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Endogenous Growth in the Presence of Informal Credit Markets: A Comparative Analysis Between Credit Rationing and Self-Revelation Regimes

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Abstract

This paper examines whether the presence of informal credit markets reduces the cost of credit rationing in terms of growth. In a dynamic general equilibrium framework, we assume that firms are heterogenous with different degrees of risk and households invest in human capital development. With the help of Indian household level data we show that the informal market reduces the cost of rationing by increasing the growth rate by 0.7 percent. This higher growth rate, in the presence of an informal sector, is due to the ability of the informal market to separate the high risk from the low risk firms thanks to better information. But even after such improvement we do not get the optimum outcome. The findings, based on our second question, suggest that the revelation of firms' type, based on incentive compatible pricing, can lead to almost 2 percent higher growth rate as compared to the credit rationing regime with informal sector.

Journal of Economic Literature Classification: O16, O17, E26

Keywords: credit rationing, informal credit markets, self revelation mechanism

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1 Introduction

The core tenets of the financial development and economic growth mainly revolve around the two broad issues. First, how financial development and economic growth are related to each other. And, second, how financial development can take place. The former one delves into the endogeneity issue while the second issue tries to resolve the imperfection in credit market due to asymmetric information. However, in doing so, most of the studies in the literature ignored the existence of informal source as one of the components of the broader credit channel and consider, instead, the formal credit channel as the sole source of external finance for the firms.

The incorporation of moneylenders' credit deserves attention because, in the parlance of development finance, the formal and informal credit channels in most of the developing countries are either horizontally or vertically integrated to each other. As for instance, in India, formal and informal credit markets have a horizontal coexistence. Under such an environment, when these two markets compete with each other, a spillover of excess demand for credit from formal to informal credit market takes place under credit rationing. This increases the moneylenders' bargaining power. They often use this power to interlock credit contracts with other contracts, mainly, purchase and sale of inputs and final products (Bell, 1990). It is often argued that, such interlocking acts as a disincentive to the firms to invest efficiently and hence, lowers growth.

Alternatively, in some other developing countries like Philippines (see Floro and Ray (1997)), informal credit has been attempted to interlink vertically with the formal source by extending formal funds to a group of informal lenders. In this arrangement, the informal lenders borrow from formal sector and then re-lend it to the grass root level borrowers. Such contractual hierarchy is backed up by the belief that the rural moneylenders have a wider information set as compared to the formal financial sector which, makes it easier for them to spread their network at the grass root level.

Therefore, to give our model a more general form, we introduce an informal credit channel as another source of external funds. Based on the existing set up in Indian context, the informal sector, in our model, is assumed to be composed of households and rural moneylenders. We resolve the endogeneity issue by using a dynamic general equilibrium framework with households' investment decision in human capital. One important consideration in this regard is the focus on the households' financial cost in human capital development, not their cost in terms of time. We consider two different credit regimes - the self revelation regime based on incentive mechanism and the credit rationing regime– in order to answer the following questions: First, in the presence of asymmetric information, how does informal source of credit influence growth under credit rationing when households decide to invest in human capital? Second, can market clearing loan rates under self revelation regime lead to higher growth rate? Our first question tries to capture the intricacies of the effect of different components of credit on growth. The second one explores the proper way of financial development in order to achieve higher growth.

We formulate our objectives based on the following literature. According to the early studies in the literature, like Schumpeter (1911), financial development can act as a catalyst to economic growth by reallocating resources. But this result is based on a very critical assumption that the loss due to market imperfections is not substantial. However, many recent studies have posited some conflicting results which make the relationship ambiguous. This ambiguity comes mainly from two sources - first, cross country evidence, and, second, the causal relationship.

Cross country evidence is well documented by the several studies. Roubini and Sala-i-Martin (1991) find no clear cut relationship between financial development and growth. Their cross country evidence suggests that while countries with high financial repression experience low economic growth quite expectedly, some countries with high growth and high repression are also quite surprisingly present. Jappelli and Pagano (1994) suggest that the reason behind such high growth in the highly repressed countries is a higher savings rate.

Jappelli and Pagano argue that credit market imperfections impose borrowing constraints on consumption loans. The consumers have to save more under such a situation in order to carry out the unconstrained consumption plan. Under such circumstances, the consumption loan will increase with a decrease in rationing and will lead to a decline in propensity to save. As a consequence, the economy will experience lower growth. Or, in nutshell, more stringent credit rationing leads to higher growth because of households' higher propensity to save. In this context, this view and the disincentive effect of the informal credit under credit rationing from development perspective, as mentioned earlier, do not lead to any general consensus regarding the effect of credit rationing on growth.

The other source of ambiguity in the literature originates from the endogeneity issue between growth and financial development. According to King and Levine (1993), financial development causes economic growth. They support their findings by saying that the predetermined components of financial development are good predictors of growth over the next 10 to 30 years.

Demirgüç-Kunt and Maksimovic (1996) hold the same opinion. With cross-country evidence they show that growth is positively related to the stock market turnover and different measures of law enforcement. Using state level data for the US, Jayaratne and Strahan (1996) also show a positive influence of liberalization of the banking sector on growth. The findings of Levine and Zervos (1998) reveal that measures of market liquidity are strongly related to growth, capital accumulation and productivity. But stock market size is not strongly related to growth. They also show that bank lending to the private sector has a strong effect on growth.

While these above mentioned studies show a strong causal relationship between credit market development and economic growth, some others are not so enthusiastic about this relationship. Goldsmith (1969) shows, with empirical evidence, that the one to one correspondence between economic and financial sector development is very weak. The causal direction may be made confidently with the help of some other factor that links these together. Rajan and Zingales (1998) points out that the key linking factor between financial development and growth could be the propensity to save. The effect of endogenous savings on the long run growth rate of the economy makes the growth and financial development seem correlated. Moreover, financial development is represented by the size of the stock market or by the lending activity. The predictive power of the financial market incorporates the present value of growth opportunities in its own reaction function and foster its own growth. In the same fashion, lending also increases on the basis of anticipated growth.

Greenwood and Jovanovic (1990) (henceforth, G-J), overcome the causality issue by considering financial intermediation and economic growth as endogenous in their model. Financial intermediaries can invest more productively than individuals because of their better ability to identify investment opportunities. As a result, they can invest more in productive projects and can foster growth.

The major limitation of the G-J model is that it ignores the problems of asymmetry in information at the level of the entrepreneurs. Also, the assumption that the intermediary has a better information set regarding efficient investment projects that entrepreneurs do not have, in a way, sidelines the adverse selection issue that originates from the heterogenous borrowers with different degrees of risk.

In our model we ignore this possibility of loan volume augmentation due to expected growth. In our model banks neither have memory nor are they forward looking. They maximize each period's expected profit based on available information. The volume of loan is decided on the basis of the available information regarding the firms' type.

Our second objective encompasses this adverse selection problem and tries to answer it with the help of an incentive compatible pricing mechanism. Several studies address the issue regarding the nature of financial development in order to foster economic growth. Many seminal studies have argued in favor of credit rationing (Jaffe and Russel (1976), Stiglitz and Weiss (1981), Williamson (1987)). Alternatively, there are number of studies (Bester (1985), Besanko and Thakor (1987)) which, under certain specific situations, favor market clearing pricing that assures separating equilibrium based on collateral. Most of the above mentioned studies are purely theoretical.

