On the Neutrality of Financial Repression*

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February 10, 2020

Abstract

In this paper, we theoretically analyze the capital misallocation effect of financial repression—namely, a regulation to provide cheap loans to (public) firms, in less-developed economies. Limited contract enforcement and asymmetric information between lenders and borrowers are the features of the environment we study. We show raising the interest rate does not screen low-productive firms; due to adverse selection such firms borrow and strategically default. Hence, financial repression does not cause capital misallocation. Advanced enforceability of financial contracts and/or a rise in asset collateralizability of firms break the neutrality result, in which case the free market outcome achieves the optimal allocation of capital.

Keywords: Financial Repression, Capital Misallocation, Less-Developed Economies, Contract Enforcement, Asymmetric Information, Asset Collateralizability, Strategic Default.
JEL: G1, O1, P4.

1 Introduction

Financial repression is a prevalent government intervention policy in less-developed countries and has been the topic of the development literature and discussions of policymakers for decades. Among social costs discussed in the literature associated with this policy is capital misallocation. The

*Previously circulated as "Capital Misallocation Effect of Financial Repression in Less-Developed Economies".

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basic view is that repressing the interest rate in the loan market induces less-productive plants to demand for a loan. Capital is not allocated to where it is mostly productive—capital misallocation is the result.

In this paper, we argue that for financial repression to cause capital misallocation, enforceability of financial contract is the determinant. Financial repression is defined as a regulation on (public) banks to provide cheap loans to firms. In an economy with the possibility of strategic default on loans and asymmetric information on the borrowing firms' productivity, financial repression may be just neutral in regards to the allocation of capital. Neutrality holds if contract enforcement is poor and asset collateralizability of firms is limited—both of which are critical challenges for less-developed economies. Repressing the interest rate on loans would in fact *decrease* the ratio of non-performing loans in the economy. We theoretically analyze financing decision of firms and equilibrium effects of financial repression on the aggregate capital productivity and default ratio in the loan market. We characterize the constrained efficient allocation and the free market outcome and assess the implications of financial repression.

Our model is a synthesis of Stiglitz and Weiss (1981) and Gertler and Kiyotaki (2010). As in Stiglitz and Weiss (1981) there exists asymmetric information in the loan market: a bank cannot observe the productivity of a borrowing firm. But, in our model there is no uncertainty in the productivity. As in Gertler and Kiyotaki (2010) contract enforcement is limited: a borrowing firm can strategically default on her loan, and only a proportion of her assets would be accessible for the lenders (banks) upon a default. This proportion represents the power of legal institutions in enforcing loan contracts and imposing credible punishments on defaulting borrowers.

The key features of the model are the firms' financing decision and the strategic default of borrowing firms due to the limited enforcement of financial contracts. Strategic default could be avoided ex-ante if there was no asymmetric information between banks and borrowing firms. Basically, a bank cannot observe a borrower's productivity and should lend her just based on the posted collateral by the firm. The firm knows her productivity and can decide to borrow or not; if she borrowed, she decides whether to repay the loan or strategically default on the loan.

Crucial in our analysis is a screening mechanism in the environment with asymmetric information. The increase in the loan interest rate naturally filters out firms with less capital productivity from the loan market, if strategic default is not an option for borrowers. We show that even with limited contract enforcement and strategic default as an option, given a low ratio of the quantity of regulated loans to collateralizable assets of firms, the screening mechanism is active and increasing the interest rates can divert the capital to high-productive firms, without causing a default on loans in the equilibrium. Hence, repressing the interest rates in the lending market indeed results in capital misallocation.

For the screening mechanism to be active, what matters is enforceability of loan contracts, and the quantity of regulated loans scaled with the volume of collateralizable assets of firms. Under limited contract enforcement, when banks are required to lend a high quantity of loans and/or firms are weak in providing pledgeable assets as a collateral for loans, the entire pool of firms borrow and the low-productive ones default; only the high-productive firms have the incentive to repay the loans. In equilibrium, the screening mechanism does not work; distorting loan interest rate only changes the margin of defaulting on loans, not the decision to demand a loan ex-ante. Therefore, repressing the interest rate per-se does not cause capital misallocation. In fact, the economy gets stuck in the worst possible allocation of capital—both low- and high-productive firms demand and receive a loan, no matter whether the interest rate on loan is regulated or not. Financial repression is neutral.

