

Capital Misallocation and Financial Repression in Less-Developed Economies

Mehran Ebrahimiyan ^{*1} Seyed Ali Madanizadeh ^{†2}

¹Wharton School of the University of Pennsylvania

²Sharif University of Technology

December 15, 2017

Abstract

In this paper, we theoretically analyze the capital misallocation effect of financial repression as in less-developed economies with limited contract enforcement and asymmetric information between lenders and borrowers. Requiring the financial market to provide cheap loans to (semi-) public firms results in capital misallocation; we show however that raising the interest rate does not screen the low-productive firms and even exacerbates capital misallocation due to adverse selection of low-productive firms who borrow and strategically default. Reducing the quantity of regulated credits, increasing aggregate pledgeable wealth of firms, and institutional development in enforcing financial contracts improve the allocation of capital and lower the equilibrium ratio of non-performing loans.

Keywords: Capital Misallocation, Financial Repression, Less-Developed Economies, Contract Enforcement, Asymmetric Information, Strategic Default.

1 Introduction

Capital misallocation explains a considerable share of the output per worker gap between less-developed and developed economies. [Banerjee and Duflo](#)

*e-mail Address: ebrm@wharton.upenn.edu

†e-mail Address: madanizadeh@sharif.edu

(2005) estimate the ratio of output per worker in USA versus India to be 6.4:1 based on the aggregate endowments' ratio in the two countries, while it is 11:1 based on actual output data. Hsieh and Klenow (2009) also report a wide range in productivities of active plants in India and China compared to USA, which generates 30-50% aggregate TFP loss in China and 40-60% aggregate TFP loss in India.

As Hall and Jones (1999) point out, social infrastructures defined as institutions and government policies are determining factors of TFP differences, where capital misallocation is one of such channels. Judicial and legal systems affecting the enforceability of contracts and financial market infrastructures such as a credit rating system are two important institutions that can largely affect the allocation of capital and aggregate TFP. On the other hand, financial repression, as one of the government intervention policies that may affect the allocation of capital, has been the topic of the literature and policy-makers discussions for decades, especially the Less-Developed Countries (LDCs).

In this paper, we theoretically analyze the effects of financial repression on capital misallocation in economies with poor contract enforcements, strategic defaults and asymmetric information on the borrower's productivity. Financial repression is defined as a regulation on banks to provide cheap loans to (semi-) public firms (or holding a minimum amount of state's bonds). We analyze financing decision of firms and equilibrium effects of these intervening policies on the aggregate productivity and capital allocation among heterogeneous firms. We then find the socially optimal and the market interest rates and evaluate the aggregate outcome.

The key features of the model are the firms' financing decision and strategic default of borrowers due to the limited enforcement of financial contract, the features that exist in all economies but is more prevalent in LDCs¹. The other important feature of the model is the asymmetric information between financial intermediaries and borrowing firms regarding the productivity of the firms. Basically, a bank cannot observe an entrepreneur's productivity and can lend her a fraction of her collateral. The entrepreneur knows her productivity and can decide to borrow or not; if she borrowed, she decides whether to pay the loans back or voluntarily default.²

Our model is a synthesis of Stiglitz and Weiss (1981) and Gertler and Kiyotaki (2010). As in Stiglitz and Weiss (1981) and Mankiw (1986), there

¹Kiyotaki, et al (2011) estimate a value of 0.5 for a measure of contract enforcement in USA, a country with strong judicial system and strong institutions.

²As mentioned before, the asymmetric information is a feature of all financial markets but it is a more severe issue in LDCs with poor infrastructures like lacking an applicable credit rating system.

is asymmetric information in the firms' productivities, but in our model there is no uncertainty in productivity for each one. On the other hand, following [Gertler and Kiyotaki \(2010\)](#) and [Gertler and Karadi \(2011\)](#), due to poor contract enforcement, the borrowers (firms) can default on their loans, and only a proportion of their wealth would be accessible for the lenders (banks) called "Contract Enforcement Measure (CEM)". CEM is considerably less than one in less-developed economies. This measure represents the power of legal institutions in enforcing loan contracts and imposing high punishments on defaulters; thus it is a proxy for financial system development.

We find that with poor contract enforcements and asymmetric information, government regulation on the amount of lending increases the equilibrium Non-Performing-Loans (NPLs) resulted from voluntarily defaults. We show that with a low level of regulated loans, the screening mechanism of changing the price of regulated credits is active, such that increasing the interest rates can divert the capital to only productive firms, without an increase in NPLs.

In contrast, when banks should lend a high quantity of loans (scaled by aggregate potential collaterals of firms) to the firms, then all the firms borrow and the low-productive ones default; only the most productive firms have incentive to repay back the loans. In equilibrium, the screening mechanism does not work; instead, the number of defaulting firms increases. Therefore the government interventions/regulations on the interest rates does not change capital misallocation of such economies since the economy is at its worst allocation of capital. Improvements in the contract enforcement or an increase in the pledgeable wealth, can decrease the number of defaulting firms and the NPLs, but not the misallocation of capital.

Finally, and more interestingly, if the the quantity of imposed credit and/or enforceability of contracts are not too low nor too high, then we are in intermediate equilibria where only a fraction of low-productive firms borrow and default. In these equilibria providing cheap loans may counter-intuitively increase capital misallocation since screening marginal firms would boost the equilibrium loan to collateral ratio and makes incentive for low productive firms to borrow and default. We show that increasing the interest rates increases the average productivity which is followed by a subsequent decrease. Therefore there is an optimum interest rates a government can set which crucially depends on quantity of credit scaled by aggregate pledgeable wealth of all potential borrowers.

Moreover, we show that capital misallocation decreases, if enforcing the loan contracts improves. Contract enforcement plays a critical role in making the screening mechanism to be active, i.e. raising the minimum threshold of falling into the inefficient equilibrium. Therefore, the financial system may

be a good intermediary, whenever the ratio of loans to the pledgeable wealth of firms is less than a specific threshold, in which legal institutions can insure the repayments of the loans. This threshold depends on the average level of contract enforcement in the economy.

Lastly, we analyze the outcome of financial market liberalization in the sense that allowing banks to set their profit maximizing interest rates freely. Credit rationing may be the result of such a frictional market, even in our framework where there is no uncertainty in the productivity of firms. Whereas increasing the interest rate may raise the profits of the bank from higher loan returns of productive firms, there may be profit loss because of the defaults of low-productive firms, replacing marginal firms with net productivity close to the interest rate, which no longer can take the loan. Moreover, it is shown that market rates, as an equilibrium outcome of firms/banks interactions, may be higher than the optimal rate that generates the efficient allocation of capital; this is a result of banks' incentive to charge higher rates and earn some portion of the remained wealth even in case of defaults compared to charging low rates and earning low returns from the firms' payments.

Therefore there may remain free room for a government's mild repression policy (price ceiling for loan market) to induce higher average productivity³. However, it is shown that in developing and underdeveloped economies, the maximum interest rates in which the screening mechanism still works could not be high because of weak contract enforcement, and in all possible values of interest rates, the maximum achievable average capital productivity is not far above the minimum value; so government interventions/regulations may not considerably change capital misallocation. The efficiency of allocation is highly sensitive to enforceability of contracts determining equilibrium cost of defaults.

