Access to capital in rural Thailand: An estimated model of formal vs. informal credit

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Motivation

- Contracts available in rural areas vary according to characteristics of **borrowers** and **lenders** and according to the type of **project** being financed.
- Example: Free loans among friends, Collateralised loan from a bank, unsecured loan from a moneylender but at higher interest rate.
- Traditional view has been that poor farmers are exploited at the hands of moneylenders who charge exorbitant rates. This view serves as a ground for many policy interventions that aim at helping supply formal credit to the poor.
- This paper is in the league of papers that challenge this traditional view and show that informal credit is still used despite injection of formal credit and increased presence of formal credit doesn't affect the interest rates. In addition, it shows that
  - borrowers with collateralisable assets tend to be more active in the formal credit market.
  - borrowers often diversify between both formal and informal credit markets.

Introduction

- In this paper, a contract theory model has been developed that provides a unified view of co-existence of formal and informal credit markets. The model has two key features:
  - Fixed cost must be paid in order to obtain external credit, which is higher in case of banks than in case of moneylenders.
  - Banks have limited ability to enforce credit contracts, which is not the case with moneylenders.
- **Imperfect Enforceability by Banks**: A project requires both *fixed* and *working* capital. Fixed capital remains after production, while working capital transforms into output. So the borrower has an option to default after the loan is granted and before the production is started, thus keeping all the working capital but losing savings deposited in bank, and fixed capital which is seized.This imposes a maximum on the amount of working capital that the bank is willing to lend.

The Model

- Static and deterministic model
- Agents are income maximizers. Four sources of heterogeneity in agents:
  wealth b, entrepreneurial ability z, project type (K, η)
  K is the maximum scale at which the project can be operated.
  η is fraction of working capital relative to total capital
- Four options to finance the project:
  Self finance (S), Formal Bank (B), Informal Moneylender (M), Both (BM)
- Banks rely on legal system for enforcements, while moneylenders may resort to other mechanisms.
- Banks lend out of collected deposits, while moneylenders lend out of their own wealth and funds borrowed from the bank, hence, opportunity cost of funds for the moneylender will typically be higher.

The Model

- TRADE OFF: Banks have access to lower cost of funds, while money lenders can prevent clients from "running away" with the borrowed capital.
- Time line of the events is given by the following figure:

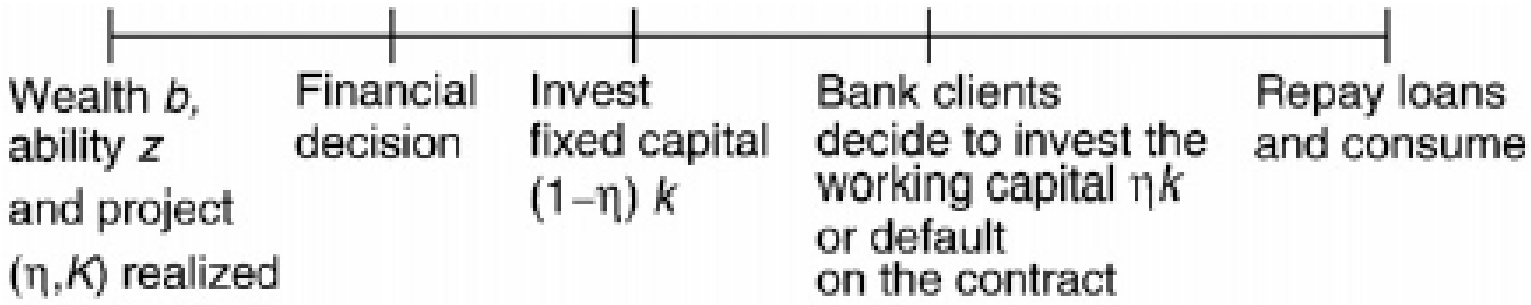


Fig. 1. Time-line of the model.

The Model

- Each agent has access to the following technology:

$$f(z, k; K, \eta) = zk + \tilde{\delta}(1 - \eta)k \tag{1}$$

  s.t $k \leq K$. Here $\tilde{\delta}(1 - \eta)$ captures the fixed capital left after the production has taken place. $\tilde{\delta}$ is the fraction of non-depreciated capital. For notational simplicity, let $\tilde{\delta}(1 - \eta) = \delta$

- *constrained* household: one which invest $k < K$
  unconstrained household: one which invests $k = K$

The model

- Net income when entrepreneur decides to self finance:

$$Y_s(z, b; K, \eta) = \max_k zk + \delta k + (b-k)r_d \quad s.t. \quad k \leq b, \quad k \leq K; \quad (2)$$

- Optimal choice of capital:

$$k_S(z; K, \eta) = \begin{cases} K & \text{if} \quad z \geq r_d - \delta \quad \textit{and} \quad b \geq K, \\ b & \textit{if} \quad z \geq r_d - \delta \quad \textit{and} \quad b < K, \\ 0 & \textit{if} \quad z < r_d - \delta \end{cases} \quad (3)$$

The model

- If the agent goes to the bank, she borrows $l_B = k - b$ and will not deposit anything at the bank because $r_B > r_D$
- Agent's net income if he borrows from the bank is given by

$$Y_B(z, b; K, \eta) = \max_k zk - (k - b)r_B + \delta k - \Gamma_B \tag{4}$$

$$s.t \quad k \leq K \quad and \quad zk - (k - b)r_B + \delta k \geq \eta k \tag{5}$$

- Last constraint captures the enforcement disadvantage that banks have in dealing with the moral hazard problem of the agents. We assume that banks have no legal means to prevent a borrower from "consuming" the working capital.
- Implicit in the above problem is the notion that banks operate in a competitive setting, thus will offer contracts that maximise agent's income.

The model

- Optimal choice capital depends on whether the enforcement constraint is binding or not. If it binds, maximum amount of capital that bank is willing to land is given by:

$$k^c = \frac{br_B}{\eta - (z + \delta - r_B)}$$

- Net income is given by:

$$Y_{Bu} = (z + \delta - r_b)K + r_B b - \Gamma_B \quad \text{when the constraint doesn't bind} \tag{6}$$

$$Y_{Bc} = \eta k^c - \Gamma_B \quad \text{when it binds} \tag{7}$$

The model

- When the agent resorts to a moneylender, he borrows $l_M = K - b$
- Net income of the agent:

$$Y_M(z, b; K, \eta) = \max_k z * k - (k - b) * r_M + \delta - \Gamma_M \tag{8}$$

- It is assumed that $r_M > r_B$
- Also, since the moneylender is not subject to enforcement problems and operates in a competitive environment, he will advance $l_M = K - b$ so that the agent operates the project at maximum capacity.

