal sorting and the matching incentives from supply and demand for credit given the differences in the intermediation costs, the competition induced by the heterogeneity on productivity of both entrepreneurs and intermediaries, and the prices of other relevant markets. To assess the implications of the framework, this paper works with a unique collection of datasets that combines information from banks, firms, and credit contracts for the commercial credit banking system in Mexico, and uses as source of experiment the observed expansion in banking activity resulting from a change in the law allowing the introduction of new commercial banks to the market. The empirical analysis presents a series of findings in terms of positive assortative relationships, market outreach, and contractual outcomes consistent with the implications of the model given an exogenous increase in the number of intermediaries and strong complementarity in productivity.

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"[...] credit is essentially the creation of purchasing power for the purpose of transferring it to the entrepreneur, but not simply the transfer of existing purchasing power. [... This] characterizes, in principle, the method by which development is carried out in a system with private property and division of labour. [...] It is only thus that economic development could arise from the mere circular flow in perfect equilibrium. And this function constitutes the keystone of the modern credit structure."

JOSEPH A. SCHUMPETER. 1936. *The Theory of Economic Development*, Chapter III: Credit and Capital, p. 107.

1 Introduction

Diversity among agents is a fundamental characteristic of every market and plays a central role in determining the organization, structure, and differences in outcomes observed in an industry. Many studies in economic development, industrial organization, finance, and banking, have analyzed the effects of diversity in the credit market and found specific relations between the heterogeneity of the agents and the market outcomes that describe the structure of this industry.[1] For example, banks specialize in different types of clients, and credit contracts relate to characteristics of both lender and borrower such as productivity, size, and risk. Likewise, the entry of new banks enhances competition, increases the number of demand served, and modifies contracts within the market. Little research has been done to understand the underlying incentives driving these stylized facts and how simultaneoulsy they determine one another. The need for a unifying framework is crucial from different perspectives, including market regulation, economic development, and public policy, since this industry is a primary source of external funding for entrepreneurs and firms, allowing innovation, investment, and risk sharing, and thereby enabling development and growth.

In this paper I pursue two complementary objectives to fill this gap in the literature with an integrated approach that examines the structure of the credit market. First, I develop a competitive matching model for entrepreneurs and financial intermediaries when they are searching for a credit partner and decide the optimal scale of operations in their respective markets. This characterization allows for a better understanding of the source of sorting among the agents on how the market outcomes are *hedonically* determined by the diversity in quality of the agents. The second goal of my research is to complete the proposed framework with an assessment of the implications of the model using the Mexican credit market as a case study. I work with a unique collection of datasets combining information from banks, firms, and credit contracts, and find organizational, financial outreach, and contractual outcomes that support the predictions of the model in these dimensions.

The model I present in this paper closely follows the continuous-type matching framework developed by Sattinger (1979), Gretsky, Ostroy, and Zame (1992), and Chiappori, McCann, and Nesheim (2008). However, in contrast with those studies, I allow for the selection of both the credit partner and the credit size borrowed or loaned by each agent on the demand and supply sides of this market. The agents make their choices considering the competitively determined interest rate (potentially different in each contract) and the conditions of other relevant markets.

[1] See the related literature section for more references.

In my approach for the credit market, the sources of diversity are the entrepreneur's technology for producing a final marketable good, as well as the intermediary's technology for creating financial services. The complementarity inducing the matching incentives of intermediaries an entrepreneurs is the heterogeneity in the intermediation costs for financial services; this assumption can be justified by several arguments, for instance, more productive firms are better organized to consolidate a credit transaction; or raising funds in the market is relatively easy for banks if the project in which they invest has higher returns.

The market solution is a stable assignment of bank-client relationships, each with a contract that subscribes a level of capital and an interest rate. The agents of each relationship maximize profits given their contract and the selection of their credit partner. Under some conditions in the technology and heterogeneity of the agents, the equilibrium sorting of intermediaries and clients into partnerships is such that more productive banks give credit to more productive firms; this is equivalent to a positive assortative assignment. Also, the credit and the scale of production of both intermediaries and entrepreneurs increase in their respective types. The profits also increase in the agent's productivity type, and differences in profits on each side of the market are *differential rents* associated to this characteristic. Moreover, the equilibrium interest rates are competitively determined and permit the Pareto efficient distribution of the surplus generated within each credit relationship given the optimal selection of the capital; however, the interest rates decrease for better banks and firms only if the complementarities in costs is strong for all the possible coalitions of agents.

The proposed matching framework identifies the effects of changes in the market's fundamentals as the combination of several margins derived from the optimal behavior of agents, including a new dimension of analysis: the assortative organization of credit partnerships. The sorting of agents into credit partnerships is an underlying force necessary to understand both the entry and exit from the credit market, and therefore the characteristics of the contracts. For example, an increase in the number of intermediaries that preserves the distributions of types for both supply and demand, modifies the assortative organization of bank-client relationships; all entrepreneurs who previously got credit in the market *match* with better intermediaries, allowing for an expansion in the quality and trading at each match. Additionally, entrepreneurs entering the market are served by banks with lower productivity and granting low levels of credit.

The theoretical framework in this paper does not offer a model that accounts for all the possible matching incentives that might determine the credit contracts and the selection of a partner. For instance, there could be further elements determining these choices such as searching costs, risk, experience, economies of scale, or complementarities in other financial services. My model, regardless the abstraction on the nature of interaction of the agents, can address the observed outcomes in the credit market, and provides a useful conceptual framework to characterize the elements that simultaneously determine this equilibrium using Mexico as case study.

The empirical section works with a unique set of data combining information on contracts, banks, and firms for the Mexican credit market from 2004 to 2007. Moreover, I use the expansion of the number of banks resulting from a change in the law in 2004-05 as a source of experiment for an increase in the relative size of intermediaries. I present three types of evidence supporting the implications of the framework in terms of matching assortativeness, outreach, and contractual outcomes.

In terms of assortativeness, I found that banks with lower cost rates of capitalization, a measure of their own productivity to raise funds in the market, provide credit to more productive firms, as measured by their average yearly sales per-worker. This finding is robust to different model specifications and control variables such as the bank's size, and the age and location of the firm. This evidence suggests a positive sorting of credit relationships among firms and banks. Also, I observe that intermediaries dealt in average with lower productivity clients when comparing the first and last quarter of available data.

During the period of bank growth and increase in banking indicators, there was an expansion in the outreach of intermediation, as measured by percentage of firms with credit from banks. A firm's productivity has a positive and significant effect on the probability of having credit, and the firms entering into the credit market are less productive when compared to those firms who already had credit before the change. These results are also robust to several model specifications and also consistent with the predictions of the model.

The evidence on contracts shows that the observed distributions of credit and interest rates have been skewed into lower credit sizes and higher interest rates. The correlation between interest rates and credit size is negative and significant for each of the periods analyzed. When studied separately, the credit size of a contract is positively related to the productivity of a firm, and negatively related to the funding cost rate of the banks; the outreach, measured by the percentage of firms with credit, is associated to larger credit size. On the other hand, the interest rate of a contract is negatively related to the productivity of the firm, positively correlated to several specifications of the funding cost of the bank, and positively correlated to the outreach of financial services.

Overall, this paper has two main contributions to the existing literature. First, my model extends the applications of matching theory introducing new margins of decision for studying the credit market. The characterization of the equilibrium permits a better understanding of the incentives and multiple decision margins underlying the structure of this market. Moreover, this approach provides new possibilities for studying the effects of changes in the market conditions such as: i) fusion of banks, ii) merging of firms, iii) technological innovation in banking services, and iv) financial and credit openness. Second, my paper assesses the implications of the model using a unique dataset that combines information on banks, firms, and contracts for Mexico. This research is the first for this country to address the importance of both sides of the credit market using contracts information. Empirical evidence supports some of the implications of the model and opens new research agendas on the empirical analysis of this market, first by expanding the proposed setup to include new dimensions of matching incentives, and second by using the full information of the framework to estimate and calibrate the model.

The rest of the document proceeds as follows. Section 2 documents a literature review on banking relationships and recent studies using different matching approaches to the credit market. Section 3 describes the empirical motivation for the Mexican economy. Section 4 presents the matching model for the credit market; it introduces the relevant concepts, propositions, and equilibrium properties of the solution. This section concludes with a particular structural example, a simulation, and two comparative statics exercises. Section 5 introduces the characteristics of the datasets for the empirical analysis. Section 6 provides the empirical assessment on the matching framework for the Mexican credit market. Section 7 presents the research agenda derived from this study.

2 Related Literature

An extensive line of research on banking has developed on the analysis of financial intermediation combining different types of micro and macro datasets for several countries.[2] These studies have found specific and consistent relationships between financial intermediaries and the clients they serve; for example, loans originated by large banks have lower interest rates and are less likely to be secured by collateral than similarly sized bank loans granted by small banks; these papers conclude that larger banks have higher quality borrowers relative to the smaller bank clients, and support the idea of some market specialization in terms of quality.

The empirical literature on banking for Mexico has focused on analyzing the determinants of the observed credit levels, the differences on bank's interest rate spreads, and the relationships of aggregate outcomes to the behavior of the banks following a traditional industrial organization approach. These papers have found mixed evidence on the relationships of the previous foreign bank entry experience, the financial outreach, and the aggregate market outcomes. Looking at the period after the 1994 crisis, Haber and Musacchio (2005) find that foreign banks grant less credit, are more selective in their loans, and charge lower interest rate spreads than domestic banks to attract lower risk credits; however, foreign banks are more profitable than their domestic counterparts because they charge higher fees given their market power. Schulz (2006) finds that the main contribution of foreign bank entry was to help recapitalize the banking sector and improve its asset quality, but had limited effects on efficiency or lending. Beck and Martinez-Peria (2008) use quarterly country, bank, and bank-municipality-level data and find that as foreign bank participation increased, so the number of municipalities with bank presence, but the number of loan and deposit accounts fell for the country and for banks after they became foreign; this fall in the number of loans was partially compensated by an increase in domestic bank loans. Moissinac (2006) performs a series of regressions and finds a positive relationship between bank lending and the balance sheet indicators of capital adequacy and credit quality. Finally, Haber (2009) provides four hypothesis to explain the observed low credit outcomes in the Mexican banking market, namely: i) the alternative sources of finance for banks, ii) the unintentional consequence of the Government 1990's bailout (FOBAPROA), iii) an oligopoly structure of the market, and iv) a weak legal environment to enforce contract rights. The author uses information for the aggregate market and for the banks and reaches mixed conclusion on these conjectures; particularly, his empirical analysis shows that Mexican largest banks earn rents from market power by offering credit at a relatively low interest rate than their competitors, but charging higher bank's fees.

A new line of study in banking and finance has explored the implications of both heterogeneity and matching incentives on some specific outcomes of the credit contracts such as agricultural land lease contracts and risk aversion (Ackerberg and Botticcini 2002), entrepreneurs and venture capitalists (Sørensen 2007), financial credit contracts, risk to default, and monitoring costs (Dam 2007), and interest rate spreads across contracts (Chen 2008). Though these papers have found mixed evidence of the assortative organization of supply and demand for credit, and describe some of the possible effects of diversity on the contractual outcomes, they have simplified the incentives behind matching relationships by assuming a reduced form set of equations or an assortative solution *de-facto*. As a result, these frameworks either lack of identification of the fundamental source of heterogeneity driving the outcomes, or don't analyze the aggregate implications of the sorting for a change in the market environment.

[2] See Gorton and Winton (2001) for an extensive review on the different roles of financial intermediaries, and Strahan (2008) for a summary on the findings of empirical research on banking.

3 Empirical Motivation

The Mexican corporate credit market is an interesting example for analyzing the implications of the proposed credit matching framework for at least three motives. First, it replicates many of the observed aggregate market findings of other studies, but in a developing economy with a relatively recent privatized banking sector and with relative low outreach performance when compared to other countries. Second, after a dramatic fall and long period decrease in the levels of bank's corporate credit resulting from the Mexican 1994-95 crisis, a change in the law allowed the introduction of new types of banks, thus increasing the number of intermediaries in the market; this exogenous change creates a potential source of experiment for the model. Finally, access to a unique collection of datasets on banks, firms, and detailed information on equilibrium contracts enables the assessment of the micro implications of the model beyond the aggregate market outcomes.

According to information collected by Banco de Mexico (2009), banks represent the second option for financing capital requirements among Mexican firms after their own input suppliers, and notably above the almost nonexistent financing through the formal capital stock market. Nonetheless, the relative performance of Mexican banking activity has been considerably below the average when compared to other countries. For instance, Haber (2009) shows that during 2005 Mexico had the lowest credit portfolio as percentage of GDP relative to other OECD countries. For that same year, Mexico also had the fourth lower private credit-to-GDP ratio in Latin America, below countries such as Ecuador, Peru, Bolivia, and Guatemala.

A change in the law in 2004-05 approved by the Mexican Senate and implemented by the Ministry of Finance and Banco de Mexico allowed the introduction of 15 new banks to the 29 already in operation (Banco de Mexico 2008). The change in the number of credit suppliers induced a dramatic shift in the dynamics of the indicators of corporate banking in Mexico. For example, this variation led to a trend-breaking increase in the total personnel and branches in the banking sector as both grew by more than 20 percent between 2005 and 2007. Also, the bank's credit portfolio started to increase at a higher pace during 2006, and by the end of 2007 the total commercial bank credit loaned at the market was 18 percent of the GDP. In this same period the provision of corporate credit in Mexico increased from 5.9 to 8.4 percent of the GDP, and the number of new contracts created per month tripled. Given the low rate of completion in signed contracts, this led to a massive increase in the stock of the total number of corporate credit contracts reported at each month (Figure 1.1).

The average characteristics of firms with credit among the Mexican commercial banks differ when measured in several dimensions. For instance, when comparing the third quarters of 2004 and 2007, the sales and labor force differed among banks. Moreover, when we study the sales per worker, as proxy of productivity for the firm, we observe large and consistent heterogeneity in the mean of this variable among the Mexican commercial banks. A comparison between these two periods reveals that after the introduction of new intermediaries, the average client had lower productivity, lower sales, and lower labor force for most of the banks (Table 1.1).

Along with the observed differences in the organization of banks and clients into partnerships, the structure of the contracts offered by each institution also differed within and across periods (Table 1.2). In particular, the average and different percentiles of both contractual credit size and interest rates for each bank are notably different among these institutions, as are the number of contracts created during the two periods observed.

These three types of stylized fact replicate the findings for other countries regarding the observed aggregate structure of the market. The aim of this paper is to provide a consistent unified framework that simultaneously explains the previous aggregate evidence of banking relationships and identifies the source of changes of the equilibrium.

4 Theoretical Framework

4.1 Elements of Matching Incentives in a Credit Relationship

The analysis of aggregate outcomes such as interest rate's spreads and portfolio credit levels hides many of the interactions occurring at disaggregate level at the assortative, extensive, and intensive margin decision of the agents. The availability of microdata with information on contracts, and on the agents on both side of the market, permits to analyze several dimensions lost when studying the aggregate information and not captured in the typical representative agent assumption done in market regressions.

From a micro-theoretical perspective, the importance of intermediation costs in determining the structure of financial intermediaries goes back to Townsend (1979). More recently, Greenwood and Jovanovich (1990) and Townsend and Ueda (2006) used the existence of intermediation costs to explain the patterns of growth and inequality in an economy. The matching approach, on the other hand, has been useful to study the market organization under diversity of supply and demand since the seminal works by Gale and Shapley (1962), Shapley and Shubik (1971), and Becker (1972). Recent extensions to the matching theory for continuous heterogeneity done by Gretsky, Ostroy, and Zame (1992) and Chiappori, McCann, and Nesheim (2008) further help to identify the equilibrium properties and the hedonic implications by expanding the frameworks of Sattinger (1979).

Consider a closed local economy and assume there are two disjoint sets of agents that characterize the supply and demand of the credit market, namely "financial intermediaries" and "entrepreneurs," respectively.[3] Intermediaries could differ in their size, location, and their own costs to finance the capital requirements of their clients. On the other hand, entrepreneurs and potential clients can be different in their talent, the size of the demand they face for their product, geographical location, economic sector, among many other factors. Assume the entrepreneurs are characterized by a parameter $\theta \in \Theta = [\theta_L, \theta_H]$ that summarizes their heterogeneity, while the intermediaries are different according to an index $\omega \in \Omega = [\omega_L, \omega_H]$.

Financial intermediaries and entrepreneurs freely meet in a spot competitive market environment, and they are potential partners for a joint relationship. Each agent can select both its credit partner and the level of capital to trade, given the competitive price for this financial service. Each intermediary and client relationship is described by a credit contract $\mathcal{C} = \{k, R\}$ characterized by: i) a level of capital k to be financed by the intermediary to the entrepreneur at the beginning of the period; and ii) a fixed payment R per unit of capital loaned due at the end of each period.

No asymmetric information is assumed so the heterogeneity on both sides of the market is known by all agents. Also, to gain insights of the interaction induced in this pure matching

[3] In the context of this model the "financial intermediaries" are a collection of venture capitalists, money lenders, and branches of commercial banks, so there is a large number of this type of agents in the market, each having a very close "better" and "worse" competitor.

environment, searching costs are negligible and there is no risk of default. The following sections describe in detail the nature of the incentives for each class of agents and provide the definition and properties of the equilibrium.

4.1.1 Entrepreneurs - Potential Clients

The demand for credit resources is determined by potential firms requiring capital or financial services. Define the entrepreneur as a household with an instantaneous utility $u(y_t) = y_t$. The utility is a function of his own consumption y_t. The entrepreneur has a non-tradable income flow $\mathcal{Y}$ each period and this is assumed to be a subsistence good for consumption. The potential entrepreneur has a project at hand which gives a flow of output $q(k;\theta)$ and is a function of the level of both the level of capital k, and the exogenously given productivity parameter of the entrepreneur θ defined in a compact space $\Theta = [\theta_L, \theta_H]$ with cumulative distribution $G_\Theta(\cdot)$. The technology of production for entrepreneurs requires financial services k (*capital* henceforth) they competitively demand from intermediaries, and takes the form:

$$q(k;\theta) = A(\theta)k^\alpha \tag{1}$$

Like in Lloyd-Ellis and Bernhard (2000) and Gine and Townsend (2004), the elemental source of heterogeneity on the demand side for credit θ is related to the entrepreneur's ability for starting a firm; this parameter shifts the marginal return for each unit of capital investment. In this setup, the entrepreneur's own productivity is a specific non tradeable input θ affecting positively the marginal product of capital through a function $A(\theta)$, with $A(\theta) > 0$ and $A_\theta(\cdot) > 0\ \forall\theta \in \Theta$.

Each entrepreneur has no initial capital to finance its project or to trade, so they require outside funding from a financial intermediary. The entrepreneur can competitively demand capital in the form of credit at a given price to be paid at the end of the period. The price reflects the gross interest rate for the resources and might depend on the entrepreneur's and bank's types. Entrepreneurs take the price value as given as it is not possible to switch types; so let this value be defined by $R(\omega, \theta)$ where ω is the index identifying the intermediary.

All the entrepreneurs can sell their homogeneous output at a given price P. Let $B(k;\omega,\theta)$ be the total cost for borrowing k units of capital at a given interest rate $R(\omega,\theta)$ then an entrepreneur of type θ derives instantaneous utility $u(\cdot)$ in the following possible states:

$$u(P,k;\omega,\theta) = \begin{cases} \mathcal{Y} & \text{if in autarky, so } \omega = \varnothing \\ \mathcal{Y} + Pq(k;\theta) - B(k;\omega,\theta) & \text{if in a relationship with } \omega \in \Omega \end{cases} \tag{2}$$

where $\varnothing$ stands for empty given an unmatched element θ. The set of instantaneous utilities, and the value induced by the structure of potential contracts offered at the market, jointly determines the incentives to accept a partner which is the solution to the extensive margin of the entrepreneur's problem.

4.1.2 Financial Intermediaries - Banks

The financial intermediary, or bank, is an agent with non-transferable resources $\mathcal{K}$ and able to raise funds at the market for being transformed into financial services (capital) for productive local investment. It has a linear instantaneous utility of the form $v(y_t) = y_t$, which is a function of its own consumption y_t.

Assume there exist a continuum of banks different by their technology index type ω defined on the compact space $\Omega = [\omega_L, \omega_H]$ with cumulative distribution $F_\Omega(\cdot)$. The heterogeneity in production arises from differences in technologies, experience, or in the managerial capacities for processing credits at the market. In this idea, the production function is a reduced form of the bank's technology[4] given by the form:

$$k(s; \omega, \theta) = b(\omega, \theta) s^\beta \tag{3}$$

Here, the production of capital depends on the level of funding resources competitively demanded by intermediaries s, and a technology component $b(\omega, \theta)$ depending on the type of entrepreneur it is serving θ, and on its own technology of services ω. The returns to scale on the production of loans are determined by β, while the component $b(\omega, \theta)$ shifts the productivity of the production of financial services according to the degree of complementarity between entrepreneur and bank types at a given pairwise relationship (ω, θ). The rest of the paper will assume that better type banks (high ω type) are more productive when they have a higher productivity firm (high θ type) as their client. This is a shortcut to the capacity for reading information from the bank, as more productive firms might provide better balance statements, or the ability of the intermediary to raise funding from the market given quality of the project they are financing. Mathematically $b(\omega, \theta) > 0$, $b_\omega(\cdot) > 0$, $b_\theta(\cdot) > 0$, and $b_{\omega\theta}(\cdot) > 0$ for all $\theta \in \Theta$ and $\omega \in \Omega$.

