Banking Relations, Competition, and Entrepreneurial Research Incentives

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Abstract: - When banks incur sunk costs to provide ex-ante information about customers, exclusive banking relations will occur under intense price competition when monitoring costs are low. When monitoring costs are sufficiently high, only non-monitored finance will be provided, typically, by multiple lenders. While multiple lending generally is (second-best) efficient when it emerges, relationship lending typically is not.

In our framework, the informational rents in relationships of a single financier (house bank) typically exceed the risk premium required for financing projects from the unscreened pool of applicants. Accordingly, when entrepreneurs can affect repayment probabilities by sunk ex-ante investments prior to the financing stage, in a house bank regime investment incentives are typically lower than under conditions of competitive non-monitored lending.

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1. Introduction

As banking markets are becoming increasingly exposed to competition within the industry and to competition from capital markets and other non-banking industries the future of the banking industry has become a widely discussed concern. How will regulatory and technological changes affect the structure of modern banking? Will banks increasingly focus on their traditional core functions of lending and running the payment system, or will they increasingly be integrated into the capital market functions?

In this paper we concentrate on banks' credit business. It is often argued that less competitive banking markets are characterized by bank-firm relationships, while competitive systems tend to establish multiple lending relationships. According to this view, increasing competitiveness should break up banking relationships and generate competitive lending markets with multiple lenders, and, ultimately, converge to capital market finance. Is this necessarily a valid view of the banking market? Are banking relations more likely to emerge in protected markets or in competitive markets? How does competition affect banks' monitoring incentives? How will firms' funding conditions and, hence, conduct be affected by more intensely contested banking markets?

Consequently, our analysis contributes to the question of how entrepreneurial research incentives are affected by the change in market conditions in the banking sector. This issue is central for the discussion of the role of banks for start-up financing of small and innovative firms, and, hence, for economic development and growth.

To address these issues we analyze an economy endowed with heterogeneous types of entrepreneurs who differ in their ability to conclude research projects. This ability can be affected by entrepreneurs' long-term investments such as investments in human capital. Moreover, ability is determined by nature such that human capital investment yield higher returns to talented entrepreneurs than to untalented ones. Banks provide two types of services, financing and monitoring. By monitoring they can learn about entrepreneur's innate research abilities at a fixed cost and, in principle, fine tune lending rates according to repayment risk. Banks may, however, also choose to provide non-monitored finance without incurring the screening cost, in which case

they have to offer identical funding conditions to talented and untalented entrepreneurs. In order to abstract from the pool externalities generated in situations of imperfect screening we shall concentrate on the case when screening yields perfect information about the entrepreneur's type.[1]

Entrepreneurs' research projects last for two stages, a research stage and a development stage. The success of the research venture is determined by the entrepreneur's innate ability and by the amount of his human capital investment. If the research stage is successfully completed a product can be developed and sold on the market. Hence, in our model cash-flows can be generated only at the end of the development stage. However, resources are needed both, for the research and the development stage. Accordingly, banks can provide finance in both stages. There is repeated competition for customers by banks. So, in principle, lending relationships may endogenously form between an entrepreneur and a single bank that may be viewed as a house bank. A house bank in our framework would thus be a bank financing exclusively both project stages.

It is shown that house-bank relations may emerge quite naturally in a cartel as well as under competitive market conditions when monitoring costs are sufficiently low. This finding seems to accord well with recent empirical observations that document that the number of relationships may not be closely related to the competitiveness of the banking system at large (Harhoff, Körting, 1997, Ongena, Smith, 1998a, 1998b) but that it may be related to intrinsic properties of the projects, i.e. possibly the general research environment as emphasized in our framework.

Interestingly, and in contrast to the trust of the literature on ex-post verification, house-bank financing appears as high cost financing means, especially, when the intensity of competition among banks is high. Under competitive conditions and when monitoring costs are low, in equilibrium only a single bank invests in the monitoring activity. This bank can be viewed as a house bank. It subsequently exploits its informational monopoly relative to its uninformed competitors.[2] This monopoly rate exceeds the actuarial fair rate of lending to an unscreened pool. Hence, multiple lending by non-monitoring banks provides cheaper sources of funds than house-bank financing.