The model

- Finally, it may be in agent's interest to borrow from both the sources. Since $r_M > r_B$, agents borrow from bank as much as the bank is willing to lend, i.e $l_B = k^c - b$, and then borrow remaining $l_M = K - k^c$ from the moneylender.
- Net income of the agent in this case would be:

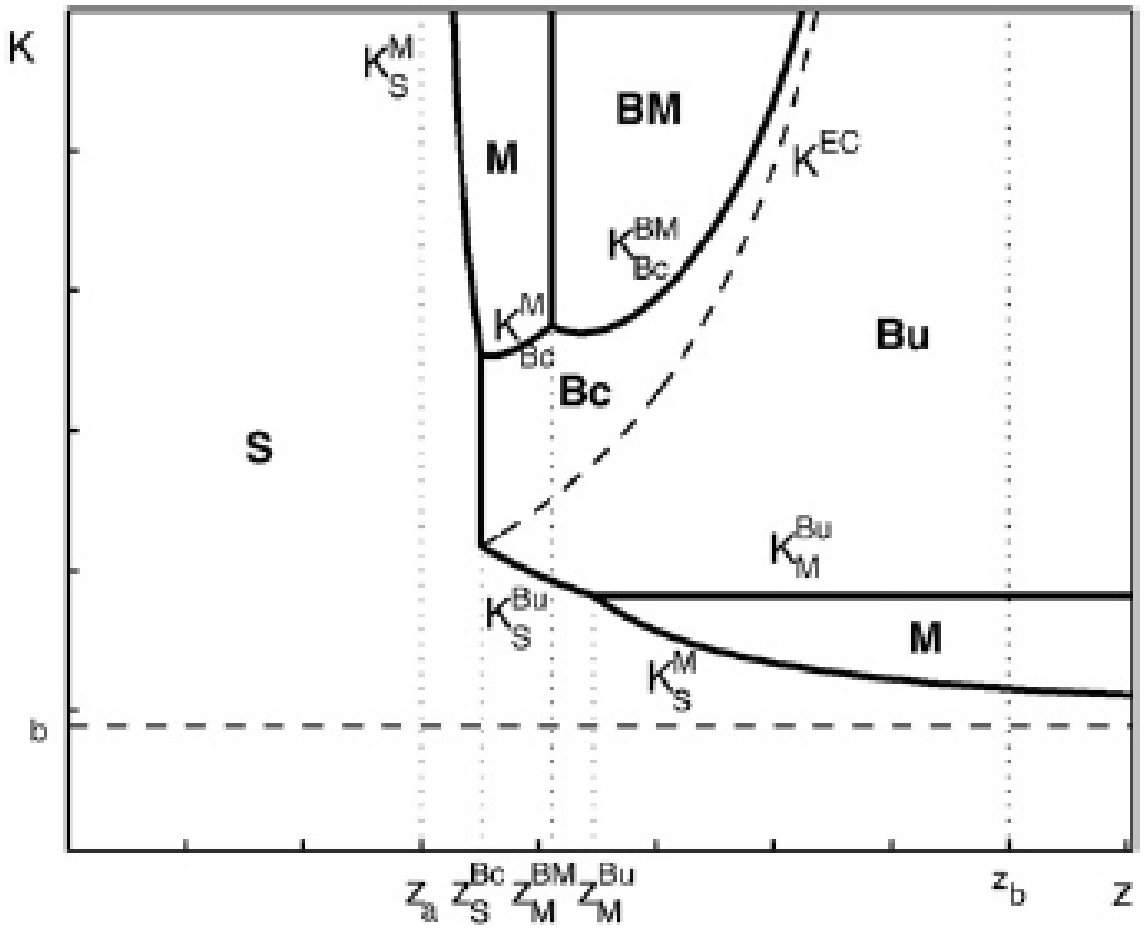
$$Y_{BM}(z, b; K, \eta) = zK - (k^c - b)r_B - (K - k^c)r_M + \delta K - \Gamma_B - \Gamma_M \tag{9}$$

$$Y_{BM}(z, b; K, \eta) = Y_M(z, b; K, \eta) + (k^c - b)(r_M - r_B) - \Gamma_B \tag{10}$$

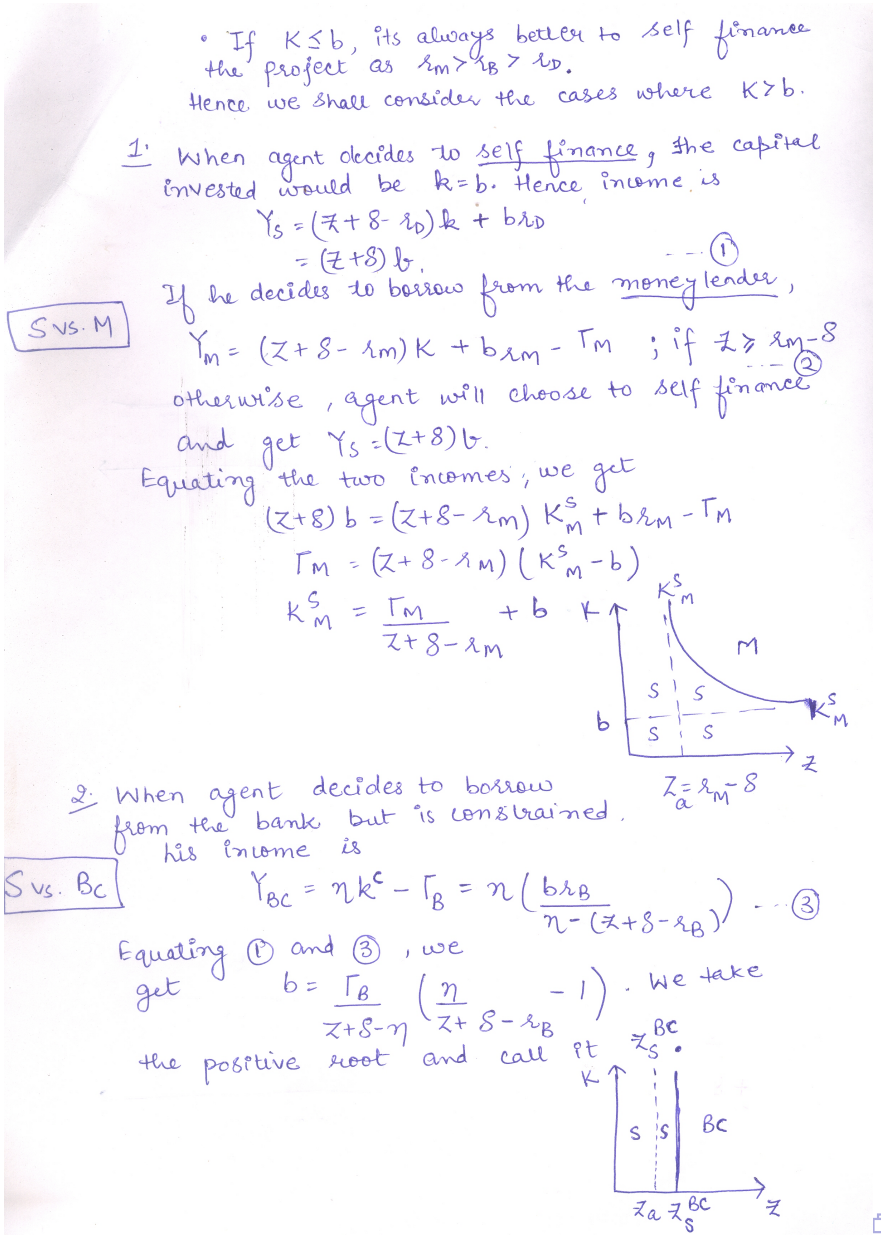
$$= Y_{BC}(z, b; K, \eta) + (K - k^c)(z + \delta - r_M) - \Gamma_M \tag{11}$$

The Financial Choice Diagram

- Based on the maximal capacity K and entrepreneurial ability z, agent will choose a credit contract that yields him the highest income. The diagram that explains her financial choice is given below:



The financial choice diagram



• If $K \leq b$, its always better to self finance the project as $i_M > i_B > i_D$.
Hence we shall consider the cases where $K > b$.