The intermediary can competitively raise funds s from the deposit market at a gross interest rate (price) p to be paid at the end of the unique period. Then, at a given match (ω, θ) the minimum cost for providing a level of capital k is:

$$c^b(p, k; \omega, \theta) = p \left[\frac{k}{b(\omega, \theta)} \right]^{\frac{1}{\beta}} \tag{4}$$

Therefore, the complementarity of productivity between intermediaries and entrepreneurs operates as a Spence-Mirrlees single-cross condition through the cost of intermediation. The competitive interest rate might differ among types, $R(\omega, \theta)$. Therefore, conditional on being in a contract relationship, a bank of type ω derives a total revenue equal to $L(k; \omega, \theta) = R(\omega, \theta)k$ and the instantaneous utility $v(\cdot)$ under the following possible states:

$$v(p, k; \omega, \theta) = \begin{cases} \mathcal{K} & \text{if not lending, so } \theta = \varnothing \\ \mathcal{K} + L(k; \omega, \theta) - c^b(k; \omega, \theta) & \text{if in a relationship with } \theta \in \Theta \end{cases} \tag{5}$$

where $\varnothing$ stands for empty given an unmatched element ω. The intermediaries face no fixed costs, and they can collect any capital requirements $k(\theta)$ from the entrepreneur if it covers the cost of capitalization in the market deposits, so the extensive margin for intermediaries refers to participate or not in the corporate credit market.

4.1.3 Timing and the Option for a Credit Contract

The timing of the decision-making process is assumed to be similar to the one of a non-atomic matching marriage market. At each period a continuum of entrepreneurs and intermediaries

[4] This assumption follows the *intermediation approach* of banking, where financial institutions collect deposits and purchase funds to be subsequently transformed into loans by combining them as inputs along with capital, labor, and technology. See Clark(1988), Freixas and Rochet (1997), and the references therein.

meet at the market searching for a partner. All information is perfectly observable and all potential meetings occur at not cost of searching within each period at an almost instantaneous time. Therefore, this analysis focuses on the stable matching equilibrium reached when no individual or joint coalition can block the current assignment of agents and the implied allocation of resources.

This research uses two fundamental elements to build the theoretical framework that describes the equilibrium from the interaction of both supply and demand: i) the unique stable matching solution with assortative characterization resulting from matching models with transferable utility and supermodularity; and ii) the Pareto endogenous efficient sharing rule that arises from a collective model with bargaining and competition. The following section describes in detail the links among these two elements and the properties of the stable matching solution in the proposed environment for entrepreneurs and intermediaries.

4.2 Characterizing the Assortative Matching Solution

4.2.1 Equilibrium: Feasibility, Stability, and Optimality

Following the conventional framework for a matching environment with continuous types as presented by Sattinger (1979), Gretsky, Ostroy, and Zame (1992), and more recently Chiappori, McCann, and Nesheim (2008), we define the credit assignment game (CAG henceforth) as a non-atomic cooperative environment characterized by a triplet $\{\mathbf{A}, Q, M(\cdot)\}$, where $\mathbf{A}$ is a measurable space of players; $Q(\cdot)$ is a real-valued function; and $M(\cdot)$ is a subset of measures with properties described below in detail.

Define $\bar{\mathbf{\Omega}} = \Omega \cup \{\varnothing_\Omega\}$ and $\bar{\mathbf{\Theta}} = \Theta \cup \{\varnothing_\Theta\}$ as the expanded space of agents constructed by introducing an isolated point $\varnothing_\Omega$ for each unmatched entrepreneur, and one element $\varnothing_\Theta$ for each unmatched bank; each of these new spaces has its own expanded measure to integrate the potential dummy-partners for the unmatched agents. Define the CAG measurable space of agents $\mathbf{A} = (A^{(\cup)}, A^{(\mathcal{B})})$, where $A^{(\cup)}$ is the union of the extended sets of intermediaries and entrepreneurs, $A^{(\cup)} = \bar{\Omega} \cup \bar{\Theta}$; $A^{(\times)}$ is the Cartesian product of the extended sets for the types of agents, $A^{(\times)} = \bar{\Omega} \times \bar{\Theta}$; and $A^{(\mathcal{B})}$ is equal to the Borel sigma-algebra defined over the underlying extended sets $\bar{\Omega}$ and $\bar{\Theta}$. Also, for the extended measure functions $F_{\bar{\Omega}}$ and $G_{\bar{\Theta}}$, and the extended measurable spaces $\bar{\mathbf{\Omega}}$ and $\bar{\mathbf{\Theta}}$ we define the combined population measure $\wp$ characterized over the set $A^{(\mathcal{B})}$. Each element $a^{(\mathcal{B})} \in A^{(\mathcal{B})}$ is said to describe a **coalition of agents**.

The second element of the CAG provides the value $Q(\cdot)$ generated by a pairwise coalition of agents $a^{(\times)} \in A^{(\times)}$. Associated with each possible pair partnership (ω, θ) consisting of a bank of type $\omega \in \bar{\Omega}$, and an entrepreneur of type $\theta \in \bar{\Theta}$, there is a real number $Q(\cdot)$ that defines the surplus value of this coalition, namely $Q : A^{(\times)} \to \mathbb{R}$. This real-valued relationship is known as the **characteristic function** and in this matching context it appears as if both entrepreneur and intermediary acted as a vertically integrated firm, particularly:

$$Q(k;\omega,\theta) = Pq(k;\theta) - c^b(k,p;\omega,\theta) \tag{6}$$

$$= PA(\theta)k^\alpha - p\left[\frac{k}{b(\omega,\theta)}\right]^{\frac{1}{\beta}} \tag{7}$$

The surplus generated at this pairwise relationship of one unit of deposit substracted from this market creates value through the productivity of the intermediary by creating capital k,

then through the productivity of the entrepreneur by converting this capital into a final good $q(k)$, and this value is ultimately enhanced by the complementarity among productivities that exist on the costs of financial intermediation. This condition implies that, at each matching relationship (ω, θ) such that $\varphi(\omega) = \theta$ and $\psi(\theta) = \omega$, the payment-cost from entrepreneur for having credit $B(k; \omega, \theta)$ equals the revenue of the financial intermediary in this transaction $L(k; \omega, \theta)$:

$$B(k; \omega, \theta) = L(k; \omega, \theta) \tag{8}$$

To have a complete description of the surplus, we have the following normalization conditions for the dummy partner types:

$$\begin{array}{ll} Q(\varnothing_\Omega, \theta) = U(\theta, \varnothing_\Omega) = 0 & \text{for all } \theta \in \bar{\Theta} \\ Q(\omega, \varnothing_\Theta) = V(\omega, \varnothing_\Theta) = 0 & \text{for all } \omega \in \bar{\Omega} \end{array} \tag{9}$$

This assumption ensures the ability of each agent to remain unmatched, and so, normalizes the utility of this option to be zero.

The surplus value of each credit transaction is assumed to be pairwise determined, therefore any larger coalition is valuable only as it can organize itself in pairs (may be factional pairs of agents) consisting of an intermediary (or a fraction of it) and an entrepreneur (or a fraction of it), but allowing for redistribution of the resources reached by the coalition once these pairs are formed. Therefore, the surplus value $\mathbf{Q}(s)$ for a coalition $s \in A^{(\mathcal{B})}$ is:

$$\mathbf{Q}(s) = \begin{cases} Q(w, t) & \text{for } s \in A^{(\times)} \\ \max\{\sum_{s_j \in S} Q(s_j)\} & \text{for any set of coalitions } S \text{ such that } s_j \in A^{(\mathcal{B})} \end{cases} \tag{10}$$

By the way the linear profits are introduced for both classes of agents, we can apply the results of **transferable utility** between the agents in a coalition. So for any pairwise match (ω, θ) the surplus of the coalition can be distributed among the partners: i.e., if ω receives a payment $V(\omega)$, then θ receives $U(\theta)$ such that $U(\theta) + V(\omega) \leq Q(\omega, \theta)$.

Finally, the last element of the CAG defines $M(A^{(\times)})$ to be the Banach space of *countably additive* Borel Measures on $A^{(\times)}$ equipped with the total variation norm; this family of functions includes all the measures v such that $\|v\| = \sup_\pi \sum_{E_i} |v(E_i)|$ over all finite measurable partitions π of $A^{(\times)}$.

For the CAG triplet $\{\mathbf{A}, Q, M(A^{(\times)})\}$, we define an **assignment** X as a measure on $A^{(\times)}$ summarizing all the partnership activities in the market; hence $X : A^{(\times)} \to \mathbb{R}$ is the distribution of the extended space of banks $\bar{\Omega}$ giving credit to extended space of entrepreneurs $\bar{\Theta}$.

Then for the CAG, the set $\{(U^s(\theta), V^s(\omega)), X^s\}$ is a **stable outcome** (or the payoffs and assignment functions are stable) if the following condition is satisfied: [5]

$$U^s(\theta) + V^s(\omega) \geq Q(\omega, \theta) \quad \forall (\omega, \theta) \in A^{(\times)} \tag{11}$$

[5] This condition normalizes the utility outside the match to be equal to zero.

By construction, the stability condition includes the option to remain unmatched, or being matched with the dummy counterpart, namely:

$$\begin{array}{ll} U^s(\theta) \geq Q(\varnothing_\Omega, t) = 0 & \forall \theta \in \bar{\Theta} \\ V^s(\omega) \geq Q(\omega, \varnothing_\Theta) = 0 & \forall \omega \in \bar{\Omega} \end{array} \tag{12}$$

The stability of the outcome requires two types of conditions. The first refers to **individual rationality**, and reflects that each agent always has the option to remain without a credit relationship. The second condition requires that the outcome **is not blocked** by any different set of agents; if the second condition is not satisfied, then it would be beneficial for any of the elements to finish its current partnership, and form a new partnership with someone else, which would grant them a higher payoff.

The proposed environment has the following new property that complements the previous results on stable matching, but allowing the selection of the intensity of trade. This intensive margin within the match is defined by the capital traded between intermediaries and entrepreneurs at each credit relationship $k^*(\omega, \theta)$.

Proposition 1 *: **Optimal Capital, Stable Matching Assignment, and Equivalence of Solutions**. Let $\{\mathbf{A}, Q, M(A)\}$ be CAG with a Cobb-Douglas production specification and assume the following set of conditions holds:*

i) $m(\omega, \theta) = [A(\theta) b(\omega, \theta)^\alpha]^{\frac{1}{1-\alpha\beta}} > 0$	$\forall \{\theta \in \Theta,\ \omega \in \Omega\}$
ii) $m_{\omega\theta}(\omega, \theta) > 0$	$\forall \{\theta \in \Theta,\ \omega \in \Omega\}$ *, and not switching signs*
iii) $\alpha < 1$ *and* $\beta < 1$	*for the production functions specifications*
iv) $F_\Omega(\omega)$	*is the cumulative density function for* Ω
v) $G_\Theta(\theta)$	*is the cumulative density functions for* Θ

Then, for a given set (p, P) of strictly positive prices, the set $\{X^*(\omega, \theta), U^*(\theta), V^*(\omega)\}$ is a stable matching solution of the CAG if and only if it attains the efficient level of capital at every match, i.e.

$$\begin{aligned} k^*(\omega, \theta) &= \arg\max_{k \in \mathbb{R}_+} \{Q(k; \omega, \theta)\} \quad \textit{for } (\omega, \theta) \in X^*(\omega, \theta) \\ &= \left[\frac{P \beta \alpha A(\theta) b(\omega, \theta)^{\frac{1}{\beta}}}{p} \right]^{\frac{\beta}{1-\alpha\beta}} \\ &\textit{and} \\ Q^*(\omega, \theta) &= U^*(\theta) + V^*(\omega) \quad \textit{for } (\omega, \theta) \in X^*(\omega, \theta) \end{aligned}$$

Moreover, the surplus at the match evaluated at $k^*(\omega, \theta)$ is upper-semi continuous on both agents' types. Therefore, by Gretsky, Ostroy, and Zame (1992), the core of the game is non-empty, the competitive Walrasian equilibria exist, and the solutions to these problems are effectively equivalent.

Proof. □ See Appendix B. ■

The previous result states that under perfect information, no transaction or searching costs, and no further frictions to entry, there exists a stable assignment on which the endogenous size of the surplus is maximized at each relationship. The capital traded within each

partnership in the stable assignment solution maximizes the social welfare, so this assortative solution and the allocation of resources implied must attain a Pareto optimal solution.

The equivalence of solutions implies that if X^* is an optimal assignment, then it is compatible with any set of stable payoffs $(U^s(\theta), V^s(\omega))$. Furthermore, $\{(U^s(\theta), V^s(\omega)), X^s\}$ is a stable outcome, then X^s is an optimal assignment X^* in the game. Hence, under some additional identification conditions and by finding a stable assignment in a matching framework we would be able to characterize an optimal assignment X^* and then recover the Pareto stable set of payoff $\{U^*(\theta), V^*(\omega)\}$ associated with it. [6]

4.2.2 Identifying the Assortative Solution

Consider the extended measurable sets $\bar{\mathbf{\Omega}}$ and $\bar{\mathbf{\Theta}}$ and their respective extended measures $F_{\bar{\Omega}}(\cdot)$ and $G_{\bar{\Theta}}(\cdot)$. Also assume the population measure implied by the conditions above $\wp$ on $A^{(\times)}$ is $M(A^{(\times)})$. Becker (1973) shows that in order to guarantee a **positive assortative matching solution** between the elements of $\bar{\Omega}$ and $\bar{\Theta}$, the cross derivative condition on the surplus for the pairwise credit relationship should satisfy the following property:

$$\frac{\partial^2 Q^*(\cdot,\cdot)}{\partial\theta\partial\omega} > 0$$

The proposed credit assignment framework has a second proposition to complement the first result presented in the previous section.

Proposition 2 *: **Positive Assortative Assignment and Endogenous Capital**. Let $\{\mathbf{A}, Q, M(A)\}$ be CAG with a Cobb-Douglas production specification and assume the conditions of Proposition 1 are satisfied. Then, $k^*(\omega,\theta)$ sustains a positive assortative assignment solution. Moreover, the assignment solution is unique and pure, namely, a one-to-one matching.*

Proof. □ See Appendix B. ■

This new proposition states that, in equilibrium, the low cost of more efficient intermediaries should attract high types and more productive entrepreneurs and clients in the observed contracts. This result is an extension of market equilibrium and optimality, as it is simultaneously satisfied under the premises that guarantee the existence of a stable matching solution in Proposition 1. The mathematical elements behind this idea represent a special form of the single-cross or Spence-Mirrlees condition for a one-dimensional matching variable case that guarantees the surplus function $Q(\cdot)$ implied by the production and intermediation cost in equilibrium, is upper semi-continuous on both agents' types.[7]

With this new result in mind, define N_Θ and N_Ω as the number of entrepreneurs and intermediaries of each continuous type of agents in the economy respectively. Let us normalize the original measures of the banks to a value $\rho = \frac{N_\Omega}{N_\Theta}$ such that if there is an equal mass of

[6] For a broader description of of stability and optimality given the elements of the model, please refer to the appendix.

[7] In fact, Chiappori, McCann, and Nesheim (2008) generalize this result for matching in multiple dimensions in terms of a generalized Spence-Mirrlees mathematically known as "twist condition."

both banks and entrepreneurs $\rho = 1$, if there are relatively more banks than entrepreneurs then $\rho > 1$, and finally $\rho < 1$ implies more entrepreneurs than banks.

A pure positive assortative matching solution, such as the one resulting from the conditions assumed above, implies the following market clearing condition for the agents in terms of the original distributions of types:

$$\rho\left[1 - F_{\Omega}(w)\right] = 1 - G_{\Theta}(t) \tag{13}$$

Given the relative abundance of either side of the market, ρ would define which class of agents remains without a partner. Consider without loss of generality the case where there is a relative abundance of entrepreneurs. If $\rho < 1$ there exists a critical value of entrepreneur θ_{CR} who is the last to get credit of the lowest bank type ω_L. For that critical value it is true that $F_{\Omega}(\omega_L) = 0$ so $\theta_{CR} = G_{\Theta}^{-1}(1-\rho)$. Therefore all entrepreneurs with type $\theta < \theta_{CR}$ are unable to get credit from banks, or equivalently, these entrepreneurs will match with the dummy bank partner $\varnothing_{\Omega}$. This second condition will define the **extensive margin** of credit when abundance is on the demand side of the market.

Under the positive assortative equilibrium and given a value of ρ, for a specific intermediary agent $w \in \Omega$, the entrepreneur $\theta > \theta_{CR} \in \Theta$ that matches w will be defined by $\varphi(w)$ and should satisfy the following assignment function:

$$\varphi(w) = G_{\Theta}^{-1}\left(1 - \rho[1 - F_{\Omega}(w)]\right) \tag{14}$$

Similarly, for the entrepreneur of type $t > \theta_{CR} \in \Theta$, the bank $\omega \in \Omega$ that matches is defined by $\psi(t)$, and is given by:

$$\psi(t) = F_{\Omega}^{-1}\left(1 - \frac{1}{\rho}\left[1 - G_{\Theta}(t)\right]\right) \tag{15}$$

The solutions $\varphi(w)$ and $\psi(t)$ are the **intermediary-client assignments**, and either of these functions determine the allocation of banks and entrepreneurs in the model as a function of ρ.

4.2.3 Surplus Distribution, Equilibrium Profits, and Hedonic Contracts

The positive assortative solution and the structural results from the setup provide identification to the distribution of the surplus gains from a bank-client coalitions given the intensive margin at which capital is traded within the stable match assortative distribution.

Equipped with the previous propositions, we can see that the **stability of the matching solution** $\{(\omega^*, \theta^*)\}_{\substack{\omega^* \in \Omega \\ \theta^* \in \Theta}}$ induced by X^* requires that the **stable matching payoff** for each θ satisfies:

$$U^*(\theta) = \max_{\omega} \left\{Q(\omega, \theta) - V(\omega)\right\}$$

Therefore by the first order condition for the agent θ given the positive assortative matching solution $\omega = \psi(\theta)$ and the envelope condition the following differential equation to be satisfied at the equilibrium payoff:

$$\frac{\partial}{\partial \theta} U^*(\theta) = \left.\frac{\partial}{\partial \theta} Q^*(\omega, \theta)\right|_{\omega = \psi(\theta)}$$

This implies a solution of the type:

$$U^*(\theta) = \bar{U}(\theta) + K_\theta \tag{16}$$

Similarly, by stability of the match (ω, θ), we require that for each ω with stable match partner $\theta = \varphi(\omega)$ the utility function in terms of the intermediary type satisfies at equilibrium:

$$V^*(\omega) = \bar{V}(\omega) + K_\omega \tag{17}$$

As in Sattinger (1979), the payoff to a particular agent at the equilibrium can be interpreted in terms of *differential rents*, as it depends on his productivity relative to other agents on the same side of the market. In the context of the model, $U^*(\theta)$ and $V^*(\omega)$ define in equilibrium the surplus division between two agents at match, which implicitly defines the interest rate and the capital level. This solution depends on heterogeneity for the agents in the economy. By definition, for a pair (ω, θ) the value of such matching relationship is therefore:

$$Q^*(\omega, \theta) = U^*(\theta) + V^*(\omega) = \bar{U}(\theta) + \bar{V}(\omega) + K_\omega + K_\theta \tag{18}$$

To recover the constants K_ω and K_θ we have two conditions to hold in the solution of the model in terms of the surplus and the relative constraint given by the abundance of the market from either supply or demand. The first condition is given by feasibility at equilibrium, no transfers outside the match, and no resource misallocated within the match; the second condition has to do with the indifference condition in the participation constraint for the critical type agent getting credit. This condition depends on ρ, which determines the relative abundance of measure on the supply or demand side of the market.

The assumption $\rho < 1$ will guarantee the identification of the constants K_ω and K_θ as all entrepreneurs with lower type than $\theta_{CR} = G_\Theta^{-1}(1-\rho)$ would unambiguously be without credit. To keep the lower entrepreneur type just indifferent, we assume zero profits to this entrepreneur type and normalize the utility from being outside the market equal to the one being with dummy partner, $U^*(\theta|\varnothing_\Omega) = U^*(\theta_{CR}) = 0$, so this allows us to identify K_θ:

$$U^*(\theta_{CR}) = \bar{U}^*(\theta_{CR}) + K_\theta = 0 \Leftrightarrow K_\theta = -\int_{\theta_L}^{\theta_{CR}} \left[\frac{\partial}{\partial x} Q(\omega, x) \Big|_{\omega=\psi(x)} \right] dx \tag{19}$$

Then, solving the differential equation over the relevant range for the entrepreneur the market solution is given by the following system of equations:

$$U^*(\theta) = \int_{\theta_{CR}}^{t} \left[\frac{\partial}{\partial x} Q(\omega, x) \Big|_{\omega=\psi(x)} \right] dx, \text{ for } \theta \in [\theta_{CR}, \theta_H] \tag{20}$$

$$V^*(\omega) = Q^*(\omega, \varphi(\omega)) - U^*(\varphi(\omega)), \text{ for } w \in \Omega \tag{21}$$

$$\varphi(\omega) = G_\Theta^{-1}\left(1 - \rho[1 - F_\Omega(\omega)]\right), \text{ for } w \in \Omega \tag{22}$$

Finally, the constant K_ω characterizes the value of the matching rents that goes to the intermediaries given the relative scarcity of supply in the market.

The proposed framework identifies the differential rents for both sides of the market in the tradition of Sattinger (1979) and Chiappori, Iyigun, and Weiss (2008), but allows for the optimal selection of the intensity of trade within each matching relationship, hence endonge-

nously determining the size of the matching surplus at the assortative solution. Provided the equilibrium setting and conditions of the two other propositions are satisfied, we have the following proposition.

Proposition 3 *: **Differential Rents and Equilibrium Outcomes**. Let $\{\mathbf{A}, Q, M(A)\}$ be CAG with a Cobb-Douglas production specification and assume the conditions of Proposition 1 are satisfied, then at the positive assignment solution $U^*_\theta(\cdot) > 0$, $V^*_\omega(\cdot) > 0$, $k^*_\omega(\cdot) > 0$, $k^*_\theta(\cdot) > 0$, $q^*_\theta(\cdot) > 0$, and $s^*_\omega(\cdot) > 0$.*

Proof. □ See Appendix B. ■

This proposition establishes the rules on inequality that must prevail in the equilibrium of contracts, profits, and production when we compare each side of the market in terms of the heterogeneity parameters.

