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FINANCIAL LIBERALIZATION AND THE DEVELOPMENT OF MICROCREDIT

José J. Cao-Alvira
Luca G. Deidda

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CRENoS – CAGLIARI
VIA SAN GIORGIO 12, I-09100 CAGLIARI, ITALIA
TEL. +39-070-6756406; FAX +39-070- 6756402

CRENoS - SASSARI
VIA TORRE TONDA 34, I-07100 SASSARI, ITALIA
TEL. +39-079-2017301; FAX +39-079-2017312

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Financial liberalization and the development of microcredit

José J. Cao-Alvira * Luca G. Deidda†

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Abstract

We analyze the debt origination process in which a lender offers prospective borrowers a microcredit product alongside a traditional bank loan, and the impact anti-usury mandates can cause within this credit market. This is a paper about the prospects of financial liberalization following a more flexible determination of anti-usury rates and, with it, the development of a formal microcredit market. In the presence of asymmetric information, a lender assesses a borrower's credit worthiness via a screening process, which its effectiveness is negatively affected by the opaqueness of the borrower's financial information. For this economy, an equilibrium is possible where all opaque borrowers, regardless of their true riskiness, are rationed from credit where usury rates are exogenously set too low by regulatory authorities. Were the anti-usury mandate was relaxed, these borrowers would have the option of financing through microcredit.

Keywords: Microcredit, Asymmetric Information, Bank Downscaling, Usury Rates

JEL-Codes: O16, G14, G21, G28

*Università di Sassari, CRENoS, DiSEA, , via Torre Tonda n. 34, 07100, Italy, Tel.: +39-079-2017333, Fax: +39-079-2017312, E-mail: deidda@uniss.it.

†Graduate School of Business Administration, University of Puerto Rico, U.S.A., and Research Associate, Business School, Universidad Sergio Arboleda, Colombia, E-mail: josejulian.cao@upr.edu.

1 Introduction

Alas in its beginnings microcredit mostly referred to small uncollateralized loans to the poorest of the poor offered via group-lending contracts by a solidarity organization, currently the market for microcredit involves much more heterogeneous contract terms and composition of lenders and borrowers. This shift can be attributed to the significant and increasing presence of commercial banks in the market, alongside and/or competing with specialized microfinance institutions and NGOs. Commercial banking has arguably created new balances in the mission of microcredit by combining two previously separate institutional logics, e.g. a development logic guided towards helping the poor and a banking logic requiring profits to support operations, see Battilana and Dorado (2010). On this, using a privileged data set from the Microfinance Information Exchange (or MIX) on 18 million active borrowers from 346 microfinance institutions for the 2002-2004 period, Cull, Demirgüç-Kunt and Morduch (2009) found that microfinance banks, when compared to NGOs or non-bank financial institutions, exhibited inclinations towards individual lending over group-lending, granting loans of greater volume and serving a customer base who are substantially better off. Evidently these banking institutions do not typically replicate the outreach and methods of non-for-profit organizations.

A considerable number of microfinance practitioners, with Nobel Laureate Muhammad Yunus among these[1], have expressed concerns about the growing commercialization of microcredit and an inevitable primary focus on profitability over poverty reduction of microcredit financial institutions [Copestake (2007)]. Commercial capital is seen by its proponents as a necessary and a more efficient supplier of credit to the unbanked. The work by Cull, Demirgüç-Kunt and Morduch (2009) found that the highest fees on microcredit are being charged by institutions driven by a social mission and not by commercial microfinance institutions, and attribute most of this discrepancy to the cost structure of both organizational types. Hermes and Lensink (2011) further claim that the presence of microfinance banks in the market may even put pressure on social-driven microfinance institutions to reduce interest rates and agency costs, and increase efficiency.

The interest of commercial banks in microfinance is been reported to be motivated by the expected profitability of microcredit loans, the existence of government regulations requiring microcredit lending by the commercial banking sector, the opportunity for the bank to show its corporate social responsibility [Hermes and Lensink (2011)], and the loss of clients for traditional banking services to bigger international banks [Schicks (2007)]. The process by which commercial banking institutions enter the microcredit market, while still primarily offering traditional banking

[1]Reference, for instance, Yunus (2007).

products, is commonly referred as "downscaling". Commercial bank downscaling into the microcredit market requires organizational adjustments intended to more efficiently originate and service debt to a very specific population of borrowers that are not traditional bank customers. This is typically done by creating a specialized internal unit within the bank, outsourcing micro-lending operations to an external organization, or by creating a regulated subsidiary.[2] Albeit the incentives to downscaling and the possible restructuring efficiency gains, the screening and monitoring costs of unbanked and informational opaque prospective borrowers can significantly increase a traditional bank's costs of issuing uncollateralized debt. The weight of adverse selection from the unsuccessful screening of unbanked individuals and informational opaque firms is placed either or jointly on lenders, increasing the perceived risk of their portfolio and hindering its possibilities of securing commercial credit if needed [Morduch (2000)], or on borrowers, by rationing their credit and leaving unbanked potentially successful entrepreneurs [Presbitero and Rabellotti (2013)], increasing their cost and decreasing their availability of credit [e.g. Berger, et. al. (2001), Clarke, et. al (2005), and Petersen and Rajan (1994)], and strengthening their dependence on the informal finance sector [Chandavarkar (1992)].

Microfinance institutions, commercial and social-driven alike, rely in technological advances and behavioral mechanisms to overcome these adverse effects of asymmetric information. Group-lending being one of the original inventions of behavioral mechanisms that is credited with the high repayment rates of microcredit, see Townsend (2006) and Cull, Demirgüç-Kunt and Morduch (2009). More fertile microcredit markets have experienced the creation of credit bureaus that collect information on past history of microcredit loan performance [De Janvry, McIntoch and Sadoulet (2010)], and microcredit contracts that require specialized screening of loan applications and intensive monitoring of borrowers [Navajas, et. al. (2003)]. Microfinance institutions with less access to technological advances on processing loan applications often rely on directed lending programs or other forms of lending with liberalized screening criteria [Karlan and Zinman (2010)]. Microfinance institutions with a standardized loan contract, with no screening, often only rely on credible threats of denying future finance or increases in loan amounts if the borrower defaults on its credit [see Navajas, et. al. (2003) and Presbitero and Rabellotti (2013)].