Finally, and more interestingly, in an intermediate range of contract enforceability, the economy enters an equilibrium where all high-productive firms borrow and repay the loan; plus, a fraction of low-productive firms borrow and default. In these equilibria financial repression is not neutral; however, providing cheap loans may *improve* on the allocation of capital. Screening marginal firms who demand a loan by increasing the interest rate would shrink the population of borrowing firms and endogenously increases the leverage ratio in the equilibrium: the loan to collateral ratio rises. This rise makes incentive for low-productive firms to demand a loan and strategically default. Capital is allocated to low-productive firms if the interest rate on loan rises. In other words, capital misallocation is the result of *not* repressing the interest rate on regulated loans.

In general, we show that either financial repression is neutral—the allocation of capital is not sensitive to the interest rate of the regulated loans at all (weak contract enforcement); or the average capital productivity is inverse-U shape with respect to the loan interest rate (advanced contract enforcement). In the later case, in low-rates region screening mechanism is active and default ratio is zero; increasing the interest rate improves on the allocation of capital. In higher rates, increasing the interest rate is followed by an increase in the loan-to-collateral ratio and demand and default by low-productive firms; the average productivity of loans declines. Therefore, there is a unique optimum interest rate that achieves the socially optimal allocation of capital. Nevertheless, with poor contract enforcement the range of variation in average productivity of capital with respect to the loan interest rate shrinks; average productivity is almost always equal to the worst possible level—financial repression becomes neutral.

We analyze the outcome of financial market liberalization. We study the environment that allows a monopoly bank to set a profit-maximizing interest rate on regulated loans. Credit rationing may be the result, even in our framework where there is no uncertainty in the productivity of firms. While increasing the interest rate may raise the profit of the bank from higher loan returns paid by high-productive firms, there may be profit loss because of the demand and default on loans by low-productive firms. We show that market interest rate, as an equilibrium outcome of the interaction of firms and the bank, may be higher than the socially optimum rate, which achieves the efficient allocation of capital. This is the case because the bank have the incentive to charge higher rates to earn some portion of the generated wealth by high-productive firms upon their default on loans, rather than collecting a low return rate on loans from both low- and high-productive firms.

This result justifies a mild repression policy (price ceiling for loan market) to induce higher average productivity. By doing so, the ratio of default on loans goes down as well, which could avoid other (non-pecuniary) costs in the economy not discussed in our model. Nevertheless, we argue that, as in underdeveloped and developing economies the contract enforcement is weak, the maximum interest rate in which the screening mechanism remains active could not be high and in all possible ranges of interest rates, the maximum achievable average capital productivity is not far above the worst case scenario; so government interventions may not considerably impact the average productivity of capital. Ultimately, the allocation of capital is highly sensitive to enforceability of financial contracts which determines the scope of the screening mechanism and the allocation of capital in the financial market.

Related Literature. Our paper connects two lines of literature. A mature literature discussing aggregate implications of financial repression and a recent literature explaining the role of capital misallocation for output-per-capita in less-developed economies.

Capital misallocation explains a considerable share of the gap in output per worker between less-developed and developed economies. Banerjee and Duflo (2005) show that a wide gap in output per worker between USA and India is due to the allocation —not quantity of the aggregate endowments.

Hsieh and Klenow (2009) also report a wide range in productivity 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. Why low-productive firms survive in less-developed economies? In this paper, we ask to what extent financial repression policies can explain this fact.

