Favoritism or Markets in Capital Allocation?*

Mariassunta Giannetti	Xiaoyun Yu
Stockholm School of Economics,	Kelley School of Business
CEPR and ECGI	Indiana University
mariassunta.giannetti@hhs.se	xiyu@indiana.edu

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Abstract

Casual observation suggests that capital allocation is often driven by favoritism and connections rather than by market mechanisms and information on future expected returns. We investigate when favoritism or markets emerge as an equilibrium outcome in the allocation of capital. We show that when information is unreliable and costly, financiers do not have incentives to investigate distant investment opportunities and allocate capital to entrepreneurs they are familiar with (favoritism). If the pool of saving is relatively small, favoritism can lead to an efficient allocation of resources. As the economy develops and its pool of saving increases, information production and the identification of distant investment opportunities (markets) become crucial for efficient investment decisions. Nevertheless, favoritism may still emerge in equilibrium. Since competition for capital is lower in an equilibrium with favoritism, entrepreneurs can enjoy high rents. Even high quality entrepreneurs may thus have no incentive to join markets with high disclosure standards that can foster information acquisition, but they rather prefer to run inefficiently small firms. Hence, in equilibrium financiers fund even low-quality entrepreneurs if they are familiar with them.

Keywords: Crony capitalism; Disclosure; Information production; Listing requirements.

I Introduction

One of the main functions of a financial system is to facilitate capital flows from individual savers to the highest return investments (Levine, 2006). It is quite common that the highest return investments are new technologies or opportunities that financiers are unfamiliar with. To fund such investment opportunities financiers need to acquire information. However, financial systems often fail to foster information acquisition and to promote flows of capital to high productivity investments and new technologies. 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 businesses or in the ones of family members (Almeida and Wolfenzon, 2006); and that a large number of firms around the world choose not to be listed in a stock market and raise capital only from a narrow circle of family and friends (Pagano, Panetta and Zingales, 1998).

Capital allocation thus seems to be driven by favoritism and connections more than by market mechanisms based on information about future expected returns. Favoritism in capital allocation may arise if financiers are reluctant to acquire information because the available information is imprecise, unreliable or costly. Lack of disclosure can make the return to information acquisition so unattractive that financiers save the cost and pass on potentially good investment opportunities; instead, they choose to fund entrepreneurs whom they are already familiar with because of geographical proximity or personal connections. Increasing disclosure may not necessarily alleviate the problem, as disclosure quality depends on the reliability of information and the corporate governance environment.

In this paper, we explore the conditions under which financiers find it optimal to identify distant investment opportunities instead of favoring close entrepreneurs; we also analyze the implications of information acquisition (or the lack thereof) for capital allocation, investment returns and entrepreneurial rents. We show that when the pool of saving is relatively small, an efficient allocation of resources can be achieved even if financiers do not investigate new investment opportunities and fund only entrepreneurs they are familiar with. This is because the traditional technology, which is not subject to information asymmetry, offers a relatively high rate of return to financiers when the pool of saving is small. To receive funding, a close entrepreneur has to compete with the traditional technology by offering an even higher return, a return that low-productivity entrepreneurs typically cannot afford. Hence, even in the absence of information acquisition, capital is allocated efficiently to the most productive investment opportunities. The only constraint to the growth of high-productivity entrepreneurs is the low level of saving in the economy.

As the economy develops and its pool of saving increases, information production and the identification of distant investment opportunities become crucial for achieving an efficient allocation of capital. A high level of initial saving drives down the return to the traditional technology. In the absence of information acquisition, financiers lack alternative investment opportunities and fund close entrepreneurs even if they have low productivity. High-productivity entrepreneurs' investment instead is lower than optimal as they receive funding only from close financiers, but they could also employ the capital of distant financiers.

Information production has also dramatic effects on entrepreneurial rents and the equilibrium return to financiers' investment. Financiers have limited investment opportunities if they do not acquire information. Entrepreneurs thus face little competition to attract capital and can offer low returns to financiers. This implies that if financiers do not acquire information, not only can low-productivity entrepreneurs be funded, but also high productivity entrepreneurs can enjoy high rents. Hence, in equilibrium high-productivity entrepreneurs may not have incentives to induce information acquisition by establishing higher disclosure standards.