This study draws heavily from our previous study to lay out the base line model. To suit our requirements, we incorporate the following specifications in this study. First, we assume that households invest in human capital. Second, we focus mainly on endogenous growth in the presence of asymmetric information. As in our earlier study, we consider that firms' type is private information and not available to banks. Therefore, banks have two options - either they ration credit in order to hedge against risk, or, devise some mechanism by paying incentive to the firms so that they tell the truth. In our analysis we examine both options to find a solution to arrest the adverse selection problem and determine their respective growth implications.

The introduction of an extra asset like human capital not only assures endogenous growth in the model but also it determines endogenously households' tradeoff between households loan and investment in human capital, given their resource constraint. We also intend to quantify endogenous growth under the two alternative credit regimes.

The main contribution of this paper is to show quantitatively the difference in growth path between the alternative regimes, credit rationing and direct revelation in the presence of asymmetric information, in a dynamic general equilibrium framework. Our model also shows that the informal sector influences growth positively and reduces the cost of credit rationing. With the consideration of heterogenous agents in production, the direct revelation mechanism acts as a separating tool. This leads the market based incentive compatible pricing of loan to overcome the dependence of firms on household funds.

We divided our study into four sections. Section 2 outlines the baseline model. In this section we set up the two different banking regimes separately and define their corresponding equilibrium. Section 3 is devoted to quantify our model economy by estimating the steady state equilibrium values and presents the results. Last section concludes.

2 Baseline Model: An Overview

There are four types of decision makers in our model economy: firms, banks, households and informal moneylenders. Two types of firms - low risk and high risk, constitute the production sector. Both types of firms have same level of return when they succeed or fail. But their probability of success are different and that information is unknown to the banks, making them ex-ante identical to the banks. Firms lack endowment and therefore they take production loans either from banks or from informal markets. Both of these loans are assumed to be perfect substitutes to each other. The wedge in loan rates between formal and informal credit market drives the firms to borrow first from the formal sector.

Banks offer deposit contracts, maturing in the end of the period. They also sell shares in the financial market to diversify their risks. Banks convert these deposits and stocks into loans without any cost and extend them to the firms.

Households maximize their life time utility from consumption and from the sum of loans being offered by them to the low risk relatives and friends and formal loans by banks. The reason behind incorporating loans in the utility function is motivated by the data and will become clear later. Households invest in human capital. The resources devoted to human capital compete with other investments and consumption.

The total loan volume gives household utility because households are aware of the exorbitantly high rate of interest charged by money lenders. They prefer their low risk relatives or friends not to be dependent on moneylenders for production loans unless they are not covered by the formal sector or households. Similarly, households may have friends or relatives with high risk projects. Priority wise, households always prefer to offer loans to their low risk relatives or friends first. But because of their resource constraint they can only serve a fraction of their low risk relatives or friends. Therefore, households always prefer both their high and low risk relatives or friends to be covered by formal sector. Thus, total volume of loan offered by formal sector along with low risk households loan gives households a positive utility.

Households generally do not charge any interest rates for their loans. Households extend loans only when they know the owner of the firms from very close network like friend or family members and, the projects taken up by these firms are less risky.

In our model, informal money lenders are risk neutral and lend in the informal market when the excess demand for loan spills over from the formal market because of credit rationing. The reallocative effect of credit rationing induces the informal money lenders to offer more loans in the informal market instead of savings with banks. Moneylenders can, at a cost, find the risk of the firms they are lending to.

Model Specification

2.1 Households

We assume a large number of identical households in our model who maximize their life time utility from consumption and lending. The total volume of formal as well as households loan to firms gives households positive utility. This is because a broader coverage by both formal and households loans lowers the possibility of the firms' dependence on informal moneylenders for loan at higher rates. Labor is considered to be inelastic. Another important assumption in this regard is that households have private information about the firms' type as they are owned by their relatives or friends. The representative household solves the following problem :

$$V = \max_{C_t, H_{LR,t}, D_t, S_t, i_{h,t}} \sum_{t=0}^{\infty} \beta^t \left[\frac{(C_t + \frac{(L_t+H_t)^e}{e})^{1-\sigma}}{1-\sigma} \right] \quad (1)$$

S. T. :

$$C_t + D_t + S_t + H_{LR,t} + i_{ht-1} \leq w_{t-1}k_{ht-1} + (1 + h_{LR,t-1})H_{LR,t-1} + (1 + r_{t-1})(D_{t-1} + S_{t-1}) \quad (2)$$

$$k_{h,t} = (1 - \delta)k_{h,t-1} + i_{h,t-1} \quad (3)$$

where D_t denotes the quantity of goods deposited with the bank at time t, S_t is real amount of stock purchased, C_t is real consumption, w_t is wage rate, $k_{h,t}$ is human capital, $H_{LR,t}$ is the amount of household sector loan and $h_{LR,t}$ is the household sector loan rate in real terms, e is the elasticity of substitution between consumption and loan and δ is the depreciation rate of human capital. The weighted average cost of capital ($WACC$), r_t or the risk adjusted per unit cost of deposit and stock at time t. The discount factor β lies in the open unit interval, $0 \leq \beta \leq 1$. The constant elasticity of substitution parameter σ is strictly positive. In our case we assume $\sigma = 1$[1].

2.2 Firms

The degree of risk makes firms heterogenous in our model. For simplicity we consider only two types of firms - low risk and high risk. Firms' type is private information to themselves and their relative households or friends. But banks do not have this information. Firms production process is composed of two stages. In the first stage firms convert their borrowing into capital. In the second stage firms utilize their capital and hire labor to produce a single consumption good as final product. Firms can borrow from either banks (the formal credit

[1]The Euler Equations are given in the Appendix

market) or from households/moneylenders (the informal one). These two types of loans are perfect substitutes. Given this backdrop we can write the two stages of firms' production process as :

Stage 1: Firms produce their own capital. Firms do not have any initial wealth. So, they have to borrow in order to produce their capital. Firms produce capital using the following linear function:

$$K_t = L_t + T_{i,t} \qquad\qquad i = HR, LR \tag{4}$$

where K_t is the total amount of capital produced. L_t and $T_{i,t}$ represent amount of loan taken from banks and from households/moneylenders respectively in period t.

Stage 2: Firms convert their capital into a consumption good. The return of the i^{th} firm's project is a random outcome. All successful projects yield the same return, i.e., ψ percent more output above mean level irrespective of type. Output is zero when they fail. Only difference is in their rate of success.[2] We defined the firms with higher success rate as the low risk firms (LR) and firms with lower rate of success as the high risk firms. With corresponding rate of success (ϕ_i) the expected production can be written as:

$$E_t[f(k_t)] = \gamma_i A k_t^m (k_{h,t})^{(1-m)} \tag{5}$$

where

$$\gamma_i = \phi_i(1+\psi) \tag{6}$$

The equation of motion for capital takes the following form:

$$k_{t+1} = (1-\delta)k_t + i_t \tag{7}$$

where i_t is investment in period t and k_t is the per capita capital stock in period t. Firm's profit maximization problem can be written as

$$\max_{k_t, k_{ht}} E_t\pi_t = \gamma_i A k_t^m (k_{h,t})^{(1-m)} - (1+j_t)k_t - w_t k_{ht} \tag{8}$$

[2]See De Meza and Webb (1987) for a similar assumption

$j_t = l_t$ or h_t depending upon sources of loan. F.O.C.s w.r.t.