[1] See Broecker (1990), Gehrig (1998) and Dell´Aricca et al. (1999) for analyses of the pool externalities that arise under imperfect screening.

On the other hand, under a completely cartellized banking system, entrepreneurs research incentives are even worse and financing costs are even higher. Accordingly, only a small degree of market power in the banking sector may be socially desirable and maximize research activity as well as general growth prospects.

By emphasizing ex-ante information production (screening) this paper is related to the literature on credit-worthiness tests (Broecker, 1990, Riordan, 1993, Gehrig, 1998, Dell´Aricca et al 1999). While this literature concentrates on the externality imposed by rejections of loan applications on competitors, in this paper we maintain the assumption of perfect screening. As we show, in this context, bilateral funding relations may emerge quite naturally at the research stage even under competitive conditions. Due to the fixed nature of monitoring expenses, multiple relations will emerge only in situations when banks choose to offer non-monitored finance. This happens when monitoring costs are sufficiently high.

Our paper is also closely related to the literature on banking relationships (Sharpe, 1990, Rajan, 1992, v. Thadden, 1995). While that literature focuses on ex-post monitoring, relationships there are only possible, under the assumption that the initial financier maintains an informational advantage in later rounds of financing. This assumption is not necessary in our context. In contrast to this literature we model the opposite extreme when research results (patents) are publicly observable. Accordingly, in principle, relationships appear quite vulnerable to competition in our context. As emphasized before, relationships emerge for completely different motives. They are necessary to fund banks' sunk monitoring outlays at the research stage and develop into relationships due to some small amount of switching costs.

Finally, this paper may also be viewed as a contribution to the old debate about the growth-enhancing virtues of a concentrated banking system with house-bank relations (Gerschenkron, 1968), the so-called German model, on one hand, and the disciplining forces of competitive markets, the so-called Anglo-Saxon model on the other hand.

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[2] This has also been pointed out by Sharpe (1990) in the context of an ex-post verification model. In these models, however, unscreened finance is even more costly than housebank finance. See also the discussion with respect to the

The paper is organized as follows. Section 2 set out the basic model. Section 3 presents the first best allocation as a point of reference. Section 4 analyzes the allocation in a cartelized banking environment, whereas section 5 analyzes the other polar case of Bertrand-type price competition. Section 6 discusses policy issues and section 7 concludes.

2. The Model

Consider an economy with a continuum of entrepreneurs and B bankers. Entrepreneurs are endowed with one research project each and lack any source of finance. Bankers are endowed with plenty of funds but are short of research ideas. There is heterogeneity among entrepreneurs; some are talented and can affect the success probabilities by the provision of private effort while the remaining are less talented and accordingly have lower success probabilities. Banks have access to a screening technology that allows them to discriminate among talented and unable entrepreneurs.

Entrepreneurs:

More specifically, entrepreneurs are characterized by their project. We consider research projects that extend over two stages (periods), an initial research stage in period 1 and a subsequent development and marketing stage in period 2. The research stage requires resources $I_1 > 0$ but does not yield any cash-flow. The research stage either concludes as a success (state S) or a failure (state F). The outcome of the research stage is publicly observed.[3] In case of success further development of the project is possible. In this case an investment of I_2 at the beginning of period 2 will return a certain cash-flow of $R(e, I_2) > 0$ at the end of the period. The cash-flow is assumed to be strictly monotonic and concave. The variable *e* constitutes private effort of the entrepreneur and will be discussed below. In the case of failure of the research project generates a cash-flow of zero in period 2.

