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The Role of Credit Market Competition on Lending Strategies and on Capital Accumulation

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Abstract

This paper examines the role of credit market competition in the dynamic of capital accumulation. It is shown that the lending relationship problem which seems to characterize competitive credit markets can have negative repercussions for capital accumulation. In contrast, monopoly power in banking can be beneficial for growth. A monopolist bank may lower the equilibrium quantity of credit, but it allows a better allocation of credit supply. This result reconciles with the available empirical evidence and suggests a positive role for monopoly power in banking, especially for developing countries.

1 Introduction

This paper analyzes the interaction between credit market competitievness and economic growth. It argues that in a dynamic setting the choice of a perfectly competitive credit market entails an economic trade-off rather than an unequivocal benefit. On the one hand, a financial intermediary with market power causes a reduction in the equilibrium supply of credit. On the other hand, an intermediary with market power generates a growth enhancing externality attributable to its superior ability to establish a close lending relationship with high quality entrepreneurs.

There are many examples in economic history where it appears that market power in the credit sector enhanced growth. For example, a highly concentrated system of large banks was crucial to the development of many European countries in the nineteenth century (see Gerschenkron [10], Cameron [5], Cohen [7]). Likewise, Sylla [30] has argued that monopoly-enhancing regulation in the financial sector at the time of the Civil War contributed to industrialization in the United States. By the same token, Japan's post-war development is considered to have been boosted by its main-bank system (see Mayer, [20]).[1]

Nevertheless, in the literature on financial intermediation and growth, which expanded considerably in recent years (e.g. Greenwood and Jovanovic [13], Bencivenga and Smith [3], King and Levine [18], [19], Pagano [23], Saint Paul [26]) the effects of alternative credit market structures on the dynamic of capital accumulation have not received much attention. The conventional wisdom is that financial intermediaries with market power only generate inefficiencies and that this is harmful to growth (e.g., see Pagano [23]).

If monopoly power in banking can indeed have beneficial effects on growth, as the above-mentioned anectodal evidence seems to suggest, how can we

[1] More general empirical evidence is still not available in the literature. In a panel study, still in progress, Cetorelli and Gambera [6] find evidence that monopoly power in the credit market is beneficial for developing countries but not for developed ones.

identify the exact channel (or channels) of causality? In a recent thread of literature it is argued that competition in financial markets is detrimental to the establishment of specific, long-lasting relations between a bank and a firm: intuitively, problems of information and incentives could be overcome more easily if a bank were able to establish a close relationship with her client firms.[2] A bank may be willing to bear the cost of funding young firms with no record of performance if she can share in the future stream of profits of such firms, should they turn out to be successful. However, in highly competitive credit markets, a bank knows that she may not be able to maintain a tie with the successful firms because these firms (given their new status) will in the future seek the lowest-cost supply of credit available in the market. This intuition is formalized, for example, by Petersen and Rajan [25]. They have a model where competition in banking can actually induce credit rationing, in the sense that potentially high quality, but young and unknown, entrepreneurs may not get funded. Credit availability increases in concentrated financial markets. They provide substantial empirical evidence in support of their thesis.

Mayer [20], [21] also makes this point. He suggests another example of the lending relationship problem: a bank may be willing to provide rescue finance for a financially distressed firm if she expects the firm to promise high returns in the future. But once the firm is out of financial distress it can seek the lowes-cost funding available in the economy and this may indeed discourage the competitive bank to provide rescue funding to begin with (Mayer [21], page 25).

Could this negative aspect of competition in the credit sector also have negative consequences for growth? In this paper I attempt to answer this question incorporating the lending relationship problem in a general equi-

[2] See Mayer [20], Petersen and Rajan [24], [25] for details of the theory. Empirical evidence supporting the beneficial effects of lending relationships are those of Hoshy, Kashyap and Scharfstein [16] [17], Gibson [11] on the Japanese banking system, and those of Berger and Udell [4] and Petersen and Rajan [24] [25] on the US system.

librium, dynamic model of capital accumulation. I analyze two benchmark economies, one with a perfectly competitive credit sector and the other with a monopolistic intermediary. I show that a monopolist bank can perform a costly screening activity and supply credit to high quality entrepreneurs, rejecting applications of low quality types (the bank can establish a lending relationship with the high quality entrepreneurs). In a competitive market, screening is prevented by the threat of free riding of competitor banks. In equilibrium, banks will instead choose to lend indiscriminately to all lenders, lowering the average quality of the capital stock.

Market power in banking thus generates an economic externality by enhancing capital allocation. However, the "natural" rent-extraction behavior of the monopolist bank produces a well known negative effect on equilibrium quantities (the inefficient monopolist argument highlighted by Pagano [23]). I show that under plausible conditions the first effect can offset the second, and therefore the steady state level of capital can be higher when the credit market is monopolistic.

This paper thus shows the existence of a trade-off between the quantity reduction effect and the quality improvement effect on capital of monopolistic banking. This trade-off is claimed to be particularly relevant for economies in early stages of development, where monopoly power in the credit market may be preferred to perfect competition.[3]

The paper is organized as follows. In Section 2 the economy and its relevant sectors are described. Section 3 focuses on the differences in lending strategies in the two benchmark economies. Section 4 analyzes the equilibrium in the credit market and the dynamic of capital accumulation. Comparisons between the two benchmark economies in steady state and the main results are drawn in Section 5. Section 6 provides a discussion on the relevance of

[3] This point challenges the prevalent preference for competition enhancing regulation, for developed as well as developing countries, maintained in the literature on financial reforms (e.g. Vittas [32], Vittas and De Long [33], The World Bank [34]).

the results and the robustness of the basic assumptions. Section 7 contains concluding remarks.

2 The Economy

The economy is populated by overlapping cohorts, each with unit mass, living for two periods. Population is assumed to be constant. Every young agent is a potential entrepreneur, endowed with one production project, with no capital and with a unit of labor. In old age individuals do not work and do not own a productive technology. When young, they will attempt to operate the production project. If successful they will hire labor and produce. If unsuccessful, they will supply their labor in successful lines of production. In either case, they will have an income at the end of the first period. The amount they decide to save to finance next period consumption represents the supply of capital for the next generation of young entrepreneurs.

Production is assumed to be a two-stages process. In a first stage, entrepreneurs are engaged in the set up of the capital stock (purchase and installation of machinery, operation plants set up, etc.). The outcome of this first stage follows an idiosyncratic random process. If the capital set up is successful, the entrepreneur will then proceed to hire labor, output will be obtained in this second stage, and the entrepreneur will pay back the factors of production. If the capital set up is not successful, capital is completely lost, the entrepreneur will not hire labor nor will he produce, and will default on the payment for the capital service originally supplied.[4]

There are two types of entrepreneurs. A type H is successful in the set-up stage with probability p and unsuccessful with probability $1-p$. If successful, the entrepreneur will then produce, adopting the production technology

[4]This modelling approach is used, for example, in Azariadis [1]. Its main advantage is that it leaves the actual production stage free of any source of uncertainty. This modelling strategy has no effect on the quality of the results.

$$y_t = f(k_t) \equiv \delta k_t^{\gamma}, \tag{1}$$

$\delta > 0, \gamma < 1$, where y_t and k_t are, respectively, production per capita and capital per-capita at time t.