Government repressing policies of reducing interest rate of loan markets, besides decreasing aggregate savings ([McKinnon \(1973\)](#) and [Shaw \(1973\)](#)), results in capital misallocation, hence it reduces average productivity of capital and economic growth (see [Roubini and Sala-i Martin \(1992\)](#))⁴. [Fry \(1980\)](#), [Bencivenga and Smith \(1992\)](#), [Demetriades and Luintel \(1997\)](#), and [Williamson and Mahar \(1998\)](#) discusses other costs of financial repression. [Chari et al. \(2014\)](#) discusses the optimality of financial repression and he shows that it is not optimal when there is Government commitment; however, it may be optimal when there is a lack of commitment..

³See [Stiglitz \(1993\)](#) for other empirical and theoretical justifications.

⁴To find other costs of financial repression see [Fry \(1980\)](#), [Bencivenga and Smith \(1992\)](#), [Demetriades and Luintel \(1997\)](#), and [Williamson and Mahar \(1998\)](#).

A similar work to ours is the general equilibrium analysis of financial repression and contract enforcement in [Antunes et al. \(2008\)](#), showing a large drop in output per worker if we change the U.S. judicial systems into a one similar to that of a developing country like Latin Americans or high growth Asian countries. What we do is the introduction of asymmetric information in addition to the contract enforcement as two frictions which collectively generate the mentioned capital misallocation. In our model, the average productivity of capital can be decreased by adverse selection of firms in the financial markets; weak contract enforcement and strategic default then may not allow screenings of the firms via charging a high price of loan.

Asymmetric information seems to be a friction of financial markets in developing and under-developed economies. Credit rating systems in developing countries, though they have had rapid growth, “are still in their infancy and information sharing between lenders remains insignificant” ([Luoto et al. \(2007\)](#)). [Gormley \(2014\)](#) shows how the asymmetric information in the financial market affects the aggregate net output; heterogeneity is crucial here, as well. As shown in many studies like [Clementi and Hopenhayn \(2006\)](#), the financing constraints arisen from asymmetric information has large impacts on a firm’s performance.

However, the quality of contract enforcement such as ones in a well-developed economy’s judicial system, plays a critical role in our model. Less-developed countries have weak judicial and enforcement systems ([Hall and Jones \(1999\)](#)). The higher ratio of persistent nonperforming loans in less-developed economies can be a sign the for low power of loan contract enforcements in those nations. The average ratio of nonperforming loans is 10.7% for low-income and 6.3% for high-income countries, between 2002-2013⁵. [Cooley et al. \(2004\)](#) show that limited contract enforceability can affect the aggregate output and its volatility, making financial contracts constrained-efficient. On the other hand, [Nguyen and Qian \(2012\)](#) also use the World Bank Enterprise Survey and document how largely banks accept collateral in different countries. Finally, [Diaz-Alejandro \(1985\)](#) points out the importance of contract enforcement for financial markets in discussing the roots of financial crisis after financial liberalization in several Latin American countries in the 1980s.

In what follows we introduce the model in section section 2. In section section 3, we characterize the equilibrium and discuss the results about the effects of financial repression on misallocation and how the screening mechanism works in each equilibrium. In section 4 we analyze the results and

⁵Based on World Bank data, the average is taken on existing data between 2000-2013. low/high income countries are defined as countries that have GNI per capita less/more than 4,100\$ in year 2013.

elaborate on the effects of the optimum interest rates on capital misallocation and we explain the behavior of the economy when we liberalize the rates to the profit maximizing interest rates. In section section 5 we conclude.

2 The Model

This section introduces the model. There is a single capital/final good, a bank supplying loan as a financial intermediary, and a continuum of risk-neutral firms. The technology of firms is constant return to scale with capital. Firms are heterogeneous in productivity, but have a same initial wealth w . There is asymmetric information on the productivity of a firm (r); it is perfectly known by the firm, but, the bank is completely uninformed. There is no signaling instrument.

The model is static; there are three steps in timing structure. In the first step, firms draw a deterministic capital productivity (r) from the population cumulative distribution function $F : [r_{min}, r_{max}] \rightarrow [0, 1]$, which shows the relative mass of firms with productivity more than r . Then firms decides on whether or not to demand for a loan, and, if a firm decides to demand, declares its wealth as a collateral to the bank; the value of a firm's wealth is verifiable by the banks at no cost.

In the second step, the bank distributes loans among the firms who demand a loan. The bank supplies an exogenous amount of total loan (L) with a prespecified interest rate (R), required by the government. We assume the bank delivers the loans across demanding firms based on a same (endogenous) loan-to-collateral ratio. A borrower then receives an endogenous amount of loan, called by l , determined by the equilibrium population of borrowers.

In the final step, the firms produce $(1 + r)k$ units of final good, where $k = w + l$ for a borrowing firm, and $k = w$ for a firm without a loan. Borrowing firms then decide whether to repay or default on the loan. There is no social cost of default. If a firm defaults, the bank possesses a fraction θ of the firm's final wealth and the firm owners can privately consume the remained $1 - \theta$ fraction. The institutional parameter θ represents the degree of contract enforcement in the economy. In a less-developed economy with poor contract enforcement, a defaulting firm can run away with almost all of his wealth after a default, so θ is close to zero. θ has a common value for all the firms and is publicly known. On the other hand, non-defaulting firms simply repay $(1 + R)l$ to the bank. At the end, all the firms consume their final wealth.

We solve for the strategy of firms by backward induction. The borrowing

firm i with net capital return rate r_i repays the loan l if and only if:

$$(w + l)(1 + r_i) - l(1 + R) \geq (w + l)(1 + r_i)(1 - \theta) \quad (1)$$

Here $(w + l)(1 + r_i)$ is the final wealth of the firm, $l(1 + R)$ is the cost of repaying the loan, and $1 - \theta$ is the part of the firm's wealth that is divertible after a default. One can easily rewrite the *no default condition* as $r_i \geq r_{ndc}$, where r_{ndc} is defined as bellow

$$\text{No Default Condition: } r_i \geq r_{ndc} := \widehat{l}(1 + R)/\theta - 1 \quad (2)$$

where $\widehat{l} := l/(l + w)$ is the endogenous ratio of loan to operational scale of the borrowing firms.

High-productive firms prefer to repay the loan based on a prespecified interest rate R , instead of giving up a proportion of their relatively high return to the bank via defaulting on the loan. The cut-off productivity of doing default, r_{ndc} , is decreasing with θ , the proportional cost of default for a borrower. Also, r_{ndc} is increasing with R and \widehat{l} . An increase in interest rate R reduces the incentive of borrowers to repay the loan, so only firms with higher productivity would not default. Also, if \widehat{l} is high, the relative value of the borrower's wealth as the "collateral" is low and the borrowers prefer to not repay a (relatively) high cost $(1 + R)l$.

The strategy of firm i in demanding a loan depends on the relation between r_i and r_{ndc} . The demand condition is $r_i \geq R$ if $r_i \geq r_{ndc}$, since repaying the loan is preferred in this case. If $r_i \leq r_{ndc}$, the firm demands if⁶

$$(w + l)(1 + r_i)(1 - \theta) \geq w(1 + r_i)$$

We can derive the demand condition as

$$\text{Demand Condition: } \begin{cases} \theta \leq \widehat{l} & r_i \leq r_{ndc} \\ r_i \geq R & r_i \geq r_{ndc} \end{cases} \quad (3)$$

Figure 1 shows the optimal decision of a firm with productivity r_i , exposed to the loan-to-wealth ratio \widehat{l} . If \widehat{l} is larger than θ , the firm demands for the loan, no matter whether it is high- or low-productive. The capital productivity of the firm determines the decision to default. On the other hand, if $\widehat{l} \leq \theta$, a firm demands for a loan only if its productivity is more than R , and no firm defaults. An increase in the enforceability of financial contracts, θ , shifts up the horizontal dash-line; also the sloped dashed line

⁶One should note that if a firm demands a loan, it reveals all of its initial wealth w as the collateral to the bank to get higher amount of loan.