At the positive assortative matching solution $\{(U^*(\theta), V^*(\omega)), X^*\}$, the capital traded within the match $k^*(\omega, \theta)$ must increase in each agents' type, so highly productive firms will have larger credit from lower cost banks, and low productive firms would get low credit from high cost banks. Also, as a direct implication of this result, the production of the final good $q^*(\theta)$ is increasing in the entrepreneur's type, so high productive firms will have absolute larger production in the final market, while low productive firms will have absolute lower production in this market. To complement this finding, the savings requirement from a bank $s^*(\omega)$ must be increasing in the bank's type, so highly productive banks will have larger holding of savings in the market and provide larger loans, while low productive banks will have absolute lower holding of savings in this market and will provide smaller loans. Moreover, the profits on both sides of the market also increase on their own types, yet the differential rents each agent perceives ultimately depends on the technological parameters, and the heterogeneity characteristics of the market.

Using the set of equilibrium conditions in production, costs, the utilities, the Pareto optimality, and the identification of capital traded, we can identify and deconstruct the utility transfers among agents into the capital and the relevant gross interest rates. The following two structural conditions define the equilibrium gross repayment as a function of the optimal capital and the interest rate among agents:

$$\begin{aligned} U^*(\theta) = &\begin{cases} 0 & \text{if } \psi(\theta) = \varnothing_\Omega \\ Pq^*(\theta) - B^*(\psi(\theta), \theta) & \text{if } \psi(\theta) \neq \varnothing_\Omega \end{cases} \\ V^*(\omega) = &\begin{cases} 0 & \text{if } \varphi(\omega) = \varnothing_\Theta \\ L^*(\omega, \varphi(\omega)) - C^*(\omega, \varphi(\omega)) & \text{if } \varphi(\omega) \neq \varnothing_\Theta \end{cases} \end{aligned} \tag{23}$$

The equilibrium conditions above resemble the elements for an equilibrium transfer for a hedonic model with buyers and sellers exchanging matching equilibrium contracts $\mathcal{C}^* = \{k^*(\omega, \theta), R^*(\omega, \theta)\}$[8] with endogenous quality in terms of both types of agents, and utility transfer equal to $B^*(\psi(\theta), \theta) = L^*(\omega, \varphi(\omega)) = R^*(\omega, \theta)k^*(\omega, \theta)$ for every matching pairwise (ω, θ) with $\varphi(\omega) = \theta$ and $\psi(\theta) = \omega$.

[8] See Rosen (1974) for the classical reference in the topic; consult Ekeland, Heckman, and Nesheim (2003) for an econometric analysis of identification and estimation of such models.

These conditions allow us to identify the implicit price involved at each transaction using the equilibrium transfers given the optimal capital $k^*(\omega,\theta)$; using the entrepreneur's equilibrium payoff $U^*(\theta)$, capital $k^*(\psi(\theta),\theta)$, the optimal production $q(\theta)$, and the assortative assignment $\psi(\theta)$, the gross interest rate solution takes the form of a hedonic price in terms of the entrepreneur's type θ defined as follows:

$$R^*(\theta) = R(\psi(\theta),\theta) = \begin{cases} \frac{Pq^*(\theta_{CR})}{k^*(\theta_{CR})} & \text{if} \quad \theta = \theta_{CR} \\ \\ \frac{Pq^*(\theta)-U^*(\theta)}{k^*(\theta)} & \text{if} \quad \theta > \theta_{CR} \end{cases} \tag{24}$$

The equilibrium interest rate is a non-linear function of either the entrepreneur's or the bank's type, which depends of the endogenous size of surplus within the partnership, and of the relative scarcity of the two agent's types. This implies that at each credit contract there exists a competitive price that might differ from the marginal cost of intermediation and that determines the division of the coalition surplus in terms of the competition among agents pursuing the same objectives and the relative scarcity of either supply or demand. Rather than risk allocation, asymmetric information, economics of scope, or the gains in information from future relationships, it is the potential gains from complementarity in transaction costs the force that drives the sorting and the implicit hedonic rate charged to the entrepreneurs.

According to Ledgerwood (1998), the size of the financial intermediation sector can be measured by two credit market indicators: the **outreach,** which measures the scale or number of clients served by the financial intermediaries; and the **depth**, which provides the scale of transactions as measured by the resources allocated in the market. The matching framework provides specific predictions on these two dimensions or margins of the performance of financial intermediaries. From an aggregate perspective, the outreach is measured by the percentage of firms with credit. The model also provides a measure of the total portfolio of resources allocated at the market, and the value created in this market given the optimal assignment of intermediaries and entrepreneurs. In particular, the total size of capital allocated in the credit market is the depth of financial intermediation and is the sum over those entrepreneurs obtaining credit in equilibrium:

$$K^*(\Omega,\Theta) = \int_{\theta_{CR}(\rho)}^{\theta_H} k^*(\psi(t),t)dt \tag{25}$$

To conclude, in the spirit of Schumpeter's idea on the role of credit, the added value of the credit market is the sum of the surpluses of the total credit market relationships at the optimal matching equilibrium and is given by:

$$S^*(\Omega,\Theta) = \int_{\theta_{CR}(\rho)}^{\theta_H} Q^*(\psi(t),t)dt = \tag{26}$$

$$= \left[[\beta\alpha]^{\frac{\alpha\beta}{1-\alpha\beta}} - [\beta\alpha]^{\frac{1}{1-\alpha\beta}}\right]\left[\frac{P}{p^{\alpha\beta}}\right]^{\frac{1}{1-\alpha\beta}} \int_{\theta_{CR}(\rho)}^{\theta_H} m(\psi(t),t)dt \tag{27}$$

By Proposition 1, the added value of the credit relationships at the market in equilibrium

achieves a first best Pareto solution and is a function of the matching assortative solution of intermediary-client partnerships and the essential parameters of the economy, including technologies, heterogeneity distribution, and prices for other relevant markets. Therefore, the assortative market solution induces the maximum welfare allocation of resources from deposits to entrepreneurs through the financial intermediaries.

4.3 Assessing the Assortative Matching Solution: An Example

To gain insights about the implication of the framework, this section presents the solution for the model with a Cobb-Douglas production specifications assuming a Pareto heterogeneity on the parameters associated to the technology of production on both sides of the market. This framework resembles some of the original work proposed by Sattinger (1979) and explored in detail by Heckman (2007), but expands the analysis to consider the new margins of decision in the matching model with endogenous capital. In particular, we assume two normalized spaces on Θ and Ω with types $\omega \geq 1$ and $\theta \geq 1$ and the following Pareto cumulative distributions:

$$F_{\Omega}(\omega) = 1 - \omega^{-\lambda_{\omega}} \tag{28}$$
$$G_{\Theta}(\theta) = 1 - \theta^{-\lambda_{\theta}} \tag{29}$$

The coefficients $\lambda_{\omega} > 1$ and $\lambda_{\theta} > 1$ ensure finite variances in both distributions and also measures the inequality within the types; a larger Pareto coefficient indicates a more equal distribution within each class of agents.

Therefore, assuming the conditions for a pure credit relationships hold and $\rho < 1$, the matching function solves the market clearing condition on the normalized types and is given by:

$$\psi(\theta) = \begin{cases} \rho^{\frac{1}{\lambda_{\omega}}} \theta^{\frac{\lambda_{\theta}}{\lambda_{\omega}}} & \text{if } \theta \geq \theta_{CR}(\rho) = \left[\frac{1}{\rho}\right]^{\frac{1}{\lambda_{\theta}}} \\ \varnothing_{\Omega} & \text{if } \theta < \theta_{CR}(\rho) = \left[\frac{1}{\rho}\right]^{\frac{1}{\lambda_{\theta}}} \end{cases} \tag{30}$$

Furthermore, assume the following type to productivity relationships satisfying the requirements of the propositions from the last section hold:

$$A(\theta) = \theta^{\kappa},\ \kappa > 0;\ \theta \geq 1 \tag{31}$$
$$b(\omega, \theta) = \theta^{\mu}\omega^{\psi};\ \mu > 0 \text{ and } \psi > 0 \tag{32}$$
$$m(\omega, \theta) = \theta^{\frac{\kappa+\mu\alpha}{1-\alpha\beta}} \omega^{\frac{\psi\alpha}{1-\alpha\beta}} \tag{33}$$

Evaluating the expressions at the optimal level of capital and normalizing $U^*(\theta_{CR}) = 0$, the solution for the entrepreneur's utility at equilibrium is:

$$U^*(\theta) = \left[\frac{a}{b}\right][\theta^b - \theta^b_{CR}] \tag{34}$$
$$\text{with} \quad :$$
$$a = \left[\frac{\kappa + \mu\alpha}{1-\alpha\beta}\right]\left[[\beta\alpha]^{\frac{\alpha\beta}{1-\alpha\beta}} - [\beta\alpha]^{\frac{1}{1-\alpha\beta}}\right]\left[\frac{P}{p^{\alpha\beta}}\right]^{\frac{1}{1-\alpha\beta}} \rho^{\left[\frac{\psi\alpha}{\lambda_{\omega}[1-\alpha\beta]}\right]}$$
$$b = \left[\frac{1}{1-\alpha\beta}\right]\left[\kappa + \alpha\left[\mu + \frac{\lambda_{\theta}}{\lambda_{\omega}}\psi\right]\right]$$

The slope of the equilibrium marginal utility represents the differential rents for the entrepreneur, and they can either increase or decrease in the entrepreneur type. Heckman (2007) explored the convexity and concavity for the prototypical Sattinger model. In this expanded environment, the convexity of the utility for entrepreneurs depends upon the following parametric condition:

$$\kappa + \alpha \left[\mu + \beta + \frac{\lambda_\theta}{\lambda_\omega} \psi \right] > 1 \tag{35}$$

From the necessary conditions for a stable matching equilibrium we know that the following conditions must hold:

$$\begin{aligned} \kappa, \mu, \psi &\in (0, \infty) \\ \alpha, \beta &\in (0, 1) \\ \lambda_\theta, \lambda_\omega &\in (1, \infty) \end{aligned}$$

Therefore, by the positive assortative solution, the optimality of the matching, and the uniqueness of equilibrium in general, we know that for those at the market the capital solution from the entrepreneur's perspective is given by:

$$\begin{aligned} k^*(\theta) &= k^*(\psi(\theta), \theta) = \begin{cases} 0 & \text{if } \theta < \theta_{CR}(\rho) \\ c\theta^d & \text{if } \theta \geq \theta_{CR}(\rho) \end{cases} \\ \text{for} &: \\ c &= \left[\frac{P\beta\alpha}{p} \right]^{\frac{\beta}{1-\alpha\beta}} \rho^{\frac{\psi\beta}{\lambda_\omega[1-\alpha\beta]}} \\ d &= \left[\frac{1}{1-\alpha\beta} \right] \left[\kappa\beta + \mu + \frac{\lambda_\theta}{\lambda_\omega} \psi \right] \end{aligned} \tag{36}$$

As with the entrepreneur's utility, we can define the properties of the optimal capital in terms of the entrepreneur's type. In particular $k^*(\theta)$ is convex with respect to its type θ as long as the following condition holds:

$$\mu + \beta[\kappa + \alpha] + \frac{\lambda_\theta}{\lambda_\omega} \psi > 1 \tag{37}$$

Now, by definition, for any entrepreneur of type $\theta > \theta_{CR}(\rho)$ we know the specific values of $k^*(\psi(\theta), \theta)$ and $q^*(\theta, k^*(\psi(\theta), \theta))$ at the optimal stable matching by the theorem, therefore the gross interest rate in terms of the entrepreneur's type is defined by:

$$R^*(\theta) = R^*(\psi(\theta), \theta) = Pc^{d[\alpha-1]}\theta^{\kappa - d[1-\alpha]} - \left[\frac{a}{bc\theta^d} \right] \left[\theta^b - \theta^b_{CR}(\rho) \right]$$

4.4 Simulation, Equilibrium, and Comparative Statics

This section presents a simulation of the model and describes two comparative statics exercises for the model. The first part describes the assortative solution. The second part presents the effects of a change in the relative number of intermediaries as measured by ρ; this experiment assumes that the increase is uniform along the set of types, so preserves the distribution of both classes of agents unchanged. The third part analyzes the effect of an exogenous increase in the cost of funding for banks as measured by the interest rate paid to the deposits.

4.4.1 Assortative Equilibrium

The parameters for the simulation were selected to satisfy the conditions that guarantee the equilibrium and consistency of the model and are shown in Table 2.1. Under this parametric specification, the matching function for $\rho_1 = 0.50$ has (by construction) a positive assortative solution between banks and firm; the critical value of the last entrepreneur having credit in this market is $\theta_{CR}(\rho_1) = 1.8271$ (Figure 2.4).

The equilibrium utilities for both entrepreneurs and intermediaries are concave and increasing in their own types for those agents with a matching partner, while by definition it is zero for those entrepreneurs outside the market. From the equilibrium utilities we can recover the equilibrium transfers from entrepreneurs to banks for each type of agents resulting from the transaction of capital. Under the parametric specifications, the transfers increase in each agent's type; although the entrepreneurs respective utilities increase, so does the equilibrium transfer they pay to the intermediaries to get financed (Figure 2.5).

By Proposition 3, the equilibrium capital increases for both agents' types. In this example the matching complementarity on costs dominates the decreasing returns to scale in credit production, so the equilibrium interest rate as a function of the agent's types decreases on the respective types for both intermediaries and entrepreneurs, implying that higher type matching relationships have larger credit, larger scale of production, and lower interest rates (Figure 2.6).

Using the specification described above, an artificial random sample of 10,000 draws was created to replicate the distributions of the observed contracts. Given the equilibrium capital size is an exponential random variable in the entrepreneur's type, it results in a Pareto distribution re-sized to the new parameters as a function of the technologies and the heterogeneity parameters. On the other hand, the distribution of the interest rate has a large concentration on the upper level values. Therefore, given the negative relationship between interest rate and credit size in the environment, we are more likely to observe small contracts with large interest rates, and a lower density on the higher capital with low interest rates (Figure 2.7).

4.4.2 Comparative Statics 1: Increase in Number of Intermediaries ρ.

The first comparative statics exercise assumes an increase in the relative supply of intermediaries with respect to the demand for capital from entrepreneurs such that it preserves the distribution of both types. Specifically, the relative supply increases from $\rho_1 = 0.50$ to $\rho_2 = 0.85$. This change has a direct effect on the outreach of credit defined by the density of firms with credit and measured by $G(\theta_{CR}(\rho_1)) - G(\theta_{CR}(\rho_0))$.

The increase in the number of intermediaries has a second effect in terms of the organization of the bank-client relationship. The matching function changes both in the critical value of entrepreneur getting credit, and in the slope of the function. The new lower type entrepreneur $\theta_{CR}(\rho_2) = 1.1518$ and due to the assortativeness nature of the equilibrium, all banks end up with a lower quality matched client and all entrepreneurs who previously had credit get contracts from better type banks (Figure 2.8).

The expansion in the number of contracts and new clients will have an extensive effect on the financial depth of banking as measured by the capital granted in equilibrium. Under

the new stable match the capital traded within the new equilibrium relationships should be higher for all entrepreneur with credit. For the intermediaries, the effect of the new entrants would depend on the relative position of their own productivity regarding those new banks entering the market. Nonetheless, the displacement in the matching function is such that the average credit size of the economy will be lower from the intermediaries perspective.

The change in the assortative matching modifies the structure of the equilibrium contracts for all intermediaries and entrepreneurs. The lower quality of the clients attended by each intermediary decreases the size of the loan each bank provides and, under the parametric specification, elevates the cost enough to increase the interest rate for all intermediaries. From the entrepreneur's perspective, the new low type entrepreneurs who get credit might have lower credit size relative to those contracts previously observed. The interest rate from the entrepreneur's perspective are lower for those previously at the market, resulting from being matched with lower cost banks; but the entrants have relative higher interest rates than those observed before the expansion, as they match with the relative low productivity banks (Figure 2.9). The new diversity in contracts implies at the aggregate level a higher density on previously unobserved low levels of credit size, and a larger measure of contracts with higher interest rates (Figure 2.10). To conclude, the effect of new entrants and the new allocation of surplus raise the profits for each entrepreneur's type. Therefore, the interest rate paid should be lower in equilibrium to all entrepreneurs.

4.4.3 Comparative Statics 2: Increase in the Price Rate of Savings p

The second exercise involves a change in the competitive price paid by the banks for capitalizing their credit projects. This price is a shortcut to the relative scarcity of supply of deposits or a direct reference to the macro monetary policy reference rate.[9]

A change in the price for collecting savings increases the capitalization costs of the banks, scaling down the potential surplus value at all the possible relationships. Nonetheless, this increase in the price of savings has no effect on the assortative matching assignment between intermediaries and entrepreneurs. In particular, as no fixed costs are assumed for either supply or demand, the assortative relationship solution is the same under the two scenarios, and neither new entrants nor exits occur at the credit market. Therefore, all the changes occur in the intensive margin of capital traded within each relationship.

The change in the deposits rate affects both the capital traded at the match k^* and the levels of the interest rate $R^*(\omega, \theta)$ for all of the credit relationships. In particular, this change increases the cost of providing financial services, and reduces the value of all the surplus for pairwise relationships of banks and clients. As a result, this reduces the capital traded as direct effect from the higher cost of collecting resources and also would increase the interest rate for all the entrepreneurs type $\theta > \theta_{CR}(\rho)$. Then, at the aggregate level, the increase in the savings rate raises the marginal costs of financial services for all the intermediaries in the economy changing the distribution of the optimal capital solution. Moreover, the increased costs of intermediation reduces the level of profits for each type of entrepreneurs and intermediaries.

[9] The transmission channel of monetary policy in a setup as the proposed is a topic to be covered in a forthcoming research.

5 The Mexican Datasets

This research assesses the implications of the framework through a unique collection of Mexican datasets that combines information on banks, firms, and credit contracts for the Mexican commercial credit banking. The joint datasets compile quarterly information from the Mexican Central Bank (Banco de México), the Ministry of Economics (SEC), and the National Commission of Bank and Securities (CNBV). Particularly, I use the Regulatory Reports of Banking Credit Portfolio (R04 Report), a non-public database that registers all the commercial credit transactions in the Mexican banking system by month.

To gather a better knowledge about the intermediaries, a comprehensive dataset was built combining several sources including information from Secretaría de Hacienda y Crédito Público, Banco de México, Comisión Nacional Bancaria y de Valores, Asociación Mexicana de Bancos, and others. The final data collection compile quarterly information from 2004 to 2007 for each of the registered commercial banks, including: 1) the financial statement elements; 2) the balance account sheet; 3) the number of branches, personal, and accounts by locality; 4) the capital requirements by risk category; 5) capitalization cost, the returns on assets, and returns on equity; and 6) the number of ATMs and credit card's terminals.

The information for the demand side of the credit market is built from the System of Information for Mexican Firms (Sistema de Información Empresarial de México, or SIEM). Compiled as a continuous census updated on a daily basis, SIEM is organized and collected by the Mexican Ministry of Economy. It provides information on 20 fields related to a firm's characteristics. By exploring SIEM's data we can identify by firm code the month and year where the business started, the labor force, if the firm exports its products, if the firm imports some of its inputs, if the firm provides services to the government, the size of sales ranked in 7 categories, the economic sector divided in 10 different activities, and the geographic location of the firm identifying which of the 32 Mexican states in which the firm is running.

Finally, the information on supply and demand for credit is combined with the contractual elements from the Regulatory Reports of Banking Credit Portfolio (Reportes Regulatorios de Cartera de Crédito: Desagregado de Créditos Comerciales, or R04). This proprietary dataset is collected by the CNBV and analyzed by the General Direction of Financial System Analysis in Banco de Mexico. The R04 is a national census in which each bank provides information on the status of the active credit operations each month. This report has been mandatory by month since June 2001, but the data are consistently built since 2003. In this report the banks provide information on 48 fields for credits that the institution has registered in the areas of commercial credits, credits to financial companies, credits to government companies, and loans for developers and housing construction.

Contracts information in R04 is linked to the financial intermediaries information using the bank code for each quarter of the sample; this resulting dataset can be merged to the SIEM information using the Mexican firm's standardized code (RFC).[10] By combining the three sources, we can study both sides of the market at the intensive and extensive margins. The coincidence of information on both datasets is not perfect, but does allow quarterly information for more than 2,230,000 contracts in R04 with firm information in SIEM and bank information between 2004:1 and 2007:4.[11]

[10] For a detailed explanation of the construction and properties of the database, please refer to Appendix C.

[11] A note on notation: from now the representaiton $Y : Q$ will refer to the Q^{th} quarter of the Y year

6 The Mexican Corporate Credit Market: Evidence on Matching, Outreach, and Contracts

This section uses the matching framework as a guideline to search for the specific relationships that prevail in the assortative equilibrium between the structure of the credit market and the characteristics of the agents. Moreover, this section uses the expansion in the number of intermediaries as setup for a natural experiment to test the implications of this change over the organization of the market.

Previous studies for the Mexican credit market have neglected the analysis of demand for credit and the contribution of the diversity and competition of clients in determining the structure of the market. The availability of information on the firms opens the possibility to analyze a rich set of testeable hypotesis derived from the one-to-one matching framework proposed in the previous sections. In particular, the model studied provides specific conjectures on the sorting of agents, and on several extensive and intensive margins of the credit market including the outreach and the depth of financial intermediation.