A type L entrepreneur is doomed to fail with probability one in the capital set-up stage. Since capital is lost, a type L entrepreneur will never hire labor and will never produce.[5]

The quality of an entrepreneur is not known by either the bank or the agent. It is however known that the proportion of type H entrepreneurs in the population is $0 < \Theta < 1$, where Θ is a known constant.[6]

Let c_t and c_{t+1} be consumption at time t and $t+1$ for a representative member of generation t. Agents are assumed to maximize the following homothetic utility function,

$$U(c_t, c_{t+1}) = c_t^{\alpha} + \beta c_{t+1}^{\alpha}, \qquad \alpha < 1 \ . \tag{2}$$

It is assumed the existence of an initial cohort of old agents at $t = 0$ who are endowed with a stock of capital per capita $k_0 > 0$.

Credit in this economy is fully intermediated. Banks will emerge for two reasons. First, they can collect savings, s, and give credit to a large number of entrepreneurs, thus achieving diversification of idiosyncratic risk. Second, there exists a screening technology. Banks can learn the quality

[5] The extension to a continuum of possible outcomes of the first stage of production is straightforward. The random process would be defined by a probability distribution $g_i(k), \quad i = H, L$ over the support $k \in [0, k^*]$, where k^* is the original amount of capital put into the set-up stage.

[6] The model is based on the ability of a bank to establish a relationship with a firm. It is crucial that there be an information problem to be solved, but it does not necessarily have to imply asymmetric information. See, for example, Sharpe [28] for a similar modeling strategy.

type by spending an amount b per project.[7] Therefore banks can perform two functions in this economy that are usually recognized as typical functions fulfilled by credit institutions.

If all banks choose to perform both activities, then, a) only type H entrepreneurs will receive loans; b) type H idiosyncratic risk will be eliminated at the aggregate level. In this case, a bank's expected revenues will be $pR(s-b)$,where R is the rate of return of successful capital.

Assume a proportional screening cost, $b=(1-\tau)s$. Hence, $(s-b)=\tau s$. The bank's expected revenues is then rewritten as τpRs.

If a bank does not perform screening, it will indiscriminately loan out funds, relying on the law of large numbers (a first time) to capture the proportion Θ of type H entrepreneurs and (a second time) to diversify risk.

Banks' expected revenues when they do not perform screening is therefore ΘpRs. In both cases, bank's expected cost is rs, where r is the deposit rate payed to savers.

For the analysis to be interesting, assume $\Theta<\tau$, so that screening is economically sensible. The assumption, corresponding to $(1-\Theta)>(1-\tau)$, means that the cost of screening is lower than the loss in expected revenues from giving credit to type L entrepreneurs.

3 The role of credit market structure on the lending strategy

Banks' screening activity produces valuable information on the quality type of prospective entrepreneurs. This can actually be a problem when the credit

[7] Banks' ability to access the screening technology comes from the fact that they gather savings from a large number of agents, allowing them to screen a large number of entrepreneurs. Young entrepreneurs themselves could not employ the screening technology because they have no initial capital. Old agents, who have capital, could not afford individually to screen a large number of entrepreneurs.

industry is perfectly competitive: a bank that offers credit to a screened and recognized type H entrepreneur is actually certifying to the credit community the quality level of this subject. The very fact that such entrepreneur is offered credit is a signal for competitor banks of his quality type. Once a bank has sustained the cost of screening, the contract she can write must reflect this unrecoverable cost component. The screened entrepreneur, on the other hand, will be free to seek lower cost suppliers of finance, i.e. banks that did not sustain the cost of screening. A free riding problem is therefore likely to emerge.

This argument is a direct application of the lending relationship problem highlighted in introduction. By performing screening on a potential entrepreneur, the bank is in fact attempting to establish a specific relationship with the firm. With perfect competition the screening bank knows she cannot establish such relationship and that she may not ever be able to recover the screening cost.

It is important to point out that, in order to capture the essence of the lending relationship problem in a two-period overlapping generations setting, we must assume that the information on screened, type H entrepreneurs becomes immediately available to other banks.[8] This assumption is necessary because in this setting the capital market, by construction, opens and closes instantaneously at the end of every period. In a multi-period setting we would not need such assumption. For example, in Petersen and Rajan [25], the quality of an entrepreneur becomes known after one period, by simple observation of the outcome of production. With this alternative set up the lending relationship problem would be more clearly highlighted, but the incorporation of the dynamic analysis would become unnecessarily more complicated.[9]

[8]However, it is not crucial to the analysis the assumption that the information becomes available at no cost. In section 6 I show that the outcome would not change if a free-riding bank would have to pay a positive fraction of the original cost sustained by the screening bank.

[9]In any event, assuming that the information on screening becomes immediately avail-

I will argue that in a perfectly competitive credit industry the free riding problem is so stark that screening will not be performed by any bank. Banks will choose instead to rely on risk diversification only, lending indiscriminately to all entrepreneurs. A monopolist bank, on the other hand, not facing the threat of free riding from competitors, will choose to screen because it is profitable and will reject credit applications of type L entrepreneurs. The ability of the monopolist bank to accept only type H entrepreneurs, generates a positive externality on the economy as a whole, since a lower fraction of the original capital is lost in the production process. This approach thus allows me to establish a possible positive channel between market power in banking and capital accumulation. However, it is also true that the monopolist will act as such, trying to extract the maximum rent in the credit market, and this economic effect is well known to be negative. The sign of the net effect is the subject of analysis of the following section.

I formalize this intuition by analyzing two benchmark economies, one with perfectly competitive banking and the other with a monopolist bank. The state of development of the credit sector and its market structure are exogenously imposed. While the endogenous determination of industry equilibrium in the credit market, together with its endogenous growth in size would be an interesting exercise,[10] I choose to take the market structure as exogenously given. In this respect the paper follows the suggestion of Cameron [5], McKinnon [22] and Shaw [29], already highlighted in Bencivenga and Smith [3], that differences across countries in the financial structure seem to depend primarily on legislation and government regulation. In addition, by imposing market structure exogenously, the normative implications of the paper

able is not so unrealistic in the chosen setting. It is after all in the best interest of the screened type H entrepreneur to make an effort to publicize his certified new status. In a multiperiod framework, a high quality entrepreneur could signal his type building a reputation based on prompt repayments (see Diamond [8], [9]).

