Connections and Information Acquisition in Capital Allocation*

Mariassunta Giannetti
Stockholm School of Economics,
CEPR and ECGI
mariassunta.giannetti@hhs.se

Xiaoyun Yu
Kelley School of Business
Indiana University
xiyu@indiana.edu

May 2009

*This paper was previously circulated under the title "Favoritism or Markets in Capital Allocation?" We thank Franklin Allen, Utpal Bhattacharya, Philip Bond, Brian Bucks, Chun Chang, Todd Gormley, Denis Gromb, Dalida Kadyrzhanova, Chandra Kanodia, Diana Knyazeva, Ross Levine, Matej Marinc, John McConnell, Giovanna Nicodano, Marco Pagano, Paul Povel, Raj Singh, Javier Suarez, Tan Wang, Andy Winton, and seminar participants at the AFA (San Francisco), Bocconi University, the EFA (Ljubljana), the RICAFE2 Conference (Amsterdam), the Stockholm School of Economics, the Indian School of Business Summer Research Conference in Finance (Hyderabad), the Conference on Corporate Governance in Family/Unlisted Firms (Thun), the CEPR/Studienzentrum European Summer Symposium in Financial Markets (Gerzensee), the Conference on The Changing Geography of Banking (Ancona), the ECB Conference on Financial System Modernization and Economic Growth in Europe (Berlin), the European Winter Finance Conference (Andermatt), the 17th Annual Financial Economics and Accounting Conference (Atlanta), the University of Frankfurt, and the MIT/Tsinghua University China International Conference in Finance (Chengdu) for valuable comments. This paper was started when Yu was visiting the Swedish Institute for Financial Research, which we thank for the generous hospitality. Giannetti also acknowledges financial support from the Swedish National Science Foundation (Vetenskapprådet), the Jan Wallander and Tom Hedelius Foundation and the European Commission (grant CIT5-CT-2006-028942).

Abstract

We investigate to what extent, depending on the level of development, financiers allocate capital on the basis of prior connections, instead of collecting information on the productivity of several potential entrepreneurs. We explore the effects of information acquisition (or the lack thereof) on investment efficiency, financiers' returns and entrepreneurial rents and show that there may be both under-investment and over-investment in information acquisition. Our results have implications for the desirability of formal financial markets, connected lending, and the characteristics of markets that are more likely to attract entrepreneurs' capital raising activities.

Keywords: Finance and growth; Information acquisition; Competition for capital; Connection-based vs. market based financial systems.

JEL Codes: G3; O16

I Introduction

The main function of a financial system is to facilitate capital flows from individual savers to the highest return investments (Levine, 2006). Information acquisition about new potential entrepreneurs is believed to be crucial for achieving this goal. However, the empirical evidence shows that financial intermediaries often convey funds to their cronies (La Porta, Lopez-de-Silanes and Zamarripa, 2003); that entrepreneurs reinvest funds in their own businesses or in those of family members (Almeida and Wolfenzon, 2006); and that a large number of firms around the world choose not to be listed on a stock market but raise capital only from a narrow circle of family and friends (Pagano, Panetta and Zingales, 1998). Thus, it appears that social ties help to explain investment behavior, especially in developing countries (Banerjee and Munshi, 2004) and that capital allocation is driven more by prior connections than by information on future expected returns.

In this paper, we explore to what extent, depending on the level of development, financiers allocate capital on the basis of prior connections, instead of collecting information on the productivity of several potential entrepreneurs. We investigate the implications of information acquisition (or the lack thereof) for investment efficiency, financiers' returns and entrepreneurial rents and show that there may be both under-investment and over-investment in information acquisition.

When initial capital is low, 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.

For intermediate levels of initial capital, when the average quality of entrepreneurs is high, some financiers acquire information because they are likely to identify several high quality entrepreneurs and to be able to pretend high returns. As a consequence, capital is invested by higher productivity entrepreneurs, but the economy's aggregate 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.

When initial capital is even higher, the marginal return from investing in traditional activities is low. Without information acquisition, financiers lacking alternative investment opportunities fund close entrepreneurs even if they have low productivity and high-productivity entrepreneurs under-invest. In this situation, information acquisition increases the economy's aggregate output.

However, if the average quality of potential entrepreneurs is low, financiers' expected benefit from information acquisition does not compensate the cost; therefore, financiers fund only connected entrepreneurs even if they have low productivity.

Our results are consistent with empirical evidence showing that 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., connections) may be preferable to formal financial markets (i.e., information acquisition) in emerging economies and that only at later stages of development, formal capital markets are 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 to attract 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 gain from attracting distant financiers increases, entrepreneurs are willing to renounce to some rents in order to invest more.

Finally, our model implies that the average quality of entrepreneurs raising capital – which may be interpreted as the effect of institutional arrangements such as listing standards – affects competition for capital even in an economy in which any amount of capital can be invested at

the highest possible return. If the average quality of entrepreneurs goes down, it becomes harder for financiers to identify several high quality entrepreneurs. Thus, financiers have limited outside options and receive lower returns. This may weaken financiers' incentives to acquire information. The effect on entrepreneurial rents is ambiguous depending on whether the capital supply effect or the rent effect prevail.

In economies with mature markets, in which all financiers acquire information, an increase in the average quality of entrepreneurs unambiguously decreases entrepreneurial rents by boosting competition for capital. This mechanism provides an alternative explanation for why underpricing (a measure of financiers' returns) is higher during "hot markets", when there is a large number of IPOs and the average quality of firms raising capital is expected to be high. Additionally, our results shed light on why firms abandon markets where disclosure and listing standards have become too demanding, as is currently happening in the United States.

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). The most of the literature focuses on the economic roles of financial intermediaries. Instead, we abstract from whether capital is allocated through intermediaries or directly by investors and investigate when financiers move away from allocating capital on the basis of connections. In this respect, we contribute to the literature on connection-based vs. market-oriented financial systems (see Rajan and Zingales, 2003) by showing 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.

In our model, information acquisition allows financiers to engage in winner-picking, similarly to headquarters in internal capital markets (Stein, 1997). Differently from Stein, however, we endogenously model the incentives to produce information and analyze the general equilibrium implications of the "winner-picking" effect. 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 also if financiers do not have an incentive to investigate several potential entrepreneurs. Additionally, we explore the conditions under which financiers have incentives to produce information, the consequences on financiers' equilibrium return to investment, and entrepreneurial rents.

The rest of the paper is organized as follows. Section II describes the model. Sections III through VI present the results. Sections VII and VIII provide some extensions and empirical evidence. Section IX concludes. All proofs are in the Appendix.

II The Model

We consider an economy with two types of risk neutral agents: a number N of penniless entrepreneurs and a continuum I of financiers.

A Financiers

Each financier is endowed with initial capital $k > 0$. Hence, the total initial capital (saving) of the economy is kI. Financiers can fund the entrepreneurs or the general technology up to their endowment.

An entrepreneur can be either "close" or "distant" to a financier. An entrepreneur is close because of geographical proximity or personal connections. We model closeness from the perspective of the *ex ante* information acquisition and normalize other costs (such as monitoring costs) to zero. In particular, we assume that financiers are aware of close entrepreneurs and can evaluate their type at no cost.

To be able to fund a distant entrepreneur, financiers 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. Spending τ is thus necessary not only to distinguish between real entrepreneurs, which we describe in the next section, and an infinite number of impostors who would just run away with the money, but also to observe the type of distant entrepreneurs. In this way, we capture that expanding the investment horizon beyond one's own neighborhood entails a cost. It will be clear later that spending τ also involves benefits.[1]

[1] 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

All financiers can invest in a general technology, described in the next subsection, at no cost.

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. Exogenous private benefits can, however, be easily incorporated in our model as their effect is equivalent to increasing the cost of information acquisition.

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 alternatives. Henceforth, we refer to such a situation as *connection-based financing*. Alternatively, a financier may acquire information about some distant entrepreneurs and consider funding them. We label such a situation as *information-acquisition-based financing*.

Financiers who allocate capital on the basis of prior connections 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 and 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.

For tractability, we make the following assumptions. First, each financier has only one close entrepreneur and evaluates at most one distant entrepreneur.[2] Second, if financiers evaluate a distant entrepreneur, all financiers close to entrepreneur i evaluate the same entrepreneur j (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).

(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 whose size is constrained by overload problems.

[2] The mechanisms we illustrate generalize readily if financiers acquire information about a finite number of distant entrepreneurs or if there are many close entrepreneurs with limited investment capacity.

B Entrepreneurs and Technologies

Each entrepreneur is endowed with a project. Projects are new ideas with different productivities. For simplicity, we assume that entrepreneurial projects have a constant return to scale technology with productivity A^H or A^L, where $A^H \geq A^L$. Productivity defines the entrepreneur's type. The fraction of H (L) entrepreneurs is α^H $(1-\alpha^H)$. 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. His payoff is zero if he does not receive funding.

All entrepreneurs have the same mass of close financiers and compete to attract capital from close and distant financiers who are aware of them. Entrepreneurs bid sequentially by offering a fraction of the output produced per unit of capital invested. We assume that entrepreneurs can discriminate between financiers with different evaluation strategies.[3]

The assumption that financiers are offered differential treatment is likely to be satisfied at early stages of development as there are few market participants and their identities are well known to entrepreneurs. This assumption also finds support in the empirical evidence on the IPO process. Institutional investors that are part of an underwriter's network are expected to participate repeatedly and indiscriminately to deals and to contribute to information production. In exchange for this commitment, these investors are allocated stocks in the pre-IPO market at a better price than retail investors and other institutional investors that are not part of the network (who can buy stocks only at the first day trading price).[4]

The bargaining game between an entrepreneur and a financier is as follows: An entrepreneur is randomly selected to make the first offer which is observed by other entrepreneurs and all financiers who are aware of the entrepreneur. Other entrepreneurs can counter-offer. The game ends when the financier accepts an offer. As we show in the Appendix, in equilibrium, entrepreneurs end up offering a return that is at most equal to the return of the alternative investment opportunities available to the financier. Thus, the outcome of the multi-period bargaining is the same of (one-period) Bertrand competition with symmetric information. For this reason, to simplify the exposition, in what follows, we often write that entrepreneurs offer financiers a return per unit of capital invested.

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

[4] The discretionary allocation of IPOs to institutional investors is believed to promote information production (Ljungqvist and Wilhelm, 2002).

Similarly to Almeida and Wolfenzon (2005 and 2006), all financiers can invest in a general technology, which provides a return per unit of capital invested $g(\omega)$, where ω is the aggregate capital invested. This general technology captures any well-known activities that do not require new entrepreneurial skills (e.g., agriculture and any traditional sector in which innovation is not important). 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.

Our assumptions aim to capture that any amount of capital can be invested with high return if the financial system allows investors to identify and fund new entrepreneurial ideas; if the financial system fails to spur information acquisition and the most of the activities that are funded are well-known, however, the marginal productivity of capital decreases. In this context, we explore the different financial arrangements that may emerge in equilibrium and their desirability depending on the level of the initial capital, which captures the economy's stage of development.[5]

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 should information acquisition occur, financiers decide how to allocate their capital between 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:*

[5] As is common in growth models, we assume that the technology (production functions) do not change with development.

[6] In this way, financiers are equal when we analyze their decision to acquire information. This assumption does not affect the 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 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 output (return) that maximizes their payoffs;*
- *Financiers allocate their initial capital 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;*
- *At given returns, all financiers who wish to fund a given entrepreneur or the general technology do so.*

III Costless Information about Distant Entrepreneurs

We first describe the equilibrium if evaluating a distant entrepreneur involves no cost ($\tau = 0$). Financiers can thus identify and fund all H entrepreneurs, regardless of whether they are close or distant. Since financiers have access to all investment opportunities, there are no market segmentations. The resulting capital allocation represents the first best that the economy can achieve.

In equilibrium, L entrepreneurs are never funded. When the economy's initial capital (kI) is lower than $g^{-1}\left(A^H\right)$, even H entrepreneurs are not funded. This is because for such low levels of initial capital, the general technology can employ all capital and yet generate a return higher than A^H – the highest possible return an entrepreneur can offer.

When the initial capital exceeds the threshold $g^{-1}\left(A^H\right)$, the return of the general technology falls to A^H, and H entrepreneurs receive funding from close and distant financiers. Since entrepreneurs compete to attract capital, they end up offering return A^H per unit of capital invested. The return to investment is never lower than A^H.[7]

Definition 2 *A capital allocation is efficient if the average productivity of capital is at least A^H.*

[7] Since the general technology and the entrepreneurial investment opportunities are linear, average and marginal returns to capital are equal. Therefore, we use "average" and "marginal" returns interchangeably.