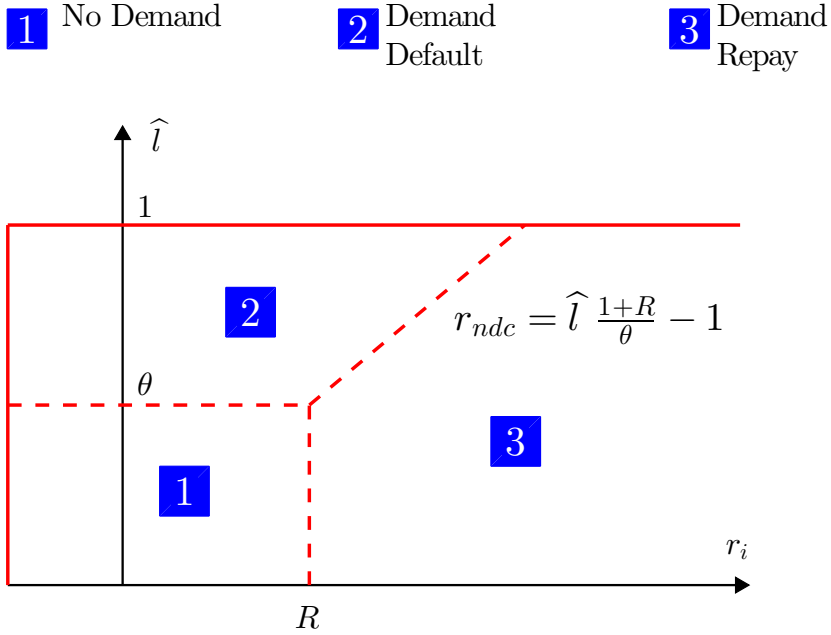


Figure 1: The best response of firm i with productivity r_i , given the loan wealth ratio of $\hat{l} = l/(l + w)$. R is the real interest rate of loans and θ is the proportion of a firm's wealth that is accessible by the bank if the firm defaults.

rotates in counterclockwise direction. Therefore the default region shrinks. On the other hand, if R increase, the vertical dash-line moves to the right and the sloped dashed line rotates clockwise. Thus low-productive firms will no longer demand if the amount of (scaled) loan is low. However, the default region also expands, so the decision of a firm may be changed from demand and repay to demand and default if the loan to wealth ratio is high.

Bank's Profit

The bank's expected return rate is derived from

$$1 + \bar{R} = (1 - P_D)(1 + R) + P_D\theta(1 + r_{ndc}^-)/\hat{l} \quad (4)$$

Here P_D is the probability that a borrowing firm defaults and r_{ndc}^- is the average productivity of defaulting firms, i.e. firms with productivity less than r_{ndc} . \bar{R} is increasing in θ and decreasing in \hat{l} for any distribution of firms' productivity; an increase in θ , decreases the probability of default, P_D , and also increases the bank's share of a borrowing firm's wealth if the firm defaults. Also, increasing \hat{l} , raises the probability of default and decreases a firm's wealth value in unit of delivered loan, thus lowering the bank's expected return rate.

The effect of R on \bar{R} is not clear; on the one hand, the profit of the bank from supplying loan to non-defaulting firms increases; on the other hand, the probability of default might be higher, if the loan ratio is more than the critical ratio θ (see fig. 1), so the expected return of loans may decrease.

3 Equilibrium

In this section, we define and solve for the partial equilibrium in the financial market and analyze the equilibrium behavior of the firms.

Definition 1 (Equilibrium). *Given the government's intervention policy determining the interest rate of loans, R , and an exogenous total amount of supplied loans, L , the equilibrium is defined by:*

- A value of \hat{l} determining the scaled amount of loan a borrower receives,
- A decision rule determining type of each firm: {No Loan, Loan & Repay, Loan & Default},

such that:

1. Firms' decisions is the best response to the scaled loan value \hat{l} and interest rate R (shown in fig. 1),
2. Resource constraint holds:

$$L = \mathcal{M}_D l \tag{5}$$

where \mathcal{M}_D shows the population of firms who demand/receive a loan.

In the following propositions we characterize the equilibria of the economy. We define “high-productive” firms as the firms with productivity higher than R , and “low-productive” firms as the firms with productivity less than R . W refers to the total wealth of all firms and $W_R^+ := F(R)W$ is defined as the wealth of high-productive firms. Finally, $\hat{\theta}$ is defined as $\hat{\theta} := \theta/(1 - \theta)$, which is increasing with θ , the enforceability of loan contracts.

Proposition 1. *If $L \leq \hat{\theta}W_R^+$, there is a unique equilibrium in which only high-productive firms receive a loan and repay the loan.*

Proof. Since high-productive firms demand a loan in all values of L , W and R (see fig. 1), we have $\mathcal{M}_D \geq F(R)$; hence, from the assumption in the proposition, $L \leq \hat{\theta}\mathcal{M}_D W$. Therefore, using the resource constraint ($L =$

$\mathcal{M}_D l$) and the definition of $\hat{\theta} := \theta/(1 - \theta)$, we find that $\hat{l} \leq \theta$. In this case, according to the firms' optimal choice in fig. 1, low-productive firms have no incentive to demand for a loan (see area 1). Hence, $\mathcal{M}_D = F(R)$ and so $l = L/F(R)$. Also, since $\hat{l} \leq \theta$, high-productive firms do not default (see area 3 in fig. 1). Here, the default ratio is $P_D = 0$ and the net expected return rate for the bank is $\bar{R} = R$. \square

Proposition 2. *If $\hat{\theta}W \leq L$, there is a unique equilibrium in which all the firms receive a loan; a positive measure of borrowers (including the low-productive firms) default.*

Proof. Since $\mathcal{M}_D \leq 1$, from the assumed condition in the proposition we find $\hat{\theta}\mathcal{M}_D W \leq L$. Therefore, using the resource constraint and the definition of $\hat{\theta}$ we find $\hat{l} \geq \theta$. In this case, according to the firms' best responses shown in fig. 1, all firms demand for loan (areas 2 and 3). Therefore, $\mathcal{M}_D = 1$ and $l = L$, and so $\hat{l} = L/(L + W)$. In this kind of equilibrium, the ratio $P_D = 1 - F(r_{ndc})$ of loans is given to the defaulting firms. Since $R \leq r_{ndc} = \frac{L}{L+W} \frac{1+R}{\theta} - 1$, all low-productive firms and a subset of high-productive firms with productivity $r \in [R, r_{ndc})$ default on loans. \square

Proposition 3. *If $\hat{\theta}W_R^+ < L < \hat{\theta}W$ there are multiple equilibria, in which all the high-productive firms and a subset of low-productive firms demand for a loan; low-productive firms receive a share $P_D = 1 - \hat{\theta}F(R)W/L$ of total loans and default. High-productive firms repay the loan.*

Proof. We first prove that $\hat{l} = \theta$. Firstly, if $\hat{l} > \theta$ all the firms would demand for a loan, so from the resource constraint $l = L$ and so $\hat{l} > \theta$ implies $L/W > \hat{\theta}$ which contradicts the assumption in the proposition. Secondly, if $\hat{l} < \theta$ just high-productive firms demand for a loan, so from the resource constraint $l = L/F(R)$ and hence $\hat{l} < \theta$ implies $L/WF(R) < \hat{\theta}$ which again contradicts the assumption of the proposition. Hence, $\hat{l} = \theta$, and so $\mathcal{M}_D = L/(\hat{\theta}W)$.

