Economic Development and Relationship-Based Financing

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Abstract

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Keywords: Finance and growth; Information acquisition; Competition for capital; Relationship-based vs.arm's length financial systems

JEL Classifications: G3, O16

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Formal finance involves costly information acquisition about distant entrepreneurs, while relationship-based finance allows financiers to fund a narrow circle of close entrepreneurs without engaging in costly information acquisition. We show that in developing economies with low capital endowments, relationship-based finance is optimal because only high-quality entrepreneurs receive funding. However, formal finance may emerge in equilibrium and has the only effect of shifting rents from entrepreneurs to financiers. In more developed economies with higher capital endowments, formal finance becomes necessary to prevent low-quality entrepreneurs from being funded. Nevertheless, relationship-based financing may persist in equilibrium and capital may be allocated to low-quality close entrepreneurs even when there are high-quality distant entrepreneurs.

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I Introduction

A central tenet of financial economics is that formal financial markets are necessary to fund investment and spur growth (Levine, 2006). This dominant view is challenged by accumulating macro- and micro-economic evidence. At the macro-economic level, in economies at low stages of development, the supply of formal finance appears uncorrelated with growth (Rioja and Valev, 2004). At the micro-economic level, in a variety of countries and institutional contexts, productive investment opportunities are funded by informal financiers with prior relationships with the entrepreneurs (Banerjee and Munshi, 2004; Franks, Mayer and Rossi, 2009; Braggion, 2011). In these studies, a variety of relationship-based financial arrangements, including close relationships between banks and firms (e.g., Hoshi, Kashyap, and Scharfstein, 1991; Petersen and Rajan, 1994), business groups that reinvest their profits exclusively in firms within the group (Khanna and Yafeh, 2007), and financing from a narrow circle of family and friends (Allen, Qian, and Qian, 2004), are praised for overcoming information asymmetry.

Puzzlingly, a growing body of empirical evidence also documents that relationship-based finance leads to the funding of low-productivity entrepreneurs and dubs it as crony capitalism (e.g., La Porta, Lopez-de-Silanes and Zamarripa, 2003; Charumilind, Kali and Wiwattanakantang, 2006). To the best of our knowledge, we lack a theoretical framework that can rationalize the mixed empirical evidence.

This paper takes up this challenge and proposes a theoretical framework to study 1) how financiers allocate capital as the economy develops, and 2) whether and under what conditions a relationship-based capital allocation can be socially efficient.

In our model, formal finance involves costly information acquisition about distant entrepreneurs with potentially valuable investment opportunities, while relationship-based finance allows financiers to fund a narrow circle of close entrepreneurs without engaging in costly information acquisition. We then explore how an economy's capital endowment, cost of information acquisition, and investment opportunities determine the importance of relationship-based financing, and

how formal financing (or the lack thereof) affects investment efficiency, financiers' returns, and entrepreneurial rents.

Our model is based on the following trade off. On the one hand, formal finance is costly. On the other hand, formal finance allows financiers to identify more high-productivity entrepreneurs, generating competition among entrepreneurs to obtain financing. The increased competition for funding is beneficial to the financiers because it expands their outside options, allowing them to capture a larger fraction of the project surplus from the entrepreneurs.

We show that when the total capital available for investment is scarce, as in economies at early stages of development, financiers do not acquire information and fund only connected entrepreneurs. Since financiers can employ their capital in traditional activities with high returns, they fund connected entrepreneurs only if they have high productivity. Formal finance and institutions fostering information acquisition are therefore unimportant.

As the total capital increases and the return from investing in traditional activities goes down, financiers can allocate more capital to entrepreneurs, either through formal or relationship-based financing. In this case, the incentives to acquire information and thus, the extent of formal financing in the economy, depend on the cost of information acquisition and the average quality of potential entrepreneurs.

If the cost of acquiring information is relatively low and the average quality of entrepreneurs is relatively high, financiers acquire information because they are likely to identify several high-quality entrepreneurs and the entrepreneurs' competition for (scarce) capital allows financiers to appropriate a large share of the project surplus. As a consequence, capital is allocated to entrepreneurs with higher productivity, but the real sector output may be lower because the increase in output is not sufficient to cover the information acquisition cost. Thus, there may be over-investment in information acquisition because the primary effect of information acquisition is to shift rents from entrepreneurs to financiers.

By contrast, if the cost of information acquisition is relatively high and the average quality of entrepreneurs is relatively low, financiers may lack incentives to acquire information because they

are unlikely to identify several high-quality entrepreneurs and to be able to appropriate a large share of the project surplus. Financiers thus invest in close entrepreneurs even if they have low productivity. In this situation, formal finance could increase the real sector output (net of the information acquisition cost). Yet, financiers do not acquire information because their expected return from doing so does not compensate the cost and there is under-investment in information acquisition.

Our results are consistent with empirical evidence showing that a capital allocation based on personal connections spurs growth in capital-scarce economies (Allen, Qian and Qian, 2005; Allen et al., 2008) but leads to progressively less efficient investment as the economy accumulates capital (see, for instance, Lamoreaux, 1996). Most importantly, our model proposes that informal mechanisms to allocate capital (i.e., relationships) may be preferable to formal finance (i.e., information acquisition) in emerging economies and that only at later stages of development, formal finance is welfare-enhancing.

Our model also suggests in which situations high-productivity entrepreneurs may favor reforms to spur information acquisition. Information acquisition has two opposite effects on the payoffs of high-productivity entrepreneurs. On the one hand, information acquisition increases competition for capital, forcing high-productivity entrepreneurs to offer high returns to financiers and decreasing their rents per unit of capital invested (rent effect). On the other hand, if financiers do not acquire information, high-productivity entrepreneurs receive funding only from close financiers and run inefficiently small firms (capital supply effect).

The capital supply effect prevails over the rent effect and high-productivity entrepreneurs benefit from financiers' information acquisition only if they can attract a sufficiently large pool of capital. When the supply of capital increases, for example, triggered by a financial liberalization, high-productivity entrepreneurs favor mechanisms that reduce information acquisition costs, such as an increase in transparency. This is consistent with the empirical evidence documenting that financial liberalization not only brings more funds to capital-poor countries, but also improves transparency. This evidence is often interpreted to be the result of foreign investors' pressure. We highlight

another reason why financial liberalization may spur an improvement in transparency: As the benefits from attracting distant financiers increase, entrepreneurs renounce to rents in order to invest more.

This paper contributes to the literature analyzing how different financial systems and institutions affect economic performance at different stages of development (Allen and Gale, 2000; Boot and Thakor, 1997). Most of the literature focuses on the economic roles of markets and financial intermediaries, which are often the preferred form of finance in advanced economies. It remains unclear whether markets and financial intermediaries are preferred to alternative forms of finance in developing economies (Allen, Carletti, Qian and Valenzuela, 2012). In this paper, we abstract from whether capital is allocated through intermediaries or directly by investors; instead, we investigate when financiers move away from allocating capital on the basis of relationships, and whether doing so is welfare-enhancing. Other work explores the role of prior relationships between entrepreneurs and financiers on the cost of capital and access to funds (see, for instance, Sharpe, 1990; Rajan, 1992; Petersen and Rajan, 1994 and 1995), but does not investigate in which economic and institutional environments relationships are likely to be the main driver of capital allocation. Instead, we provide a formal framework to understand the patterns of relationship-based and arm's length financing informally described by Rajan and Zingales (2003); we show under what conditions financiers allocate capital only if they have close ties with the entrepreneurs, and when instead entrepreneurs are able to tap a wider circle of financiers.

The inefficiency of the equilibrium in which financiers allocate funds based on personal ties is similar to the one highlighted by Almeida and Wolfenzon (2006). Almeida and Wolfenzon show that, because of the limited pledgeability of externally funded projects' output, conglomerates may choose to fund mediocre projects internally when other firms in the economy have higher-productivity projects that are in need of external capital. We abstract from problems of enforcement affecting the pledgeability of output and show that inefficiencies in investment may arise if financiers do not have an incentive to investigate several potential entrepreneurs.

The rest of the paper is organized as follows. Section II describes the model. Sections III through

V present the results. Sections VI provides some extensions. Section VII provides conclusions and empirical implications. All proofs are in the Appendix.

II The Model

We consider an economy with two types of risk neutral agents: a (large) number N of penniless entrepreneurs and a continuum I of financiers. Although the main results are obtained in a static framework, we discuss a dynamic extension in Section VI.D.

A Entrepreneurs and Technologies

Since our objective is to explore how the financing arrangements of an economy vary with economic development, we borrow our technological assumptions from development economics. Following the seminal work of Lewis (1955), we consider two sectors: A modern entrepreneurial sector in which new ideas are being financed and productivity does not decrease with investment, and a traditional sector with decreasing returns to scale. The traditional sector captures any traditional activities that do not require new entrepreneurial skills (e.g., agriculture and any activity in which innovation is not important). The difference in returns between the traditional sector and sectors creating new ideas (entrepreneurial projects) is common in growth theory (see, for example, Romer, 1986) and aims to capture that only new ideas can prevent the productivity of capital from falling. In this context, we explore how different mechanisms of financing favor or hinder the migration of capital from the traditional sector to the entrepreneurial sector.

A.1 Entrepreneurs

Each entrepreneur is endowed with a project. Projects are new ideas with different productivities. Entrepreneurial projects have a constant return to scale technology with productivity A^H or A^L, where $A^H > A^L$. Productivity defines the entrepreneur's type. The fraction of H and L entrepreneurs are α^H and $1-\alpha^H$, respectively. Entrepreneurs have no capital endowment. The more

capital an entrepreneur attracts, the larger the size of the firm he runs. An entrepreneur's payoff (rent) is the share of the project output that he can appropriate and that will be determined by bargaining with the financiers. His payoff is zero if he does not receive funding.

A.2 Traditional Sector

Similarly to Almeida and Wolfenzon (2005 and 2006), we model any traditional activities that do not require new entrepreneurial skills using a general technology, which provides a return per unit of capital invested $g(\omega)$, where ω is the aggregate capital invested.

The return to the general technology is decreasing, for instance because the price of crops drops if too much is produced. To ensure that the output of the general technology increases in the invested capital, we assume that $\frac{\partial(\omega g(\omega))}{\partial \omega} > 0$. For simplicity, we also assume $g(0) > A^H$, which ensures a positive investment in the general technology in equilibrium, and $\lim_{\omega \to \infty} g(\omega) < A^L$, which implies that even L entrepreneurs can be more productive than the general technology for a sufficiently large level of ω. As will be clear later, these assumptions are irrelevant to the result that information acquisition is suboptimal when an economy's capital endowment is low. In fact, all we need is that $g(\omega)$ is decreasing, and is not too much lower than A^H for a low level of ω.

In our economy there are no technological barriers to development; any amount of capital could be invested by high-productivity entrepreneurs if financiers could identify and fund new entrepreneurial ideas. However, as it will become clear later, capital absorption problems arise if the financial system fails to spur information acquisition as the aggregate capital in the economy rises. Without information acquisition, the most of the activities that are funded are well-known, and the marginal productivity of capital decreases faster than otherwise. In this context, we explore the different financial arrangements that may emerge in equilibrium and their desirability depending on the level of the capital endowment.

B Financiers

Financiers can fund the entrepreneurs or a general technology up to their endowment. Each financier is endowed with capital $k > 0$. Hence, the total capital endowment of the economy is kI. We think of kI as determined by economic development. In the spirit of the law and finance literature (La Porta, Lopes-de-Silanes, Shleifer and Vishny, 1998), we make comparative statics with respect to kI and analyze how institutions, such as the cost of acquiring information, affect the allocation of capital, and how their impact varies with the stage of economic development.

To maintain a neutral stance on the efficiency of relationship-based financing, we assume that relationships pertain each entrepreneur-financier pair, but are unrelated to the quality of the entrepreneur. This is also consistent with the existing empirical evidence showing that both high- and low-quality entrepreneurs may obtain relationship-based financing (e.g., Charumilind, Kali and Wiwattanakantang, 2006; Franks, Mayer and Rossi, 2009; Braggion, 2011). An entrepreneur is connected to a financier due to geographical proximity or social relationships. In what follows, we refer to entrepreneurs who are connected (not connected) to a given financier as close (distant) to that financier.

While financiers can invest in the general technology or in a close entrepreneur at no cost, to fund a distant entrepreneur, they have to acquire information at cost τ. One can interpret τ as the cost of becoming aware of new investment opportunities and evaluating a distant entrepreneur's business. First, spending τ is necessary to identify a distant entrepreneur and being able to invest. One may think that otherwise an infinite number of (unmodelled) fly-by-night entrepreneurs, who would just run away with the money, makes investment unprofitable. In this way, we capture that expanding the investment horizon beyond one's own connections entails a cost. Second, spending τ is necessary to observe the type of a distant entrepreneur.[1] One can also interpret τ as the difference in the cost of acquiring information about connected and unconnected entrepreneurs, respectively, where the cost of evaluating a connected entrepreneur is normalized to zero.[2] It will

[1] In Subsection VI.E, we consider an extension in which financiers are able to invest without knowing the entrepreneur's type and there are no zero-productivity entrepreneurs. We show that all results are robust.