Information acquisition has two opposite effects on high-productivity entrepreneurs' payoffs. On the one hand, lack of information acquisition reduces competition for capital, allowing entrepreneurs to offer a lower return to external financiers and to enjoy a higher rent per unit of capital invested. On the other hand, if financiers do not acquire information, high-productivity entrepreneurs can be funded only by close financiers and thus run inefficiently small firms. This should induce them to voluntarily improve disclosure. We show that high-productivity entrepreneurs favor stricter (even though lower than optimal) disclosure standards only if they can attract a sufficiently large pool of capital.

Hence, high-productivity entrepreneurs may favor an improvement in disclosure standards when the supply of capital increases, for example, triggered by a financial liberalization. This is consistent with the empirical evidence. Stulz (1999) notices that often, financial liberalization not only brings more funds to capital-poor countries, but also improves corporate governance, as more sophisticated foreign investors start monitoring and domestic companies become targets of potential foreign takeovers. In this paper, we highlight another reason why financial liberalization may spur an improvement in corporate governance and especially disclosure: The gain from attracting distant financiers increases and it becomes attractive for entrepreneurs to renounce to some rents.

Interestingly, the incentive to increase disclosure by a few high-quality entrepreneurs may generate spillover effects in the capital market. High disclosure increases financiers' equilibrium return to investment. Hence, entrepreneurs that increase their disclosure standards, for instance by listing in an exchange with higher disclosure requirements, attract all external financiers. Since financiers have no incentive to evaluate entrepreneurs that are known to have low disclosure standards, lower productivity entrepreneurs can only choose to adopt the same disclosure standards in order to attract external funds. In this respect, our model implies that higher disclosure standards are "contagious".

Mandatory disclosure standards are instead crucial in economies with mandatory level of saving and with a closed capital market. In this case, the initial saving is high enough to drive down the return of the traditional technology so that even low productivity entrepreneurs are funded. However, financiers' information acquisition does not bring sufficiently larger investment to high productivity entrepreneurs to compensate for lower rents. Hence, high quality entrepreneurs would not have an incentive to voluntarily join an exchange that requires higher disclosure standards.

This paper contributes to the literature analyzing how different financial systems and institutions may affect economic performance at different stages of development (Allen and Gale, 2000). We show that institutions fostering information acquisition are unimportant for an efficient allocation of saving at early stage of development (low domestic saving). Mandatory disclosure becomes crucial at intermediate stages of development as even high quality entrepreneurs have no incentive to improve disclosure. When an economy reaches high level of development (high domestic saving) or liberalizes capital flows, entrepreneurs may voluntarily improve disclosure, even though to a level that does not completely eliminate inefficiency in capital allocation.

In our model, information acquisition allows financiers to engage in winner-picking, similarly to headquarters in internal capital markets (Stein, 1997). Contrary to Stein however, we do not assume that some financiers (the headquarter in his model) have better information but 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 on the basis of closeness and personal ties, instead of acquiring information on distant investment opportunities, 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 do not acquire information. We abstract from problems of enforcement affecting the pledgeability of output and show that inefficiencies in investment allocation may arise also if financiers do not have an incentive to investigate new investment opportunities. Additionally, we explore the conditions under which financiers have incentives to produce information, the consequences on financiers' equilibrium return to investment and entrepreneurs' incentives to improve disclosure standards.

Our paper is also related to a vast literature on disclosure (Healy and Palepu, 2001). This literature generally analyzes the disclosure decisions of a firm in isolation. We analyze incentives to disclose and the effects of disclosure in an equilibrium model. We show that disclosure affects competition for external funds, and consequently investor equilibrium returns. Like Fishman and Hagerty (1989), we propose that greater disclosure may improve investment efficiency. This arises however for very different reasons. Fishman and Hagerty, like most of the papers in the disclosure literature, analyze a secondary equity market. Disclosure improves efficiency only to the extent that gives stronger incentives to management. We analyze a primary equity market. In this context, disclosure improves efficiency because it allows a more efficient allocation of investment across entrepreneurs with different productivity.