Using $\hat{l} = \theta$ and the assumptions of the proposition we find that $F(R) < \mathcal{M}_D < 1$. Here, all the high-productive firms, plus a subset of low-productive firms demand in an equilibrium. All low-productive firms are indifferent between “demand” and “no demand” actions (they are on the horizontal dash-line in fig. 1), and there is no incentive for any firm to deviate to another type. In this regime, there are multiple equilibria; in any equilibrium a measure $\mathcal{M}_D - F(R)$ of low-productive firms are selected to receive a loan.

In all equilibria here, $\hat{l} = \theta$, so $r_{ndc} = R$; hence, all low-productive firms will default and all high-productive firms repay the loan. Since every agents receive a same amount of loan, the fraction of total loans received by high-productive agents is $F(R)/\mathcal{M}_D$, so given $\mathcal{M}_D = L/(\hat{\theta}W)$ we conclude that the default probability is $P_D = 1 - \hat{\theta}F(R)W/L$. \square

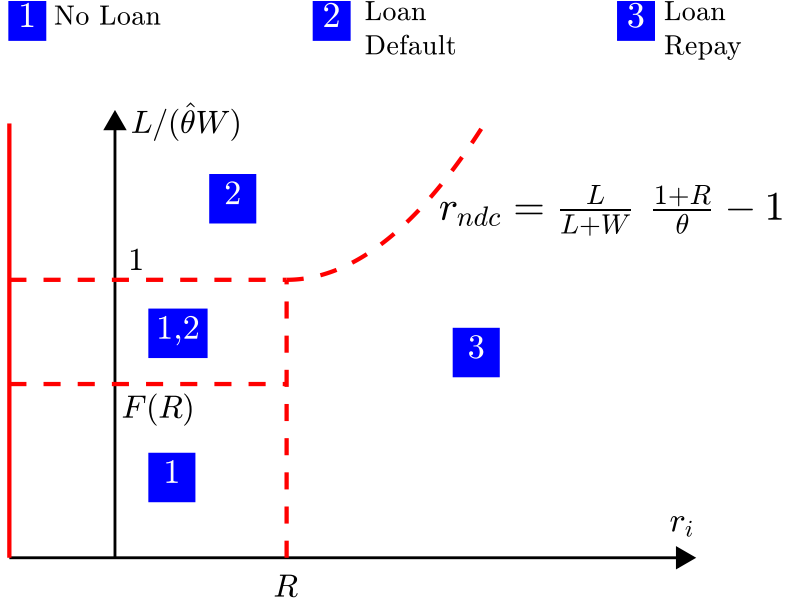


Figure 2: The equilibrium type of a firm with capital productivity r_i as a function of macro-variables; R is the real interest rate of loans, L is the total amount of loans, W is the total wealth of firms and $\hat{\theta}$ shows the enforceability of contracts.

Figure 2 summarizes the optimal decision of firms in equilibrium(s) as a function of macro-variables, L , W and R . There are three types of equilibria, based on the ratio of total loan (L) to the total wealth of firms (W), and the interest rate of loans (R). First, the “efficient” equilibrium, in which $L/(\hat{\theta}W) \leq F(R)$ and just the high-productive firms receive a loan; no firm defaults in this type of equilibrium. Second, the “inefficient” equilibrium occurs if $1 \leq L/(\hat{\theta}W)$, in which all the low- and high-productive firms receive a loan; all the low-productive firms, and the high-productive firms with productivity below $r_{ndc} = \frac{L}{L+W} \frac{1+R}{\theta} - 1$ default. Lastly, we have the “intermediate” equilibria, where $F(R) < L/(\hat{\theta}W) < 1$; in this type, all of the high-productive firms plus a subset of low-productive firms demand for a loan. High-productive firms repay the loan but low-productive firms default.

Figure 3 shows the ratio of firms that default in equilibrium, as a function of R and L/W . The CDF of the productivity of the firms is specified by *Pareto* with minimum 1% and average 3%. The strategic behavior of agents in different equilibria is reflected in this figure. Increasing L/W changes the type of equilibrium from efficient to intermediate, and finally to the inefficient equilibrium; so DR increases. Also, increasing R , either changes the equilibrium from efficient to intermediate, if initially the equilibrium is efficient, so increases DR , or increases DR via shifting the default threshold

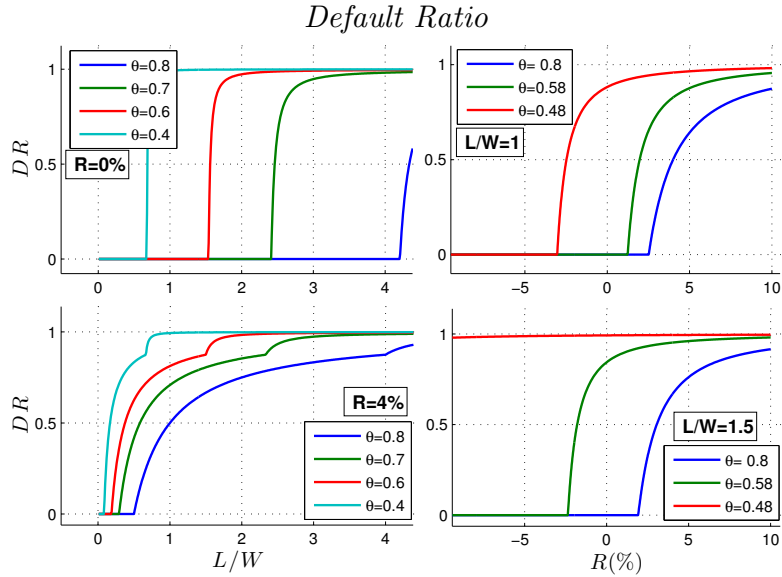


Figure 3: The ratio of firms that default, DR , as a function of interest rate (R) and total loan to total wealth ratio (L/W) in different values of the contract enforcement power (θ). The productivity distribution of firms is *Pareto* with minimum 1% and average 3%.

r_{ndc} if the equilibrium is inefficient.

4 Results

This section studies the equilibrium results of the model in terms of aggregate outcomes and capital misallocation. First, we analyze the screening role of interest rates in filtering low-productive firms in the financial market, given the asymmetric information problem and possibility of default. Second, we find the optimal regulation policy in this market, defined as setting a value for the loan interest rate, called “optimum interest rate”, that maximizes the equilibrium average capital productivity of the hired loans. We then examine the misallocation effects of government intervention in setting suboptimal price for loans. Finally, we find the interest rate that maximizes the net expected profit of the bank, called “market interest rate”, and compare the market with the optimal outcome.

The analysis presented here are straightforward results of propositions 1, 2 and 3. As we explained in proposition 3, in the intermediate regime there are multiple equilibria. We calculate macro variables, such as average productivity of capital, by averaging on the values of macro-variables over

all possible outcomes of the intermediate equilibria.

