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# Liquidity Constraint and Child Labor In India: Is Market Really Incapable Of Eradicating It From Wage-Labor Households?

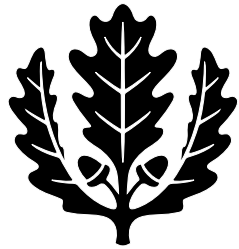
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**Liquidity Constraint and Child Labor In India: Is Market Really Incapable Of Eradicating It From Wage-Labor Households?**

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## **Abstract**

One way to measure the lower steady state equilibrium outcome in human capital development is the incidence of child labor in most of the developing countries. With the help of Indian household level data in an overlapping generation framework, we show that production loans under credit rationing are not optimally extended towards firms because of issues with adverse selection. More stringent rationing in the credit market creates a distortion in the labor market by increasing adult wage rate and the demand for child labor. Lower availability of funds under stringent rationing coupled with increased demand for loans induces the high risk firms to replace adult labor by child labor. A switch of regime from credit rationing to revelation regime can clear such imperfections in the labor market. The equilibrium higher wage rate elevates the household consumption to a significantly higher level than the subsistence under credit rationing and therefore higher level of human capital development is assured leading to no supply of child labor.

**Journal of Economic Literature Classification:** O16, O17, E26

**Keywords:** Credit Rationing, Informal Credit, Child Labor, Self Revelation Mechanism

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# 1 Introduction

On the basis of the Narasimham Committee Report (1991) the financial reform in India started in the same year by deregulating interest rate, reducing required reserve and SLR in order to achieve higher efficiency. Among all, the interest rate deregulation invites special attention because even though the interest rates beyond a threshold of Rs. 200,000, have been deregulated the loans below this threshold have been kept under regulated rate.

The proponents of mixed strategy in interest rate deregulation justified it on the ground that while the predetermined loan rate for the loans below the threshold would act as a protective guideline to curb misallocation of resources, competition in the market for larger loans would increase the returns on the bank loans. According to Werner (1999), '(T)hese efforts have been justified to overcome shortcomings and distortions in the banking sector and improve efficiency in mobilizing and allocating resources, thus providing the basis for accelerating economic growth and development'.

However, the interest rate regulation coupled with the banks' lack of proper risk measuring instruments leads to stringent credit rationing. The Indian experience suggest that when banks fail to identify the associated risk in production for each firms, the true cost of operation increases with an increase in volume of loans. Therefore, banks prefer to ration credit even if they can meet up the entire demand. The households level survey data that we use for our analysis shows that almost 82 percent of the borrowers received a loan below Rs. 25,000 even when the limit is Rs. 200,000 under this category (Table 1)<sup>1</sup>. The rest of it is scattered among other ranges with only 1.5 percent over the threshold. The table also shows that loans have been extended irrespective of the associated degree of risk.<sup>2</sup>

The purpose of this study is mainly twofold. First, to explain why child labor exists under credit rationing and, second, how the problem can be addressed by proposing an alternative financial development. The income inadequacy to maintain the subsistence level of consumption is a very common phenomenon in the developing countries and such inadequa-

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<sup>1</sup>The data has been collected for 700 rural agrarian households from 12 states for the period 1997-98 to 2000-01 by the Agro Economic Research Cell and Units, Govt. of India.

<sup>2</sup>The methodology used to determine the high risk and low risk firms has been given in Section 4.

Table 1: Performance of the Formal Sector in Rural India ('000 Rs.)

item	< 25	25 – 50	50 – 100	100 – 200	200 >	Total
Total Number	428(84.68)	55 (10.5)	16 (3.05)	17 (3.24)	8 (1.53)	524 (100)
Low Risk	207	19	8	7	3	244
High Risk	221	36	8	10	5	280

cies in income originate from lower human capital development. Lower adult income induces parents to supply child labor to smooth their consumption. Therefore, one way to measure such lower steady state value of human capital development is the incidence of child labor in most of the developing countries. According to the ILO Report (2001), over 250 million children work worldwide. Among all sectors, agriculture alone uses 70 percent of these child workers (Ashagrie (1998)).

The degree of parental selfishness is often given a significant weight by many researchers to explain the incidence of child labor (Basu and Van (1998), Baland and Robinson (2000), Ranjan (2001), Cigno, Rosati, Tzannatos (2002) and Guarcello (2003)). The high incidence of child labor in the poor countries have a comparative advantage in the production of labor intensive goods with unskilled workers. In such situations with high demand for unskilled worker and with no or minimum altruism, parents send their children to work in order to increase both, their family income as well as their leisure. Trade sanction is suggested to be one of the effective policy measures to banish it with the expectation that a trade sanctions on such countries would reduce the unskilled wage and increase the skilled wage and, would in turn, induce the parents to send their children to school (Ranjan (2001)). However, the alternative argument suggests that a decline in unskilled wage reduces the income of the unskilled workers. According to Ray (2002), in a world with credit constraints, it would make the matter worse by driving the children from credit starved households on to the labor market.

According to Nardinelli (1990), if child labor is the product of the market then it must be efficient and legal interventions are futile. Alternatively, Basu (2003) with a reference of

Satz (2002), argues that when one person (parents) decides for the other (child), It is against the consumers' sovereignty and should not be considered as the outcome of the market. Baland and Robinson (2000) mentioned that socially inefficient child labor may arise in equilibrium because parents fail to fully internalize its negative effects. They pointed out two main reasons for child labor. First, the imperfection of capital market in translating future earning potential into present spending power. Second, the inability of parents to make negative bequest to their children. Similar results by Ranjan (1999) indicates that non existence of markets for loans against future earnings of children gives rise to an inefficient labor supply. Pallage and Zimmermann (forthcoming) argue that international transfers can get a poor country out of a development trap, and thus eradicate child labor, but the process is very slow.

According to this literature, borrowing constraints may play the key role in the allocation decision of households between consumption and investment, particularly investment in human capital. By creating such borrowing constraints, the capital market imperfections leads to an under investment in the human capital of their children even when the parents are altruistic. Therefore, better access to credit may contribute to a reduction in child labor (Basu and Van (1998), Baland and Robinson (2000), Ranjan (2001), Cigno, Rosati, Tzannatos (2002) and Guarcello (2003)).

Most of the above mentioned studies consider current loans against future human capital income of children as a tool to smooth consumption. Yet human capital loans are unknown even in developed countries. When it is present it is applicable only for those who have reached a minimum level of education, mostly at the undergraduate or graduate levels.

We posit child labor is the outcome of insufficient adult income and such insufficiency results from suboptimal production. To make a permanent dent into the problem of child labor, therefore, requires more attention on the capital market imperfection related to production loan.

We incorporate formal bank loans and informal moneylenders in our model to capture the broader credit channel for production loans. Informal credit channel coexist in most of the developing countries under credit rationing and they are either vertically or horizontally

integrated to each other. In the case of India, our country of interest for this study, these two channels are horizontally integrated and a spillover of demand for production loan takes place under credit rationing from the formal to the informal credit market.

Another contribution of this paper is the proposal of an alternative credit regime to ensure financial development. We find that firms with different degrees of success rates can be separated based on an incentive mechanism and such a separating equilibrium automatically takes care of the adverse selection problem. Once the banks can hedge against risk by charging differentiated loan rates, appropriate amounts of loan can be extended to different firms based on their risk type. This mechanism not only clears the credit market imperfection significantly but also reduces the incidence of child labor drastically by banishing the costly informal credit markets.

Given this backdrop, the main objectives of this study are to find out that under asymmetric information

- is it possible to reduce child labor under credit rationing regime? If yes, how?
- Can market based pricing of credit through a self revelation mechanism promise a significantly better outcome?