1. When agent decides to self finance, the capital invested would be $k = b$. Hence income is

$$Y_S = (Z + \delta - i_D)k + b i_D$$
$$= (Z + \delta) b. \quad \cdots (1)$$

S vs. M

If he decides to borrow from the moneylender,

$$Y_M = (Z + \delta - i_M) K + b i_M - \Gamma_M \quad ; \text{ if } Z \geq i_M - \delta \quad \cdots (2)$$

otherwise, agent will choose to self finance and get $Y_S = (Z+\delta) b$.

Equating the two incomes, we get

$$(Z+\delta) b = (Z + \delta - i_M) K_M^S + b i_M - \Gamma_M$$
$$\Gamma_M = (Z + \delta - i_M)(K_M^S - b)$$
$$K_M^S = \frac{\Gamma_M}{Z + \delta - i_M} + b$$

2. When agent decides to borrow from the bank but is constrained, his income is

S vs. Bc

$$Y_{BC} = \eta k^c - \Gamma_B = \eta \left(\frac{b i_B}{\eta - (Z + \delta - i_B)} \right) \quad \cdots (3)$$

Equating (1) and (3), we get

$$b = \frac{\Gamma_B}{Z + \delta - \eta} \left(\frac{\eta}{Z + \delta - i_B} - 1 \right)$$

. We take the positive root and call it Z_S^{BC}.

The financial choice diagram

3. Net income from going to the bank and getting unconstrained credit

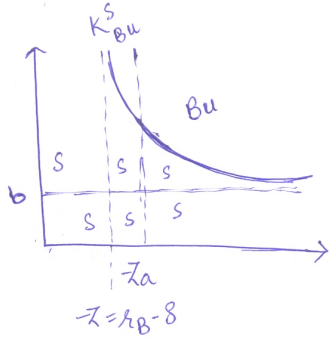
$$Y_{Bu} = (\bar{z} + \delta - r_B) K + b r_B - \Gamma_B \quad \text{--- (4)}$$

Equating (1) and (4), we get

$$\Gamma_B = (\bar{z} + \delta - r_B)(K^S_{Bu} - b)$$

$$K^S_{Bu} = \frac{\Gamma_B}{\bar{z} + \delta - r_B} + b$$

S vs. Bu



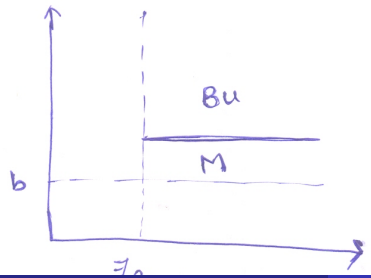
4. Comparing unconstrained borrowing from the bank with borrowing from the moneylender

$$(\bar{z} + \delta - r_B) K^{Bu}_M + b r_B - \Gamma_B =$$

$$(\bar{z} + \delta - r_m) K^{Bu}_M + b r_M - \Gamma_M$$

$$\Rightarrow \quad K^{Bu}_M = b + \frac{\Gamma_B - \Gamma_M}{r_M - r_B}$$

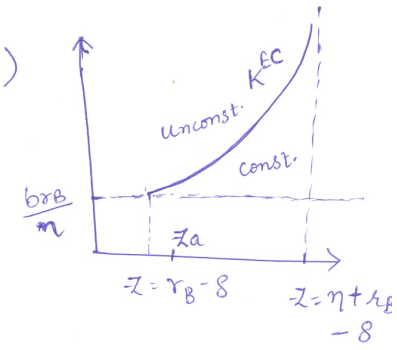
Bu vs M



The financial choice diagram

5. Being constrained or unconstrained, depend on K and z too.

$$K^{EC} = \frac{b r_B}{\eta - (z + \delta - r_B)}$$



6. Borrowing from both Bank and moneylender vs. only bank.

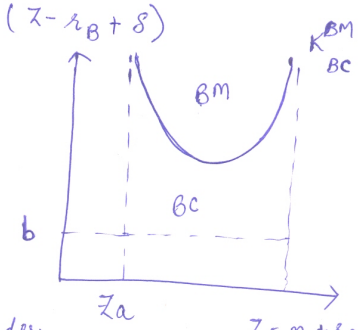
$$Y_{BM} = Y_{BC} + (K - k^C)(z + \delta - r_M) - \Gamma_M$$

$$Y_{BC} = Y_{BC} + (K^{BM}_{BC} - k^C)(z + \delta - r_M) - \Gamma_M$$

$$\Gamma_M = (K^{BM}_{BC} - k^C)(-z + \delta - r_M)$$

$$K^{BM}_{BC} = \frac{\Gamma_M}{z + \delta - r_M} + \frac{b r_B}{\eta - (z - r_B + \delta)}$$

BM vs. B



7. Constrained Bank loan vs. Moneylender

$$\eta k^C - \Gamma_B = (z + \delta - r_M) K^M_{BC} + b r_M - \Gamma_B$$

$$K^M_{BC} = \frac{1}{z + \delta - r_M} \left[\frac{b \eta r_B}{\eta - (z - r_B + \delta)} - b r_M - (\Gamma_B - \Gamma_M) \right]$$