A capital allocation is efficient if (1) L entrepreneurs do not receive funding, and (2) investment in the general technology is less than or equal to $g^{-1}\left(A^H\right)$. This is because any amount of capital can be employed at A^H with a constant return to scale entrepreneurial technology. Hence, when the initial capital exceeds $g^{-1}\left(A^H\right)$, ω_0 such that $g\left(\omega_0\right) = A^H$ is invested in the general technology, whereas H entrepreneurs attract the rest of the capital, $kI - g^{-1}\left(A^H\right)$. On average, each of them invests $\frac{kI - g^{-1}\left(A^H\right)}{\alpha^H N}$.

For $\tau > 0$, the capital allocated to H entrepreneurs may be lower than $\frac{kI - g^{-1}\left(A^H\right)}{\alpha^H N}$ in equilibrium because financiers over-invest in the general technology and because they fund L entrepreneurs. The distance between $\frac{kI - g^{-1}\left(A^H\right)}{\alpha^H N}$ and the average investment of H entrepreneurs therefore captures the deviation from the efficient capital allocation.

IV Connection-based Capital Allocation

We now explore how capital is allocated when information acquisition is costly. In this section, we characterize the equilibrium in which financiers do not acquire information about distant entrepreneurs and invest only in the close entrepreneur or the general technology. This describes the equilibrium in the game subtree in which capital is allocated only on the basis of prior connections.[8] In the next section, we derive conditions under which at least some financiers find it optimal to acquire information.

The following proposition states the conditions under which different types of entrepreneurs are funded.

Proposition 1 *Suppose that financiers do not invest in information acquisition.*

- *Then, in equilibrium,*

  1. *if* $kI < g^{-1}\left(A^H\right)$*, no entrepreneur is ever funded and financiers' return to capital is* $g(kI)$*;*
  2. *if* $g^{-1}\left(A^H\right) \leq kI < \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$*, only* H *entrepreneurs are funded;*
  3. *if* $kI \geq \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$*, both types of entrepreneurs are funded.*

[8] This also describes the equilibrium of the model if $\tau \to \infty$.

- *Financiers' equilibrium return decreases in kI for* $kI \leq \frac{g^{-1}(A^L)}{1-\alpha^H}$ *and is* A^L *for* $kI > \frac{g^{-1}(A^L)}{1-\alpha^H}$.

Case A of Figure 1 summarizes the equilibrium outcomes for different levels of initial capital. When financiers do not acquire information, entrepreneurs face no competition for capital from other entrepreneurs and offer financiers at most the return of the general technology (g). If the initial capital is small, the general technology attracts all capital because of its high return. No entrepreneur receives funding. Investment decisions are identical to the ones observed with costless information. Hence, capital allocation is efficient.

As the amount of capital grows, the return to the general technology decreases; H entrepreneurs can thus attract capital by offering return g. As long as the initial capital is lower than $\frac{g^{-1}(A^L)}{1-\alpha^H}$, the marginal return of the general technology remains higher than A^L. Since L entrepreneurs cannot offer the return of the general technology, they are not funded. Only when the economy's initial capital exceeds $\frac{g^{-1}(A^L)}{1-\alpha^H}$, L entrepreneurs receive funding.

Connections lead to an efficient capital allocation at early stages of development (i.e., $kI \leq \frac{g^{-1}(A^H)}{1-\alpha^H}$), when at most a few (high-productivity) entrepreneurs can be funded due to the low level of initial capital and the return of the general technology is A^H. As the initial capital grows, investment decisions become increasingly inefficient. Even if only H entrepreneurs are funded, many financiers are unable to identify H entrepreneurs and over-invest in the general technology. In equilibrium, H entrepreneurs invest less than the efficient level $\frac{kI-g^{-1}(A^H)}{\alpha^H N}$ and the productivity of the general technology is lower than A^H. For an even higher initial capital, not only over-investment in the general technology occurs, but also lower productivity entrepreneurs receive funding. Hence, there are too many, too small entrepreneurs with low productivity. The average productivity of capital and financiers' equilibrium returns thus decrease in the economy's initial capital.

V Costly Information Acquisition about Distant Entrepreneurs

In this section, we investigate under what conditions some financiers acquire costly information about distant entrepreneurs and how this affects capital allocation. Information acquisition is optimal for some financiers only if the expected return from evaluating a distant entrepreneur is sufficiently large to compensate for the cost.

We recognize that in the real world the cost of information acquisition prevents financiers from evaluating all distant entrepreneurs. For simplicity, we capture this by assuming that financiers evaluate at most one distant entrepreneur.

When financiers are unable to evaluate all distant entrepreneurs, capital markets remain segmented and fail to spur an efficient capital allocation. The extent to which capital is misallocated depends on the stage of economic development and financiers' incentives to acquire information.

A Funding Only High-Productivity Entrepreneurs

Here we characterize an equilibrium in which information acquisition emerges at an intermediate stage of development (initial capital). In this case, the return of the general technology is so high that L entrepreneurs cannot attract funding.

The following proposition describes at which level of initial capital such an equilibrium emerges. Cases B and C of Figure 1 present the relevant intervals.

Proposition 2 *Some financiers acquire information and fund only H entrepreneurs if* $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+ I\tau < kI < \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + I\tau$.

If we interpret information acquisition as markets in which entrepreneurs are able to attract capital from distant financiers, an implication of Proposition 2 is that markets do not emerge for low levels of initial capital. When the initial capital is low $\left(kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau\right)$, connection-based capital allocation is the only equilibrium. Expanding the investment opportunity set by observing a distant entrepreneur does not significantly improve the expected return, since the general technology already offers high return at no cost. Hence, financiers do not acquire information and invest in close entrepreneurs only if they can offer a return higher than the general technology, as in the equilibrium described in Proposition 1.

For higher levels of initial capital, increasing investment in the general technology decreases its return. Since entrepreneurs, aware of this, would offer a low return to financiers, the payoff from spending τ and investigating a distant entrepreneur becomes attractive. Nevertheless. some financiers acquire information and fund exclusively H entrepreneurs only if

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

which implies that the interval in Proposition 2 is well-defined. Otherwise, costly information acquisition does not occur at intermediate stages of development and capital is allocated through connections.

If Condition (1) holds, some financiers acquire information, while the rest invest in the close entrepreneurs or in the general technology without evaluating distant investment opportunities. The mass of financiers acquiring information increases in the initial capital. Connection-based financing may thus coexist with costly information acquisition.

Condition (1) indicates that the emergence of information acquisition at early stages of development is favored by certain characteristics of the economy: a high proportion of H entrepreneurs; a large difference in productivity between H and L entrepreneurs; and/or a low cost of information acquisition. In particular, a higher proportion of H entrepreneurs strengthens 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, to which they have access without incurring the information acquisition cost.

When some financiers acquire information, capital market segmentations are partially overcome: Financiers who acquire information allocate capital to the entrepreneurs with highest productivity, whether distant or close. On average, investment in the general technology decreases and H entrepreneurs invest more. While capital allocation is improved, it is less efficient than with $\tau = 0$. Since with probability $\left(1-\alpha^H\right)^2$ some financiers do not identify any H entrepreneur, for high levels of initial capital, there is over-investment in the general technology.

It is interesting to note that if $A^L \leq g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{I\tau A^L}{A^H-A^L} + \left(1-\alpha^H\right)I\tau\right)$, a more restrictive condition than (1), some financiers acquire information for $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau \leq kI \leq \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$ even though without information acquisition they would still fund only H entrepreneurs (Case B of Figure 1). They do so in order to improve their outside options and obtain return A^H if they discover two H entrepreneurs (with probability $\left(\alpha^H\right)^2$). This case is more likely to arise if α^H is particularly high and/or if τ and A^L are particularly small.

If instead, $g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{I\tau A^L}{A^H-A^L} + \left(1-\alpha^H\right)I\tau\right) < A^L < g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2\frac{I\tau A^L}{A^H-A^L}\right)$, Propositions 1 and 2 imply that for $kI \in \left[\frac{g^{-1}\left(A^L\right)}{1-\alpha^H}, \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau\right]$, financiers do not acquire information and both

H and L entrepreneurs are funded. Only when capital exceeds the threshold $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$, some financiers acquire information and stop funding L entrepreneurs (Case C of Figure 1). In this case, information acquisition appears to improve capital allocation to an even larger extent, as L entrepreneurs would have received funding had financiers not acquired information.

This discussion implies that institutions fostering information acquisition are unimportant at early stages of development when connections lead to efficient funding decisions. Costly information acquisition is a sort of luxury good that may emerge only when economies reach a minimum level of development. Once countries have reached an intermediate level of initial capital, institutions affecting the cost of information acquisition or the average quality of entrepreneurs lead to divergent development paths as information acquisition does not necessarily emerge for a given level of initial capital. In economies with favorable characteristics, information acquisition emerges for intermediate levels of initial capital and prevents low-productivity projects from ever being funded. In economies with less favorable conditions, connections remain the only mechanism to allocate capital even if they lead to significant capital misallocation and information acquisition becomes an equilibrium only after the economy has experienced a decrease in the return to capital which is unrelated to the quality of its investment opportunities.

B Funding Low-Productivity Entrepreneurs

We now study an equilibrium in which L entrepreneurs attract external capital even though all financiers acquire information. The following proposition shows that such an equilibrium emerges at late stages of development (high initial capital). Cases B, C and D of Figure 1 present the relevant intervals.

Proposition 3 *All financiers acquire information and fund both H and L entrepreneurs if $kI > \max\left(\frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau, \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau\right)$.*

As shown in Proposition 2, if (1) holds, financiers acquire information for levels of initial capital below $\frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$. Proposition 3 implies that once capital exceeds this threshold, financiers continue to acquire information, but fund both H and L entrepreneurs (Cases B and C of Figure 1). This is because the initial capital is so high that the return of the general technology is below A^L when all financiers who identify two L entrepreneurs invest in the general technology. Financiers

thus acquire information in equilibrium because fostering competition between L entrepreneurs can improve their return. Even if incentives to acquire information are strong and the local market segmentation is reduced, capital allocation becomes progressively more inefficient as capital increases. This result, however, depends on the simplifying assumption that financiers acquire information about only one distant entrepreneur. In Section VII, we discuss how the results can be generalized if this assumption is relaxed.

Our simplifying assumption does not drive the results if (1) does not hold; in other words, if conditions are less favorable to information acquisition. In this case, capital allocation is driven by connections for relatively higher levels of initial capital and is therefore less efficient. Only once a large amount of capital has been accumulated $\left(kI \geq \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau > \frac{g^{-1}(A^L)}{(1-\alpha^H)^2} + I\tau\right)$, financiers acquire information (Case D of Figure 1).[9]

At this late stage of development, capital is so high that L entrepreneurs continue to be funded. Even though spurring competition between L entrepreneurs increases financiers' returns, productivity of capital remains low. If we interpret information acquisition as markets, this implies that not only markets emerge at later stages of development, but also that they work less efficiently when conditions are unfavorable.

VI Welfare Effects

A Financiers' and Entrepreneurs' payoffs

Different equilibrium configurations have dramatic effects on agents' payoffs. The following proposition compares financiers' returns when information is costly ($\tau > 0$) with their returns when information is costless ($\tau = 0$) and when capital is allocated only on the basis of connections ($\tau = \infty$).

Proposition 4 *Financiers' returns are (weakly) higher with costless information than with costly information acquisition. Financiers have higher returns when at least some of them acquire information than in a connection-based capital allocation.*

[9] As is clear from Figure 1, if $A^L \geq g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H-A^L}\right)$ (Case D), $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$ implies a higher level of capital than in the case in which $A^L < g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H-A^L}\right)$ (Cases B and C).

With costless information, financiers can identify all available investment opportunities. Competition among high-productivity entrepreneurs drives up the return necessary for attracting funds. In equilibrium, financiers' return per unit of capital invested is at least A^H, the highest attainable return in a capital-abundant economy.

When information is costly and initial capital is high, financiers' expected return is lower than A^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. Even though spending τ and observing the productivity of a distant entrepreneur increase the return to investment in some states of the world, financiers obtain return A^H only if they identify two high-productivity entrepreneurs. Whenever financiers identify entrepreneurs with different productivities, they are offered only the return of their second-best investment opportunity.

Compared to a connection-based capital allocation, information acquisition leads to higher returns for financiers as it expands their investment opportunities and increases competition for funds. Even if only a subset of financiers acquires information, the others enjoy higher returns thanks to smaller investment in the general technology.