In this study we try to find out the necessary and sufficient conditions to overcome the child labor problem in this context. While our first objective tries to capture the interactions among different socio-economic factors and finds out these necessary and sufficient conditions, our second objective tries to explore whether some alternative is still possible to satisfy these conditions when credit rationing fails.

The outline of this study is planned as follows: In section 2 we outline an overlapping generation model in a dynamic general equilibrium framework. We also lay out the equilibrium conditions in this section. Section 3 is devoted to the estimation and calibration of the equilibrium outcomes. Section 4 concludes.

## 2 Baseline Model

The households, the firms, the banks and the moneylenders are the four decision making units in our model. In a three period overlapping generation set up we consider that our agent household uses her unit time allocation either in human capital development or work in her childhood. In the next period, when she is adult, she works as adult labor full time and allocates her income between present consumption and savings for the next period when she is old. Our agent also cares about her child's welfare.

Based on the degree of risk, we assume firms are heterogenous in our model. They use only labor for production and make the wage payment by borrowing from the banks. Under credit rationing firms go to the informal credit market for loans after being rejected by the banks. No firm has initial endowment in our model.

We assume two different financial regimes to describe the banks' problem in India. First, we consider the situation existing in India where credit rationing is prevalent in the economy for the loans below a threshold of Rs. 200,000. Interestingly, the households level sample data we used for this study<sup>3</sup> shows no production loans beyond this threshold in rural India. Moreover, about 93 percent of the loans are rather between Rs. 25,000 to 50,000 range. This may be either because they are prohibited to do so, or because they do not have the proper information about firms' type, leading to the typical adverse selection problem and credit rationing. We analyze the consequence of credit rationing on adult wage and child labor in our model with and without an overflow of constrained loan to an informal credit market. Next, we propose revelation regime as an alternative to credit rationing. In this regime banks offer different loan contracts to high and low risk firms based on incentive compatibility.

### Households

We consider a three period overlapping generation model for our analysis. In period  $t - 1$  our agent is a child and is endowed with 1 unit of time. Her parents can distribute her time between education ( $e_{t-1}$ ) or work ( $1-e_{t-1}$ ). Child labor is compensated at the rate  $w_{c,t-1}$

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<sup>3</sup>Collected by Agro Economic Research Centers and Units, Govt. of India



and given to parents, as children do not consume. Time not spent in working is used for human capital accumulation, and depends on parents' human capital. Our agent completes her education when she is child and gets no education as adult.

In period  $t$  the agent becomes adult and uses her entire time endowment to work. She gets an adult wage  $w_{a,t}$ , based on her human capital. The agent distributes her entire income (which may include income from her children) in period  $t$  between consumption and saving in the bank ( $D_t$ ).  $D_t$  matures in the beginning of the period  $t+1$ . The agent also maximizes her child's welfare in the next period. Instead of assuming that the gap between required and actual consumption as the sufficient condition for child labor supply as described in the luxury axiom by Basu and Van (1999), we consider it as necessary condition and the level of parental altruism decides the sufficient condition for no child labor supply. The existence of the gap between the actual and required child labor supply driven by the composite effect of the necessity and parental altruism, thus, will have an important role in our analysis in crafting accurate policy measure.

In period  $t+1$  the agent grows old and retires from work. She then consumes all her savings she deposited in the bank in period  $t$ .

Based on the above description, the budget constraint of our agent in period  $t$  and  $t+1$  are

$$c_t^{t,A} + D_t \leq w_{a,t}n_t, \quad (1)$$

$$c_{t+1}^{t,O} = (1 + r_{d,t})D_t, \quad (2)$$

$$\text{where, } w_{a,t}n_t = w_{a,t}n_{a,t}h_t + \omega w_{a,t}n_{c,t}, \quad (3)$$

$$n_{c,t} = 1 - e_t \quad (4)$$

$$0 < e_t \leq 1, \quad (5)$$

$$\text{and, } \omega = \frac{w_{c,t}}{w_{a,t}}. \quad (6)$$

From the above, we get the following life time budget constraint:

$$c_t^{t,A} + \frac{c_{t+1}^{t,A}}{1 + r_{d,t}} \leq w_{a,t}n_t, \quad (7)$$

where  $e_t$  is the fraction of the child's time devoted to human capital,  $h_t$ .

In our model we also consider that our agent maximizes the discounted value of their child's welfare. In that regard the life time budget constraint for the period  $t$  children for period  $t + 1$  and  $t + 2$  becomes

$$c_{t+1}^{t,C} + \frac{c_{t+2}^{t,C}}{1 + r_{d,t+1}} \leq w_{a,t+1}n_{t+1}. \quad (8)$$

Children's human capital accumulation uses time in education and parent's human capital as in Pallage and Zimmermann (forthcoming):

$$h_{t+1} = \xi_1 e_t^{\xi_2} h_{A,t}^{\xi_3} \quad \text{where } 0 < \xi_2, \xi_3 < 1 \text{ and } h_A > 1. \quad (9)$$

The households have a minimum subsistence level of consumption,  $\underline{c}$ . Therefore, households' objective is to maximize the discounted life time utility from their inter-temporal consumption over the minimum subsistence level as well as their child's welfare:

$$V_t(h_{A,t}) = \max_{e_t, h_{t+1}, c_t} \ln(c_t^{t,A} + \frac{c_{t+1}^{t+1,O}}{1 + r_{d,t}} - \underline{c}) + \sigma V_{t+1}(h_{t+1}), \quad (10)$$

$$c_t^{t,A} + \frac{c_{t+1}^{t+1,O}}{1 + r_{d,t}} \leq (1 - e_t)\omega w_{a,t} + w_{a,t}n_{a,t}h_t, \quad (11)$$

$$h_{t+1} = \xi_1 e_t^{\xi_2} h_{A,t}^{\xi_3}, \quad (12)$$

From the F.O.C we get  $e_t$  as

$$e_t = \left[ \frac{\sigma \xi_1 \xi_2 h_{A,t}^{\xi_3} n_{a,t+1} w_{at+1}}{\omega w_{a,t}} \right]^{\frac{1}{1-\xi_2}}. \quad (13)$$

Therefore, supply of child labor,  $n_{c,t}$  becomes

$$n_{c,t} = 1 - \left[ \frac{\sigma \xi_1 \xi_2 h_{A,t}^{\xi_3} n_{a,t+1} w_{at+1}}{\omega w_{a,t}} \right]^{\frac{1}{1-\xi_2}} \quad (14)$$

Where,  $\sigma$  represents the parental altruism towards their children. Both variables,  $e_t$  and  $n_{c,t}$  being bounded by  $[0,1]$ , create the possibility of corner solution.

## Firms

There are two types of firms. Given the technology, the production is same for both types of firms when they succeed or fail.<sup>4</sup> The expected production differs based on their success

<sup>4</sup>Similar type of assumption has been made by DeMeza and Webb (1987)

rate. The higher success rate of the low risk firms leads to a higher demand for loans as compared to the high risk firms. The technology is labor intensive and the firms use only labor for production. There are two types of labors available - the adult labor and child labor. Adult labor and child labor are considered to be substitutes in our model. Firms choose either one over the other or an optimum combination of both of them. Given this backdrop, the labor demand for firms at period  $t$  can be written as

$$n_t = n_{a,t}h_t + \omega n_{c,t} \quad (15)$$

where, the use of child labor,  $n_{ct} = (1 - e_t)$  and  $\omega$  is the relative labor efficiency of children with  $\omega < 1$ .