[10]For the endogenous determination of the size of the credit market see for example Greenwood and Jovanovic [13].

are made more clear. For example, should the regulator favor monopoly or competition? Is there a role for the identification of an optimal dynamic path for regulation?

3.1 Lending strategy with competitive banking

In this first economy, banks are assumed to be Nash-competitors. There are $I > 1$ banks. A bank $i \in I$ chooses a strategy z_i simultaneously to all other banks. The bank can choose to spend in screening ($z_i = YS$), or not to spend ($z_i = NS$). The payoffs are expressed in terms of profits, π_i. In equilibrium, perfect competition assures that a zero-profit condition holds. Also, as explained above, the information on screened, type H entrepreneurs becomes immediately public in the capital market.

Definition 1 *A Nash equilibrium for the competitive banking industry is a strategy profile* $z^* = (z_1^*, \ldots, z_I^*)$ *such that, for all* i, $\pi_i = 0$ *and* $\pi(z_i^*, z_{-i}^*) \geq \pi(z_i, z_{-i}^*)$.

Definition 2 *Let* $\iota \subseteq I$ *be the subset of banks which decides to spend in screening, i.e.* $z_{i\in\iota} = YS$.

Proposition 1 *The unique Nash equilibrium of the competitive banking industry is* $z^* = (NS_1, \ldots, NS_I)$*, i.e.* $\iota^* = \oslash$.

Proof. I first show that $\iota^* = \oslash$ is an equilibrium. If all banks choose NS, they will rely on a pure risk diversification lending strategy and the total revenue will be $s\Theta pR$. The contract with savers, given the zero-profit condition, will be $r = \Theta pR$. Suppose bank i deviates and decides instead to screen. Since the certification of type H entrepreneurs becomes immediately public information, all other banks–which did not sustain the screening cost–can offer a better contract to such entrepreneurs, leaving bank i with a net loss, $\pi_i < 0$. Thus, there is no incentive, for any bank, to deviate from the optimal strategy $z_i^* = NS$.

The uniqueness of the equilibrium should be straightforward. Suppose $\iota' \neq \oslash$ is an equilibrium. From the previous reasoning, a bank $i \in \iota'$ will be subject to free riding and will suffer a net loss. If this bank decides to deviate and choose instead NS, it will benefit from free riding and will make at least zero profits. Therefore, $\iota' \neq \oslash$ is not an equilibrium.[11]

Uniqueness also rules out (non degenerate) equilibria in mixed strategy, where a bank screens with probability $q \in (0,1)$. Since playing NS yields unambiguously the highest payoff, regardless of the pure strategy played by the other banks, it will continue to yield the highest payoff for any randomization over pure strategies chosen by the other banks. □

In sum, with perfect competition among banks and the possibility of free riding in the screening activity, the existing, unique equilibrium contract is the one reflecting non expenditure in screening,[12]

$$r = \Theta p R. \tag{3}$$

[11] Assuming intensive coordination, simultaneous screening by *all* banks could perhaps be sustained. But if such coordination could be achieved by banks on the lending strategy, it seems hard to believe they would not use the same coordinating ability to impose collusive prices in the credit market, but this is incompatible with the assumption of perfect competition.

[12] It is perhaps worthwhile to point out that the competitive credit market in this model does not suffer from the Grossman and Stiglitz [14] paradox of non existence of a competitive equilibrium. In their model of asset trading, an uninformed trader can gain from free riding only when many agents have become informed. This way the price, which the uninformed trader observes, conveys a significant amount of information. Since the marginal contribution of an informed trader to the informativeness of the price is by assumption negligible, when nobody is informed it pays to become informed (and this breaks the equilibrium) because there is no risk of direct free riding by uninformed agents. In my model instead, banks become informed of the screened entrepreneurs' quality directly from the activity of the screening banks. Hence, no screening is the unique equilibrium.

3.2 Lending strategy with monopolistic banking

In this second economy, there is only one chartered bank, who behaves as a profit mazimizer monopolist. The bank consumes its profits (it is not owned by agents).[13] Since the bank does not face any free-riding threat and since by assumption $\Theta < \tau$, she will choose to engage in screening and increase the expected revenues from lending. The profit maximization problem of the monopolist bank can be written in terms of the choice of the optimal quantity of credit to loan out:

$$\operatorname*{Max}_{s_t} pR_{t+1}(\tau s_t)\tau s_t - r_{t+1}(s_t)s_t, \tag{4}$$

where $R_{t+1}(\cdot)$ and $r_{t+1}(\cdot)$ are well defined demand and supply schedules of capital. Writing the maximization with s_t as choice variable makes it clear how screening affects the bank's behavior. Notice that she will obtain a return from τs_t units of savings only, but every unit promises a higher expected return. Notice also that she still has to pay back depositors for the full amount originally received, s_t.

When we analyze the overall effects on the dynamic of capital accumulation it will be more convenient to express the maximand in terms of k_{t+1} rather than s_t .

[13] This assumption simplifies the analysis. It turns out, however, that if the bank rebates profits to old agents, the negative effects on quantities generated by the monopolistic bank would be reduced, if not eliminated, and this would amplify (perhaps excessively) the positive aspect of monopoly in banking.

4 Equilibrium in the credit market and the dynamic equilibrium

4.1 The competitive equilibrium

Let us first analyze the equilibrium in the competitive benchmark. According to proposition 1, competitive banks will not engage in screening. This means that total savings at time t will become capital at time $t+1$,

$$k_{t+1} = s_t. \tag{5}$$

As reflected in the equilibrium contract, expression (3), the competitive bank will operate to the point where expected profits are equal to zero, i.e.

$$\Theta p R_{t+1} s_t = r_{t+1} s_t. \tag{6}$$

Recall now the production function, equation (1). Entrepreneurs will enter the market for capital and labor with the following demand schedules:

$$\begin{aligned} R_{t+1} &= \gamma \delta k_{t+1}^{\gamma-1}, & (7) \\ \omega_{t+1} &= (1-\gamma)\delta k_{t+1}^{\gamma}. & (8) \end{aligned}$$

The savings supply at time t will be a value s^* that maximizes equation (2),

$$s_t^* = \arg\max U = (\omega_t - s_t)^\alpha + \beta (r_{t+1} s_t)^\alpha. \tag{9}$$

Solving this maximization problem and expressing the savings supply schedule in terms of r_{t+1}, we have

$$r_{t+1} = \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left[\frac{\omega_t - s_t}{s_t}\right]^{\frac{\alpha-1}{\alpha}}. \tag{10}$$

Using the capital market equilibrium condition (5), and the wage income equation (8), we can rewrite (10) as

$$r_{t+1} = \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left[\frac{(1-\gamma)\delta k_t^{\gamma} - k_{t+1}}{k_{t+1}}\right]^{\frac{\alpha-1}{\alpha}}. \tag{11}$$