A caveat for the proposed environment must be added. The implications of the framework should be evaluated in the light of other alternative hypothesis of industrial organization and contract theory regarding the structure of capital and interest rates in a non-matching setup. The presence of fixed costs, barriers of entry, information asymmetries, possibility of default in contracts, and other rigidities are challenges to the pure matching model. These rigidities might induce additional incentives for the collusion of intermediaries and entrepreneurs in other margins rather than pure transaction costs, such as risk sharing. These changes might in principle modify the pure one-to-one solution; covering all of these rigidities in a unique setup is a challenge beyond the scope of this document.[12] For these reasons, rather than presenting an exhaustive estimation of the matching model of credit, this sections provides a first approach to the empirical relationships that must prevail among the different elements that characterize the equilibrium of the model.

This section is organized in three sets of empirical analyses. The first set studies the evidence on positive assortative matching among banks and clients and the potential change in the relationship structure between 2004 and 2007. The second set analyzes the outreach and financial depth of intermediation as defined by the percentage of firms with credit, and the creation of new credit per period. The third set studies the specific conjectures of the model for the contract elements, including the predictions on credit size and productivity for firms and banks.

6.1 Banks, Firms, and Matching Evidence in Productivity

The first section of the empirical analysis presents evidence of the matching between banks and firms according to observed measures of productivity on both sides of the market. While identifying the exact matching function is beyond the purpose of the current paper, this section presents empirical statistics supporting the assortative organization of banks and clients in terms of measures of productivity; moreover, the section assesses the change in

[12] For instance, some results not explored by the framework include the existence of a non-continuum of banks, the ability of banks to attract multiple clients, and clients to make contracts with different banks, in the line of the many-to-many matching models proposed Kelso and Crawford (1982).

the extensive margin of the assortative matching resulting from the expansion in the number of intermediaries.

Under the matching hypothesis, banks specialize in different types of clients; in particular more productive banks attract higher type firms, and vice-versa. A first analysis for testing this implication is to measure the differences in the productivity of the clients among banks, and observe if these differences are statistically significant. Using the pool of information of new contracts created each quarter from 2004:1 to 2007:4, for a firm i the average yearly sales per worker $y_{i,t}$ was calculated for each contract, as valued in constant 2004:1 pesos. This observed measure of productivity is assumed to be positively correlated with the unobserved productivity parameter of the firm; therefore, for the rest of the analysis I assume $corr(y_{i,t}, \theta_{i,t}) > 0$ to proxy the value for $\theta_{i,t}$.

Table 4.1 shows the set of tests to compare pairwise differences on average productivity of the clients among all the banks in the Mexican credit market using a t-test for the pool of new contracts created each period. This method compares banks pairwise and tests if there are statistically significant differences among the average productivity of the firms attended between each of the 300 pairs of banks. In general, using a Welch-Satterwhite statistic, the results suggests that for 265 of the pairs of banks studied there exist a statistically significant difference in the average productivity of the clients they are attending during the period analyzed. Therefore the hypothesis of equal average productivity is rejected in 88.3 percent of the pairwise bank comparisons at a 5 percent level of significance. This first analysis suggests statistical differences among intermediaries' clients given the credit contracts they have; nonetheless, the matching hypothesis provides more information about the driving force behind this sorting of clients among banks: the positive assortative matching on the productivity of both sides of the market.

The empirical study of productivity for the intermediaries presents several additional challenges, as modern commercial banks provide services in multiple markets such as savings, investment, and mortgages, generating profits in each of them. Moreover, as contestable markets theory suggests (Dickens 1994), there might be further complementarities among these services making the identification of profits from lending harder to identify. Nonetheless, by construction and definition, all commercial banks share a common feature: they require resources from the deposits market in order to allocate and transform these resources into credit or other service.

In this regard, the cost rate of capitalization (CRC) measures the weighted average cost paid by an intermediary to raise resources from the public in any deposit instrument.[13] Independent of the application of their available resources and resulting profits in these markets, in equilibrium and given their production technologies parameter ω, more efficient banks should face lower costs of capitalization relative to resources collected, and so with lower levels of CRC. Hence, for a bank j in a given quarter t I use $CRC_{j,t}$ as the empirical measure of the productivity technology index $\omega_{j,t}$ assuming that $corr(CRC_{j,t}, \omega_{j,t}) < 0$ across bank types.

To measure the actual matching relationship between intermediaries and firms productivities and its statistical significance as a proxy estimation of the matching function, in this

[13] https://accigame.banamex.com.mx/capacitacion/Ibero/04/04_03.htm

section I estimate a set of least squares regressions for the pool of contracts with banks' and firms' information, from 2004:1 to 2007:4:

$$y_{m,t}(\theta) = \beta_0 + \beta_1 CRC_{m,t}(\omega) + \beta_2 CRC_{m,t}(\omega)T_t + \gamma T_t + \lambda X_{m,t} + \varepsilon_{m,t} \tag{38}$$

where for observed new contract in a matching $m(\omega, \theta)$ at a quarter t signed among a bank ω and a firm θ, the variable $y_{m,t}(\theta)$ is the average real sales per worker of the firm, $CRC_{m,t}(\omega)$ measures the capitalization rate cost for the banks, T_t are indicator variables for the years 2005, 2006, and 2007, and $X_{m,t}$ measures other controls for the bank's and firm's characteristics such the geographic location of the firm on each of the Mexican states, the age and total sales for the firm, and bank's capital, number of employees, and number of branches. The analysis considered the entire pool sample of new contracts at each period. The results for this exercise are reported in Table 4.2.

Under the hypothesis of assortative matching in productivity, the coefficient β_1 must be statistically significant reflecting the sorting of the agents into credit partnerships, even when controlling for fixed effects of time and geographic location, or other characteristics of the agents. Moreover, if there is positive assortative matching between banks and clients, then β_1 must be negative, reflecting that more productive firms match with more productive − lower cost − banks. The estimations of this model suggest positive assortative relationship between banks and firms as measured by their respective CRC and average productivity. For instance for the first model specification, an increase in the CRC rate of 1 point implies a reduction of 0.28 million pesos per year and per worker in the productivity of the firm to which the bank is linked. The negative coefficient among the models is statistically significant and goes from -0.20 to -0.97 depending on the model specification; though different in magnitude, these results suggest that banks with higher capitalization cost are matched in credit contracts with less productive firms as measured by their average productivity. This result is consistent across model specifications, even when controlling by firm's characteristics such as sales per year, age, exports, and provision of services to the government.

A second piece of evidence has to do with the comparative statics of the matching relations given the expansion in the number of intermediaries over time. The first effect is related to the change in the average quality of the firms with credit, as proxied by the constant associated to this linear approximation of the matching function. This effect is recovered by estimating the coefficient β_0 and then adding the effects of time control dummies T for each respective year t. The evidence shows a statistically significant fall in the constant associated with productivity of the firms in the model between 2004 and 2007; in particular the regression constant for the third model specification implies that relative to 2004 the firm's average productivity as measured by millions of pesos per year and per worker is -1.93 for 2005, -2.88 for 2006, and -3.25 for 2007. Results are similarly sizeable and significant, when controlling by bank's characteristic. These findings suggests that, *ceteris paribus*, the pool of firms getting credit at each year differ, and they have lower productivity each year, even when controlling by geographic characteristics. The driving force behind this low quality entry is analyzed in the next section.

Finally, the effect of the banking expansion during this period on the slope of the assortative relationships might be studied through the coefficient β_2 associated to the cross product of the time variables and the capitalization cost of the banks CRC, adding these coefficients to β_1. However, the estimation evidence of the models does not provide robust arguments

across model specifications regarding the change in the "slope" of the matching relationship in time under this methodology. For instance, if ignoring the time fixed effects, the estimations suggest that there has been a stronger matching among productivities. These results suggest that some of the effects from banking expansion might indeed be captured by the time-fixed effects. Using the framework proposed, one possibility for this mixed evidence could be associated to changes in the technology distribution types across banks that does not preserves the distribution during the period of study. If this is the case, further analysis must be done to test for this new hypothesis.

6.2 Market Outreach and Financial Depth

This section establishes the link between the introduction of new banks in the Mexican market during the period studied and the outreach of the credit market. Under the matching model hypothesis, with excess of demand for credit, the firms that get credit from banks are those with relatively higher productivity, while entrepreneurs below certain critical productivity level stay outside the market without a credit options from banks. Given an expansion in the intermediaries that preserves the distribution of types, this critical value is reduced, and there must be an increase in the credit lines granted. The increase in the number of firms having credit must be biased toward low productive firms who previously were outside the market.

The first empirical measure of outreach is the observed percentage of firms registered in SIEM actually having commercial credit from banks at each quarter of the sample of R04 datasets from 2004:1 to 2007:4. This measure is a proxy for demand attended by financial intermediaries and is a lower bound of the credit access, as it does not reflect those credit lines the firm might have using other banks' debt instruments, such as credit cards, or personal credit to the owner. The analysis of this variable shows an increase from 2004 to 2007 with an increment from 1.21 percent to 4.02 percent. These levels remain low in absolute values, but the relative increase in this short period could be a result of the expansion of banking services toward more firms. A second empirical measure of credit outreach is the percentage of labor force hired by firms with credit. Durind this same period, the percentage of workers in firms with credit increased from 8.34 percent in 2004:1 to 13.12 percent in 2007:4, with an increasing trend within this period of study. Finally, a third measure of outreach is the percentage of total sales of those firms with credit with respect to the aggregate sales in the SIEM dataset; this variable also increases in time from 7.21 percent to 14.48 percent between 2004:1 and 2007:4. (Table 4.3.1).

The credit matching environment predicts that in equilibrium the firms with credit from banks are those with relatively higher productivity. To test for this possibility, define $D_{i,t}$ as an indicator that the firm i had a credit line with any given bank during the quarter t. The following probabilistic model analyzes the conditional probability of having credit:

$$\begin{aligned} prob(D_{i,t} &= 1|X_{i,t}) = prob(\Gamma X_{i,t} > \varepsilon_{i,t}) \\ for &: \varepsilon_{i,t} \sim N(0, \sigma^2) \end{aligned} \tag{39}$$

where the set of variables determining the probability of having credit of the firm $X_{i,t}$ includes the average productivity of the firm $y_{i,t}(\theta)$, the total labor force of the firm, the age of the firm, two indicators to define if the firm exports their output or imports their inputs, an indicator

to describe if the firm provides goods and services to the government, and fixed effects for the geographic location of the firm.

Table 4.3.2 reports the coefficients on the average sales and labor force from estimating a probit model for each quarter between 2004 and 2007. Consistent with the matching framework, the coefficient for the change in probability associated to the productivity of the firm, as measured by the average yearly sales per worker, is positive and statistically significant for each of the quarters studied. An increase in the average sales per worker of 1 million pesos per worker raises the probability of getting credit in 0.06 percent in 2004:1, and this coefficient steadily increases until it reaches 0.18 percent by 2004:4. Moreover, this increasing trend in this coefficient suggests that the likelihood for getting credit has improved along the period studied for firms relative to their productivity.

With the probit model described above, I constructed a fourth empirical measure of outreach using the predicted probability of a firm having credit when controlling by the firm's characteristics. Figure 4.2.1 shows the trends for both the observed probability and the predicted probability in time. Both the empirical and estimated outreach in this measure suggests that, during the period of expansion in banking, there has been an increase in the probability of getting credit for registered firms. The observed and predicted trends might not entirely be due to the expansion of the new banks, but they are consistent with the expected result from the inclusion of new intermediaries into the market given the lack of growth in the productivity of the Mexican economy during the period studied.

A third implication of the expansion in the number of banks predicts that the firms who have new credit lines should have relative lower productivity than those who got credit before. Therefore, given this inclusion of marginal firms close to the critical value getting credit, the average productivity should be lower at the market for both the pool of firms with and without credit. Table 4.4 shows several findings that suggest consistency with the predictions of the matching framework. First, the median productivity in the pool of firms with credit is consistently higher than those firms without credit; moreover, this measure decreases in time for both categories, as expected. From 2004:1 to 2007:4 the average productivity decreased from 0.78 to 0.53 million of real pesos per worker per year for firms with credit, while it decreased from 0.33 to 0.29 million of real pesos per worker for firms without credit. Also, the median of the two measures of size of the firm, as defined by the sales per year and the size of the labor force, decreased during the same period, suggesting that among the firms with credit, the entrants at each period are both smaller and with lower productivity relative to those firms who had credit before. Also, firms leaving the non-credit pool were those with relatively higher productivity conditional on this characteristic, lowering the average and mean characteristics for those firms remaining without credit. These results are similar to those findings in other papers. For instance, Cetorelli (2004) argues that in France after the bank deregulation in the 1980s the increased competition on this market led to better credit availability, and as evidence he shows that the average size of firm declined after reform concentrated in bank-dependent industries. Moreover, Cetorelli and Strahan (2006) report similar evidence in the United States after the removal of interstate restrictions on banking.

6.3 Endogenous Matching and the Contractual Outcomes

A third set of analyses regarding the implications and the effects of the observed expansion in banking services has to do with the characteristics of new contracts signed each period. The

matching framework predicts that, given an increase in the number of intermediaries, the creation of credit must be biased toward previously low productive firms, though at equilibrium they require lower levels of credit from their intermediaries. The evidence presented supports the expected assumptions from a matching environment: banks and firms sort themselves in a positive matching solution given the complementarity in transaction costs. In particular, the previous two subsections analyzed the characteristics of the market at the equilibrium contracts without linking the specific elements of the contract to the characteristics of the firms or banks. Nonetheless, we can use the full structural framework to simulate and gather information on some of the observed features of the Mexican credit market. To this purpose, the empirical distributions of both credit size and interest rate are presented.

Table 4.5 presents the decile distribution of credit size of new credits created each quarter with information on both firms and banks. In particular, the table shows that there has been an increase in the outreach and number of credit lines created per period, but the distribution of those credit lines has been consistently concentrated in lower levels of credit over time. For instance, following the trend in the median value of the credit size, for the first quarter of 2004 the value of the credit was \$4.95 million pesos, but the median value consistently reduces in time to reach \$0.83 million pesos in the last quarter of 2007. Hence, during the period of expansion in the number of intermediaries, the increase in credit lines has not been uniform among their sizes, but biased toward low credit lines. This finding suggests consistency with the matching framework in terms of the expected changes in the market financial depth. Similarly, Table 4.6 shows the observed distribution of interest rates for the new credit created each quarter. The data show a relative increase in the density of the new credits toward high interest rates during this period. For instance, the median interest rate increased from 5.5 percent in 2004:1 to 11.8 percent in 2007:1. It is worth note that 11.8 was in the 90th decile of interest rate distribution of observed interest rates for the first 3 quarters of analysis. These steady displacements in both credit size and interest rate distributions are shown in the Figure 4.3.1 by comparing the cumulative distributions of both credit size and interest rates for 2004:1 and 2007:1.

To analyze the co-movements of these two distributions given the equilibrium contracts, I estimated the correlation between credit size and interest rate for each of the 16 cross-section quarters of datasets. Table 4.7 below shows the correlations between credit size and interest rate when studying different specifications for the model such as controlling by bank, economic sector of the firm, and geographic location. The correlation is consistently negative in a rank between -0.2372 and -0.3447 for 2006:4 and 2004:3 respectively. Again, while other factors could give origin to a negative equilibrium correlation between credit size and interest rate, this result is consistent with the implications of the model.

Finally, a series of regressions models were estimated using the following specification for the contractual credit size $k_{i,t}$ and interest rate $R_{i,t}$ for a firm i in a period t using information for each firm:

$$k_{i,t} = \delta_0 + \delta_1 y_{i,t}(\theta) + \delta_2 r_t + \delta_3 M_t + \epsilon_{i,t} \quad (40)$$

$$R_{i,t} = \phi_0 + \phi_1 y_{i,t}(\theta) + \phi_2 r_t + \phi_3 M_t + \xi_{i,t} \quad (41)$$

where $y_{i,t}(\theta)$ is the observed average productivity of the firm used to approximate the heterogeneity parameter θ, r_t is the aggregate raising cost of deposits for banks to use as proxy of p_t in the model, and M_t is the observed percentage of firms with credit to approximate

the outreach measure ρ_t in the model. The variables are related to the aggregate conditions of the market and the models included optionally fixed effects $G_{i,t}$ for geographic location as defined by the state where the firm operates at the moment of the contract. Also, to test for robustness of the results for different measures of cost for deposits, three different definitions of aggregate raising fund rates were exclusively tested and included as part of the model: the bank's funding rate (*tasa de fondeo bancario*), the inter-bank's equilibrium funding rate (*tasa interbancaria de equilibrio*), and the Government funding rate (*tasa de fondeo gubernamental*).

Using the theoretical framework as guideline, if the matching hypothesis holds the coefficients in the capital equation must reflect that higher productive firms should get higher levels of capital $\delta_1 > 0$, an increase in the capitalization cost for banks should reduce the capital borrowed at equilibrium $\delta_2 < 0$, and an increase in the outreach should also increase the capital borrowed by the entrepreneur as it matches with a better bank in equilibrium expanding the selection in the intensive margin. On the other hand, in the interest rate regression, the expected results from the model are that more productive firms should get lower interest rates $\phi_1 < 0$, higher fundraising costs for the banks increase the price paid by the entrepreneurs $\phi_2 > 0$, and a higher competition among intermediaries and so a higher density of firms getting credit should reduce the interest rate paid in equilibrium. Table 4.8 presents the estimations for these models under different specifications of the fundraising cost rate.

The different models for the capital equation show that the main expected predictions of the matching framework are consistent with the data. For credit size, the sign of productivity of the firm is positive and significant on all the specifications; this coefficient is consistently in a magnitude of 0.11, meaning that an increase in the average sales per worker per year in 1 million pesos, increases the credit typical size by 0.11 million pesos. The three different rates used as proxy for the common fundraising cost are negative related to credit size, and sizeable in terms of the estimated coefficient; the values are between -0.03 and -0.04 depending if the fixed effect by state were included in the specification. The market deepening proxy for ρ, M_t shows a positive sign, suggesting that for a given firm's productivity, the expansion in this variable increases the average credit size it has in equilibrium.

On the interest rate equation estimations, the signs of the regressions also satisfy the expected results when the complementarity in intermediation costs dominates the decreasing returns to scale of production for credit. In particular, more productive firms face lower interest rates; this coefficient is relatively stable across models specifications for the fundraising cost rate in a value of -0.25 and -0.22 depending if the fixed effects for state are included or not. Similarly, the different measures of fundraising cost rates are positively related to the interest rate of the contract, and their size is relatively equivalent in terms of the effect each of these measures has over the aggregate interest rate; an increase of 1 percentage point in the aggregate raising cost for the banks rises the contractual rate in 0.16 points in average when controlling by firm's characteristics. Nonetheless, contrary to what the theoretical model predicts, a higher degree of market deepening M_t also has a positive effect on the interest rate, when controlling for other factors including the fixed effects of the geographic location of the firm; this positive coefficient might be related to a potential change in the technologies or distribution of quality of either the entrepreneurs or the intermediaries not captured by a pure expansion in ρ. This implies that the model requires other techniques to disentangle these two simultaneous changes of the environment; this is a topic for future research.

In general, the expected results implied by the matching model in terms of the stable equilibrium and the changes in the structure given an expansion in the number of intermediaries hold for the outcomes of interest. The analysis suggests a positive assortative organization of credit relationships and changes in this sorting given the introduction of new intermediaries into the market. During the period of expansion in the number of intermediaries there was an increase in the number of credit contracts biased toward low productive firms resulting in an increase in the outreach of banking credit. The results suggest that simultaneously with the modification in the extensive margin, as measured by the outreach of banking, there were also changes in the intensive margin of credit. Finally, the contracts, defined by the interest rate and the credit size, satisfy most of the expected conditions of the model in terms of productivity of the firm, market deepening, and aggregate fundraising cost rate.

7 Conclusions

Rosen (2002) summarized the research agenda of markets with diversity in the study of three main topics: (1) how suppliers and demanders sort themselves into partnerships, (2) what is the value created by this assortative organization, and (3) what are the consequences of this assignment over the inequality in the observed outcomes. In this paper I have developed a competitive matching model to analyze how heterogeneity in productivity from supply and demand for credit and the complementarity in the intermediation cost of financial services jointly determine the structure of the market as defined by the assortative organization of intermediaries and clients, and the distribution of equilibrium contracts. The structure of the market is defined simultaneously by the sorting of intermediaries and clients into credit partnerships, and the induced intensive and extensive margins of decisions derived from their optimal behavior.

The theoretical matching framework provides specific conditions under which a pure stable matching with positive assortative solution among entrepreneurs and intermediaries exists in the credit market. Moreover, given the ability of agents to select both the partner and the level of trade within each contract, the capital at the stable match maximizes the joint surplus of the coalition at each relationship, and the market equilibrium reaches a Pareto optimal solution. Among other results, the stability of the match implies that in equilibrium more productive firms have larger levels of credit and larger scale of production, and intermediaries with lower costs provide higher levels of credit. The interest rate at which capital is traded and its implied distribution at equilibrium are identified from the payoffs of the agents; nonetheless, the interest rate decreases with respect to the productivity of the agents only if the complementarity in intermediation cost is strong enough to compensate the increase cost derived from the larger scale of production.

My research presents specific predictions on the nature of outreach, contracts heterogeneity, and profitability that must prevail in equilibrium given the recent entry of banks. To assess the implications of the proposed framework, this research took advantage of R04, unique Mexican dataset that permits me to identify the fundamental elements of each contract in the commercial credit market, including the interest rate, and the loan size by bank and client. The R04 information for the period 2004 to 2007 is combined with performance variables for commercial banks collected from several sources including CNBV and Banco de Mexico, and with information on firms identified from SIEM national census of firms.

The analysis of the Mexican credit market suggests evidence of positive assortative matching between banks and firms as measured by capitalization cost and average productivity. Using the pool of contracts, the estimated models suggest that banks with lower capitalization cost are matched with more productive firms. This result is consistent across model specifications when controlling for firm's characteristics such as location, age, if the firm exports, and if it provides goods or services to the government at any level.