There are two types of entrepreneurs. A portion $0 < \lambda < 1$ is talented and can affect the success probability $\pi(e)$ of the research stage and the return in the development stage $R(e, I_2)$ by their

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ex-post verification literature below.

own effort choice $e \geq 0$. The remaining portion $1-\lambda$ is less able and has a constant success probability of $0 < \mu < 1$ independent of their effort choice. Moreover untalented entrepreneurs can only generate a return of $R(0, I_2)$ at the development stage. Moreover we will assume that $\pi(e)$ is strictly increasing in *e* as long as $\pi(e) < 1$, and $\pi(0) = \mu$.

We interpret effort as human capital investment which is sunk prior to the research stage. This implies that the actual financing conditions in the research stage will not affect the effort choice directly. Talented entrepreneurs' incentives to invest in human capital will only be affected by their expectations about funding conditions at later stages. At the same time their human capital investments will also affect future repayment probabilities and, hence, funding conditions.

Banks:

Consider B risk neutral banks. They have access to capital markets, where they can lend and invest at the interest rate r_0. Denote the interest factor or repayment rate by $R_0 = 1 + r_0$.

By applying a screening technology banks can learn the true talent of an entrepreneur at the beginning of the research stage. This test costs a fixed amount of $k>0$ and informs perfectly about the true type.[4] The test results remain private information of the banks at the beginning of the research stage. Since research output is observable, at the end of the research stage talented and successful entrepreneurs are publicly revealed.

Banks compete for entrepreneurs both at the beginning of the research and the development stages. Under our assumptions only successful projects will be developed in stage two.[5] We will consider different variants of modes of competition in the sections below.

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[3] For example, the firm might have acquired a patent.

[4] This assumption is rather strong. See Broecker (1990) and Gehrig (1998) for examples with imperfect credit worthiness tests and their implications

[5] It would be easy to introduce an informational advantage for financiers at the research stage. For example, there could be some residual uncertainty about the payoffs in the development stage about which „house banks" (financiers of the research stage) would enjoy an informational advantage as in von Thadden (1995). By ignoring these possibilities the chances for relationships to emerge are substantially reduced. Since in our framework effort choice is sunk at the financing stage, the contractual complications emphasised by von Thadden do not arise.

Let us summarize the timing of decisions:

Sequence of events:

At an initial stage entrepreneurs select their effort level *e* and incur a cost of *C(e).*

At the research stage all potential entrepreneurs apply for loans. Banks decide whether to monitor or not, i.e. $m \in \{0, k\}$. Based on their evaluations banks offer loan contracts (R_{1b}, I_{1b}) including repayment rates R_{1b} and loan sizes I_{1b}. Entrepreneurs select among the best offers. At the end of the stage nature draws the state of nature {S, F}.

At the development stage banks compete for the successful entrepreneurs by offering loan contracts (R_{2b}, I_{2b}). Again entrepreneurs select among the best offers.[6]

We shall assume that entrepreneurs are protected by limited liability. Moreover we will assume seniority of first period claims. Therefore, period-1 loans have to be repaid at the end of period 2 before any other loan is repaid.[7]

Finally, assume that entrepreneurs have to pay a very small switching cost $\varepsilon > 0$ when establishing a new financing relation at the development stage. This assumption will only affect behavior in cases of indifference, since we shall be interested situations with almost negligible switching costs only.

3. First and Second Best

Before we start the strategic analysis consider the hypothetical full information optimum (first best) as a reference case. Since the opportunity cost of finance is denoted by the interest factor $R_0 = 1 + r_0$, in the first best world a talented entrepreneur should use this rate for his development

[6] The precise model of competition will vary across sections in order to capture different degrees of competitiveness and modes of market conduct.

[7] Remember that period 2 is the only time a positive cash-flow can occur in our framework.

decision at stage 2 and the risk adjusted rate $\frac{R_0}{\pi(e)}$ at the research stage. With these opportunity costs in mind the first best solution maximizes the talented entrepreneurs' objective function:[8]

$$\max_{e,I_2} U(e,I_2) = \pi(e)(R(e,I_2) - \frac{R_0^2}{\pi(e)} I_1 - R_0 I_2) - C(e)$$

Because of the strict concavity of $R(e,I_2)$, the first best solution is uniquely determined.