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

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

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, entre-

preneurs may prefer a higher market segmentation in order to enjoy a higher rent on a smaller scale project.

Proposition 5 suggests that the rent effect always prevails when information is costless because with probability 1, H entrepreneurs compete with other H entrepreneurs and their expected payoff is zero. Therefore, entrepreneurs are unable to enjoy any benefits from larger investment.

When information is costly ($\tau > 0$), the net effect of lower market segmentation on H entrepreneurs' payoff is ambiguous (L entrepreneurs' payoff is unaffected because they cannot offer a return lower than A^L).

The two following corollaries consider special cases under which either the capital supply effect or the rent effect prevails.

Corollary 1 *For* $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < kI < \frac{g^{-1}(A^L)}{(1-\alpha^H)^2} + I\tau$, *$H$ entrepreneurs prefer a connection-based capital allocation to an information-acquisition-based capital allocation if* $\alpha^H \geq \frac{1}{2}$.

Corollary 1 considers an equilibrium in which financiers acquire information and fund only H entrepreneurs. It establishes that for intermediate levels of initial capital, H entrepreneurs prefer a connection-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 negative effect on entrepreneurs' payoffs of a lower rent per unit of capital invested prevails over the positive capital supply effect.

Corollary 2 *If* $kI \geq \max\left(\frac{2(1-\alpha^H)}{2(1-\alpha^H)-1}I\tau, \frac{g^{-1}(A^L)}{(1-\alpha^H)^2} + I\tau, \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau\right)$, *$H$ entrepreneurs always prefer an information-acquisition-based capital allocation to a connection-based capital allocation.*

The intuition behind Corollary 2 is the following: For high levels of initial capital, the return of the general technology is low in equilibrium. Financiers are offered low returns unless they evaluate two H entrepreneurs. Hence, H entrepreneurs expect to enjoy high rents even if financiers acquire information. In comparison to a connection-based capital allocation, information acquisition allows H entrepreneurs to invest more. Since the increment in investment is large for high levels of initial capital, the capital supply effect prevails.

The relative importance of the rent and capital supply effects is ambiguous in more general cases. Figure 2 shows with some numerical examples how entrepreneurs' payoffs with information acquisition vary with the level of initial capital. When initial capital is relatively low, H entrepreneurs'

payoff may decrease in the level of initial capital. 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 initial capital 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. When initial capital is low, transparency is inconsequential. As capital increases, greater transparency (lower τ) gives financiers an incentive to acquire information. However, H entrepreneurs may not favor a decrease in τ, because they prefer a connection-based capital allocation. As capital rises further, the capital supply effect eventually dominates and H entrepreneurs' resistance to improved transparency diminishes.

B Allocation of Capital between Real and Financial Sectors

So far, we have shown that, as capital increases above a certain threshold, information acquisition allows to allocate capital more efficiently across entrepreneurs and between entrepreneurial and general technologies. However, information acquisition entails a cost. One can interpret this cost as investment in the financial sector. Hence, the financiers' problem can be viewed as the decision to allocate capital between the real (entrepreneurial or general technologies) sector and the financial sector.

By investing in information acquisition, financiers may increment their expected wealth to a lower (or higher) extent than the economy's aggregate output (the total output of entrepreneurial and general technologies net of the information acquisition costs). This implies that financiers' decisions whether to acquire information do not necessarily increase the economy's aggregate output and therefore are not always efficient from a social welfare point of view.

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

Proposition 6 *For intermediate levels of capital, there is under-investment in information acquisition in equilibrium if α^H is small.*

Proposition 6 suggests that whether there is under-investment in information acquisition depends on the economy's characteristics. In particular, if the fraction of L entrepreneurs is relatively 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 there is under-investment in the financial sector.

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

Proposition 7 *For low levels of initial capital, there is over-investment in information acquisition if α^H is large.*

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 entrepreneurial output. They do so because by acquiring information they can appropriate a larger share of the entrepreneurial output. At low level of development, this may decrease social welfare. Interestingly, there is never over-investment in information acquisition at late stages of development.

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 financial markets in different phases of development. Informal finance is generally extended to entrepreneurs that are well-known to financiers, similarly to our close entrepreneurs. Formal finance requires information acquisition about some distant investment opportunities. When initial capital is low, if they arise, formal financial markets allow financiers to appropriate a larger share of the output. Even though financiers enjoy higher equilibrium returns, formal finance allows only a small increment in investment by high-productivity entrepreneurs. This is not sufficient to compensate 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 initial capital increases, information acquisition would allow a large increment in high quality entrepreneurs' investment. Formal financial markets are thus desirable. However, they 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.

VII Extensions

A Choosing Where to Raise Capital

So far, we have analyzed financiers' incentives to acquire information about distant investment opportunities. The most straightforward interpretation of the model is that the mechanisms for capital allocation vary across economies at different stages of development.

Our model also proposes that the distinction between connection-based and information-acquisition-based financial systems is not dichotomic. In the equilibrium with information acquisition, the crucial factors affecting entrepreneurs' payoffs are the initial capital (kI) and the probability of having to compete with other H entrepreneurs (α^H). The latter can be interpreted as a market's listing standards, which affect the average quality of entrepreneurs, but may also be related to the level of transparency that makes it easier to identify good investment opportunities. In what follows, we explain how these institutional features affect entrepreneurial rents. Since their payoffs depend on the institutional environment, entrepreneurs may choose to raise capital in markets where they obtain larger expected payoffs.

A larger proportion of H entrepreneurs increases competition for capital. In turn, this decreases entrepreneurial rents (per unit of capital invested) and increases financiers' returns. Nevertheless, it may affect favorably entrepreneurs' payoffs if only a subset of financiers acquires information. In this case, a marginal increase in α^H induces a larger set of financiers to produce information. If this set is sufficiently large, an improvement in listing standards may increase the supply of capital to the entrepreneurial sector so much that the ability to invest a larger amount of capital more than compensates the lower rent.

As shown in the numerical examples presented in Figure 2, the increase in the supply of capital brought about by an increase in α^H is captured by the curvature of the function $g(.)$. *Ceteris paribus*, the flatter the function $g(.)$ is, the larger the set of financiers who start acquiring infor-

mation for a given level of initial capital. The amount of capital that each entrepreneur is able to invest may more than compensates the reduced rent, as in Panel A of Figure 2. Therefore, if only a subset of financiers acquires information, H entrepreneurs may favor an improvement in listing standards (higher α^H).

Proposition 8 *When all financiers acquire information, H entrepreneurs' payoff decreases in α^H.*

In a mature market, all financiers acquire information and an increase in α^H does not bring a large increase in the supply of capital. Hence, H entrepreneurs are adversely affected by an improvement in listing standards, as is proved in Proposition 8.

B Bargaining Power

Our model assumes that entrepreneurs have all 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 earning a return $g(\Omega)$ or can fund an H entrepreneur. In this case, Nash bargaining implies that the 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 an 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, 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 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 as initial capital increases. 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, L entrepreneurs would not necessarily be funded. If the institutional environment was favorable to information acquisition, financiers would start evaluating more distant entrepreneurs, without ever funding low productivity entrepreneurs. If the environment was instead somewhat less favorable to information acquisition, financiers would fund low-productivity entrepreneurs and only when their capital endowment increases sufficiently, they would choose to further expand their investment opportunities. Similarly to 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 as the economy accumulates capital in environments that are less favorable to information acquisition. Finally, if the environment is averse to information acquisition, an equilibrium with information acquisition in which only H entrepreneurs are funded never emerges (as is the case if (1) does not hold).

Our model also assumes that the expected quality of entrepreneurs is the same regardless of their location. 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 connection-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, connection-based financing would still lead to efficient investment decisions at early stages of economic development.

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 connection-based financing would limit entry.

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 unchanged 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 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, connection-based financing leads to an inefficient capital allocation even at early stages of development.

VIII Empirical Implications

In this section, we discuss the implications of our theory and provide some supporting empirical evidence.

Implication 1 *Allocation of capital based on personal connections is widespread and only high productivity entrepreneurs receive funding at early stages of development. Differences in the way capital is allocated emerge at intermediate stages of development depending on the country's institutional environment.*

Lamoreaux (1996) writes that the banks active in New England in the early nineteenth century resembled "investment clubs". Bank directors funneled the bulk of the funds under their control to themselves, their relatives, or others with personal ties to the board. Nevertheless, households bought bank stocks as connection-based financing guaranteed them high and steady earnings. Local banks thus fueled the region's economic development. As the century progressed, bank performance declined. In order to attract savers, banks developed new credit standards for evaluating the creditworthiness of distant borrowers. These new credit standards fostered an ethic of professionalism that ran counter to the values that originally sustained insider lending. At the same time, they made it 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. We argue that capital accumulation is the main driving force explaining why the performance of credit allocation based on personal ties sharply deteriorated during the century and why it may have become optimal for financiers (banks in this context) to acquire information on distant investment opportunities.

The importance of connection-based financing also emerges from the more recent experiences of emerging economies. 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.

Connections do not affect bank lending only. For instance, Franks, Mayer and Rossi (2008) show that in the U.K. still in the first half of the 20th century ordinary shareholders lived close to the company's city of incorporation and its board of directors. 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 recurring to information acquisition. Consistently with our model, business groups are often believed to enhance economic performance in early phases of development (Khanna and Yafeh, 2007).

At intermediate stages of development, differences emerge on whether connection-based financing remains prevalent or financiers acquire information and markets develop. If financiers acquire enough information, new highly productive entrepreneurial projects are funded and the economy reaches high level of output like the U.S. and the U.K. Our model suggests that their growth path may have been favored by institutions favoring an increase in transparency and information

acquisition. In other countries, such as Korea or Japan, connection-based financing remains prevalent, thus leading to lower productivity of capital, even if the same technological opportunities are available.

Implication 2 *Transparency spurs information production and improves capital allocation at late stages of development, but fails to foster markets at earlier stages of development.*

Our model implies that connections are the only equilibrium mechanism for capital allocation at early stages of development, independently from the cost of information acquisition and the average quality of entrepreneurs. Hence, any attempts of improving transparency and listing standards to foster the development of markets are doomed to fail. This may explain why notwithstanding the international financial institutions' efforts, markets have failed to develop in the low-income African economies.

Only at later stages of development, financiers are expected to be more inclined to produce information if this is cheap. Hence, for middle and high income economies, we should observe that in more transparent countries more firm-specific information is available. Middle- and high-income economies are typically the only ones to be included in cross-sectional empirical studies. Morck, Yeung and Yu (2000) show that firm-specific variation in returns – a proxy for the extent of information acquisition – is positively correlated with transparency. Durnev, Morck and Yeung (2004) also document that firm-specific variation in stock returns is positively associated with a measure of efficiency of corporate investment. Our model provides an explanation for their findings, alternative to the ones in the existing literature.[10]

Most importantly, our model implies that it is natural not to observe any relation between transparency or, more in general, institutional quality and financial market development if long periods of time are considered (Rajan and Zingales, 2003). This may depend on the fact that institutions are unimportant at early stages of development even though they are crucial for the development of financial markets and their efficiency (i.e., the emergence of an adequate level of information acquisition).

Furthermore, our model suggests caution in interpreting the results of the finance and growth literature (Levine, 2006). The proportion of financiers acquiring information may be seen as a

[10] See, for instance, Jin and Myers (2006).

measure of financial development. In our model, financial development is partly an endogenous institution that not only fosters but also follows economic development. When information acquisition emerges, it does have a positive effect on investment efficiency. This effect may be underestimated, as shown by Beck, Levine and Loyaza (2000), if econometricians do not consider that connection-based capital allocation is efficient at early stages of development.

Finally, a straightforward extension of our model implies that countries with better disclosure or a higher proportion of high quality entrepreneurs attract more information acquisition efforts from foreign investors and ultimately larger capital inflows. This implication is consistent with the findings of Leuz, Lins and Warnock (2008).

Implication 3 *Countries become financially integrated with the rest of the world only at relatively high stages of development.*

Another interpretation of our model is that financiers can fund domestic entrepreneurs without cost but bear a cost τ in order to be able to invest in a foreign country. Financiers from capital-poor countries are unlikely to investigate distant investment opportunities. Only when a sufficient amount of capital has been accumulated, investors find it optimal to evaluate foreign investment opportunities and we may observe international capital flows.