$$k_{it}: \quad (1 + j_{it}) = \gamma_i Am \left(\frac{k_{hit}}{k_{it}}\right)^{1-m} \tag{9}$$

$$k_{h,it}: \quad w_t = \gamma_i A(1-m) \left(\frac{k_{it}}{k_{hit}}\right)^{m} \tag{10}$$

From equations (9) and (10) we get demand for formal (L_t) and informal (T_t)loan

$$L_{it} = k_{h,it} \left(\frac{\gamma_i Am}{1 + l_{i,t}}\right)^{\frac{1}{1-m}} \tag{11}$$

$$T_{it} = k_{hi,t} \left(\frac{\gamma_i Am}{1 + h_{it}}\right)^{\frac{1}{1-m}} \tag{12}$$

$$k_{hit} = k_{it} \left(\frac{\gamma_i A(1-m)}{w_t}\right)^{\frac{1}{m}} \tag{13}$$

$$i = LR, HR$$

2.3 Informal money lenders

Moneylenders are the residue claimants of the excess demand for loans from the formal sector. They are assumed to be risk neutral and maximize their expected profit. One crucial assumption here is that moneylenders do not have prior information about the firms type. But since they operate in a small jurisdiction, they can glean this information by incurring some cost.

Moneylenders maximize their expected profit in the following way:

$$\max_{M_{HR,t}, M_{LR,t}} E_t \pi_{m,t} = \phi_{HR}(1-\alpha)\eta h_{HR,t} M_{HR,t} + \phi_{LR}(1-\alpha)(1-\eta)(1-\lambda) h_{LR,t} M_{LRt} - (c_{LR} M_{LRt} + c_{HR} M_{HRt}) \tag{14}$$

where $M_{i,t}$ is the loan amount offered by the money lenders, ϕ_i is the success rate and c_i is the cost coefficient of the i^{th} type of firm in the informal sector[3].

[3]F.O.Cs are given in the Appendix

2.4 Banks

We consider two regimes: One where there is an interest rate ceiling and uniform interest rate regardless of firms' type; this leads to credit rationing. In the other, banks freely set interest rates and manage to separate good and bad risks with a schedule; this is termed as self revelation. For most of the developing countries, or even in some developed countries, credit rationing is used as both profit maximizing as well as risk hedging device against asymmetric information. In this section we propose an alternative regime, called self revelation regime to make a comparative study. We compare the steady state growth paths for both regimes. In this section we first discuss the credit rationing regime with and without informal credit markets and examine how flow of funds from different sources contribute to growth of the economy. Then next, we discuss the self revelation regime and its steady state growth path to compare with the former one.

2.4.1 Credit Rationing Regime

In this case we assume that banks are price takers in the loan market but price in the deposit and stock markets are endogenous. Banks diversify their risk by equating the price for combined fund (deposit and stocks) to the weighted cost of capital using the capital asset pricing model. They have a uniform loan rate, $\overline{l_t}$, predetermined by the central bank. We assume that the proportion of high risk firms is ρ and that of low risk firms is $(1-\rho)$. But banks face a pooled demand from both types of firms as they do not have the information regarding the type of each firm. Therefore, to hedge against such risk, and due to asymmetric information, banks ration credit. They decide to cater a fraction of the market demand and this fraction is endogenously determined so as to maximize profit. Through rationing, banks turn down some of the borrowers' demand for loans even if the borrowers are willing to pay a higher price.

Under credit rationing the funds flow in the following way. Let α be the proportion of loan demanded that banks supply under credit rationing regime. If the firm is rationed out then it goes to the informal market. So, with probability $(1-\alpha)$, firms go to the informal market to get loans. This implies that the banks supply only αL_t^D if the total revealed demand for loan is L_t^D in the formal sector. The pool will be identical because the high demand firms will take the guise of the low demand firms for the formal loan. In this way high demand firms can reap the benefit of certain amount of surplus if they operate on the lower demand curve in the guise of low demand firms. They fulfil their extra demand from the informal market supply. Let us consider

$$L_t^{FD} = k_{ht}\left[\rho\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} + (1-\rho)\left(\frac{\gamma_{LR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}}\right] \tag{15}$$

be the actual demand generated from both high risk and low risk firms. But total demand revealed in the formal market from the identical pool will be

$$L_t^D = k_{ht}\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}}$$

In that case total supply of formal loan will be

$$L_t^S = \alpha k_{ht}\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} \tag{16}$$

Now, the part of total demand for loan that is hidden from the formal sector by the low risk firms to maintain an identical pool is

$$k_{ht}\left[\rho\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} + (1-\rho)\left(\frac{\gamma_{LR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} - \left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}}\right] \tag{17}$$

or,

$$k_{ht}(1-\rho)\left[\left(\frac{\gamma_{LR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} - \left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}}\right] \tag{18}$$

Thus, the demand for informal loan is composed of the current revealed demand and the hidden demand:

$$\sum_{i=LR,HR} T_{i,t} = k_{ht}\left[(1-\alpha)\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} + (1-\rho)\left(\left(\frac{\gamma_{LR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} - \left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}}\right)\right] \tag{19}$$

where $\sum_{i=LR,HR} T_{i,t}$ is the total demand for informal loan. If we denote η by the proportion of high risk firms in the informal demand mix then demand from the high risk firms that goes to the moneylenders is

$$M_{HR,t} = k_{ht}\eta(1-\alpha)\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} \tag{20}$$

The rest of the informal loan demand comes from the low risk firms which is equal to

$$T_{LR,t} = k_{ht}\left[(1-\alpha)(1-\eta)\left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} + (1-\rho)\left(\left(\frac{\gamma_{LR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}} - \left(\frac{\gamma_{HR}Am}{1+\bar{l}_t}\right)^{\frac{1}{1-m}}\right)\right] \tag{21}$$

Households cannot supply all of this. Denote by λ, the share they provide to low risk firms at a very low (in the equilibrium it is zero) interest rate. In that case, the supply of household sector loan will be

$$H_{LR,t} = k_{ht}\lambda\left(\frac{Am}{1+\bar{l}}\right)^{\frac{1}{1-m}}\left[\gamma_{HR,t}^{\frac{1}{1-m}}(\rho+\eta\alpha-\eta-\alpha) + (1-\rho)\gamma_{LR,t}^{\frac{1}{1-m}}\right] \tag{22}$$

and rest of the demand from residual low risk firms goes to the moneylenders. Therefore, demand for moneylenders loan from low risk firms will be

$$M_{LR,t} = k_{ht}(1-\lambda)\left(\frac{Am}{1+\bar{l}}\right)^{\frac{1}{1-m}}\left[\gamma_{HR,t}^{\frac{1}{1-m}}(\rho+\eta\alpha-\eta-\alpha) + (1-\rho)\gamma_{LR,t}^{\frac{1}{1-m}}\right] \tag{23}$$

Before we set up banks' profit maximizing problem under the credit rationing regime, we want to assume that

i. banks get return only from loan it extends. Rest of the funds it keeps with the central bank as non-interest bearing asset.

ii. banks have sufficient funds to cater to the total demand for loans in the formal market.