Traditional banks are often dissuaded from downscaling to microcredit on markets where usury rates are present. Being these organizations classified as financial institutions binds their microcredits contracts to the interest caps determined by the usury rates. A restriction that regularly does not apply to NGOs, see Peck Christen and Rosenberg (2000). Financial repression

[2]Schoombee (2004) for South Africa, and Westley (2006) and Prior and Argandoña (2009) for Latin America offer very complete accounts and examples on ways in which traditional banks downscaled into microcredit.

resulting from anti-usury laws has been well-established by a considerable number of important works in the scientific literature. A non-exhaustive list of these include Stiglitz and Weiss (1981), McKinnon (1984), McKinnon (1989), Villegas (1989), Chandavarkar (1992), Homer and Sylla (1996), Glaeser and Scheinkman (1998), Dehejia et. al. (2005), and Rigbi 2013). A thriving parallel informal financial sector and credit rationing are common frictions often observed in jurisdictions where anti-usury laws are in place. Although principally aimed at this sector, see Chandavarkar (1992) and Snow and Buss (2001), the informal finance sector has the ability to circumvent anti-usury laws and can represent a principal form of financing in developing economies. Additionally, concerns over social inequality and aggregate welfare arise when it's considered that empirical research on credit markets has shown that lower income and informational opaque borrowers are the most vulnerable to the credit rationing resulting from anti-usury mandates.

In this paper we analyze the debt origination process in which a lender offers prospective borrowers a microcredit product alongside a traditional bank loan product and the impact anti-usury rates on loans can cause in this credit market. This is a paper about the prospects of financial liberalization following a more flexible determination of anti-usury rates and, with it, the development of a formal microcredit market. We test if anti-usury mandates, in the form of interest rate ceilings, in the presence of assymetric information can indeed ration credit to those borrowers perceived as the riskiest of a population even when a microcredit option exists, and assess how a microcredit market can develop once anti-usury rates are abolished. To do this we develop a screening model of a competitive credit market constrained by an anti-usury mandate where borrowers have the option to apply for either a traditional bank loan or a microcredit loan from a lender. Loan contracts differ in interest rates and time they require to process the borrower's application. Borrowers are heterogeneous with respect to riskiness and the transparency (or opaqueness) of their information on credit-worthiness. Lenders can screen borrowers applying for loans and obtain an informative signal in their true riskiness. The quality of the signal on the riskiness of an applicant diminishes with the opaqueness of his/her credit-worthiness information. A result of the model is the possibility to obtain an equilibrium where all opaque borrowers, regardless of their true riskiness, will be rationed from credit in an economy where usury rates are exogenously set too low by regulatory authorities. Were the anti-usury mandate was relaxed, these borrowers would have the option of financing through microcredit.

The rest of the paper is organized as follows. The next section presents the theoretical model used for analysis. Section 3 contains a numerical exercise where the calibration of a model economy is presented and analyzed. Section 4 concludes, and an technical Appendix is included at the end of the manuscript.

2 The Model

We consider a competitive credit market populated by a large number, F of borrowers and a large number L lenders. All agents are risk-neutral. Each lender is endowed with one unit of financial resources. Each borrower is endowed with a project that needs one unit of finance and delivers R if the borrower is successful and zero otherwise. Lenders' opportunity cost is γ. We consider the case in which, $L/F > 1$, so that there is abundancy of financial resources.

Lenders offer lending contracts characterized by a cost of credit r and an amount t of application processing time, so that a contract is generally defined as $C = \{r, t\}$.

Borrowers are heterogeneous along two dimensions: riskiness, ρ, and Informational transparency, τ. We have risky (R) and safe (S) borrowers –so that $\rho = (R, S)$, opaque (O), and transparent (T) ones –so that $\tau = (O, T)$. Correspondingly, borrower's type is identified by, $\theta = (\rho, \tau)$.

Borrowers' type is decided by nature: ρ equals S with probability π and R with probability $1 - \pi$, while τ equals T with probability λ and O with probability $1-\lambda$. The payoff of a financed borrower of type θ as a function of a lending contract $C = \{r, t\}$, where r is the cost of credit, and t is the amount of time that the lender takes to process the loan application is

$$\beta^t(R - r) \tag{1}$$

in present value terms in case of success, and zero otherwise. We assume that borrowers of type R have a lower probability of success than those of type S: $p_R < p_S$. Accordingly the expected payoff for a financed borrower of riskiness ρ is

$$p_\rho \beta^t(R - r) \tag{2}$$

Lenders can acquire an informative signal $s = R, S$ about the true riskiness of a perspective borrower at a cost $c > 0$. The signal s has the following probabilistic structure. Given the true riskiness, ρ, of a borrower, the signal s is correct, i.e. $s = \rho$, with probability $\sigma_{\rho,\rho}$ and wrong, i.e. $s \neq \rho$, with probability $1 - \sigma_{\rho,\rho}$, where $\sigma_{\rho,\rho}$ is assumed to be an increasing function of t: The longer the lender takes to process a loan application, the more time the lender has got to acquire information about the borrower, which results in a better signal. We assume that acquiring a signal requires more time in the case of opaque borrowers as opposed to the case of transparent ones. Accordingly, we specify banks' screening technology as follows:

$$\sigma_{\rho\rho} = \begin{cases} \overline{\sigma} & \text{if } t \geq t_\tau \\ \underline{\sigma} & \text{if } t < t_\tau \end{cases} \tag{3}$$

where $t_T < t_O$. Note that having observed a signal $s = S$, the conditional probability that the borrower is S is:

$$Pr(\rho = S|s = S) = \frac{\pi\sigma_{SS}}{\pi\sigma_{SS} + (1-\pi)\sigma_{SR}} \tag{4}$$

Similarly, having observed a signal $s = R$, the conditional probability that the borrower is R is:

$$Pr(\rho = R|s = R) = \frac{(1-\pi)\sigma_{RR}}{(1-\pi)\sigma_{RR} + \pi\sigma_{RS}} \tag{5}$$

The signal is informative if:

$$Pr(\rho|s = \rho) > Pr(\rho) \tag{6}$$

where $Pr(\rho)$ is the unconditional probability that borrower's riskiness is ρ, with $Pr(\rho = S) = \pi$. Accordingly, given symmetry, i.e. $\sigma_{RS} = \sigma_{SR}$, and $\sigma_{SS} = \sigma_{RR}$, a signal is informative, i.e. $Pr(\rho|s = \rho) > Pr(\rho)$, if

$$\sigma_{\rho\rho} > \frac{1}{2} \qquad \rho = S, R \tag{7}$$

Note also that the signal is mis-informative, i.e. $Pr(\rho = j|s = j) < P(\rho)$, $j = S, R$, if:

$$\sigma_{\rho\rho} < \frac{1}{2} \qquad \rho = S, R \tag{8}$$

Finally, the signal is uninformative if

$$\sigma_{\rho\rho} = \frac{1}{2} \qquad \rho = S, R \tag{9}$$

Given the above, we assume that

$$\overline{\sigma} > \frac{1}{2} \tag{10}$$

$$\underline{\sigma} = \frac{1}{2} \tag{11}$$

Finally, we assume adverse selection, in that only borrowers' of type S are worth financing: $p_S R > \gamma > p_R R$.