The financial choice diagram

8 Moneylender vs. Bank and Moneylender

$$Y_{BM} = Y_M + (k^c - b)(r_M - r_B) - \Gamma_B$$

$$Y_M = Y_M + (k^c - b)(r_M - r_B) - \Gamma_B$$

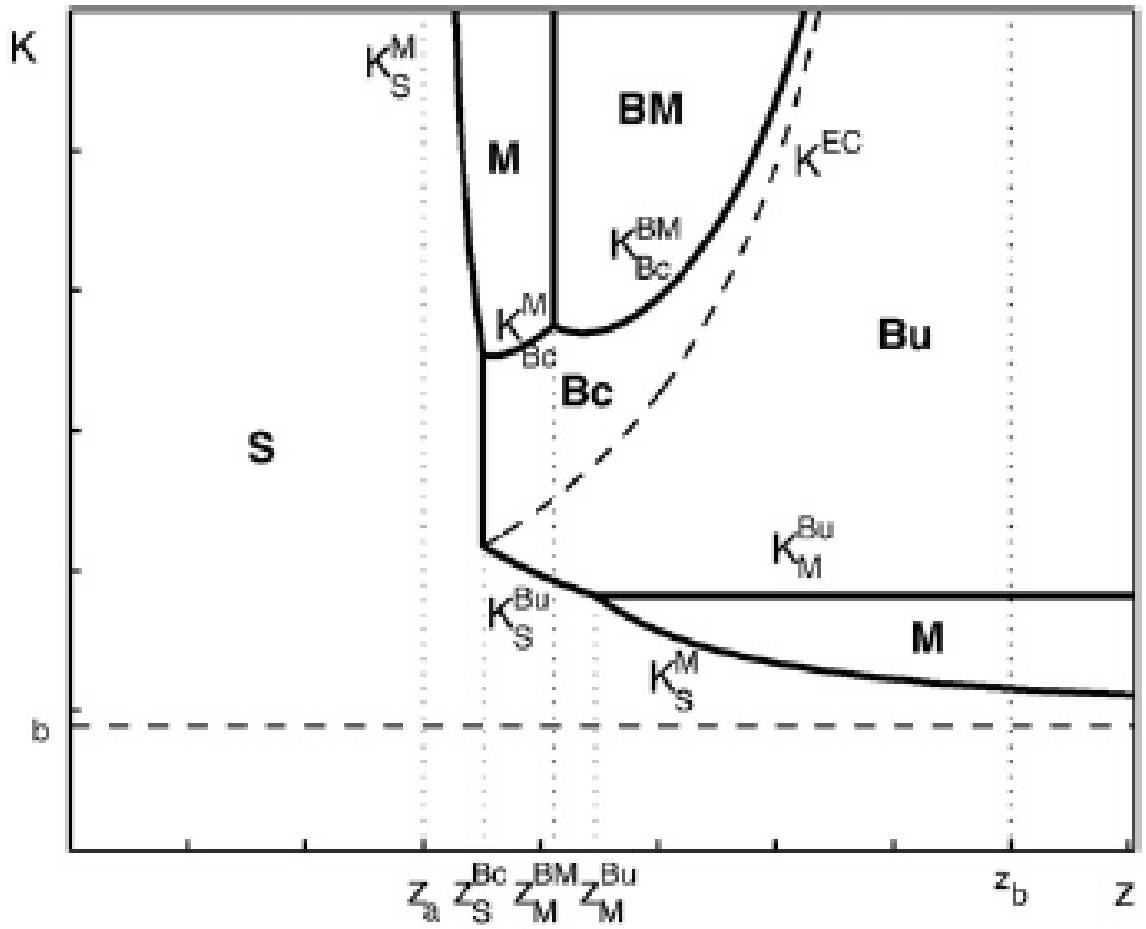
M vs. BM

$$b\left(\frac{r_B}{\eta - (\zeta - r_B + \delta)} - b\right) = \frac{\Gamma_B}{r_M - r_B}$$

$$z_M^{BM} = \eta - \delta + \frac{\Gamma_B r_B}{\Gamma_B + b(r_M - r_B)}$$

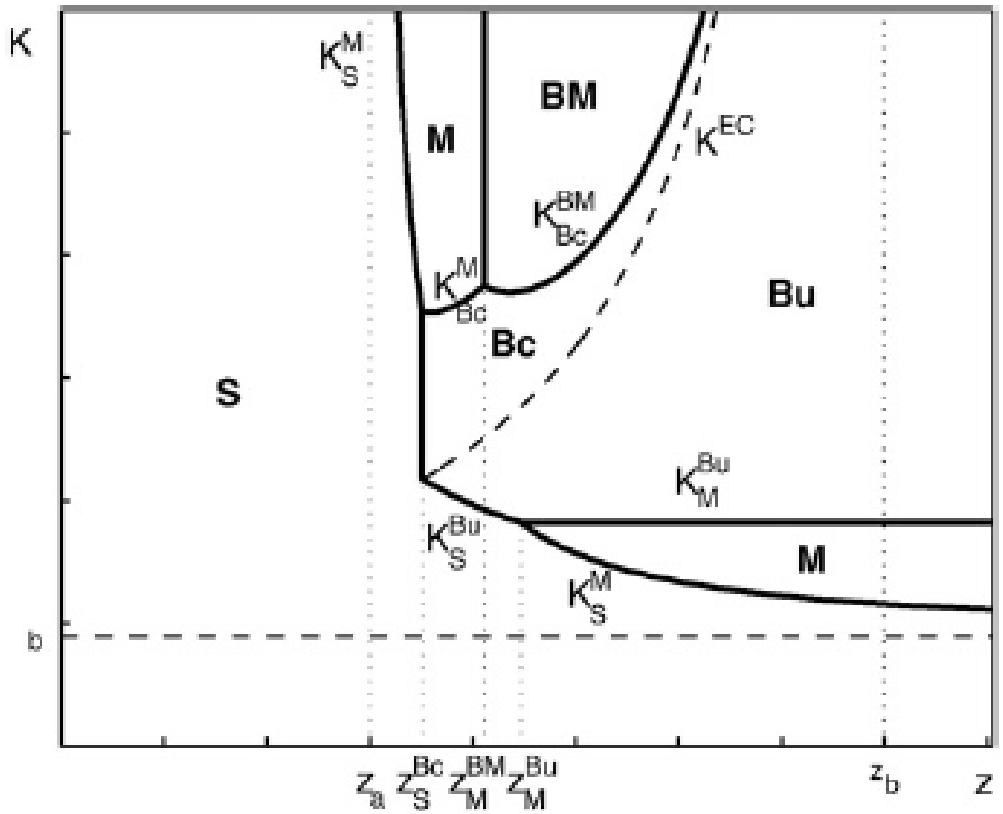
The Financial Choice Diagram

If K is below K_s^M or K_S^{BU}, the borrower chooses to self finance.
For a given level of K, as you increase z, borrower starts to look for outside options to borrow.