Result 3.1 (First Best)

The first best effort e^F and the first best investment level $I_2{}^F$ are determined by the following conditions:

i) $$\frac{\partial \pi(e^F)}{\partial e}\left(R(e^F, I_2^F) - R_0 I_2 - \frac{R_0^2}{\pi(e^F)} I_1 \right) + \pi(e^F) \frac{\partial R(e^F, I_2{}^F)}{\partial e} = C'(e^F)$$

ii) $$\frac{\partial R(e^F, I_2{}^F)}{\partial I_2} = R_0$$

Because of the informational frictions the first best cannot be attained. In a second best world banks need to monitor to learn about the entrepreneurs' types. As long as monitoring costs are sufficiently low in the second best world they will acquire the information. Otherwise, monitoring will not take place.

Result 3.2 (Second Best)

i) *If* $\lambda\left(\frac{R_0}{\mu} - \frac{R_0}{\pi(e^F)} \right) I_2^F \geq k$ *banks will monitor in the second best allocation. In this case second best effort and investments are given by* $e^*(k) = e^F$ *and* $I_2^* = I_2^F$.

[8] We define payoffs in terms of the final period 2.

ii) *If* $\lambda\left(\frac{R_0}{\mu}-\frac{R_0}{\pi(e^F)}\right)I_2^F < k$ *banks will not incur any monitoring expenses. In this case second best effort* $e^*(k)$ *and the second best investment level* I_2^* *are decentralized by the actuarially fair rate of the unscreened pool* $\frac{R_0}{\lambda\pi(e^*)+(1-\lambda)\mu}$*:*

$$\frac{\partial\pi(e^*)}{\partial e}\left(R(e^*,I_2^*)-R_0I_2^*-\frac{R_0^2}{\lambda\pi(e^*)+(1-\lambda)\mu}I_1\right)+\pi(e^*)\frac{\partial R(e^*,I_2^*)}{\partial e}=C'(e^*)$$

$$\frac{\partial R(e^*,I_2{}^*)}{\partial I_2}=R_0$$

Because entrepreneurial incentives are monotonic in the retained surplus, second best investment levels are strictly below first best levels when monitoring is not socially desired.

Corollary 3.3

When $\lambda\left(\frac{R_0}{\mu}-\frac{R_0}{\pi(e^F)}\right)I_2^F < k$ *second best investment is below the first best level,* $e^*(k) < e^F$.

Let us now analyze different market structures and compare the results with second best allocations. In section 4 we analyze a cartellized banking industry and in section 5 we study a competitive banking market with price competition.

4. Monopoly

Let us consider the case of a single bank first. This case may also be interpreted as the cartel solution, when cartel members agree to share monopoly profits according to some exogenous sharing rule. Such (implicit) cartel arrangements may manifest themselves in the absence of effective competition during the relationship[9] and more or less identical lending conditions at the beginning of the research stage.

[9] For example, luring away clients during a relationship may be considered and sanctioned as „bad business practice“.

The cartel faces the following tension. If it chooses to monitor with probability 1, in equilibrium talented entrepreneurs will anticipate the monitoring decision rationally. They also anticipate that the cartel's pricing decision will leave zero surplus for them. Accordingly, in this case they have no incentive to invest in ex-ante effort. In this situation the cartel actually prefers not to monitor at all. If the cartel does not monitor, however, talented entrepreneurs could earn positive rents and, hence, are tempted to invest in effort. This tension can only be solved in the case of high monitoring costs, in which case the cartel prefers never to monitor and talented entrepreneurs will benefit partially from their efforts.

Let $\bar{I}_2 = \arg\max_{I_2} \left(R(0, I_2) - R_0 I_2\right)$ be the optimal scale of the development project of untalented entrepreneurs and $\bar{e} = \arg\max_e \left(\pi(e)\left(R(e, I_2) - R(0, \bar{I}_2)\right) - C(e)\right)$ be the optimal level of effort of talented entrepreneurs when the c artel imposes a repayment equivalent to the maximal revenue of untalented entrepreneurs' projects.