Given perspective borrower's transparency, we call a microcredit loan, a contract C characterized by a waiting time lower than t_τ. Similarly, we define bank loan, a contract C characterized by a waiting time greater than t_τ.

2.1 Lender's expected profits

Given a gross interest rate on leding r, the expected profits of a lender that only offers bank loans, conditional on a positive signal, $s = S$, are given by $u_B \equiv p_B r - c$, where

$$p_B \equiv \frac{\pi\overline{\sigma}}{\pi\overline{\sigma} + (1-\pi)(1-\overline{\sigma})} p_S + \frac{(1-\pi)(1-\overline{\sigma})}{\pi\overline{\sigma} + (1-\pi)(1-\overline{\sigma})} p_R \tag{12}$$

is the probability of repayments on bank loans. We assume that the screening technology is strictly profitable in the sense that $p_B R - c > \gamma$.

The expected profits of a lender that offers microcredit loans, i.e does not acquire meaningful signals about borrowers' riskiness is given by $u_M \equiv p_M r$, where

$$p_M \equiv \pi p_S + (1 - \pi) p_R \tag{13}$$

is the probability of repayments on microcredit loans. We assume $p_M R > \gamma$ so that there exist values of r such that a microcredit loan is profitable to lenders. Note that, for any given r, $u_B > u_M$ holds for c small enough, since $\overline{\sigma} > 0.5$ and $p_R < p_S$.

Note that, since waiting is costly for borrowers, either a financial institution operates as a bank, in which case only lends to borrowers for which the signal is positive, or as a microcredit institution that does not extract any signal. In other words, in equilibrium, lending conditional on a negative signal is ruled out.

2.2 Sorting conditions

Lemma 1 (Sorting Condition)**.** *Let $C_M \equiv \{r_1, t_1\}$ and $C_B \equiv \{r_2, t_2\}$ a bank loan and a microcredit contract, respectively., with $t_1 < t_2$. Then, other things equal, if a risky borrower prefers C_B over C_M then, a safe borrower strictly prefers C_B to C_M.*

Proof. See appendix.

2.3 Timing and equilibrium concept

An equilibrium in the credit market is pure strategy subgame perfect Nash equilibria (SPNE) of the following game:

Stage 1: Lenders simultaneously announce contracts;

Stage 2: Borrowers choose whether to borrow or not and according to which contract;

Stage 3: Lenders decide whether to accept or reject each individual loan application they receive (probably the same as widthdraw the contract);

Stage 4: Exchange, if any, takes place.

In our analysis, we restrict our attention to robust SPNE.

Definition 1 (Equilibrium)**.** An equilibrium is a set of a set of strategies for borrowers and lenders and a system of beliefs such that: 1. Agents' strategies are best reply given other at each stage of the game; 2. Beliefs are derived using Bayes's rule whenever possible.

3 Laissez faire Economy

Preliminary results

Lemma 2 (Monotonicity)**.** *Let $\mathcal{C}^E$ the set of contracts played with positive probability in a given equilibrium E. Consider two contracts, $C' = \{r', t'\}$, $C'' = \{r'', t''\}$, with $C' \neq C''$. Then, if $C', C'' \in \mathcal{C}_E$, $r' > (<)[=]r''$ implies $t' < (>)[=]t''$.*

Proof. The proof follows immediately from the fact that agents' payoff is strictly decreasing both in r and t.

The following result about separation between risky and safe types holds.

Lemma 3 (No separation according to risk)**.** *There is no equilibrium in which safe borrowers separate.*

Proof. See appendix.

In a separating equilibrium where all risky borrowers are separated from safe ones, risky borrowers would be unable to borrow as their projects have have a negative expected net present value. Differently, as competition drives lenders' profits to zero, safe borrowers would be able to borrow at a cost such that they make strictly positive expected profits. But then, risky borrowers would have an incentive to mimic safe ones, which implies that separation between risky and safe borrowers is never an equilibrium. Similarly, in an equilibrium where some of the safe borrowers separate from the rest by applying for bank loans subject to screening, lenders' screening is not a subgame perfect equilibrium strategy: since only safe borrowers are applying for bank loans, lenders best reply is not to screen applicants, which destroys the candidate equilibrium.

3.1 Equilibrium characterization

Given lemma 3, the equilibrium candidates are: (a) "Transparency separating equilibria" which transparent borrowers go for banking contracts and opaque ones go for microcredit; (b) "Transparency pooling equilibria" where all borrowers demand either banking or microcredit. We analyze separating equilibria first.

a. Transparency separating equilibria (TSE). Define, two critical values for $\alpha \equiv \beta^{-1}$,

$$\overline{\alpha} \equiv \left[\frac{(1-\overline{\sigma})(R-r_B)}{(R-r_M)}\right]^{\frac{1}{t_T}} \tag{14}$$

$$\underline{\alpha} \equiv \left[\frac{\overline{\sigma}(R-r_B)}{(R-r_M)}\right]^{\frac{1}{t_O}}. \tag{15}$$

where,

$$r_B = \frac{[\gamma + c]}{p_B} \tag{16}$$

and

$$r_M = \frac{\gamma}{p_B}. \tag{17}$$

The following result applies to the case of Transparent separating equilibria (TSE)

Lemma 4. *The TSE if it exists is unique: i. All transparent borrowers demand bank loans according to the contract,* $C_B = \{\frac{\gamma+c}{p_B}, t_T\}$*; ii. All opaque borrowers demand microcredit,* $C_M = \{\frac{\gamma}{p_M}, 0\}$*; iv. Rationing only takes place in the bank loan market. The fraction of rationed borrowers is* $\lambda[(1-\pi)\overline{\sigma} + \pi(1-\overline{\sigma})]$*. Necessary conditions for the existence are* $R > \gamma/p_M$*,* $R > (\gamma + c)/p_B$*,* $\overline{\alpha} \geq \underline{\alpha}$*, and* $\alpha \in [\underline{\alpha}, \overline{\alpha}]$*.* □

Proof. See appendix.

b. Transparency pooling equilibrium (PE). The following result holds,

Lemma 5. *Any TPE with financial exchange, when it exists, is characterized as follows. 1) If* $\alpha < \underline{\alpha}$ *all borrowers demand bank loans: i. The bank contract is* $C_{BT} = \{\frac{\gamma+c}{p_B}, t_T\}$ *for transparent borrowers and* $C_{BO} = \{\frac{\gamma+c}{p_B}, t_O\}$*; ii. The fraction of rationed borrowers is* $[(1-\pi)\overline{\sigma} + \pi(1-\overline{\sigma})]$*. 2) If* $\alpha \geq \overline{\alpha}$*, all borrowers demand microcredit; i. the microcredit contract is* $C_M = \{\frac{\gamma}{p_M}, 0\}$ abd all borrowers are financed. Necessary conditions for existence are $R > \gamma/p_M$*,* $R > (\gamma + c)/p_B$*,* $\alpha \geq \overline{\alpha}$ *or* $\alpha \leq \underline{\alpha}$*.*

Prevailing equilibrium. Having characterized separating and pooling equilibria we can now analyze what equilibrium prevails depending on the values of parameters. We restrict our attention to parameter configuration such that: 1. financial exchange takes place; 2. Banking is a viable activity, and, 3. No rationing occurs under microcredit.