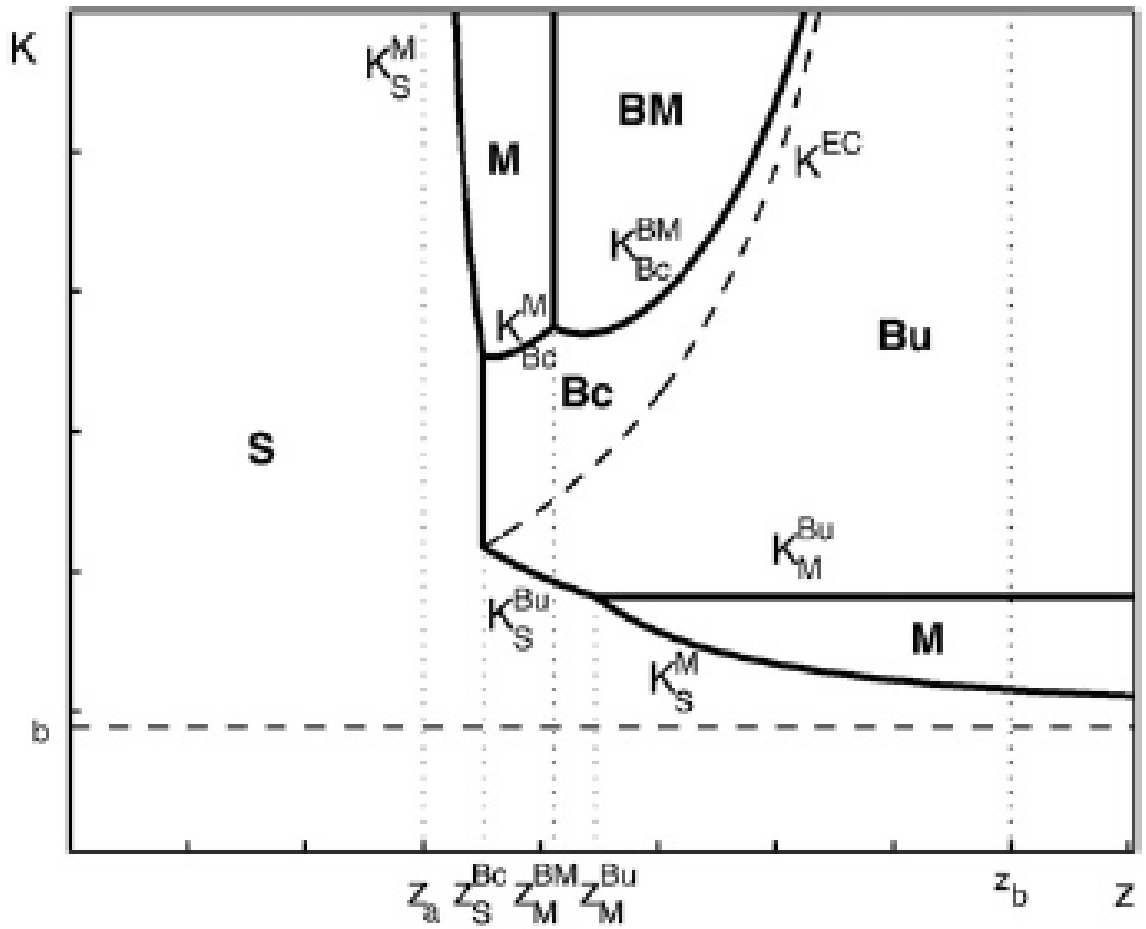
The Financial Choice Diagram

When K is below K_M^{Bu}, project size is small, hence low r_B does not compensate for high Γ_B.
Since b is fixed, amount of credit needed increases with K. Because z is low, bank is not willing to lend enough capital to make savings on interest payments worthwhile.



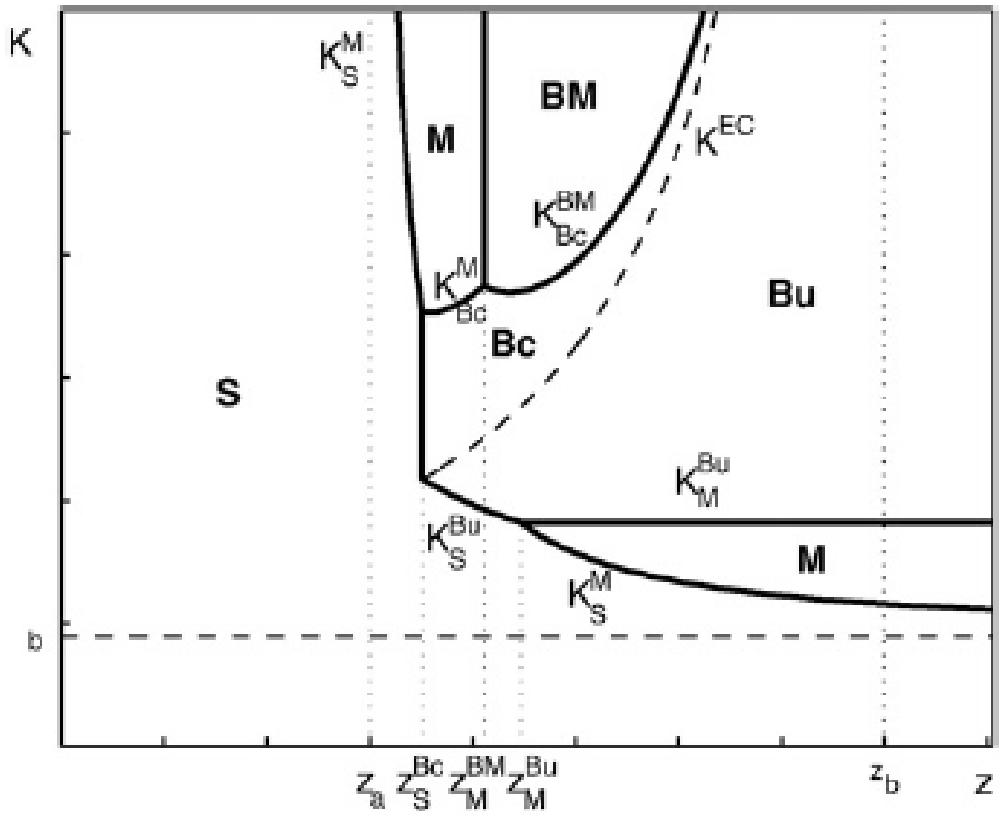
The Financial Choice Diagram

K^C is increasing in z. Thus for a given pair (z,K) in the upper region M, as you increase z keeping K fixed, bank shall be willing to lend more, and borrower will reach a point where he will find profitable to save on interest payments by borrowing from the bank.