[2] For simplicity of exposition, we emphasize that connections between financiers and entrepreneurs reduce the *ex*

be clear later that spending τ also involves benefits.

Financiers maximize their final expected wealth net of the information acquisition cost. We do not explicitly consider that financiers may enjoy private benefits from funding close entrepreneurs. However, as we show in Subsection VI.A, exogenous private benefits can be readily incorporated in our model.

Note that we do not allow financiers to pool resources and delegate information acquisition like in Diamond (1984). Under the assumptions of our model, this arises as an equilibrium outcome if financiers have to verify that the intermediary (the one of them who is delegated to acquire information) is not an impostor who would run away with the money by spending τ. More in general, one may think of our financiers as intermediaries who can deal more efficiently with limited size portfolios (as, for instance, Inderst, Mueller and Munnich (2007) and Fulghieri and Sevilir (2009) show in the context of venture capitalists).

All entrepreneurs have the same mass of close financiers and compete to attract capital from close and distant financiers who are aware of them. For tractability, we make the following assumptions. First, each financier has only one close entrepreneur and evaluates at most one distant entrepreneur.[3] Second, if financiers evaluate a distant entrepreneur, all financiers close to a given entrepreneur evaluate the same distant entrepreneur (and *vice versa*). That is, we posit that financiers belonging to a given clientele evaluate the same entrepreneurs. This technical assumption is not crucial for our results and simply ensures that financiers are equal *ex ante* and *ex post*. It is consistent with the empirical evidence suggesting that companies with similar characteristics (such as size, stock liquidity or dividend yields) cater to the same investor clienteles (Falkenstein, 1996).

Entrepreneurs sequentially offer each financier a share of the project surplus until the financier accepts an offer. We assume that entrepreneurs can discriminate between financiers with different evaluation strategies.[4] This assumption is likely to be satisfied when the identities of market

ante costs from establishing a relationship (such as information acquisition costs or the cost of making the entrepreneurial output verifiable). However, τ may also include any *ex post* costs (such as monitoring costs).

[3] In Subsection VI.E, we show that the mechanisms generalize readily if financiers acquire information about a finite number of distant entrepreneurs or if there are many close entrepreneurs with limited investment capacity.

[4] This ensures that financiers do not free-ride in their decisions to acquire information.

participants are well known to entrepreneurs, as is often the case especially at early stages of development.[5]

Whether a financier accepts an entrepreneur's offer depends on her alternative investment opportunity. The financier's alternative investment opportunity is the general technology, or, should the financier acquire information, the higher between the productivities of the other (distant) entrepreneur and of the general technology.

C Timing and Definition of Equilibrium

The timing of the events is as follows: At time 0, financiers choose whether to acquire information on a distant entrepreneur. For tractability, we assume that financiers choose whether to acquire information before observing the close entrepreneur's productivity.[6] After observing the productivity of the close entrepreneur and of the distant entrepreneur (and receiving their offers) should information acquisition occur, financiers decide how to allocate their capital between the entrepreneur(s) and the general technology. At time 1, outputs are realized and returns are distributed to financiers.

Definition 1 *An equilibrium consists of financiers' beliefs, information acquisition decisions, capital allocations, and returns, such that:*

- *Financiers decide whether to acquire information in order to maximize the expected return on their capital endowment net of the information acquisition cost;*
- *Taking as given the return of the general technology and the other entrepreneur's expected offer (if some financiers acquire information), entrepreneurs offer financiers a fraction of the project output (return) that maximizes their payoffs;*

[5] Investors are often differentially treated even at later stages of development. For instance, in the IPO process, investors who are part of the underwriter network receive stocks at lower prices than other investors.

[6] In this way, financiers are equal when we analyze their decision to acquire information. This assumption does not affect the qualitative results of the model because, as will be clear later, incentives to acquire information are particularly strong when financiers are close to an H entrepreneur.

- *Financiers allocate their capital endowment in order to maximize the expected return on their capital endowment and take as given the return offered by the entrepreneur(s) and the general technology;*

- *All agents' beliefs are realized in equilibrium.*

In what follows, we show that two mechanisms of capital allocation emerge and may coexist in equilibrium. First, financiers may fund close entrepreneurs or the general technology, without knowing any distant alternatives. Henceforth, we refer to such a situation as *relationship-based financing*. Alternatively, a financier may acquire information about a distant entrepreneur and consider funding him. We label such a situation as *formal financing*.

Financiers who allocate capital on the basis of prior relationships behave as if they were willing to forfeit returns to avoid transactions with distant entrepreneurs. Our approach follows studies of labor market discrimination (see Becker, 1971; Phelps, 1972). Financiers are not necessarily prejudiced, but they are ignorant of the productivity of distant entrepreneurs and consequently, more inclined to fund close entrepreneurs. For this reason, local markets for capital may remain segmented. Market segmentation is partially overcome if investors acquire information because capital allocation is driven by distant and close entrepreneurs' relative productivities.

III Preliminaries

A How Entrepreneurs and Financiers Share the Project Surplus

The equilibrium payoffs of financiers and entrepreneurs depend on how they share the project surplus, which is in turn determined by the equilibrium outcome of a bargaining game between financiers and entrepreneurs.

We model the bargaining game between an entrepreneur and a financier as follows: An entrepreneur is randomly selected to make the first offer, which is observed by the financier. If the first offer is not accepted, the other entrepreneur of which the financier is aware (if any) can counter-offer.

The game ends when the financier accepts an offer.

Hereafter, we characterize entrepreneurs' and financiers' optimal strategies and their equilibrium payoffs under the assumptions that entrepreneurs observe whether financiers had previous offers to invest from other entrepreneurs and no agent lies (or makes an offer) when there is no chance to attract investment.

Lemma 1 *The optimal strategy of an L entrepreneur is to always bid a share of the project output equal to* 1 *if he is randomly selected first and not to make counteroffers. The optimal strategy of an H entrepreneur is to bid a share of the project output equal to* $\max\left\{\frac{A^L}{A^H}+\varepsilon, g(\omega)+\varepsilon\right\}$ *and to counteroffer the same amount if he observes one counteroffer; the H entrepreneur counteroffers 1 to any further counteroffers. A financier accepts the first offer that is equal to the return of her second-best investment opportunity.*

Lemma 1 implies that financiers' equilibrium return is always equal to the return of their second-best investment opportunity. In what follows, we explore how this affects financiers' expected payoffs from acquiring information and the allocation of capital.

B Benchmarks

How efficiently capital is allocated in equilibrium is captured by the marginal productivity of capital (i.e., by the return on the marginal unit of capital invested), which in our economy is equivalent to the return of the general technology, $g(.)$.

We consider two benchmark economies. In the first benchmark economy, financiers do not acquire information about distant entrepreneurs and fund only close entrepreneurs or the general technology. In other words, capital is allocated only on the basis of prior relationships.

The following proposition describes the equilibrium marginal productivity of capital (MPK) with relationship-based financing. To simplify the notation, we define $\omega_H \equiv g^{-1}\left(A^H\right)$ and $\omega_L \equiv g^{-1}\left(A^L\right)$. Since the return to the general technology is decreasing and $A^H > A^L$, it is immediate that $\omega_H < \omega_L$.

Proposition 1 ***Relationship-Based Financing****. If no financier acquires information, then the marginal productivity of capital (MPK) for different levels of kI is:*

$$MPK^R = \begin{cases} g(kI) & if \quad kI \leq \omega_H \\ A^H & if \quad \omega_H < kI \leq \frac{\omega_H}{1-\alpha^H} \\ g\left(kI\left(1-\alpha^H\right)\right) & if \quad \frac{\omega_H}{1-\alpha^H} < kI \leq \frac{\omega_L}{1-\alpha^H} \\ A^L & if \quad kI > \frac{\omega_L}{1-\alpha^H} \end{cases}$$

In equilibrium, when $\omega_H < kI \leq \frac{\omega_L}{1-\alpha^H}$, only H entrepreneurs are funded. Financiers obtain a return which is equal to MPK.

In an economy in which capital is allocated only through relationships, financiers' returns coincide with MPK. Entrepreneurs, aware of financiers' investment opportunities, offer at most the return of the general technology. Proposition 1 also implies that L entrepreneurs receive funding for kI larger than $\frac{\omega_L}{1-\alpha^H}$. For kI larger than this threshold, the general technology employs an amount of capital equal to ω_L. Thus, its productivity has dropped to A^L and financiers without a close H entrepreneur convey an amount of capital equal to $\left(1-\alpha^H\right)(kI-\omega_L)$ to L entrepreneurs. This implies that the amount of capital allocated to L entrepreneurs increases with kI.

In the second benchmark economy, all financiers acquire information about distant entrepreneurs. The following proposition describes the equilibrium MPK in such an economy.

Proposition 2 ***Formal Financing****. If all financiers acquire information about distant entrepreneurs, the marginal productivity of capital (MPK) for different levels of kI is:*

$$MPK^F = \begin{cases} g(kI-I\tau) & if \quad kI \leq \omega_H + I\tau \\ A^H & if \quad \omega_H + I\tau < kI \leq \frac{\omega_H}{(1-\alpha^H)^2} + I\tau \\ g\left((kI-I\tau)\left(1-\alpha^H\right)^2\right) & if \quad \frac{\omega_H}{(1-\alpha^H)^2} + I\tau < kI \leq \frac{\omega_L}{(1-\alpha^H)^2} + I\tau \\ A^L & if \quad kI > \frac{\omega_L}{(1-\alpha^H)^2} + I\tau \end{cases}$$

In equilibrium, when $\omega_H + I\tau < kI \leq \frac{\omega_L}{(1-\alpha^H)^2} + I\tau$, only H entrepreneurs are funded. Financiers

can obtain a return on investment that is higher than MPK.

Figure 1 illustrates the differences in the marginal productivity of capital with relationship-based financing (Proposition 1) and formal financing (Proposition 2).

There are two main differences between a relationship-based and an information-based capital allocation. First, in the latter, at least some financiers can obtain a return that is larger than MPK, because the actual return obtained by a financier is equal to the productivity of her second-best investment opportunity. When a financier acquires information, she is able to invest in two H entrepreneurs with probability $\left(\alpha^H\right)^2$. In this case, competition for capital drives her return above MPK to A^H.

Second, with information acquisition, financiers can allocate more capital to the entrepreneurs with the highest productivity, whether distant or close. Formally, in a relationship-based capital allocation, only a fraction α^H of financiers are close and are therefore able to fund H entrepreneurs. In an information-based capital allocation, a fraction $1-\alpha^H$ of financiers are close to an L entrepreneur, but are able to identify a distant H entrepreneur with probability α^H. Thus, thanks to information acquisition, a fraction $2\alpha^H - \left(\alpha^H\right)^2$ of financiers is able to fund H entrepreneurs and less capital is invested in the general technology. This prevents the marginal productivity of capital from decreasing as fast as in an economy in which the capital allocation is completely driven by relationships. In addition, the range of capital endowments for which only H entrepreneurs obtain funding is larger than in an economy in which financiers fund exclusively close entrepreneurs. As Figure 1 indicates, the difference in productivity between the two regimes of capital allocation is larger if the difference between A^H and A^L and/or α^H are relatively large, and/or if $g'(.)$ is larger in absolute value.

Propositions 1 and 2 also indicate that there are two instances in which the marginal productivity of capital does not depend on whether financiers acquire information in an economically relevant way.[7] The first instance is when the economy's capital endowment is scarce – kI smaller

[7]Note that when $kI < \omega_H$, MPK is higher with information acquisition ($MPK^F = g\left(kI - I\tau\right)$) than without ($MPK^R = g\left(kI\right)$), because by acquiring information, financiers destroy $I\tau$ units of capital.

than ω_H. In this case, even H entrepreneurs are not funded. This depends on our assumption that for such low levels of capital endowment, the general technology can employ all capital and yet have a productivity higher than A^H – the highest possible return an entrepreneur can offer to a financier.

The second instance is when capital is abundant – kI larger than $\frac{\omega_L}{(1-\alpha^H)^2} + I\tau$. In this case, the marginal productivity of capital is identical in the two benchmark economies because, for simplicity, we assume that financiers can acquire information on at most one distant entrepreneur.

In what follows, we concentrate on the set of parameters in which the results do not derive mechanically from our simplifying assumptions. For this reason, we impose the following condition on kI.

Assumption 1 *The level of capital endowment is such that* $kI \in \left(\omega_H + I\tau, \frac{\omega_L}{(1-\alpha^H)^2} + I\tau\right)$.