Proposition 1. *Existence and characterization of the equilibrium of the credit market are as follows: 1) If* $\alpha \in (\underline{\alpha}, \overline{\alpha})$ *a unique TSE emerges such that opaque borrowers go for microcredit and transparent ones go for bank loans. If 2)* $\alpha \notin (\underline{\alpha}, \overline{\alpha})$*, a unique TPE emerges, such that, if* $\alpha > \overline{\alpha}$ *all borrowers go for microcredit, and if* $\alpha < \underline{\alpha}$ *all borrowers go for bank loans. If* $\alpha = \underline{\alpha}$*, or* $\alpha = \overline{\alpha}$ *then TSE and TPE coexist.*

Proof. See appendix.

4 Financial liberalization and emergence of microcredit

In the absence of financial repression, depending on parameter configurations, the credit market finds itself either in a TSE or in a TPE. In a SE, opaque borrowers demand microcredit finance, characterized by a higher interest rates and lower waiting times thank banking loans, which are demanded by transparent borrowers. In a TPE, either all borrowers demand microcredit or the all demand bank loans, depending on parameter configurations.

Consider, however, the possibility that the government imposes an interest rate ceilng, $\overline{r}$. The following result holds,

Proposition 2. *Assume* $\alpha \in (\underline{\alpha}, \overline{\alpha})$ *and* $R > \max(\gamma/p_M, (\gamma+c)/p_B)$*. If* $\gamma/p_M > \overline{r}$*,* $(\gamma+c)/p_B < \overline{r}$*: 1. In the presence of the interest rate ceiling, the prevailing equilibrium is a TPE, which is unique and characterized as follows: i. All borrowers demand bank loans; iii. The bank contract is* $C_{BT} = \{\frac{\gamma+c}{p_B}, t_T\}$ *for transparent borrowers and* $C_{BO} = \{\frac{\gamma+c}{p_B}, t_O\}$*; iii. The fraction of rationed borrowers is* $[(1-\pi)\overline{\sigma} + \pi(1-\overline{\sigma})]$*; 2. In the absence of the interest rate ceiling, the prevailing equilibrium is a TSE, in which i. All transparent borrowers demand bank loans according to the contract,* $C_B = \{\frac{\gamma+c}{p_B}, t_T\}$*; ii. All opaque borrowers demand microcredit,* $C_M = \{\frac{\gamma}{p_M}, 0\}$*; iv. Rationing only takes place in the bank loan market. The mass of rationed borrowers is* $\lambda[(1-\pi)\overline{\sigma} + \pi(1-\overline{\sigma})]$*.*

Proof. The result immediately follows from Proposition 1: If $\alpha \in (\underline{\alpha}, \overline{\alpha})$ borrowers select a TSE; and the TSE is not feasible because of financial repression, then all demand bank loans, and a pooling characterized by bank loans emerges .

The above proposition says that financial repression in the form of interest rate ceilings affects the equilibrium outcome in the credit market. In particular, interest rate ceilings might prevent the development of microcredit. From a different perspective, financial liberalization policies according to which interest rate ceilings for usury are imposed taking into account the characteristics of each particular credit market, might take the credit market from a pooling equilibrium with no

microcredit, where the opaque and impatient borrowers –who are typical customers of microcredit institutions – are rationed, to an equilibrium where lenders offer both loan contract accesible only by transparent borrowers, and microcredit contracts to the opaque ones, who are no longer rationed.

5 Numerical Exercise

Consider the state space of parameter combinations π, R, γ, $\overline{\sigma}$, β_ϕ for $\rho = R, S$, where $\beta_\phi \equiv \beta^{t_\tau}$ – with $\phi = P, I$ ($P = patient$, $I = impatient$) – and $\beta_P = \beta^{t_T}$ and $\beta_I = \beta^{t_S}$, p_ρ for where a SE exists for this credit economy.[3] Note that, according to the new notation for β, in the rest of this section we are referring to transparent as patient (since they have to wait less to obtain a bank loan) and to opaque borrowers as impatient (since they have to wait more). Define as π^*, γ^*, R^*, β_P^*, β_I^*, p_S^* & p_R^* as a specific combination of parameter values where a SE exists over a domain of $\overline{\sigma}$. For illustration purposes, the following calibration of state variables is chosen: $\pi^* = 0.70$, $\gamma^* = 1.15$, $R^* = 1.27$, $\beta_P^* = 0.99$, $\beta_I^* = 0.75$, $p_S^* = 1.00$ & $p_R^* = 0.70$. The left diagram of Figure (1) depicts equilibrium values assumed by waiting time associated with bank loans for impatient (i.e. opaque), t_{IS}, and for patient (i.e. transparent) and risky individuals, t_{PR}, for the domain of $\overline{\sigma}$ where a SE is defined given the calibration of state variables. The right diagram of Figure (1) depicts a equivalent representation for the values of r_B and r_M. The left diagram of Figure (1) indicates that with increases in $\overline{\sigma}$, which can be interpreted as improvements in the "accuracy" of informative signal s, t_{IS} increases. The right diagram illustrates how r_B decreases as $\overline{\sigma}$ increases over its domain, and how r_M is unrelated to the values of $\overline{\sigma}$.

Figure (2) contains the indifference curves of the four types of borrowers, e.g. ICC_{PS}, ICC_{IS},ICC_{PR} & ICC_{IR}, for a calibration value of $\overline{\sigma}^* = 0.90$. The limiting values of $\hat{t}$, e.g. t_{IS} and t_{PR}, are respectively identified by the intersection of ICC_{IS} and ICC_{PR} with the interest rate r_B.

5.1 Simulation Exercise: 2004-2010 Colombian credit market

Although not the primary purpose of the paper, the estimation capacity of the model is tested simulating a real world scenario; this being the Colombian consumer and microcredit loan market

[3]The proof of Lemma 4, in the Appendix of this paper, details the conditions for existence of this type of equilibrium.