This can explain why banks from developed countries are more likely to open subsidiaries in foreign countries while banks from developing countries typically remain regional (Detragiache, Tressel and Gupta, 2008). This can also explain why low-income countries can maintain restrictions to foreign investment for domestic residents. These restrictions become unpopular and are ultimately removed when countries achieve higher level of development (see Abiad and Mody, 2005).

Implication 4 *Financial liberalizations are followed by an improvement in transparency.*

Our model implies that high-productivity entrepreneurs favor transparency if they anticipate that this brings a sufficiently large increase in investment. Thus, improvement in transparency may encounter less resistance after financial liberalization because of the possibility of attracting large amounts of foreign capital. We are not aware of any empirical work testing this implication that is particular to our model. It appears however that it would be testable. There exists indirect empirical evidence in its support. When companies cross-list in a foreign market, they voluntarily

commit to increase transparency. Pagano, Röell and Zechner (2002) show that this decision is concomitant to raising more capital, as our model suggests.

Implication 5 *Financiers' expected return is higher when competition for external funds is stronger.*

In our model, financiers' returns are positively affected by competition for capital, which depends on their investment opportunities. This implication is consistent with the empirical evidence showing that international banks charge higher interest rates than domestic banks to similar borrowers (Smith, 2003). Our model suggests that international banks having a wider set of potential borrowers demand higher interest rates.

Furthermore, financiers are likely to have more investment opportunities during IPO's "hot markets", when a larger than usual number of firms raise capital and expectations about the quality of IPOs are high. Our theory implies that financiers should be offered new equity issues at better prices. This implication is consistent with the findings of Lowry and Schwert (2002) and Benveniste, Ljungqvist, Wilhelm and Yu (2003) who show that financiers have larger initial returns on IPOs during hot markets.[11]

Finally, competition for capital has been shown to matter empirically in more general contexts. For instance, a straightforward generalization of our model would imply that financiers with more close entrepreneurs obtain higher returns in equilibrium. Consistently, Hong, Kubik and Stein (2006) find that in U.S. census regions where local firms raise more equity, equity returns are higher. Quite to the contrary, individuals who fund connected entrepreneurs through rotating savings schemes and credit associations receive very low returns on investment (Mullainathan, 2008).

Implication 6 *Markets fail to attract entrepreneurs if disclosure requirements and listing standards become too demanding.*

Our model has also implications about entrepreneurs' preferences over different markets. In particular, competition for capital, which is crucial for entrepreneurs' payoffs, is affected by the

[11] In this respect we provide an explanation, alternative 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.

fraction of high-quality entrepreneurs. The latter may depend on several characteristics of a market, such as listing and disclosure standards. Stricter listing standards are equivalent to an increase in the fraction of high-quality entrepreneurs. Disclosure requirements, besides affecting the cost of information acquisition, may have an effect similar to the one of listing standards. First, only the very best firms may be able to list if disclosure requirements increase. This implies a larger fraction of high quality entrepreneurs. Second, a decrease in the cost of information acquisition gives financiers incentives to evaluate more entrepreneurs. As financiers' investment opportunities expand, competition for capital increases.

Our results shed light on the experience of U.S. stock markets after the Sarbanes-Oxley Act. The Sarbanes-Oxley Act, introduced in 2002, considerably increased disclosure requirements and listing standards for companies listed on the U.S. markets. Marosi and Massoud (2008) show that as a consequence an increasing number of foreign firms has decided to exit the U.S. market by deregistering. An even larger number of international firms has chosen to list on the London Stock Exchange, which has lower disclosure requirements and listing standards than U.S. stock exchanges. This is somewhat puzzling because direct costs of disclosure are considered too small to fully explain these patterns (Zingales, 2006).

Our model suggests a more subtle explanation: Entrepreneurial rents decrease too much if a market attracts only the highest quality firms or if it becomes too easy for financiers to identify them. As a consequence, high-quality firms may migrate to markets where competition for capital is lower. This propensity should be more accentuated for companies that are less likely to benefit from the capital supply effect. This prediction is consistent with the findings of Piotroski and Srinivasan (2008) who show that small companies, which are less likely to raise large amounts of equity, have spurned the U.S. markets after the implementation of the Sarbanes-Oxley Act.

Furthermore, if high listing requirements cause high quality firms to migrate, entrepreneurial rents in the home market increase as there are fewer H entrepreneurs. In this case, higher disclosure and stricter listing standards are even more counterproductive for the domestic market. In the foreign market, instead, more H entrepreneurs lead to more competition for capital and lower entrepreneurial rents. Hence, firm migration re-equilibrates the relative competitiveness of markets. This explains why several exchanges with different disclosure and listing standards may coexist in equilibrium.

While markets lose competitiveness in attracting listings when the average quality of firms becomes too high, a country's stock market is also adversely affected when too many good firms migrate away, for instance because the best firms choose to list on foreign stock exchanges. If the proportion of good firms decreases too much, foreign investors have weaker incentives to acquire information about the companies that remain listed on the domestic stock exchanges. Consequently, the liquidity of the domestic stock market decreases when the best firms choose to list in a foreign stock market, as shown by Levine and Schmukler (2006).

The welfare effects highlighted by our theory are also consistent with empirical evidence showing that increases in mandated disclosure requirements increase financiers' returns, presumably because they enhance competition for capital. For instance, Bushee and Leuz (2005) find that the sharp increase in disclosure requirements mandated to firms traded on the Over-The-Counter Bulletin Board (OTCBB) by the SEC in 1999 increased financiers' returns while at the same time forcing a substantial number of firms into a less regulated market.

IX Conclusions

This paper examines under which conditions capital is predominantly allocated on the basis of prior connections. It shows that the acquisition of information about distant investment opportunities is unnecessary at early stages of development. As the economy accumulates capital, information acquisition on distant investment opportunities becomes crucial for preventing low-productivity entrepreneurs from being funded. Nevertheless, even high-productivity entrepreneurs may favor a connection-based capital allocation because they enjoy higher rents when financiers have information on a limited set of investment opportunities. Interestingly, even though information acquisition 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. At later stages of development, formal financial markets are preferable, but whether they emerge depends on the level of transparency and institutional development.

References

Abiad, Abdul and Ashoka Mody, 2005, Financial reform: What shakes it? What shapes it?, *American Economic Review* 95, 66-88.

Allen, Franklin and Douglas Gale, 2000, Comparing financial systems. MIT Press: Cambridge, MA.

Allen, Franklin, Jun Qian and Meijun Qian, 2005, Law, finance, and economic growth in China, *Journal of Financial Economics* 77, 57-116.

Allen, Franklin, Rajesh Chakrabarti, Sankar De, Jun Qian and Meijun Qian, 2008, The financial system capacities of China and India, mimeo, University of Pennsylvania.

Almeida, Heitor and Daniel Wolfenzon 2005, The effect of external finance on the equilibrium allocation of capital, *Journal of Financial Economics* 75, 133-164

Almeida, Heitor and Daniel Wolfenzon, 2006, Should business groups be dismantled? The equilibrium costs of efficient internal capital markets, *Journal of Financial Economics* 79, 99-144.

Benerjee, Abhjit and Kaivan Munshi 2004, How efficiently is capital allocated? Evidence from the knitted garment industry in Tirupur, *Review of Economic Studies* 71, 19-42.

Beck, Thorsten, Ross Levine and Norman Loayza, 2000, Finance and the sources of growth, *Journal of Financial Economics* 58, 261-300.

Becker, Gary S., 1971, The Economics of Discrimination, University of Chicago Press.

Benveniste, Lawrence M., Alexander Ljungqvist, William J. Wilhelm and Xiaoyun Yu, 2003, Evidence of information spillovers in production of investment banking services, *Journal of Finance* 58, 577-607.

Boot, Arnoud W. A. and Anjan V. Thakor, 1997, Financial system architecture, *Review of Financial Studies* 10, 693-733.

Bushee, Brian J. and Christian Leuz, 2005, Economic consequences of SEC disclosure regulation: Evidence from the OTC bulletin board, *Journal of Accounting and Economics* 39, 233-264.

Christensen, Jakob, Anne-Marie Gulde, and Catherine Pattillo, 2006, Bankable assets: Africa faces many obstacles in developing financial systems, *Private Sector Development*, World Bank, July.

Detragiache, Enrica, Thierry Tressel, and Poonam Gupta, 2008, Foreign banks in poor countries: Theory and evidence, *Journal of Finance* forthcoming.

Diamond, Douglas W., 1984, Financial Intermediation and Delegated Monitoring, *Review of Economic Studies* 51, 393-414.

Durnev, Artyom, Randall Morck and Bernard Yeung, 2004, Value enhancing capital budgeting and firm-specific stock return variation, *Journal of Finance* 59, 65-105.

Falkenstein, Eric G., 1996, Preferences for stock characteristics as revealed by mutual fund portfolio holdings, *Journal of Finance* 51, 111-135.

Franks, Julian R., Colin Mayer, and Stefano Rossi, 2008, Ownership: Evolution and regulation, *Review of Financial Studies*, forthcoming.

Hong, Harrison, Jeffrey D. Kubik and Jeremy C. Stein, 2008, The only game in town: Stock price consequences of local bias, *Journal of Financial Economics*, forthcoming.

Jin, Li and Stewart C. Myers, 2006, R^2 around the world: New theory and new tests, *Journal of Financial Economics* 79, 257-292.

Khanna, Tarun and Yishay Yafeh, 2007, Business groups in emerging markets: Paragons or parasites?, *Journal of Economic Literature* 45, 331-372.

Lamoreaux, Naomi R., 1996, Insider lending, NBER Series on long-term factors in economic development: Cambridge, MA.

La Porta, Rafael, Florencio Lopez-de-Silanes, and Guillermo Zamarripa, 2003, Related lending, *Quarterly Journal of Economics* 128, 231-268.

Leuz, Christian, Karl V. Lins, and Francis E. Warnock, 2008, Do foreigners invest less in poorly governed firms?, *Review of Financial Studies*, forthcoming.

Levine, Ross, 2006, Finance and growth: Theory and evidence. In Philippe Aghion and Steven Durlauf, eds. Handbook of Economic Growth. The Netherlands: Elsevier Science.

Levine, Ross and Sergio Schmukler, 2006, Internationalization and stock market liquidity, *Review of Finance* 10, 153-187.

Ljungqvist, Alexander P. and William J. Wilhelm, Jr., 2002, IPO allocations: discriminatory or discretionary?, *Journal of Financial Economics* 65, 167-201.

Loughran, Tim and Jay R. Ritter, 2002, Why don't issuers get upset about leaving money on the table in IPOs?, *Review of Financial Studies* 15, 413-443.

Lowry, Michelle and William G. Schwert, 2002, IPO market cycles: Bubbles or sequential learning?, *Journal of Finance* 57, 1171- 1198.

Marosi, András and Nadia Massoud, 2008, "You can enter but you cannot leave..." – U.S. securities markets and foreign firms, *Journal of Finance* 53, 2477-2506.

Morck, Randall, Bernard Yeung and Wayne Yu, 2000, The information content of stock markets: Why do emerging markets have synchronous stock price movements?, *Journal of Financial Economics* 58, 215-260.

Mullainathan, Sendhil, 2008, Development economics through the lens of psychology, *Proceedings of the Annual Bank Conference on Development Economics*, forthcoming.

Pagano, Marco, Fabio Panetta and Luigi Zingales, 1998, Why do companies go public? An empirical analysis, *Journal of Finance* 53, 27-64.

Pagano, Marco, Ailsa A. Röell and Josef Zechner, 2002, The geography of equity listing: Why do companies list abroad?, *Journal of Finance* 57, 2651 - 2694.

Phelps, Edmund S., 1972, The statistical theory of racism and sexism, *American Economic Review* 62, 659-661.

Piotroski, Joseph and Suraj Srinivasan, 2008, Regulation and bonding: The Sarbanes-Oxley Act and the flow of international listings, *Journal of Accounting Research* 46, 383-425.

Rajan, Raghuram G., 1992, Insiders and outsiders: The choice between informed and arm's-length credit, *Journal of Finance* 47, 1367-400.

Rajan, Raghuram, and Luigi Zingales, 2003, The great reversals: The politics of financial development in the twentieth century, *Journal of Financial Economics* 69, 5-50.

Rajan, Raghuram G. and Luigi Zingales, 2003, Saving Capitalism from the Capitalists, Crown Business, New York.

Smith, David C., 2003, Loans to Japanese borrowers, *Journal of the Japanese and International Economies* 17, 283-304.

Stein, Jeremy C., 1997, Internal capital markets and the competition for corporate resources, *Journal of Finance* 52, 111-133.