Let the production function of each firm be

$$f(n_t) = An_t^m \quad (16)$$

Where,  $m$  is the labors' share in the production. We assume firms do not have any endowments. They borrow from either the formal or from the informal sectors ( under credit rationing) for the wage payment. Under credit rationing, a proportion of firms,  $\alpha$ , gets loan from the formal sector and the rest,  $1 - \alpha$  is pushed to the informal sector, if it exists, at a much higher rate. Loans from both sectors are perfect substitutes and the total loan demand by firms is :

$$\begin{aligned} L_t^D &= w_{a,t}n_t \\ &= w_{a,t}h_t n_{ai,t} + \omega w_{a,t}n_{c,t}. \end{aligned} \quad (17)$$

The expected profit maximization can be stated as:

$$\max_{n_t} E_t \pi_t = A\gamma_i n_t^m - (1 + l_t)L_t^D \quad (18)$$

$$\text{S.T.} \quad L_t^D = w_{a,t}n_t.$$

where,  $\gamma_i = \phi_i(1 + z)$  with  $\phi_i$  as the respective success rates and  $z$  is the percentage gain in output over the average when the firms are successful. The above objective maximization of firms implies the labor demand and loan demand as

$$n_t = \left( \frac{A\gamma_i m}{(1 + l_t)w_{a,t}} \right)^{\frac{1}{1-m}}, \quad (19)$$

and

$$L_t^D = \left( \frac{A\gamma_i m}{w_{a,t}^m (1 + l_t)} \right)^{\frac{1}{1-m}}, \quad (20)$$

and the corresponding willingness to pay a loan rate

$$l_t = \frac{A\gamma_i m}{w_{a,t}^m L_t^{1-m}} - 1. \quad (21)$$

## Banks

In the following part of our analysis we solve the banks' and money lender's optimization problems under credit rationing to determine the steady state formal and informal loan amounts and rates that dictate the above mentioned wage rates. Then, for a comparative analysis, we also propose an alternative regime where banks separate the high risk and low risk firms and offer loans accordingly to hedge against risks. Banks, in our proposed model, can do it by devising a price incentive mechanism. The main objective of this exercise is to find out whether the alternative regime can improve the consumption level by increasing the wage rate.

### Credit Rationing Regime

The credit rationing regime is characterized by the situation where the formal sector loan extension is subject to regulated interest rate and prudential norms governed by the policies of central bank and government. As we find in India, even after reform, that up to Rs. 200,000 the interest rate is pre specified and banks do not have control over it. Moreover, given the inability of the banks to fix the asymmetric information problem due to lack of proper information or proper infrastructure to gather it, higher proportion of high risk firms in the pool at a given predetermined loan rate increases banks' expected loss. This forces banks to adopt credit rationing as a hedging device against default risks. Under this regime banks supply only a fraction even if they have enough resources to meet the total demand.

We assume that the banks can supply only a fraction  $\alpha$  of loans demanded under this regime and  $\alpha$  is endogenously determined based on the administered loan rate and the success rate of the firms. This implies that if the total revealed demand for loan is  $L_t^{FD}$  in the formal

sector, then banks supply only  $\alpha L_t^{FD}$ . The pool will be identical because the low risk firms with high demand will take the guise of the high risk firms with low demand. The hidden extra demand of the low risk loans spills over to the informal market. This adverse selection problem in the formal loan market leads the high demand firms to reap some surplus by operating on the lower demand curve in the guise of low demand or high risk firms. Let  $\rho$  be the proportion of high risk firms, we get

$$L_t^D = \rho \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} + (1 - \rho) \left( \frac{\gamma_{LR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}}, \quad (22)$$

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

$$L_t^{FD} = \rho \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} + (1 - \rho) \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}},$$

or,

$$L_t^{FD} = \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}},$$

due to adverse selection. Then the total supply of formal loans will be

$$L_t^{FS} = \alpha \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}}. \quad (23)$$

Now, as we have mentioned earlier that under credit rationing, low risk firms do not reveal their entire demand to the formal sector and leads to an adverse selection problem by creating an identical pool of borrowers in the formal markets. The low risk firms make themselves identical with the high risk firms in order to reap a surplus by operating on the lower demand curve. Thus, the amount of hidden demand of the low risk firms to maintain an identical pool to the banks is

$$L_t^D - L_t^{FD} = \rho \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} + (1 - \rho) \left( \frac{\gamma_{LR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} - \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} \quad (24)$$

$$= (1 - \rho) \left[ \left( \frac{\gamma_{LR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} - \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} \right]. \quad (25)$$

Now, along with the  $(1 - \alpha)L_t^{FD}$  fraction of loans due to rationing, the hidden demand also gets accumulated with it. This makes a total spillover of total demand for informal loans:

$$T_{i,t} = (1 - \alpha) \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} + (1 - \rho) \left[ \left( \frac{Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} \left( \gamma_{LR,t}^{\frac{1}{1-m}} - \gamma_{HR,t}^{\frac{1}{1-m}} \right) \right], \quad (26)$$

where  $T_{i,t}$  is the total demand for informal loans. Let us assume that  $\eta$  is the proportion of high risk firms in the informal demand mix. Then demand from the high risk firms that goes to the moneylenders is

$$M_{HR,t} = \eta(1 - \alpha) \left( \frac{\gamma_{HR,t} Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}}. \quad (27)$$

The rest of the demand for informal loan comes from the low risk firms. Therefore, demand for moneylenders loan from low risk firms will be

$$M_{LR,t} = \left( \frac{Am}{w_{a,t}^m (1 + \bar{l}_t)} \right)^{\frac{1}{1-m}} \left[ \gamma_{HR,t}^{\frac{1}{1-m}} (\rho + \eta\alpha - \eta - \alpha) + (1 - \rho) \gamma_{LR,t}^{\frac{1}{1-m}} \right]. \quad (28)$$

For banks' profit maximizing problem under credit rationing regime, we assume that

- i. there is no reserve requirement for the banks. Thus, they can convert all their deposits into loans.
- ii. banks choose the proportion of demand for loan to be catered  $\alpha$ , endogenously, based on available funds in order to make zero profit in the long run.

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

$$\max_{L_t, \alpha} E_t[\Pi_t^B] = \alpha \phi_{HR}(\bar{l}_t) L_t^D - (r_{d,t}) D_t \quad (29)$$

$$\text{S. T. } L_t^D \geq D_t \quad (30)$$

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

$$\alpha^* = \frac{r_{d,t}}{\bar{l}_t \phi_{HR}} \quad (31)$$

Given the fixed share of household loans, this optimum value of  $\alpha$  then determines the share of informal loans under credit rationing.

Notice that  $\alpha$  is inversely related to the success rate of the high risk firms,  $\phi_{HR}$ . This indicates that for higher success rate of the high risk firms, banks can reach its long run zero profit goal even for a lower value of  $\alpha$ . This becomes important in the latter part of our analysis when we describe the distorting effects of stringent credit rationing.

## Self-Revelation Regime

The self revelation regime is proposed as an alternative to credit rationing in order to compare relative efficiencies under different regimes. Banks set prices for differentiated loans in this regime. The difference of this regime from the credit rationing is that banks intend to disburse loan to different types of investment projects at different rates instead of a single prime lending rate as imposed in India. Loans are differentiated on the basis of the associated degree of risk. In our model we adopt the ‘Direct Revelation Principle’ from Myerson (1979). Under asymmetric information, revelation mechanism leads to a Bayesian Nash equilibrium under an induced communication game among many other Bayesian equilibria iff it is incentive compatible.

The communication game with mediation plan under this regime can be explained in the following way. The bank being the mediator asks every firm to sign a contract that they will obey bank’s authority. The bank then come up with incentive compatible contracts such that each firm loose by not telling the truth. When each firm reveal their type the bank disseminate the required information to the other type of firms and allow them to play the game. With sufficient information when the bank makes those incentive compatible contracts each and every firm reveal their type for their own interest.