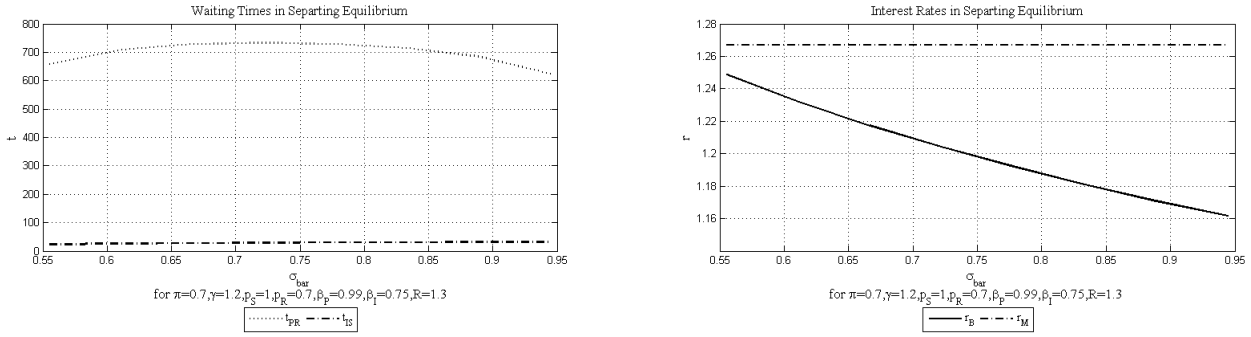

Figure 1: **The left diagram depicts the values assumed by t_{IS} and t_{PR} given π^*, γ^*, R^*, β_P^*, β_I^*, p_S^* & p_R^* for the domain of $\overline{\sigma}$ where a SE is also defined. The right diagram depicts a equivalent representation for the values of r_P and r_I.**

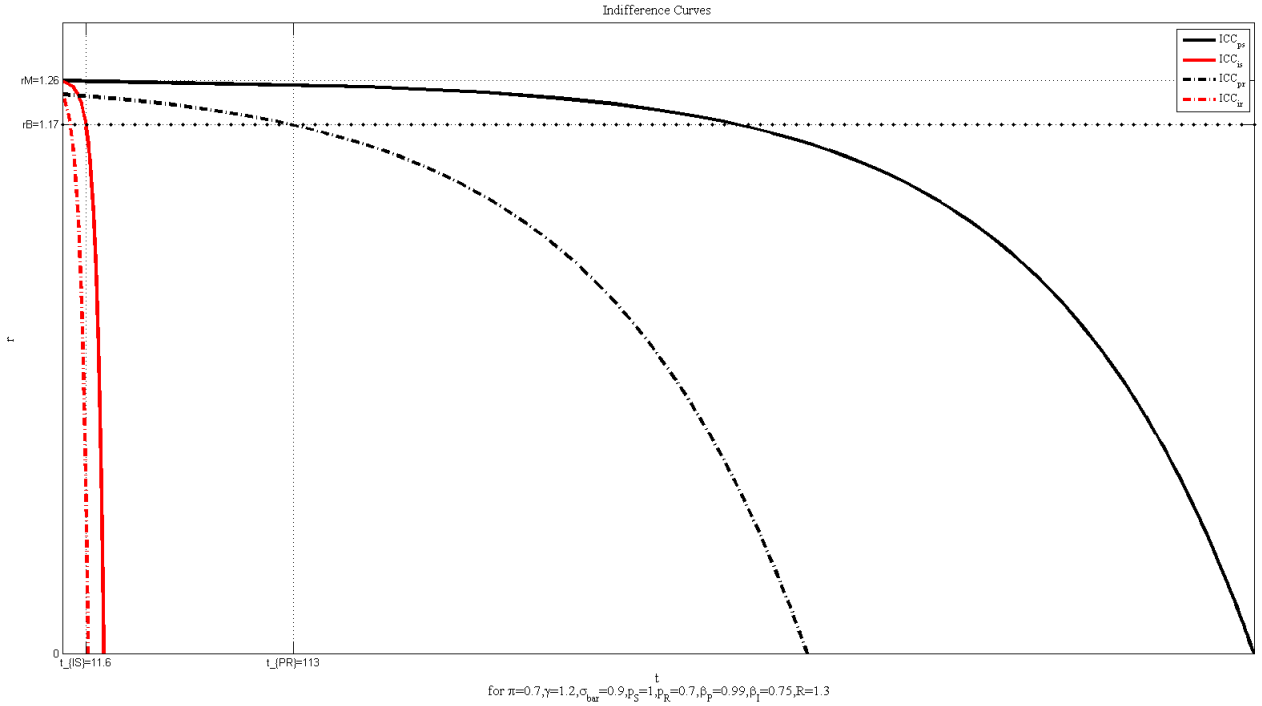

Figure 2: **Indifference curves of the four types transparent borrowers, e.g. ICC_{PS}, ICC_{IS},ICC_{PR} & ICC_{IR}, at the calibrated values of the state economy.**

for the 2004-2010 period. Recent developments in the Colombian banking system are an adequate illustration on the repressive capacity of usury rates on credit markets. Anti-usury legislation, mainly in the form of an interest rate ceiling, exists in Colombia since 1971. Initially after its implementation Colombian anti-usury laws only allowed for the existence of a unique interest rate ceiling that restricted the upper bound of all loan types carried out by financial institutions in the country. Two important regime changes occurred in Colombia during the analyzed period. The first of these was the October 2002 agreement between the Colombian government and the banking sector, where 31 banking institutions signed an agreement committing their own resources to foster the development of microcredit loans in the country, see Delfiner & Perón (2007) and Ministry of Economic Development (2002). This agreement expired in December 2006. The second regime change occurred on December 2006[4], when the at the time existing undifferentiated interest rate ceiling for both consumer and microcredit loans was abolished, and in its place two distinct usury rates were enacted for each type of loans. The left and right panels in Figure 3 depict the average monthly interest rates charged by the Colombian banking institutions for consumer and microcredit loans from 2004:01 to 2010:12, respectively. Both panels in the Figure also contain the usury rates on consumer and microcredit loans established by the Colombian banking authorities. Once a distinction on the usury rate of consumer and microcredit loans was enacted in December 2006, the usury rate on microcredit loans has always exceeded that of consumer loans and traditional bank lending of microcredits has from significantly surged; e.g. the yearly average volume of non-collateralized microcredit loans for the 2004-2006 period is $2.53 million USD and for the 2007-2010 period is $12.16 million USD. [5] Considering that historically microcredit in Colombia has been an enterprise reserved for NGOs and the (occasionally predatory) informal sector, it can be argued that the financial liberalization resulting from the more flexible definitions of usury rates expanded the supply of credit in the formal financial sector in Colombia and allowed for the development of the microcredit market.