Within the above interval, we will explore how capital is allocated in equilibrium when financiers optimally choose whether to acquire information. The marginal productivity of capital in equilibrium will be a linear combination of the marginal productivity of capital in the two benchmark economies. In this context, we will establish when it is privately optimal for financiers to acquire information and to what extent their decision to acquire information is also socially optimal. As will be clear later, since the marginal productivity of capital is not necessarily equal to the return obtained by the financiers when they acquire information, privately and socially optimal decisions may differ.

IV Costly Information Acquisition about Distant Entrepreneurs

Here we investigate under what conditions at least some financiers acquire costly information about distant entrepreneurs. Whether information acquisition is optimal depends on the expected return from evaluating a distant entrepreneur. This in turn may differ from the marginal productivity of capital or from the productivity of the investment that the financier actually funds because the

actual return obtained by the financier is equal to the productivity of her second-best investment opportunity.

Proposition 3 *There are critical levels τ^* and τ^{**} (defined in the proof) such that:*

For $\tau \leq \tau^{**}$, relationship-based finance is the only equilibrium if $kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H - A^L)} + I\tau$; If $kI \geq \frac{I\tau A^L}{(\alpha^H)^2(A^H - A^L)} + I\tau$, at least some financiers acquire information. Both with relationship-based finance and formal finance only H entrepreneurs are funded.

For $\tau^{**} < \tau \leq \tau^*$, relationship-based finance is the only equilibrium if $kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H - A^L)} + I\tau$; at least some financiers acquire information otherwise. If $\frac{\omega_L}{1-\alpha^H} \leq kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H - A^L)} + I\tau$, both H and L entrepreneurs are funded; only H entrepreneurs are funded for other levels of kI.

For $\tau > \tau^*$, relationship-based finance is the equilibrium. Both H and L entrepreneurs are funded if $kI > \frac{\omega_L}{1-\alpha^H}$; only H entrepreneurs are funded for other levels of kI.

Figure 2 provides a visual characterization of the equilibria for different levels of the capital endowment and of the information acquisition cost.

When the capital endowment is low, expanding the investment opportunity set by observing a distant entrepreneur does not significantly improve financiers' expected returns, since the general technology already offers high return at no cost. Hence, financiers forego information acquisition and invest in close entrepreneurs as long as they are at least as productive as the general technology.

Institutions fostering information acquisition matter once the economy reaches a minimum threshold of the capital endowment (i.e., $kI \geq \frac{I\tau A^L}{(\alpha^H)^2(A^H - A^L)} + I\tau$). Whether relationship-based financing remains prevalent or formal finance emerges and financiers allocate capital more broadly depends on the country's cost of information acquisition.

For formal finance to exist, it is crucial that $\tau \leq \tau^*$. This condition implies that an equilibrium with information acquisition is more likely to emerge (i.e., τ^* is larger) if the proportion of H entrepreneurs is relatively high and/or there is a large difference in productivity between H and L entrepreneurs. In particular, a higher proportion of H entrepreneurs strengthens financiers' incentives to acquire information for the following reason. Financiers benefit from discovering a

distant H entrepreneur only if they are close to an H entrepreneur, as competition for capital allows them to obtain return A^H. Otherwise, financiers are offered only the return of their second-best investment opportunity, which is equal to MPK and to which they have access without incurring the information acquisition cost. Thus, the cost of information acquisition, together with an economy's investment opportunities, affects the equilibrium configurations for different levels of the capital endowment.

In economies with very low cost of information acquisition ($\tau \leq \tau^{**}$), financiers acquire information for low levels of the capital endowment. Thus, the marginal productivity decreases relatively slowly as kI increases and relationship-based financing leads to funding of high-quality entrepreneurs. L entrepreneurs are never funded.

In economies with intermediate cost of information acquisition ($\tau^{**} < \tau < \tau^{*}$), financiers acquire information for relatively higher levels of the capital endowment. Productivity first decreases to A^L and low-quality entrepreneurs receive financing from connected financiers. Specifically, L entrepreneurs receive an amount of capital $\left(1-\alpha^H\right)\left(kI-\omega_L\right)$ for $kI > \frac{\omega_L}{1-\alpha^H}$. However, the financial systems of these economies evolve. Once capital reaches the threshold $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$, financiers begin to acquire information and the productivity of capital increases again to A^H.

Lastly, if the cost of information acquisition is high ($\tau > \tau^{*}$), connections are the only mechanism to allocate capital. As the capital endowment increases, low-quality entrepreneurs receive funding. In these economies, relationship-based financing becomes crony capitalism and the productivity of capital decreases fast even though the technological opportunities are similar to economies with lower costs of information acquisition.

It is important to note that differences in the cost of information acquisition associated to different equilibrium configurations are plausible. This is easily illustrated with a numerical example. Consider an economy with $A^H = 0.8$, $A^L = 0.6$, $\alpha^H = 0.1$, and $g(\omega) = \left(90-\omega^2\right)^{0.5}$. Such an economy with capital endowment $kI = 10.535$ may have no information acquisition, funding of L entrepreneurs and productivity of the general technology equal to A^L for $\tau = 0.04$, which is 0.38% of the capital endowment and 5% of the productivity of the H entrepreneurs and 6.67% of

the productivity of the L entrepreneurs and the general technology. In the same economy with a cost of information acquisition equal to 0.02, some financiers would acquire information and in equilibrium only H entrepreneurs would be funded.

Importantly, for $\tau < \tau^*$, formal finance becomes prevalent with respect to relationship-based finance as capital increases.

Corollary 1 *For $\tau < \tau^*$ and $\frac{I\tau A^L}{(\alpha^H)^2(A^H - A^L)} + I\tau \leq kI < \frac{\widehat{\omega}}{(1-\alpha^H)^2} + I\tau$ (where $\widehat{\omega}$ is defined in the proof), a mass of financiers equal to $2I - \frac{\widehat{\omega}}{(1-\alpha^H)^2(k-\tau)}$ and increasing in k acquires information.*

For $\tau < \tau^*$ and $kI > \frac{\widehat{\omega}}{(1-\alpha^H)^2} + I\tau$, all financiers acquire information.

The intuition behind Corollary 1 is the following. A larger investment in the general technology decreases the marginal productivity of capital and financiers' outside option. Since entrepreneurs, aware of this, would offer a low return to financiers, investigating a distant entrepreneur becomes attractive for an increasing mass of financiers as long as the cost of information acquisition is relatively low ($\tau < \tau^*$). Thus, if an equilibrium with information acquisition indeed emerges, a mass of financiers increasing in the level of the capital endowment acquires information. The rest of financiers invest in the close entrepreneurs or in the general technology without evaluating distant investment opportunities. Relationship-based financing may thus coexist with formal financing for intermediate levels of the capital endowment.

The implications of Proposition 3 are consistent with several pieces of empirical evidence. First, in countries with low capital endowments, relationship-based financing prevails and appears to lead to the funding of high-quality investment opportunities. For example, Allen, Qian and Qian (2005) and Allen et al. (2008) provide evidence that Chinese and Indian firms rely on informal loans provided by connected financiers, such as family, friends or suppliers, to sustain their high growth rates. Franks, Mayer and Rossi (2009) show that in the first half of the 20th century, ordinary shareholders in the U.K. lived close to the company's city of incorporation and its board of directors and obtained high rate of returns. Furthermore, business groups, consisting of legally independent firms bound together by formal and informal ties, may be viewed as a way to fund

close entrepreneurs without resorting to information acquisition. Consistently with our model, it has been argued that business groups enhance economic performance in early phases of development (Khanna and Yafeh, 2007).

Second, the ability of the financial system in certain institutional environments to endogenously and gradually transform as the economy accumulates capital is consistent with the historical experience of the US. Lamoreaux (1996) writes that in New England in the early nineteenth century, bank directors funneled the bulk of the funds under their control to themselves, their relatives, or others with personal ties to the board. Nevertheless, relationship-based financing guaranteed banks high and steady earnings. Local banks thus fueled the region's economic development. As the century progressed, bank performance first declined and the banks developed new credit standards for evaluating the creditworthiness of distant borrowers that ran counter to the values that originally sustained insider lending. At the same time, it became more difficult for entrepreneurs in the region to obtain funding. Consistently with our model, during the nineteenth century, New England had transformed from a capital-scarce to a capital-abundant region. Similarly, shareholders in the UK started to invest in distant firms in the second half of the 20th century (Franks, Mayer and Rossi, 2009). We argue that capital accumulation and institutions guaranteeing a relatively low cost of information acquisition are the main reasons explaining why it became optimal for financiers to acquire information on distant investment opportunities.

Finally, Proposition 3 can explain why financial systems do not always evolve to favor the reallocation of capital from the traditional to the entrepreneurial sector as capital accumulates. South Korea in the second half of the nineties is a good example of a country with relatively high level of capital endowment and high cost of information acquisition. After decades of sustained growth, fostered by a relationship-based financial system, the financing of low-quality investment opportunities pushed South Korea into a crisis (Corsetti, Pesenti and Roubini, 1997). Growth resumed only after legal reform, which in the lens of our model should have strengthened financiers' incentives to search for high-quality distant entrepreneurs by lowering τ.

V Welfare Effects

This section explores the welfare implications of different regimes of capital allocation. We first compare the individual payoffs of financiers and entrepreneurs with and without information acquisition, respectively. Afterwards, we evaluate the social welfare consequences of information acquisition.

A Financiers' and Entrepreneurs' Payoffs

Different equilibrium configurations have large effects on agents' payoffs.

Proposition 4 *Financiers appropriate a larger fraction of project output when at least some of them acquire information than in a relationship-based capital allocation.*

Without information acquisition, the expected return to financiers is lower than A^H when the capital endowment rises above ω_H. This effect is not due to a large amount of capital chasing limited investment opportunities because, under our assumptions, any amount of capital can be invested with return A^H. The lower equilibrium return is due to market segmentation. Information acquisition leads to higher returns for financiers as it expands their investment opportunities and increases competition for funds. Spending τ and observing the productivity of a distant entrepreneur increase the return to investment because with probability $\left(\alpha^H\right)^2$, financiers identify two high-productivity entrepreneurs and obtain return A^H. Whenever financiers identify entrepreneurs with different productivities, in equilibrium, they are offered only the return of their second-best investment opportunity. Importantly, even if only a subset of financiers acquires information, the others enjoy higher returns thanks to smaller investment in the general technology.

Since alternative investment opportunities matter, our model predicts that financiers enjoy higher returns when a larger than usual number of H entrepreneurs raise capital and expectations about their quality are high. Such a situation resembles IPO "hot markets". Our theory implies that financiers should be offered new equity issues at better prices, as is consistent with the findings

of Lowry and Schwert (2002) and Benveniste, Ljungqvist, Wilhelm and Yu (2003).[8]

While a reduction in market segmentation increases financiers' payoffs, it may increase or decrease the payoffs of entrepreneurs.

Proposition 5 *H entrepreneurs can be either better off or worse off when at least some financiers acquire information than with a relationship-based capital allocation. The payoff of L entrepreneurs is always zero.*

As the proof of Proposition 5 indicates, market segmentation has two opposite effects on entrepreneurs' payoffs. First, reducing market segmentation (by decreasing τ) helps capital to flow to more productive entrepreneurs. The reduction in capital misallocation allows high-productivity entrepreneurs to run larger projects. Hence, lower market segmentation causes a positive capital supply effect.

Second, lower market segmentation expands financiers' investment opportunities and increases competition for funds. Competition forces entrepreneurs to offer financiers higher returns and decreases entrepreneurial rents per unit of capital invested. Given the negative rent effect, entrepreneurs may prefer a higher market segmentation in order to enjoy a higher rent on a smaller scale project. The net effect of lower market segmentation on H entrepreneurs' payoff is ambiguous (L entrepreneurs' payoffs are unaffected because they cannot offer a return lower than A^L).

The following corollary considers a special case under which the rent effect prevails.

Corollary 2 *If $\alpha^H \geq \frac{1}{2}$, H entrepreneurs prefer a relationship-based capital allocation to an information-based capital allocation.*

Corollary 2 establishes that H entrepreneurs prefer a relationship-based capital allocation if competition for funds from other H entrepreneurs is relatively high $\left(\alpha^H \geq \frac{1}{2}\right)$. In this case, the

[8] In this respect we provide an alternative explanation to the prospect theory (Loughran and Ritter, 2002) for why entrepreneurs are generally content to leave money on the table during hot markets. Also note that since during hot markets many similar firms go public, costs of information acquisition are believed to be lower due to information spillovers (Benveniste, Ljungqvist, Willhelm and Yu, 2003). Hence, underpricing cannot be considered a reward for higher costs of information acquisition.

negative effect on entrepreneurs' payoffs of a lower rent per unit of capital invested prevails over the positive capital supply effect.