Substituting equation (7) and (11) in (6), we obtain a first-order difference equation in k describing both, the equilibrium in the competitive credit market at any time t, and the dynamic evolution of capital:

$$\Theta\gamma p\delta k_{t+1}^{\gamma-1} - \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left[\frac{(1-\gamma)\delta k_t^{\gamma} - k_{t+1}}{k_{t+1}}\right]^{\frac{\alpha-1}{\alpha}} = 0. \tag{12}$$

4.2 The monopolistic equilibrium

We turn now to the corresponding analysis for the monopolist bank. The bank faces a downward sloping credit demand function and an upward sloping credit supply function, represented by equations (7) and (10), respectively. Since the monopolist bank engages in screening, only a fraction τ of the total savings at time t will be loaned out to entrepreneurs at time $t+1$,

$$k_{t+1} = \tau s_t. \tag{13}$$

The equilibrium in the credit market is determined by the solution of the bank's profit maximization problem, expression (4).

Substituting the capital market equilibrium condition (13) in (10), and entering this new expression together with (7) in the profit maximization problem, we obtain

$$\underset{k_{t+1}}{\text{Max}} \ \gamma p\delta k_{t+1}^{\gamma} - \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left[\frac{(1-\gamma)\delta k_t^{\gamma} - \tau^{-1}k_{t+1}}{\tau^{-1}k_{t+1}}\right]^{\frac{\alpha-1}{\alpha}} \cdot k_{t+1}. \tag{14}$$

The solution of the maximization problem is a first-order difference equation in k describing both the equilibrium in the monopolistic credit market at any time t, and the dynamic evolution of capital:

$$\gamma^2 p\delta k_{t+1}^{\gamma-1} - \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left\{ \frac{\left[\frac{1}{\alpha}\tau(1-\gamma)\delta k_t^{\gamma} k_{t+1}^{-1} - 1\right]}{\left[\tau(1-\gamma)\delta k_t^{\gamma} k_{t+1}^{-1} - 1\right]^{\frac{1}{\alpha}}} \right\} = 0. \tag{15}$$

5 Analysis in steady state

We turn now to a comparison of the two benchmark economies, focusing on their long-run behavior. The analysis in steady state allows us to see how the credit market structure affects the potentials for the economy to reach high levels of capital accumulation. It will become apparent under what conditions (if any) the monopolist bank can bring the economy to achieve a higher steady-state level of capital. Recall that the monopolist bank affects negatively capital accumulation exercising its market power (higher loan rate-lower deposit rate, hence lower quantity of capital), but it produces a positive effect as well, allowing a superior selection of entrepreneurs, resulting in a better allocation of productive capital.

Definition 3 *A steady-state equilibrium for an economy with competitive banking and with a monopolist bank are values k_C and k_M, respectively, such that*

$$\Theta\gamma p\delta k_C^{\gamma-1} - \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left[(1-\gamma)\delta k_C^{\gamma-1} - 1\right]^{\frac{\alpha-1}{\alpha}} = 0, \tag{16}$$

$$\gamma^2 p\delta k_M^{\gamma-1} - \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left\{ \frac{\left[\frac{1}{\alpha}\tau(1-\gamma)\delta k_M^{\gamma-1} - 1\right]}{\left[\tau(1-\gamma)\delta k_M^{\gamma-1} - 1\right]^{\frac{1}{\alpha}}} \right\} = 0. \tag{17}$$

Rearranging terms we obtain

$$\Theta\gamma p\delta k_C^{\gamma-1} = \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left\{ \frac{\left[(1-\gamma)\delta k_C^{\gamma-1} - 1\right]}{\left[(1-\gamma)\delta k_C^{\gamma-1} - 1\right]^{\frac{1}{\alpha}}} \right\}, \tag{18}$$

$$\gamma^2 p\delta k_M^{\gamma-1} = \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left\{ \frac{\left[\frac{1}{\alpha}\tau(1-\gamma)\delta k_M^{\gamma-1} - 1\right]}{\left[\tau(1-\gamma)\delta k_M^{\gamma-1} - 1\right]^{\frac{1}{\alpha}}} \right\}. \quad (19)$$

Proposition 2 *Both economies converge to unique steady-state levels of capital per capita.*

Proof. The left-hand side of both (18), (LHS_C), and (19), (LHS_M), are linearly increasing in $k_C^{\gamma-1}$ and $k_M^{\gamma-1}$, respectively. The right-hand side of (18), (RHS_C), has a vertical asymptote for $k_C^{\gamma-1} = \frac{1}{(1-\gamma)\delta}$ and it converges monotonically to 0 as $k_C^{\gamma-1} \to \infty$. The right-hand side of (19), (RHS_M), also has a vertical asymptote, for $k_M^{\gamma-1} = \frac{1}{\tau(1-\gamma)\delta}$ and it converges monotonically to 0 as $k_M^{\gamma-1} \to \infty$. Thus, in both cases there is a unique steady state, k_C and k_M . □

The following Proposition and the consequent Corollary summarize the basic result from the comparative analysis of the steady-state equilibria.

Proposition 3 *The steady-state level of capital per capita when banking is competitive is strictly higher if* $\Theta \geq \gamma$.

Proof. Refer to Figure 1. The vertical asymptote for RHS_M is in correspondence of a value on the horizontal axis strictly higher than the one correspondent to the vertical asymptote for RHS_C. Hence, every point of RHS_M is strictly to the right of RHS_C. If $\Theta \geq \gamma$, then LHS_C is steeper than LHS_M, which must imply that $k_M^{\gamma-1} > k_C^{\gamma-1}$, or, $k_C > k_M$. □

The interpretation of this result is as follows. Given the available technology, summarized by the parameter γ , if the proportion Θ of type H entrepreneurs were already relatively high, the loss in output associated with lending capital to type L entrepreneurs would be relatively small. Therefore, the value added of the screening technology would also be small. “Purchasing” the use of such technology, allowing for a monopolist bank, would not compensate the loss in output associated with the typical rent extraction activity of the monopolist.

Remark. Notice that $\Theta > \gamma \not\Leftrightarrow \Theta < \tau$. While the second inequality, assumed to assure that screening was economically desirable, strictly pertained to the functioning of the credit market, the first one is an economic-wide, general equilibrium condition which takes into account the banks' behavior and the interactions with the rest of the economy.

A corollary to the previous Proposition follows naturally.

Corollary 4 *The steady-state level of capital per capita when there is a monopolist bank is strictly higher* only if $\Theta < \gamma$.