As we have discussed earlier that the firms have different demand coefficients based on their success rates. Between two types of firms in our model,

1. high risk firms with a lower demand coefficient,  $\gamma_{HR}$ , operate on a lower demand curve. In this case, banks set the price in such a way so that they can take away all the surplus from high risk firms. Therefore, for the high risk firms with low demand and a probability of success,  $\phi_{HR}$ , participation constraint is binding - i.e,

$$E_t[R_{HR,t}] = \phi_{HR}L_{HR,t}(l_{HR,t}) \quad (32)$$

where  $E_tR_{HR,t}$  is the banks’ expected total revenue from the high risk firms.

2. low risk firms with higher demand coefficient,  $\gamma_{LR,t}$ , should operate on a higher demand curve. But they have incentive to operate on the lower demand curve because, by doing

so, they can enjoy a surplus. This creates an adverse selection problem. Therefore, under the self selection regime, the low risk firms with higher demand should be bounded by the incentive constraint.

Under revelation regime, the borrowers will reveal their type only if, at least, their previous payoff is assured. To do that banks have to know the actual surplus the low risk firms were enjoying by operating on a lower demand curve. As we see from the firms demand functions (Equation (21)), the willingness to pay for the high risk firm for any given level of loan,  $L_{HR}$  is

$$1 + l_{HR,t} = \frac{\gamma_{HR,t}Am}{w_{a,t}^m(L_{HR,t})^{1-m}}. \quad (33)$$

For the low risk firm for the same amount of loan is

$$1 + l_{LR,t} = \frac{\gamma_{LR,t}Am}{w_{a,t}^m(L_{HR,t})^{1-m}}. \quad (34)$$

These above two equations imply that a less risky firm has a  $\frac{\gamma_{LR,t} - \gamma_{HR,t}}{w_{a,t}^m L_{HR,t}^{1-m}}$  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

$$Q_t = \left[ \frac{\gamma_{LR,t} - \gamma_{HR,t}}{w_{a,t}^m L_{HR,t}^{1-m}} \right] L_{HR,t} \quad (35)$$

$$= Am \left( \frac{L_{HR,t}}{w_{a,t}} \right)^m (\gamma_{LR,t} - \gamma_{HR,t}). \quad (36)$$

where  $Q_t$  is total surplus. Therefore, the incentive constraint for the high demand or low risk firms to self select themselves is

$$E_t[R_{LR,t}] = \phi_{LR} L_{LR,t} (l_{LR,t}) - Am \left( \frac{L_{HR,t}}{w_{a,t}} \right)^m (\gamma_{LR,t} - \gamma_{HR,t}), \quad (37)$$

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.  $\phi_{LR}$  is the success rate of the low risk firms. To induce the firms with high demand to reveal their type, banks under such a communication game with mediation can promise to return



the surplus they were enjoying. This way banks can motivate the less risky firms to demand for  $L_{LR,t}$  amount instead of  $L_{HR,t}$ . Now with  $\rho$  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 :

$$\max_{L_{LR,t}, L_{HR,t}} E_t \Pi_t^B = \rho E_t(R_{HR,t}) + (1-\rho)E_t(R_{LR,t}) - r_{d,t}D_t \quad (38)$$

$$\text{S.T. } E_t R_{LR,t} = \phi_{LR} L_{LR,t} (l_{LR,t}) - Am \left( \frac{L_{HR,t}}{w_{a,t}} \right)^m (\gamma_{LR,t} - \gamma_{HR,t}), \quad (39)$$

$$E_t R_{HR,t} = \phi_{HR} L_{HR,t} (l_{HR,t}) \quad (40)$$

$$D_t = \rho L_{HR,t} + (1-\rho)L_{LR,t}, \quad (41)$$

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

$$l_{HR,t}^* = \frac{r_{d,t}}{\phi_{HR}} + \frac{(1-\rho) Am^2 (\gamma_{LR,t} - \gamma_{HR,t})}{\rho \phi_{HR} w_{a,t}^m (L_{HR,t})^{1-m}}, \quad (42)$$

$$l_{LR,t}^* = \frac{r_{d,t}}{\phi_{LR,t}} \quad (43)$$

## Informal Moneylenders

Informal moneylenders are risk neutral. Money lenders are price setters and set the price based on the expected degree of risk associated with the firms. Since a fraction of low risk firms goes to the households after being rejected by the formal sector, the money lenders are left with the pool of residual high and low risk firms. Money lenders do not have prior information regarding firms' type. But since they operate under a small jurisdiction, they can glean this information by incurring some cost. We assume moneylenders have market power in setting the price so that they can keep a margin of profit over their cost. Thus, moneylenders maximize their expected profit in the following way:

$$\begin{aligned} \max_{M_{HR,t}, M_{LR,t}} E_t \pi_{m,t} = & \phi_{HR} (1-\alpha) \eta l_{hHR,t} M_{HR,t} + \phi_{LR} (1-\alpha) (1-\eta) l_{hLR,t} M_{LR,t} \\ & - (c_{LR} M_{LR,t} + c_{HR} M_{HR,t}), \end{aligned} \quad (44)$$

where  $M_{i,t}$  is the loan amount offered by the money lenders,  $\phi_i$  is the success rate and  $c_i$  is the cost coefficient of the  $i_{th}$  type of firm in the informal sector.

F.O.C with respect to  $M_{HR,t}$  and  $M_{LR,t}$  :

$$M_{HR,t} : l_{hHR,t} = \frac{c_{HR}}{(1-\alpha)\eta\phi_{HR}}, \quad (45)$$

$$M_{LR,t} : l_{hLR,t} = \frac{c_{LR}}{(1-\eta)(1-\alpha)\phi_{LR}}. \quad (46)$$

Now, given  $\eta$ ,  $\alpha$  and  $\phi_i$ ,  $l_{hi,t}$  depends directly on the corresponding information cost of the moneylenders for different types of loan.

## 2.1 Steady State Equilibrium Under the Credit Rationing Regime

To evaluate the steady state equilibrium we use the solutions to the maximization problems of households, banks, firms and the informal moneylenders together with the equilibrium conditions. Along this path we assume no growth in the economy. The economy is characterized by the following equations:

1. From Equation (23), (31) and (50) we get total supply of formal loan under credit rationing as

$$\alpha \left( \frac{\gamma_{HR} Am}{w_{a,t}^m (1 + \bar{l})} \right)^{\frac{1}{1-m}}. \quad (47)$$

2. From Equation (27), (31), (45) and (50), we get demand for moneylender's loan by high risk firms

$$M_{HR} = \eta(1-\alpha) \left( \frac{\gamma_{HR} Am}{w_{a,t}^m (1 + l_{h,HR})} \right)^{\frac{1}{1-m}}. \quad (48)$$

Since the money lenders supply the entire amount, this is the optimum value for high risk moneylenders' loans.