The rest of the paper is organized as follows. Section II describes the model. Section III derives the equilibrium implications. Section IV derives the level of disclosure that a stock exchange competing for attracting entrepreneurs sets. Section V presents the empirical implications of the model and some supportive empirical evidence. Section VI concludes. All proofs are in the Appendix.

II The Model

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

Each entrepreneur is endowed with a constant return to scale technology with productivity A^s, where $s \in \{H, M, L\}$. Productivity level A^s can be interpreted as the return per unit of capital invested. We assume that $A^H \geq A^M \geq A^L$. The prior probabilities of A^H, A^M and A^L are α^H, α^M and $\alpha^L \equiv 1 - \alpha^H - \alpha^M$, respectively. Capital can also be invested in a traditional technology which provides a return per unit of capital invested $g(\omega)$, where ω is the total capital invested in $g(.)$. We assume that the return to the traditional technology is decreasing in the total capital invested and that $\frac{\partial \omega g(\omega)}{\partial \omega} > 0$. The latter assumption captures that the total output from the traditional technology increases in the invested capital. To concentrate on the more important case, we also assume $g(0) > A^H$ to ensure a positive investment in the traditional technology in equilibrium.

Each financier is endowed with an initial capital $k > 0$. Hence, the total capital available in this economy is kI. Financiers can provide capital to the entrepreneurs or invest in the traditional technology. Each financier observes the type of the closest entrepreneur and can invest in the closest entrepreneur or in the traditional technology without cost. For simplicity, we assume that each entrepreneur has the same mass of close financiers. To fund one more entrepreneur, financiers have to acquire information at a cost of τ. One can interpret τ as the cost of becoming aware of a new investment opportunity and evaluating a distant entrepreneur's business. It will be clear later that the return to evaluating an entrepreneur depends on disclosure and entrepreneurs' competition for capital.

Financiers invest in the technology that provides highest return. The return offered by the traditional technology is $g(\omega)$, while entrepreneurs are assumed to compete *a la* Bertrand to attract capital from financiers by offering a return on capital invested. This is equivalent to say that entrepreneurs offer financiers equity in the project at a price that guarantees a given return. Therefore, if a $H-$type entrepreneur offers entrepreneurs return A_L, the financiers will receive a fraction $\frac{A_L}{A_H}$ of the output produced per each unit of capital invested. Similarly, a $L-$type entrepreneur who offer investors a return A_L, promises 100 per cent of the output produced per each unit of capital invested.

The timing of the events is as follows: At time 0, financiers choose whether to acquire information on a distant entrepreneur. Close financiers and financiers who evaluated a given distant entrepreneur observe the entrepreneur's productivity and decide how to allocate their capital between entrepreneur(s) and the traditional technology. At time 1, the returns are realized and payoffs are distributed.

III Information Acquisition and Competition for Capital without Disclosure

A Two polar cases

In this section we first discuss two polar cases, when no entrepreneur is ever funded and when all financiers evaluate all entrepreneurs. We then explore the cases where each financier evaluates a subset of entrepreneurs.

In the first polar case, no entrepreneur is ever funded if:

$$kg(kI) > kA^H$$

Note that the right hand side is the expected payoff from investing in the closest entrepreneur under the assumption that entrepreneurs offer the highest possible returns. The left hand side is the individual payoff of investing in the traditional technology when no entrepreneurs are funded. Therefore when this inequality holds, no entrepreneur receives funding. Consequently, no financier finds it optimal to evaluate a distant entrepreneur because the expected payoff from following such a strategy is at most $(k-\tau)\left(\alpha^H A^H + \alpha^M A^M + \left(1-\alpha^H-\alpha^M\right) A^L\right)$, which is clearly lower than kA^H. Hence, no information acquisition is optimal.