Result 4.1 (Monopoly - Cartel)

i) *When the information cost is small, i.e.* $k < \lambda\pi(\bar{e})\left(R(\bar{e}, \bar{I}_2) - R(0, \bar{I}_2)\right)$*, there is no pure strategy equilibrium. In the mixed strategy equilibrium the cartel monitors with a positive probability less than one and talented entrepreneurs randomize between zero and* $\bar{e} > 0$.

ii) *When the information cost is large, i.e.* $k \geq \lambda\pi(\bar{e})\left(R(\bar{e}, \bar{I}_2) - R(0, \bar{I}_2)\right)$*, a pure strategy equilibrium exists, in which the cartel never monitors and the talented entrepreneurs provide strictly positive effort* $\bar{e} > 0$.

Proof: The proof of part ii) is straightforward. When monitoring costs are high enough, non-monitoring is the cartel's dominant strategy. In this case talented entrepreneurs provide positive effort $\bar{e} > 0$ knowing that they going to be taxed the maximal rent of untalented entrepreneurs. Since the returns on effort have been assumed to be monotonic in *e*, they will provide the level of effort that maximizes their residual surplus net of private monitoring costs.

In order to prove i) observe that the cartel cannot credibly commit to leave any of the surplus generated by $e > 0$ to talented entrepreneurs. So, whenever the cartel chooses to monitor, entrepreneurs receive no compensation for the private costs *C(e)>0*. Hence, when the cartel

monitors with probability 1, talented entrepreneurs provide minimal effort. On the other hand, when entrepreneurs provide minimal effort, banks have no incentive to monitor. In case banks don't monitor with probability 1, talented entrepreneurs provide effort $\bar{e}$. Hence a pure strategy equilibrium does not exist. A mixed strategy equilibrium exists in which talented entrepreneurs randomize between the two effort levels 0 and $\bar{e} > 0$ and banks randomize between monitoring and non-monitoring. Q.e.d.

Accordingly, in any equilibrium entrepreneurs earn positive expected revenues and therefore provide positive expected effort.

Corollary 4.2 (Entrepreneurs' Payoffs - Cartel)
Talented entrepreneurs' payoffs are strictly positive when banks form a cartel. Expected effort, however, is below the second best.

Proof: The first statement follows immediately from Result 4.1. To establish the second statement, observe that according to Result 3.2 second best investment is first best for low monitoring costs (i) and corresponds to competitively provided non-monitored finance for high monitoring costs (ii). Hence Result 4.1 implies that for low enough monitoring costs effort incentives are strictly worse in the cartel and for high enough monitoring costs, since in both cases the cartels extracts a strictly positive surplus. Q.e.d.

Accordingly, also in our environment there may be good reasons to ban cartel agreements. However, will unfettered competition necessarily dominate cartellized conduct? Will society always prefer the resulting allocations of a competitive environment relative to a banking cartel?

5. **Price Competition**

Consider now the other polar case, when banks compete in prices. In this case, typically, all surplus remains with the entrepreneurs. Will it be possible to sustain an allocation with monitored finance under Bertrand type price competition and, hence, are banking relationships compatible with price competition?

In order to address these issues the game has to be solved by backward induction. So let us consider first the financing game for given effort levels of talented entrepreneurs and then determine the optimal levels later.

i) Fixed effort

Since the success of research projects can be publicly observed and since we have abstracted from residual risk in the development stage, equilibrium repayment rates for successful ventures at stage 2 are $R_{2b} = R_0$ for all new financiers at the development stage. If at least two banks are involved in financing the research stage R_{2b} is the equilibrium rate for all banks. If there is only one financier *h* in the research stage, this bank, i.e. the housebank, charges the equilibrium rate $R_{2h} = R_0 + \varepsilon$. Repayment rates are constant for any loan size.[10]

At stage 1 banks decide first whether to monitor and then offer contracts.