4.1 The Screening Role of Loan Return Rate

In this section, we analyze the equilibrium average productivity of capital hired by the firms, called by r_a , as a function of exogenous variables, θ , R , L/W , and the distribution of the productivity of the firms, $F(r)$. We analyze the screening role of interest rate in filtering the low-productive firms in the financial market.

In an economy with weak contract enforcement (small θ) changing the interest rate of loans, R , does not affect the average productivity of the capital employed by heterogeneous firms with different potential productivities. Corollary 1 formally states this claim.

Corollary 1. *There is a threshold called θ_0 , such that in all economies with $\theta \leq \theta_0$, all the firms receive a loan, for any loan interest rate R , and average productivity of capital in equilibrium is independent of R : $r_a = \bar{r}$ the average productivity of all the firms in the economy. θ_0 is:*

$$\theta_0 = L/(L + W) \quad (6)$$

Proof. If $\theta \leq \theta_0$, we know $\hat{\theta} \leq L/W$; so the equilibrium is inefficient (see proposition 2) in which all the firms including low- and high-productive ones take a loan (areas 2 and 3 in fig. 2). Hence, $r_a = \bar{r}$, i.e. the average productivity of all firms. Because changing R , does not affect the condition $\theta \leq \theta_0$, this result holds for any R . \square

In the inefficient equilibrium, given the possibility of strategic default, all the firms demand and take a loan, so the average productivity of loans employed in different plants is simply the mean productivity of all the firms in the economy. In this case the price of loan cannot be used as a screening instrument to improve the allocation of capital.

The interesting equilibria in which the screening mechanism is active are efficient and intermediate equilibria, emerging in case $\theta > \theta_0$. Corollary 2 describes the effect of a change in interest rate, R , on the average productivity of loans in this case. We assume $F(\cdot)$ is continuous and strictly decreasing function, and θ is strictly less than one, so $\hat{\theta} < \infty$.

Corollary 2. *Suppose $\theta > \theta_0$; for any given L/W and θ , there is a unique interest rate called R^* , such that for all $R \leq R^*$, r_a is strictly increasing with R , and for all $R \geq R^*$, r_a is strictly decreasing with R . r_a takes its maximum at $R = R^*$, which is solved from*

$$F(R^*) = L/(\hat{\theta}W). \quad (7)$$

Proof. Because $\theta > \theta_0$, $L/(\widehat{\theta}W) < 1$, therefore the equilibrium is not inefficient (see fig. 2). For large enough R , $F(R)$ is close to zero, so we have $F(R) < L/(W\widehat{\theta})$, whereas for small enough R , $F(R)$ is close to one, so we have $F(R) > L/(W\widehat{\theta})$. Since the relative mass of high-productive firms, $F(R)$, is strictly decreasing and continuous function there exists a unique interest rate, called R^* , such that $F(R^*) = L/(\widehat{\theta}W)$. For all $R > R^*$, $F(R) < L/(\widehat{\theta}W)$; thus the equilibrium is in intermediate regime; also, for all $R \leq R^*$, $F(R) \geq L/(\widehat{\theta}W)$, so equilibrium type is efficient.

In the efficient equilibrium, only high-productive firms receive a loan (see proposition 1); so the average productivity of capital in this case is: $r_a(R) = r_R^+$, where r_R^+ is the average productivity of high-productive firms (firms with productivity higher than R). Because $F(\cdot)$ is continuous and strictly decreasing, r_R^+ is strictly increasing with R .

In the intermediate equilibria, a mixture of low- and high-productive firms take a loan (see proposition 3). By substituting the ratio of loans received by low-productive firms from proposition 3, and taking weighted average over the average productivity of loan received by each group of high- and low-productive firms, we obtain the following equation for the aggregate productivity of capital in the intermediate regime:

$$r_a(R) = r_R^+ - [1 - \widehat{\theta}F(R)W/L](r_R^+ - r_R^-), \quad (8)$$

where r_R^- and r_R^+ stands for the average productivity of low- and high-productive firms. Since $F(\cdot)$ is continuous and strictly decreasing, one can show that $r_a(\cdot)$ in eq. (8) is strictly decreasing with R .

Therefore, for values of R less (greater) than R^* the average productivity is increasing (decreasing) with R , and so the average productivity of the loans employed by the firms is maximum at $R = R^*$ defined in eq. (7). \square

In the efficient equilibrium only high-productive firms demand for a loan; so the screening mechanism is active and low-productive firms are filtered by an increase in the loan return rate. In an intermediate equilibrium, however, increasing R replaces marginal firms, which have productivity slightly above R , with a subset of low-productive firms having a productivity possibly strictly below R . Thus, the aggregate productivity decreases by an increase in R . In summary, there is an optimal interest rate, R^* , in which the screening mechanism does its best in filtering low-productive firms and improving on the allocation of capital.

Figure 4 shows the aggregate productivity, r_a , as a function of loan interest rate, R . The productivity distribution of the firms is *Pareto* with minimum 1% and average 3%. According to the value of total loan over

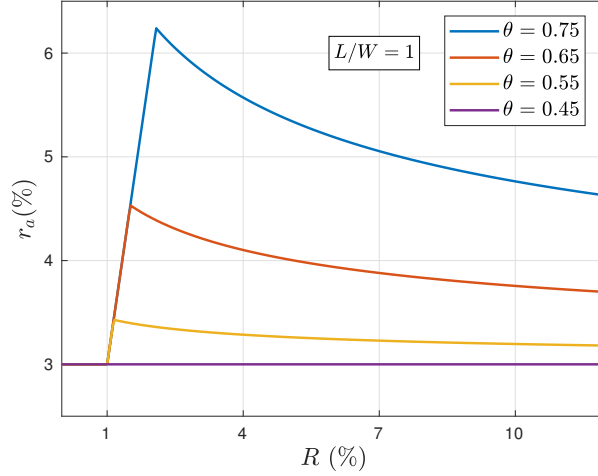


Figure 4: Aggregate productivity of capital, r_a , as a function of interest rate, R , for different values of contract enforcement, θ . The productivity distribution of firms is *Pareto* with minimum 1% and average 3%. The ratio of total loan to total wealth in the economy, L/W , is equal to 1. Analytically, $r_a(\cdot)$ depends on $\frac{W}{L} \cdot \frac{\theta}{1-\theta}$.

wealth, $L/W = 1$, θ_0 , i.e. the threshold of θ in which equilibrium switches to inefficient regime is 0.5. Therefore, in case $\theta = 0.45$, all the firms will receive a loan, independent of the R , and the aggregate productivity is 3%: the average productivity of all existing firms. However, for higher values of θ , the economy may be in efficient, or intermediate equilibria. If R is below the critical value of eq. (7) loans are received by high-productive firms, so given the Pareto specification the aggregate productivity of capital increases linearly with R . If R rises, the population and so total wealth of demanding firms shrinks and since the ratio of loan to wealth increases, low-productive firms will be motivated to demand for a loan; thus the average productivity of capital falls. One should note that the ratio $L/(\hat{\theta}W)$ is the main determinant of the aggregate productivity of capital; so the effect of increasing total loans, L , is similar to the effect of decreasing θ . In other words, a powerful contract enforcement allows the financial market to deliver a larger amount of total loan to the firms, preserving the capital allocation efficiency.

4.2 Optimal Interest Rate & Allocation of Capital

In section 4.1 we showed there is a loan return rate, called optimal interest rate that maximizes the aggregate productivity of capital. Here we discuss the characteristics of optimum interest rate and the maximum achievable productivity that is implied by the optimal rate.