Proof. This is self evident from inspection of Figure 2.□

Reversing the previous argument, it is now necessary that the screening technology had an intrinsically high value, as represented by the low proportion of type H entrepreneurs, but the condition is not sufficient. Even though LHS_M is steeper than LHS_C it is still possible that the intersections with the respective right-hand sides are such that $k_M^{\gamma-1} > k_C^{\gamma-1}$ (hence $k_C > k_M$). The economic intuition for $\Theta < \gamma$ to be only a necessary condition is that, despite the beneficial effect of screening, market conditions could be such that the negative effect associated with rent extraction prevailed. Hence, Θ must be smaller enough than γ for the first effect to more than compensate the second. However, in order for the analysis to be non-trivial, it is necessary to prove that, under general conditions, Θ does not need to be neglibly small for $k_M > k_C$ to be true. Or, which is the same, we do not need to assume extreme economic conditions in order for $k_M > k_C$ to hold for reasonably high values of Θ.

The following proposition and the subsequent comparative static analysis will be sufficient to show that monopoly can be superior to competition for reasonable parameter conditions.

Proposition 5 *There exists a* Θ^* *such that, for any* $\alpha, \gamma, \tau, \beta, p, \delta$ *in their admissible ranges,* $k_M(\Theta^*) = k_C(\Theta^*)$ *and* $k_M(\Theta) > k_C(\Theta)$ *for* $\Theta < \Theta^*$*,* if and only if $\gamma < \Theta^* < 0$.

Proof. First, we know from proposition 3 that $k_C > k_M$ if $\Theta^* \geq \gamma$, for any value of the parameters. Therefore, in order for $k_C = k_M$ to hold, it must be that $\Theta^* < \gamma$. Second, recalling (18) and from inspection of Figure 2, we can see that as Θ^* goes to zero, LHS_C becomes horizontal. Therefore, as $\Theta^* \to 0$, $k_C^{\gamma-1} \to +\infty$, hence $k_C \to 0$. Recalling equation (19), we see that $k_M^{\gamma-1}$ (k_M) does not depend on Θ, and it is well defined and strictly positive for any value of $\Theta^* > 0$. Therefore $k_M > k_C$ as $\Theta^* \to 0$ and $k_M(\Theta^*) = k_C(\Theta^*)$ *only if* $\Theta^* > 0$.

Sufficiency follows from the fact that the function $(k_M - k_C)$ is continuous in Θ. Since $(k_M - k_C) < 0$ for $\Theta \geq \gamma$ and $(k_M - k_C) > 0$ as $\Theta \to 0$, then if $(k_M - k_C)$ is a continuous function in Θ, there is a $\gamma > \Theta^* > 0$ where $(k_M - k_C) = 0$.□

The main point of the proposition has been to show that Θ^* is strictly greater than zero, and therefore there is a dense set of non-trivial values of $\Theta \in (0, \Theta^*)$ such that $k_M > k_C$. The actual value of Θ^*, i.e. how close it can approach γ, clearly depends on the magnitude of the other parameters affecting the steady-state conditions (18) and (19). To see this, notice that given the definition of Θ^*, we can combine (18) and (19) and rewrite them as one implicit function,

$$\Omega(\Theta^*, k^*, \alpha, \gamma, \tau, \beta, p, \delta) = \tag{20}$$
$$(\gamma - \Theta)p\delta k^* - \frac{1}{\beta}^{\frac{1}{\alpha}} \left\{ \frac{\frac{1}{\alpha}\tau(1-\gamma)\delta k^* - 1}{(\tau(1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}} - \frac{(1-\gamma)\delta k^* - 1}{((1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}} \right\} = 0,$$

where $k_M(\Theta^*) = k_C(\Theta^*) \equiv k^*$.

Comparative static analysis of (20) provides information on how Θ^*varies with the other parameters of the economy. This will tell us how wide it is the set of economies for which we can reasonably expect $k_M > k_C$ to hold.

Of particular relevance for our analysis are the size of the screening cost $(1-\tau)$, and the parameter α, which will be shown to measure savings supply elasticity conditions. τ and α are the two parameters which are exclusively in (19), therefore directly responsible in affecting the comparison between the two steady states. The other parameters, β, p, δ, enter in both conditions (18) and (19) and therefore do not affect such comparison. Intuition on the importance of γ is also provided.

Comparative static in τ. It is easy to show, and intuitively apparent, that as the adoption of the screening technology becomes less costly (a higher τ), Θ could also become larger for $k_M > k_C$ to hold, i.e. $\frac{d\Theta}{d\tau} > 0$.

Applying the implicit function theorem on Ω, we have

$$\frac{d\Theta}{d\tau} = -\frac{\Omega_\tau}{\Omega_\Theta} = -\frac{-\frac{1}{\beta}^{\frac{1}{\alpha}}((1-\gamma)\delta k^*)^2 \tau\,(\alpha-1)\,\frac{(\tau(1-\gamma)\delta k^*-1)^{-\frac{1+\alpha}{\alpha}}}{\alpha^2}}{-p\delta k^*} > 0 \qquad (21)$$

Expression (21) is strictly positive since $\alpha < 1$.

Comparative static in α. Recalling the savings supply function, equation (10), let $\vartheta \equiv \frac{ds}{dr}\frac{r}{s}$ be the elasticity of supply. Then, differentiating (10) in s, multiplying by $\frac{s}{r}$ and simplifying,

$$\frac{dr}{ds}\frac{s}{r} = \frac{(1-\alpha)}{\alpha}\frac{\omega}{\omega - s}.$$

Taking the inverse we have

$$\vartheta \equiv \frac{ds}{dr}\frac{r}{s} = \frac{\alpha}{(1-\alpha)}\frac{\omega - s}{\omega}. \qquad (22)$$

As one can see, $\vartheta = \infty$ for $\alpha = 1$ (horizontal supply schedule) and $\vartheta = 0$ for $\alpha = 0$ (vertical supply schedule).

The effect of a change in supply elasticity on Θ^* is, at least in part, clear. An inelastic supply will favor rent extraction by the monopolist bank, and this could hinder the beneficial effect of screening. Therefore, a lower α requires Θ^* to be smaller. Although this statement is correct, the overall effect of a change in α on Θ^* is less straigthforward, as the analysis in comparative static shows (for computational convenience the differentiation is done in terms of $\frac{1}{\alpha}$):

$$\frac{d\Theta}{d(1/\alpha)} = -\frac{\Omega_{1/\alpha}}{\Omega_\Theta} = -(\frac{1}{-p\delta k^*}) \times \{\frac{1}{\beta}^{\frac{1}{\alpha}} \left(\ln \frac{1}{\beta}\right) \times \tag{23}$$
$$\left(\frac{\frac{1}{\alpha}\tau(1-\gamma)\delta k^* - 1}{(\tau(1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}} - \frac{(1-\gamma)\delta k^* - 1}{((1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}}\right) -$$
$$-\frac{1}{\beta}^{\frac{1}{\alpha}}[\tau\frac{(1-\gamma)\delta k^*}{(\tau(1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}} - \frac{\frac{1}{\alpha}\tau(1-\gamma)\delta k^* - 1}{(\tau(1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}}\ln(\tau(1-\gamma)\delta k^* - 1) +$$
$$+\frac{(1-\gamma)\delta k^* - 1}{((1-\gamma)\delta k^* - 1)^{\frac{1}{\alpha}}}\ln((1-\gamma)\delta k^* - 1)]\}.$$