The Financial Choice Diagram

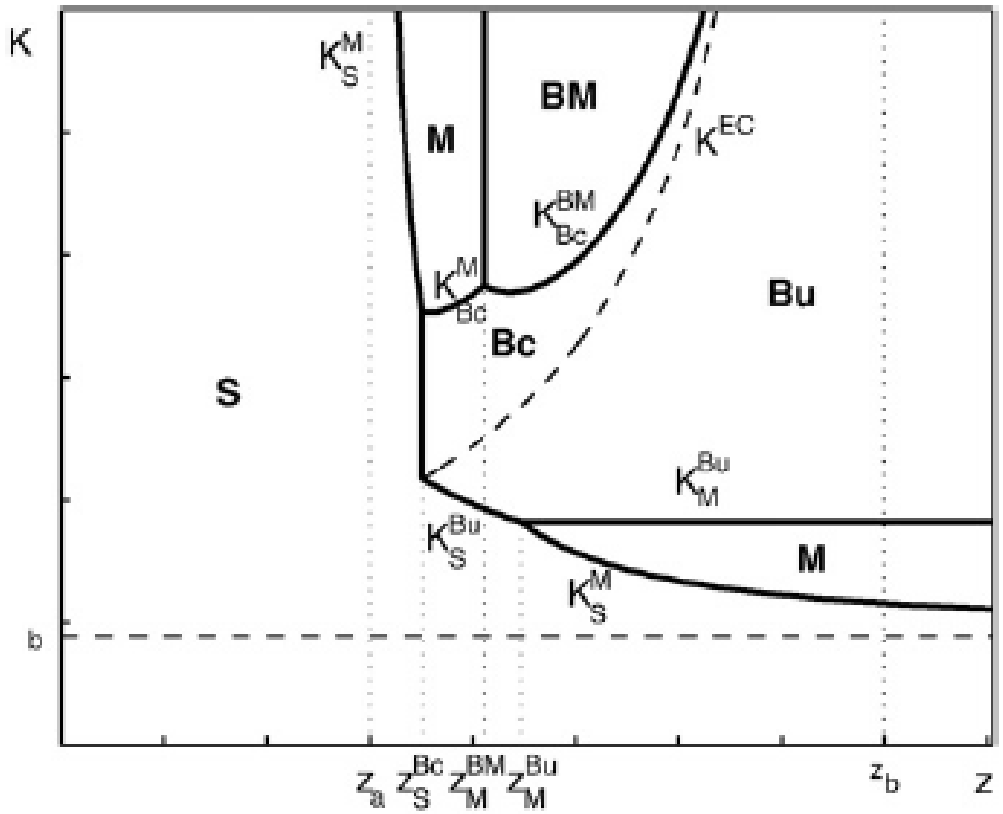
When K is between K^{EC} and K_M^{BU}, borrower will borrow from the bank and stay unconstrained.
K is between K^{EC} and K_{BC}^{M} or K_{BC}^{BM}, bank will borrow from the bank and stay constrained.
Why won't he go ahead and borrow the rest from the moneylender?



The Financial Choice Diagram

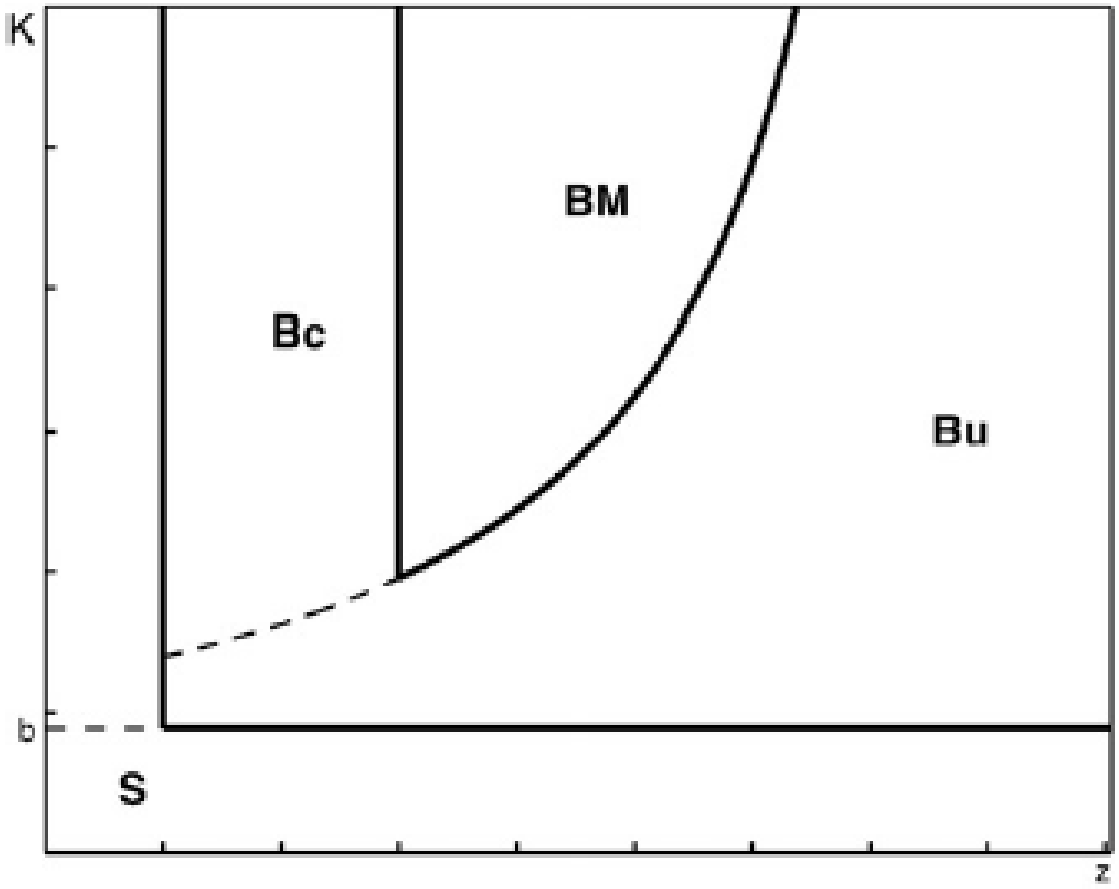
There exist wealth levels $\hat{b}$ and $\tilde{b}$ such that, $\hat{b} < \tilde{b}$ such that

- if $0 \leq b < \hat{b}$, then regions M merge
- if $\hat{b} \leq b < \tilde{b}$ and $\eta > r_M - r_b$, then you get this figure.
- if $b \geq \tilde{b}$ and $\eta > r_M - r_b$, then top region M disappears.Why?
- if $\eta < r_M - r_b$, top region M and region BM disappear.Why?



The Financial Choice Diagram

What happens when fixed costs Γ_b and Γ_M are set to zero.
Agents first borrow from the bank, and only those who are constrained and have enough ability borrow additional funds from the moneylender. Region M disappears. Why?