Also consistent with the framework, there has been an increase in the outreach of banking credit to firms under several defininitions including: percentage of firms with credit, percentage of labor force hired by firms with credit, and percentage of total sales for firms with credit. Moreover, the change in probability associated to the productivity of the firm is positive and statistically significant for all the quarters studied under different model specifications; moreover, this coefficient decreases in time, implying that the conditions to get credit have improved for low productivity firms. The median productivity for the firms with credit is consistently higher than those firms without credit; and consistent with the implications of the model, this measure decreases over time for both categories. This combined evidence supports the hypothesis that the new credit is biased toward firms with low productivity when compared to firms already in the market, but these new firms with credit have relatively higher productivity when compared to those staying outside the market.

The results in outreach are consistent with Cetorelli (2004) as the increased competition on credit market led to better credit availability but the reduced the average size of firm with credit. Moreover, Cetorelli and Strahan (2006) report similar evidence in the United States after the removal of interstate restrictions on banking; the model would predict those observed changes as a result of the integration of low productivity firms requiring low levels of credit. My research finds that the introduction of new banks, as in Beck and Martinez-Peria (2008), increases the outreach but in my research this is more detailed measured by the percentage of firms with credit and the actual levels of credit they obtain, rather than just municipalities with bank presence and the number of contracts granted. In contrast with Haber and Musacchio (2005) the ability of charging low interest rate from more potentially efficient banks is not related to their market power, but rather, to the quality of clients the banks are able to attract given their technologies. The hard screening of clients is also a natural devise of all banks to select those that keep their costs of production for credit low, and allows them to maintain the low interest rates able to attract better firms. Also, consistent with the results of Moissinac (2006), this paper shows that bank lending and profitability must be positively correlated in equilibrium. The predictions of the model and the evidence on contracts are also supported by the empirical findings of related works like Crawford (1991), Besanko and Thakor (1992), and Chiappori, Perez-Castrillo, and Verdier (1995), among others.

The traditional approach followed by the industrial organization empirical literature on banks has focused on the implications of certain structure of supply over the outcomes of credit and the pricing of the loans granted. For instance, higher profits of banks positively related to lower interest rates are regarded as signals of potential market power. Nonetheless, this paper suggests that the market structure that prevails in equilibrium could be indeed part of the solution as it is the case for the hedonic models and the observed organization of the credit market studied in this research. The conclusion from both the theoretical framework and the empirical assessment is that sorting of agents into credit partnerships plays a central role in determining the observed rents and levels of credit.

The theoretical framework I proposed in this paper and the empirical assessment does not account for all the possible sources of matching incentives that might affect credit contracts such as risk, experience, economies of scale, or complementarities in other financial services. For these reasons, this research opens a rich reseach agenda derived from the possibility of expanding the analysis to include new dimensions of matching complementarities and analyze the importance of these incentives into the observed structure that prevails in the market using an extended setup. Finally, the combination of tractable theoretical results, closed form solutions, and access to empirical datasets that capture the essential elements of the credit heterogeneity, makes it possible to develop and implement new methods of estimation, and to test the policy implications of bank fusions, better technologies, and financial opening, in a future research.

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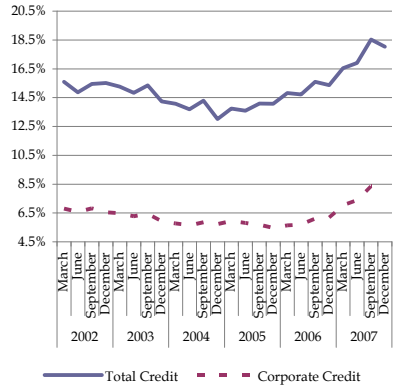
Appendix

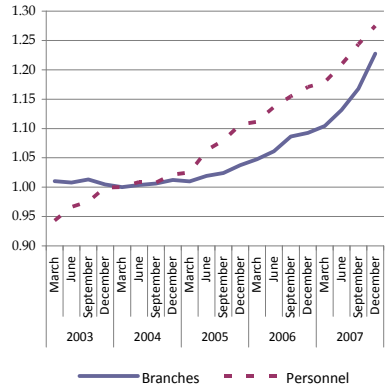
A. Figures and Tables

FIGURE 1.1. CREDIT MARKET ACTIVITY INDICATORS, MEXICO 2002-2007

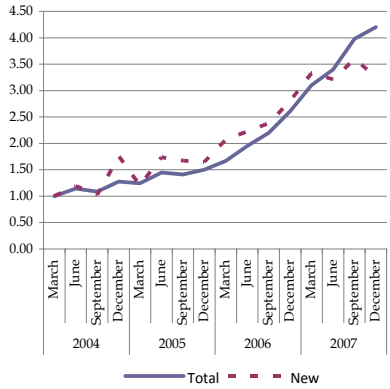
Total Credit and Corporate Credit (% of GDP)



Personnel and Branches Index (Index 2004:1=1)



Number of Contracts: Total and New (Index 2004:1=1)



Sources:
i) INEGI, Mexico. Several years.
ii) Comision Nacional Bancaria y de Valores. Several years.
iii) Reporte de Credito Comercial (R04). Comision Naciona Bancaria y de Valores. Several years.

TABLE 1.1. MEAN CHARACTERISTICS OF FIRMS BY BANK [1/, 2/, 3/]
Mexico, New Contracts by Quarter, 2004:3, 2007:3, and Panel Sample

Bank	2004:3				2007:3			
	Sales	Labor Force	Sales per Worker	Age	Sales	Labor Force	Sales per Worker	Age
A	5.1	36	0.71	13	1.9	10	0.46	10
B	4.6	23	0.70	13	3.7	21	0.61	13
C	4.8	48	0.71	14	3.2	20	0.51	13
D	6.0	125	1.97	17	5.4	59	0.87	15
E	6.3	25	1.70	17	4.5	21	0.87	14
F	7.1	47	0.84	13	6.0	50	0.93	17
G	5.6	37	0.69	14	4.6	32	0.62	15
H	4.9	38	0.74	13	5.0	38	0.68	15
I	6.1	20	1.38	18	5.5	32	0.91	17
J	9.1	31	1.29	15	5.9	30	0.76	16
K	3.9	24	0.57	11	-	-	-	-
L	6.1	19	1.36	11	5.2	50	0.41	14
M	9.7	40	1.14	16	7.7	34	0.65	17
N	6.3	108	0.31	16	5.9	57	0.45	15
O	8.1	248	1.16	20	3.8	39	0.56	13
P	8.2	12	0.84	12	6.7	90	0.35	12
Q	7.4	37	2.16	18	4.8	52	0.79	19
R	12.3	76	0.50	21	8.0	49	0.29	15
S	9.3	959	0.01	15	15.8	1839	0.02	26
T	10.6	47	1.71	12	6.7	39	0.19	14
U	8.7	44	2.78	12	0.0	0	0.00	0
V	16.4	620	0.09	29	10.6	56	5.32	11
W	8.7	102	1.70	14	0.0	24	0.02	10
X	7.1	36	3.61	13	4.0	3	3.97	8
Y	-	-	-	-	2.6	26	0.05	11
A1	-	-	-	-	0.2	45	0.01	19
B1	-	-	-	-	1.3	136	0.01	24
D1	-	-	-	-	7.9	136	0.05	5
Total	7.6	116.8	1.2	15.4	5.1	110.6	0.8	14.1

1/ Information of the firm with credit from the bank at the respective quarter and year.
2/ Bank's identity withheld by confidentiality agreement.
3/ Sales measured in million of 2004:01 valued pesos by year. The values are originally reported in ranks; the value in the table refers to average value of the medians by bank.
Sources:
i) Catalogo Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.
ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 1.2. MEAN AND PERCENTILES OF LOAN SIZE AND INTEREST RATES BY BANK [1/,2/,3/,4/]
Mexico, New Contracts by Quarter, 2004:3 and 2007:3

Bank	Elements of the Contracts	2004:3							2007:3						
		Number of Contracts	Mean	Percentile					Number of Contracts	Mean	Percentile				
				10	25	50	75	90			10	25	50	75	90
A	Loan	42,637	231.0	0.6	3.8	34.4	196.0	196.0	250,712	79.9	0.1	0.3	0.4	1.8	88.0
	Rate		8.6	5.2	6.7	7.3	8.1	11.4		16.0	5.2	7.5	19.7	20.2	20.2
B	Loan	20,999	23.6	0.2	0.3	0.7	2.0	9.8	17,565	53.7	0.3	0.4	1.3	4.6	35.2
	Rate		11.5	6.1	9.2	12.4	14.5	15.3		8.4	3.8	5.7	8.5	11.4	13.3
C	Loan	6,649	7.7	0.1	0.1	0.3	0.5	8.9	38,638	2.2	0.1	0.1	0.2	0.4	0.8
	Rate		12.8	6.2	11.6	14.7	14.7	15.0		12.4	13.1	13.1	13.2	13.2	13.2
D	Loan	15,398	139.0	19.6	68.7	128.0	221.0	221.0	28,779	128.0	8.8	22.0	88.0	176.0	308.0
	Rate		7.7	7.1	7.3	7.7	8.1	8.5		6.0	4.3	5.3	6.1	6.4	7.1
E	Loan	4,618	33.9	0.5	1.5	5.9	19.6	139.0	15,165	25.8	0.3	0.5	0.9	4.4	17.6
	Rate		6.7	4.1	5.2	6.8	8.1	9.7		7.0	4.3	5.7	7.6	8.5	8.5
F	Loan	14,992	213.0	20.3	29.5	150.0	383.0	383.0	582	71.4	0.8	1.3	7.2	37.1	167.0
	Rate		7.3	6.3	7.0	7.5	7.7	7.9		5.1	2.9	3.9	5.2	6.1	6.1
G	Loan	2,635	9.9	0.1	0.3	1.0	2.9	11.8	7,709	9.9	0.1	0.3	0.9	2.6	10.1
	Rate		8.8	5.0	6.9	8.1	11.7	13.8		7.6	3.1	5.2	8.0	10.9	11.8
H	Loan	2,657	15.6	0.1	0.2	1.0	4.9	17.7	5,616	11.7	0.1	0.2	0.7	2.9	13.3
	Rate		8.4	4.6	5.8	7.3	10.8	11.5		6.6	3.3	4.7	6.1	9.5	9.9
I	Loan	2,754	5.3	0.2	0.4	1.0	2.5	7.9	3,489	7.2	0.2	0.4	0.9	2.6	8.8
	Rate		9.4	6.2	7.9	9.8	11.0	11.9		7.6	4.2	5.5	7.1	9.9	11.8
J	Loan	1,279	12.1	0.3	0.8	2.0	5.9	18.1	2,737	7.7	0.4	0.7	1.8	4.4	15.5
	Rate		1279.0	8.0	4.6	5.9	7.8	10.1		2737.0	7.1	4.0	5.2	7.1	9.9
K	Loan	9,637	12.0	0.1	0.1	0.3	1.0	2.9							
	Rate		10.7	6.0	8.1	11.8	13.8	14.2							
L	Loan	278	13.3	2.0	4.9	9.8	19.6	31.9	3,351	22.3	2.3	6.0	17.6	43.9	44.0
	Rate		6.0	3.3	3.4	5.9	8.4	9.4		6.3	5.1	6.1	6.2	7.1	7.6
M	Loan	1,451	11.6	1.5	2.9	4.9	14.0	29.5	1,152	13.6	1.8	3.5	4.4	10.6	22.0
	Rate		7.5	5.9	7.1	7.8	8.4	8.9		5.8	2.3	5.0	6.1	7.1	8.0
N	Loan	7,897	192.0	24.5	147.0	245.0	245.0	306.0	13,627	173.0	8.8	44.0	220.0	220.0	502.0
	Rate		7.5	5.5	7.2	7.7	8.0	9.2		6.1	4.7	6.1	6.1	6.1	7.1
O	Loan	366	177.0	1.5	4.9	15.2	58.9	271.0	2,763	69.0	0.0	0.1	0.1	1.0	77.0
	Rate		6.6	4.6	5.3	6.7	7.7	8.7		10.9	3.8	7.8	13.1	13.1	15.4
P	Loan	429	9.0	3.9	9.8	9.8	9.8	9.8	175	6.2	0.8	1.8	4.4	8.8	8.8
	Rate		8.9	8.1	8.5	8.7	9.1	10.1		7.8	8.0	8.0	8.0	8.0	8.1
Q	Loan	197	26.2	4.8	7.4	17.2	36.8	58.9	328	28.6	4.4	5.8	14.1	35.2	57.7
	Rate		6.6	4.3	5.7	6.8	7.4	8.2		5.5	4.2	4.7	5.5	6.0	6.9
R	Loan	172	50.0	8.9	11.2	63.8	68.7	68.7	281	73.7	9.7	17.4	89.7	121.0	135.0
	Rate		5.6	2.8	4.3	5.8	7.3	7.8		2.8	0.7	1.2	2.6	3.4	6.4
S	Loan	94	102.0	19.6	52.5	64.8	210.0	236.0	398	90.1	19.6	21.6	47.0	211.0	211.0
	Rate		4.5	1.2	1.5	4.7	7.1	7.2		4.2	2.5	2.9	4.7	4.7	5.2
T	Loan	273	98.6	3.0	9.4	45.8	177.0	224.0	120	150.0	8.7	19.4	55.8	229.0	484.0
	Rate		4.3	1.1	1.7	4.7	5.5	6.6		4.4	2.7	3.1	3.6	4.5	5.9
U	Loan	264	58.3	1.2	2.0	35.4	134.0	134.0	60	121.0	22.0	22.0	158.0	176.0	220.0
	Rate		3.8	1.0	1.7	4.6	5.0	5.6		4.1	3.0	3.1	3.6	4.5	5.6
V	Loan	37	19.0	9.8	9.8	9.8	9.8	54.0	52	70.4	26.4	26.4	88.0	106.0	106.0
	Rate		5.0	1.8	5.2	5.2	5.3	6.4		4.0	3.6	3.6	3.6	4.5	4.5
W	Loan	76	87.1	11.2	34.4	44.7	116.0	229.0	60	365.0	87.4	154.0	336.0	674.0	674.0
	Rate		4.1	0.4	0.4	4.3	6.2	8.1		2.9	2.5	2.8	2.9	3.0	3.9
X	Loan	76	267.0	187.0	187.0	187.0	216.0	344.0	43	9.7	1.1	1.8	3.5	10.6	26.4
	Rate		4.8	4.1	4.3	4.6	5.0	5.2		5.4	4.5	4.7	4.7	6.1	7.1
Z	Loan	10	1520.0	1280.0	1280.0	1520.0	1770.0	1770.0							
	Rate		10.0	5.0	4.7	4.7	5.0	5.2							
A1	Loan								62	10.7	0.9	4.4	8.8	17.6	17.6
	Rate									62.0	5.8	4.2	5.5	5.7	6.1
B1	Loan								12	82.1	22.0	48.4	48.4	132.0	143.0
	Rate									3.8	1.9	1.9	4.5	4.8	4.9
C1	Loan	6	245.0	70.7	70.7	224.0	442.0	442.0							
	Rate		4.6	4.4	4.4	4.4	4.9	4.9							
D1	Loan								11	8.5	0.1	0.1	0.1	0.1	4.4
	Rate									20.3	7.1	23.5	23.5	23.5	23.5
E1	Loan								6	34.7	6.7	25.3	44.0	44.0	44.0
	Rate									5.2	5.2	5.2	5.2	5.2	5.2
Total	Loan	135,881	133.0	0.3	1.2	24.5	196.0	306.0	393,493	71.2	0.1	0.3	0.5	17.6	132.0
	Rate		8.8	5.7	7.0	7.7	9.8	14.7		13.3	4.8	6.1	13.2	20.2	20.2

1/ New credits lines created during each quarter.
2/ Bank's identity withheld by confidentiality agreement.
3/ Loan in million of 2004:01 valued pesos by year.
4/ Interest rate calculated in terms of 2004:01 pesos value discounting the observed future inflation rate per year for each period.
Sources:
i) Catalogo Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.
ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

FIGURE 2.1. ASSORTATIVE MATCHING AND TIMING OF THE ENVIRONMENT

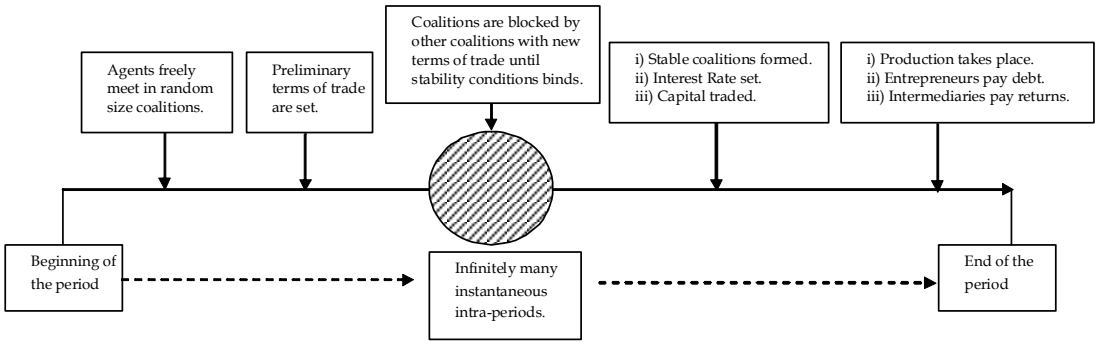


FIGURE 2.2. MATCHING SOLUTION FOR DIFFERENT VALUES OF ρ

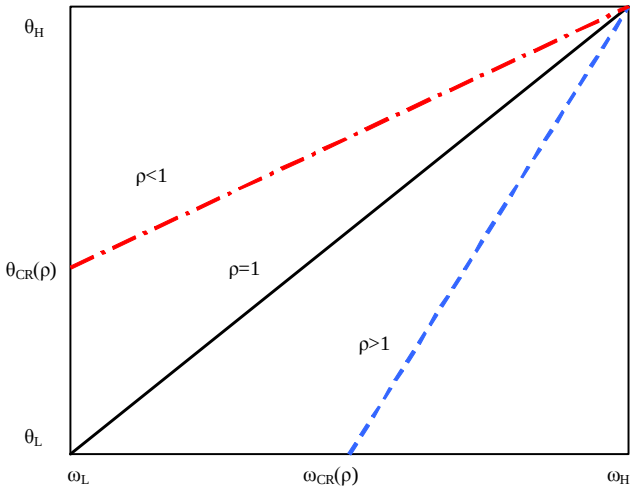


FIGURE 2.3. DISTRIBUTION PRESERVING INCREASE IN THE NUMBER OF INTERMEDIARIES "ρ"

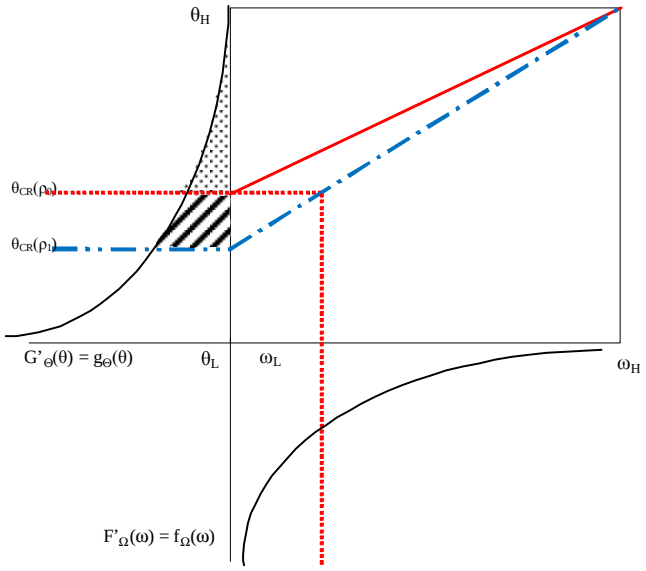


TABLE 2.1. PARAMETERS FOR SIMULATION

Technology					
Firms:	α =	0.25	Banks:	β =	0.95
	κ =	0.10		μ =	0.10
				φ =	0.10
Heterogeneity					
Banks:	λ_ω =	1.10	for	Ω =	$(1,\infty)$
Firms:	λ_θ =	1.10	for	Θ =	$(1,\infty)$
Deepening:	ρ_1 =	0.50		ρ_2 =	0.85
Prices					
Good:	P =	1.00			
Deposits:	p =	1.04			

*/ Parameters satisfying model conditions.