A simulation is performed over $T = 84$ time periods considering parameter values π^*, β_P^*, β_I^*, p_S^* & p_R^* for the Colombian consumer and microcredit loan markets. At each simulated time period, a I amount of banks, all facing identical values of γ and R, simultaneously offer traditional bank loans C_B and microcredit loans C_M. Banks differ from one another on the quality of the screening technology $\overline{\sigma}$ available. This feature allows each bank to offer distinct bank loan contracts C_B that may differ among competitors, e.g. in terms of interest rate and waiting time. The simulation allows for I, γ, R and $\overline{\sigma}$ to vary on each period to best fit the 2004:01-2010:12 Colombian credit

[4]Decreto 3078 del 08 de septiembre de 2006

[5]Source: Colombian Financial Superintendency.

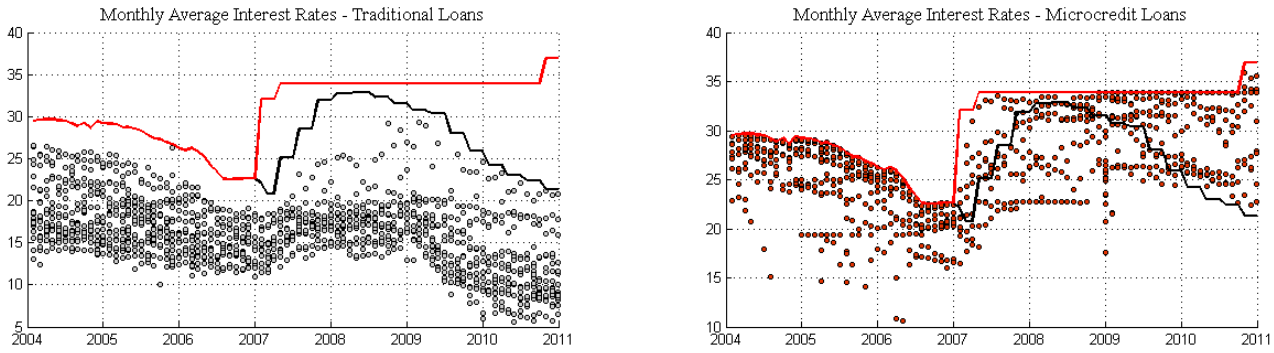

Figure 3: **Average monthly interest rates charged by Colombian banking institutions for consumer (left) and microcredit (right) loans from 2004:01 to 2010:12, and the historical usury rates on these types of loans as established by the Colombian banking authorities; black line for $\overline{r}_B$ and red for $\overline{r}_M$. Source: Colombian Financial Superintendency.**

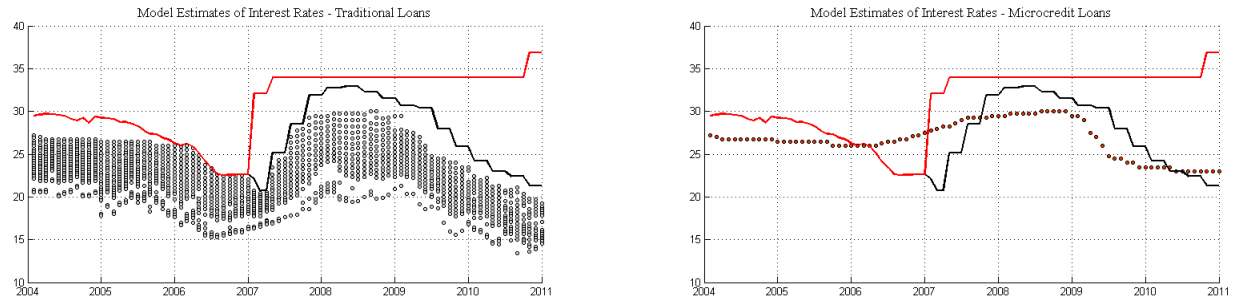

Figure 4: **Simulated time series of interest rates for consumer (left) and microcredit loans (right) of Colombian banking institutions for 2004:01 to 2010:12. Historical values of the usury rates $\overline{r}_B$ (black) and $\overline{r}_M$ (red) are also portrayed in the diagrams.**

market. The source of the data on the Colombian credit market is the Financial Superintendence of Colombia. The amount I of banks offering bank and micro loans is the actual amount of banks offering these types of loans in Colombia on a given period. As for γ, we use the historical values of the intervention rate of the Central Bank of Colombia plus a 10% markup. R is assumed to be a 10% markup over the period's value of γ. Regarding upper limiting values for the interest rates of bank and microcredit loans, i.e. $\overline{r}_B$ and $\overline{r}_M$, the model simulation considers the actual historical values assumed by the usury rate on Colombian consumer and micro loans during this time period.

Using **Lemma 4** it is possible to find the separating equilibrium contract C_M for microcredit loans at this stage of the simulation procedure. The right panel of Figure (4) depicts the estimated values of the interest rate of microcredit loans for the 2004:01-2010:12 Colombian credit market. Comparing these estimated values with the actual interest rates of this type of loans, see right

panel of Figure (3), allows for a visual assessment of the model simulation. Both diagrams also contain the historical values of usury rates $\overline{r}_B$ and $\overline{r}_M$.

The I calibrated values of $\overline{\sigma}$ at a given period are chosen from the set of N feasible values of $\overline{\sigma}$ such that the I simulated values of r_B best fit the first, second, third and fourth moments of the corresponding month's average values of the interest rate of consumer loans as reported by Colombian banking institutions. For this, at a given period and using the corresponding month's value of γ and R, r_B is calculated along the domain of $\overline{\sigma}$ where a SE exists. This domain of $\overline{\sigma}$ where a SE exists is further restricted to the N values of $\overline{\sigma}$ where the calculated value of r_B is at or below the usury rate. Next, the number of possible I combinations of $\overline{\sigma}$ among the N feasible $\overline{\sigma}$ are identified, e.g. ${}_NC_I$. The optimal combination of I values for $\overline{\sigma}$ are those that minimize the geometric distance between the first four moments of the equilibrium values of r_B and the first four moments of the actual values of the Colombian consumer interest rates r_B^{col} observed in the data; that is: $\|M^4(r_B) - M^4(r_B^{col})\|$ where, for a column vector $\overrightarrow{x}$, $M^4(\overrightarrow{x}) = [mean(\overrightarrow{x}), var(\overrightarrow{x}), assym(\overrightarrow{x}), curt(\overrightarrow{x})]$. The left panel of Figure (4) contains the estimated values of the interest rates on these Colombian loans for 2004:01-2010:12. The left panel of Figure (3) contains the actual values assumed by these time series. Both diagrams also depict the historical values of the usury rates of both types of loans.