A vast literature discusses financial repression in less-developed economies (McKinnon, 1973; Shaw, 1973; Fry, 1980; Bencivenga and Smith, 1992; Demetriades and Luintel, 1997; Williamson and Mahar, 1998). This literature mostly focuses on the implications for aggregate savings—supply side, rather than demand side of the financial market. Roubini and Sala-i Martin (1992) document an adverse impact of financial repression on economic growth and theoretically justify the policy from a government's point of view, despite its impact on productivity of capital. In their model, there is no friction in the production side, except for the distortion caused by financial repression. Therefore, by construction, financial repression is socially destructive.

On the other hand, a few research studies argue that financial repression may be optimal in a second-best world. Diaz-Alejandro (1985) argues that limited contract enforcement in financial markets can explain why several Latin American countries in the 1980s experienced financial crisis after terminating financial repression. Stiglitz (1993) broadly supports government interventions and mild repression from a social point of view, because of market failure. More recently, Chari et al. (2020) theoretically shows financial repression, in terms of policies that force banks to hold government debt, is optimal if the government might not commit to not default on its debt.

We show financial repression, i.e., a policy that limits the interest rate on loans, does not cause capital misallocation per-se. Contract enforcement is the key determinant. Through the lens of our model, this means the inability of a borrower to hold cash against the contractual right of the lender. In this regard, our paper theoretically confirms the empirical results of Hall and Jones (1999). Social infrastructures—namely, legal and judicial institutions and government policies that protect the return to individual units from diversion, is the key determinant of the productivity of the aggregate endowments in the economy.

A direct result of limited enforceability in our model is that a high fraction of borrowers default on loans. In fact, the average ratio of nonperforming loans in 2002-2013 is 10.7% for low-income countries while it is 6.3% for the rest.[1] This gap is what we can explain by limited enforceability *and* asym-

[1] Data source: World Bank; low income countries are defined as countries that have a GNI per capita in the bottom quartile—less than 4,100$, in year 2013.

metric information as two frictions in the financial market. In contrast, research studies on financial friction and capital misallocation mostly consider limited contract enforcement as the only friction, which in effect translates into a collateral constraint that prevents borrowers from defaulting (Antunes et al., 2008; Midrigan and Xu, 2014; Itskhoki and Moll, 2019). Default ratio is zero in equilibrium. In our setup, asymmetric information generates a screening mechanism: *higher* price of loan filters out low-productive borrowers and improves on efficiency. The scope of this screening mechanism is determined by enforceability of loan contracts.

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 $F : [r_{min}, r_{max}] \to [0, 1]$, 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:

$$(w+l)(1+r_i) - l(1+R) \geq (w+l)(1+r_i)(1-\theta) \tag{1}$$

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

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

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 if[2]

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

We can derive the demand condition as

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

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

[2] One 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.

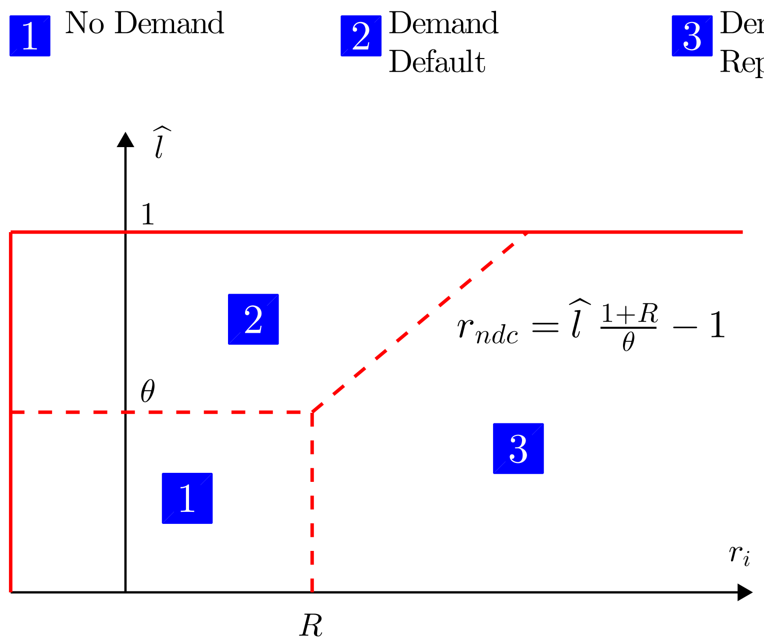

Figure 1: The best response of firm i with productivity r_i, given the loan wealth ratio of $\widehat{l} = l/(l+w)$. R is the real interest rate of loans and θ is the proportion of a firm's wealth that is accessible by the bank if the firm defaults.