In the second polar case, evaluating all entrepreneurs is optimal if $\tau \simeq 0$. Note that in this case, *any* investor can identify type H entrepreneurs, who are capable of offering a return of $A^H > A^M > A^L$. Entrepreneurs compete *a la* Bertrand to attract capital and end up offering a return of A^H per unit of capital invested. Hence, only type H entrepreneurs are funded. In equilibrium, at time 0, ω_0 such that $g(\omega_0) = A^H$ is invested in the traditional technology, while the rest of the capital, $kI - \omega_0$, is invested in type H entrepreneurs. We assume that entrepreneurs receive equal amount of capital. Therefore, type H entrepreneurs can invest $\frac{kI-\omega_0}{\alpha^H}$.

In what follows, we explore the equilibrium implications of costly information acquisition. Without loss of generality, we assume that a financier can fund at most two entrepreneurs by spending τ. We then explore the equilibrium under the assumptions that a) financiers do not acquire information about distant entrepreneurs and can invest either in the closest entrepreneur or in the traditional technology b) financiers acquire information about one distant entrepreneur and can invest either in the close entrepreneur, in the distant entrepreneur they evaluated or in the traditional technology. Last we compare the payoffs under each intermediate case to arrive to financiers' equilibrium choice.

B No information acquisition

We start with the scenario in which financiers *do not* acquire information, so each financier can fund only the closest entrepreneur.

Denote ω_1 as the equilibrium amount of capital invested in the traditional technology, when each financier does not acquire information and funds at most one entrepreneur. The following proposition states the conditions under which all types of entrepreneurs are funded.

Proposition 1 *Suppose financiers do not invest in information acquisition. In equilibrium, if* $\left(1-\alpha^H-\alpha^M\right)kI > g^{-1}\left(A^L\right)$*, then all types of entrepreneurs are funded and financiers' return to capital is* A^L*.*

The condition in Proposition 1 states that, if an economy's initial capital (kI) is relatively large, the equilibrium return for external financiers is relatively low (A^L). This effect is not due to a large amount of capital chasing limited investment opportunities – under our assumptions, any amount of capital could be invested at return A^H. Indeed, A^H is the equilibrium return in the second polar case in which information is freely available $(\tau \simeq 0)$.

Instead, the low equilibrium return A^L in Proposition 1 is due to the fact that markets are segmented by asymmetric information. In some instances, financiers do not have investment opportunities more profitable than investing in L entrepreneurs. In other cases, M and H entrepreneurs, being aware that financiers do not have investment opportunities alternative to the traditional technology, offer low returns to external financiers.

Proposition 1 implies that if capital is abundant there is a serious capital misallocation. First, since financiers cannot identify H entrepreneurs, they overinvest in the traditional technology. In turn, this drives the return down to A^L. Second, M and L entrepreneurs are funded even though capital could be invested at higher return A^H.

Capital misallocation is less severe if the initial saving of the economy is lower. This is the case because when the initial saving is low, the marginal return to investing in the traditional technology remains relatively higher. Hence low productivity entrepreneurs are not funded because financiers can invest and obtain higher return from the traditional technology. For instance, if $\left(1-\alpha^H\right) kI < g^{-1}\left(A^M\right)$, only H entrepreneurs are funded and the equilibrium return for financiers is $g\left(\left(1-\alpha^H\right) kI\right)$. If $\left(1-\alpha^H-\alpha^M\right) kI < g^{-1}\left(A^L\right)$, only H and M entrepreneurs are funded, and the equilibrium return for financiers is $g\left(\left(1-\alpha^H-\alpha^M\right) kI\right)$. Hence, if the initial saving is smaller than the lower bound $\frac{g^{-1}\left(A^M\right)}{\left(1-\alpha^H\right)}$, the capital allocation is efficient as the equilibrium return to capital is $g\left(\left(1-\alpha^H\right) kI\right)$.

We can obtain interesting insights on different agents' welfare by comparing the payoffs in the equilibrium with no information acquisition with the payoffs in the polar case in which information is freely available. Financiers are clearly better off when information is freely available as they can obtain a return of A^H (which is larger than the return in the case of no information acquisition, whatever the initial saving is).