The relative importance of the rent and capital supply effects is ambiguous in more general cases. Figure 3 shows with some numerical examples how entrepreneurs' payoffs with information acquisition vary with the level of the capital endowment. When the capital endowment is relatively low, H entrepreneurs' payoff may decrease in the level of the economy's capital endowment. This depends on the fact that as capital increases more financiers acquire information. More information acquisition decreases the rent per unit of capital invested, without allowing a large increase in investment. This effect is more pronounced if the proportion of H entrepreneurs is larger, as information acquisition increases competition for capital to a larger extent. When the capital endowment is sufficiently high, all financiers acquire information. Hence, further increases in capital can only benefit H entrepreneurs by enabling them to invest more.

Our analysis has implications for H entrepreneurs' attitudes towards transparency, interpreted as a lower cost of information acquisition τ. Transparency is inconsequential when the capital endowment is low. Only when the capital endowment exceeds a minimum threshold, greater transparency (lower τ) gives financiers an incentive to acquire information. However, H entrepreneurs may not favor a decrease in τ, especially when there are a large number of high-quality entrepreneurs, because they prefer a relationship-based capital allocation. As the capital endowment increases, H entrepreneurs' resistance to improved transparency diminishes.

B When is Relationship-Based Financing Desirable?

So far, we have shown that, when the capital endowment is above a certain threshold, information acquisition allows capital to be allocated more efficiently across entrepreneurs and between entrepreneurial and general technologies. However, information acquisition entails a cost. Here, we show that financiers' individually optimal decisions on whether to acquire information do not necessarily maximize the economy's output net of information acquisition costs and therefore, are not necessarily efficient from a social welfare point of view.

The following proposition gives conditions under which acquiring information about distant entrepreneurs would increase the output of the economy, but a relationship-based capital allocation prevails in equilibrium. In other words, there is *under-investment* in information acquisition.

Proposition 6 *If the capital endowment is sufficiently high and α^H is sufficiently small, in equilibrium there is under-investment in information acquisition.*

If the fraction of L entrepreneurs is sufficiently high, information acquisition has only a small effect on entrepreneurs' competition for capital, resulting in a small increase in financiers' expected wealth. Hence, in equilibrium, financiers do not acquire information even though doing so would increase the output of the economy, net of information acquisition costs.

There may also be *over-investment* in information acquisition. In this case, information acquisition reduces the economy's output, net of information acquisition costs.

Proposition 7 *If the capital endowment is sufficiently low and α^H is sufficiently large, in equilibrium there is over-investment in information acquisition.*

When the fraction of H entrepreneurs is high, financiers have an incentive to invest in information acquisition even if this has only small positive effects on the (aggregate) entrepreneurial output. They do so because by acquiring information they can appropriate a larger share of the entrepreneurial output. Since the main role of information acquisition is to shift rents from entrepreneurs to financiers, if the capital endowment is sufficiently low, this may decrease social welfare. Interestingly, there is never over-investment in information acquisition for higher levels of the capital endowment.

Proposition 7 implies that information acquisition can be welfare-decreasing even if it improves capital allocation in the real sector of the economy. Hence, pursuing policies that stimulate information acquisition without taking into account the costs may be detrimental.

These results have bearings for the desirability of formal finance in different phases of development. Formal finance requires information acquisition about some distant investment opportunities.

When the capital endowment is low, formal finance allows financiers to appropriate a larger share of the output. Even though financiers enjoy higher equilibrium returns, formal finance may allow only a small increase in investment by high-productivity entrepreneurs. This is not sufficient to compensate for the cost of information acquisition. For this reason, it is preferable that capital is allocated through informal channels that do not require information acquisition even though high-quality entrepreneurs are not able to invest as much.

As the capital endowment increases, information acquisition always allows an increase in high-quality entrepreneurs' investment that is large enough to more than compensate the cost of acquiring information. Formal finance is thus desirable. Put differently, costly information acquisition is a sort of luxury good that is desirable only when economies reach a minimum level of development. However, it may not emerge if financiers are not able to appropriate a sufficiently large fraction of the increment in output because of low competition for capital.

VI Extensions

A Private Benefits

Connections may be thought to be associated with private benefits. Therefore, one may ask whether private benefits could yield results similar to the ones we have highlighted so far. If not, one may still wonder whether our results are robust to the inclusion of private benefits. Below we address these two questions in turn.

We assume that financiers can obtain private benefits b per unit of capital invested in a close entrepreneur;[9] b is common knowledge.

First, we assume that there is no market segmentation that may be overcome with information acquisition. Financiers fund close H entrepreneurs instead of the general technology as long as $A^H + b > g(kI)$. Furthermore, when $A^L + b > \max\left\{A^H, g(kI)\right\}$, financiers with a close L entrepreneur

[9] We do not consider fixed private benefits because our objective is to study economies with different capital endowment (and aggregate output). If private benefits were fixed for any level of the capital endowment, financiers could invest a small amount ϵ in the close entrepreneur and obtain the private benefits of control. The rest of the capital could be invested efficiently.

fund the L entrepreneur even if they can identify distant H entrepreneurs at no cost. If instead $A^L + b < A^H$, L entrepreneurs are never funded.

This implies that in an economy without market segmentation and with high private benefits, financiers would fund close entrepreneurs regardless of their productivity and the level of the capital endowment. Therefore, this mechanism cannot explain why economies evolve away from relationship-based financing even without legal reform (as in the historical periods described by Lamoreaux (1996) and Franks, Mayer and Rossi (2009)), whereas our model with market segmentation offers this insight.

Second, we explore how introducing private benefits in our model with market segmentation would affect the results. We consider the case in which $A^L + b < A^H$, because otherwise no financier would ever consider acquiring information and funding a distant H entrepreneur. Since the private benefits are publicly observable, a close entrepreneur always offers the financier a return that is b lower than the return offered by a distant entrepreneur. Thus, private benefits leave the expected return from acquiring information unaffected. The Appendix shows formally that incentives to acquire information remain unchanged. However, private benefits make investing in close L entrepreneurs more attractive. Thus, for a high level of the capital endowment, financiers that acquire information and fail to identify a distant H entrepreneur may fund the close L entrepreneur, instead of the general technology.

B Bargaining Power

Our model assumes that entrepreneurs have all the bargaining power and can appropriate the surplus from investment. This assumption appears directly applicable to situations in which capital is raised from small financiers. Our results however can be easily generalized to situations in which financiers and entrepreneurs share the bargaining power.

To see this, assume that financiers and entrepreneurs share the investment surplus by Nash bargaining. Consider the case in which a financier can invest her capital endowment k earning a return $g(\Omega)$, which depends on the (aggregate) amount of capital invested in the general technol-

ogy, or can fund an H entrepreneur. In this case, Nash bargaining implies that the H entrepreneur obtains a payoff of $\frac{1}{2}\left(A^H - g(\Omega)\right)k$ and the financier obtains a payoff of $\frac{1}{2}\left(A^H - g(\Omega)\right)k + g(\Omega)k$. Consider now a financier that acquires information. If the financier identifies another H entrepreneur, she is able to obtain a payoff of $A^H k$, while the entrepreneur's payoff is zero. This implies that as long as entrepreneurs have some bargaining power, the financiers' payoff is increasing in the set of their investment opportunities. Hence, by providing incentives to acquire information, transparency increases financiers' returns similarly to the case in which entrepreneurs have all the bargaining power.

If financiers have all the bargaining power, entrepreneurs' competition for capital becomes unimportant. This is related to Rajan (1992): If relationships confer an informational monopoly power to financiers, they lead to a lower payoff for entrepreneurs than arm's length financial transactions. Financiers are likely to have all the bargaining power if they are large as is the case with a monopolistic banking sector. In this respect, our model suggests that in environments with low transparency and a large proportion of low-productivity entrepreneurs, a concentrated financial sector may improve capital allocation as a financier with bargaining power is able to obtain a higher return from investing in information acquisition. Note that, however, the cost of information acquisition and the average quality of entrepreneurs still affect incentives to investigate distant entrepreneurs and therefore the efficiency of capital allocation and financiers' returns; only the effect on entrepreneurial rents disappears.

C Financial Intermediary

Our basic model does not distinguish between direct and indirect financing. Nevertheless, one may wonder how the equilibrium would be affected in the presence of a financial intermediary. In this subsection, we introduce an intermediary, which, at a cost, can specialize in identifying high-quality entrepreneurs along the lines of Biglaiser (1993). Specifically, by spending an amount of capital T^I, the intermediary can identify with probability one at least two H entrepreneurs, effectively guaranteeing return A^H. We assume that $T^I > \tau I$. This assumption captures that specialization is

costly and that intermediated finance involves a trade off between a higher probability of identifying H entrepreneurs and a higher cost of investing.

We first consider how such an intermediary would affect an equilibrium with information acquisition. Under the previous assumptions that output is verifiable, but investment is not, such an intermediary would indeed have an incentive to collect capital K and invest it, instead of running away with K, if the following participation constraint is satisfied:[10]

$$A^H kI - T^I \geq \left(\left(\alpha^H\right)^2 A^H + \left(1 - \left(\alpha^H\right)^2\right) g\left(\left(kI - \tau I\right)\left(1 - \alpha^H\right)^2\right)\right)\left(kI - \tau I\right)$$

This participation constraint captures that the intermediary has to offer financiers that tender capital $K = kI$ at least the return that they would obtain in an equilibrium with information acquisition. The participation constraint compares the return on investment net of the information acquisition cost that a specialized intermediary can obtain with the return that financiers can obtain with direct financing.[11] Thus, a specialized intermediary is more likely to emerge if H entrepreneurs are relatively scarce (α^H is low). Also, since with direct financing the expected return of financiers decreases for larger levels of capital, a specialized intermediary is more likely to emerge in equilibrium at more advanced stages of development.

We can similarly describe the case in which financiers do not acquire information. The participation constraint of the intermediary would be:

$$A^H kI - T^I \geq g\left((1 - \alpha^H)kI\right)(kI)$$

This participation constraint captures that the intermediary has to offer financiers that tender capital $K = kI$ at least the return that they would obtain in an equilibrium without information

[10] We are writing the participation constraint for the case in which all financiers acquire information. None of the mechanisms we describe would change for the case in which some financiers do not acquire information.

[11] The left hand side of the condition is the (aggregate) payoff on investment a specialized intermediary can obtain ($A^H K$), net of his information acquisition cost T^I. The right hand side, as described formally in the proof of Proposition 2, is the payoff that financiers can earn if each of them spends τ to acquire information and identify a distant entrepreneur.

acquisition.[12] It is important to note that for small α^H, a specialized intermediary may allow an economy to move away from relationship-based financing at earlier stages of economic development, especially if T^I is relatively small.

It remains true however that relationship-based financing is an equilibrium and is optimal at low stages of development. Since the specialized intermediary is able to appropriate the entrepreneurial rent, it may emerge even by allowing just a small reallocation of investment and increase in the output of the economy. A specialized intermediary could thus exacerbate the distortion related to too much information acquisition at low level of development, highlighted in Proposition 7.

D Dynamics

So far we have derived all our results by solving a static model, even though in the interpretation of the results we have implicitly allowed capital to dynamically grow over time. In this subsection, we illustrate how the static economy can be seen as the steady state of an overlapping generation model in which the old generation invests (as the financiers do) and consumes before dying.

To introduce a link between different stages of the economy, we let each young generation of financiers to work in the traditional sector and receive a wage compensation, which they invest in the second and last period of their life. For this reason, we transform the general technology as $l^s g(\omega)\omega$, where l is the mass of the young generation working in the traditional sector, s is a parameter of the production function, capturing the labor share, and ω is the amount of capital invested in the general technology. Under our assumptions that the mass of financiers is I, $l = I$. Thus, the amount of capital that financiers can invest at the beginning of their second and last period of life equals the wage they have earned when they are young: $sg(\omega)\omega I^s$.

We further assume that entrepreneurs are infinitely lived firms and always reinvest any profits in the entrepreneurial technology. However, since financiers invest only once no information is accumulated or transmitted.

[12] The right hand side of the condition is the payoff that financiers earn with relationship-based financing (described formally in the proof of Proposition 1).

While studying the dynamics of this economy is beyond the scope of this paper, it is worth noticing that even if no information acquisition at low level of capital is optimal, it can be costly in the long-run as the economy may remain stuck in a steady state with no information acquisition and low level of capital and output.

E Other Robustness

For tractability, we have imposed several simplifying assumptions that are not crucial for our findings. We now discuss the general implications if some of these assumptions are relaxed.