The sign of (23) is ambiguous. A careful examination shows, however, that, all else equal, $\frac{d\Theta}{d(1/\alpha)} > 0$ when $\frac{1}{\alpha}$ is large (inelastic supply) and $\frac{d\Theta}{d(1/\alpha)} < 0$ when $\frac{1}{\alpha}$ is small (elastic supply). We can provide some economic intuition through a simple supply and demand representation, as in Figure 3. The curve S is the savings schedule. The curve D_C is the demand schedule in the competitive scenario. The curve D_M is the corresponding demand schedule in the monopolistic benchmark: screening is equivalent to a parametric shift of the demand curve (aggregate capital is more productive). The value k_C is the equilibrium quantity of capital in the competitive market. Whether the corresponding k_M is to the right or to the left of k_C depends on the magnitude of the screening cost $(1-\tau)$ and on how strong it is the negative effect of rent extraction (for the sake of clarity, Figure 4 only shows the case where $k_M > k_C$). When the elasticity of supply is high (low $\frac{1}{\alpha}$), as in Figure 4, its decrease (an increase in $\frac{1}{\alpha}$) will certainly produce negative effects on equilibrium quantity, hence Θ^* would have to decrease to maintain

$k_M = k_C$ (a wider shift to the right for D_M).[14] As the elasticity continues to decrease, the negative effect will first grow larger, but at some point, to a further decrease in elasticity it will correspond a reversal of the effect on quantity (see Figure 5). The intuition is that when the supply function is very steep, for as much as the monopolist bank can exercise market power, agents will still want to mantain high levels of savings, hence high quantity of capital supply (rent extraction is mostly performed by affecting interest rates rather than quantities). Hence, for inelastic supply conditions (high $\frac{1}{\alpha}$), Θ^* is "allowed" to increase again.

Similar analyis could be done to evaluate the effect of a change in demand elasticity. Recall the capital demand schedule, equation (7). Let $\eta \equiv \frac{dk}{dR}\frac{R}{k}$ be the elasticity of capital demand. It is easy to show that

$$\eta = \frac{1}{\gamma - 1}, \tag{24}$$

therefore $\eta = 0$ for $\gamma = 1$ and $\eta = -\infty$ for $\gamma = 0$.

Therefore, γ represents both, the degree of capital intensity of the technology and an indicator of capital demand elasticity. The comparative static analysis, which is omitted for briefness, would also show a cumbersome relationship between γ and Θ^*. At first glance one may expect that the closer γ to 1, the more relaxed the conditions for $k_M > k_C$. However, it appears that in order to maximize the likelihood that $k_M > k_C$, γ cannot be too close to 1: still referring to Figure 3, the parametric shift in demand due to screening is not very effective if the demand schedule is flat, i.e. if γ is close to 1 (clearly the parametric shift would be the highest when γ is very close to 0, but since we still need the condition $\Theta < \gamma$ for $k_M > k_C$, a too small γ is also not desirable).

[14] Still for reasons of clarity, in both Figure 4 and 5 the D_c curve and the correspondent equilibrium value k_c are not drawn. The shaded areas correspondent to the loss in revenues due to the screening cost are also omitted.

In sum, as long as there is a relatively low proportion of high quality entrepreneurs ($\Theta < \gamma$), different combinations of non-trivial economic conditions, such as relatively low cost of screening, relatively high savings elasticity, and relatively low capital demand elasticity, can make the economy with a monopolist bank to achieve a higher steady-state capital per capita. I will argue in the concluding remarks what kind of economies could be more likely to show such conditions.

6 Discussion

The analysis has hinged upon the recognized difficulties for competitive banks to establish exclusive relationships with specific (high quality) firms. Some comments on the robustness of this assumption are in order. For example, could contract writing between the bank and the firm solve the problem? As discussed in the Petersen and Rajan's paper [25], contracts that tie bank and firm could be hard to write and difficult to enforce. In our scenario, for example, we could imagine a contract in which a bank, agreeing to screen an entrepreneur, forces him to accept a loan from the bank. First, political reasons may make such a contract hard to enforce, given its "extortionary" nature (see Petersen and Rajan, page 415). In addition, once the entrepreneur is screened, a competitor bank could still offer lower cost funding, allowing the entrepreneur to pay back the original loan, while still finding room for a positive profit, which could induce the free-riding bank to attract the depositors of the original bank with better rates, thus threatening bankruptcy.

Another solution to the problem would be to allow the bank to hold an equity position with the firm. This way, it would not matter whether the firm "leaves" the bank after being screened, since the bank would ultimately recover the loss by the participation in profit sharing. Equity participation is indeed an (obvious) example of close relationship between a bank and a firm.

This is certainly a solution but it is by no means obviously implementable, as it is still discussed in Petersen and Rajan. In fact, one can actually argue that monopoly power gives to the bank an implicit equity stake in the firm which allows her to internalize the externality associated with screening.

Does the result of no screening in competitive banking depend on the assumption of full free riding? I argue that the intuition holds for intermediate degrees of free riding, i.e. where the information on the quality type to a free rider is not available at zero cost but at a positive proportion of the original cost sustained by the screening bank. Suppose $(1-\tau)\varepsilon$ is the cost of screening for a free rider, where $0 \leq \varepsilon \leq 1$. If $\varepsilon = 0$, then free riding is costless, as it has been assumed so far. If $\varepsilon = 1$ then screening is as costly as it is for the original bank, thus there is no free riding. Consider $0 < \varepsilon < 1$. $[1-(1-\tau)\varepsilon]s$ is what a free rider can lend out. This amount is obviously greater than $(1-\tau)s$, the amount the original bank can lend out. The gain from free riding can then be expressed by the difference, $(1-\varepsilon+\tau\varepsilon-\tau)s = (1-\varepsilon)(1-\tau)s$. The free-riding bank could offer savers of the original bank a strictly higher deposit rate and/or a lower loans rate to the screened firms, and still make a positive profit. For example with a contract such as $r = \frac{(1-\varepsilon)(1-\tau)}{\xi}R$, where ξ is any costant greater than one. Hence free-riding will occur for any $0 \leq \varepsilon < 1$.