The diagrams in Figure (4) portray three important equilibrium implications of the model concerning the Colombian consumer and micro loan market for the 2004:01-2010:12 period. The first of these is that, on equilibrium, the interest rate on a microcredit loan offered by a banking institution will never be lesser than the rate simultaneously offered on a traditional loan. The second is that microcredit loans were not profitable for Colombian banking institutions during the last three quarters of 2006, when the market experienced a significant decline of the usury rate shared by both loans, and only became profitable again in 2007:01 after the separation of usury rates. Because of this, the model predicts that new issuance of microcredit loans by banking institutions would have fallen to zero during the last three quarters of 2006,[6] this would be a case of a PE where lenders offer only the bank loan contract C_B. The last prediction of the model is that if the separation of the usury rates of traditional and microcredit loans have not occurred, microcredit loans would have not been profitable for banks during the first three quarters of 2007 and the last two quarters of 2010, and only traditional bank loans would have been offered in the

[6]Although Colombian banking institutions committed to promote, increase and sustain microlending, during this period the volume of non-collateralized microcredit loans experienced its first contraction since October 2002. The growth rates of the volume in USD of these loans for the four quarters of 2006 are, respectively, 9%, -3%, 15% and 22%.

Colombian credit market.

6 Conclusion

This paper analyzes the debt origination process in which a lender offers prospective borrowers a microcredit product alongside a traditional bank loan product and the impact anti-usury rates on loans can cause in this credit market. This is a paper about the prospects of financial liberalization following a more flexible determination of anti-usury rates and, with it, the development of a formal microcredit market. We test if anti-usury mandates, in the form of interest rate ceilings, in the presence of assymetric information can indeed ration credit to those borrowers perceived as the riskiest of a population even when a microcredit option exists, and assess how a microcredit market can develop once anti-usury rates are abolished. To do this we develop a screening model of a competitive credit market constrained by an anti-usury mandate where borrowers have the option to apply for either a traditional bank loan or a microcredit loan from a lender. Loan contracts differ in interest rates and time they require to process the borrower's application. Borrowers are heterogeneous with respect to riskiness and the transparency (or opaqueness) of their information on credit-worthiness. Lenders can screen borrowers applying for loans and obtain an informative signal in their true riskiness. The quality of the signal on the riskiness of an applicant diminishes with the opaqueness of his/her credit-worthiness information. A result of the model is the possibility to obtain an equilibrium where all opaque borrowers, regardless of their true riskiness, will be rationed from credit in an economy where usury rates are exogenously set too low by regulatory authorities. Were the anti-usury mandate was relaxed, these borrowers would have the option of financing through microcredit.

A Appendix

A.1 Proof of Lemma 1

If a risky borrower prefers C_B over C_M then,

$$(1-\overline{\sigma})p_R\beta^{t_2}(R-r_2) \geq p_R\beta^{t_1}(R-r_1). \tag{18}$$

But then, given $\sigma > 0.5$, ,

$$\overline{\sigma}p_S\beta^{t_2}(R-r_2) > p_S\beta^{t_1}(R-r_1) \tag{19}$$

holds. That is, safe borrowers strictly prefer C_B over C_M.□

A.2 Proof of Lemma 3

Consider a separating equilibrium where all safe borrowers separate from risky borrowers: Safe borrowers demand bank loans subject to screening and risky ones demand microcredit contracts. Lenders' zero profits' condition implies that the cost of credit for risky types exceeds the gross return R. Hence, risky types must not be borrowing and earn zero profits. Similarly, lenders' zero profits condition implies that hte cost of credit for safe types is strictly lower than the gross return R, so that safe types earn a strictly positive payoff. But then, if the cost of credit for safe types is below R, and risky types have always an incentive to mimic.

Consider now an equilibrium inwhich some of the safe separate from the risky, by demanding a banking contract subject to screening. Then, lenders would find it profitable to deviate and not incur the screening cost. But then, all safe will find it convenient to deviate and demand bank loans which destroys the candidate equilibrium.

A.3 Proof of Lemma 4

First we characterize the TSE. and then discuss existence.

i. Processing time In any TSE, the processing time associated with bank loans supplied to borrower of transparency τ must satisfy, $t_B = t_\tau$, while irrespectively of transparency, that for microcredit loans must satisfy, $t_M = 0$. The proof is immediate. Consider an TSE equilibrium in which $t > t_\tau$ for some τ. Then, since t_τ is the amount of time lenders need in order to screen applicants of transparency τ, a lender could attract all transparent borrowers and make strictly positive profits by offering a contract characterized by a slightly higher cost of credit and a lower processing time, which destroys the candidate equilibrium. An equivalent argument can be put forward to conclude that $t_M = 0$.

ii. Participation and incentive compatibility constraints Lenders' participation constraints (PCs) are described by the following,

$$(PC_i) : p_i r_i \geq \gamma$$

where $i = B$ for bank loans, and $i = M$ for microcredit loans. As for borrowers,

$$\alpha^{-t} p_\rho (R - r_B) \geq 0. \tag{20}$$

is the participation constraint for a borrower of riskiness ρ when applying for bank loans, with $t = t_O, t_T$ for bank lonas, depending whether the borrower is opaque or transparent. The PC for borrowers of riskiness ρ applying for microcredit is

$$p_\rho(R - r_M) \geq 0. \tag{21}$$

Borrowers' incentive compatibility constraints are:

$$(ICC_{TS}) \quad : \quad \alpha^{-t_T}\overline{\sigma}p_S(R - r_B) \geq p_S(R - r_M) \tag{22}$$

$$(ICC_{TR}) \quad : \quad \alpha^{-t_T}(1 - \overline{\sigma})p_R(R - r_B) \geq p_R(R - r_M) \tag{23}$$

$$(ICC_{OS}) \quad : \quad \alpha^{-t_O}\overline{\sigma}p_S(R - r_B) \leq p_S(R - r_M) \tag{24}$$

$$(ICC_{OR}) \quad : \quad \alpha^{-t_O}(1 - \overline{\sigma})p_R(R - r_B) \leq p_R(R - r_M) \tag{25}$$

iii. Cost of credit. Competition among lenders implies that lenders' participation constraints must be satisfied as strict equalities, so that:

$$r_B = \frac{\gamma + c}{p_B} \tag{26}$$

where,

$$p_B = \frac{\pi\overline{\sigma}}{\pi\overline{\sigma} + (1 - \pi)(1 - \overline{\sigma})}p_S + \frac{(1 - \pi)(1 - \overline{\sigma})}{\pi\overline{\sigma} + (1 - \pi)(1 - \overline{\sigma})}p_R \tag{27}$$

and

$$r_M = \frac{\gamma}{p_M} \tag{28}$$

where,

$$p_M = \pi p_S + (1 - \pi)p_R. \tag{29}$$

Note that $\overline{\sigma} > 0.5$ implies $p_M < p_B$ so that $r_B < r_M$. Given $R > 0$, borrowers' participation constraints are satisfied so long as γ is sufficiently small.