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 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.

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 de-*

termining the interest rate of loans, R, and an exogenous total amount of supplied loans, L, the equilibrium is defined by:

- *A value of $\widehat{l}$ 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 $\widehat{l}$ and interest rate R (shown in fig. 1),*
2. *Resource constraint holds:*

$$L = \mathcal{M}_D l \tag{4}$$

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, $\widehat{\theta}$ is defined as $\widehat{\theta} := \theta/(1-\theta)$, which is increasing with θ, the enforceability of loan contracts.

Proposition 1. *If $L \leq \widehat{\theta} W_R^+$, 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, $L \leq \widehat{\theta}\mathcal{M}_D W$. Therefore, using the resource constraint ($L = \mathcal{M}_D l$) and the definition of $\widehat{\theta} := \theta/(1-\theta)$, we find that $\widehat{l} \leq \theta$. 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 $\widehat{l} \leq \theta$, 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 $\overline{R} = R$. □

Proposition 2. *If $\widehat{\theta} W \leq L$, 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 $\widehat{\theta}\mathcal{M}_D W \leq L$. Therefore, using the resource constraint and the definition of $\widehat{\theta}$ we find $\widehat{l} \geq \theta$. 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 $\widehat{l} = L/(L+W)$. 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. □

Proposition 3. *If $\widehat{\theta}W_R^+ < L < \widehat{\theta}W$ 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 $P_D = 1 - \widehat{\theta}F(R)W/L$ of total loans and default. High-productive firms repay the loan.*

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

Using $\widehat{l} = \theta$ 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, $\widehat{l} = \theta$, 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 $P_D = 1 - \widehat{\theta}F(R)W/L$. □

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 $L/(\widehat{\theta}W) \leq F(R)$ and just the high-productive firms receive a loan; no firm defaults in this type of equilibrium. Second, the "inefficient" equilibrium

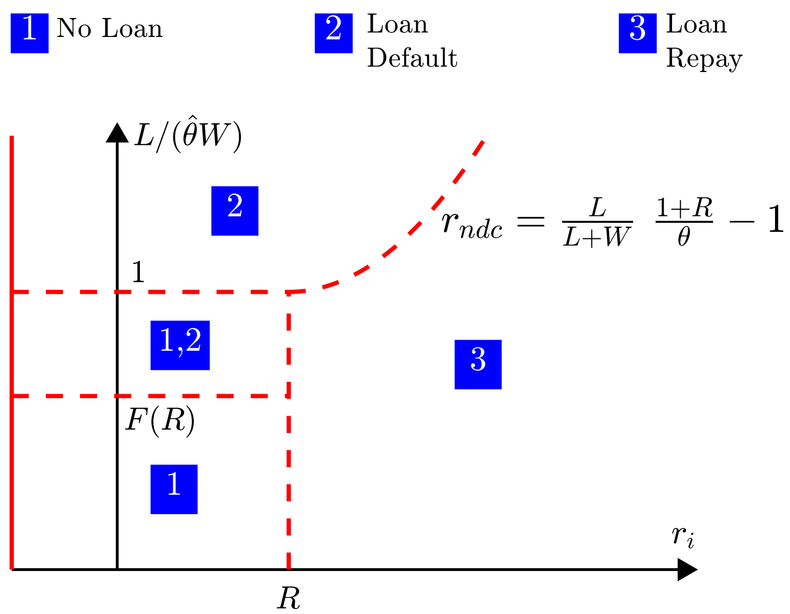

Figure 2: The equilibrium type of a firm with capital productivity r_i as a function of macro-variables; R is the real interest rate of loans, L is the total amount of loans, W is the total wealth of firms and $\widehat{\theta}$ shows the enforceability of contracts.

occurs if $1 \leq L/(\widehat{\theta}W)$, 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 $F(R) < L/(\widehat{\theta}W) < 1$; 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 r_{ndc} if the equilibrium is inefficient.