Our model assumes that financiers evaluate at most one distant entrepreneur. This implies that in any economy the equilibrium becomes progressively more inefficient and ultimately resembles the one prevailing with relationship-based financing as the capital endowment increases. For this reason, we restrict our focus to $kI \leq \frac{\omega_L}{(1-\alpha^H)^2} + I\tau$ by imposing Assumption 1. In a more general version of the model, financiers would have an incentive to evaluate more than one distant entrepreneur as their capital endowment goes up. Hence, the marginal productivity of capital would not necessarily drop to A^L. If the institutional environment were favorable to information acquisition (i.e., τ is low), financiers would start evaluating more distant entrepreneurs, without ever funding low-productivity entrepreneurs. If information acquisition was instead too costly, financiers would fund low-productivity entrepreneurs and only when their capital endowment increases sufficiently, they would choose to further expand their investment opportunities. Precisely like in the current version of the model, this extension implies that economies with an institutional environment favoring information acquisition maintain a relatively high productivity of capital as they grow, while productivity decreases faster and experiences cycles as the economy accumulates capital in environments that are less favorable to information acquisition. Finally, if the environment is not favorable to information acquisition, an equilibrium with information acquisition in which only H entrepreneurs are funded never emerges (as is the case if $\tau > \tau^*$).

Our model also assumes that the expected quality of entrepreneurs is the same regardless of their location and connection with financiers. This is a simplifying assumption that does not

affect the main message. If entrepreneurs in location A were systematically less productive than entrepreneurs in location B, in a relationship-based capital allocation, financiers in location A would invest relatively more in the general technology, while financiers in location B would fund entrepreneurs to a larger extent. Even though incentives to acquire information would be affected, relationship-based financing would still lead to efficient investment decisions at early stages of economic development.

The qualitative properties of the equilibrium would be equally unchanged if only a handful of entrepreneurs had connections and the others were unable to start a business without information acquisition. If the distribution of the types of connected and unconnected entrepreneurs were equal, our results would be unchanged, but relationship-based financing would limit entry. If, on the other hand, unconnected entrepreneurs were more productive, relationship-based financing would not lead to an efficient capital allocation, but it could still emerge in equilibrium.

So far, we have assumed that financiers cannot invest in a distant entrepreneur without spending τ because distant entrepreneurs are unknown. The implications of our model would be similar if financiers had the option to invest in distant entrepreneurs without spending τ and therefore expected a return $\alpha^H A^H + (1 - \alpha^H)A^L$. Also in this case, financiers would have no incentive to fund a distant entrepreneur if the expected return of unknown type distant entrepreneurs is less than that of the general technology. Additionally, incomplete information about the entrepreneurs' type would lead to an inefficient allocation of capital, similarly to the version of the model we present.

Finally, we have assumed that entrepreneurial projects are constant return to scale and therefore, any amount of capital can be invested by high-quality entrepreneurs. Our results hold, however, if high-quality entrepreneurs are able to invest at most a finite amount of capital as long as capital is scarce with respect to their investment opportunities. Interestingly, if a minimum level of investment is required to undertake an entrepreneurial project, it may not be possible to fund entrepreneurial activity without information acquisition. In this case, relationship-based financing leads to an inefficient capital allocation even at early stages of development.

VII Conclusions and Empirical Implications

This paper examines under which conditions capital is predominantly allocated on the basis of prior connections. It shows that formal finance is unnecessary and even harmful at early stages of development, when the level of the capital endowment is low. As the economy accumulates capital, formal finance and the acquisition of information about distant investment opportunities become crucial for preventing low-productivity entrepreneurs from being funded. Nevertheless, even high-productivity entrepreneurs may favor a relationship-based capital allocation because they enjoy higher rents when financiers have information on a limited set of investment opportunities. Interestingly, even though formal finance allows capital to flow to more productive projects, it is not always desirable from a social welfare point of view. In fact, the costs of information acquisition can outweigh the benefits of a more efficient allocation of capital across entrepreneurs. Thus, informal finance may dominate formal financial markets in developing economies.

While in most of our comparative statics we focus on an economy's capital endowment, the association between relationship-based financing and development highlighted by our theory may arise also because the cost of acquiring information on distant investment opportunities decreases at later stages of development. For instance, accumulation of human capital or improvements in information and communication technologies may lead to a decrease in the cost of information acquisition that reinforces the negative association between relationship-based financing and development.

Our theory sheds light on the existing empirical evidence and offers new avenues for empirical research. At the macro level, the implications of our theory are consistent with empirical evidence showing that the relationship between a country's financial development and its economic growth is not uniform, but varies depending on the stage of development (Rioja and Valev, 2004). Financial development may be seen to capture the amount of finance allocated by financiers who collect information. At early stages of development, as we argue, financial development appears to have little or no effect on growth. The positive effect of financial development on growth is largest at intermediate stages of development.

At the micro level, our theory helps to put in context a variety of empirical studies that sometimes indicate that close relationships between entrepreneurs and financiers spur growth (as for instance Allen, Qian and Qian (2005) find for China or Lamoreaux (1996), Franks, Mayer and Rossi (2009) and Braggion (2011) document for the history of the US and the UK) and sometimes dub them as crony capitalism (e.g., La Porta, Lopez-de-Silanes and Zamarripa, 2003; Charumilind, Kali and Wiwattanakantang, 2006). Our model reveals that these are aspects of the same phenomenon. Empirically, we are unlikely to find that financiers allocate capital to low-quality connected entrepreneurs in countries in which institutions lower information acquisition costs. We expect to observe an inefficient allocation of investment only in financial systems with weak institutions, but at later stages of development. These implications are testable using long panel data for growing emerging economies or international micro data providing information on the allocation of credit and other forms of financing across countries at different stages of development.

Our model also implies that financiers in geographical areas or industrial sectors with strong growth opportunities and relatively scarce capital may spend a considerable amount of resources in identifying distant investment opportunities. These situations involve over-investment in information acquisition or, put differently, "too much" (distant) financing, and have been neglected in empirical research. An interesting avenue for future empirical research would be to explore whether under these conditions the formal financial system may indeed become too big and result in inefficiently high rents for financiers. For instance, a natural test building on the work of Philippon and Reshef (2007) would evaluate whether the premium of wages in the financial sector increases at times of high growth opportunities and whether such an increase is associated with a decrease of the share of the surplus appropriated by entrepreneurs.

More in general, we expect the geography and organization of financing to vary with an economy's capital endowment, quality of investment opportunities and institutions favoring information acquisition. An improvement along any of these parameters implies that local financial markets and social ties lose importance, while the economy's financial system becomes more tightly integrated and funding is allocated through a centralized market rather than by local financiers. These effects

could be tested exploring the returns obtained by financiers. These are expected to be highly dispersed if financial markets are segmented by search costs and to converge if information acquisition helps to partially overcome these costs. We believe that studying empirically these situations is an exciting area for future research.

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A Appendix

A Proof of Lemma 1

Here we show that Lemma 1 describes the equilibrium of the bargaining game and that no deviations from the strategies described in Lemma 1 are optimal. We discuss the game for $A^L \geq g(\omega)$. The reasoning is similar and follows readily for $A^L < g(\omega)$.

Consider the case in which the financier is first approached by an H entrepreneur. By bidding $\frac{A^L}{A^H} + \varepsilon$, where ε is infinitesimally larger than zero, the H entrepreneur can win at the first offer if the competing entrepreneur is L type. In fact, his bid guarantees the financier a return $A^L + A^H\varepsilon$, which is marginally larger than A^L, the maximum return the L entrepreneur can offer by bidding 1. Also note that any bid corresponding to a return below A^L cannot be an equilibrium because the competing entrepreneur can counter-offer with probability 1. Deviating and soliciting an offer from

the L entrepreneur would not guarantee the financier a higher payoff because the H entrepreneur continues to offer $\frac{A^L}{A^H} + \varepsilon$ and to wait and see whether a counteroffer arrives (revealing that the other entrepreneur is also type H). If the competing entrepreneur is H type, he can win by bidding 1. This leaves the entrepreneur who bids first with a payoff of zero (which is the same as the payoff from winning when competing with an H entrepreneur). Hence, bidding $\frac{A^L}{A^H} + \varepsilon$ is a weakly dominant strategy for an H entrepreneur who bids first. It guarantees financiers a return that is equivalent to the return of their second-best investment opportunity.

Now consider an L entrepreneur who bids first. Since the lowest return that the financier would accept is A^L, the L entrepreneur will bid 1. He receives funding and enjoys zero payoff if the competing entrepreneur is L type (and $g(\omega) \leq A^L$). The L entrepreneur is not funded if the competing entrepreneur is H type and can bid $\frac{A^L}{A^H} + \varepsilon$. Also in this case, the payoff of the L entrepreneur is zero.

This proves that a financier accepts the first offer that is equal to the return of her second-best investment opportunity. ■

B Proof of Proposition 1

When financiers do not acquire information, the maximum amount of capital that can be used to fund H entrepreneurs is $\alpha^H kI$. The capital of financiers who are not close to an H entrepreneur is $kI\left(1-\alpha^H\right)$. In equilibrium, entrepreneurs offer financiers at most the return of the general technology, which is equal to MPK in Proposition 1. When the capital endowment (kI) is so low that MPK is higher than the most productive entrepreneur $\left(g(kI) > A^H\right)$, no entrepreneur is funded. All financiers invest in the general technology and MPK is equal to $g(kI)$.

As kI rises, $g\left(kI\right)$ falls. When $g(kI) \leq A^H$, H entrepreneurs offer financiers a return that is equal to MPK. As long as $g\left(kI\left(1-\alpha^H\right)\right) > A^L$, MPK is still higher than the maximum return that L entrepreneurs can offer even if all capital of financiers who are not close to an H entrepreneur – $kI\left(1-\alpha^H\right)$ – is invested in the general technology. So for $\omega_H \leq kI < \frac{\omega_L}{1-\alpha^H}$, only H entrepreneurs receive funding.

For $g(kI) \leq A^H$ but $g\left(kI\left(1-\alpha^H\right)\right) > A^H$, if only the capital of financiers who are not close to an H entrepreneur were invested in the general technology, it would yield a return higher than A^H. In this case, even financiers who are close to H entrepreneurs find it optimal to allocate part of their capital endowment to the general technology up to the point that its productivity is equal to A^H. Specifically, these financiers allocate ω_1, where $0 < \omega_1 < kI\alpha^H$, to the general technology, and the rest $kI\alpha^H - \omega_1$ to H entrepreneurs. The total capital allocated to the general technology is thus $kI\left(1-\alpha^H\right)+\omega_1$. The MPK of the economy and financiers' equilibrium return is $g\left(kI\left(1-\alpha^H\right)+\omega_1\right) = A^H$.

If $A^L < g\left(kI\left(1-\alpha^H\right)\right) \leq A^H$, then $\omega_1 = 0$, and financiers who are close to H entrepreneurs allocate all their capital to H entrepreneurs. The MPK of the economy and the financiers' equilibrium return is now $g\left(kI\left(1-\alpha^H\right)\right) \in \left(A^L, A^H\right]$, which decreases in kI.

When $g\left(kI\left(1-\alpha^H\right)\right) < A^L$, in equilibrium, financiers allocate Ω_1, such that $g\left(\Omega_1\right) = A^L$, to the general technology, and $kI - \Omega_1$ to H and L entrepreneurs. Note that in equilibrium, the MPK of the economy, $g\left(\Omega_1\right)$, does not fall below A^L, because entrepreneurial projects have constant returns to scale.

The fraction of L entrepreneurs is $1-\alpha^H$; this implies that once $kI > \frac{\omega_L}{1-\alpha^H}$, the capital invested by L entrepreneurs is $\alpha^L\left(kI-\omega_L\right)$. ■

C Proof of Proposition 2

The main difference from the proof of Proposition 1 is that now at least some financiers can obtain a return that is higher than MPK. The following helps to prove Proposition 2. First, when all financiers acquire information to identify a distant entrepreneur by spending τ, the total capital available to invest is $kI-\tau I$. Second, a fraction $\left(1-\alpha^H\right)^2$ of financiers are close to an L entrepreneur and identify also a distant L entrepreneur through information acquisition. Therefore, the amount of capital that cannot be allocated to H entrepreneurs is $(kI-\tau I)\left(1-\alpha^H\right)^2$.

When the capital endowment kI is so low that the general technology has a return higher than the most productive entrepreneur $\left(g(kI-\tau I) > A^H\right)$, no entrepreneur is funded. All financiers

invest in the general technology and the MPK of the economy, which is equal to the financiers's equilibrium return, is $g(kI - \tau I)$.

If $g(kI - \tau I) \leq A^H$, as long as $g\left((kI - \tau I)\left(1 - \alpha^H\right)^2\right) > A^H$, the total capital from financiers who encounter both close and distant L entrepreneurs yields a return from investing in the general technology higher than A^H. Even financiers who can fund H entrepreneurs find it optimal to allocate part of their capital endowment to the general technology up to the point that the MPK is equal to A^H. In equilibrium, financiers obtain a return equal to MPK.