The opposite, however, is true for entrepreneurs of different types. As shown in the previous Subsection, when information is freely available, neither $L-$type nor M-type entrepreneurs are funded as any amount of capital can be invested at a return of A^H. In the case of no information acquisition, however, both $L-$type and M-type entrepreneurs benefit from information asymmetry by receiving $\frac{kI-\omega_1}{N}$ from financiers, the same amount of funding that H type entrepreneurs receive.

In the equilibrium with no information acquisition, the payoff to L entrepreneurs is zero as they have to distribute all the output to external financiers. However, the payoff to M entrepreneurs is positive – not only will M entrepreneurs receive funding $\frac{kI-\omega_1}{N}$ like the rest of entrepreneurs, but they can also keep $A^M - A^L$ units of output for each unit of investment.

Interestingly, although H entrepreneurs are funded in both cases, they prefer the case of information asymmetry over the case in which information is freely available. In the latter case, since L and M entrepreneurs are not financed, H entrepreneurs are indeed funded with a greater amount of capital: $\frac{kI-\omega_1}{\alpha^H N}$, instead of $\frac{kI-\omega_1}{N}$. The payoffs of H entrepreneurs, however, are zero, as they compete for capital with other H entrepreneurs and end up offering a return of A^H. This does not happen in the case of no information acquisition, in which they have a payoff of $\frac{kI-\omega_1}{N}\left(A^H - A^L\right) > 0$. Clearly, H entrepreneurs are worse off without asymmetric information. High productivity entrepreneurs thus prefer to run smaller firms and offer lower returns to external financiers.

The above results are summarized in the following Corollary.

Corollary 1 *(The welfare of entrepreneurs) All three types of entrepreneurs are (weakly) better off with no information acquisition than with symmetric information. In particular, the payoffs of type M and H entrepreneurs are larger when financiers observe only the type of the closest entrepreneur.*

C Costly information acquisition with perfect signals

We now consider the scenario in which information acquisition about a distant entrepreneur is optimal. For simplicity, when financiers evaluate two entrepreneurs, we assume that all financiers, close to entrepreneur i, evaluate the same entrepreneur j if they choose to acquire information on a distant entrepreneur. That is, we posit that financiers belonging to a given clientele evaluate the same entrepreneurs. This technical assumption is not crucial and simply ensures that investors are equal *ex ante* and *ex post.* It is, however, consistent with empirical evidence suggesting that different companies cater to clienteles of investors who select companies with similar characteristics in terms of size, stock liquidity or dividend yields (Falkenstein, 1996).

In addition, we assume that entrepreneurs can offer different returns to financiers with different evaluation strategies: any financier acquiring information can be offered a return different from that of the financiers who can invest in at most the closest entrepreneur. The fact that financiers' are offered differential treatment finds support in the empirical evidence on the IPO process. Institutional investors that are part of an investment bank's network are expected to participate repeatedly and indiscriminately to an investment bank's deals and to contribute to produce information. In exchange for this commitment, investors that are part of the network 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).[1] Investors can also buy stocks at different prices in the grey market for IPOs (a when-issued market for IPO shares active before the subscription period, especially in European countries).[2] Finally, investors are offered similar securities at different prices depending on their information when companies (or more often banks) raise funds through securitizations (Firla-Cuchra and Jenkinson, 2006).

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

[2] See Cornelli, Goldreich and Ljungqvist (2006).

By spending τ, a financier learns the true type of a distant entrepreneur. The financier evaluates a distant entrepreneur only if she expects a return larger than A^L. Otherwise, she could always obtain A^L by funding the closest entrepreneur or investing in the traditional technology. In equilibrium, the expected return from evaluating an entrepreneur must be at least as large as the payoff from investing in the traditional technology or in the closest entrepreneur. This implies that in an equilibrium with information acquisition $L-$type entrepreneurs are never funded. Depending on parameters' values, there may be two type of equilibria in which either both H and M entrepreneurs are funded or only H entrepreneurs are.