3. The rest of the demand from residual low risk firms is supplied by moneylenders. Therefore, from Equations (28), (31), (46) and (50) we get the supply of moneylenders loan from low risk firms as

$$M_{LR} = \left( \frac{Am}{w_{a,t}^m (1 + l_{h,LR})} \right)^{\frac{1}{1-m}} \left[ \gamma_{HR}^{\frac{1}{1-m}} (\rho + \eta\alpha - \eta - \alpha) + (1 - \rho) \gamma_{LR}^{\frac{1}{1-m}} \right] \quad (49)$$

4. According to our model, the total loan that firms get, either from formal or informal sources is used to hire labor. Therefore, given the efficiency of each type of labor, we get from Equation (47) through (49) and (17) the equilibrium wage rate of the adult under credit rationing

$$w_a = (Am\gamma_{HR})^* \left[ \frac{\frac{\alpha}{(1+i)^{\frac{1}{1-m}}} + (1-\alpha) \left( (1-\eta)(\gamma_{HR}^{\frac{1}{1-m}} (\rho + \eta\alpha - \eta - \alpha)(1-\rho)\gamma_{LR}^{\frac{1}{1-m}})(\lambda^2 + \frac{(1-\lambda)^2}{(1+l_{h,LR})^{\frac{1}{1-m}}} + \frac{(1-\alpha)\eta^2}{(1+l_{h,HR})^{\frac{1}{1-m}}}) \right)}{h + \omega n_c} \right]^{1-m} \quad (50)$$

5. From the above Equations from (47) through (50), we get total supply of loan under credit rationing as

$$L^{CR} = \left( \frac{Am\gamma_{HR}}{w_a^m} \right)^{\frac{1}{1-m}} * \left[ \frac{\alpha}{(1+i)^{\frac{1}{1-m}}} + (1-\alpha) \left( (1-\eta)(\gamma_{HR}^{\frac{1}{1-m}} (\rho + \eta\alpha - \eta - \alpha) + (1-\rho)\gamma_{LR}^{\frac{1}{1-m}})(\lambda^2 + \frac{(1-\lambda)^2}{(1+l_{LR})^{\frac{1}{1-m}}} + \frac{(1-\alpha)\eta^2}{(1+l_{HR})^{\frac{1}{1-m}}}) \right) \right] \quad (51)$$

6. We assume that in the steady state the wage rate of each type of labor is equal to their marginal products. As firms pay efficiency wages to the child or adult labors, they are indifferent between the use of child labor or adult labor. The use of child labor in the production, therefore, depends exclusively on the supply of child labor by the households.

This supply is positive only when the households earning from adult labor is not sufficient to maintain consumption at the subsistence level. The gap in earning to maintain it is fulfilled by the child labor income. Therefore,

$$w_{a,t}(n_a h_t + \omega n_c) = \underline{c}. \quad (52)$$

7. Given the values of  $\sigma$  and  $\omega$  and  $n_a = 1$ , Equation (14) gives us the equilibrium value of child labor under credit rationing as

$$n_c = 1 - \left[ \frac{\sigma \xi_1 \xi_2 h_A^{\xi_3}}{\omega} \right]^{\frac{1}{1-\xi_2}}. \quad (53)$$

8. It also shows that given the education level of parents and the ratio of efficiency wages of the child to adult labor, the supply of child labor,  $n_{c,t}$ , will be zero for a particular value of  $\omega$ , the efficiency wage ratio. In other words, there will be no supply of child labor when

$$\omega \leq \sigma h_A^{\xi_3} \xi_1 \xi_2 \quad (54)$$

9. Now from Equation (52) we get the minimum required wage rate for child labor supply to be zero. Considering  $n_c = 0$  and  $n_a = 1$ , we get from this equation that

$$\underline{w}_a = \frac{c}{h} \quad (55)$$

While this is the necessary condition for zero supply of child labor, Equation (54) serves as the sufficient condition for that. Therefore, the degree of altruism of the parents, given their education and efficiency-wage ratio, determines the child labor supply.

## 2.2 Steady State Equilibrium under Self-Revelation Regime

To evaluate the steady state equilibrium under this regime we use the solutions to the maximization problems of households, banks, moneylenders and firms, together with the equilibrium conditions. In this regime banks can identify different types of firms using truth telling incentive mechanism and can decide the corresponding prices for each type of firms. Due to banks' total coverage, there are be no moneylender loans in equilibrium. Again, we assume no growth. The economy is characterized by the following equations:

1. By equating high risk firms' willingness to pay from Equation (33) with banks' willingness to accept, Equation (42), we get the optimum quantity of high risk loans supplied

$$L_{HR}^{SR} = \left( \frac{Am(\gamma_{HR}\rho\phi_{HR} - m(1-\rho)(\gamma_{LR} - \gamma_{HR}))}{w_a^m \rho(\phi_{HR} + r_d^{ss})} \right)^{\frac{1}{1-m}}. \quad (56)$$

2. By equating low risk firms' willingness to pay from Equation (34) with banks' willingness to accept, Equation (43), we get the optimum quantity of low risk loan supplied

$$L_{LR}^{SR} = \left( \frac{\phi_{LR}\gamma_{LR}Am}{w_a^m(\phi_{LR} + r_d^{ss})} \right)^{\frac{1}{1-m}}. \quad (57)$$

3. By using the optimum high risk loan amount in Equation (33), we get the optimum loan rate for high risk loans

$$l_{HR}^{ss} = \frac{\gamma_{HR}\rho r_d^{ss} + m(1-\rho)(\gamma_{LR} - \gamma_{HR})}{\gamma_{HR}\rho\phi_{HR} - m(1-\rho)(\gamma_{LR} - \gamma_{HR})}. \quad (58)$$

4. From Equation (43) we get the low risk loan rate,

$$l_{LR}^{ss} = \frac{r_d^{ss}}{\phi_{LR}} \quad (59)$$

5. From Equation (56) and (57) we get the total loan supply under this regime as

$$L^{ss} = \rho L_{HR}^{ss} + (1-\rho)L_{LR}^{ss} \quad (60)$$

6. Using the same equations we get the adult wage rate offered by firms under self revelation regime without child labor

$$w_a = \left[ \frac{1}{h} \left( \rho \frac{Am(\gamma_{HR}\rho\phi_{HR} - m(1-\rho)(\gamma_{LR} - \gamma_{HR}))}{\rho(\phi_{HR} + r_d)} \right)^{\frac{1}{1-m}} + (1-\rho) \frac{Am\phi_{LR}\gamma_{LR}}{\phi_{LR} + r_d} \right)^{\frac{1}{1-m}} \right]^{1-m} \quad (61)$$

In the next section we intend to compare the adult wage rates under self revelation with the threshold wage rate required for no child labor supply,  $\underline{w}_a$ . If this wage rate under self revelation is higher than  $\underline{w}_a$ , we can claim that total supply of child labor from the wage labor households will be zero and thus, the equilibrium under self revelation will be free from child labor.

### 3 Equilibrium Estimation and Calibration

Some parameters like inflation rate, weighted cost of capital, share of labors in agriculture and deposit rate are macroeconomic in nature. We use these parameter values directly from the literature in the Indian context. They are summarized in Table 2.

As discussed in the beginning of this section, we use a sample of 700 households from 12 states and their loan history collected by the *Agro-economic Research Centers and Units, Ministry of Agriculture, Government of India*. Out of 700 borrowers, 570 households have borrowing history while 130 households do not history. The 570 borrowing households are comprised of 121 landless households, 184 marginal farmer households, 145 small farmer

Table 2: Policy Parameters Taken from the Data in the context of India

Parameters	Description	Value
$\pi$	Inflation rate	.087
$r_d$	Deposit rate	.020
$m$	Share of labor in production	.76
$\bar{l}$	Administered real loan rate	.053

Source: Shirai Sayuri. (2002): "Road from State to Market - Assessing the General Approach to Banking Sector Reform in India", Asian Development Bank Institute Research Paper, No.32.

households and 120 medium and large farmer households<sup>5</sup>. We use different regression models to estimate the following parameters.

Estimations of the parameters summarized in Table 3 are done in the following way:

- i.  $\psi$  = Percentage gain in production over mean level when the project is successful: We first regress the log of real value of production on the log of different inputs and implements used. Percent deviation of actual from the estimated real production is considered as the expected gain,  $\psi$  for each firms. Since there are no technological differences assumed between high risk and low risk firms therefore, this expected gain is considered to be same for all types of firms.
- ii.  $A$  = Technology parameter or the scale parameter.
- iii.  $h_A$  = Parental education level in terms of average years of attendance in school or college: We find the average number from the maximum number of years spent by the mother or father to get their highest degree. We use our sample data to find this number.
- iv.  $n_c$  = Percentage child labor supplied by labor households: We use directly the average value of this percentage from the same sample.