In that case, banks' profit maximization problem can be written as

$$\max_{L_t,\alpha} E[\pi_t^B] = \alpha\phi_{HR}\bar{l}_t L_t^D - r_t(D_t+S_t) \tag{24}$$

$$\text{S. T. } D_t + S_t \geq L_t^D \tag{25}$$

Solving for $\alpha*$ from the zero profit condition, we get

$$\alpha^* = \frac{r_t}{\bar{l}_t \phi_{HR}} \tag{26}$$

In the deposit market the weighted average cost of capital, r_{t-1}, or, the uniform rate for deposit and stocks is obtained from the Capital Asset Pricing Model (CAPM), r_t can be constructed as

$$r_{t-1} = \frac{r_{d,t-1}D_{t-1}}{(D_{t-1}+S_{t-1})} + \frac{p_{s,t-1}S_{t-1}}{(D_{t-1}+S_{t-1})} \tag{27}$$

where,

$$p_{s,t-1} = r_{d,t-1} + [E(r_{mt}) - r_{d,t-1}]\mu \tag{28}$$

and,

$$\mu = \frac{\text{Cov}(S_{t-1}, r_{mt})}{\text{Var}(r_{mt})} \tag{29}$$

where $r_{d,t-1}$ is deposit rate in period $t-1$, $p_{s,t-1}$ is price of securities, $E[r_{m,t}]$ is the expected market price in period t.

Equilibrium and Balanced-Growth Equations: Credit Rationing Regime

An equilibrium in this model economy is a sequence of prices $\{w_t, r_t, h_{LR,t}, h_{HR,t}\}_{t=0}^{\infty}$, allocations, $\{c_t, i_{kht}, i_{kt}\}_{t=0}^{\infty}$, stock of physical and human capital, $\{k_t, k_{ht}\}_{t=0}^{\infty}$, stock of financial assets, $\{D_t, S_t, H_t, M_{LR,t}, M_{HR,t}, L_t\}_{t=0}^{\infty}$, and policy variables $\{r_{d,t}, \bar{l}_t\}_{t=0}^{\infty}$, such that :

1. The allocations and stocks of financial assets solve the household's date t maximization problem, equation (1), given prices and policy variables.

2. The real allocations solve the firm's date t profit maximization problem, Equation (12), given prices and policy variables.

3. The stock of financial assets solve informal money lender's maximization problem, equation (18), given prices and policy variable.

4. The stock of financial assets solve the bank's date t profit maximization problem, equation (30), given prices and policy variables.

5. The loanable funds market equilibrium condition: $k_t = L_t + T_t$ where $T_t = \lambda(1-\eta)(1-\alpha)H_t + (1-\lambda)(1-\eta)(1-\alpha)M_{LRt} + \eta(1-\alpha)M_{HRt}$ and $L_t = \alpha(D_t + S_t)$.

6. Goods market equilibrium condition satisfies $c_t + i_{h,t} + i_t = f(k_t)$ for all t.

To calculate the balanced growth equations we use the solutions to the maximization problems of households, banks, firms and the informal moneylenders together with the equilibrium conditions. Along this balanced growth path output grows at a constant rate. The economy is characterized by the following balanced growth equations:

1. Households' utility maximization with respect to H_{LR} and k_h, leads to the following supply of household sector loan

$$H^s = \left(\frac{w_t + 1 - \delta}{w_t + 2 - \delta}\right)^{\frac{1}{1-e}} - L^s \tag{30}$$

Equating above households loan supply with demand (equation (22)) from firms we find the value of λ, i.e, proportion of low risk loan that households supplies under credit rationing.

$$\lambda = \frac{\left(\frac{H^{ss}}{k_h}\right)}{(Am)^{\frac{1}{1-m}}\left[\gamma_{HR,t}^{\frac{1}{1-m}}(\rho + \eta\alpha - \eta - \alpha) + (1-\rho)\gamma_{LR,t}^{\frac{1}{1-m}}\right]} \tag{31}$$

2. From equation (16) we get total supply of formal loan by banks

$$\frac{L}{k_h} = \alpha\left(\frac{\gamma_H Am}{1+\bar{l}}\right)^{\frac{1}{1-m}} \tag{32}$$

3. From equation (20) we get high risk moneylender's loan

$$\frac{M_{HR}}{k_h} = \eta(1-\alpha)\left(\frac{\gamma_H Am}{1+\bar{l}}\right)^{\frac{1}{1-m}} \tag{33}$$

4. From equation (23) we get money lender's supply of low risk loan

$$\frac{M_{LR}}{k_h} = (1-\lambda)\left(\frac{Am}{1+\bar{l}}\right)^{\frac{1}{1-m}}\left[\gamma_{HR}^{\frac{1}{1-m}}(\rho+\eta\alpha-\eta-\alpha)+(1-\rho)\gamma_{LR}^{\frac{1}{1-m}}\right] \tag{34}$$

5. From equation (31) to (34), capital per unit of human capital

$$\frac{k}{k_h} = \frac{L}{k_h} + ((1-\alpha)(1-\eta)\lambda)\frac{H}{k_h} + (1-\alpha)\eta\frac{M_{HR}}{k_h} + (1-\alpha)(1-\eta)(1-\lambda)\frac{M_{LR}}{k_h} \tag{35}$$

6. From households utility maximization with respect to deposit or stock and firms' profit maximization with respect to capital (equation (9)) we get

$$r = \gamma_i A(1-m)(\frac{k}{k_h})^m - \delta \tag{36}$$

7. From the above equation and equation (27) we get the growth rate

$$g_{cr} = \beta\left(1 + (\gamma_i A(1-m)(\frac{k}{k_h})^m - \delta)\right) \tag{37}$$

2.4.2 Self-Revelation Regime

We propose an alternative regime to credit rationing, termed as self revelation regime to compare relative performances of banks under different regimes. We characterize this regime as a sequential communication game with intermediation plan. The formulation of our model under this regime is done in the line of Myerson (1979). According to him the revelation mechanism is a Bayesian Nash equilibrium under induced communication game. Thus, a mediation plan is incentive compatible iff it is a Bayesian equilibrium for all players to report their types honestly and to obey the mediator's recommendations when she uses the mediation plan. In a communication game there may be many Bayesian equilibria but a direct mechanism with truth telling leads to a Bayesian Nash equilibrium. This equilibrium is also known as the incentive compatible equilibrium (Gibbons (1992)). In short, truth telling is a Bayesian Nash equilibrium iff it is incentive compatible.

In our model, banks under this regime are assumed to be monopolistically competitive and set prices for differentiated loans based on their communication with the firms. Banks are assumed to disburse loan to different types of investment projects at different rates instead of a single prime lending rate. Loans are intended to be differentiated on the basis of the associated degree of risk. But banks have asymmetric information on each individual's type. In this situation banks formulate an incentive mechanism based on demand such that each firm self-selects.

We set up the bank's maximization problem by using information taken from firms' maximization problem. Between two types of firms in our model,

1. high risk firms with lower demand coefficient, γ_{HR}, operate on a lower demand curve. Therefore, banks set the price to a level that helps the banks to take away all the surplus from high risk firms. For the high risk firms participation constraint is binding - i.e,

$$E_t[R_{HR,t}] = \phi_{HR} L_{HR,t} l_{HR,t} \tag{38}$$

   where $E_t[R_{HR,t}]$ is the expected total revenue from the high risk firms.

2. low risk firms with higher demand coefficient, γ_{LR}, should operate on a higher demand curve. But they operate on the lower demand curve instead along with the high risk firms. The incentives that drives them to do so is the surplus they can enjoy by hiding their type. This creates an adverse selection problem. Therefore, under the self selection regime, low risk firms should be bounded by the incentive constraint.