Lemma 1 *When financiers find it optimal to acquire information, L entrepreneurs are never funded. In equilibrium, either only H entrepreneurs or both H and M entrepreneurs are funded.*

In an equilibrium with information acquisition, some financiers may optimally choose to invest their capital in the traditional technology and the closest entrepreneur (without spending τ), while others choose how many entrepreneurs to evaluate. The following Proposition gives conditions under which some financiers actually have an incentive to evaluate a distant entrepreneur. It also describes which types of entrepreneurs receive funding in equilibrium.

Proposition 2 *Assume that acquiring information on a distant entrepreneur involves a cost τ.*

- *Financiers acquire information and only $H-$type entrepreneurs are funded if and only if*

$$\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right)\geq\frac{\tau}{k-\tau} \tag{1}$$

- *When $\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right)<\frac{\tau}{k-\tau}$, financiers acquire information and both H and M entrepreneurs are funded if and only if*

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

- *When $\left(\alpha^H+\alpha^M\right)^2\left(\frac{A^M}{A^L}-1\right)+\left(\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right)<\frac{\tau}{k-\tau}$, financiers do not invest in information acquisition, and all three types of entrepreneurs are funded if*

$$\left(1-\alpha^H-\alpha^M\right)kI>g^{-1}\left(A^L\right). \tag{3}$$

Proposition 2 suggests that financiers acquire information in equilibrium if the magnitude of the return offered by entrepreneurs is sufficiently large to offset the cost of information acquisition τ.

If condition (1) is satisfied, financiers find it optimal to acquire information and fund only H entrepreneurs. This is more likely the case when the probability of encountering a type H entrepreneur is high and/or the productivity of type H entrepreneur strongly dominates the productivity of M entrepreneurs. Note that when $\tau \longrightarrow 0$, this condition always holds, and we are back to the second polar case in which information is freely available.

If condition (1) does not hold, financiers may nevertheless have an incentive to acquire information if condition (2) is satisfied. In this case, it is optimal for financiers to acquire information and to fund both H and M entrepreneurs (instead of H entrepreneurs only). Condition (2) also requires that the return from investigating a distant entrepreneur is sufficiently large; it is more likely to hold if M and H entrepreneurs' productivity is sufficiently larger than A^L, but A^M is relatively similar to A^H; if there are sufficiently many of M and H entrepreneurs; or if the cost of information acquisition is low relative to the capital endowment of the financier.

Lastly, when condition (2) is not satisfied, information acquisition is not optimal and financiers do not evaluate distant entrepreneurs. It initial saving is sufficiently high, all three types of entrepreneurs are funded in equilibrium as described in Proposition 1.

Different equilibrium configurations have dramatic effects on agents' payoffs. Proposition 3 compares payoffs in the case of costly information acquisition with the costless information acquisition benchmark case. .

Proposition 3 *In comparison to the equilibrium with costless information, financiers are offered lower returns and entrepreneurs are better off in the equilibrium with costly information acquisition.*

The intuition of Proposition 3 is straightforward. When information is freely available, financiers can identify all available investment opportunities. Competition for funds among high productivity entrepreneurs drives up the return that must be offered to attract funds. In equilibrium, the return to the financiers is A^H per capital invested, the highest attainable return in a capital-abundant economy (as discussed in Subsection II.B, in such an economy $kI > g^{-1}(A^H)$).

When there is asymmetric information, the expected return of financiers is less than A^H. In a high-saving economy, unless financiers spend a cost of τ to evaluate a distant entrepreneur, they are confined to the investment opportunities of the traditional technology and the closest entrepreneurs and to a return A^L, which is clearly lower than A^H. Even if spending τ and observing the productivity of a distant entrepreneur increases the return to investment in some states of the world, it does not warrant an expected payoff of A^H. In fact, financiers' return do not depend only on the type of entrepreneurs they happen to evaluate, but also on their other investment opportunities. Financiers thus obtain a return A^H only if they have the opportunity of investing in two high productivity entrepreneurs as competition for funds between the two high-productivity entrepreneurs drives up the return to investment. In all remaining cases, financiers identify entrepreneurs with different productivity. In equilibrium, they are offered only the return of their best alternative investment opportunity, which is lower than A^H, and fund the most productive entrepreneurs.