Also, do the results hold for industry equilibrium intermediate to the two benchmarks? Without entering in a full scale model of imperfect competition I provide the following argument. Suppose a model of monopolistic competition, with banks equidistant from each other lying in a circle (Salop [27]). Define as ν the cost for a bank to access the market of her neighbors, a function of the distance between banks. Thus ν represents a measure of the degree of market power.[15] Then, if $\nu + (1-\tau)\varepsilon > (1-\tau)$, there is no free riding. The LHS of the disequality represents the total cost for a bank

[15] In this type of models the distance really proxies for a certain degree of product differentiation which allows a firm to exercise positive market power.

to free ride, while the RHS is the cost of screening. Thus, we can define $\nu^* = (1-\varepsilon)(1-\tau)$ as the minimum degree of market power necessary to avoid free-riding. Any industry equilibrium configuration between ν^* and perfect competition ($\nu = 0$) will involve free riding.

As a final remark, notice that having chosen the pure monopoly benchmark, I have made sure that free riding could not occur, and thus the economy could fully benefit from the screening externality. On the other hand, the negative effect of rent extraction is also at its maximum. Therefore the identification of conditions according to which the net effect may be positive is a "fair" exercise. For intermediate market structures such conditions are likely to be even more relaxed than those identified in the previous section.

7 Concluding remarks

I have presented two general equilibrium, dynamic models of capital accumulation featuring two extreme benchmark industry equilibrium conditions in the credit market. I show that the lending relationship problem which seems to characterize competitive financial markets has negative repercussions for capital accumulation.

Focusing on the potential lending strategies available in the market, I found a possible channel through which monopoly power in banking can be beneficial for growth. A monopolist bank may lower the equilibrium quantity of credit, but it allows a better allocation (higher quality) of credit supply.

This result reconciles with the available historical evidence cited in introduction. In this sense the paper is a first attempt to propose a theory of financial intermediation and growth in which the credit market structure plays a non-trivial role for capital accumulation.

Certainly there are conditions under which monopoly power has an overall negative effect. As it has been shown, either a very expensive screening technology or inelastic conditions of savings supply, are such that the net effect on growth of monopolistic banking is adverse. In fact, it would have been suspicious, and non correspondent to reality, if I had shown an unconditional superiority of monopoly over competition.

The results presented in this paper seem to be particularly relevant for developing countries. A developing country, for example, is likely to be characterized by major difficulties in contract writing and enforceability and by underdevelopment (or plain non-existence) of equity markets. Monopoly power in the credit market could be a plausible solution to these problems in order to enhance the process of capital accumulation.[16] We could also argue that at lower stages of development, an economy is characterized by a lower average quality of productive capital, for example due to lack of infrastructures, knowledge, experience, and other environmental factors. This is equivalent in the model to assume a low Θ. As I have shown in section 5 when Θ is low the beneficial effect of monopoly power is at its maximum.[17] If we are willing to associate a positive correlation between the severity of these problems with the stages of economic development, then the model suggests that monopoly power in banking is more likely to be beneficial to growth for developing countries than for already developed ones.

[16] The same conclusion is also suggested in Petersen and Rajan [25].

[17] It is also true that we may expect in a developing country a higher difficulty in screening (a lower τ) and perhaps a higher cost of free riding, in the sense that it may not be so easy for an entrepreneur to advertise his quality level after being screened. This higher cost of free riding is however counter balanced by the higher difficulty in contract writing, so the total effect may not be very strong. Finally, a lower τ may be compensated by the presence of conditions more favorable to enhance the beneficial effects of monopoly, such as high supply elasticity and low demand elasticity.

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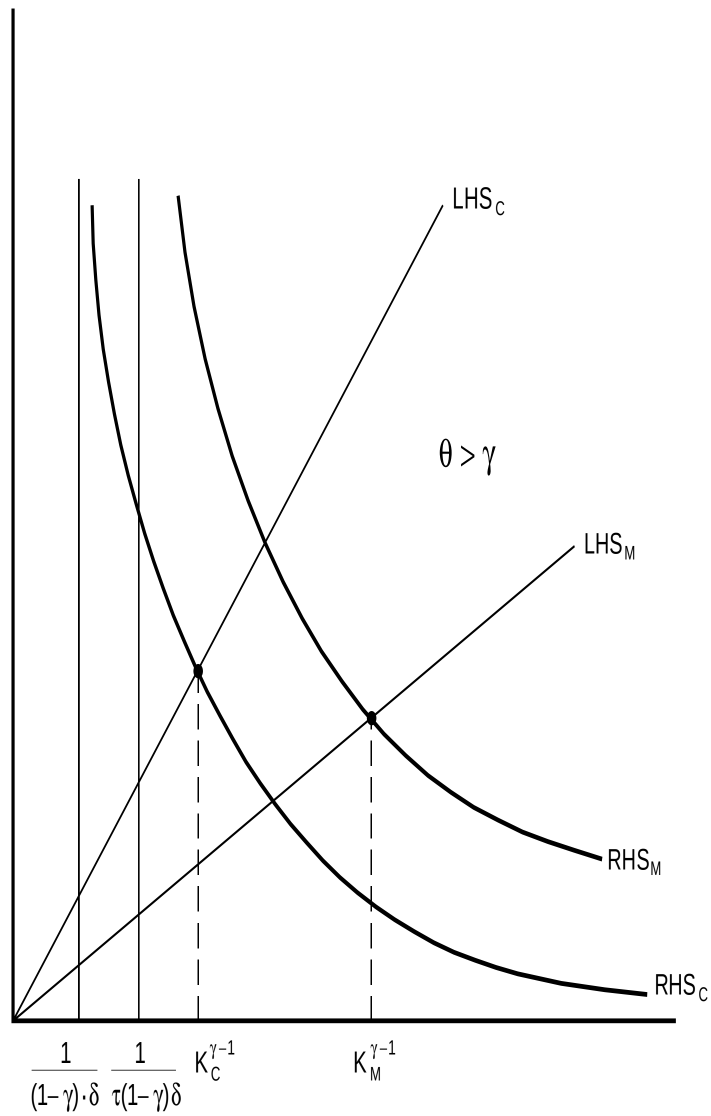
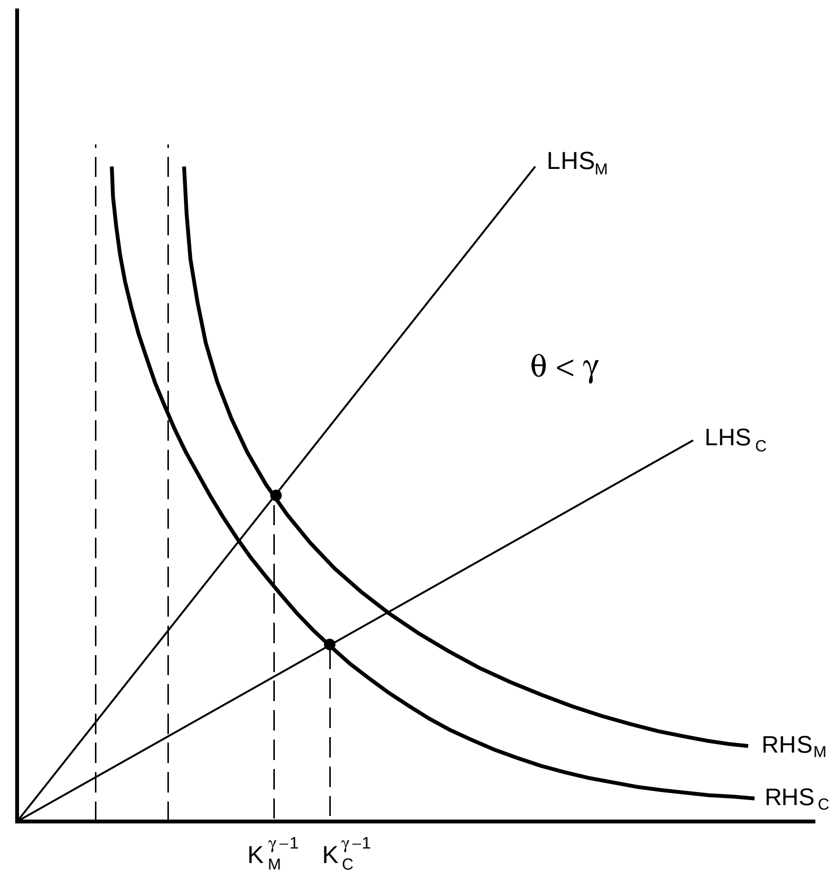
Figure 1