If at least two banks monitor, they will quote identical equilibrium repayment rates $\hat{R}_{1b}^m = \frac{R_0}{\pi(e^m)}$ for talented entrepreneurs and $\tilde{R}_{1b}^m = \frac{R_0}{\mu}$ for untalented entrepreneurs. Note that $\hat{R}_{1b}^m > \tilde{R}_{1b}^m$ for $e > 0$. In this case all actively monitoring banks earn a negative expected payoff of -*k* while non-monitoring banks earn zero expected payoffs.

If no bank monitors, in the subsequent equilibrium they charge non-monitored finance with repayment rates $R_{1b}^n = \frac{R_0}{\lambda\pi(e) + (1-\lambda)\mu}$. This is the actuarial fair rate when the pool of applicants is not monitored. In this case all banks earn zero expected profits. Monitored finance is viable as long as $\max_{I_2}\left(R(0, I_2) - R_0 I_2\right) \geq R_0 R_{1b}^n I_1 = \frac{R_0^2}{\mu} I_1$, which we will assume throughout the sequel.

[10] In this sense loan contracts at the development stage are linear. We shall see that at the research stage equilibrium contracts may no longer be linear in the investment level.

If only one bank monitors, this bank can exploit its informational advantage at the lending stage. The single active bank can usefully be interpreted as a housebank. Since all the other banks face an adversely selected pool those banks have to charge an equilibrium rate of $R_{1b}^{nh} = \frac{R_0}{\mu}$. The housebank maximizes profits by matching this rate (or undercutting slightly), i.e. $R_{1b}^{h} = R_{1b}^{nh} = \frac{R_0}{\mu}$. In this case the housebank earns expected profits of $G_{1b}^{h} = \lambda\left(\frac{R_0}{\mu} - \frac{R_0}{\pi(e)}\right)I_1 - k$ while its non-monitoring competitors earn zero expected payoffs. Hence, for low levels of monitoring costs k the role of a housebank is profitable. For high levels, though, monitoring is too costly.

An interesting consequence of this analysis is the observation that competitive non-monitored finance is always cheaper than lending under the conditions of a housebank regime.

Result 5.1 (Cost of Funding)

For any e>0 non-monitored finance is cheaper than housebank lending.

Proof: For any given effort level *e>0* banks requested repayment rates satisfy the relation $R_{1b}^{h} = R_{1b}^{nh} = \frac{R_0}{\mu} > R_{1b}^{n} = \frac{R_0}{\lambda\pi(e) + (1-\lambda)\mu}$ as long as $\pi(e) > \mu$. Q.e.d.

This result contrasts with the supposed advantages attributed to housebank financing in models with ex-post information production (e.g. Sharpe, 1990, von Thadden, 1998). The potential gain in a reduction of agency costs is more than offset by the housebank's oligopoly rents. In this s ense competitive non-monitored finance is strictly preferable for entrepreneurs.

Based on the analysis above it turns out that depending on the monitoring costs both, non-monitored finance and housebank finance can emerge in equilibrium. However, in any economy at most one of the two regimes can occur.

Result 5.2 (Housebanks vs. Multiple Lending)

a) When monitoring costs are low, i.e. when $\lambda\left(\frac{R_0}{\mu}-\frac{R_0}{\pi(e)}\right)I_1 > k$ *, the house-bank equilibrium arises. In this equilibrium a single bank incurs the monitoring costs. All banks offer identical repayment rates* $R_{1b}^h = R_{1b}^{nh} = \frac{R_0}{\mu} = R_1^h$ *to each entrepreneur. Only the house bank earns strictly positive period 1 revenues* $G_{1b}^h = \lambda\left(\frac{R_0}{\mu}-\frac{R_0}{\pi(e)}\right)I_1 - k > 0$ *in a given lending relationship.*[11]

b) When monitoring costs are high, i.e. when $\lambda\left(\frac{R_0}{\mu}-\frac{R_0}{\pi(e)}\right)I_1 < k$ *, multiple lending from at least two banks arises in equilibrium. Banks offer non-monitored finance. Equilibrium repayment rates are* $R_{1b}^n = \frac{R_0}{\lambda\pi(e)+(1-\lambda)\mu} = R_1^n$*. No bank earns positive expected profits.*