Zingales, Luigi, 2006, Is the U.S. market losing its competitive edge?, mimeo, the University of Chicago.

A Appendix

A The Bargaining Game between Entrepreneur and Financier

Two entrepreneurs whose types can be either H or L are competing to attract the capital from financiers (the game is easily generalized to include the return of the general technology). Entrepreneurs observe whether financiers had previous offers to invest from other entrepreneurs and no agent lies if this does not increase her payoff. Consider the strategy of an H entrepreneur who bids first by offering a share of the output. By bidding $\frac{A^L}{A^H} + \varepsilon < 1$, where ε is infinitesimally larger than zero, he can win at the first offer if the competing entrepreneur is L type. In fact, his bid guarantees financiers 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. 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 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 financiers accept is A^L, the L entrepreneur will bid 1. He receives funding and enjoys zero payoff if the competing entrepreneur is L type. 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. Financiers' equilibrium return is equal to the return of their second-best investment opportunity.

B Proof of Proposition 1

In equilibrium, entrepreneurs offer financiers at most the return of the general technology. If the general technology has a return higher than the most productive entrepreneur $\left(g(kI) > A^H\right)$, no entrepreneur is funded. All financiers invest in the general technology and obtain return $g(kI)$.

If $g(kI) \leq A^H$, H entrepreneurs offer financiers the return of the general technology. As long as $g\left(kI\left(1-\alpha^H\right)\right) > A^L$, the return of the general technology 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 $g^{-1}\left(A^H\right) \leq kI < \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$, only H entrepreneurs receive funding.

If $g(kI) \leq A^H$ but $g\left(kI\left(1-\alpha^H\right)\right) > A^H$, even financiers who are close to H entrepreneurs find it optimal to invest part of their capital endowment in the general technology up to the point that its return is equal to A^H. Hence, there exists $\omega_1 \in \left(0, kI\alpha^H\right)$ such that $kI\left(1-\alpha^H\right) + \omega_1$ is invested in the general technology, and the rest of capital, $kI\alpha^H - \omega_1$, is allocated to H entrepreneurs. 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. Financiers' equilibrium return is $g\left(kI\left(1-\alpha^H\right)\right) \in \left(A^L, A^H\right]$, which decreases in kI.

When $g\left(kI\left(1-\alpha^H\right)\right) < A^L$, if all financiers close to L entrepreneurs invested their capital in the general technology, they would obtain a return lower than 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.[12]■

[12] Note that there cannot be an equilibrium with $g\left(\Omega_1\right) < A^L$, as entrepreneurial projects have constant returns to scale, and an entrepreneur can attract funding by offering $g\left(\Omega_1\right) + \epsilon$ with $\epsilon \to 0$. So in equilibrium, $g\left(\Omega_1\right) + \epsilon = A^L$.

C Proof of Propositions 2 and 3

Propositions 2 and 3 are obtained from the following two lemmas.

Lemma 1 *Suppose* $A^L < g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H - A^L}\right)$. *Then*

1. *If* $kI < g^{-1}\left(A^H\right)$, *financiers do not acquire information and invest only in the general technology;*

2. *If* $g^{-1}\left(A^H\right) \leq kI \leq \min\left(\frac{g^{-1}\left(\frac{\left(\alpha^H\right)^{2(k-\tau)}}{\tau+\left(\alpha^H\right)^{2(k-\tau)}}A^H\right)}{1-\alpha^H}, \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}\right)$, *financiers do not acquire information and fund only the close* H *entrepreneurs;*

3. *If* $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau < kI < \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + I\tau$, *some financiers acquire information, and only* H *entrepreneurs are funded;*

4. *If* $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} \leq kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$, *financiers fund both* H *and* L *entrepreneurs and do not acquire information.*

5. *If* $kI > \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + I\tau$, *financiers acquire information and fund both* H *and* L *entrepreneurs.*

Proof. We consider the five regions for kI in Lemma 1 in order. Cases B and C of Figure 1 summarize the equilibrium outcome for different levels of initial capital and different parameter configurations.

Region 1. If $kI < g^{-1}\left(A^H\right)$, then $g\left(kI\right) > A^H$. H entrepreneurs cannot offer the return of the general technology and financiers have no incentives to fund close entrepreneurs. Since $g\left(kI\right)k > A^H k > A^H\left(k-\tau\right)$, no financier has an incentive to acquire information and fund distant entrepreneurs. So $kI < g^{-1}\left(A^H\right)$ ensures that acquiring information is never optimal. In equilibrium, all capital is invested in the general technology.

Region 2. An equilibrium in which financiers fund only close H entrepreneurs without acquiring information exists if the following conditions are satisfied: (a) financiers have incentives to fund at least some close H entrepreneurs, (b) no financier has an incentive to acquire information, and (c) no financier has an incentive to fund a close L entrepreneur.

Condition (a) holds if close H entrepreneurs can offer financiers at least the return of the general technology. That is, $A^H \geq g(\Omega_2)$, where $\Omega_2 \leq kI$ is the amount of capital invested in the general technology. This implies $kI \geq g^{-1}\left(A^H\right)$.

A financier who acquires costly information may receive the following returns. With probability $\left(\alpha^H\right)^2$, both entrepreneurs are type H; to attract capital, both entrepreneurs offer return of $A^H > g$. 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 $g > A^L$ and is funded (L entrepreneurs cannot offer g). Finally, with probability of $\left(1-\alpha^H\right)^2$, both entrepreneurs are type L and the general technology offers higher return. Therefore, her expected payoff is: $\left(\left(\alpha^H\right)^2 A^H + \left(1-\left(\alpha^H\right)^2\right) g(\Omega_2)\right)(k-\tau)$.

Financiers who *do not* acquire information invest either in the close entrepreneur or in the general technology and have expected payoff $g(\Omega_2)\,k$. This is because the close entrepreneur is aware of her alternative investment opportunities and offers at most the return of the general technology. As long as $A^H > g > A^L$, H entrepreneurs receive capital from financiers who do not acquire information. If the close entrepreneur is type L, financiers invest in the general technology.

Hence, if $g(\Omega_2)\,k \geq \left(\left(\alpha^H\right)^2 A^H + \left(1-\left(\alpha^H\right)^2\right) g(\Omega_2)\right)(k-\tau)$, financiers have no incentive to acquire information. The previous inequality can be rewritten as $g(\Omega_2) \geq \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H$.

Finally, financiers have no incentive to fund L entrepreneurs if $g(\Omega_2) > A^L$.

Hence, an equilibrium in which financiers do not acquire information and fund only close H entrepreneurs exist if

$$\Omega_2 \leq \min\left(g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H\right), g^{-1}\left(A^L\right)\right) \tag{2}$$

Since at least some financiers fund their close H entrepreneurs instead of the general technology, and financiers close to L entrepreneurs invest in the general technology, the capital invested in the general technology is $\Omega_2 = \left(1-\alpha^H\right)kI + \omega_2$, where $\omega_2 \geq 0$ is the capital invested in the general technology by financiers who are close to H entrepreneurs.

Substituting $\Omega_2 = \left(1-\alpha^H\right)kI + \omega_2$ into (2) and re-arranging, we obtain:

$$kI \leq \frac{\min\left(g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H\right), g^{-1}\left(A^L\right)\right) - \omega_2}{1-\alpha^H}. \tag{3}$$

The equilibrium condition under which financiers do not acquire information and fund only the close H entrepreneurs then becomes

$$g^{-1}\left(A^H\right) \leq kI \leq \frac{\min\left(g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right), g^{-1}\left(A^L\right)\right)}{1-\alpha^H}. \tag{4}$$

To establish the upper bound of (4) for kI, first consider $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H < A^L$. Then (4) becomes

$$g^{-1}\left(A^H\right) \leq kI \leq \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$$

Note that $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H < A^L$ is equivalent to $kI < \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau$. Then (4) becomes

$$g^{-1}\left(A^H\right) \leq kI \leq \min\left(\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau, \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}\right). \tag{5}$$

Next, consider $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H > A^L$, which is equivalent to $kI > \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau$. Then (4) becomes $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau \leq kI \leq \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{1-\alpha^H}$. Note that this implies that the equilibrium with no information acquisition (in Region 2) and the equilibrium with information acquisition (in Region 3) coexist in the interval $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau \leq kI \leq \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{1-\alpha^H}$. This interval is well-defined if $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau < \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$, which is equivalent to $A^L < g\left(\frac{\left(1-\alpha^H\right)I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + \left(1-\alpha^H\right)I\tau\right)$.

Region 3. In the equilibrium with information acquisition and with only H entrepreneurs funded, only a subset of financiers may find it optimal to acquire information. So the capital invested into the general technology is

$$\Omega_3 = \left(1-\alpha^H\right)\omega_3 + \left(1-\alpha^H\right)^2\left(I - \frac{\omega_3}{k}\right)(k-\tau), \tag{6}$$

where $\left(1-\alpha^H\right)\omega_3$ is the capital invested into the general technology by those financiers who do not acquire information and are close to L entrepreneurs.

Such an equilibrium exists if the following conditions are satisfied: (a) financiers who acquire information and evaluate a distant entrepreneur have no incentive to deviate by not acquiring information; (b) financiers have no incentive to deviate by funding an L entrepreneur; (c) financiers have an incentive to fund H entrepreneurs.

The expected payoff from not acquiring information is $g(\Omega_3)k$, as even H entrepreneurs, being aware of financiers' alternative investment opportunities, offer at most g. The expected payoff from acquiring information and funding only H entrepreneurs is $\left(\left(\alpha^H\right)^2 A^H + \left(1-\left(\alpha^H\right)^2\right) g(\Omega_3)\right)(k-\tau)$.

Condition (a) is met if $\left(\left(\alpha^H\right)^2 A^H + \left(1-\left(\alpha^H\right)^2\right) g(\Omega_3)\right)(k-\tau) \geq g(\Omega_3)k$. This inequality can be rewritten as

$$g(\Omega_3) \leq \frac{\left(\alpha^H\right)^2 (k-\tau)}{\tau + \left(\alpha^H\right)^2 (k-\tau)} A^H. \tag{7}$$

If inequality (7) is strictly satisfied, all financiers acquire information and $\omega_3 = 0$. If inequality (7) is weakly satisfied, then some but not all financiers acquire information ($\omega_3 > 0$).

Condition (b) holds if $g(\Omega_3) > A^L$.

Finally, since $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H < A^H$ for any $\tau > 0$, condition (c) is always satisfied.

To characterize Region 3, first consider $\omega_3 > 0$, which implies $g(\Omega_3) = \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H$. Then $g(\Omega_3) > A^L$ can be written as

$$I(k-\tau) > \frac{I\tau A^L}{\left(\alpha^H\right)^2 \left(A^H - A^L\right)} \tag{8}$$

and (6) becomes $\Omega_3 = \left(1-\alpha^H\right)\omega_3 + \left(1-\alpha^H\right)^2 \left(I - \frac{\omega_3}{k}\right)(k-\tau) = g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H\right)$, which can be re-written as

$$I(k-\tau) = \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H\right) - \left(1-\alpha^H - \left(1-\alpha^H\right)^2\left(\frac{k-\tau}{k}\right)\right)\omega_3}{\left(1-\alpha^H\right)^2} < \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)} A^H\right)}{\left(1-\alpha^H\right)^2} \tag{9}$$

for any $\omega_3 > 0$. Thus, combining (8) and (9) we obtain the condition necessary for an equilibrium with information acquisition and funding of only H entrepreneurs:

$$\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} < I\left(k-\tau\right) < \frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2}. \tag{10}$$

Next, consider $\omega_3 = 0$. In this case, $g\left(\Omega_3\right) < \frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H$, where $\Omega_3 = \left(1-\alpha^H\right)^2 I\left(k-\tau\right)$. Together with $g\left(\Omega_3\right) > A^L$, we have

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

which is equivalent to

$$\frac{g^{-1}\left(\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H\right)}{\left(1-\alpha^H\right)^2} < I\left(k-\tau\right) < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2}. \tag{11}$$

The interval specified in (11) is well-defined for $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H > A^L$, 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 (11) and (10), (7) and $g\left(\Omega_3\right) > A^L$ hold for

$$\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} < I\left(k-\tau\right) < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2}. \tag{12}$$

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

Region 4. We consider an equilibrium in which financiers do not acquire information and fund close entrepreneurs of either type. Financiers have an incentive to fund close L entrepreneurs if

$$g\left(\left(1-\alpha^H\right)kI\right) \leq A^L. \tag{13}$$

The expected payoff for financiers who acquire information and fund both H or L entrepreneurs is $\left(\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\left(1-\alpha^H\right) + \left(1-\alpha^H\right)^2\right)A^L\right)\left(k-\tau\right)$.