If $A^L < g\left((kI - \tau I)\left(1 - \alpha^H\right)^2\right) \leq A^H$, all financiers who do not identify an H entrepreneur fund the general technology. The fraction of financiers who provide funding to H entrepreneurs is $\left(\alpha^H\right)^2 + 2\alpha^H\left(1 - \alpha^H\right)$. In equilibrium, $MPK = g\left((kI - \tau I)\left(1 - \alpha^H\right)^2\right)$ and L entrepreneurs do not obtain funding because the highest return they can offer is lower than g.

Financiers' expected return is higher than MPK because with probability $\left(\alpha^H\right)^2$, a financier encounters both a close and a distant H entrepreneur and competition for capital forces H entrepreneurs to offer the financier return A^H. With probability of $2\alpha^H\left(1 - \alpha^H\right)$, one entrepreneur is type H and the other is type L; the H entrepreneur offers $MPK = g\left((kI - \tau I)\left(1 - \alpha^H\right)^2\right)$ and is funded. So the financiers' expected return is

$$\left(\alpha^H\right)^2 A^H + \left(1 - \left(\alpha^H\right)^2\right) g\left((kI - \tau I)\left(1 - \alpha^H\right)^2\right)$$

When kI rises further such that $g\left((kI - \tau I)\left(1 - \alpha^H\right)^2\right) < A^L$ (i.e., when $kI > \frac{\omega_L}{(1-\alpha^H)^2} + \tau I$), financiers allocate their capital between the general technology and H and L entrepreneurs such that in equilibrium, the MPK and the financiers' return is $g(.) = A^L$. In this case, both H and L entrepreneurs are funded.■

D Proof of Proposition 3

Let ω_2 be the total capital held by financiers who do not acquire information. Since each financier is endowed with capital k, the mass of financiers who acquire information is thus $I - \frac{\omega_2}{k}$.

In equilibrium, at least a subset of financiers acquire information and fund only H entrepreneurs if the payoff from doing so is at least as high as the payoff from not acquiring information. When a financier acquires information, with probability $\left(\alpha^H\right)^2$ she is close to an H entrepreneur and also identifies a distant H entrepreneur. Competition between the two entrepreneurs yields her a return A^H. With probability $1-\left(\alpha^H\right)^2$, she is only offered the second-best alternative, which is the return to the general technology (since we show below that L entrepreneurs are not funded in equilibrium, the return to the general technology must be bigger than A^L). Formally, information acquisition occurs if

$$\left(\left(\alpha^H\right)^2 A^H + \left(1-\left(\alpha^H\right)^2\right) g\left(\Omega_2\right)\right)(k-\tau) \geq g\left(\Omega_2\right) k \tag{1}$$

where Ω_2 is the capital invested into the general technology when $I-\frac{\omega_2}{k}$ financiers acquire information. Specifically,

$$\Omega_2 = \left(1-\alpha^H\right)\omega_2 + \left(1-\alpha^H\right)^2\left(I-\frac{\omega_2}{k}\right)(k-\tau). \tag{2}$$

Note that Ω_2 consists of two components. The first, $\left(1-\alpha^H\right)\omega_2$, is the capital invested into the general technology by those financiers who are close to L entrepreneurs and who *do not* acquire information, as the return to the general technology is higher than what L entrepreneurs can offer. By contrast, financiers who are close to H entrepreneurs and who *do not* acquire information invest in the connected H entrepreneurs. Second, among the $I-\frac{\omega_2}{k}$ financiers who acquire information by spending τ, a fraction $\left(1-\alpha^H\right)^2$ of them are close to L entrepreneurs and also identify a distant L entrepreneur. The capital invested by those financiers in the general technology is thus $\left(1-\alpha^H\right)^2\left(I-\frac{\omega_2}{k}\right)(k-\tau)$.

Condition (1) can be rewritten as

$$g\left(\Omega_2\right) \leq \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H, \tag{3}$$

and $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H < A^H$ for any $\tau > 0$. Intuitively, financiers can find it optimal to acquire information only if the return to the general technology is lower than A^H; otherwise, information acquisition would not affect their payoff.

If inequality (3) is weakly satisfied, then some but not all financiers acquire information ($\omega_2 > 0$). If inequality (3) is strictly satisfied, all financiers acquire information and $\omega_2 = 0$.

To characterize the interval of kI under which (3) holds, first consider $\omega_2 > 0$, which implies $g(\Omega_2) = \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H$, or

$$\left(1-\alpha^H\right)\omega_2 + \left(1-\alpha^H\right)^2\left(I - \frac{\omega_2}{k}\right)(k-\tau) = g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right) \tag{4}$$

(4) can be re-written as

$$I(k-\tau) = \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right) - \left(1-\alpha^H-\left(1-\alpha^H\right)^2\left(\frac{k-\tau}{k}\right)\right)\omega_2}{\left(1-\alpha^H\right)^2} < \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2} \tag{5}$$

for any $\omega_2 > 0$.

Lastly, with only H entrepreneurs being funded, L entrepreneurs cannot offer a return higher than the one of the general technology. Then $g(\Omega_2) = \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H > A^L$ can be written as

$$k - \tau > \frac{\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} \tag{6}$$

Combining (6) and (5), we obtain the condition for an equilibrium with information acquisition and funding of only H entrepreneurs:

$$\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} < I(k-\tau) < \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2}. \tag{7}$$

Next, consider $\omega_2 = 0$. In this case, $\Omega_2 = \left(1-\alpha^H\right)^2 I\left(k-\tau\right)$ and $g\left(\Omega_2\right) < \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H$. Together with $g\left(\Omega_2\right) > A^L$, we have

$$g^{-1}\left(\frac{\left(\alpha^H\right)^2\left(k-\tau\right)}{\tau+\left(\alpha^H\right)^2\left(k-\tau\right)}A^H\right) < \left(1-\alpha^H\right)^2 I\left(k-\tau\right) < \omega_L,$$

which is equivalent to

$$\frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2} < I\left(k-\tau\right) < \frac{\omega_L}{\left(1-\alpha^H\right)^2}. \tag{8}$$

The interval in (8) is well-defined as long as $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H > A^L$, which is equivalent to $I\left(k-\tau\right) > \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}$.

Combining (8) and (7), we conclude that, as stated in Proposition 3, at least some financiers acquire information and fund only H entrepreneurs if

$$\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} < I\left(k-\tau\right) < \frac{\omega_L}{\left(1-\alpha^H\right)^2}. \tag{9}$$

This equilibrium exists if the interval $\left(\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}, \frac{\omega_L}{\left(1-\alpha^H\right)^2}\right)$ is well defined. That is, if $\tau < \tau^* \equiv \frac{\omega_L}{I}\left(\frac{\alpha^H}{1-\alpha^H}\right)^2\left(\frac{A^H}{A^L}-1\right)$.

Lastly, we show that if financiers acquire information, then L entrepreneurs are not funded. In order for L entrepreneurs to receive funding, it must be that they can offer at least the return of the general technology. In particular, financiers who are close to an L entrepreneur and also identify a distant L entrepreneur through information acquisition are indifferent between investing in the general technology and funding the entrepreneurs if they earn return A^L. That is, if $A^L \geq g\left(\left(1-\alpha^H\right)^2 I\left(k-\tau\right)\right)$, which can be re-written as

$$kI > \frac{\omega_L}{\left(1-\alpha^H\right)^2} + I\tau. \tag{10}$$

This in turn implies that information acquisition is optimal. So all financiers acquire information and fund both H and L entrepreneurs if (10) holds. However, levels of kI satisfying (10) are ruled out under Assumption 1.

To establish whether L entrepreneurs obtain financing if $kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$, we reason as follows.

If $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < \frac{\omega_L}{1-\alpha^H}$, then some financiers find it optimal to acquire information for $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < kI < \frac{\omega_L}{1-\alpha^H}$, a level of capital endowment for which L entrepreneurs do not obtain financing even without information acquisition (Proposition 1). Note that $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < \frac{\omega_L}{1-\alpha^H}$ implies $\tau \leq \tau^{**} \equiv \frac{\omega_L}{I}\frac{(\alpha^H)^2}{1-\alpha^H}\left(\frac{A^H-A^L}{(\alpha^H)^2A^H+\left(1-(\alpha^H)^2A^L\right)}\right)$. This proves that for $\tau \leq \tau^{**}$, L entrepreneurs are never funded.

If instead $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau > \frac{\omega_L}{1-\alpha^H}$, or $\tau > \tau^{**}$, then for $\frac{\omega_L}{1-\alpha^H} < kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$, both H and L entrepreneurs receive financing (as follows from Proposition 1). That is, the capital invested into L entrepreneurs is $\left(1-\alpha^H\right)(kI-\omega_L)$ for $kI > \frac{\omega_L}{1-\alpha^H}$.

Once kI exceeds $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$, at least some financiers acquire information as long as $\tau < \tau^*$; in this case, L entrepreneurs stop receiving financing.■

E Proof of Corollary 1

The proof of Proposition 3 shows that when $\omega_2 > 0$, some, but not all, financiers acquire information about distant entrepreneurs. Solving for ω_2 from (4), we obtain the mass of financiers that *do not* acquire information:

$$\frac{\omega_2}{k} = \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right) - \left(1-\alpha^H\right)^2 I\left(k-\tau\right)}{\left(1-\alpha^H\right)^2\left(k-\tau\right)} = \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2\left(k-\tau\right)} - I \qquad (11)$$

Therefore, the mass of financiers that acquire costly information to investigate distant entre-

preneurs is:

$$I - \frac{\omega_2}{k} = 2I - \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2(k-\tau)} \tag{12}$$

Since both $g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)$ and $\frac{1}{(1-\alpha^H)^2(k-\tau)}$ decrease in k, their product, $\frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{(1-\alpha^H)^2(k-\tau)}$, decreases in k. Thus (12) increases in k.

Lastly, when $\omega_2 = 0$, which requires $kI > \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2} + I\tau$ (i.e., condition (8) holds), all financiers acquire information.

Setting $\widehat{\omega} \equiv g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)$, this proves Corollary 1.■

F Proof of Proposition 4

The proof of Proposition 4 follows readily from Proposition 1 and Proposition 2, where MPK with information-based financing is at least as large as MPK with relationship-based financing. Furthermore, financiers earn a return identical to MPK with relationship-based financing, but at least as high as MPK with information-based financing.■

G Proof of Proposition 5

The negative rent effect of information acquisition on entrepreneurs' payoffs follows from the positive effect of information acquisition on financiers' payoffs in Proposition 4. However, information acquisition also increases the supply of capital for entrepreneurs. The net effect on entrepreneurs' payoffs is ambiguous because it depends on the relative magnitude of these two effects.

The positive capital supply effect can be easily seen as follows. Proposition 3 indicates that H entrepreneurs are the only recipient of financing when financiers acquire information. By contrast, L entrepreneurs obtain funding if $kI > \frac{\omega_L}{1-\alpha^H}$ (Proposition 1). This means that for $\frac{\omega_L}{1-\alpha^H} < kI < \frac{\omega_L}{(1-\alpha^H)^2} + I\tau$, H entrepreneurs can invest more if financiers acquire information. This in turn may

compensate the lower rent per unit of capital invested.

The proof of Corollary 2 provides precise conditions under which the rent effect dominates the capital supply effect.■

H Proof of Corollary 2

We compare the payoffs of H entrepreneurs in a relationship-based capital allocation and in an information-based allocation. First, we compute the expected payoff of an H entrepreneur with information-based financing, which from Proposition 3 we know emerges for $kI > \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$ and $\tau \leq \tau^*$.

When financiers do not acquire information, or when financiers acquire information but do not discover a distant H entrepreneur, an H entrepreneur's rent per unit capital invested is $A^H - g(\Omega_2)$, where Ω_2 is given in (2). The rent per unit of capital invested is zero if financiers encounter both close and distant H entrepreneurs.