Proof: See the discussion above to establish a). The claim b) follows form the observation that entrepreneurs can protect themselves from the minimal market power of a single financier due to switching costs only when they establish at least two funding relations during the research stage. Q.e.d.

As is standard in models of Bertrand competition with fixed market entry costs, at most one bank will incur the monitoring cost *k*. If such a bank exists it can be considered a house bank, since it has an informational advantage with respect to its competitors. However, it enjoys some monopoly power and can earn an informational rent. In particular, the house bank does not improve financing terms relative to outside banks.

ii) Optimal effort choice

Only talented entrepreneurs can affect repayment probabilities by providing ex-ante effort. They maximize expected utility

$$\max_e U(e, I_2) = \pi(e)(R(e, I_2^*(R_2)) - R_1 R_0 I_1 - R_2 I_2^*(R_2)) - C(e),$$
$$\text{where } I_2^*(R_2) = \arg\max_{I_2} \left(R(e, I_2) - R_2 I_2\right).$$

Define the optimal effort choice under house bank finance

$$e^h = \arg\max_e \left(\pi(e)\left(R(e, I_2^*(R_0 + \varepsilon)) - R_1^h R_0 I_1 - (R_0 + \varepsilon) I_2^*(R_0 + \varepsilon)\right) - C(e)\right)$$

and under multiple lending

$$e^n = \arg\max_e \left(\pi(e)\left(R(e, I_2^*(R_0)) - R_1^h R_0 I_1 - R_0 I_2^*(R_0)\right) - C(e)\right)$$

Talented entrepreneurs' investment incentives are monotonic in their residual surplus. Accordingly, under non-monitored finance they will provide larger effort than under house-bank financing, i.e. $e^n > e^h$. In other words, entrepreneurial research incentives are greater under non-monitored finance relative to a house-banking allocation. A complete equilibrium characterization of conditions for the occurrence of house-banking equilibria and multiple lending equilibria is provided by Result 5.3.

Result 5.3 (Endogenous Regimes)

a) *When* $k \le \lambda\left(\frac{R_0}{\mu} - \frac{R_0}{\pi(e^h)}\right) I_1$ *the house-bank equilibrium will occur.*

b) *When* $\lambda\left(\frac{R_0}{\mu} - \frac{R_0}{\pi(e^h)}\right) I_1 < k < \lambda\left(\frac{R_0}{\mu} - \frac{R_0}{\pi(e^n)}\right) I_1$ *no pure strategy equilibrium exists.*

c) *When* $\lambda\left(\frac{R_0}{\mu} - \frac{R_0}{\pi(e^n)}\right) I_1 \le k$ *multiple lending with non-monitored finance will occur.*

It is worth emphasizing that both, house bank financing and multiple lending do emerge under conditions of (Bertrand-) competition in different subsets of the parameter space. House bank equilibria can be expected mainly in economies with low monitoring costs, while multiple lending relationships are a feature of economies with high monitoring costs.

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[11] Because of the switching costs ε the house bank also earns positive second period revenues. Since we are mainly

Moreover, it is easy to see that the competitive outcome under multiple lending provides second best research incentives, while the house bank regime provides for a strictly worse research environment.

Result 5.4 (Efficiency of Banking Equilibrium)

Research incentives in the house bank regime are strictly below second best, i.e. $e^h < e^*(k)$, *while they are second best in the multiple lending regime, i.e.* $e^n = e^*(k)$.