One can see from fig. 4 that the average productivity curve takes higher

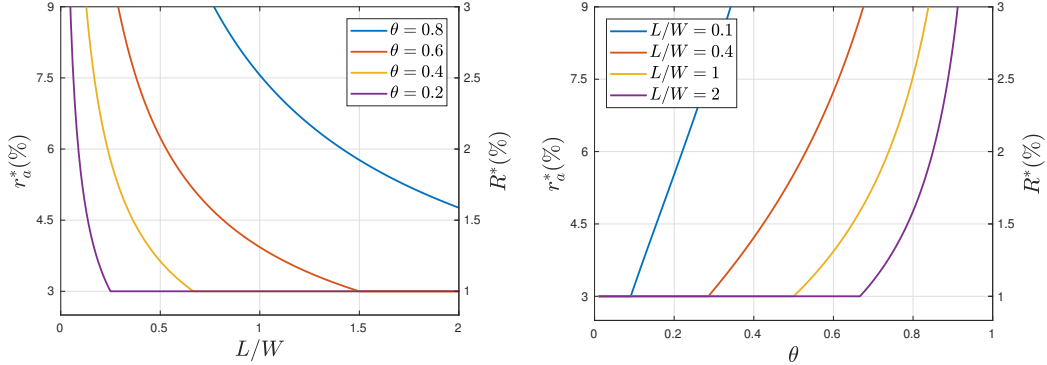


Figure 5: Optimal interest rate, R^* , and the maximum achievable aggregate productivity, r_a^* , as a function of financial contract enforceability, θ , and total loan to wealth ratio, L/W . The productivity distribution of firms is *Pareto* with minimum 1% and average 3%. Analytically, r_a^* and R^* are functions of $\frac{W}{L} \cdot \frac{\theta}{1-\theta}$.

values in an economy with higher θ . From eq. (8) it is seen that the optimal interest rate, R^* , is increasing with θ and decreasing with L/W ; the intermediate equilibria replaces efficient equilibrium in a higher loan interest rates, given a lower L/W and/or a higher θ . Intuitively, a high aggregate collateral value owned by potential borrowers in the financial market and a high punishment on defaulting firms reduces incentive for low-productive firms to enter the financial market, so there is a wide range of loan interest rates, in which increasing loan return rate in the financial market would screen the low-productive firms.

Figure 5 plots the socially optimal interest rate, R^* , and the associated maximum achievable productivity, $r_a^* = r_{R^*}^+$, as a function of total loan to wealth ratio, L/W , and default cost ratio for the borrowers, θ , for a Pareto productivity distribution with minimum 1% and mean 3%. The allocation of capital resources distributed by the bank is highly efficient, if the total amount of loans the bank lends in the financial market is low relative to the total collateral value of the firms (small L/W). Enforcing financial contracts and inducing firms to repay the loans is easier, given a higher aggregate wealth of firms potentially used as a collateral for borrowing, so there is room to screen low-productive firms and improve on the allocation of capital. Equivalently, given L/W , there is a threshold $\theta_0 = L/(L+W)$, such that if $\theta \leq \theta_0$ the inefficient equilibrium takes place, and as discussed in corollary 1 the aggregate capital productivity is equal to the minimum possible value, independent of R . However, if $\theta > \theta_0$, the efficient and intermediate equilibria replace the inefficient equilibrium, and the loan interest rate, R , may be used to improve the allocation of capital. Now the maximum achievable capital

productivity is increasing with θ , and in the Pareto specification is highly sensitive to θ .

Assuming a Pareto productivity distribution with average \bar{r} and tail index σ , one can solve eq. (7) for the socially optimal interest rate, R^* , and obtain the maximum possible aggregate productivity in the economy, r_a^* , as a function of L/W and θ , in an economy with $\theta \geq \theta_0 = L/(L + W)$, or equivalently: $L/W \leq \frac{\theta}{1-\theta}$

$$r_a^* = \left[\frac{\theta}{1-\theta} \cdot \frac{W}{L} \right]^{1/\sigma} \bar{r} \quad (9)$$

Given $\theta = 0.5$, increasing the (scaled) aggregate collateral level in economy (W/L) from 1 to 3, or equivalently, given $L/W = 1$, increasing enforceability of contracts (θ) from 0.5 to 0.75, improves the maximum aggregate capital productivity from the minimum value of 3% to 6.25%, in an industry with Pareto productivity distribution with minimum 1% and average 3%. One should note that the total amount of loans delivered to the firms, L , may remain the same; but given a high θ , or a higher W , loans are employed by high-productive plants, so the difference between average productivities is purely because of an improve in the allocation of capital.

In an economy with a high cost of strategic default for borrowers, government intervention in the financial market, via providing cheap loans to special sectors may result in capital misallocation. From eq. (7), it is seen that $F(R^*) < 1$, if L/W is low and/or θ is high ($\theta > \theta_0$); therefore, R^* should be more than the minimum productivity of a firm in industry; setting interest rates in a way that all firms can demand a loan is not efficient. However, as shown, the extent of improvement in allocation of capital after relaxing the price may depend on L/W and θ . It is seen from fig. 4 that in the situations with high L/W and low θ , the average productivity is not highly affected by changing R , so reducing interest rate may not have considerable consequences in terms of allocation efficiency.

4.3 Monopoly Market Equilibrium

In the previous section we showed that if the aggregate wealth capable of being used as the collateral for borrowing is high enough and also the contract enforceability is above a critical threshold, government interventions in financial market via controlling loan price is not efficient. What about the allocation of capital without a government intervention in financial market? This section examines the outcome of a de-regulated financial market, in which the bank as a monopoly lender sets the interest rate of loans (R). The monopoly market outcome is compared with the optimal allocation analyzed in the previous section.

The definition of a monopoly market equilibrium is similar to the benchmark equilibrium with controlled loan price (definition 1), except here the loan interest rate is endogenously determined by the profit-maximizing bank. In this section we assume $\theta \geq \theta_0 = L/(L+W)$; otherwise, as discussed before, all the interest rates result in a same average productivity and liberalizing the market doesn't affect aggregate productivity. Hence, in the analysis here the benchmark equilibrium (with pre-specified loan price) is either in efficient or intermediate regime.

Definition 2 (Monopoly Market Equilibrium). *Given an exogenous total amount of supplied loans, L , the monopoly market equilibrium is defined by:*

- A loan interest rate R^m ,
- A value of \hat{l} determining the scaled amount of loan a borrower receives,
- A decision rule determining type of each firm: {No Loan, Loan & Repay, Loan & Default},

such that:

1. Firms' decisions is the best response to the scaled loan value \hat{l} and interest rate R^m (shown in fig. 1),
2. The loan interest rate R^m maximizes the bank's expected return specified in eq. (4),
3. Resource constraint holds (eq. (5)).

The monopoly loan price, R^m , is the interest rate that maximizes the expected profit of the bank obtained from eq. (4) in delivering total exogenous loan L to the endogenous group of firms who demand and receive a loan. It is clear to see R^m is greater than or equal to R^* . For the values of R^m below R^* , the equilibrium type is efficient, so the bank's expected interest rate is the same as loan return rate R ; the bank will then increase the interest rate at least up to the social optimal level.