A financier has no incentive to acquire information if and only if

$$\left(\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\left(1-\alpha^H\right) + \left(1-\alpha^H\right)^2\right) A^L\right)(k-\tau) \leq g(\Omega_4)k, \tag{14}$$

where Ω_4 is the equilibrium amount of capital invested in the general technology.

Additionally, L entrepreneurs must be able to offer at least the return of the general technology. Hence $g\left(\Omega_4\right) \leq A^L$. Thus, $\left(\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\left(1-\alpha^H\right) + \left(1-\alpha^H\right)^2\right)\right) A^L\left(\frac{k-\tau}{k}\right) \leq A^L$. The latter is equivalent to

$$\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} \geq I\left(k-\tau\right). \tag{15}$$

Combining (13) and (15), we obtain that this equilibrium exists for $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} \leq kI \leq \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau$**,** if the interval is well-defined, which implies $A^L > g\left(\frac{\left(1-\alpha^H\right)I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + \left(1-\alpha^H\right)I\tau\right)$.

Region 5. Consider an equilibrium in which financiers have incentives to acquire information and to fund both H and L entrepreneurs. Financiers acquire information if

$\left(\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\left(1-\alpha^H\right) + \left(1-\alpha^H\right)^2\right) A^L\right)(k-\tau) \geq g(\Omega_4)k.$

Additionally, L entrepreneurs can offer the return of the general technology if $A^L \geq g(\Omega_4)$.

Financiers who observe two L entrepreneurs may find it optimal to fund an entrepreneur if $kI \geq \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$. This in turn implies that information acquisition is optimal.

So all financiers acquire information and fund both H and L entrepreneurs if $kI > \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$.

■

Lemma 2 *Suppose* $A^L \geq g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H-A^L}\right)$. *Then*

1. *If* $kI < g^{-1}\left(A^H\right)$*, financiers do not acquire information and invest only in the general technology;*

2. *If* $g^{-1}\left(A^H\right) \leq kI < \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$*, financiers do not acquire information and fund only* H *entrepreneurs;*

3. *If* $kI \geq \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$*, both types of entrepreneurs are funded. In equilibrium, some financiers invest in information acquisition if* $kI \geq \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau$.

Proof. We consider the three regions in Lemma 2 in order.

Region 1. See the proof of Region 1 in Lemma 1.

Region 2. Similarly to the proof of Region 2 in Lemma 1, we establish that financiers do not acquire information and fund only close H entrepreneurs if inequality (4) is satisfied. Like before, if $\frac{\left(\alpha^H\right)^2(k-\tau)}{\tau+\left(\alpha^H\right)^2(k-\tau)}A^H < A^L$, (4) becomes

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

Condition $A^L \geq g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H-A^L}\right)$ implies that $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} < \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} + I\tau$. Hence, the equilibrium in which financiers do not acquire information and fund only close H entrepreneurs exists for $g^{-1}\left(A^H\right) \leq kI \leq \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$.

Region 3. From the proof of Lemma 1, we know that an equilibrium with information acquisition and funding of only H entrepreneurs (Region 3 in Lemma 1) does not exist if $A^L \geq g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H-A^L}\right)$.

Then for $kI \geq \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$, there are two equilibria. In the first equilibrium, financiers do not acquire information and invest in the general technology to the point that $g(\Omega_4) = A^L$. All financiers earn return A^L and both types of entrepreneurs are funded.

This equilibrium exists if no financier finds it optimal to deviate by acquiring information and L entrepreneurs can offer g: $\left(\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\left(1-\alpha^H\right) + \left(1-\alpha^H\right)^2\right)A^L\right)(k-\tau) \leq g(\Omega_4)k = A^L k$, which implies $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)} \geq I(k-\tau)$. Hence, the equilibrium in which no information is acquired and all entrepreneurs are funded exists for $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} \leq I(k-\tau) \leq \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}$. The condition $A^L \geq g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H-A^L}\right)$ ensures the interval is well-defined.

In the second equilibrium, financiers find it optimal to acquire information and fund both H and L entrepreneurs. In particular, L entrepreneurs are funded if $g(\Omega_5) \leq A^L$. Additionally, financiers find it optimal to acquire information if

$$\left(\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\left(1-\alpha^H\right) + \left(1-\alpha^H\right)^2\right)A^L\right)(k-\tau) \geq g(\Omega_5)k$$

Together these two conditions imply $I(k-\tau) \geq \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}$.

Financiers who acquire information have an incentive to fund L entrepreneurs if $kI \geq \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$. Note that condition $A^L \geq g\left(\left(\frac{1-\alpha^H}{\alpha^H}\right)^2 \frac{I\tau A^L}{A^H - A^L}\right)$ implies $\frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} \leq \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)}$. Therefore this equilibrium exists if $I\left(k-\tau\right) \geq \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)}$. In equilibrium, all financiers acquire information. ■

It follows readily that from Region 3 of Lemma 1, we obtain Proposition 2. From Region 5 of Lemma 1 and Region 3 of Lemma 2, we obtain Proposition 3. This completes the proof of Propositions 2 and 3.■

D Proof of Propositions 4 and 5

The proofs follow readily from the discussion in the text.■

E Proof of Corollary 1

First, recall that information acquisition emerges at early stages of development only if $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2}$ and $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} + I\tau < kI < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$. We want to show that under these conditions H entrepreneurs always prefer a capital allocation based on connections to the one based on information acquisition if $\alpha^H \geq \frac{1}{2}$.

To establish this, we need to compare the relevant entrepreneurs' payoffs in a connection-based capital allocation and with information acquisition.

Case A If $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} + I\tau < \frac{g^{-1}\left(A^L\right)}{1-\alpha^H} < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$, then

A.1 For $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} + I\tau < kI < \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$, financiers fund only H entrepreneurs both in a connection-based capital and in an information-acquisition-based capital allocation.

A.2 For $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} < kI < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$, financiers fund both H and L entrepreneurs in a connection-based capital allocation; in an information-acquisition-based capital allocation, financiers fund only H entrepreneurs for low kI.

Case B If $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} < \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} + I\tau < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$, then for $\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)} + I\tau < kI < \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2} + I\tau$, financiers fund H and L in a connection-based capital allocation; in an information-acquisition-based capital allocation, financiers fund only H entrepreneurs.

Notice that H entrepreneurs' payoffs in a connection-based capital allocation and with information acquisition in Case B are the same as their payoffs in Case A.2. So we need to consider only two cases.

First, we compare entrepreneurs' payoffs when only H entrepreneurs are funded. In this case, the capital invested in the general technology is $\Omega_1 = \left(1-\alpha^H\right)k+\omega_1$. From the proof of Proposition 2, we know that if $\omega_1 > 0$, $g(\Omega_1) = A^H$. Clearly, when financiers acquire information and fund only H entrepreneurs, $\Omega_3 < \Omega_1$. This implies that $g(\Omega_3) \geq A^H$. Thus, it cannot be individually rational for a financier to acquire information if $\omega_1 > 0$ in a connection-based capital allocation. Hence, we only have to consider $\omega_1 = 0$. H entrepreneurs' expected payoff in a connection-based capital allocation that is relevant for our comparison is $\left(A^H - g\left(kI\left(1-\alpha^H\right)\right)\right)\frac{kI}{N}$.

When some financiers acquire information and only H entrepreneurs are funded, H entrepreneurs expect to receive a positive rent, $A^H - g\left(\Omega_3\right)$, with probability 1 for attracting capital from financiers who do not acquire information, and with probability $1-\alpha^H$ for attracting capital from financiers who acquire information. H entrepreneurs can attract capital $\frac{\omega_3}{N}$ from financiers who do not acquire information and $\frac{(k-\tau)\left(I-\frac{\omega_3}{k}\right)}{\frac{N}{2}}$ from financiers who acquire information if they observe an L entrepreneur. The 2 at the denominator takes into account that when some financiers acquire information the world is segmented in $\frac{N}{2}$ markets.

Thus, if $\left(A^H - g\left(\Omega_3\right)\right)\left(\frac{2(k-\tau)\left(I-\frac{\omega_3}{k}\right)\left(1-\alpha^H\right)}{N}+\frac{\omega_3}{N}\right) \leq \left(A^H - g\left(kI\left(1-\alpha^H\right)\right)\right)\frac{kI}{N}$, H entrepreneurs prefer a connection-based capital allocation. This condition is equivalent to

$$\left(\frac{A^H - g\left(\Omega_3\right)}{A^H - g\left(kI\left(1-\alpha^H\right)\right)}\right)\left(\frac{2\left(k-\tau\right)\left(I-\frac{\omega_3}{k}\right)\left(1-\alpha^H\right)+\omega_3}{kI}\right) \leq 1.$$

Note that $g\left(\Omega_3\right) \geq g\left(kI\left(1-\alpha^H\right)\right)$ as $\Omega_3 = \left(1-\alpha^H\right)\omega_3 + \left(1-\alpha^H\right)^2\left(I-\frac{\omega_3}{k}\right)(k-\tau) \leq kI\left(1-\alpha^H\right)$. The first term is always less than 1. Also, $2\left(k-\tau\right)\left(I-\frac{\omega_3}{k}\right)\left(1-\alpha^H\right)+\omega_3 < kI$ can be rewritten as $2\left(1-\alpha^H\right)(k-\tau)\left(I-\frac{\omega_3}{k}\right) < k\left(I-\frac{\omega_3}{k}\right)$, which is always satisfied if $\alpha^H \geq \frac{1}{2}$. This implies that if $\alpha^H \geq \frac{1}{2}$, a connection-based capital allocation is always preferred to the capital allocation based on information acquisition at early stages of development.

Next, consider the case in which only H entrepreneurs are funded in the equilibrium with information acquisition but both H and L are funded in a connection-based capital allocation. In the connection-based capital allocation, H entrepreneurs' expected payoff is $\left(A^H - A^L\right)\frac{kI}{N}$,

and therefore is preferred if $\left(A^H - g\left(\Omega_3\right)\right)\left(\frac{2(k-\tau)\left(I-\frac{\omega_3}{k}\right)\left(1-\alpha^H\right)}{N}+\frac{\omega_3}{N}\right) \leq \left(A^H - A^L\right)\frac{kI}{N}$, which is equivalent to $\left(\frac{A^H-g(\Omega_3)}{A^H-A^L}\right)\left(\frac{2(k-\tau)\left(I-\frac{\omega_3}{k}\right)\left(1-\alpha^H\right)+\omega_3}{kI}\right) \leq 1$.

H entrepreneurs always prefer a connection-based capital allocation as each of the components on the left hand side of the inequality is less than one if $\alpha^H \geq \frac{1}{2}$.■

F Proof of Corollary 2

Financiers acquire information and fund both H and L entrepreneurs under two different parameters' configurations. In either case, H and L entrepreneurs are funded both in a connection-based capital allocation and with information acquisition at late stages of development.

First, consider $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} > \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2}$. In this case, financiers acquire information and fund both H and L entrepreneurs if $kI > \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$. An H entrepreneur's rent per unit of capital in a connection-based capital allocation is $A^H - A^L$. With information acquisition, his rent per unit of capital is $\left(1-\alpha^H\right)\left(A^H - A^L\right)$ because it is positive only when he is evaluated with an L entrepreneur.

Since H entrepreneurs can invest $\frac{kI}{N}$ in a connection-based capital allocation, their expected payoff is $\left(A^H - A^L\right)\frac{kI}{N}$. With information acquisition, they can invest $\frac{2(k-\tau)I}{N}$ if they are evaluated with an L entrepreneur. Their expected payoff is then $\left(1-\alpha^H\right)\left(A^H - A^L\right)\frac{2(k-\tau)I}{N}$, which is greater than his payoff in a connection-based capital allocation if and only if $\left(1-\alpha^H\right)\left(A^H - A^L\right)\frac{2(k-\tau)I}{N} \geq \left(A^H - A^L\right)\frac{kI}{N}$. That is, $kI \geq \frac{2\left(1-\alpha^H\right)}{2(1-\alpha^H)-1}I\tau$. Imposing the condition for information acquisition, we obtain that an H entrepreneur prefers information acquisition to a connection-based capital allocation if

$$kI \geq \max\left(\frac{2\left(1-\alpha^H\right)}{2\left(1-\alpha^H\right)-1}I\tau, \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}+I\tau\right). \tag{16}$$

Now, consider $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)} \leq \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2}$. As above, H entrepreneurs' expected payoffs are $\left(A^H - A^L\right)\frac{kI}{N}$ in a connection-based capital allocation and $\left(1-\alpha^H\right)\left(A^H - A^L\right)\frac{2(k-\tau)I}{N}$ with information acquisition. So an H entrepreneur prefers the latter if and only if $kI \geq \frac{2\left(1-\alpha^H\right)}{2(1-\alpha^H)-1}I\tau$.