In an economy with N entrepreneurs and $I - \frac{\omega_2}{k}$ financiers acquiring information, each H entrepreneur attracts $\frac{\omega_2}{N}$ unit of capital from (close) financiers who do not acquire information. Each H entrepreneur also attracts $\frac{(k-\tau)\left(I-\frac{\omega_2}{k}\right)}{\frac{N}{2}}$ unit of capital from financiers who acquire information and enjoy a positive rent with probability $1-\alpha^H$ (i.e., if the financier does not discover another H entrepreneur). The 2 at the denominator takes into account that when some financiers acquire information the world is segmented in $\frac{N}{2}$ markets. With probability α^H, the financier discovers another H entrepreneur. Thus, whether the entrepreneur attracts the financiers' capital or not, the entrepreneur's rent on that portion of capital invested is zero. Therefore, the expected payoff of an H entrepreneur with information-based financing is:

$$\left(A^H - g(\Omega_2)\right)\left(\frac{\omega_2}{N} + \left(1-\alpha^H\right)\frac{2(k-\tau)\left(I-\frac{\omega_2}{k}\right)}{N}\right) \tag{13}$$

Next, we compute the expected payoff of an H entrepreneur with relationship-based financing. Since there are N entrepreneurs in an economy with capital endowment kI, each H entrepreneur

attracts $\frac{kI}{N}$ unit of capital. From the proof of Proposition 1, for $\omega_H < kI < \frac{\omega_L}{1-A^H}$, H entrepreneurs can offer the financiers the return of the general technology: $g\left(kI\left(1-\alpha^H\right)+\omega_1\right)$. Since $g\left(kI\left(1-\alpha^H\right)+\omega_1\right) = A^H$ if $\omega_1 > 0$ and $A^L < g\left(kI\left(1-\alpha^H\right)+\omega_1\right) < A^H$ if $\omega_1 = 0$, for $\frac{\omega_H}{(1-\alpha^H)} < kI < \frac{\omega_L}{1-A^H}$, H entrepreneurs expect a (positive) payoff:

$$\left(A^H - g\left(kI\left(1-\alpha^H\right)\right)\right)\frac{kI}{N} \tag{14}$$

When $kI > \frac{\omega_L}{1-A^H}$, even L entrepreneurs can attract funding, and each H entrepreneur can offer the second-best alternative return, in this case, the return to L entrepreneurs. Therefore, H entrepreneurs' expected payoff is:

$$\left(A^H - A^L\right)\frac{kI}{N} \tag{15}$$

H entrepreneurs prefer relationship-based financing over information-based financing if (14) > (13), or if (15) > (13). Consider the former condition ((14) > (13)) which is equivalent to

$$\left(\frac{A^H - g\left(\Omega_2\right)}{A^H - g\left(kI\left(1-\alpha^H\right)\right)}\right)\left(\frac{2\left(k-\tau\right)\left(I-\frac{\omega_2}{k}\right)\left(1-\alpha^H\right)+\omega_2}{kI}\right) \leq 1. \tag{16}$$

The first component of the left hand side of (16) is always less than 1 as long as $g\left(\Omega_2\right) > g\left(kI\left(1-\alpha^H\right)\right)$. Note that requiring $g\left(\Omega_2\right) > g\left(kI\left(1-\alpha^H\right)\right)$ is the same as requiring $\Omega_2 = \left(1-\alpha^H\right)\omega_2 + \left(1-\alpha^H\right)^2\left(I-\frac{\omega_2}{k}\right)\left(k-\tau\right) \leq kI\left(1-\alpha^H\right)$, or equivalently,

$$\omega_2 + \left(1-\alpha^H\right)\left(I-\frac{\omega_2}{k}\right)\left(k-\tau\right) \leq kI \tag{17}$$

(17) is satisfied as:

$$\begin{aligned}\omega_2\left(1-\left(1-\alpha^H\right)\frac{k-\tau}{k}\right)+\left(1-\alpha^H\right)I\left(k-\tau\right) &\leq kI\left(1-\left(1-\alpha^H\right)\frac{k-\tau}{k}\right)+\left(1-\alpha^H\right)I\left(k-\tau\right)\\ &\leq kI\end{aligned}$$

The second component of the left hand side of (16) is less than 1 if $2\left(k-\tau\right)\left(I-\frac{\omega_2}{k}\right)\left(1-\alpha^H\right)+\omega_2<kI$, which can be rewritten as $2\left(1-\alpha^H\right)\left(k-\tau\right)\left(I-\frac{\omega_2}{k}\right)<k\left(I-\frac{\omega_2}{k}\right)$. The latter in turn is always satisfied if $\alpha^H\geq\frac{1}{2}$.

H entrepreneurs prefer relationship-based financing also if (15) > (13), which is equivalent to $\left(\frac{A^H-g(\Omega_2)}{A^H-A^L}\right)\left(\frac{2(k-\tau)\left(I-\frac{\omega_2}{k}\right)\left(1-\alpha^H\right)+\omega_2}{kI}\right)\leq 1$. The first component is always less than 1 because Proposition 3 implies that $g\left(\Omega_2\right)>A^L$. The second component has already been shown to be less than 1 if $\alpha^H\geq\frac{1}{2}$.

Therefore, if $\alpha^H\geq\frac{1}{2}$, an H entrepreneur always prefers a relationship-based capital allocation to the capital allocation based on information acquisition.■

I Proof of Proposition 6

In equilibrium, there is under-investment in information acquisition if information acquisition would increase the output but a relationship-based capital allocation prevails. We now derive the conditions under which this occurs.

Let $M\leq I$ be the mass of financiers acquiring information. Consider $\tau>\tau^{**}$. Proposition 3 indicates that for $\frac{\omega_L}{1-\alpha^H}<kI<\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$, relationship-based financing prevails and financiers who are close to L entrepreneurs fund L entrepreneurs. The average productivity of these entrepreneurs is A^L. With information acquisition, a fraction α^H of financiers who are close to L entrepreneurs identify and fund H entrepreneurs, whose productivity is A^H. The social gain of information acquisition is therefore $\left(\left(1-\alpha^H\right)kM\right)\alpha^H(A^H-A^L)$. Since the aggregate cost of information acquisition is τM, information acquisition improves social welfare if and only if $\left(\left(1-\alpha^H\right)k\right)\alpha^H(A^H-A^L)>\tau$, or

$$kI>\frac{\tau I}{\left(1-\alpha^H\right)\alpha^H(A^H-A^L)} \tag{18}$$

This implies that under-investment in information acquisition occurs for $\frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-A^L)}<kI<\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$ as long as the interval is well defined. This is more likely if α^H is relatively

small. Also $\tau > \tau^{**}$ is more likely to hold for a small α^H.

Now consider $\tau > \tau^*$, which is also is more likely to hold for a small α^H. In this case, information acquisition never emerges in equilibrium. Thus there is under-investment in information acquisition if $kI > \frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-A^L)}$.

Thus, an equilibrium with under-investment in information acquisition exists if kI is sufficiently large as requested by (18) and α^H is relatively small.■

J Proof of Proposition 7

In equilibrium, there is over-investment in information acquisition if financiers acquire information even though this leads to a lower output net of information acquisition costs than a relationship-based capital allocation. We now derive conditions under which this occurs.

Consider $\tau < \tau^{**}$. Proposition 3 indicates that for $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < kI < \frac{\omega_L}{1-\alpha^H}$, at least some financiers acquire information and fund only H entrepreneurs. In particular, financiers who are close to an L entrepreneur and who, by acquiring information, identify an H entrepreneur, can invest in a project with productivity A^H. If instead, financiers do not acquire information, those who are close to an L entrepreneur invest in the general technology, which generates an average return of $g\left(\left(1-\alpha^H\right)kI\right)$. Hence, the social gain from information acquisition is $\left(\left(1-\alpha^H\right)kM\right)\alpha^H(A^H - g\left(\left(1-\alpha^H\right)kI\right))$. Since the aggregate cost of information acquisition is τM, information acquisition reduces social welfare if $\left(\left(1-\alpha^H\right)k\right)\alpha^H\left(A^H - g\left(\left(1-\alpha^H\right)kI\right)\right) < \tau$, or

$$k < \frac{\tau}{\left(1-\alpha^H\right)\alpha^H\left(A^H - g\left(\left(1-\alpha^H\right)kI\right)\right)}. \tag{19}$$

Together with $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < kI < \frac{\omega_L}{1-\alpha^H}$, this implies that over-investment in information acquisition exists for

$$\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} + I\tau < kI < \min\left(\frac{\tau I}{\left(1-\alpha^H\right)\alpha^H\left(A^H - g\left(\left(1-\alpha^H\right)kI\right)\right)}, \frac{\omega_L}{1-\alpha^H}\right)$$

as long as the interval is well defined.

Note that under $\tau < \tau^{**}$, $g\left(\left(1-\alpha^H\right)kI\right) > A^L$. Then $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau < \frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-g((1-\alpha^H)kI))}$ is more likely to hold if α^H is large. It is also straight forward that $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < \frac{\omega_L}{1-\alpha^H}$ is more likely to hold if α^H is large.

To summarize, over-investment in information acquisition is more likely to occur if α^H is relatively large and kI relatively low (i.e., $kI < \min\left(\frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-g((1-\alpha^H)kI))}, \frac{\omega_L}{1-\alpha^H}\right)$).■

K Private Benefits Extension

We discuss how private benefits affect a financier expected returns under different scenarios to demonstrate that incentives to acquire information do not change.

If financiers acquire information, four scenarios may occur:

1. A financier is close to an H entrepreneur, and identifies a distant H entrepreneur through information acquisition. To attract capital, the close H entrepreneur offers $A^H - b$ and the distant one offers A^H. The financier's return, inclusive of private benefits, is A^H and the close H entrepreneur is funded.[13]

2. A financier is close to an H entrepreneur, and identifies a distant L entrepreneur through information acquisition. To attract capital, the close H entrepreneur offers $g(\Omega_2) - b$ as long as $g(\Omega_2) - b \leq A^H$. The financier's return is thus $\min\left(A^H, g(\Omega_2)\right)$. The close H entrepreneur is funded if $g(\Omega_2) - b \leq A^H$. Otherwise, the financier invests in the general technology.

3. A financier is close to an L entrepreneur, and identifies a distant H entrepreneur through information acquisition. To attract capital, the distant H entrepreneur offers $\min\left(A^H, g(\Omega_2)\right)$ and the financier's return is thus $\min\left(A^H, g(\Omega_2)\right)$. The distant H entrepreneur is funded.

4. A financier is close to an L entrepreneur, and identifies a distant L entrepreneur through information acquisition. The financier invests in the general technology if $g(\Omega_2) > A^L + b$.

[13] This is because the close H entrepreneur can always offer $A^H - b + \varepsilon$ (so that the financier gets $A^H + \varepsilon$) to outbid the distant H entrepreneur who can only offer at most A^H.

A financier will acquire information if and only if doing so generates higher payoff than investing costlessly in the general technology:

$$\left(\left(\alpha^H\right)^2 A^H + 2\alpha^H\left(1-\alpha^H\right)\min\left(A^H, g\left(\Omega_2\right)\right) + \left(1-\alpha^H\right)^2 g\left(\Omega_2\right)\right)(k-\tau) \geq g\left(\Omega_2\right)k \qquad (20)$$

Clearly, $\min\left(A^H, g\left(\Omega_2\right)\right) = A^H$ will never satisfy the expression (20) because the left hand side of (20) then becomes

$$\left(\left(\alpha^H\right)^2 A^H + 2\alpha^H\left(1-\alpha^H\right)A^H + \left(1-\alpha^H\right)^2 g\left(\Omega_2\right)\right)(k-\tau) < g\left(\Omega_2\right)(k-\tau) < g\left(\Omega_2\right)k \quad (21)$$

This means that a financier acquires information and (20) holds only when $A^H > g\left(\Omega_2\right)$.

In this case, the expression (20) becomes

$$\left(\left(\alpha^H\right)^2 A^H + \left(1-\left(\alpha^H\right)^2\right)g\left(\Omega_2\right)\right)(k-\tau) \geq g\left(\Omega_2\right)k \qquad (22)$$

This expression is identical to condition (1) in the proof of Proposition 3. This implies that incentives to acquire information are unaffected.