Under the revelation equilibrium, the borrowers will reveal their type only if their pooling payoff is assured. To do that banks need to know the actual surplus the low risk firms were enjoying. From the two demand functions, the willingness to pay for the high risk firm for any given level of loan is

$$1 + l_{HR,t} = \frac{\gamma_{HR} A m k_{ht}^{1-m}}{(L_{HR,t})^{1-m}} \tag{39}$$

and that for the low risk firm is

$$1 + l_{LR,t} = \frac{\gamma_{LR} A m k_{ht}^{1-m}}{(L_{HR,t})^{1-m}} \tag{40}$$

The difference of the above two equations determines that the low risk firms have $\frac{\gamma_{LR}-\gamma_{HR}}{L_{HR,t}^{1-m}}$ times higher willingness to pay for the same amount of loan. In this case, the amount of surplus the low risk or high demand firms enjoy from $L_{HR,t}$ unit of loan is

$$Q_t \quad = \quad k_{ht}^{1-m} \left[\frac{\gamma_{LR} A m}{(L_{HR,t})^{1-m}} - \frac{\gamma_{HR} A m}{(L_{HR,t})^{1-m}} \right] L_{HR,t} \tag{41}$$

Or,

$$= \quad A m k_{ht}^{1-m} L_{HR,t}^{m} (\gamma_{LR} - \gamma_{HR}). \tag{42}$$

where Q_t is total surplus. The estimated surplus leads to the following incentive constraint for the high demand or low risk firms to self select themselves is

$$E_t[R_{LR,t}] = \phi_{LR} L_{LR,t} l_{LR,t} - A m k_{ht}^{1-m} L_{HR,t}^{m} (\gamma_{LR} - \gamma_{HR}) \tag{43}$$

where $E_t[R_{LR,t}]$ is the expected revenue from low risk firms, $L_{LR,t}$ and $L_{HR,t}$ are the loan amount for low risk and high risk firms and $l_{LR,t}$ is the loan rate for low risk firms. Banks can induce the firms with high demand to disclose their type by promising to return the surplus they were enjoying and can motivate the low risk firm to demand for $L_{LR,t}$ amount instead of $L_{HR,t}$. Now with ρ as the fraction of high risk firms and $(1-\rho)$ as the fraction of low risk firms, banks' profit maximization problem can be written as :

$$\max_{L_{LR,t},L_{HR,t}} E_t\Pi_t^B = \rho E_t(R_{HR,t}) + (1-\rho)E_t(R_{LR,t}) - r_t(D_t + S_t) \tag{44}$$

$$\text{S.T. } E_tR_{LR,t} = \phi_{LR}L_{LR,t}(l_{LR,t}) - Amk_{ht}^{1-m}L_{HR,t}^m(\gamma_{LR} - \gamma_{HR}) \tag{45}$$

$$E_tR_{HR,t} = \phi_{HR}L_{HR,t}(l_{HR,t}) \tag{46}$$

$$D_t + S_t = \rho L_{HR,t} + (1-\rho)L_{LR,t} \tag{47}$$

From the F.O.Cs w.r.t $L_{HR,t}$ and $L_{LR,t}$ we get :

$$l^*_{HR,t} = \frac{r_t}{\phi_{HR}} + \frac{(1-\rho)}{\rho\phi_{HR}}\frac{Am^2(\gamma_{LR} - \gamma_{HR})}{(L_{HR,t})^{1-m}} \tag{48}$$

$$l^*_{LR,t} = \frac{r_t}{\phi_{LR}} \tag{49}$$

These F.O.Cs show that for low risk firms with higher demand coefficient, banks' marginal benefit is equal to their marginal cost. Where as for the high risk firms, banks' marginal benefit is greater than their marginal cost. This extra amount can be considered as the premium that banks charge to the high risk firms to hedge against their vulnerability to default.

One important assumption to make this mechanism work is that banks do not breach the ex ante contract at the end of the contract period. If they do, the self revelation mechanism does not hold intertemporally. This assumption is rational because when all the banks are operating under revelation regime then by cheating ex post, the violator comes back to the rationing equilibrium. But in that case, only high risk firms will come to this bank because low risk firms do not have any incentive to come back to this bank by leaving lower rate of interest being offered by other banks. This will decrease the violator bank's expected pay off. Therefore, when this self selection is reached by firms under revelation mechanism no bank will have a tendency to breach the contract.

Equilibrium and Balanced-Growth Equations: Self Revelation Regime

An equilibrium in this model economy is a sequence of prices $\{w_t, r_t, l_{LR,t}, l_{HR,t}\}_{t=0}^{\infty}$, allocations, $\{c_t, i_{kht}, i_{kt}\}_{t=0}^{\infty}$, stock of financial assets, $\{D_t, S_t, L_t\}_{t=0}^{\infty}$, and policy variables $\{r_{d,t}\}_{t=0}^{\infty}$, such that :

1. The allocations and stocks of financial assets solve the household's date t maximization problem, equation (1), given prices and policy variables.

2. The real allocations solve the firm's date t profit maximization problem, Equation (12), given prices and policy variables.

3. The stock of financial assets solve the bank's date t profit maximization problem, equation (50), given prices and policy variables.

4. The loanable funds market equilibrium condition: $\frac{L_t}{k_{ht}}=\rho\frac{L_{HR,t}}{k_{ht}}+(1-\rho)\frac{L_{LR,t}}{k_{ht}}$.

5. Goods market equilibrium condition satisfies $\frac{C_t}{k_{ht}}+\frac{i_{h,t}}{k_{ht}}+\frac{i_t}{k_{ht}}=\frac{f(k_t)}{k_{ht}}$ for all t.

6. The labor market equilibrium condition : $k_{ht}^d = k_{ht}^s$.

To calculate the balanced growth equations we use the solutions to the maximization problems of households, banks, firms and the informal moneylenders together with the equilibrium conditions. Along this balanced growth path output grows at a constant rate. The economy is characterized by the following balanced growth equations:

1. By equating high risk firms' willingness to pay from Equation (13) with banks' willingness to accept, Equation (54), we get the optimum value of high risk loan supplied

$$\frac{L_{HR}^{ss}}{k_h} = \left(\frac{Am(\phi_{HR}\gamma_{HR}\rho - m(1-\rho)(\gamma_{LR}-\gamma_{HR})}{\rho(\phi_{HR}+r^{ss})}\right)^{\frac{1}{1-m}} \tag{50}$$

2. By equating low risk firms' willingness to pay from Equation (13) with banks' willingness to accept, Equation (55), we get the optimum value of low risk loan supplied

$$\frac{L_{LR}^{ss}}{k_h} = \left(\frac{\phi_{LR}\gamma_{LR}Am}{\phi_{LR} + r^{ss}}\right)^{\frac{1}{1-m}} \tag{51}$$

3. By using the optimum high risk loan amount in Equation (54), we get the optimum loan rate for high risk loan

$$l_{HR}^{ss} = \frac{\gamma_{HR}\rho r^{ss} + m(1-\rho)(\gamma_{LR} - \gamma_{HR})}{\phi_{HR}\gamma_{HR}\rho - m(1-\rho)(\gamma_{LR} - \gamma_{HR})} \tag{52}$$

4. From Equation (55) we get the low risk loan rate,

$$l_{LR}^{ss} = \frac{r^{ss}}{\phi_{LR}} \tag{53}$$

   Notice that this rate is exactly equal to the banks' marginal cost.