Default Ratio

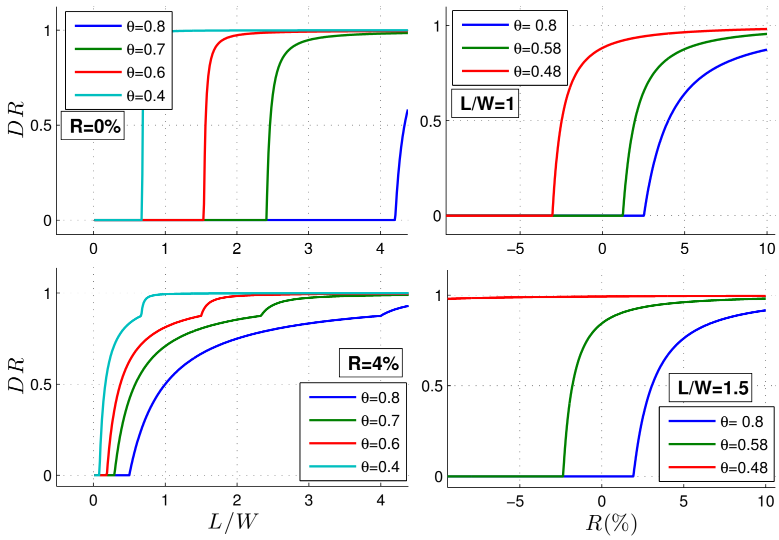

Figure 3: The ratio of firms that default, DR, as a function of interest rate (R) and total loan to total wealth ratio (L/W) in different values of the contract enforcement power (θ). The productivity distribution of firms is *Pareto* with minimum 1% and average 3%.

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:*

$$\theta_0 = L/(L + W) \tag{5}$$

Proof. If $\theta \leq \theta_0$, we know $\widehat{\theta} \leq L/W$; 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. □

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 $F(.)$ 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*

$$F(R^*) = L/(\widehat{\theta}W). \tag{6}$$

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 $F(.)$ 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:

$$r_a(R) = r_R^+ - [1 - \widehat{\theta}F(R)W/L](r_R^+ - r_R^-), \tag{7}$$

where r_R^- and r_R^+ stands for the average productivity of low- and high-productive firms. Since $F(.)$ is continuous and strictly decreasing, one can show that $r_a(.)$ in eq. (7) 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. (6). □

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

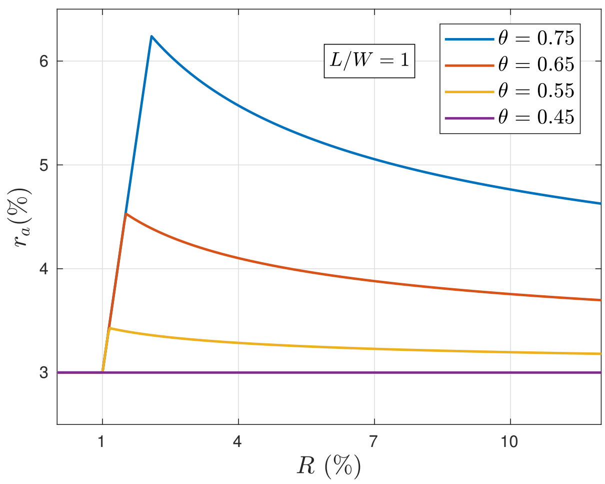

Figure 4: Aggregate productivity of capital, r_a, as a function of interest rate, R, for different values of contract enforcement, θ. The productivity distribution of firms is *Pareto* with minimum 1% and average 3%. The ratio of total loan to total wealth in the economy, L/W, is equal to 1. Analytically,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

minimum 1% and average 3%. According to the value of total loan over 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. (6) 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 $L/(\widehat{\theta W})$ 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 and 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