$\cdot\ K_C^{\gamma-1} < K_M^{\gamma-1} \Leftrightarrow \boxed{K_C > K_M}$

Figure 2



$\cdot\ K_M^{\gamma-1} < K_C^{\gamma-1} \iff \boxed{K_M > K_C}$

Figure 3

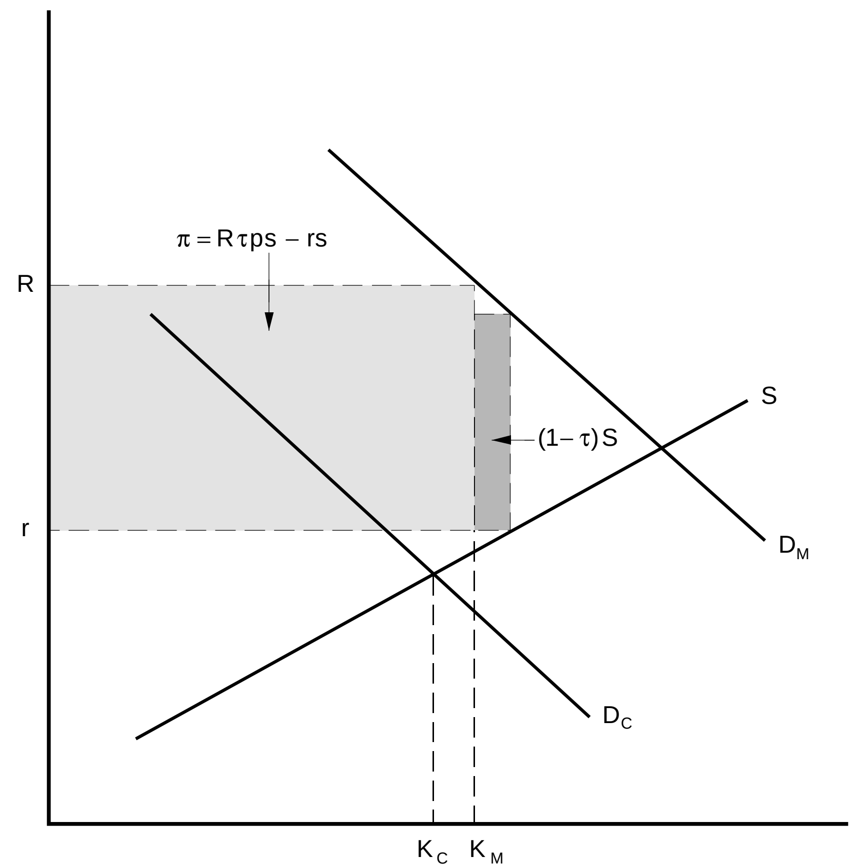


Figure 4

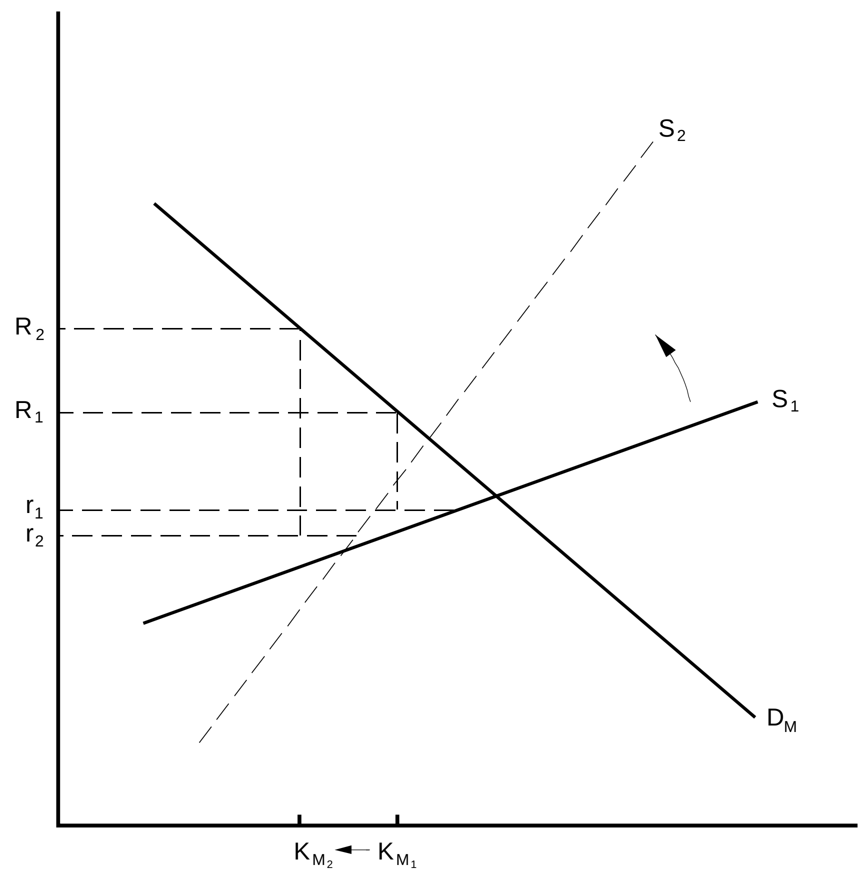


Figure 5