FIGURE 2.4. EQUILIBRIUM MATCHING FUNCTION

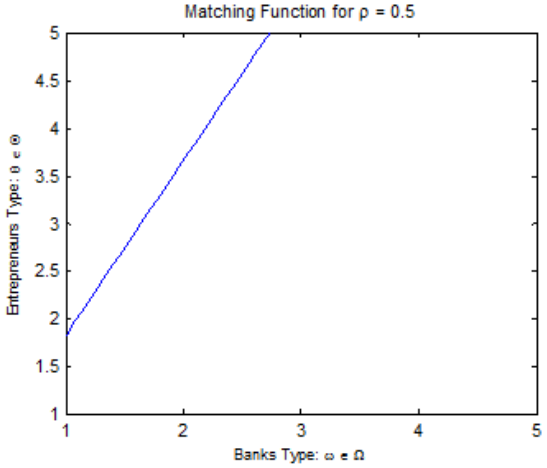


FIGURE 2.5. EQUILIBRIUM UTILITIES AND TOTAL CREDIT TRANSFERS

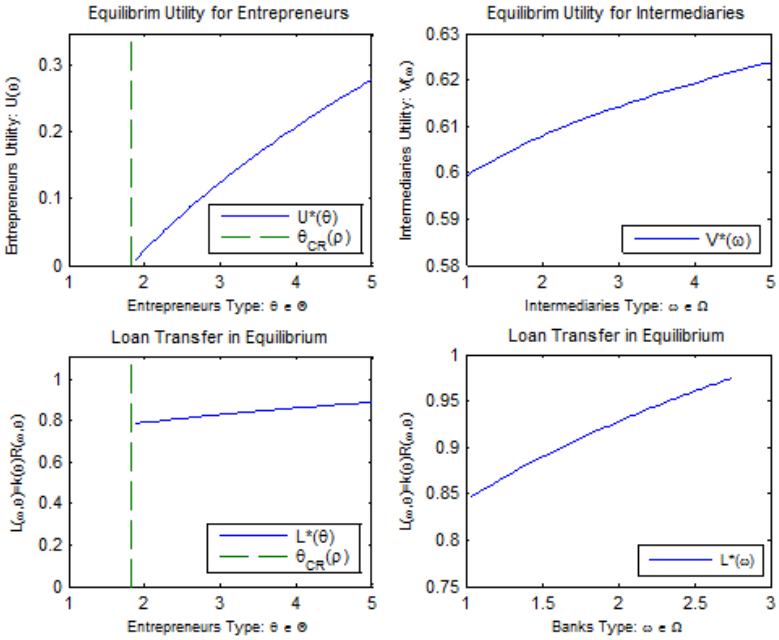


FIGURE 2.6. EQUILIBRIUM CAPITAL LOAN AND INTEREST RATE

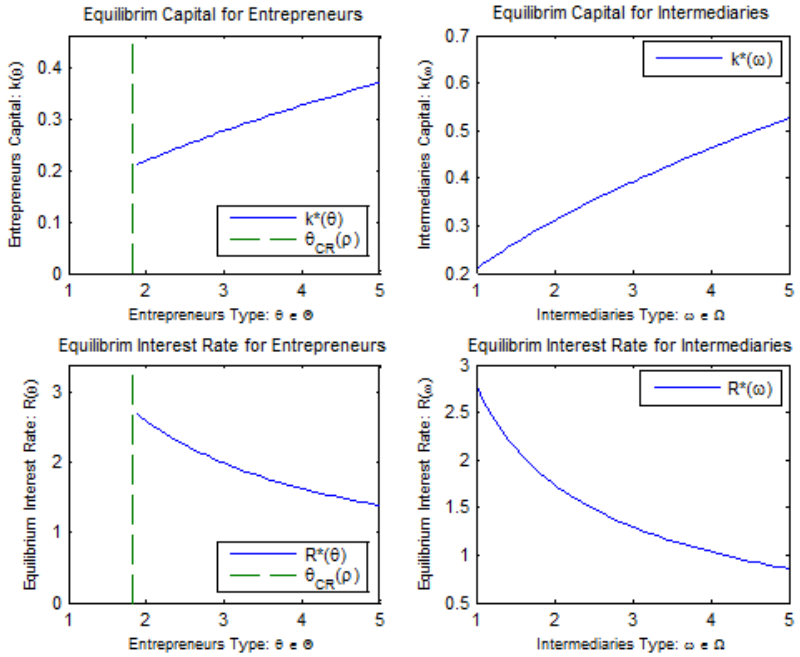


FIGURE 2.7. EQUILIBRIUM DISTRIBUTIONS OF LOANS AND INTEREST RATE

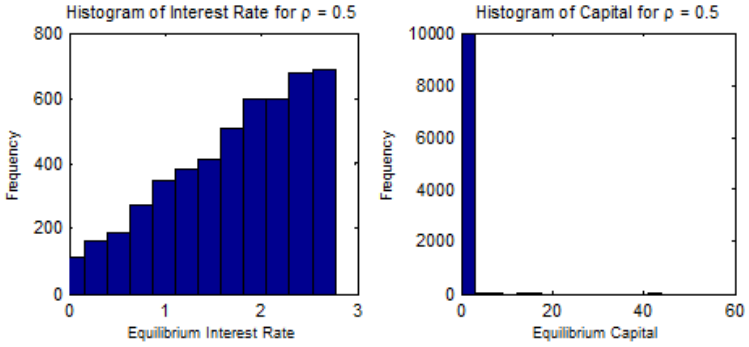


FIGURE 2.8. CHANGE IN MATCHING FUNCTION FOR AN EXPANSION IN "ρ"

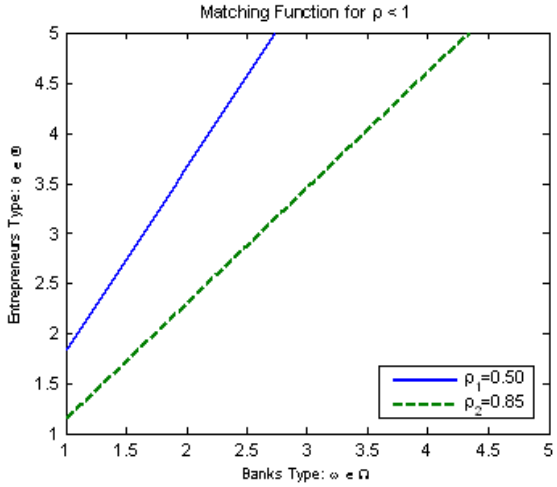


FIGURE 2.9. CHANGE IN EQUILIBRIUM CONTRACTS FOR AN EXPANSION IN "ρ"

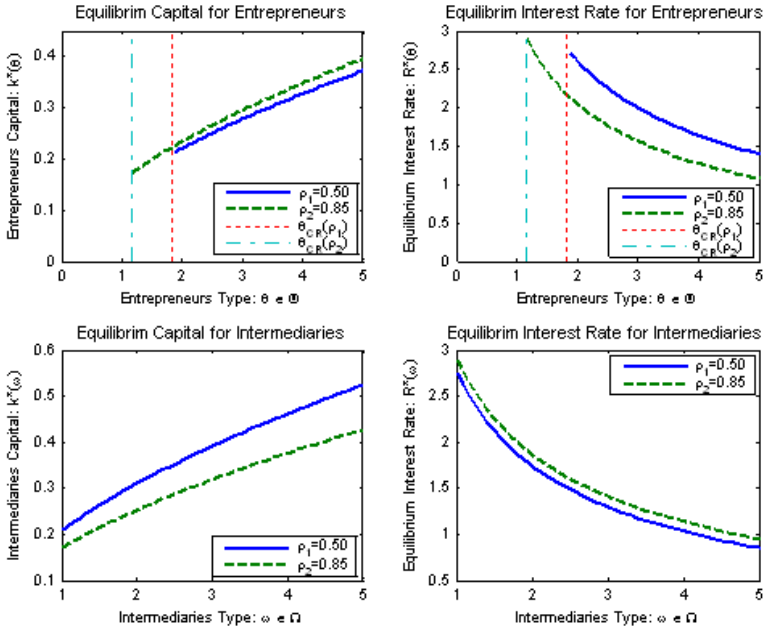


FIGURE 2.10. CHANGE IN DISTRIBUTION OF CONTRACTS FOR AN EXPANSION IN "ρ"

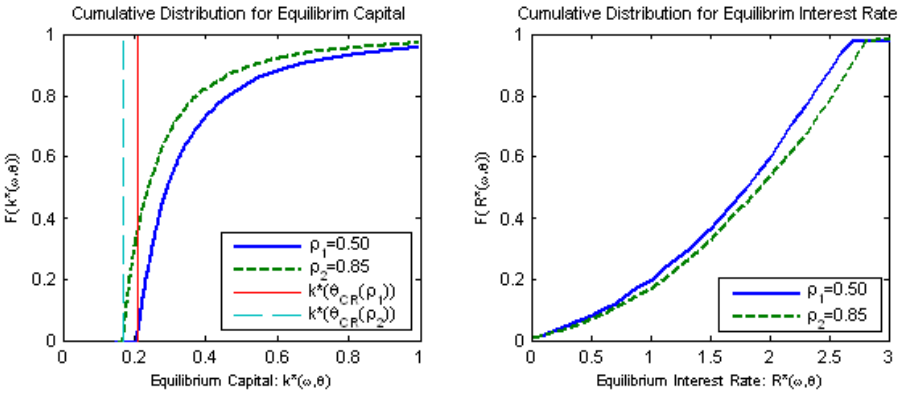


TABLE 3.1. THE STRUCTURE OF INFORMATION FOR THE CREDIT MARKET: CONTRACTS, FIRMS, AND BANKS
Mexico, by Quarter, 2006:01-2007:04.

Bank's Variables 1/		Variables at the Contract 2/		Firm's Variables 3/
Assets ROE ROA Number of Branches Number of Employees Number of ATMs Number of POSs Portfolio Composition Debt Structure Capitalization Costs	**With Contract**	**In the Credit Market** Interest Rate Capital Lent Term Geographical Location Risk Calification Collateral Rate of Reference	**With Contract**	Labor Force Rank of Sales Economic Sector Geographic Location Export Import Services to Government
Valor de Activos ROE ROA Numero Total de Sucursales Numero Total de Empleados Numero ATMs Numero TPVs Composición de Cartera Total Morosidad Costos de Captacion	**Without Cotract**	**Outside the Credit Market**	**Without Cotract**	Labor Force Rank of Sales Economic Sector Geographic Location Export Import Services to Government

Sources:
1/ CNBV. Sistemas de Pagos, Banco de Mexico. Several Years.
2/ Desagregado de Creditos Comerciales (R04). Centro de Información Financiera, Banco de Mexico.
3/ Sistema de Informacion de Empresas de Mexico, SIEM. Secretaria de Economía.

TABLE 4.1. PAIRWISE t-TEST FOR DIFFERENCES IN AVERAGE FIRM'S PRODUCTIVITY BY BANK [1/, 2/, 3/]

Mexico, Panel of New Contracts, by Quarter (2004:1-2007:4)

Bank	A	B	C	D	E	F	G	I	J	K	L	M	N	O	P	Q	R	S	T	V	X	Y	A1	B1	D1
A	0.0																								
B	142.1 *	0.0																							
C	168.2 *	18.7 *	0.0																						
D	-22.4 *	-83.7 *	-91.0 *	0.0																					
E	55.9 *	-26.7 *	-36.1 *	55.2 *	0.0																				
F	33.5 *	-17.4 *	-22.8 *	42.1 *	-1.2	0.0																			
G	95.4 *	-3.3 *	-14.5 *	74.8 *	20.4 *	14.8 *	0.0																		
I	38.3 *	-13.3 *	-18.7 *	45.9 *	2.7 *	3.2 *	-10.9 *	0.0																	
J	60.6 *	-3.3 *	-10.0 *	61.5 *	14.4 *	12.0 *	-1.1	8.6 *	0.0																
K	76.6 *	-0.4	-8.7 *	69.5 *	19.2 *	14.9 *	1.8	11.3 *	2.4	0.0															
L	119.2 *	21.5 *	11.2 *	87.9 *	37.3 *	26.0 *	19.5 *	22.3 *	14.9 *	14.3 *	0.0														
M	83.4 *	4.8 *	-3.6 *	73.5 *	23.5 *	17.9 *	6.3 *	14.3 *	5.8 *	3.9 *	-10.2 *	0.0													
N	118.7 *	23.6 *	13.7 *	88.6 *	38.7 *	27.1 *	21.3 *	23.4 *	16.3 *	16.0 *	2.2	11.9 *	0.0												
O	45.0 *	2.7 *	-1.6	51.6 *	14.8 *	13.5 *	3.8 *	10.7 *	4.2 *	2.6 *	-5.7 *	0.2	-6.7 *	0.0											
P	81.7 *	9.9 *	2.4	74.3 *	26.5 *	20.6 *	10.7 *	17.1 *	9.4 *	7.9 *	-4.6 *	4.3 *	-6.3 *	2.6 *	0.0										
Q	9.7 *	-5.2 *	-6.7 *	15.0 *	-0.5	-0.2	-4.7 *	-1.4	-4.4 *	-5.1 *	-8.2 *	-6.0 *	-8.6 *	-5.8 *	-7.1 *	0.0									
R	90.1 *	7.2 *	-1.6	76.4 *	25.9 *	19.3 *	8.3 *	15.6 *	7.3 *	5.5 *	-8.8 *	1.6	-10.6 *	0.8	-3.0 *	6.4 *	0.0								
S	231.2 *	73.0 *	62.3 *	106.2 *	57.1 *	34.3 *	40.5 *	30.4 *	24.8 *	27.2 *	13.4 *	22.5 *	9.9 *	10.9 *	14.4 *	9.9 *	21.7 *	0.0							
T	30.7 *	3.9 *	1.2	37.9 *	11.9 *	11.6 *	4.7 *	9.6 *	4.9 *	3.9 *	-1.5	2.3	-2.2	1.9	0.4	6.5 *	1.6	-4.6 *	0.0						
V	0.4	-5.2 *	-5.8 *	2.6	-3.5 *	-3.3 *	-5.0 *	-3.8 *	-4.9 *	-5.2 *	-6.4 *	-5.5 *	-6.5 *	-5.5 *	-6.0 *	-3.0 *	-5.7 *	-7.0 *	-5.9 *	0.0					
X	-0.1	-3.2 *	-3.5 *	1.1	-2.2	-2.1	-3.1 *	-2.4	-3.0 *	-3.2 *	-3.8 *	-3.4 *	-3.9 *	-3.4 *	-3.6 *	-2.1	-3.4 *	-4.2 *	-3.6 *	-0.3	0.0				
Y	183.6 *	48.6 *	35.3 *	101.4 *	51.4 *	32.3 *	33.9 *	28.4 *	22.3 *	23.7 *	9.5 *	19.1 *	6.4 *	9.7 *	11.9 *	9.5 *	18.2 *	-5.6 *	3.9 *	6.9 *	4.1 *	0.0			
A1	32.4 *	5.0 *	2.2	39.6 *	13.1 *	12.7 *	5.7 *	10.7 *	5.9 *	4.9 *	-0.6	3.2 *	-1.3	2.7 *	1.3	7.0 *	2.6 *	-3.7 *	0.7	6.1 *	3.7 *	-3.0 *	0.0		
B1	233.7 *	75.3 *	65.2 *	106.7 *	57.8 *	34.7 *	41.4 *	30.7 *	25.2 *	27.7 *	14.2 *	23.0 *	10.6 *	11.2 *	14.9 *	10.0 *	22.3 *	7.0 *	4.7 *	7.0 *	4.2 *	7.1 *	3.9 *	0.0	
D1	193.7 *	54.6 *	41.4 *	103.2 *	53.7 *	33.4 *	36.6 *	29.5 *	23.7 *	25.4 *	11.6 *	20.9 *	8.4 *	10.5 *	13.3 *	9.8 *	20.0 *	-1.7	4.4 *	7.0 *	4.1 *	3.2 *	3.5 *	-3.3 *	0.0

1/ New Credits by Quarter considering only Agricultural and Manufacturing firms.

2/ The table reports the pairwise values of the Welch-Satterthwaite t-value estimation.

3/ Bank's identity withheld by confidentiality agreement.

*/ Difference is statistically significant at the 5% level of confidence.

Sources:

i) Catalogo Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.2. REGRESSION MODELS FOR FIRM'S PRODUCTIVITY AND BANK'S CAPITALIZATION COST RATE [1/ 2/]

Mexico, Panel of New Credits, by Quarter (2004:1-2007:4)

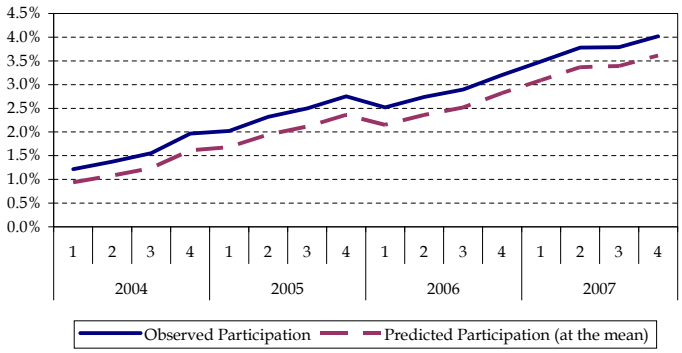
Variable	Pool of Data 2004:01 - 2007:12					
	M1	M2	M3	M4	M5	M6
Capitalization Cost Rate (CCR)	-0.28 *	-0.20 *	-0.96 *	-0.97 *	-0.35 *	-0.50 *
Constant	5.57 *	5.12 *	8.72 *	8.64 *	5.97 *	6.95 *
Year 2005 (=1 Yes)			-1.93 *	-1.85 *		
Year 2006 (=1 Yes)			-2.88 *	-3.00 *		
Year 2007 (=1 Yes)			-3.25 *	-3.97 *		
Cross Product: Year 2005 x CCR			0.58 *	0.55 *	0.09 *	0.13 *
Cross Product: Year 2006 x CCR			0.57 *	0.57 *	-0.13 *	-0.10 *
Cross Product: Year 2007 x CCR			0.71 *	0.83 *	-0.10 *	-0.04 *
Sales per Year	0.35 *	0.34 *	0.33 *	0.34 *	0.35 *	0.34 *
Age of the Firm (in Years)	-0.03 *	-0.02 *	-0.02 *	-0.02 *	-0.02 *	-0.02 *
Export (=1 Yes)	-1.86 *	-1.80 *	-1.79 *	-1.84 *	-1.87 *	-1.79 *
Government (=1 Yes)	-0.43 *	-0.37 *	-0.36 *	-0.40 *	-0.41 *	-0.37 *
Bank's Capital Level (in millions)		-0.0319 *	-0.0256 *			-0.0262 *
Bank's Number of Branches		0.0003 *	-0.0003 *			-0.0003 *
Bank's Number of Employees (in thousands)		0.0393 *	0.0418 *			0.0286 *
R-Square	0.5129	0.5215	0.5285	0.5233	0.5172	0.5247
Observations	450443	450443	450443	450443	450443	450443

1/ New credit contracts by month and year considering only firms in the Agricultural and Manufacturing Sector.
2/ The models also included a dummy variable if the firm exports (1=Yes), if the firm provides goods or services to the government (1=Yes), and one for each of the 32 Mexican states. Coefficients not reported in this table.
*/ Coefficients statistically signifcant at the 5% level of confidence.

Sources:
i) Catalogo Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.
ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

FIGURE 4.2.1. OUTREACH FROM COMMERCIAL BANK CREDIT [1/, 2/, 3/]

Mexico, by Quarter (2004:1-2007:4)



1/ The Probit model also controlled by Mexican State, coefficients not reported.
2/ All coefficients were significant at the 1% statistical level of confidence.
3/ The analysis uses the full SIEM06-07 sample of 644,499 firms at each year and quarter.
Sources:
i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.
ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.3.1. OUTREACH FOR COMMERCIAL CREDIT FROM BANKS [1/, 2/, 3/]

Mexico, Panel of Firms with and without Credit Information, by Quarter (2004:1-2007:4)

Year	Quarter	Observed Probability	Predicted Probability [1/]	Labor Force Participation	Total Sales Participation
2004	1	1.22%	0.94%	8.34%	7.21%
	2	1.37%	1.08%	8.94%	7.84%
	3	1.55%	1.24%	9.20%	8.42%
	4	1.97%	1.61%	9.88%	9.67%
2005	1	2.02%	1.68%	9.95%	9.60%
	2	2.32%	1.94%	10.72%	10.69%
	3	2.50%	2.11%	11.35%	11.21%
	4	2.75%	2.36%	11.45%	11.75%
2006	1	2.52%	2.15%	10.99%	10.95%
	2	2.74%	2.36%	11.44%	11.52%
	3	2.90%	2.52%	11.26%	11.90%
	4	3.20%	2.82%	11.72%	12.55%
2007	1	3.49%	3.09%	12.04%	13.19%
	2	3.78%	3.37%	12.60%	13.93%
	3	3.79%	3.39%	12.73%	13.84%
	4	4.02%	3.61%	13.12%	14.48%

1/ The Probit model also controlled by Mexican State, coefficients not reported.

2/ All coefficients were significant at the 1% statistical level of confidence.

3/ The analysis considered the entire SIEM06-07 sample of 644,499 firms at each year and quarter.

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.3.2. PROBABILITY MODEL OF HAVING A CREDIT FROM A BANK [1/, 2/]

Mexico, Panel of Firms SIEM and R04 Registers of Credit by Quarter (2004:1-2007:4)

Year	Quarter	Change in Probability given a Change in Variable				
		Average per Woker	Age of the Firm	Labor Force	Export	Services to Government
2004	1	0.062% *	0.009% *	0.002% *	0.637% *	0.100% *
	2	0.070% *	0.010% *	0.002% *	0.567% *	0.217% *
	3	0.079% *	0.011% *	0.003% *	0.533% *	0.301% *
	4	0.094% *	0.015% *	0.003% *	0.464% *	0.493% *
2005	1	0.093% *	0.014% *	0.003% *	0.442% *	0.510% *
	2	0.104% *	0.016% *	0.004% *	0.292% *	0.817% *
	3	0.112% *	0.017% *	0.004% *	0.265% *	0.970% *
	4	0.119% *	0.017% *	0.005% *	0.140% *	1.172% *
2006	1	0.110% *	0.015% *	0.004% *	0.301% *	0.897% *
	2	0.117% *	0.016% *	0.005% *	0.104% *	1.158% *
	3	0.122% *	0.016% *	0.005% *	-0.028% *	1.380% *
	4	0.131% *	0.017% *	0.005% *	-0.273% *	1.706% *
2007	1	0.146% *	0.017% *	0.005% *	-0.527% *	2.103% *
	2	0.159% *	0.018% *	0.006% *	-0.824% *	2.588% *
	3	0.168% *	0.016% *	0.006% *	-1.059% *	2.936% *
	4	0.183% *	0.016% *	0.007% *	-1.242% *	3.210% *

*/ Coefficients significant at the 5% statistical level of confidence.

1/ The Probit model also controlled by Mexican State, coefficients not reported in this table.