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<sup>5</sup>As per the Govt. of India a holding of 0-1 ha of land defines the farmer marginal while small farmers hold 1-2 ha. Land holding of larger size makes a farm medium or large.

v.  $\omega$  = The ratio of child to efficient adult wage rate: We use Labour Bureau, Government of India (2003), which publishes monthly average wages for adult men, women and child labors for different agricultural activities. We convert the posted adult wage rate into efficiency wage by dividing it by the corresponding human capital of that adult measured by years of education. We estimate  $\omega$  by using the ratio of the annual average of efficiency wage of adult to the child wage. We assume that all children are equally efficient and unless they finish their elementary schooling their human capital does not differ from one to the other.

vi. We use the child's level of ( $h_{t+1}$ ), time devoted to education, ( $e_t$ ) and parental years of education ( $h_{A,t}$ ) from our sample data set to estimate the following regression equation

$$\log h_{t+1} = \xi_1 + \xi_2 \log(e_t) + \xi_3 \log(h_{A,t})$$

to estimate the following parameters:

- $\xi_1$  = Scale parameter of the human capital development,
- $\xi_2$  = Share of education in child's human capital development, and
- $\xi_3$  = Share of parental education in child's human capital development.

vii.  $\sigma$  = Level of parental altruism: Using the parameters from our regression analysis into the Equation (54) we estimate  $\sigma$ .

### 3.1 Parameters Estimated using Discriminant Analysis

The household level sample data for borrowers reveals the prevalence of separating equilibrium in the informal sector. According to Figure 1, the distribution of borrowers with respect to informal interest rates has two distinct separations (at interest rates 3 and 18 percent) with three modes in the informal loan market. The first mode is at zero percent real interest rate while the other two modes correspond to 15 and 27 percent. We consider only the moneylenders loan in this model and as per its usurious characteristics, zero percent

Table 3: Parameters Estimated from Sample Data

Parameters	Description	Value
$\psi$	Percentage gain in output when successful	.81
$A$	Technological parameter	.33
$h_a$	Average level of Maximum Parental Education level	7.14
$n_c$	Percent child labor supply by labor households	.22
$\omega$	Ratio of child to adult efficiency wage rate	.47
$\xi_1$	Scale factor in human capital formation	.198
$\xi_2$	Share of child's education in human capital development	.81
$\xi_3$	Share of parental education in child's human capital development	.78
$\sigma$	Parental altruism	.60

Note: Maximum Parental education is 4 years for education up to 4<sup>th</sup> Grade, is 10 years for up to 10<sup>th</sup> Grade, is 12 for up to 12<sup>th</sup> Grade, is 15 for up to undergraduate or diploma and is 17 for up to graduate level.

We used Table 1.a in Labour Bureau, Government of India, 2002-03, for wage rates.

cannot be the actual rate. One possibility is that the actual rates are hidden. Due to such identification problem we ignore them initially and consider the separation of the rest of the borrowers at 18 percent as the separation of borrowers with low from the high rate loans. Next, we run several T-tests to identify the group of borrowers at zero percent as either low or high rate borrowers. We use successive default rates in the informal markets and use of child labor as the identifying variables. The T-tests suggest that the borrowers at zero percent interest rates are similar to the low rate borrowers.

Based on this information, we consider the borrowers with interest rates lower than 18 percent (including the zero percent) as low risk firms and borrowers above it are high risk firms. Then we use the basic characteristics of these two groups in discriminant analysis to separate the formal markets between high and low risk firms. After we categorize the firms into high risk and low risk firms for the entire market, we test the following hypothesis to



Table 4: Classification of Borrowers with Mode at Zero Percent Rate of Interest

Indicators	Informal interest rate		
	0	0 to 18	Above 18
Percent child labor used	16.77	21.77 (.1555)	47.4 (.0001)
Default rate in informal Market	22.28	26.17 (.2853)	29.26 (.0367)

Note: Figures in the parenthesis indicate the level of significance.

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

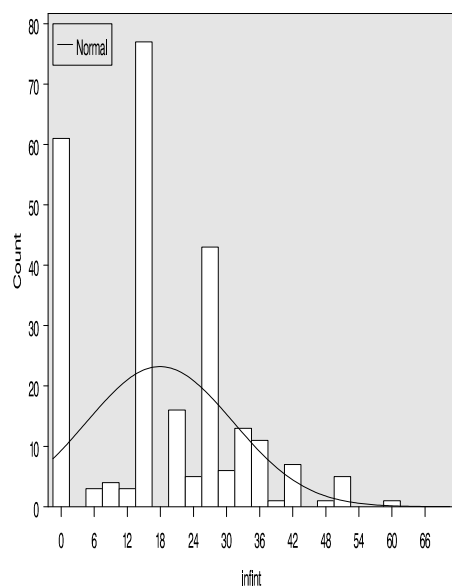


Table 5: Mean Estimated Values of Certain Indicator Variables Across High Risk and Low Risk Firms

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

justify the validity of our consideration regarding high and low risk firms in the informal markets. The hypothesis we tested in this regard are:

- High risk firms have higher default rates.
- The borrowers with diversified sources of income are low risk.
- High risk borrowers use more child labor as compared to low risk borrowers as a shock absorbing device.
- High risk firms have higher probability of default.

Table 5 represents the mean values of the indicator variables of the low and high risk groups. The findings suggest that the separation of the formal sector with the help of information available in the informal sector is statistically robust.

After we divided our sample firms into two groups - high risk and low risk, we find out the mean values of the following parameters.

- i.  $\rho$  = Proportion of high risk firms among the total borrowers = .54,
- ii.  $\phi_{HR}$  = Success rate of the high risk firms = .78,

- iii.  $\phi_{LR}$  = Success rate of the low risk firms = .86,
- iv.  $\gamma_{LR}$  = Demand coefficient for low risk firms = 1.56,
- v.  $\gamma_{HR}$  = Demand coefficient for high risk firms = 1.41,
- vi.  $\eta$  = The proportion of high risk firms in the informal market = .38,
- vii.  $x$  = Proportion of high risk firms in the formal market = .72.

Moneylenders' information cost coefficients for low risk and high risk loans,  $c_{LR}$  and  $c_{HR}$ , are obtained from our model equilibrium: Using the optimal moneylenders' loan rates along with Equations (27), (28), (45) and (46), we get the optimal cost of moneylenders per unit of loan.

The equilibrium value of the proportion of loan demand supplied by the formal market under the credit rationing regime,  $\alpha$ , is found from maximizing bank's optimization problem under credit rationing, Equations (29) through (31).

The equilibrium values of high and low risk loan rates,  $l_i$ , are obtained from Equations (58) and (59) for the revelation regime. Under the credit rationing, it is the average value estimated from the data for the period 1970 to 2000.

The equilibrium values of high and low risk loans,  $L_i$ , are given by from our model using Equations (56) and (57) for the revelation regime.

The equilibrium amounts of informal moneylenders' loans,  $M_i$ , are determined from Equations (48) and (49).

Table 7 shows that compared to the credit rationing regime, more loans can be provided with proper hedging devise against risk under revelation regime. This can be done not only by charging a higher loan rate to risky firms but also by providing a lesser amount to them as compared to low risk firms. Our results also show that thanks to proper risk identifying mechanism in the revelation rationing regime, banks end up providing more loan to both type of firms.