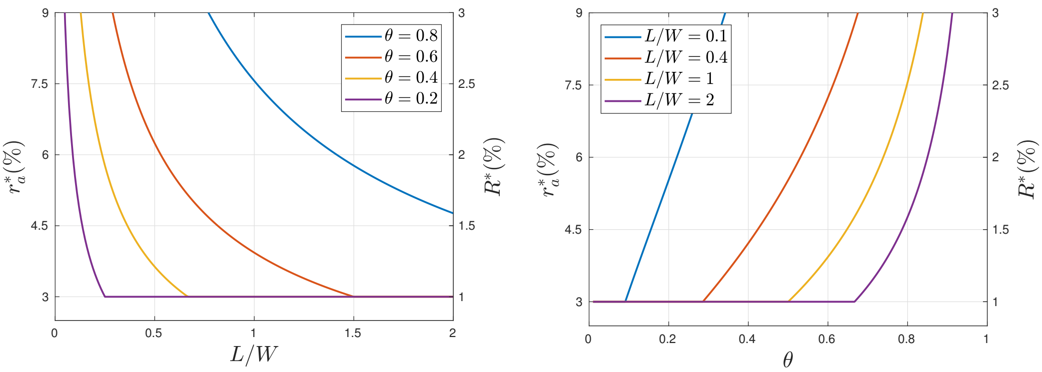

Figure 5: Optimal interest rate, R^*, and the maximum achievable aggregate productivity, r_a^*, as a function of financial contract enforceability, θ, and total loan to wealth ratio, L/W. The productivity distribution of firms is *Pareto* with minimum 1% and average 3%. Analytically, r_a^* and R^* are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

productivity that is implied by the optimal rate.

One can see from fig. 4 that the average productivity curve takes higher values in an economy with higher θ. From eq. (7) 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. (6) 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: $L/W \leq \frac{\theta}{1-\theta}$

$$r_a^* = [\tfrac{\theta}{1-\theta} \cdot \tfrac{W}{L}]^{1/\sigma}\bar{r} \tag{8}$$

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. (6), 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.

Throughout 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.

The 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.

The Bank's Profit. The bank's expected return rate is derived from

$$1 + \overline{R} = (1 - P_D)(1 + R) + P_D \theta (1 + r_{ndc}^{-})/\widehat{l} \tag{9}$$

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}.

$\overline{R}$ is increasing in θ and decreasing in $\widehat{l}$ 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 $\widehat{l}$, 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 $\overline{R}$ 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.

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* $\widehat{l}$ *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* $\widehat{l}$ *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. (9),*

3. *Resource constraint holds (eq. (4)).*

The monopoly loan price, R^m, is the interest rate that maximizes the expected profit of the bank obtained from eq. (9) 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.

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

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

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 $\widehat{\theta}$. In this case, from eq. (9), 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

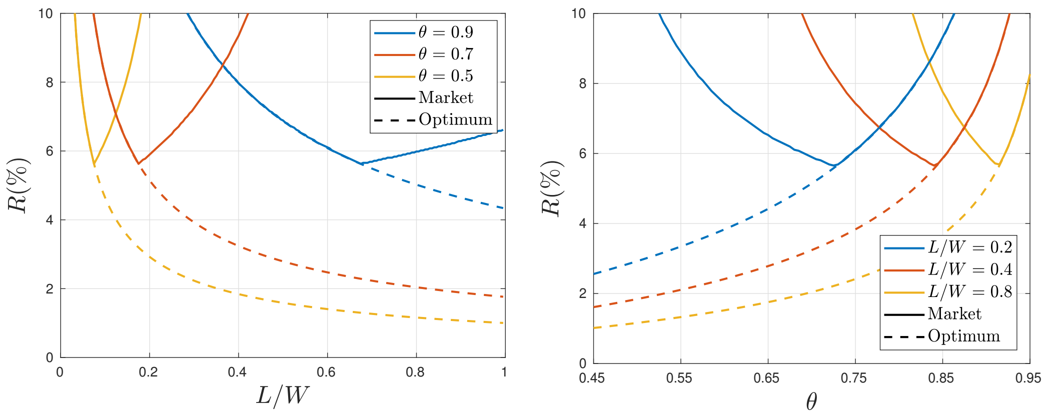

Figure 6: The socially optimal and the monopoly market interest rates as a function of L/W and θ. The productivity distribution of firms is assumed to be *Pareto* with minimum 1% and average of 3%.