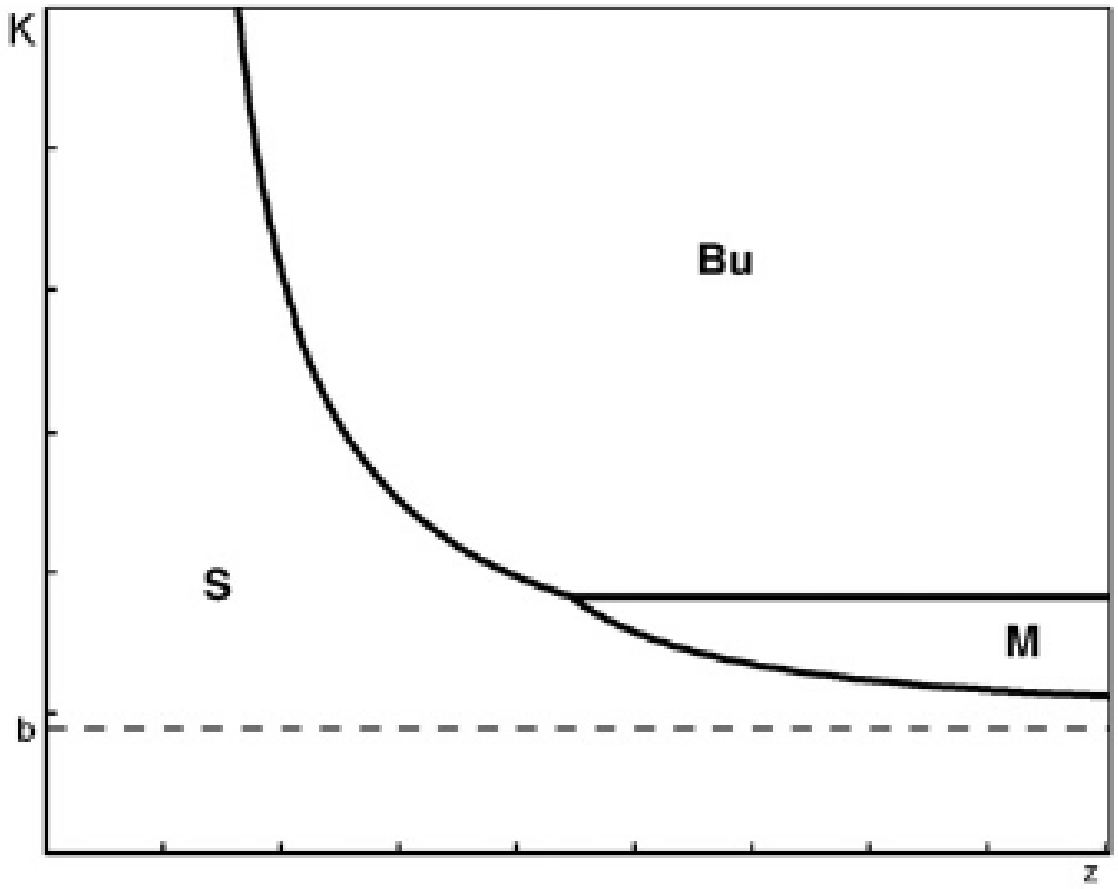


The Financial Choice Diagram

What happens when there is perfect enforcement?

Banks lend upto the maximum scale K, and choice between moneylenders and banks is solely driven by fixed costs and loan size

Region BM disappears. Why?



The Data

- The data used in this paper are from the Townsend-Thai data set and come from a cross-section survey conducted in two provinces in the Northeast and two in the Central region of Thailand in May I997.
- Survey instruments collected data on wealth, access and use of formal and informal credit, as well as household demographics, education and other characteristics.

Features of the Data

- Formal sector does bulk of the lending (69 per of the total volume) and dominates informal sector in terms of number of loans (59 per.)
- Informal lenders tend to charge a higher r. Among formal lenders, those who require collateral charge a lower r.
- From a sample of 2535 households, 34 per. self-finance, 17 per. borrow from informal sources, 36 per. from formal sources, and 13 per. borrow from both.

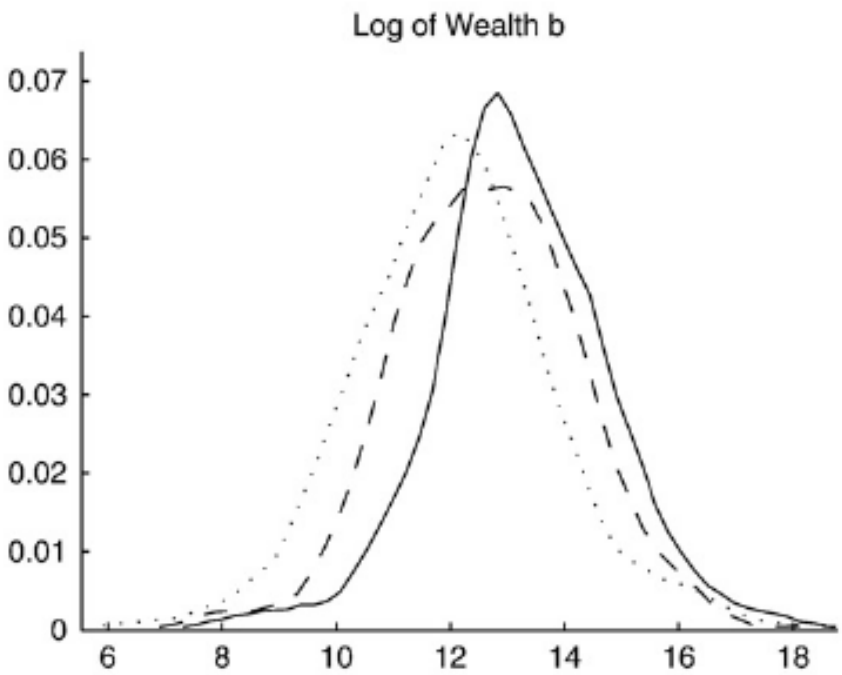
The Data

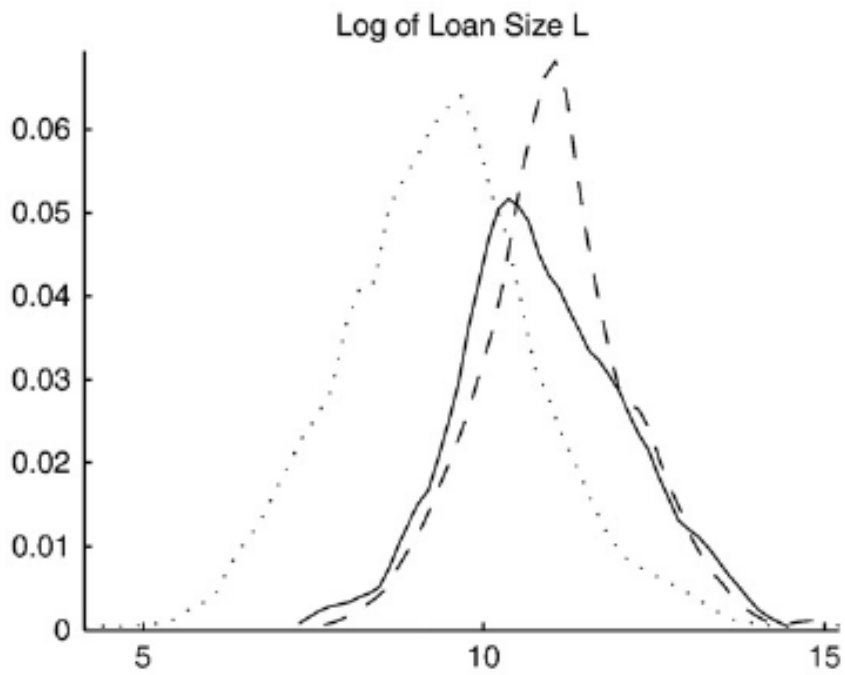
Features of the Data

- Observed borrowing k-b is largest for clients of formal institutions that require collateral, and for those who resort to both formal and informal sources. This is consistent with the prediction of the model, that institutions with high fixed cost cater to the clients with high financing requirements.
- Those who borrow from a formal institution are also wealthier than those who borrow from the informal institution or both. The model also predicts that, holding η and z constant, wealthier households will tend to resort to formal institutions more because they are in a better position to put up collateral (note that k^c is increasing in b).
- Those who borrow exclusively from the formal sources, or those who have to resort to both are more likely to report that they are credit constrained, consistent with the findings of the model.