Together with the condition for information acquisition, this implies

$$kI \geq \max\left(\frac{2\left(1-\alpha^H\right)}{2\left(1-\alpha^H\right)-1}I\tau, \frac{g^{-1}\left(A^L\right)}{\left(1-\alpha^H\right)^2}+I\tau\right). \tag{17}$$

Combining inequalities (16) and (17), we obtain Corollary 2.■

G Proof of Proposition 6

We first give a more formal version of Proposition 6 and then we prove it.

Proposition 9 *In equilibrium, there is under-investment in information acquisition if* $g^{-1}(A^H) < kI < \min\left(\frac{\tau IA^L}{(\alpha^H)^2(A^H-A^L)}+I\tau, \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}\right)$ *when* $\frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-g((1-\alpha^H)kI))} < \min\left(\frac{\tau IA^L}{(\alpha^H)^2(A^H-A^L)}+I\tau, \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}\right)$ *or if* $\frac{g^{-1}(A^L)}{1-\alpha^H} < kI < \frac{\tau IA^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$ *when* $\frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-A^L)} < \frac{\tau IA^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$.

In equilibrium, there is under-investment in information acquisition if information acquisition would increase the aggregate output but a connection-based capital allocation prevails.

Let $M \leq I$ be the mass of financiers acquiring information. First, consider $kI < \frac{g^{-1}(A^L)}{1-\alpha^H}$. In a connection-based capital allocation, financiers who are close to an L entrepreneur invest in the general technology (Case A of Figure 1), which generates an average return of $g\left(\left(1-\alpha^H\right)kI\right)$. With information acquisition, financiers who are close to an L entrepreneur and who, by acquiring information, identify an H entrepreneur can invest in a project with average productivity A^H instead 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 enhances social welfare if and only 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

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

In Case B of Figure 1 $\left(A^L \leq g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{\tau IA^L}{A^H-A^L} + \left(1-\alpha^H\right)\tau I\right)\right)$, a connection-based capital allocation is an equilibrium for $g^{-1}(A^H) < kI < \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$. Hence, condition (18) is satisfied and under-investment in information acquisition occurs if

$$\frac{I\tau}{\left(1-\alpha^H\right)\alpha^H\left(A^H - g\left(\left(1-\alpha^H\right)kI\right)\right)} < \frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H - A^L\right)}+I\tau. \tag{19}$$

Note that $A^L \leq g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{\tau I A^L}{A^H-A^L}+\left(1-\alpha^H\right)\tau I\right)$ can be written as $\frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau \leq \frac{g^{-1}(A^L)}{1-\alpha^H}$. Hence, (19) is equivalent to

$$\frac{I\tau}{\left(1-\alpha^H\right)\alpha^H\left(A^H-g\left(\left(1-\alpha^H\right)kI\right)\right)} < \min\left(\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}+I\tau, \frac{g^{-1}(A^L)}{1-\alpha^H}\right). \tag{20}$$

In Cases C and D of Figure 1 $\left(g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{\tau I A^L}{A^H-A^L}+\left(1-\alpha^H\right)\tau I\right) < A^L\right)$, a connection-based capital allocation is an equilibrium for $g^{-1}(A^H) < kI < \frac{g^{-1}(A^L)}{1-\alpha^H}$. Hence, condition (18) is satisfied and under-investment in information acquisition occurs if

$$\frac{\tau I}{\left(1-\alpha^H\right)\alpha^H\left(A^H-g\left(\left(1-\alpha^H\right)kI\right)\right)} < \frac{g^{-1}(A^L)}{1-\alpha^H} \tag{21}$$

Note that $g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{\tau I A^L}{A^H-A^L}+\left(1-\alpha^H\right)\tau I\right) < A^L$ can be written as $\frac{g^{-1}(A^L)}{1-\alpha^H} < \frac{I\tau A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$. (21) is equivalent to

$$\frac{\tau I}{\left(1-\alpha^H\right)\alpha^H\left(A^H-g\left(\left(1-\alpha^H\right)kI\right)\right)} < \min\left(\frac{I\tau A^L}{\left(\alpha^H\right)^2\left(A^H-A^L\right)}+I\tau, \frac{g^{-1}(A^L)}{1-\alpha^H}\right). \tag{22}$$

This proves the first part of Proposition 9.

Next, consider $kI > \frac{g^{-1}(A^L)}{1-\alpha^H}$. In a connection-based capital allocation, financiers who are close to L entrepreneurs fund the L entrepreneurs (Case A of Figure 1). The average productivity of their investment is A^L. With information acquisition, some financiers who are close to L entrepreneurs are able to fund H entrepreneurs. The social gain due to financiers' 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

$$kI > \frac{\tau I}{\left(1-\alpha^H\right)\alpha^H(A^H-A^L)} \tag{23}$$

Nevertheless, in Cases C and D of Figure 1 $\left(g\left(\frac{1-\alpha^H}{(\alpha^H)^2}\frac{\tau I A^L}{A^H-A^L}+\left(1-\alpha^H\right)\tau I\right) < A^L\right)$, a connection-based financial system is an equilibrium for $\frac{g^{-1}(A^L)}{1-\alpha^H} < kI < \frac{\tau I A^L}{(\alpha^H)^2(A^H-A^L)}+I\tau$. Hence, there is

under-investment in information acquisition if

$$\frac{\tau I}{(1-\alpha^H)\,\alpha^H(A^H-A^L)} < \frac{\tau I A^L}{(\alpha^H)^2\,(A^H-A^L)} + I\tau \tag{24}$$

This proves the second part of Proposition 9.

Note that Proposition 6 follows readily from Proposition 9 as (18) and (23) imply that information acquisition is welfare enhancing only if capital is larger than a certain threshold. Additionally, (20), (22) and (24) are more likely to be satisfied if $1-\alpha^H$ is large as stated in Proposition 6.■

H Proof of Proposition 7

We first give a more formal version of Proposition 7. Then we prove Proposition 7.

Proposition 10 *In equilibrium, there is over-investment in information acquisition if* $kI < \frac{g^{-1}(A^L)}{1-\alpha^H}$ *when* $\frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-g(1-\alpha^H kI))} > \frac{\tau I A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau$*, or if* $\frac{g^{-1}(A^L)}{1-\alpha^H} < kI < \frac{\tau}{(1-\alpha^H)\alpha^H(A^H-A^L)}$ *when* $\frac{\tau I}{(1-\alpha^H)\alpha^H(A^H-A^L)} > \max\left(\frac{\tau I A^L}{(\alpha^H)^2(A^H-A^L)} + I\tau, \frac{g^{-1}(A^L)}{(1-\alpha^H)^2} + I\tau\right)$.

First, consider $kI < \frac{g^{-1}(A^L)}{1-\alpha^H}$. The social gain and cost of information acquisition are computed as in the proof of Proposition 6. It is straightforward to conclude that information acquisition *reduces* social welfare if and only if

$$k < \frac{\tau}{(1-\alpha^H)\,\alpha^H\,(A^H - g\,((1-\alpha^H)\,kI))} \tag{25}$$

In Case B of Figure 1, financiers acquire information and fund H entrepreneurs in equilibrium if $\frac{\tau I A^L}{(\alpha^H)^2(A^H-A^L)} + \tau I < kI < \frac{g^{-1}(A^L)}{1-\alpha^H}$.[13] Hence, condition (25) is satisfied and in equilibrium over-investment in information acquisition occurs if

$$\frac{\tau I A^L}{(\alpha^H)^2\,(A^H-A^L)} + \tau I < \min\left(\frac{\tau I}{(1-\alpha^H)\,\alpha^H\,(A^H - g\,((1-\alpha^H)\,kI))}, \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}\right) \tag{26}$$

This proves the first part of Proposition 10.

[13] Note that for $kI < \frac{g^{-1}(A^L)}{\alpha^L}$ there is no information acquisition in Cases C and D of Figure 1.

Next, consider $kI > \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$. Following the same reasoning of Proposition 6, we obtain that information acquisition *reduces* social welfare if and only if

$$k < \frac{\tau}{(1-\alpha^H)\,\alpha^H(A^H - A^L)} \tag{27}$$

In Cases B and C of Figure 1, financiers acquire information and fund only H entrepreneurs for $\frac{\tau I A^L}{(\alpha^H)^2(A^H - A^L)} + \tau I < kI < \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + \tau I$. Hence, there is over-investment in information acquisition for $kI > \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$ if

$$\frac{\tau I}{(1-\alpha^H)\,\alpha^H(A^H - A^L)} > \max\left(\frac{\tau I A^L}{(\alpha^H)^2\,(A^H - A^L)} + \tau I, \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}\right). \tag{28}$$

Additionally, (27) may be satisfied when financiers acquire information and fund both H and L entrepreneurs (Cases B, C, and D of Figure 1). This is the case if either

$$\frac{\tau I A^L}{(\alpha^H)^2\,(A^H - A^L)} + I\tau < \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + I\tau < kI < \frac{\tau I}{(1-\alpha^H)\,\alpha^H(A^H - A^L)} \tag{29}$$

or

$$\frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + I\tau \leq \frac{\tau I A^L}{(\alpha^H)^2\,(A^H - A^L)} + I\tau \leq kI < \frac{\tau I}{(1-\alpha^H)\,\alpha^H(A^H - A^L)} \tag{30}$$

are satisfied. This implies

$$\max\left(\frac{\tau I A^L}{(\alpha^H)^2\,(A^H - A^L)} + I\tau, \frac{g^{-1}\left(A^L\right)}{(1-\alpha^H)^2} + I\tau\right) < \frac{\tau I}{(1-\alpha^H)\,\alpha^H(A^H - A^L)} \tag{31}$$

Further, (31) implies $kI > \frac{g^{-1}\left(A^L\right)}{1-\alpha^H}$. Then (28), (29), (30), and (31) suggest that when $\frac{g^{-1}\left(A^L\right)}{1-\alpha^H} < kI < \frac{\tau I}{(1-\alpha^H)\alpha^H(A^H - A^L)}$, there is over-investment in information acquisition if (31) is satisfied. This proves the second part of Proposition 10.

Here, (25) and (27) imply that initial capital must be low for information acquisition to be welfare decreasing. Moreover, (26) and (31) imply that information acquisition may emerge in equilibrium for low levels of initial capital if α^H is large. Thus, Proposition 7 follows readily from Proposition 10.■

I Proof of Proposition 8

If all financiers acquire information, H entrepreneurs' expected rent per unit of investment is $\left(1-\alpha^H\right)\left(A^H-g\left(\Omega_3\right)\right)$ or $\left(1-\alpha^H\right)\left(A^H-A^L\right)$ depending on the level of capital in the economy. From the proof of Proposition 2, we know that $\omega_3=0$ and $\Omega_3=\left(1-\alpha^H\right)^2 I\left(k-\tau\right)$ if all financiers acquire information. Clearly, $g\left(\Omega_3\right)$ increases in α^H. So H entrepreneurs' rent per unit of capital invested decreases in α^H. The capital allocated to an H entrepreneur when the rent is positive is $\left(\frac{2(k-\tau)I\left(1-\alpha^H\right)}{N}\right)$, which decreases in α^H. Since H entrepreneurs receive less capital and enjoy a smaller rent per unit of capital invested as α^H increases, their payoff decreases in α^H.■