2/ The analysis considered the entire SIEM06-07 sample of 644,499 firms at each year and quarter.

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.4. CHARACTERISTICS OF FIRMS WITH AND WITHOUT CREDIT FROM A BANK [1/, 2/, 3/]

Mexico, Panel of Firms with and without Credit Information, by Quarter (2004:1-2007:4)

Year	Quarter	Without Commercial Bank Credit				With Commercial Bank Credit			
		Average Sales per Worker	Labor Force	Sales	Export	Average Sales per Worker	Labor Force	Sales	Export
2004	1	0.33	4.63	841.6	11.4%	0.78	34.07	5286.7	21.6%
	2	0.33	4.60	828.8	11.4%	0.75	32.37	5043.5	21.0%
	3	0.33	4.60	818.1	11.4%	0.74	29.47	4756.9	20.4%
	4	0.32	4.58	801.9	11.4%	0.69	24.96	4264.1	19.2%
2005	1	0.32	4.58	794.9	11.4%	0.65	24.50	4078.9	18.8%
	2	0.32	4.56	781.7	11.3%	0.64	23.02	3936.5	18.4%
	3	0.31	4.53	773.2	11.3%	0.63	22.63	3801.5	18.2%
	4	0.31	4.54	763.8	11.3%	0.61	20.68	3582.7	17.5%
2006	1	0.31	4.55	762.2	11.3%	0.61	21.70	3614.9	17.8%
	2	0.31	4.54	751.7	11.4%	0.59	20.80	3476.6	17.0%
	3	0.30	4.56	743.6	11.4%	0.58	19.36	3364.1	16.7%
	4	0.30	4.55	733.0	11.4%	0.56	18.21	3180.6	16.0%
2007	1	0.30	4.54	721.3	11.4%	0.55	17.17	3025.3	15.5%
	2	0.29	4.53	711.8	11.4%	0.54	16.58	2926.5	15.0%
	3	0.29	4.52	705.9	11.4%	0.54	16.72	2875.3	14.6%
	4	0.29	4.51	694.5	11.4%	0.53	16.24	2805.4	14.2%

1/ Median of the variable within each comparison group.

2/ Averge Sales per Worker: measured in millions of 2004:01 valued pesos per woker per year. Sales: measured in millions of 2004:01 valued pesos per year.

3/ The analysis considered the entire SIEM06-07 sample of 644,499 firms at each year and quarter.

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.5. DISTRIBUTION OF LOAN SIZE FOR NEW CORPORATE CREDIT

Mexico, by Quarter (2004:1-2007:4) in 1000's of 2004:1 Pesos

Year	Quarter	Decile									
		1	2	3	4	5	6	7	8	9	10
2004	**1**	297	513	1,160	2,250	4,957	9,953	19,800	39,800	99,100	99,500
	2	296	591	1,186	2,457	4,929	10,900	21,200	59,300	98,300	98,800
	3	196	486	875	1,468	2,918	5,538	11,700	22,500	77,800	97,800
	4	234	484	967	1,929	3,858	9,645	15,500	26,600	77,400	96,700
2005	**1**	240	480	961	2,004	4,771	9,569	19,100	33,600	95,400	95,700
	2	168	360	570	1,045	2,666	8,247	14,200	26,600	76,000	95,000
	3	141	282	472	851	1,700	4,699	9,460	18,900	75,200	94,500
	4	122	236	428	656	1,157	2,798	9,328	14,000	33,200	93,600
2006	**1**	109	209	369	512	927	1,847	6,514	18,500	32,600	92,700
	2	132	230	366	505	874	1,191	2,531	9,190	18,400	91,600
	3	127	226	334	457	741	1,041	1,827	7,310	18,200	90,700
	4	121	221	320	451	719	932	1,702	4,523	18,000	89,900
2007	**1**	110	197	296	367	612	894	1,554	5,346	17,800	72,200
	2	108	188	272	354	550	885	1,644	7,056	17,700	88,200
	3	132	232	344	351	611	1,001	1,753	8,723	20,900	78,200
	4	162	298	345	404	839	1,295	2,600	12,900	30,200	77,700

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

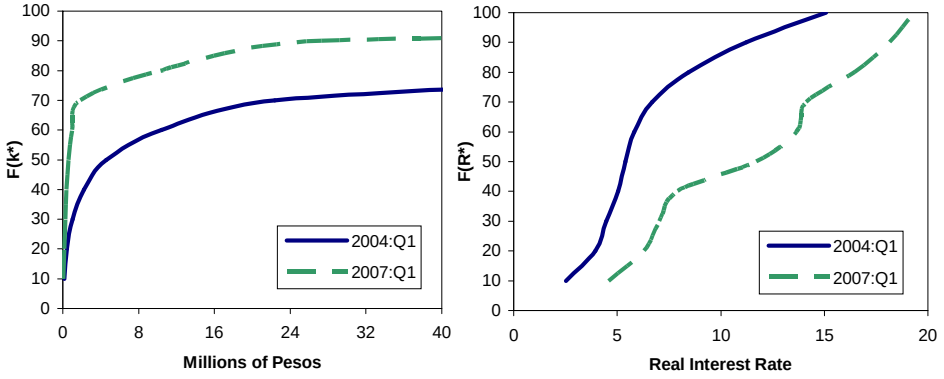
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.6. DISTRIBUTION OF INTEREST RATE FOR NEW CORPORATE CREDIT
Mexico, by Quarter (2004:1-2007:4) Real Interest Rate using Forward Inflation

Year	Quarter	Decile									
		1	2	3	4	5	6	7	8	9	10
2004	1	3.7	4.0	4.6	5.1	5.5	5.8	6.5	8.0	10.0	12.4
	2	4.9	5.3	5.9	6.1	6.2	6.7	7.2	9.0	10.8	13.6
	3	5.7	6.2	6.7	7.0	7.3	8.0	9.2	10.8	13.3	14.6
	4	6.9	7.5	8.0	8.3	8.5	9.0	9.7	11.3	13.4	15.8
2005	1	7.8	8.5	9.0	9.1	9.4	9.9	10.4	12.0	13.5	16.2
	2	8.5	9.2	9.4	9.5	10.2	10.4	12.1	13.5	15.5	17.5
	3	8.1	8.9	9.2	9.6	10.1	10.8	12.9	14.6	16.6	17.3
	4	7.4	8.1	8.4	8.9	9.3	10.9	12.7	14.1	15.6	16.7
2006	1	6.2	6.6	7.3	7.6	8.3	10.6	12.5	14.2	14.5	17.3
	2	6.1	6.5	7.2	7.6	9.2	12.0	13.0	14.3	14.6	18.4
	3	5.7	6.4	7.1	7.3	9.5	12.8	13.5	14.2	14.8	18.2
	4	5.6	6.4	7.1	7.9	10.3	13.3	14.0	14.1	17.2	18.1
2007	1	5.9	6.5	7.1	8.0	11.8	13.4	14.1	14.4	17.9	18.2
	2	5.2	5.9	6.5	7.3	10.4	13.6	13.9	18.3	18.6	20.5
	3	4.6	5.5	6.2	6.9	9.8	13.1	17.7	18.8	20.1	20.2
	4	3.8	5.1	5.9	6.2	8.6	12.9	17.3	18.2	19.6	19.9

Sources:
i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.
ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

FIGURE 4.3.1. OBSERVED DISTRIBUTIONS FOR CREDIT SIZE AND INTEREST RATE
Mexico, by Quarter (2004:1 and 2007:1), New contracts only.



Sources:
i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.
ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.
iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.8. REGRESSION MODELS FOR CREDIT SIZE AND INTEREST RATE [1/ 2/ 3/]

Mexico, Panel of New Credits, by Quarter (2004:1-2007:4)

Variable	Credit Size (Million of Mexican $)						Interest Rate (Real valued using forward inflation)					
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Firm's Productivity	0.11 *	0.11 *	0.11 *	0.11 *	0.11 *	0.11 *	-0.25 *	-0.22 *	-0.25 *	-0.22 *	-0.25 *	-0.22 *
Government Funding Rate	-0.04 *	-0.03 *					0.16 *	0.16 *				
Bank's Funding Rate			-0.04 *	-0.03 *					0.16 *	0.16 *		
Interbank's Equilibrium Funding Rate					-0.04 *	-0.03 *					0.16 *	0.17 *
Market Deepening	0.07 *	0.06 *	0.07 *	0.06 *	0.07 *	0.06 *	0.23 *	0.21 *	0.23 *	0.21 *	0.23 *	0.21 *
State Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R-Square	0.0173	0.1533	0.0172	0.1533	0.0172	0.1532	0.1079	0.2021	0.1080	0.2023	0.1082	0.2025

1/ Normalized coefficients on each variable using the pool of 450,044 observations.

2/ New credit contracts by month and year considering only firms in the Agricultural and Manufacturing Sector.

3/ The models also included a dummy variable if the firm exports (1=Yes), if the firm provides goods or services to the government (1=Yes), and one for each of the 32 Mexican states. Coefficients not reported in this table.

*/ Coefficients statistically signifcant at the 5% level of confidence.

Sources:

i) Catalogo Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

TABLE 4.7. CORRELATION MODELS FOR CREDIT SIZE AND INTEREST RATE [1/]

Mexico, Panel of Firms SIEM and R04 Registers of Credit by Quarter (2004:1-2007:4)

Year	Quarter	Coefficient of Correlation			
		M1	M2	M3	M4
2004	1	-0.2958 *	-0.2173 *	-0.1718 *	-0.1679 *
	2	-0.3322 *	-0.2399 *	-0.1878 *	-0.1906 *
	3	-0.3447 *	-0.2695 *	-0.2315 *	-0.2039 *
	4	-0.2423 *	-0.1997 *	-0.1778 *	-0.1569 *
2005	1	-0.2530 *	-0.1941 *	-0.1849 *	-0.1585 *
	2	-0.2819 *	-0.2439 *	-0.2262 *	-0.1742 *
	3	-0.2619 *	-0.2364 *	-0.2192 *	-0.1731 *
	4	-0.3005 *	-0.2784 *	-0.2604 *	-0.2344 *
2006	1	-0.3414 *	-0.3009 *	-0.2814 *	-0.2618 *
	2	-0.2785 *	-0.2563 *	-0.2404 *	-0.2337 *
	3	-0.2457 *	-0.2417 *	-0.2296 *	-0.2269 *
	4	-0.2372 *	-0.2482 *	-0.2397 *	-0.2094 *
2007	1	-0.2395 *	-0.2300 *	-0.2123 *	-0.2361 *
	2	-0.2492 *	-0.2409 *	-0.2267 *	-0.2714 *
	3	-0.2796 *	-0.2566 *	-0.2350 *	-0.2953 *
	4	-0.3125 *	-0.2619 *	-0.2366 *	-0.3004 *
Fixed Effects	**State**	No	Yes	Yes	Yes
	Sector	No	No	Yes	Yes
	Banks	No	No	No	Yes

1/ Entire sample of new contracts with information.

*/ Coefficients significant at the 5% statistical level of confidence.

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); CNVB Mexico.

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; CNBV y Banco de Mexico.

iii) Sistema de Informacion Empresarial Mexicano 2006-2007; Secretaria de Economia, Mexico.

B. Definitions, Propositions, and Proofs

Let us define a **feasible assignment** for the population measure $\wp$ in CAG $\{\mathbf{A}, Q, M(A^{(\times)})\}$ to be a measure $X^f \in M(A^{(\times)})$ such that satisfies the following conditions:

$$\begin{array}{lll} \text{i):} & X^f(B \times \bar{\Theta}) \leq F_{\bar{\Omega}}(B), & \text{for all } B \in \bar{\Omega}^{(\mathcal{B})} \\ \text{ii):} & X^f(\bar{\Omega} \times E) \leq G_{\bar{\Theta}}(E), & \text{for all } E \in \bar{\Theta}^{(\mathcal{B})} \\ \text{iii):} & X^f(\omega, \theta) \geq 0, & \text{for each } (\omega, \theta) \in A^{(\times)} \end{array} \tag{42}$$

Hence, a feasible assignment X^f is one distribution[14] of banks in $\bar{\Omega}$ providing credit to entrepreneurs in $\bar{\Theta}$ and that respects the given extended measures of the agents in the economy. At this moment, we are not ruling out the possibility of having *distributional partnerships* so $X^f(\omega, \theta) \in (0, 1)$, which has a notion of mixed strategy solution.

The **value of the game** over the set $A^{(\times)}$ for a feasible assignment of agents X^f is the sum of the continuum of surpluses conditional on this specific assignment and is given by:

$$v^f(A^{(\times)}) = \int\limits_{A^{(\times)}} Q(\omega, \theta) dX^f(\omega, \theta) \tag{43}$$

With these elements at hand, let us define the elements of the solution for the CAG given a triplet $\{\mathbf{A}, Q, M(A^{(\times)})\}$ and under the incentives and the conditions described so far we propose the following result that complements our analysis.

Now, the **optimal assignment game** considers the following continuous linear programming (CLP) and determines the maximum $v(\cdot)$ on $A^{(\times)}$ for a given manifold $Q(\cdot)$ by finding an assignment $X^* \in M(A^{(\times)})$ such that:

$$X^* = \underset{X^* \in M(A^{(\times)})}{\arg\max} \left\{ \int\limits_{A^{(\times)}} Q(\omega, \theta) dX(\omega, \theta) \mid X \text{ is feasible in } \wp \right\} \tag{44}$$

and:

$$v^*(A^{(\times)}|X^*) = \sup_{X^* \in M(A^{(\times)})} \left\{ \int\limits_{A^{(\times)}} Q(\omega, \theta) dX(\omega, \theta) \mid X \text{ is feasible in } \wp \right\} \tag{45}$$

The solution to CLP is that one of a social planner selecting an **optimal assignment** X^* for the CAG game environment, while $v^*(A^{(\times)}|X^*)$ defines the **maximum value for game**. As we consider the maximization of $v(A^{(\times)})$ over the aggregate coalitions that can be formed, this solution equals the maximum total payoff available to all the players in this game, and hence determines the Pareto assignment set. Gretsky, Ostroy, and Zame (1992) show that in

[14] Now, for the measurable spaces $\mathbf{\Omega}$ and $\mathbf{\Theta}$ the measure ϱ on $A^{(\times)} = \bar{\Omega} \times \bar{\Theta}$ is said to be double stochastic if:

$$\begin{array}{ll} \varrho(B \times \Theta) = F_{\Omega}(B), & \text{for all measurable } B \subset \Omega \\ \varrho(\Omega \times E) = G_{\Theta}(E), & \text{for all measurable } E \subset \Theta \end{array}$$

Then, every feasible measure for CLP is doubly stochastic when the constraints are reached with equality, and every doubly stochastic measure is indeed feasible.

this environment if the population measure $\wp$ on $A^{(\times)}$ is $M(A^{(\times)})$ and the surplus function $Q(\cdot)$ is upper semi-continuous, then there exists a X^* solution to CLP involving a measure $X^*(\omega,\theta)$ on $A^{(\times)}$ and $\upsilon^*(A^{(\times)}|X^*) = \int\limits_{A^{(\times)}} Q(\omega,\theta)dX^*(\omega,\theta)$ is an **optimal solution** for CLP.

Hence, by definition for an optimal assignment of the CAG $\{\mathbf{A}, Q, M(A)\}$ and as X^* is a feasible assignment we have $\upsilon^*(A^{(\times)}|X^*) \geq \upsilon^f(A^{(\times)}|X^f)$ or equivalently:

$$\int\limits_{A^{(\times)}} Q(\omega,\theta)dX^*(\omega,\theta) \geq \int\limits_{A^{(\times)}} Q(\omega,\theta)dX^f(\omega,\theta) \quad \text{, for all } X^f \neq X^* \text{ feasible} \tag{46}$$

Chiappori, McCann, and Nesheim (2008) address the question whether X^* permits to represent the optimal assignment in terms of one-to-one matching, so **fractional assignments** can be ignored. Later results will provide the necessary and sufficient conditions under which this statement turns to be true for our case so this will allow us to rule out this type solution.

To work the elements for the decentralized solution of CAG let us now define a pair of functions $U^f(\theta)$ and $V^f(\omega)$ characterized for each $\theta \in \bar{\Theta}$ and $\omega \in \bar{\Omega}$. These functions are defined as **feasible payoffs** for CAG=$\{\mathbf{A}, Q, M(A^{(\times)})\}$ if they are possible to achieve under a feasible assignment X^f, namely:

$$\int\limits_{A^{(\times)}} \left[U^s(\theta) + V^s(\omega)\right] dX^f(\omega,\theta) = \int\limits_{A^{(\times)}} Q(\omega,\theta)dX^f(\omega,\theta) \tag{47}$$

We call a **feasible outcome** to be then a set of elements $\left\{(U^f(\theta), V^f(\omega)), X^f\right\}$ such that there exists a set of feasible transfers $(U^f(\theta), V^f(\omega))$ among the members of the coalitions given by the assignment X^f. It is interesting to notice that so far, the feasible outcome is allowing for the possibility of "side payments" or transfers to agents unmatched, or matched to the dummy counterpart, given the assignment X^f.

To refine the concept of decentralized solution for the assignment problem, we say that a feasible outcome is a **stable outcome** $\{(U^s(\theta), V^s(\omega)), X^s\}$ (or the payoff and assignment functions are stable) if the following condition is satisfied[15]:

$$U^s(\theta) + V^s(\omega) \geq Q(\omega,\theta) \quad \forall(\omega,\theta) \in A^{(\times)} \tag{48}$$

Moreover, by construction the stability condition includes that possibility of remain unmatched, as it includes the matching with the dummy counterpart, namely.

$$\begin{array}{ll} U^s(\theta) \geq Q(\varnothing_\Omega, t) = 0 & \forall\theta \in \bar{\Theta} \\ V^s(\omega) \geq Q(\omega, \varnothing_\Theta) = 0 & \forall\omega \in \bar{\Omega} \end{array} \tag{49}$$

Notice that the stability of the outcome requires two type of conditions. The first type refers to **individual rationality**, and reflects the fact each agent, either bank or entrepreneur, always have the option to remain without being in relationship ("single" in the case of marriage). The second condition requires the outcome **is not blocked** by any different pair of agents.

[15] This conditions normalize the utility from being outside the match being zero.

In particular, if the second condition is not satisfied then if would be beneficial for any of the elements to finish they current partnership, and form a new partnership with someone else, which would grant them a higher payoff.

Once we defined the elements that characterize the Pareto assignment solution and the decentralized stability condition in the CAG environment, let us explore the core of the game to later describe the properties and closeness of all the solution concepts.

First, for building the core for the CAG game under a decentralized solution, let us consider now a dual problem defined as DCLP consisting in finding the functions $U^D(\theta)$ and $V^D(\omega)$ in $\mathbf{B}(A^{(\times)})$ defined as the Banach space of bounded measurable functions on $A^{(\times)}$ equipped with the supremum norm such that:

$$\min_{\{u(\cdot),v(\cdot)\}\in\mathbf{B}(A^{(\times)})} \left\{ \int_{\Theta} U(\theta) dG_{\Theta}(\theta) + \int_{\Omega} V(\omega) dF_{\Omega}(\omega) \right\} \tag{50}$$

subject to:

$$\begin{array}{lll} \text{i):} & U(\theta) \geq U(\varnothing_{\Theta}) = 0, & \forall\ \theta \in \bar{\Theta} \\ \text{ii):} & V(\omega) \geq V(\varnothing_{\Omega}) = 0, & \forall\ \omega \in \bar{\Omega} \\ \text{iii):} & U(\theta) + V(\omega) \geq Q(\omega, \theta) & \forall\ (\omega, \theta) \in A^{(\times)} \end{array} \tag{51}$$

It is interesting to notice that the constraints conditions of DCLP resemble those of the stability condition for a feasible outcome.

Proposition 1: Optimal Capital, Stable Match Assignment, and Equivalence of Solutions. Let $\{\mathbf{A}, Q, M(A)\}$ be CAG under the Cobb-Douglas production specification and assume the following set of conditions holds:

i) $m(\omega, \theta) = [A(\theta) b(\omega, \theta)^{\alpha}]^{\frac{1}{1-\alpha\beta}} > 0 \quad \forall \{\theta \in \Theta,\, \omega \in \Omega\}$
ii) $m_{\omega\theta}(\omega, \theta) > 0 \quad \forall \{\theta \in \Theta,\, \omega \in \Omega\}$, and not switching signs
iii) $\alpha < 1$ and $\beta < 1$
iv) $F_{\Omega}(\omega)$ is the cumulative density function for Ω
v) $G_{\Theta}(\theta)$ is the cumulative density functions for Θ

then, for a given set (p, P) of strictly positive prices $\{X^*(\omega, \theta), U^*(\theta), V^*(\omega)\}$ is a stable matching solution of the CAG if and only if it attains the efficient level of capital at every match, i.e.

$$\begin{array}{rcl} k^*(\omega, \theta) & = & \arg\max\limits_{k \in \mathbb{R}_+} \{Q(k; \omega, \theta)\} \quad \text{for } (\omega, \theta) \in X^*(\omega, \theta) \\ & & \text{and} \\ Q^*(\omega, \theta) & = & U^*(\theta) + V^*(\omega) \quad \text{for } (\omega, \theta) \in X^*(\omega, \theta) \end{array}$$

Moreover, the surplus at the match evaluated at $k^*(\omega, \theta)$ is upper-semi continuous, the core of the game is non-empty, the competitive Walrasian equilibria exists, and all of the solutions to these problems are effectively equivalent.