5. Capital accumulation under this regime is

$$\frac{k^{ss}}{k_h^{ss}} = \rho\frac{L_{HR}^{ss}}{k_h^{ss}} + (1-\rho)\frac{L_{LR}^{ss}}{k_h^{ss}} \tag{54}$$

6. Growth rate under self revelation regime is

$$g_{sr} = \beta\left(1 + \gamma_i A(1-m)(\frac{k}{k_h})^m - \delta\right) \tag{55}$$

3 Calibration

In order to obtain the quantitative values of the impact of the various credit regimes, we proceed to the calibration of the model. We do this for India, which is currently under rationing regime. We quantify our model by estimating the parameter values from their steady state equilibrium relationships. Some macro economic indicators like inflation rate, real deposit rate, and real rate of return on securities (Table 1) for the years from 1970 to

2000 have been taken from Sirai (2002). The share of capital has been estimated from the National Income Accounting data for India by deducting the labor share from the real GDP at factor cost. We estimated r_t, the $WACC$ from the deposit rate and stock prices.

[Table 1 comes here]

Some other parameter values, as mentioned below, are estimated from the agricultural household level sample (Agro-economic Research Centers and Units, Ministry of Agriculture, Government of India for the years 1997-2000) we used for that analysis.

Based on the characteristics of the firms with known types in the subset of informal borrowers, we used discriminant analysis to separate the firms from a unknown pool of high and low risk firms in the formal sector.

[Figure 1 comes here]

Figure 1 shows that the distribution of informal borrowers with respect to loan rate is tri-modal and the first mode is at 0 percent real interest rate. As per our consideration of the households benevolent loan to their low risk friends and family members for production we define this borrowers as the low risk borrowers and based on their characteristics we separate the low risk from the high risk in the entire credit market. To validate our claim that all the borrowers who get loans at zero percent interest are low risk, we test the following hypotheses:

- borrowers with diversified sources of income are low risk.
- Use of child labor is more by high risk firms as compared to the low risk firms.
- High risk firms have higher probability of default. The representation of the results in Table 2 validate our claim.

[Table 2 comes here]

The following parameter values have been estimated using discriminant analysis. The estimated averages of these parameters are :

i. ρ = Proportion of high risk firms among the total borrowers = .54.

ii. ϕ_{HR} = Success rate of the high risk firms = .78.

iii. ϕ_{LR} = Success rate of the low risk firms = .86.

iv. γ_{LR} = Demand coefficient for low risk firms = 1.56.

v. γ_{HR} = Demand coefficient for high risk firms = 1.41.

vi. η = The proportion of high risk firms in the informal market = .38.

vii. x = Proportion of high risk firms in the formal market = .72.

The technological parameter, A, has been calculated from equation (42). We used the value of r and $\frac{k}{k_h}$ from the available data. The estimated value of A is .23. The percent deviation of the actual output from the estimated output, ψ, has been estimated from the following regression model:

$$\log(\text{output}) = A + m_i * log(inputs)$$

We consider this deviation as the measure of percentage gain in output when the firms are successful irrespective of their type. The estimated value is .81.

Among the behaviorial parameters used in the baseline computational experiments, the estimated value of β is .98 and σ is assumed to be 1.

4 Results

Table 3 and 4 present the equilibrium values of different variables under different policy regimes. Our findings (Table 3) suggest that the uniform loan rate under credit rationing is set at such a high level that it is almost equal to the high risk loan rate under self revelation regime. This indicates that, due to the lack of proper information, the banks hedge against the default risk of the high risk firms by charging a high premium from all borrowers irrespective of their type.

[Table 3 comes here]

Another important finding is the improvement in the average wage rate from credit rationing to the self revelation regime. The average increase is around 12.5 percent. If we consider the wage rate as the representation of the human capital formation, then it can be said that such increase in wage rate is the outcome of the absence of households' tradeoff between loan and human capital development as we see under credit rationing.

The self revelation regime in our model is incentive compatible because the banks not only charge a much lower loan rate for the low risk firms but also provide a larger amount if they reveal their type. By revealing types low risk firms are also better off, both, with respect to loan rate and loan volume. This incentive compatibility of the loan contract leads to an overall increase in capital formation and higher growth rate.

The low risk firms are better off, both, with respect to loan rate and loan volume. The banks not only charge a much lower loan rate for the low risk firms but also provide a larger amount (Table 4). This leads to an overall increase in capital formation and higher growth rate.

[Table 4 comes here]

Note that, we consider the ratio of the variables to human capital, k_h, instead of output or physical capital, k. In this study we want to show how households' resource allocation decision in different investment projects, particularly, in human capital, affects the overall growth. Moreover, technically, as we know all variables grow at the same rate under balanced growth path, i.e.,

$\frac{y_{t+1}}{y_t} = \frac{k_{t+1}}{k_t} = \frac{k_{h,t+1}}{k_{h,t}} = g$. A simple reorganization gives us $\frac{k_t}{k_{h,t}} = \frac{k_{,t+1}}{k_{h,t+1}} = g$ without any loss.

[Table 5 comes here]

The above Table 5 compares the steady state growth rates under different regimes. While the first two rows of this table indicates correspond the growth rates under credit rationing without and with informal sector respectively, the third row represents the growth rate under self revelation regime. The absence of informal sector is a hypothetical situation that we consider here to separate out the importance of informal sector under credit rationing. Since rationing decision in the formal sector is independent of the existence of informal sector, we consider the supply of formal loan as the total supply of loan under credit rationing without informal sector. Based on that we estimated total capital formation and rate of growth. The situation with informal sector represents the actual situation in the Indian context. This separation of situations under credit rationing shows that the higher growth rate in the presence of informal credit market represents the contribution of this market in reducing the cost of credit rationing in terms of growth rate. As our results indicate, the incidence of informal market contributes about .7 percent to the over all growth.

A comparison of the credit rationing regime with our proposed revelation regime shows that this improvement in growth is not optimal. A change in regime from credit rationing to self-revelation can increase growth rate by more than 2 percent, as compared to credit rationing even with informal credit market.

4.1 Robustness

The two key parameters in our model under credit rationing are α, the proportion of credit rationing, and λ the proportion of household sector loans to the total low risk loan. We checked the robustness of our model by estimating the variation in different components of loans, capital and growth rate for the values of α and λ available in the sample data instead of taking it from our model. The following Table 6 represents these comparative values. Our findings in this regard suggest that the values estimated from our model is very consistent with their counterpart in the sample data.

[Table 6 comes here]

We calibrate our model for different values of ϕ_{HR}, the success rate of the high risk firms and ρ, the incidence of high risk firms, for both the regimes.[4] We also test the robustness by calibrating our model for different values of deposit rates under two different regimes.

Table 7 represents a comparison of capital-human capital ratio between the two regimes while Table 8 compares the change in marginal product of capital between these two regimes as represented by corresponding wage rates. In Table 9 we compare the growth rates for different combination of ϕ_{HR} and ρ. Table 10 shows the comparative study of growth rates between two regimes for different deposit rates.

[Table 7 and 8 come here]

Both Table 7 and Table 8 suggest that capital-human capital ratio and marginal product of labor are always higher under self revelation regime than those under credit rationing regime for any combination of ϕ_{HR} and ρ. Naturally, the rate of growth also follow the same pattern as capital-human capital ratio or MPL does. This validates our claim that

[4]We ignore the rate of success of the high risk firms below .4. Because below this level banks zero profit condition will not be achieved even for a value of α equals to 1.

self revelation leads to higher growth rate as compared to credit rationing, and with large differences.