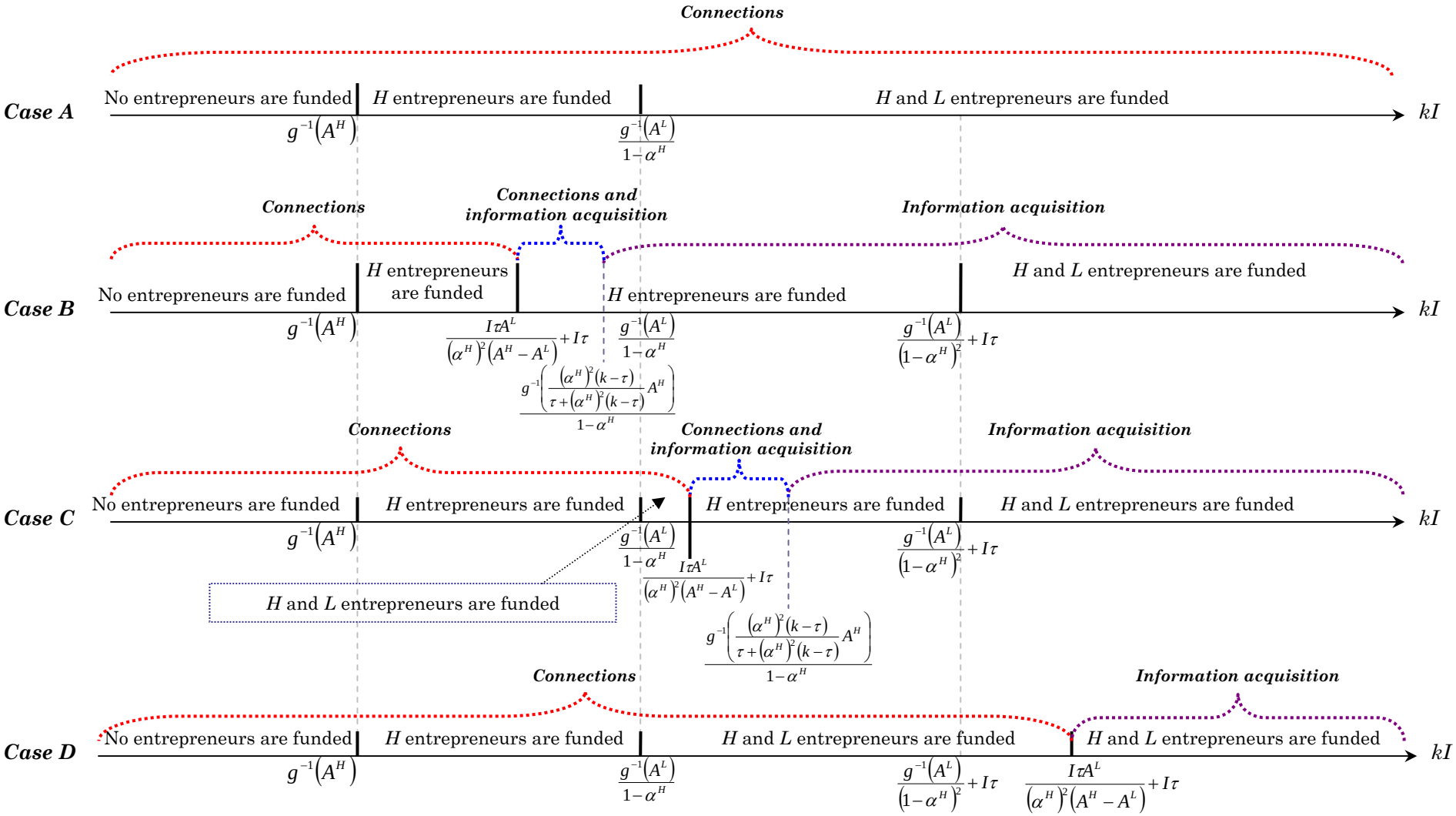


Figure 1.
The figure describes the equilibria for different levels of initial capital (kI). Case A assumes favoritism. Case B refers to $A^L \leq g\left(\frac{\alpha^L}{(\alpha^H)^2}\frac{I\tau A^L}{A^H-A^L}+\alpha^L I\tau\right)$ Case C refers to $g\left(\frac{\alpha^L}{(\alpha^H)^2}\frac{I\tau A^L}{A^H-A^L}+\alpha^L I\tau\right)<A^L<g\left(\left(\frac{\alpha^L}{\alpha^H}\right)^2\frac{I\tau A^L}{A^H-A^L}\right)$ and Case D refers to $A^L \geq g\left(\left(\frac{\alpha^L}{\alpha^H}\right)^2\frac{I\tau A^L}{A^H-A^L}\right)$

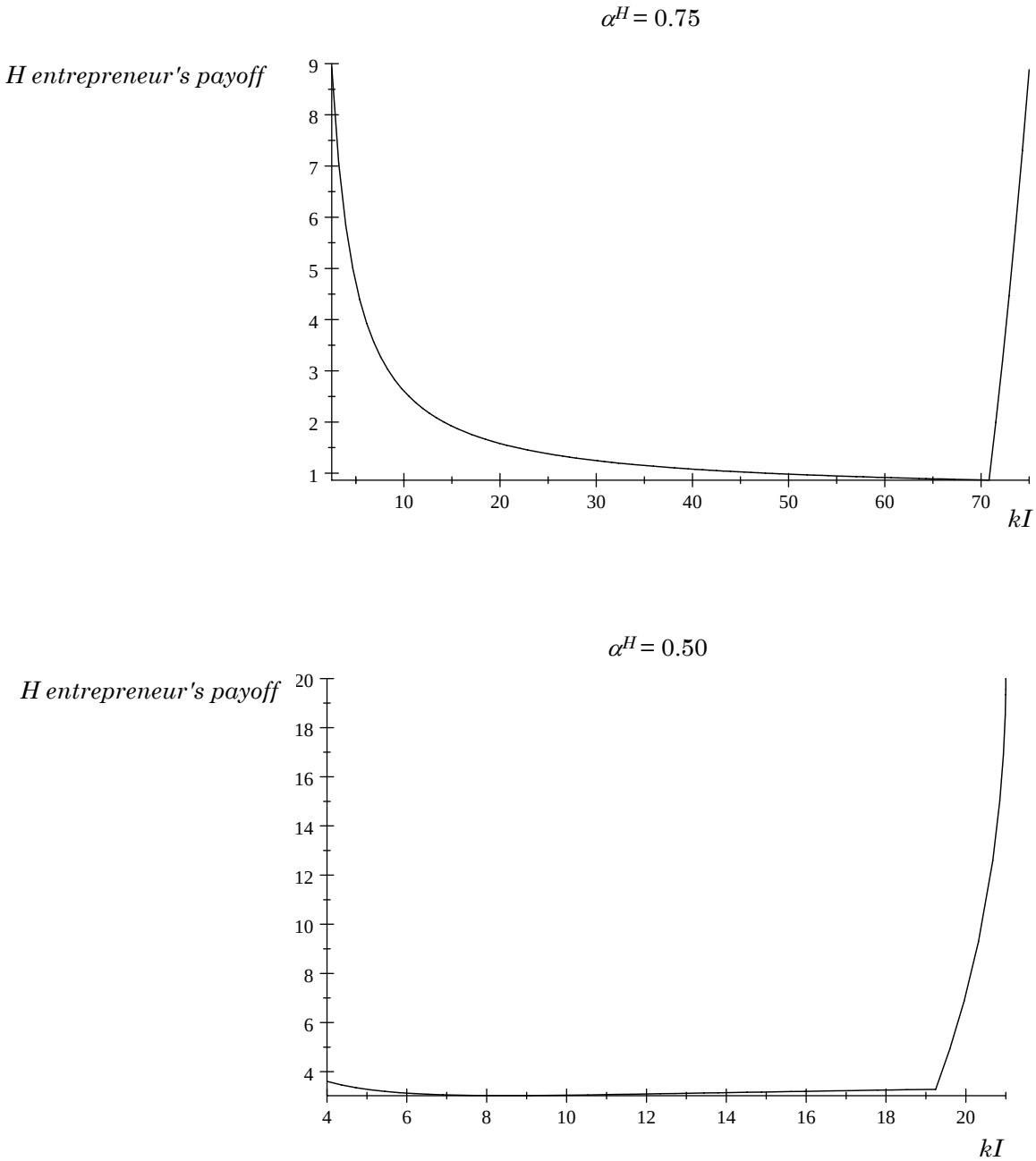
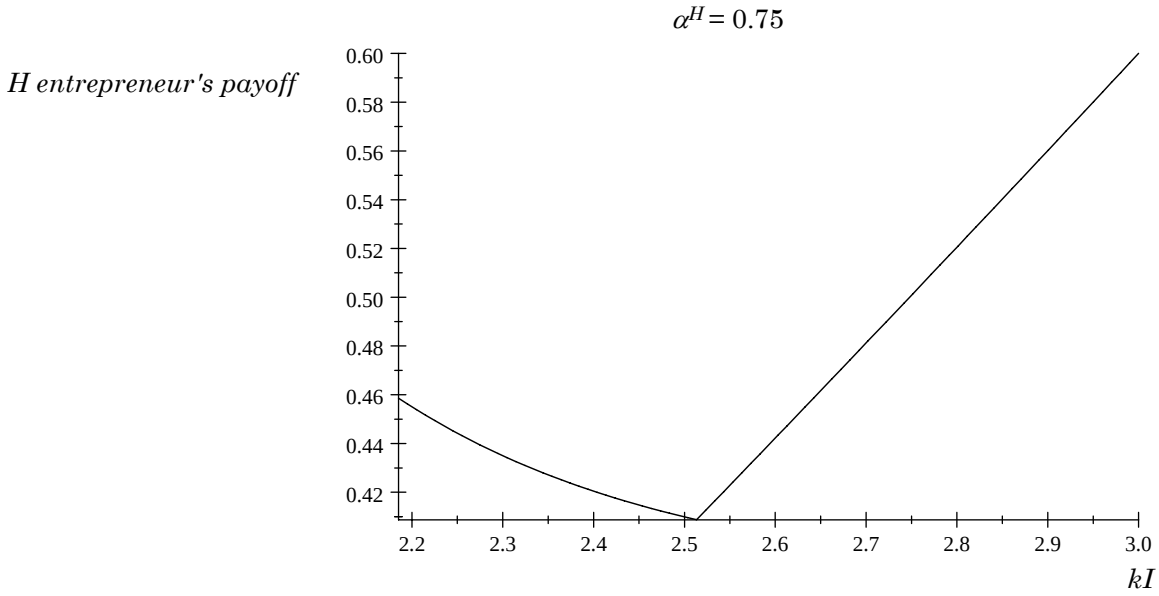


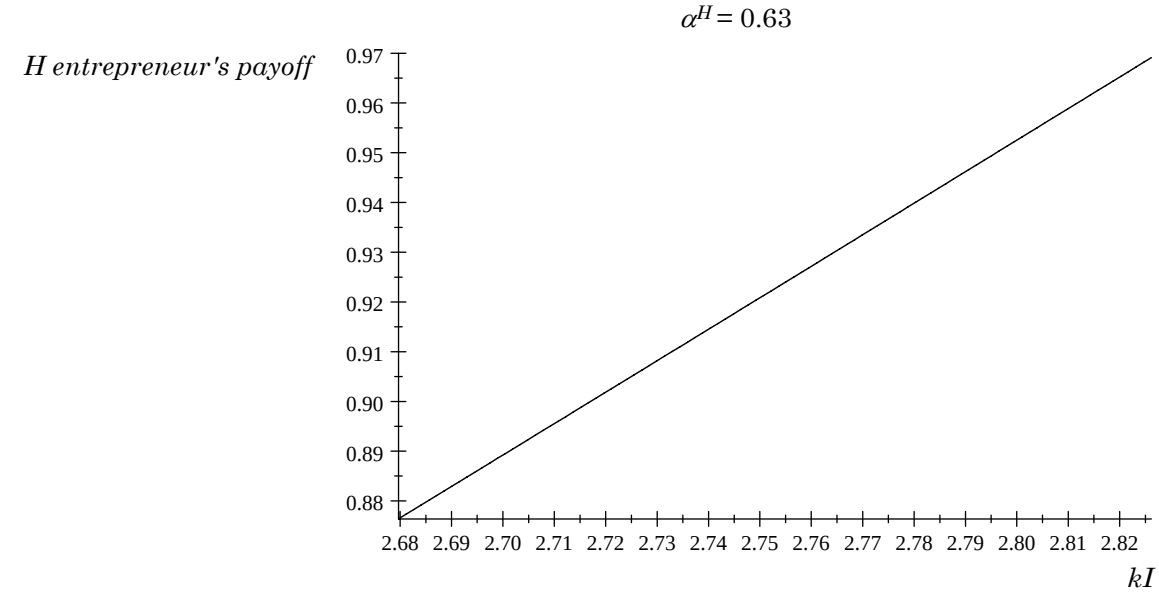
Figure 2. *H* entrepreneur's payoff when financiers acquire information and fund only *H* entrepreneurs

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

Panel A

We make the following assumptions on functional forms and parameters: $g(\omega) = (100 - \omega^2)^{0.5}$, $A^H = 5$, $A^L = 2$, $N = 10$, 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 $I = 2$.