The Data

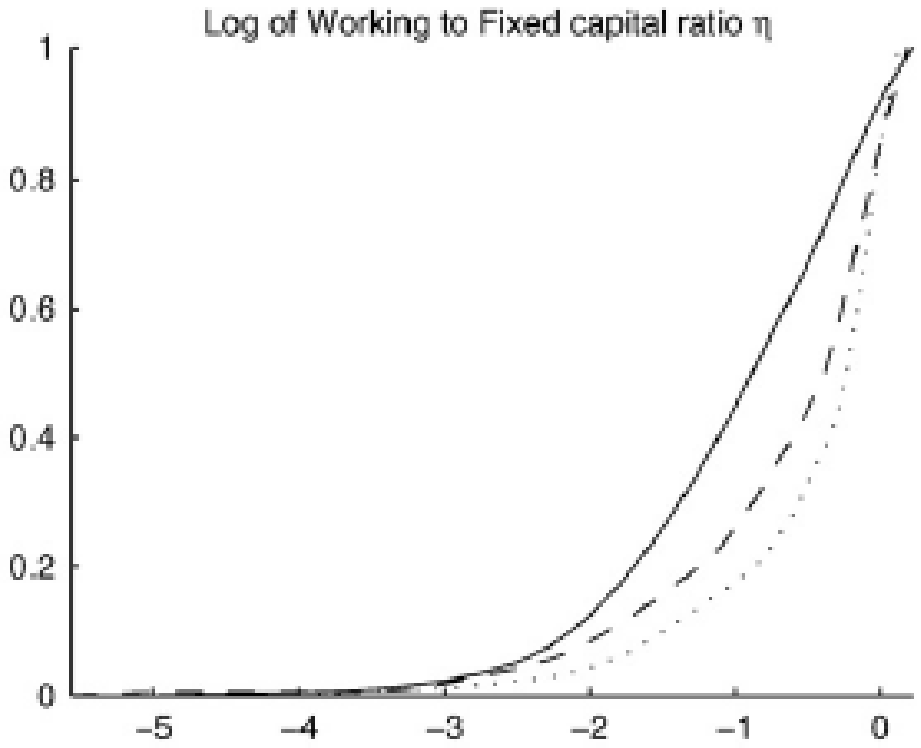
Solid: FORMAL ONLY Dotted: INFORMAL ONLY





The Data

Fraction η behaves as the model predicts. Clients of banks that require collateral have the lowest average ratio η, households that borrow from both have on average a higher ratio, whereas those who borrow from informal lenders only have the highest ratio.



Estimation of the Model

- Maximum likelihood estimation to estimate parameters of the model: fixed costs, value of default, and the parameters of the distribution functions that K and z follow.
- Estimation in two ways: taking financing choice as th dependent variable, and taking both financing choice and expected income as dependent variable.
- Log of z and K assumed to follow bivariate normal distribution.
- Two specifications of fixed cost and value of default: same across all households, allowed to vary across households.

Results

Parameter estimates

- Each estimation strategy is combined with either restricting the cost and value of default to be common or unique to each household.We thus obtain four different estimations.
- Fixed cost of formal credit is more than that of informal credit. Presence of a formal institution in the village lowers the fixed cost of borrowing, so does household characteristics like social capital, savings with a bank, and having borrowed from a formal institution in the past.
- Data doesn't support the syndication argument, that predicts that formal institutions benefit from screening done by informal lenders.
- Education, presence of a male head increase the value of default, while social capital reduces it.

Goodness of fit

The table reports average of predicted fractions for each actual borrowing choice. Diagonal elements report percentage of correct predictions under each estimation.

Goodness of fit by borrowing choice.

	Self-finance	Bank	Moneylender	Bank–m. lender
Not using income				
Self-finance	57.49	17.40	16.42	8.69
Bank	63.63	18.96	7.37	10.03
Moneylender	50.14	17.78	22.29	9.79
Bank and moneylender	59.10	20.48	8.09	12.33
Using income				
Self-finance	55.95	25.75	5.25	13.05
Bank	59.96	25.64	1.94	12.47
Moneylender	41.26	32.56	6.67	19.50
Bank and moneylender	51.08	30.17	2.46	16.29

Note: In rows, reported choice, and in columns, predicted choice.

The model correctly predicts the choice of households that self-finance, more than 50 per. of the time, it is less successful in replicating households that report other financial choices.

Goodness of fit

The table reports the predicted average growth rate of income and investment that would result, respectively, without fixed costs but limited enforcement, perfect enforcement but fixed costs, and no fixed costs and perfect enforcement, relative to the benchmark estimation from the data where enforcement is limited and fixed costs are present.

Percentage growth in investment k and income y.

	Not using exp. Inc.		Using exp. Inc.	
	k	y	k	y
Panel A: Relevance of market imperfections				
Limited enforcement, no fixed costs	0.3	0.4	0.1	0.1
Perfect enforcement, fixed costs	195.6	19.8	209.5	21.6
Perfect enforcement, no fixed costs	201.2	21.0	210.3	21.8
Panel B: Policy analysis				
5 percent cut in formal interest rate	0.8	0.9	1.0	1.3
Creation in formal institution in village	0.2	0.3	0.1	0.1
Land titling program	82.5	12.63	89.02	13.12

The reduction in fixed costs would have little impact on the growth of investment and income, if banks could enforce credit contracts perfectly, income would increase by 20 per.

Policy Analysis

- **Subsidised credit**: In context of the model, it amounts to lowering the interest rate that banks charge. Average z falls, enforcement problems become more acute.
- **Active village level branch expansion**: Lowers fixed cost, but does not alleviate enforcement problems.
- **Land titling programme**: More assets can be used as collateral, banks will have less problems in advancing the unconstrained amount, so informal finance is less needed.
- Land titling programmes have the largest impact on growth in average incomes and investment

Conclusion

- Formal lenders are accessible at some fixed cost, while informal lenders are available at no cost. Fixed cost varies across households, but it is relatively small
- Hence, limited enforcement explains such diversity of lenders
- If we compare the estimated set-up with a frictionless one without fixed transaction costs and perfect enforcement, average income would increase by 21 per. under both specifications.Hence, market imperfections are significant and there is a role for government intervention.