[Table 9 and 10 come here]

The above Table 10 captures the implications of change in deposit rate on capital accumulation and growth for both the regime. The highest value of real r_d is .057 during the period of 1970 to 2000. Therefore, to keep a parity with the variation in deposit rate during this period, we estimated the capital accumulation and growth for the corresponding deposit rate within a range of .01 to .055. In the process of calibration we assumed the other parameter values as well as the spread between the administered loan rate and the deposit rate under credit rationing as fixed. Our findings suggest that for any value of the deposit rate, both, capital accumulation and the growth rate are significantly higher in the self revelation regime.

5 Conclusion

In this paper we quantify the endogenous growth for two alternative credit regimes in the presence of informal credit market. We used a dynamic general equilibrium framework to capture the overall changes in the economy. The main contribution of this paper is mainly twofold. First, we show quantitatively the consequences of credit rationing in terms of growth under asymmetric information. We show in our model that under credit rationing, growth rate is 0.7 percent higher in the presence of informal sector than without it. Second, the incentive compatible self revelation mechanism can increase growth rate by 2 percent as compared to credit rationing with informal sector.

The uniform loan rate under credit rationing is set at such a higher level that it is almost equal to the high risk loan rate under self revelation regime. This indicates that, due to the lack of proper information, the banks hedge against the default risk of the high risk firms by charging a high premium to all the borrowers irrespective of their type. Banks' inability to separate firms from each other aggravates the adverse selection problem in the formal credit market leading to a much severe credit rationing and lower growth.

The presence of informal market reduces such cost of credit rationing in terms of growth by providing more loans to the rejected low risk borrowers as compared to high risk borrowers. This is possible because of the availability of more information to the household sector as compared to the formal sector. Moneylenders also separate the low risk borrowers from high risk borrowers by incurring a certain cost. This leads to higher growth with informal credit market as compared to credit rationing with no informal market.

But, despite such improvement in capital accumulation and growth, the overall outcome still remains suboptimal. Our second contribution in this respect suggest that when the low risk firms reveal their type because of incentive compatibility under revelation it leads to a unique Bayesian Nash equilibrium among many other Bayesian equilibria. We can therefore say that the revelation regime leads us to the optimal achievable growth rate by separating firms based on their type.

The self revelation regime in our model is incentive compatible because the banks not only charge a much lower loan rate for the low risk firms but also provide a larger amount if they reveal their type. By revealing types low risk firms are also better off, both, with respect to loan rate and loan volume. This incentive compatibility of the loan contract leads to an overall increase in capital formation and higher growth rate.

Another important finding is the improvement in the average wage rate from credit rationing to the self revelation regime. The average increase is around 12.5 percent. We can consider this improvement in wage rate as the representation of the improvement in human capital formation.

The calibration results for different values of the proportion of high risk firms, ρ, and the success rate of the high risk firms, ϕ_{HR}, suggest that capital accumulation, wage rate and growth rate are always well above the corresponding values under the credit rationing. The calibration with respect to different deposit rates also corroborates this result. These findings suggest that the self revelation regime leads to a superior steady state equilibrium in terms of growth as compared to credit rationing.

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Appendix

- The representative household solves the following problem :

$$V \quad = \quad \max_{C_t, H_{LR,t}, D_t, S_t, i_{h,t}} \sum_{t=0}^{\infty} \beta^t \left[\frac{(C_t + \frac{(L_t+H_t)^e}{e})^{1-\sigma}}{1-\sigma} \right]$$

S. T. :

$$C_t + D_t + S_t + H_{LR,t} + i_{ht-1} \leq w_{t-1}k_{ht-1} + (1 + h_{LR,t-1})H_{LR,t-1} \\ + (1 + r_{t-1})(D_{t-1} + S_{t-1})$$

$$k_{h,t} = (1-\delta)k_{h,t-1} + i_{h,t-1}$$

Details about the parameters and the variables used have been given in the text. The Euler equations are

$$D_t : \quad \frac{w_t k_{ht} + (1+h_{LR,t})H_{LR,t} + (1+r_t)(D_t+S_t) + \frac{(L_{t+1}+H_{LR,t+1})^e}{e} + i_{ht} - D_{t+1} - S_{t+1} - H_{t+1}}{w_{t-1}k_{ht-1} + (1+h_{LR,t-1})H_{LR,t-1} + (1+r_{t-1})(D_{t-1}+S_{t-1}) + \frac{(L_t+H_t)^e}{e} + i_{ht-1} - D_t - S_t - H_t} = \beta(1+r_t)$$

$$S_t : \quad \frac{w_t k_{ht} + (1+h_{LR,t})H_{LR,t} + (1+r_t)(D_t+S_t) + \frac{(L_{t+1}+H_{t+1})^e}{e} - i_{ht} - D_{t+1} - S_{t+1} - H_{t+1}}{w_{t-1}k_{ht-1} + (1+h_{LR,t-1})H_{LR,t-1} + (1+r_{t-1})(D_{t-1}+S_{t-1}) + \frac{(L_t+H_t)^e}{e} - i_{ht-1} - D_t - S_t - H_t} = \beta(1+r_t)$$

$$H_{LR,t} : \quad \frac{w_t k_{ht} + (1+h_{LR,t})H_{LR,t} + (1+r_t)(D_t+S_t) + \frac{(L_{t+1}+H_{LR,t+1})^e}{e} - i_{ht} - D_{t+1} - S_{t+1} - H_{t+1}}{w_{t-1}k_{ht-1} + (1+h_{LR,t-1})H_{LR,t-1} + (1+r_{t-1})(D_{t-1}+S_{t-1}) + \frac{(L_t+H_t)^e}{e} - i_{ht-1} - D_t - S_t - H_t} = \frac{\beta(1+h_{LR,t})}{L_t + H_t^{-(1-e)} - 1}$$

$$k_{ht} : \quad \frac{w_t k_{ht} + (1+h_{LR,t})H_{LR,t} + (1+r_t)(D_t+S_t) + \frac{(L_{t+1}+H_{LR,t+1})^e}{e} - i_{ht} - D_{t+1} - S_{t+1} - H_{t+1}}{w_{t-1}k_{ht-1} + (1+h_{LR,t-1})H_{LR,t-1} + (1+r_{t-1})(D_{t-1}+S_{t-1}) + \frac{(L_t+H_t)^e}{e} - i_{ht-1} - D_t - S_t - H_t} = \beta(w_t + 1 - \delta)$$

- Moneylenders maximize their expected profit in the following way:

$$\max_{M_{HR,t},M_{LR,t}} E_t\pi_{m,t} = \phi_{HR}(1-\alpha)\eta h_{HR,t}M_{HR,t} + \phi_{LR}(1-\alpha)(1-\eta)(1-\lambda)h_{LR,t}M_{LRt} - (c_{LR}M_{LRt} + c_{HR}M_{HRt})$$

Details about the parameters and the variables used have been given in the text. F.O.C with respect to $M_{HR,t}$ and $M_{LR,t}$:

$$M_{HR,t} \;:\; h_{HR,t} = \frac{c_{HR}}{(1-\alpha)\eta\phi_{HR}}$$

$$M_{LR,t} \;:\; h_{LR,t} = \frac{c_{LR}}{(1-\eta)(1-\alpha)(1-\lambda)\phi_{LR}}$$

Tables

Table 1: Some Policy Parameters and their Corresponding Values

Parameters	Description	Value
π	Inflation rate	.087
r_d	Real deposit rate	.096
p_s	Real rate of return on securities	.028
r	Weighted Average of cost of capital	.020
m	Share of capital in production	.24