Proof. : □ In general at the match given decreasing marginal productivity of capital on the final good, and the increasing cost of capital in the intermediary sector (condition *iii*), the

capital at the match that uniquely maximizes the surplus for a given partnership (ω, θ) is defined by:

$$k^*(\omega,\theta) = \left[\frac{P\beta\alpha A(\theta)b(\omega,\theta)^{\frac{1}{\beta}}}{p}\right]^{\frac{\beta}{1-\alpha\beta}} \tag{52}$$

For a given gross rate for funding savings p, and a given price of the final good P, the surplus at the optimal capital in each pairwise relationship is therefore:

$$\begin{aligned} Q^*(\omega,\theta) &= \Psi(\alpha,\beta,P,p)m(\omega,\theta) \\ \text{for} &: \\ m(\omega,\theta) &= [A(\theta)b(\omega,\theta)^{\alpha}]^{\frac{1}{1-\alpha\beta}} \\ \Psi(\alpha,\beta,P,p) &= \left[[\beta\alpha]^{\frac{\alpha\beta}{1-\alpha\beta}} - [\beta\alpha]^{\frac{1}{1-\alpha\beta}}\right]\left[\frac{P}{p^{\alpha\beta}}\right]^{\frac{1}{1-\alpha\beta}} \end{aligned} \tag{53}$$

for a given set of strictly positive prices (p, P) we have $\Psi(\alpha,\beta,P,\rho) > 0$ if and only if $\beta\alpha < 1$, which holds by conditions *iii*). By conditions *i*) and *ii*) the function $m(\omega,\theta)$ is a continuous differentiable function specified over the space $A^{(\times)}$. Moreover, $\Psi(\alpha,\beta,P,p)$ scales up the function $m(\omega,\theta)$ so the surplus function $Q^*(\omega,\theta)$ inherits the properties of $m(\omega,\theta)$ therefore $Q^*(\omega,\theta)$ is continuous in $A^{(\times)}$. By Gretsky, Ostroy, and Zame (1992) given the properties of $Q^*(\omega,\theta)$ and by conditions *iv*) and *v*) there exists a stable matching solution $\{X^*(\omega,\theta), U^*(\theta), V^*(\omega)\}$ and the Pareto optimal assignment, the core of the CAG game, and the competitive Walrasian equilibrium are equivalent.

Finally assume k^* does not maximizes the surplus for at least one matching relationship and let $\{X^*(\omega,\theta), U^*(\theta), V^*(\omega)\}$ be a stable outcome. Then for at least one pairwise relationship (ω_i, θ_j) at the stable match there exists a level of capital k' such that increases its own matching surplus from trading at this margin, i.e. $Q(k';\omega_i,\theta_j) > Q(k^*;\omega_i,\theta_j)$. If this is the case, then the surplus and social welfare are not maximized at the level of capital k^* and by definition the assignment X^* does not induce a Pareto efficient solution and $\{X^*(\omega,\theta), U^*(\theta), V^*(\omega)\}$ is not a stable match and this is a contradiction. ■

Proposition 2: Positive Assortative Assignment of Intermediaries and Entrepreneurs and Endogenous Capital. Consider a CAG under the Cobb-Douglas environment with transferable utility and complementarity in the production of financial services (capital). Then, $k^*(\omega,\theta)$ sustains a positive assortative assignment solution if and only if the following conditions holds:

i) $m(\omega,\theta) > 0 \quad \forall\{\theta \in \Theta, \omega \in \Omega\}$
ii) $m_{\omega\theta}(u,t) > 0 \quad \forall\{\theta \in \Theta, \omega \in \Omega\}$, and not switching signs
iii) $\alpha\beta < 1$

Moreover, the positive assortative solution is unique and pure as defined by Chiappori, McCann, and Nesheim (2008).

Proof. : □ From our setup we know that at the unique optimal capital within each match

$k^*(\omega,\theta)$ we have:

$$\begin{aligned} Q^*(\omega,\theta) &= \Psi(\alpha,\beta,P,p)m(\omega,\theta) \\ \text{for} &: \\ m(\omega,\theta) &= [A(\theta)b(\omega,\theta)^{\alpha}]^{\frac{1}{1-\alpha\beta}} \\ \Psi(\alpha,\beta,P,p) &= \left[[\beta\alpha]^{\frac{\alpha\beta}{1-\alpha\beta}} - [\beta\alpha]^{\frac{1}{1-\alpha\beta}}\right]\left[\frac{P}{p^{\alpha\beta}}\right]^{\frac{1}{1-\alpha\beta}} \end{aligned} \tag{54}$$

Therefore to have a positive assortative solution therefore it must be the case that:

$$\frac{\partial^2 Q^*(\omega,\theta)}{\partial\omega\partial\theta} > 0$$

from these conditions for a positive assortative solution to hold we require:

$$\begin{aligned} Q^*_{\omega\theta}(\omega,\theta) &> 0 \Leftrightarrow m_{\omega\theta}(\omega,\theta) > 0 \\ \frac{\partial}{\partial\omega}\frac{\partial}{\partial\theta}\left[A(\theta)b(\omega,\theta)^{\alpha}\right]^{\frac{1}{1-\alpha\beta}} &> 0 \end{aligned}$$

By construction we assumed the technology component function $b(\omega,\theta)$ depends on the type of entrepreneur it is serving θ and on its own technology of services ω. In particular $b(\omega,\theta) > 0$, $b_\omega(\cdot) > 0$, $b_\theta(\cdot) > 0$, and $b_{\omega\theta}(\cdot) > 0$ for all $\theta \in \Theta$ and $\omega \in \Omega$. Also we know $A(\theta) > 0$ and $A_\theta(\cdot) > 0\ \forall\theta \in \Theta$. Moreover, long as $\alpha\beta < 1$, condition that holds from decreasing returns to scale on the production of capital and the production of the final good, differentiability and complementarity in production on both types are sufficient conditions for this condition to hold. Therefore, as the cross partial derivative of the surplus at the optimal capital satisfies Becker's and Chiappori's theorem, this condition permit us to attain the optimal capital at the match, the Pareto optimal surplus solution of capital at the match, and indeed provides us with positive assortative matching solution. ■

Proposition 3: Equilibrium Profits for Entrepreneurs and Intermediaries. Consider a CAG with Cobb-Douglas technologies on the production for credit and final output. Then at the positive assortative matching solution $\{(U^*(\theta),V^*(\omega)),X^*\}$, both entrepreneurs and intermediaries have increasing profits in their own types respectively types.

Proof. : □ By the stable equilibrium conditions in the previous results we have that in the stable equilibrium given by $k^*(\omega,\theta)$:

$$Q^*(\omega,\theta) = \Psi(\alpha,\beta,P,p)m(\omega,\theta)$$

$$\frac{\partial}{\partial\theta}U^*(\theta) = \left.\frac{\partial}{\partial x}Q^*(\omega,x)\right|_{\omega=\psi(x)}$$

$$\frac{\partial}{\partial\omega}V^*(\omega) = \left.\frac{\partial}{\partial z}Q^*(z,\theta)\right|_{\theta=\varphi(z)}$$

Therefore, under these conditions at the optimal capital we have:

$$\begin{aligned}\frac{\partial}{\partial\theta}U^*(\theta) &= \Psi(\alpha,\beta,P,p)m_\theta(\psi(\theta),\theta) > 0\\ \frac{\partial}{\partial\omega}V^*(\omega) &= \Psi(\alpha,\beta,P,p)m_\omega(\omega,\varphi(\omega)) > 0\end{aligned}$$

■

C. The Mexican Datasets

General Overview

To assess the characteristics of the credit market in Mexico this paper combines monthly and quarterly information for the years 2004 to 2007 from three different sources for the Mexican banking system: the Credit Regulatory Report of Banks (Reporte Crediticio R04), the System of Information for Mexican Firms (SIEM), and the financial structure and performance indicators of banks from the National Commission of Banks and Securities (CNBV) and the Mexican Central Bank (Banco de Mexico). Each of these families of datasets provides information on supply, demand, and contracts at equilibrium. The information at the contract can be linked to the bank's information using the bank code for each quarter within the sample, while this resulting database can be merged to the information on the demand side using the Mexican firm's standardized code (RFC).

The Financial Intermediaries: The Financial Balance Sheet and Financial Statement

For gathering a higher knowledge on the supply side of the credit market, we proceed to build a comprehensive database combining several sources including information from: Secretaria de Hacienda y Credito Publico, Banco de Mexico, Comision Nacional Bancaria y de Valores, Asociacion Mexicana de Bancos, among others.

The final collection of supply database compile quarterly information from 2002 to 2007 for each of the 47 registered commercial banks. These datasets include: 1) the financial statement elements; 2) the balance account sheet; 3) the number of branches, personal, and accounts by locality; 4) the capital requirements by risk category; 5) the returns on assets, returns on equity, and capital rising costs; 6) the number of ATMs, and credit card's selling point terminals.

The combined sets of information provide nearly 1,000 variables for each commercial bank on each of the quarters, this without considering the rich geographical decomposition of branching structure for the same information. Let us notice that during this period, several new banks were created and started to be regulated and approved by Banco de Mexico.

The Firms: The Mexican System of Information of Firms (SIEM)

The information gathered for gaining insights on demand side of the credit market is given by the System of Information for Mexican Firms (Sistema de Informacion Empresarial de

Mexico, SIEM henceforth). Formally, SIEM is the instrument of the Mexican Government to integrate, compile, process and provide high quality information on the characteristics and location of firms in commerce, service, tourism, and industry in the country.

Compiled as a continuous census updated in a daily basis, SIEM is organized and collected by the Mexican Ministry of Economy. It provides consistent information on 20 fields of information. One of the tasks of this research was to clean and make compatible two rounds of this census gathered in April 2006, and January 2008 as they do not necessarily capture the information in the same organization and variables. By exploring the datasets, which we will call SIEM0607 in short from now, we are able to identify by firm code: the month and year where the business started business formally, the labor force of the firm, if the firm export its products, if the firm import some of its inputs, if the firm provides services to the government, the size of sales ranked in 7 categories, the economic sector divided in 10 different activities, and the geographic location of the firm identifying which of the 32 Mexican states the firm is running.

With these variables, we are able to build a unique block of datasets unifying the criteria of the variables which permit to gain information from the firm relative to other firms around the same cohort of tenure, and so, control for this concept.

One important empirical feature of SIEM datasets is the possibility of double counting of firm codes, and so the decision of the information selection from the multiple case possibility. This might arise from three different sources: 1) because the firm appears in the two census datasets, and it modifies its information by updating its previous register; 2) because for a given period the firm has several branches and each branch is registered in the census under the same code; or 3) a combination of the previous two cases. Table 3.3.1 below shows the taxonomy of firm codes by year and number of cases. From this table we observe that the number of different firm codes reported in both samples is around 753,500 firms. From these firms, we observe a large number of losses (34.8 percent) of firms originally registered in 2006 and not registered in 2007, and also a large number of inclusions (31.2 percent) of new firms added to the latest census in comparison to the previous one. From this classification we observe that 34.1 percent of the firm codes are reported in both periods.

Nonetheless, more information can be obtained from this table. For instance, almost 95 percent of the firms reports one line of information on those periods, while the other 5 percent reports information with more than one line in the data increasing the sample size.

We proceed to classify firms according to the following criteria: Type I firms are those firms with one case registered and only appear in either 2006 or 2007, but not in both, so we take the information each of them provided at the year it is available; Type II firms are those that have one case registered and appear on both 2006 and 2007 SIEM datasets, for them we take the information from 2007 i.e. the most recent round of answers; finally Type III firms are those with more than one line of information, and which might be included in either of both of the census we have. Under this criterion, almost 95 percent of the firms are either Type I or Type II, while the remaining 5 percent represent Type III firms.

In a first stage of research, we are going to use the information from Type I and Type II firms, and merge this information with the credit market counterpart information provided by

the regulatory reports. In a later stage, we will explore the mechanisms to that the inclusion of Type III firms will by including the correct measure of those variables.

The Contracts: The Regulatory Reports of Banking Credit

For carrying out the empirical estimation and evaluating the policy implications for the proposed model on the Mexican financial liberalization, this paper will use the Regulatory Reports of Banking Credit Portfolio: Disaggregated by Commercial Credit (Reportes Regulatorios de Cartera de Crédito: Desagregado de Créditos Comerciales, or R04 in short from now). This non-public database is collected by the Mexican National Commission of Banking and Securities (Comision Nacional Bancaria y de Valores, CNBV) and compiled and analyzed exclusively by the General Direction of Financial System Analysis in Banco de Mexico.

The R04 is a survey in which each bank provides information on the status of the active credit operations, during the period of the report. The frequency of elaboration and presentation of this report is mandatory by month since June 2001. While this is the official date the report started, the regularity of observations and experience on capturing the relevant information makes the information reliable starting 2003 to date. In this report the banks are requested, operation by operation, to provide information on 48 fields of all of those credits that the institution have registered in the areas of: commercial credits, credits to financial companies, credits to government companies, and loans for developers and housing construction. Any type of credit operation, excluding those in the mortgage market, should be included: the accounts receivable in force and conquered, the credits renewed and then restructured; the credits offered directly or acquired to discount; the credits relating to the "programs of restructures in UDIS "; credits to financial intermediaries, and any other banking operations that generate or can generate a right of credit in favor of the lending institution and regarding which a risk of breach exist, for example: the letters of credit, the credits offered with promotion intermediaries resources, the credits by guarantee or acceptance, the irrevocable commercial credits, etc.

The size of the datasets is relatively large. For instance, for January 2006, R04 has 1,131,560 lines of observations, classified in more than 400 economic activities, among the 7 main economic sectors. All this information is also codified to identify the individual branches on which the credit was granted for the more than 60 Mexican commercial and development banks. This database structure also permits to identify the firm and the use for which the credit is granted. Moreover, the information is a nationwide representative census of credit transaction and can be disaggregated to study the structure of credit market by municipalities, state, region, or analyze the whole structure of the Mexican economy.

The use of R04 is not simple, or straightforward. First, R04 is not intended to provide information by credit line, as each line on each of the datasets report "transactions" done from each credit line, and not a credit itself. To avoid double counting of observations from the original R04 datasets, we create a unique credit line code using: 1) the RFC name code of the firm; 2) the name code for the bank; and 3) the number of credit according to the bank institution inside settings. This variable allows us to identify the main elements of each credit line such as: interest rate, credit amount, collateral, length, spatial location, and the other variables from the lender.

A second problem detected on R04 is that they only report the current status of the debt of the loan for each line of information, and not the original credit loan size itself. To infer the distribution of original credit lines, we also identified new credits granted at each period, so we have the original credit characteristics (loan size, interest rate, collateral, etc.) without any renegotiation, and infer the actual initial conditions of the contract, and not the current liabilities from the contract on those loans granted for previous periods.

This exercise is done to avoid double counting of credit observations, as each line represent one transaction of the credit line, and not necessarily the entire credit itself is executed in one transaction. For instance, if a lender got a credit line for 1 million pesos, and he used it in 4 transactions, each of them for 250 thousand pesos within the same month, the database reports the same credit 4 times. The proposed credit code, allows us to recover only the relevant number of credits in the market.

With this new specification of the relevant unit of measure, the number of credit lines in the market we recovered is shown in the Figure 3.4.1. Our methodology identifies an increasing trend in the total number of credit lines granted in the market. This fact has been driven by an increase in the number of new credit lines reflected in a higher creation on new credit rate, but also, to a lower rate of completion for old credit lines as we can see in Figure 3.4.2. The next section compiles the results from our analysis for whole set of datasets we have, and analyze the implications over the macrostructure of the credit market, in particular, on corporate credit loans.

From the Structure of Datasets to the Structure of the Credit Market

By combining the three sources of information, R04, SIEM0607 and the CNBV and Banco de Mexico information for each bank, and after the adequate validation of data and observations for each cross section we have, we are able to study the information of both sides of the market, and at the intensive and extensive margins. The first task we performed consists in checking the coincidence of the datasets for the whole period we studied, from 2004 to 2007.

For doing this comparison, we identified each credit line considering a set of variables such as: credit code within the bank, bank code, interest repayment, and a corrected version of the firm code. To make a better merging among datasets, we recovered an alternative RFC measure by applying a special filter we created; this routine allows us to filter for any mistake, misspelling, or omissions in this variable, and using this new variable we linked all of the datasets we have and then collapsed by credit lines for each period.

If we divide the datasets in semesters, we observe that the percentage of firms in R04 with information in SIEM counterparts goes from 22.8 to 28.2 percent around the period studied. On the other hand, firms at SIEM with R04 counterpart goes from 16.3 in 2004 to almost 45.4 percent at the end of 2007. These results are shown in Table 4.1.

In absolute numbers, the coincidence of information on both datasets allows us to have information for more than 2,230,000 contracts in R04 with demand information in SIEM counterpart, for the whole period analyzed. Nonetheless, as we are going to discuss below, not all of this contracts are useful in terms of our research purposes, as only the new credit created at each period reveals the information about the actual size of the initial loan in R04 dataset.

Finally,the merged sample with the bank's information on performance and financial structure does not imply any lose of information regarding contracts, so we will leave the information of banks aside to be analyzed in the next section.

TABLE A1. COINDICENCE OF FIRM CODES AND CONTRACTS FOR R04 REPORT AND SIEM

MEXICO 2004-2007, BY SEMESTER

Classification	2004		2005		2006		2007	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
Total Contracts R04	542921	594453	679250	759190	906551	1223133	1673050	2121595
Total Firms SIEM 06-07	644499	644499	644499	644499	644499	644499	644499	644499
Contracts - only R04	419006	445982	487454	528135	645428	893336	1242169	1607289
Firms - only SIEM	637320	633421	630958	627913	628059	624907	621176	619472
Contracts R04 with SIEM information								
Number of Contracts	123915	148471	191796	231055	261123	329797	430881	514306
Contacts with SIEM information as % of R04	22.8%	25.0%	28.2%	30.4%	28.8%	27.0%	25.8%	24.2%
Firms with R04 credit as % of SIEM	1.4%	2.0%	2.3%	2.8%	2.7%	3.2%	3.8%	4.0%

Sources:

i) Desagregado de Creditos Comerciales (R04): 2005-2007; Comision Nacional Bancaria y de Valores (CNBV) y Banco de Mexico.

ii) Sistema de Informacion Empresarial Mexicano (Padron SIEM): 2006-2007; Secretaria de Economia, Mexico.

TABLE A2. CREATION OF CORPORATE CREDIT CONTRACTS IN R04 REPORT.

MEXICO 2004-2007, BY QUARTER.

Year	Month	Number of Contracts				Rotation Rates	
		New Corporate Credit Lines	Old	Implied Out	Total Corporate Credit Lines	Completion Rate[1]	New Credit Rate[2]
2004	**March**	18,686	69,917	18,432	88,603	20.9%	21.2%
	June	22,214	79,212	13,434	101,426	14.5%	24.0%
	September	19,207	77,003	18,422	96,210	19.3%	20.1%
	December	32,824	80,334	18,282	113,158	18.5%	33.3%
2005	**March**	22,454	87,572	21,783	110,026	19.9%	20.5%
	June	32,484	95,577	18,136	128,061	15.9%	28.6%
	September	31,308	93,684	29,722	124,992	24.1%	25.4%
	December	30,737	102,128	25,582	132,865	20.0%	24.1%
2006	**March**	38,598	109,447	29,840	148,045	21.4%	27.7%
	June	41,543	130,970	32,695	172,513	20.0%	25.4%
	September	44,440	150,284	39,918	194,724	21.0%	23.4%
	December	52,421	178,645	45,110	231,066	20.2%	23.4%
2007	**March**	62,190	212,873	45,513	275,063	17.6%	24.1%
	June	60,030	241,068	61,339	301,098	20.3%	19.9%
	September	67,296	285,310	52,233	352,606	15.5%	19.9%
	December	60,815	311,585	60,601	372,400	16.3%	16.3%

(1) Implicit average monthly rate at which previous quarter loans are terminated at the beginning of the current quarter.

(2) Current credit lines created during the month as percentage of total.

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); Comision Nacional Bancaria y de Valores (CNVB).

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; Comision Nacional Bancaria y de Valores (CNBV) y Banco de Mexico.

TABLE A3. CREATION OF CORPORATE CREDIT CONTRACTS IN R04 REPORT WITH SIEM INFORMATION. MEXICO 2004-2007, BY QUARTER.

Year	Month	Number of Contracts				Rotation Rates	
		New Corporate Credit Lines	Old	Implied Out	Total Corporate Credit Lines	Completion Rate[1]	New Credit Rate[2]
2004	**March**	4,773	13,057	4,879	17,830	27.2%	26.8%
	June	5,300	16,774	3,806	22,074	18.5%	24.0%
	September	4,515	17,773	3,567	22,288	16.7%	20.3%
	December	8,727	19,309	3,700	28,036	16.1%	31.1%
2005	**March**	6,008	22,981	4,994	28,989	17.9%	20.7%
	June	8,608	26,219	5,107	34,827	16.3%	24.7%
	September	8,677	27,849	6,633	36,526	19.2%	23.8%
	December	9,221	29,612	8,034	38,833	21.3%	23.7%
2006	**March**	10,178	31,237	8,146	41,415	20.7%	24.6%
	June	10,479	36,370	8,385	46,849	18.7%	22.4%
	September	10,908	40,583	9,592	51,491	19.1%	21.2%
	December	12,510	46,702	11,412	59,212	19.6%	21.1%
2007	**March**	15,892	54,455	11,559	70,347	17.5%	22.6%
	June	15,188	60,425	16,157	75,613	21.1%	20.1%
	September	15,940	68,958	13,355	84,898	16.2%	18.8%
	December	14,510	72,560	14,773	87,070	16.9%	16.7%

(1) Implicit average monthly rate at which previous quarter loans are terminated at the beginning of the current quarter.

(2) Current credit lines created during the month as percentage of total.

Sources:

i) Catalogo del Sistema Interinstitucional de Transferencia de Información (SITI); Comision Nacional Bancaria y de Valores (CNVB).

ii) Desagregado de Creditos Comerciales (R04): 2005-2007; Comision Nacional Bancaria y de Valores (CNBV) y Banco de Mexico.