However, financiers have stronger incentives to fund L entrepreneurs even if they acquire information. If $A^L + b \geq g\left(\left(1-\alpha^H\right)^2 I\left(k-\tau\right)\right)$, L entrepreneurs are funded. This can be rewritten as:

$$kI > \frac{g^{-1}\left(A^L+b\right)}{\left(1-\alpha^H\right)^2} + I\tau.$$

Thus, under Assumption 1, financiers acquire information and fund also close L entrepreneurs if $\frac{g^{-1}\left(A^L+b\right)}{\left(1-\alpha^H\right)^2} + I\tau < kI < \frac{\omega_L}{\left(1-\alpha^H\right)^2} + I\tau$.■

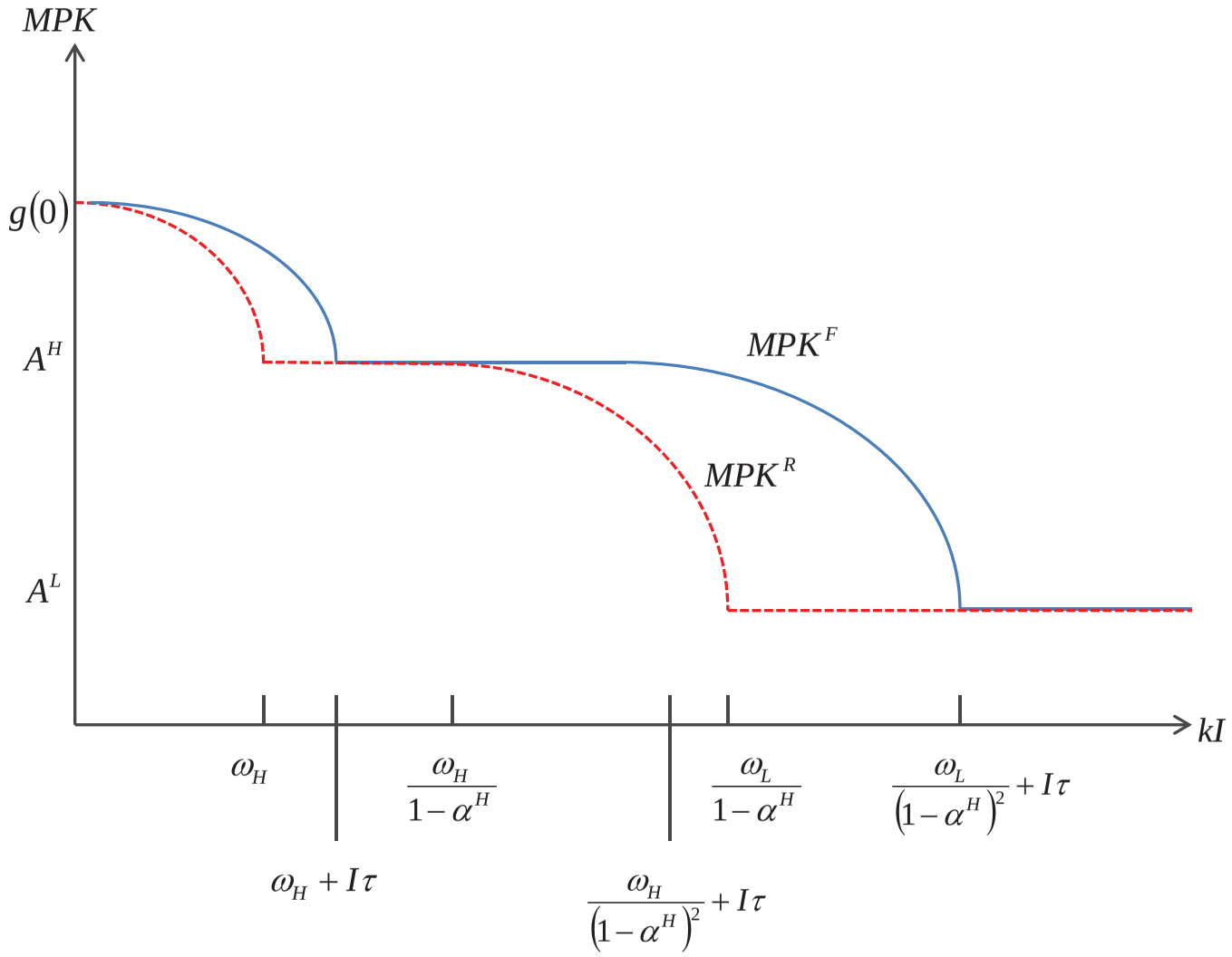


Figure 1.
This figure describes the marginal productivity of capital (*MPK*) under relationship-based financing (MPK^R) and formal financing (MPK^F). We set $\omega_H \equiv g^{-1}(A^H)$ and $\omega_L \equiv g^{-1}(A^L)$.

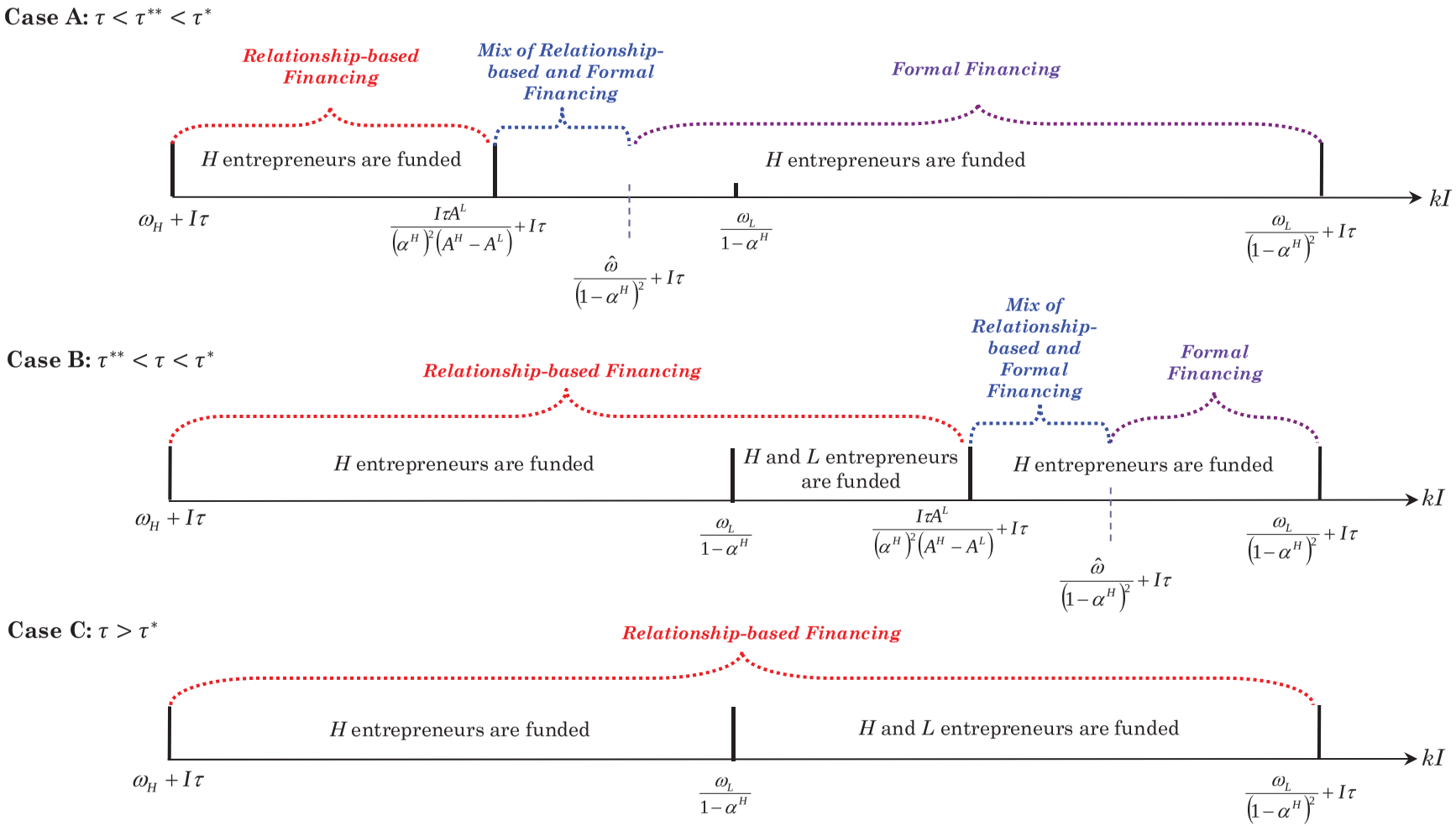
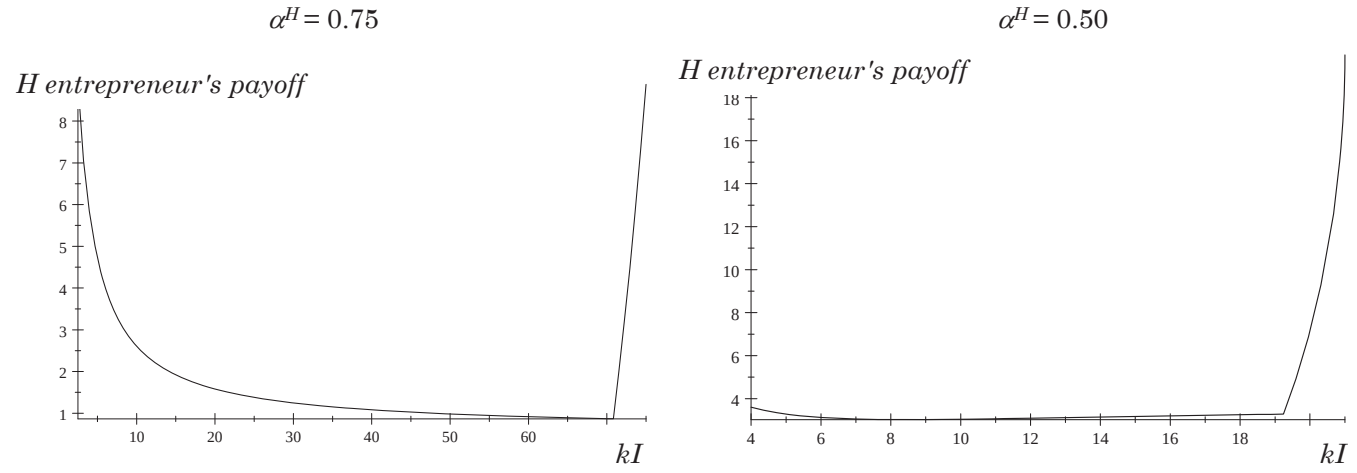


Figure 2.
This figure describes the equilibrium capital allocation for different levels of the capital endowment (kI) and the cost of information acquisition τ, as described in Proposition 3. Case A refers to $\tau < \tau^{**}$. Case B refers to $\tau^{**} < \tau < \tau^{*}$. Case C refers to $\tau > \tau^{*}$. We set $\omega_H \equiv g^{-1}(A^H)$, $\omega_L \equiv g^{-1}(A^L)$, and $\hat{\omega} \equiv \frac{g^{-1}\left(\frac{(\alpha^H)^2(k-\tau)}{\tau+(\alpha^H)^2(k-\tau)}A^H\right)}{(1-\alpha^H)^2}$.

Panel A



Panel B

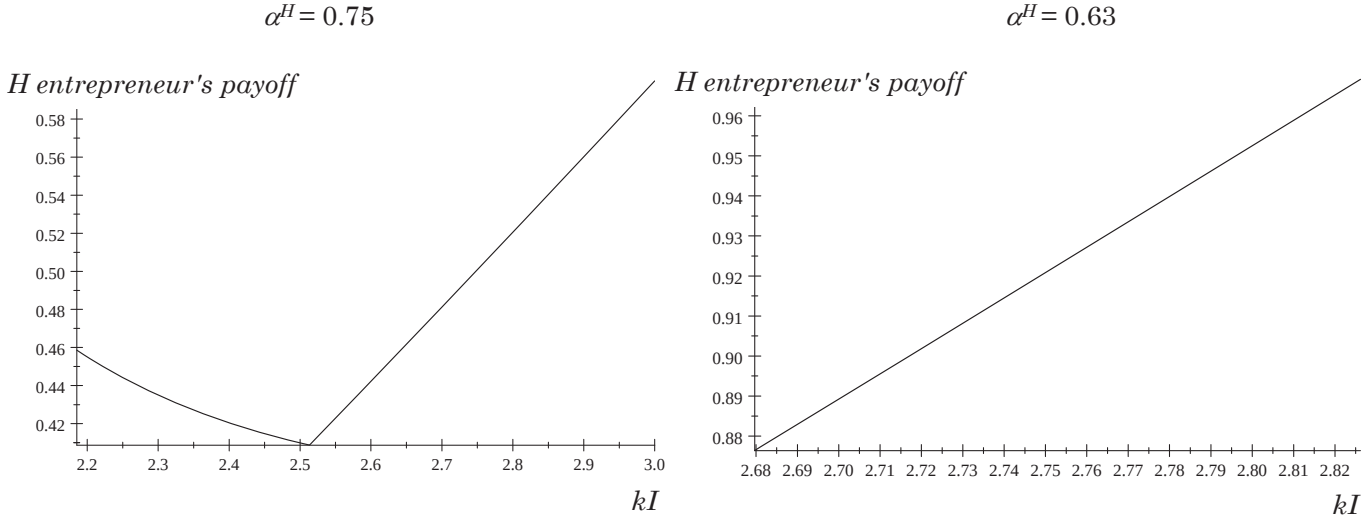


Figure 3. *H* entrepreneur's payoff when financiers acquire information and fund only *H* entrepreneurs

We represent an H entrepreneur's expected payoff as a function of the capital endowment (kI) in the equilibrium in which information acquisition occurs at an early stage of development.

Panel A

We make the following assumptions on functional forms and parameters: $g(\omega) = \sqrt{100 - \omega^2}$, $A^H = 5$, $A^L = 2$, $N = 10$, and $I = 2$.

Panel B

We make the following assumptions on functional forms and parameters: $g(\omega) = \omega^{-0.5}$, $A^H = 5$, $A^L = 2$, $N = 10$, and $I = 2$.

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