Table 2: Mean Estimated Values of Certain Indicator Variables Across High Risk and Low Risk Firms

Variables	High risk	Low risk
Percent of firms	.54	.46
percent child labor used	.38	.06
Percent income from secondary sources	.03	.30
Percent household members engaged in agriculture	.84	.39
Default rate in formal sector	.21	.12
Default rate in informal sector	.29	.15
Average default rate in both the sector	.22	.15

Table 3: Equilibrium Proportions and Rates Under Different Regimes

Parameter	Description	Under Credit Rationing		Under Self Selection	
		High risk	Low risk	High risk	Low risk
α	Fraction of credit rationing	.484	.484	-	-
δ	Depreciation rate	.03	.03	.03	.03
λ	Proportion of low risk households loan	-	.08	-	-
l^{ss}	Bank loan rate	.053	.053	.055	.023
h^{ss}	Informal sector loan rate	.270	.150	-	-
c	Cost coefficient for moneylenders' loan	.042	.038	-	-
w	Wage rate	.096	.106	.108	.119

Table 4 : Steady State Ratios of Real Sector Variables to Human Capital Across Regimes

Parameters	Description	CR	SR
$\frac{L^{ss}}{k_h^{ss}}$	Formal loan to human capital ratio	.0150	.0340
$\frac{H^{ss}}{k_h^{ss}}$	Household loan to human capital ratio	.01	-
$\frac{M_{HR}^{ss}}{k_h^{ss}}$	Moneylenders' high risk loan to human capital ratio	.006	-
$\frac{M_{LR}^{ss}}{k_h^{ss}}$	Moneylenders' low risk loan to human capital ratio	.011	-
$\frac{C^{ss}}{k_h^{ss}}$	Consumption-human capital ratio	.0900	.1002
$\frac{i^{ss}}{k_h^{ss}}$	Investment-human capital ratio	.0016	.0052
$\frac{D^{ss}+S^{ss}}{k_h^{ss}}$	Loanable Fund-human capital ratio	.0150	.0340
$\frac{k^{ss}}{k_h^{ss}}$	Capital-human capital ratio	.0200	.0340

Table 5: Steady State Growth Rates under Different Regimes

Parameters	Description	Net Growth Rate (Percent)
g_{crf}	Under credit rationing, without informal sector	3.8
g_{cr}	Under credit rationing with informal sector	4.5
g_{sr}	Under self revelation	6.6

Table 6: Comparison of Values Between the Model and Sample Data

Parameter/variable	α and λ calibrated	α and λ from sample
α	.485	.502
λ	.080	.072
$\bar{l}$	.053	.051
$\frac{L}{k_h}$	.0156	.0162
$\frac{M_{HR}}{k_h}$	.0063	.0060
$\frac{M_{LR}}{k_h}$	.0061	.0056
$\frac{k}{k_h}$	.0187	.0190
g_{cr}	4.36	4.38

Table 7: Comparison of $\frac{k}{k_h}$ between Two Regimes for Different ρ and ϕ_{HR}

	$\rho = .1$		$\rho = .25$		$\rho = .5$		$\rho = .75$		$\rho = .9$	
ϕ_{HR}	$\frac{k_{sr}}{k_h}$	$\frac{k_{cr}}{k_h}$	$\frac{k_{sr}}{k_h}$	$\frac{k_{cr}}{k_h}$	$\frac{k_{sr}}{k_h}$	$\frac{k_{cr}}{k_h}$	$\frac{k_{sr}}{k_h}$	$\frac{k_{cr}}{k_h}$	$\frac{k_{sr}}{k_h}$	$\frac{k_{cr}}{k_h}$
.4	.0343	.0132	.0286	.0131	.0205	.0129	.0166	.0127	.0146	.0127
.5	.0343	.0156	.0286	.0153	.0242	.0147	.0211	.0141	.0193	.0138
.6	.0343	.0173	.0308	.0169	.0281	.0162	.0256	.0155	.0243	.0151
.7	.0349	.0185	.0336	.0182	.0320	.0176	.0304	.0171	.0294	.0168
.78	.0364	.0192	.0359	.0191	.0350	.0188	.0342	.0184	.0337	.0183

Table 8: Comparison of Wage Rate or Marginal Product of Labor Between Two Regimes for Different Values of ρ and ϕ_{HR}

	$\rho = .1$		$\rho = .25$		$\rho = .5$		$\rho = .75$		$\rho = .9$	
ϕ_{HR}	w_{cr}	w_{sr}	w_{cr}	w_{sr}	w_{cr}	w_{sr}	w_{cr}	w_{sr}	w_{cr}	w_{sr}
.4	.0872	.1202	.0870	.1134	.0867	.1021	.0865	.0947	.0864	.0904
.5	.0909	.1202	.0903	.1134	.0894	.1063	.0885	.1002	.0881	.0966
.6	.0931	.1202	.0926	.1154	.0916	.1102	.0907	.1051	.0901	.1020
.7	.0946	.1207	.0942	.1179	.0935	.1136	.0928	.1094	.0924	.1069
.78	.0954	.1220	.0952	.1197	.0949	.1161	.0945	.1125	.0943	.1104

Note: w_{cr} and w_{sr} represent the wage rates under credit rationing and self revelation regime respectively.

Table 9: Comparison of Growth Rates (in Percent) Between Two Regimes for Different Values of ρ and ϕ_{HR}

	$\rho = .1$		$\rho = .25$		$\rho = .5$		$\rho = .75$		$\rho = .9$	
ϕ_{HR}	g_{cr}	g_{sr}	g_{cr}	g_{sr}	g_{cr}	g_{sr}	g_{cr}	g_{sr}	g_{cr}	g_{sr}
.4	4.4	6.8	4.3	6.2	4.0	5.1	3.8	4.3	3.6	3.9
.5	4.8	6.8	4.6	6.2	4.3	5.5	4.0	4.9	3.8	4.5
.6	5.1	6.8	4.9	6.4	4.5	5.9	4.2	5.4	4.0	5.1
.7	5.2	6.9	5.0	6.6	4.6	6.2	4.4	5.8	4.2	5.5
.78	5.3	7.0	5.1	6.8	4.9	6.4	4.6	6.1	4.4	5.9

Note: g_{cr} and g_{sr} represent net growth rate under credit rationing and self revelation regime respectively.

Table 10: Comparison of Growth Rates (in Percent) Between Two Regimes for Different Deposit Rates

	$CreditRationing$		$SelfRevelation$	
r_d	$\frac{k_{cr}}{k_h}$	g_{cr}	$\frac{k_{sr}}{k_h}$	g_{sr}
0.01	**0.014**	**3.37**	**0.026**	**4.52**
0.015	**0.017**	**4.18**	**0.030**	**5.40**
0.02	**0.021**	**5.06**	**0.035**	**6.32**
0.025	**0.025**	**5.99**	**0.039**	**7.27**
0.03	**0.029**	**6.97**	**0.043**	**8.25**
0.035	**0.0334**	**7.98**	**0.0477**	**9.26**
0.04	**0.038**	**9.03**	**0.052**	**10.29**
0.045	**0.043**	**10.11**	**0.057**	**11.33**
0.05	**0.048**	**11.22**	**0.061**	**12.40**
0.055	**0.053**	**12.34**	**0.066**	**13.49**

Note: r_d is deposit rate.

Figure 1: **Frequency Distribution of Number of Borrowers in the Informal Market Across Different Rates of Interest**