Proposition 4. *The monopoly market loan return rate, R^m , is greater than or equal to the socially optimal interest rate, R^* .*

Increasing the interest rate above R^* , however, may have benefit and cost for the bank. If the indirect cost, which stems from increased ratio of default, is more than direct benefit, which comes from the increased return from lending to high-productive firms repaying the loan, the de-regulated implied interest rate is the same as socially optimum interest rate. The following proposition provides a necessary condition to have an "efficient" allocation in the monopoly market outcome.

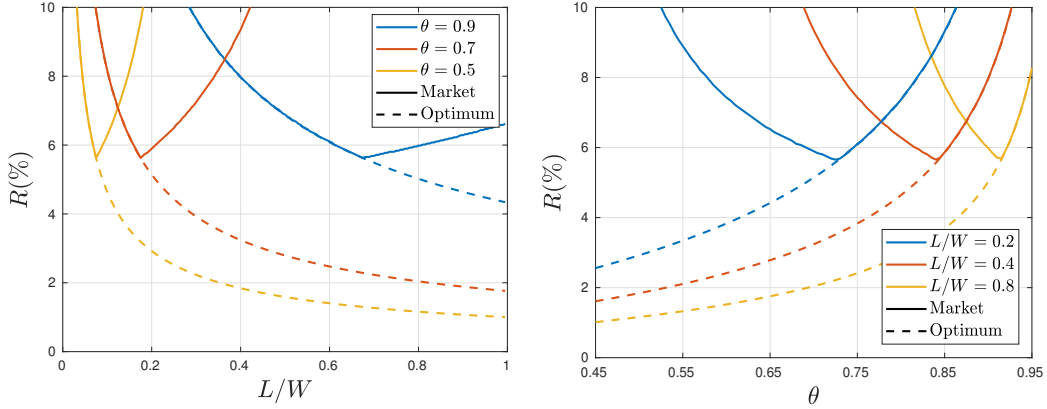


Figure 6: The socially optimal and the monopoly market interest rates as a function of L/W and θ . The productivity distribution of firms is assumed to be *Pareto* with minimum 1% and average of 3%.

Proposition 5. *Suppose $\theta > L/(L + W)$; if the monopoly market outcome is socially optimal, then:*

$$\hat{\theta} \geq \hat{\theta}_c := L/(WF(\bar{r})) \quad (10)$$

Proof. In the monopoly lending market, the bank has the choice to set the interest rate as high as possible. In high enough interest rates, r_{ndc} is arbitrary large (see eq. (2)); so all demanding firms default on the loans. Also, because the equilibrium is in the intermediate regime ($\theta \geq \theta_0$), the value of scaled loan is $\hat{\theta}$. In this case, from eq. (4), the bank's expected return is \bar{r} , the average productivity of all firms in the economy.

Hence, if the socially optimal interest rate, R^* , maximizes the expected return of the bank, the bank's expected return of setting a high R (equal to \bar{r}) should be less than or equal to the bank's expected return by setting $R = R^*$ (equal to R^*). From eq. (7), the necessary condition $R^* \geq \bar{r}$ can be rewritten as eq. (10). \square

Figure 6 shows the socially optimal and the monopoly market interest rates as a function of L/W and θ . In a high value of L/W and/or low value of θ , the optimal interest rate is low and a large fraction of firms have a productivity more than the optimum interest rate. Therefore, there is incentive for the bank to charge the borrowing firms with an interest rate above the optimal level. First, the bank will take the advantage of higher returns from non-defaulting firms; second, even if an increased loan return rate results in defaulting a group of firms, the fraction of the wealth of firms acquired by the bank after a default is more than the payoff of bank by setting a low (socially optimal) interest rate.

One may think that, given the aggregate capital resources financial market lends, the government in less-developed economies should control the loan price, because the contract enforcement is not perfect. “Mild Repression” in the financial markets may increase the productivity of capital, because the market fails in motivating banks to provide cheap loans and there is a large gap between optimal and liberalized market price of lending.

However, the real effect of terminating price control in the lending market is not necessarily significant, and there is not a wide gap between aggregate productivity of capital in a free monopoly market versus optimal outcome. Corollary 3 compares the aggregate productivity outcome in the monopoly market equilibrium, r_a^m , with the maximum achievable aggregate productivity, r_a^* , in a less-developed economy having a weak contract enforcement.

Corollary 3. *Suppose $\theta_0 \leq \theta < \theta_c$; if θ is close to θ_0 , r_a^m converges to r_a^* .*

Proof. Given a small value of θ close to θ_0 , $F(R^*) \rightarrow 1$ (see eq. (7)), so R^* moves toward minimum productivity of firms and r_a^* converges to \bar{r} . Since $\bar{r} \leq r_a^m$, and by definition $r_a^m \leq r_a^*$, if $\theta \rightarrow \theta_0$, r_a^m converges to r_a^* . \square

In a less-developed economy with weak contract enforcement and low aggregate collateral owned by potential borrowers in the financial market ($\frac{\theta}{1-\theta} \ll \frac{L}{WF(\bar{r})}$), the banks has incentive to charge an interest rate more than the socially optimal value; however, because the decision to default by low-productive firms weakens the screening effect of charging higher interest rates, the highest achievable capital productivity is not significantly above the worst case scenario, the average capital productivity of all firms. Therefore, terminating government interventions in setting prices may not significantly harm the aggregate productivity of the hired loans by the firms. Although, it results in an increase in the equilibrium loan return rate and the default ratio goes up.

Figure 7 compares the aggregate productivity of capital in the monopoly market versus socially optimal outcome. As explained, in low values of W/L and/or θ the free market implied aggregate productivity converges to the value in the socially optimal outcome, equal to the average productivity of all firms. On the other hands, in an economy with high W/L and/or θ , the optimum interest rate of lending is high, so there is no incentive for the bank to increase the price of a loan which replaces firms who repay a high interest rate with defaulting firms having possibly a low-productive technology and a low final wealth. Thus, given a level of aggregate wealth used potentially as a collateral for borrowing, there is a middle range of θ , in which the aggregate productivity of capital in the monopoly market outcome is considerably less than the maximum achievable outcome.

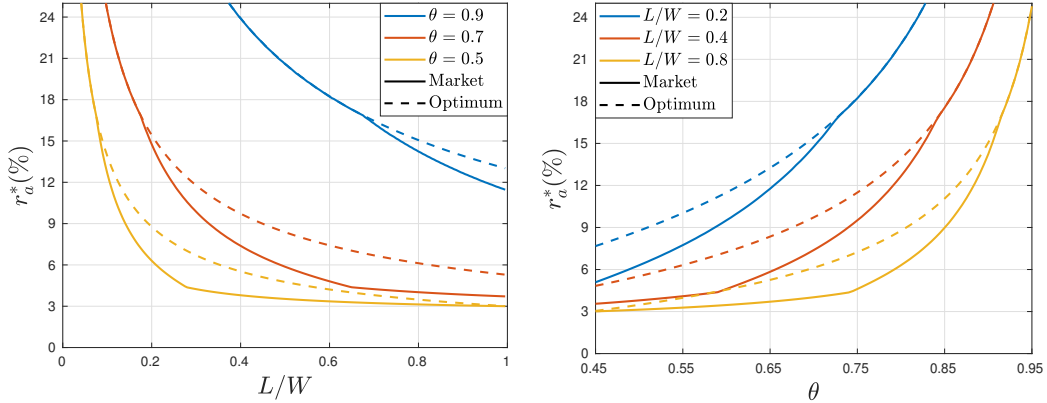


Figure 7: The monopoly market vs. socially optimum average productivity of capital as a function of L/W and θ . The productivity of firms is distributed by Pareto with minimum 1% and average 3%.