Proof: Second best research incentives require that talented entrepreneurs are rewarded the full surplus. This is guaranteed in the multiple lending regime. According to Result 5.2, for any *e>0*, in the house bank regime talented entrepreneurs are rewarded strictly less and, hence, provide strictly less effort. Moreover, according to Result 3.2 condition c) of Result 5.3. is precisely the condition under which no monitoring occurs in a second best world. Q.e.d.

This result contrasts with the literature on costly state verification (Sharpe, 1990, von Thadden, 1995), which establishes that in situations of ex-post information production house bank financing reduces financing costs and, thus, stimulates production. While it is recognized that house banks significantly share in the project's surplus, the consequences on entrepreneurial research incentives in the long run have not been discussed so far.[12]

6. Policy Implications

An immediate consequence of Results 5.3 and 5.2 is the observation that lending rates and therefore entrepreneurial research incentives are inversely related to monitoring costs. When monitoring costs are low lending terms are high and house banks appropriate a significant amount of the research surplus. In this case entrepreneurial research incentives are low. On the other hand, when monitoring costs are high, competitive non-monitored finance will occur, which yields lower lending rates and better entrepreneurial research incentives.

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interested in the case of negligible switching costs, second period profits are not reported.

Accordingly, to the extent that monitoring costs can be affected by regulatory policy, they should be made large in order to stimulate research incentives. We have shown that, paradoxically, larger monitoring costs can stimulate competition and, thus, contribute to lower lending rates and improved funding conditions.

An alternative policy option could require the institutionalization of multiple lending. However, this proposal requires that banks' monitoring activities are verifiable. If only one bank truly incurs the monitoring expenses, the resulting allocation may not differ dramatically from the house bank allocation analyzed above.

The immediate lesson for policy advice seems to be that there is nothing like a simple answer. While our analysis has highlighted the economic costs of house banks in situations when banks provide ex-ante information, the literature on costly state verification finds more benign results with respect to house banks that emphasize the benefits of coordinating ex-post verification. So the nature of the relevant information will typically affect any policy advice.

In order to provide more precise answers, based on our simple considerations, more research about the nature of the successful projects has to be concluded. In particular, the relation between human capital investment, managers effort choice, scale of research ventures and market returns has to be investigated. Presumably, this relation also depends on the governments interference into the general research and higher education environment.

7. Conclusion

This paper sheds some doubts on the efficiency of house-bank financing. It is shown that bilateral banking relations, or house-bank financing, will emerge naturally under conditions of low monitoring costs under competitive conditions.[13]

[12] It is worth emphasizing that our results also depend on the sunk character of effort investments. Von Thadden (1995), for example, analyzes a similar framework with contemporaneous effort choice. Accordingly, in his framework house banks can affect effort choice by committing to provide monitoring services.

Since house banks exert monopoly power they will not improve lending terms relative to outside banks. Moreover, since outside banks are informationally disadvantaged they charge rates worse than ex-ante fair rates of financing for a non-monitored pool of applicants. Accordingly, lending terms in banking relations are worse than under conditions of multiple lending. Under conditions of multiple lending no bank would find it profitable to invest in ex-ante monitoring. However, in our model competition guarantees the ex-ante fair rate of the unscreened pool, which is strictly lower than the relationship rate. Thus ex-ante research incentives are always better under multiple lending.

While our analysis concentrates on a rather specific model of banking competition (Bertrand price competition), a variety of different market structures and strategic constellations are conceivable that allow the banking sector at large to extract some of the projects' surplus even when information is homogeneous across competitors. In such models, and in contrast to our setup, multiple informed banks may exist ameliorating the effects of the informational rents on the strategies of insider banks. In such models competition among insider banks may benefit the entrepreneurs beyond the ex-ante fair rate for the unscreened pool. But this is a challenging avenue for further research.[14]

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[13] This result contrasts with some of the recent literature (e.g. Boot, Greenbaum, 1993), which portrays the view that house-bank relations are ultimately linked to market power.

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[14] See Dell´Aricca (1998) for an example in this direction.