From Table 8, we find significant improvements in the values of some variables crucial for this study. We see that the level of consumption under self revelation regime is much

Table 6: Parameters Estimates Obtained from Discriminant Analysis

Parameters	Description	Value
$\phi_{LR}$	Success rate of the low risk firms	.86
$\phi_{HR}$	Success rate of the high risk firms	.78
$\gamma_{HR}$	Demand coefficient for high risk firms	1.41
$\gamma_{LR}$	Demand coefficient for low risk firms	1.56
$\rho$	Proportion of high risk firms	.54
$x$	Proportion of high risk firms in the formal market	.72
$\eta$	Proportion of high risk firms in the informal market	.38

Table 7: Steady State Estimates of Equilibrium Loan Rates and Optimum Amount of Loans Under Different Regimes

Parameter	Description	Under Credit Rationing		Under Self Selection	
		High risk	Low risk	High risk	Low risk
$\alpha$	Fraction of credit rationing	.484	.484	-	-
$r_l^{ss}$	Bank loan rate	.053	.053	.055	.023
$r_h^{ss}$	Informal sector loan rate	.270	.150	-	-
$c_i$	Cost coefficient for moneylenders loan	.042	.038	-	-
$L^{ss}$	Amount of bank loan	.120	.048	.167	.362
$M^{ss}$	Amount of moneylenders' loan	.031	.123	-	-

Table 8: Steady State Estimates of Required and Optimum Consumption, Deposit and Wage Rates under Different Regimes

Parameters	Description	Threshold	CR	SS
$C$	Consumption	.291	.291	.363
$D + S$	Deposit	.168	.168	.256
$w_a$	Adult wage rate	.388	.341	.397
$\underline{\omega}$	Child- adult wage ratio	.448	.470	.407
$\delta$	Consumption Equivalence		1	1.59
$e$	Time devoted to education		.78	1
$h$	Human Capital Dev.		.75	.916

- **Note:** Threshold consumption is the subsistence level consumption ( $\underline{c}$ ).
- Required adult wage is the minimum wage rate required to maintain subsistence consumption without child labor income ( $w_a$ ).
- Threshold  $\omega$  is the maximum value of the child wage to adult efficiency wage ratio for no supply of child labor, ( $\bar{\omega}$ ).

higher than the credit rationing where households consume at the subsistence level. The consumption equivalence,  $\delta$ , under self revelation regime is 1.59 compared to credit rationing regime.

Another important findings of our study is the improvement in adult wage rate. It is not only higher than that under the existing credit rationing, it is also significantly higher than the minimum adult wage required to maintain consumption at the subsistence level without supplying any child labor. Now, when this is the necessary condition for no supply of child labor, the sufficient condition is supported by the value of  $\omega$ . The value of  $\omega$  suggests that given the child labor wage and the parental altruism, the maximum threshold value that restrains households from supplying child labor is much lower than the wage rate under self revelation regime determined by the equilibrium in the labor market (Point E in Figure 5). This result gives us an unique equilibrium under self revelation regime.

## 3.2 Calibration:

In this section we calibrate our model for different values of parental education and their altruism to find out their implication on households child labor supply decision. To do that we find out the relative importance of each of these factors and observe how their combined effect affects the child labor decision by households. Next, we incorporate these findings and lay out the actions required to satisfy the conditions for eradicating child labor.

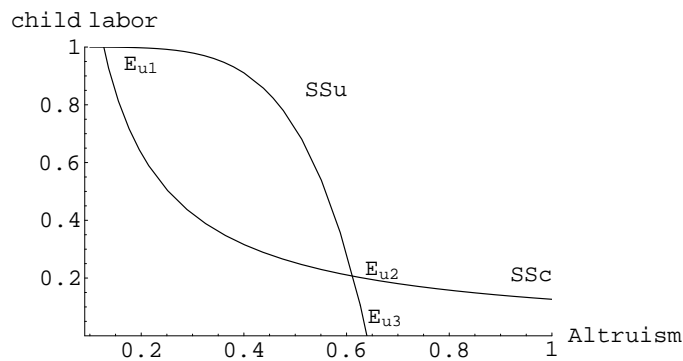
### 3.2.1 Parental Education, Altruism, and Child Labor Supply

This part of our analysis focuses mainly on the importance of parental altruism in households' child labor supply decision. As depicted in Figure 2,  $SS_u$  and  $SS_c$  curves represent the unconstrained and constrained child labor supply decision of households at different levels of parental altruism. The figure shows that given the parental education, households supply more child labor than required at lower levels of altruism but it plummets down drastically for higher values of altruism. Beyond the threshold level of altruism child labor supply is zero even if the requirement is higher to maintain the subsistence level of consumption. This finding suggests that the 'luxury axiom' is the necessary condition for households child labor supply decision while the sufficient condition is governed by households' altruism towards their children.

One of the factors that is kept fixed at its equilibrium value is the parental education level in terms of their number of years spent in school and college. The combined effect of parental education and altruism brings out even more interesting results.

Table 9 represents different combinations of parental altruism and average number of years of parents' schooling to explain it. Our findings suggest that even for a much higher level of altruism, child labor supply is very high with a lower level of parental education. As parental education increases the supply of child labor drops drastically. This is one of our crucial findings in regard to the mandatory schooling for children. Our results show that compulsory primary education does not have any significant impact on child labor supply.

Figure 2: **Actual and Required Child Labor Supply Across Different Levels of Parental Altruism**



Note:  $SS_u$  represents unconstrained supply of child labor.  $SS_c$  represents supply of child labor required to maintain subsistence consumption.

$E_{u1}$ ,  $E_{u2}$  shows where these two supply decisions are identical.  $E_{u3}$  is the level of altruism for which child labor supply is zero.

As we find that even at 90 percent altruism there will be more than 40 percent child labor—when parental education is limited to primary level. Alternatively, if parental education level is extended to even middle school, child labor supply drops to a significantly lower level even for a moderate level of parental altruism. This implies that mandatory education for children up to middle school today can lead to a drastic fall in child labor supply tomorrow by the same cohort, when they grow adult and takes the households decisions. Otherwise, any form of incentive like “mid day meal” to “bring back to school” may not have significant impact on reducing child labor supply unless we go beyond the primary level. Now, increase in education level is only possible when adult wage is considerably higher than the equilibrium wage rate that we found under credit rationing regime. In the following section we discuss our findings why drastic reduction in child labor is not possible under credit rationing through increase in adult wage rate.

### 3.2.2 Increase in Adult Wage Rate and Child Labor Supply:

Figure 3 indicates the existence of multiple equilibria under credit rationing— one with child labor ( $E_c$ ) and the other without it ( $E_u$ ). Among these two equilibria, the steady state equilibrium is the inferior one with child labor.