iv. Existence From the incentive compatibility constraints, we note that, given $t > 0$, the more stringent constraints are the following

$$(ICC_{PR}) \quad : \quad \alpha^{-t_T}(1 - \overline{\sigma})p_R(R - r_B) \geq p_R(R - r_M) \tag{30}$$

$$(ICC_{OS}) \quad : \quad \alpha^{-t_O}\overline{\sigma}p_S(R - r_B) \leq p_S(R - r_M) \tag{31}$$

The first inequality is satisfied so long as $\alpha \leq \overline{\alpha}$, and the second inequality is satisfied if $\alpha \geq \underline{\alpha}$. Accordingly, in order for a SE where transparent are separatated by opaque, the following two conditions need to be satisfied; 1. $\overline{\alpha} > \underline{\alpha}$ must hold, which in equilibrium reduces to

$$\left\{\frac{(1-\overline{\sigma})[R-(\gamma+c)/p_B]}{(R-\gamma/p_M)}\right\}^{\frac{1}{t_T}} \geq \left\{\frac{\overline{\sigma}[R-(\gamma+c)/p_B]}{(R-\gamma/p_M)}\right\}^{\frac{1}{t_O}}, \tag{32}$$

and, 2. α must be such that $\alpha \in [\underline{\alpha}, \overline{\alpha}]$. Moreover, Note also that $\gamma/p_M < R$ and $((\gamma+c)/p_B$ must hold in order for participation constraints to be satisfied .□

A.4 Proof of lemma 5

We characterize PE in which all borrowers deman bank loans and PE in which all borrowers demand microcredit loans, and then study their existence.

a. TPE with bank loans

i. Processing time The same argument as in the case of SE holds that in any PE where bank offer bank loans, $t = t_T$ for transparent borrowers, and$t = t_O$ for opaque ones.

ii. Participation and incentive compatibility constraints Lenders' participation constraints (PCs) are described by the following,

$$(PC_B) : p_B r_B \geq \gamma$$

As for borrowers,

$$\beta^t p_R(1-\overline{\sigma})(R-r_B) \geq 0. \tag{33}$$

is the participation constraint for a borrower of riskiness R when applying for bank loans, with $t = t_O, t_T$ for bank lonas, depending whether the borrower is opaque or transparent, and similarly, for a safe borrower,

$$\beta^t p_S \overline{\sigma}(R-r_B) \geq 0. \tag{34}$$

iii. Cost of credit The probability of loan repayment is

$$p_B = \frac{\pi\overline{\sigma}}{\pi\overline{\sigma} + (1-\pi)(1-\overline{\sigma})} p_S + \frac{(1-\pi)(1-\overline{\sigma})}{\pi\overline{\sigma} + (1-\pi)(1-\overline{\sigma})} p_R. \tag{35}$$

Competition across lenders drive their profits to zero, which implies

$$r_B = \frac{\gamma + c}{p_B}. \tag{36}$$

iv. Necessary conditions for existence Borrowers participation constraints are satisfied so long as $R \geq r_B$ holds. Hence, the necessary condition for the existence of a PE with banking contracts, is $R \geq (\gamma + c)/p_B$.

v. TPE with microcredit

i. Cost of credit and processing time In a pooling with microcredit, processing time equals zero. Lenders do not extract any meaningful signal. Therefore, Therefore, the probability of loan repayment is

$$p_M = \pi p_S + (1-\pi) p_R. \tag{37}$$

so that, competition among lenders, yields

$$r_M = \frac{\gamma}{p_M}. \tag{38}$$

ii. Necessary condition for existence: Borrowers' participation constraint. Borrowers participation constraints are satisfied so long as $R \geq r_M$ holds. Hence, a necessary condition for existence is $R \geq \gamma/p_M$.

iii. Necessary conditions for existence: Microcredit vs Banking Opaque and risky borrowers have the lower expected payoff if applying for banking contracts, which amounts to $(1-\sigma)\beta^{to} p_R(R - r_B)$. If a microcredit contract were available, their payoff would be, $p_R(R - r_M)$. Hence, if $(1-\sigma)\beta^{to} p_R(R-r_B) > p_R(R-r_M)$, i.e. if $\alpha < \underline{\alpha}$ all borrowers prefer banking contracts to microcredit contracts. Safe and transparent borrowers have the highest expected payoff if applying for banking contracts, which amounts to $\sigma\beta^{tr} p_S(R - r_B)$. If a microcredit contract were available they would earn $p_S(R - r_M)$ so that if $\sigma\beta^{tr} p_S(R - r_B) < p_S(R - r_M)$, that is $\alpha > \overline{\alpha}$ all borrowers prefer the microcredit contract.

A.5 Proof of Proposition 1

Consider a pooling, with bank contracts. Consider a deviation $C_M^+ = \{0, \gamma/p_M + \epsilon\}$, with $\epsilon \to 0^+$ by a lender. So long as,

$$\alpha^{-t_O} p_S \overline{\sigma}(R - \frac{\gamma + c}{p_B}) < p_s(R - \frac{\gamma}{p_M}). \tag{39}$$

such deviation would attract safe and opaque borrowers and it will be profitable given the pool of applicants (which is going to include all borrowers, since no lending occurs at the old contract in equilibrium, since the pool of applicants for that contract must have worsened given that safe and opaque go for the new contract. The above inequality reduces $\alpha > \underline{\alpha}$. Hence a PE with bank contracts never exists if $\alpha > \underline{\alpha}$, and it exists otherwise. Similarly, consider a PE with microcredit contracts. Consider a deviation, $C_B^+ = \{t_T, (\gamma + c)/p_B + \epsilon)\}$, where $\epsilon \to 0^+$. So long as,

$$\alpha^{-t_T} \overline{\sigma} p_S(R - \frac{c + \gamma}{p_B}) \geq p_S(R - \frac{\gamma}{p_M}), \tag{40}$$

then safe and transparent borrowers would be attracted such deviation. Moreover, given the pool of applicants, the deviation is profitable (Note that all borrowers go for this contract since nobody offers loans at the old contract in the subgame since the pool has worsened). The deviation would not be profitable if transparent and safe are not attracted. The above inequality reduces to $\alpha < \overline{\alpha}$, and it exists otherwise.

Consider now a separating equilibrium.

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