to $\bar{r}$) should be less than or equal to the bank's expected return by setting $R = R^*$ (equal to R^*). From eq. (6), the necessary condition $R^* \geq \bar{r}$ can be rewritten as eq. (10). □

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 productiv-

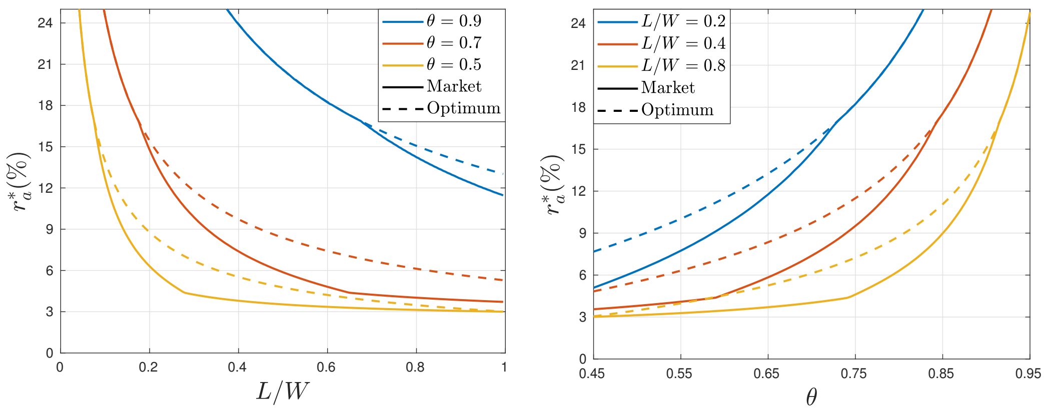

Figure 7: The monopoly market vs. socially optimum average productivity of capital as a function of L/W and θ. The productivity of firms is distributed by Pareto with minimum 1% and average 3%.

ity, 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, $F(R^*) \to 1$ (see eq. (6)), 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 $\theta \to \theta_0$, r_a^m converges to r_a^*. □

In a less-developed economy with weak contract enforcement and low aggregate collateral owned by potential borrowers in the financial market ($\frac{\theta}{1-\theta} << \frac{L}{WF(\bar{r})}$), 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 that the maximum achievable outcome.

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

We theoretically analyze the capital misallocation effect of financial repression—namely, price ceiling in the loan market, in less developed economies. Asymmetric information between lenders and borrowers in the loan market and weak enforceability of financial contracts are key features of the environment we analyze. In our model, weak contract enforcement means a defaulting borrower can hide some portion of its generated wealth. We model the demand for loan and the decision to default on a loan by firms. Banks do not observe the borrowing firms' productivity and treat them the same. Knowing this lack of information, low-productive firms may decide to borrow and strategically default on a loan.

We show that contract enforcement plays a critical role in determining the effects of government intervention policies on the allocation of capital. The standard screening mechanism of interest rate: preventing the low-productive firms from borrowing by raising the rate in the environment with asymmetric information, is not active if contract enforcement is weak and asset collateralizability of firms is limited. Thus financial repression is neutral. Higher rates—the free market outcome, only increases the mass of defaulting loans in the economy, leaving the decision to demand a loan by low-productive and the allocation of capital unchanged.

We argue financial market liberalizations have prerequisites: sophisticated judicial and legal systems to impose high costs on the defaulting borrowers. However, the necessary condition is also the sufficient condition: liberalizing the rates—allowing the bank to move to the profit maximizing rate implements the second best capital allocation, despite asymmetric information in the loan market if contract enforceability is advanced.

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