According to the results in fig. 7, given $L/W = 0.8$, the gap between the optimum and monopoly market aggregate productivity is maximal at $\theta \approx 0.75$, where $r_a^* = 7.2\%$ and $r_a^m = 4.6$. However, averaging on different values of θ , the gap is not too high. If $L/W = 0.8$, the average difference in the range $0.45 \leq \theta \leq 0.9$, where the difference between optimal and deregulated market implied productivity is nonzero, is about 1.4%; in this range the productivity of the monopoly market outcome is 5.4% on average. It is noticeable that forcing the bank to provide cheap loans result in an aggregate productivity of 3%. Therefore, a monopoly lending market may be regarded as a second best policy, considering the government failure in identifying and requiring the optimal loan interest rate.

5 Conclusion

Three features are pronounced in less-developed economies' financial markets: Government's regulation on the cheap loans to the government or government's firms, poor contract enforcement due to the weak judicial system and severe asymmetric information between the lender and the borrower due to the lack of financial markets' infrastructures.

In this paper, we introduce a theoretical framework to analyze the capital misallocation effects of financial market repression with asymmetric information and poor contract enforcement. The government intervention in setting interest rates and forcing banks to supply a certain level of lending are examined in the presence of asymmetric information between banks and the borrowing firms and the possibility of strategic default due to the poor con-

tract enforcement.

We model an equilibrium strategic default behavior due to the asymmetric information between the banks and the firms and the low cost of defaulting. Banks do not observe the borrowing firms' productivities and treat them the same. Knowing this lack of information, lower productive firms decide to borrow and voluntarily default on their loans since the legal enforcements on the contracts are not strong and they can hide some portion of the produced wealth.

We show that strong institutions to enforce contracts play a critical role in determining the effects of government intervention policies, and efficiency of the financial system in the allocation of capital. Specifically, we find that higher levels of loan to value in a poor economic institution ends up with higher equilibrium voluntary default ratios.

Also, we find that the standard screening mechanism of interest rates which can prevent the low-productive firms from borrowing is not active in a poor economic institution since firms have the option to default and gain due to the asymmetric information and poor enforcement. Thus increasing interest rates not only prevent low-productive firms to be active in the market but also increases the non-performing loans and the default ratio since more firms now have incentive to borrow and default.

To conclude, financial market liberalizations have prerequisites: sophisticated judicial and legal systems to impose high costs on the defaulting agents. Without such a system, removing interventions not only leaves capital misallocation unchanged, but also may increase the default ratio and the non-performing loans of the financial system. However the necessary condition is also the sufficient condition: liberalizing the rates, allowing banks to move to the profit maximizing rates can implement the second best capital allocation, despite the existing frictions.

The presented model has some assumptions that could be relaxed in the future researches. First, the reputations of borrowers for lenders is not analyzed. The gain from future profits may be an incentive for borrowers not to default. So maintaining such a relationship may be a substitute for the poor legal contract enforcement. This may result in a more efficient capital allocation compared to the outcome of our model. A dynamic model is required to address this dynamic relationship between firms and banks⁷.

Additionally, one can expand the decision set of the banks, allowing them to play mix and allocate different loan to values to the firms. Moreover one can also consider the social cost of defaults as well in calculating the optimal rates. Finally, it is interesting to relax the assumption that the proportional

⁷see [Stiglitz and Weiss \(1983\)](#).

cost of default for firms is exogenous. This parameter can be affected by the decision of a bank to monitor the activity of firms. Introducing this mechanism, may result in macro rationing, i.e., providing loan to a few borrowers⁸, to reduce the cost of preventing default and to perform higher control on demanding firms, thus increasing the efficiency of capital allocation.

References

- Antunes, A., T. Cavalcanti, and A. Villamil (2008). The effect of financial repression and enforcement on entrepreneurship and economic development. *Journal of Monetary Economics* 55(2), 278–297.
- Banerjee, A. V. and E. Duflo (2005). Growth theory through the lens of development economics. *Handbook of economic growth* 1, 473–552.
- Bencivenga, V. R. and B. D. Smith (1992). Deficits, inflation, and the banking system in developing countries: The optimal degree of financial repression. *Oxford Economic Papers*, 767–790.
- Chari, V., A. Dovis, and P. J. Kehoe (2014). On the optimality of financial repression. *Manuscript, University of Minnesota*.
- Clementi, G. L. and H. A. Hopenhayn (2006). A theory of financing constraints and firm dynamics. *The Quarterly Journal of Economics* 121(1), 229–265.
- Cooley, T., R. Marimon, and V. Quadrini (2004). Aggregate consequences of limited contract enforceability. *Journal of Political Economy* 112(4), 817–847.
- Demetriades, P. O. and K. B. Luintel (1997). The direct costs of financial repression: evidence from india. *Review of Economics and Statistics* 79(2), 311–320.
- Diaz-Alejandro, C. (1985). Good-bye financial repression, hello financial crash. *Journal of development Economics* 19(1), 1–24.
- Fry, M. J. (1980). Saving, investment, growth and the cost of financial repression. *World Development* 8(4), 317–327.
- Gertler, M. and P. Karadi (2011). A model of unconventional monetary policy. *Journal of monetary Economics* 58(1), 17–34.

⁸See [Ghosh et al. \(2000\)](#).

- Gertler, M. and N. Kiyotaki (2010). Financial intermediation and credit policy in business cycle analysis. *Handbook of monetary economics* 3(11), 547–599.
- Ghosh, P., D. Mookherjee, and D. Ray (2000). Credit rationing in developing countries: an overview of the theory. *Readings in the theory of economic development*, 383–401.
- Gormley, T. A. (2014). Costly information, entry, and credit access. *Journal of Economic Theory* 154, 633–667.
- Hall, R. E. and C. I. Jones (1999). Why do some countries produce so much more output per worker than others? Technical report, National bureau of economic research.
- Hsieh, C.-T. and P. J. Klenow (2009). Misallocation and manufacturing tfp in china and india. *The Quarterly Journal of Economics* 124(4), 1403–1448.
- Luoto, J., C. McIntosh, and B. Wydick (2007). Credit information systems in less developed countries: A test with microfinance in guatemala. *Economic Development and Cultural Change* 55(2), 313–334.
- Mankiw, N. G. (1986). The allocation of credit and financial collapse. *The Quarterly Journal of Economics* 101(3), 455–470.
- McKinnon, R. (1973). *Money and Capital in Economic Development*. Brookings Institution.
- Nguyen, H. and R. Qian (2012). The cross-country magnitude and determinants of collateral borrowing.
- Roubini, N. and X. Sala-i Martin (1992, July). Financial repression and economic growth. *Journal of Development Economics* 39(1), 5–30.
- Shaw, E. (1973). *Financial deepening in economic development*. Economic development report. Oxford University Press.
- Stiglitz, J. E. (1993). *The role of the state in financial markets*, Volume 21. Institute of Economics, Academia Sinica.
- Stiglitz, J. E. and A. Weiss (1981). Credit rationing in markets with imperfect information. *The American economic review*, 393–410.
- Stiglitz, J. E. and A. Weiss (1983). Incentive effects of terminations: Applications to the credit and labor markets. *The American Economic Review*, 912–927.

Williamson, J. and M. Mahar (1998). *A survey of financial liberalization*.
International Finance Section, Department of Economics, Princeton University.