Table 9: Interaction of Parental Altruism and Their Average Number of Years in School on Child Labor

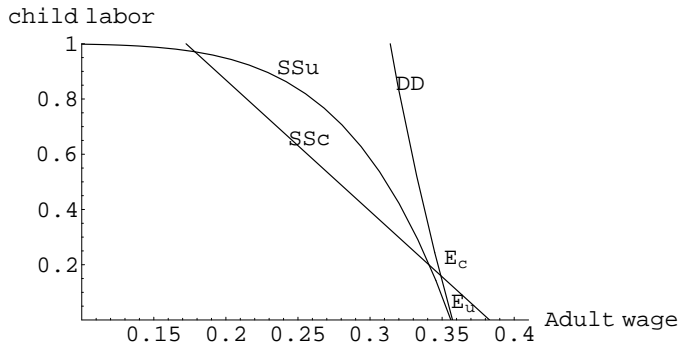
Altruism	4 Years	8 Years	10 Years
.1	1	1	1
.2	1	1	.99
.3	1	.97	.92
.4	.99	.86	.66
.5	.97	.56	0
.6	.93	0	
.7	.85		
.8	.69		
.9	.44		
1	.03		

Table 10: Rate of Success of the firms, Credit Rationing and their Impact on Adult Wage

$\phi_{HR}$	$\alpha$	$w_a$
1	.375	.345
.94	.4	.344
.84	.45	.340
.79	.48	.339
.75	.5	.338
.63	.6	.333
.54	.7	.331
.47	.8	.331
.42	.9	.332
.38	1	.336



Figure 3: Multiple Equilibria Under Credit Rationing with Different Levels of Child Labor Supply



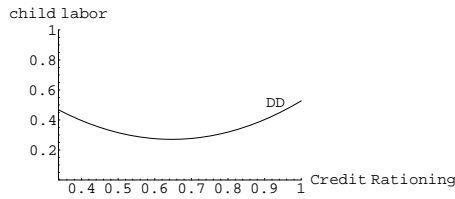
Note:  $SS_u$  represents unconstrained supply of child labor.  $SS_c$  represents constrained supply of child labor and  $DD$  represents demand for child labor.  $E_c$  and  $E_u$  are the two equilibria under credit rationing.

The Figure also suggests that the superior equilibrium, with no child labor, can be achieved only when adult wage rate is higher than the threshold value. Now, the question arises here is whether the desired adult wage rate can be achieved under credit rationing such that the equilibrium point  $E_u$  is reached.

One of the most interesting results from our model economy is the interaction between credit rationing and child labor supply. Any adult wage rate below the threshold gives rise to child labor supply. Given the inelastic adult labor supply, the adult wage rate increases only when firms demand for adult labor increases. Now, given the technology, this is possible when firms expected profit increases due to an increase in success rate. The increase in success rate of both, high and the low risk firms, leads to the similar outcomes regarding child labor supply even though they follow different path.

Interestingly, our findings suggest that the increase in adult wage under credit rationing rather distorts the market mechanism and aggravates the problem of child labor further. As we see from Table 10, an increase in probability of success of the high risk firms makes credit rationing more stringent. If we look at the banks maximization problem under credit rationing, we find that the degree of credit rationing,  $\alpha$ , is inversely related to the success rate

Figure 4: **Child Labor Demand under Different Degrees of Credit Rationing**

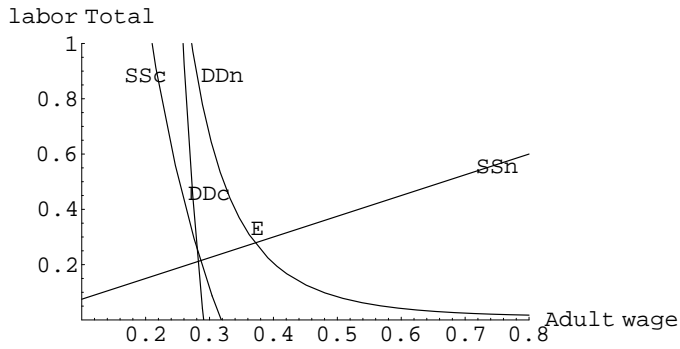


of the high risk firms (Equation (31)). As the success rate of the high risk firms increases, banks can achieve their long run equilibrium by catering a lower proportion of the demand for loan. As a result, with higher success rate, the access to formal credit decreases and firms have to depend more on informal source when they need and deserve it most from the formal sector. Larger spill over of demand for loans to the informal markets increases the bargaining power of the informal lenders and the loan rates become exorbitantly high. This higher demand for labor, coupled with stringent credit rationing and overdependence on the informal sector, forces the high risk firms to substitute adult labor with child labor and, therefore, demand for child labor increases with higher adult wage rate.

Similarly, when the success rate of the low risk firms increases it also increases the dependence of the low risk firms on the informal sector. This happens because due to adverse selection problem under credit rationing, low risk firms hide their extra demand from the banks in order to make the pool of high and low risk borrowers identical. As a result, their higher demand due to increase in success rate gets reflected only in the informal market. Such increased dependence of the low risk firms on informal source of funds forces them to supplement the extra demand for adult labor by child labor.

Figure 4 corroborates this argument by showing that demand for child labor is much higher when credit rationing is more stringent. Any policy measures in favor of stringent credit rationing to arrest child labor supply may thus, actually be fatal. Moreover, we find from Table 7, the highest achievable adult wage rate is well below the threshold value under this circumstance under credit rationing regime.

Figure 5: Total and Child Labor Demand under Self-Revelation



Note:  $SS_n$  represents supply of total labor.  $SS_c$  represents constrained supply of child labor and  $DD_n$  and  $DD_c$  represent demand for total and child labor.  $E$  is the market equilibrium under direct revelation regime.

### 3.2.3 Credit Rationing Vs. Revelation Regime

As credit rationing does not seem to eradicate child labor, removing interest rate ceiling and allowing banks to set freely interest rates and differentiate them, can. Our results show that while credit rationing leads to the inferior equilibrium, we reach the superior one under revelation regime, given the other things. As we see from Figure 5 that the market leads to the superior equilibrium even though there is a possibility of the other with child labor. Given the demand for child labor by firms, the supply takes place to compensate it only when adult wage rate is very low. The market under direct revelation regime, clears not only at a wage rate much higher than this wage rate that requires child labor, it is also higher than the threshold adult wage required to maintain subsistence consumption without child labor.

Table 7 shows the equilibrium adult wage rate and threshold required adult wage for no child labor supply. This wage rate stops child labor supply by wage labor households and establishes the superior equilibrium in the labor market driven by market clearing adult wage rate.

## 4 Conclusion

In this paper, we address the issue of child labor in the context of a developing country like India and link it with the credit market imperfections for production loans. We quantify equilibria for two different credit regimes—the existing rationing regime resulting from interest rate regulation, and, our proposed alternative, a direct revelation regime with free differentiated interest rates. We also addressed the informal credit market issue resulting from credit rationing. The main contribution of this paper is to show quantitatively why, *ceteris paribus*, credit rationing in the production loan market fails to curb child labor. With the help of the necessary and sufficient conditions for eradicating child labor, we show that our proposed alternative not only satisfies those conditions for a calibration to India but also leads to a superior equilibrium as compared to credit rationing without child labor.

With the consideration of heterogenous firms with respective success rate, we conclude that under credit rationing there is a possibility of multiple equilibria with and without child labor. Our findings show that given the situation, the market reaches the inferior one with child labor depending on households requirement to supply child labor in order to maintain the subsistence level of consumption and their degree of altruism. We find that the threshold wage rate for households not to supply child labor is much higher than the equilibrium wage rate, and as a result, child labor exists in equilibrium.

The calibration of our model for different levels of parental altruism and their education level show that the increase in adult wage under credit rationing distorts the market mechanism and aggravates the problem of child labor further. Adult labor supply being inelastic, firms higher success rate increases the adult wage rate by increasing the demand. But, credit rationing being inversely proportional to firms' success rate, firms' access to formal credit shrinks drastically when they need it most to pay the higher wage to the adult labor. Such stringent credit rationing forces firms to depend more on informal loans. Exorbitantly higher interest rates in the informal market compel the high risk firms to reshuffle their composition of labor demand in favor of more child labors.

However, in the direct revelation regime this distortion can be overcome and the superior equilibrium is achieved in the steady state by deregulating the loan market through incen-

tive based pricing. The equilibrium wage rate is significantly higher than the threshold to eradicate child labor.

Our result suggests that *ceteris paribus*, the mandatory primary level education does not have significant impact on child labor supply. But, if education becomes mandatory up to middle school, then there is a significant drop in child labor supply even for the households with low altruism.

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