While a reduction in asymmetric information spurs competition for funds and increases the welfare of external financiers who are offered a higher return to investment, it decreases the welfare of entrepreneurs. Information asymmetry affects entrepreneurs' welfare in two ways. First, an improvement in the quality of information (because financiers evaluate distant entrepreneurs or because information is freely available) allows financiers to identify a larger set of investment opportunities and thus allows capital to flow to more productive entrepreneurs. This clearly benefits higher productivity entrepreneurs because a decrease in the misallocation of capital allows them to run larger scale projects.

Second, more information increases competition for external funds. An improvement in the quality of information coincides with an expansion of financiers' investment opportunities. Since entrepreneurs compete to attract external funds, they will have to offer a higher return to external financiers in equilibrium. This decreases the rent entrepreneurs can enjoy per unit of capital invested. Depending on their productivity, entrepreneurs may prefer a higher level of information asymmetry in order to enjoy a higher rent on a smaller scale project.

The capital allocation and the competition effects influence entrepreneurs according to their type: L entrepreneurs's payoff is not affected by the extent of financiers' information. They are never funded if financiers observe a distant entrepreneur. M and H entrepreneurs are better off when information acquisition is costly. Consider M entrepreneurs first. When information is costly and financiers evaluate a distant entrepreneur, if condition (2) is satisfied, M entrepreneurs benefit from asymmetric information by receiving funding from financiers. In contrast if information is freely available, capital is allocated only to H entrepreneurs in equilibrium. In addition, since financiers are only aware of a subset of investment opportunities, competition for external funds is limited. When financiers encounter investment opportunities with different productivity, they only fund the most productive entrepreneur in equilibrium. Financiers' lack of alternative but equally competitive investment opportunities allows the most productive entrepreneur to extract a rent by offering a lower return on external funds.[3]

Finally, consider H entrepreneurs. H entrepreneurs are always funded. However, the expected payoff of H entrepreneurs is zero when information is freely available because, with probability 1, they have to compete for funding with other H entrepreneurs. This implies that they enjoy no rents even if they can run larger scale projects. Hence they are better off in the case of information asymmetry.

The rationale behind this is the following: When information is costly, even when only H entrepreneurs are funded (the case in competition for funding is stronger because investors have better alternative investment opportunities), with some probability, an H entrepreneur offers A^H in competing for capital if evaluated with another H entrepreneur. With positive probability, however, he is evaluated with an M or L entrepreneur. In this case, competition for capital is limited because external financiers lack alternative investment opportunities. Thus, by offering a return lower than A^H per unit of capital invested, an H entrepreneur can attract funding and enjoy a positive rent. This implies that entrepreneurs are better off when information acquisition is costly compared to when information is freely available.

Proposition 4 compares agents' payoffs in the case of costly information acquisition with the no information acquisition benchmark case.

Proposition 4 *In comparison to the equilibrium with no information acquisition, financiers are offered higher returns and entrepreneurs can be either better off or worse off in the equilibrium with costly information acquisition.*

Proposition 4 suggests that financiers' returns are higher with costly information acquisition.

[3] Clearly, M entrepreneurs' payoff is zero in the equilibrium with information acquisition if condition (1) is satisfied. In this case, M entrepreneurs, like L entrepreneurs, have zero payoff both with costly and costless information acquisition.

Information acquisition expands the set of possible investment opportunities available to financiers, increases competition for funds, and drives up equilibrium returns. Financiers actually find it optimal to acquire information if the increase in expected return is sufficient to compensate the cost τ.

Entrepreneurs however do *not* always benefit from information acquisition. L entrepreneurs receive funding only when financiers do not investigate distant entrepreneurs. In this case, even if they are funded, L entrepreneurs have zero payoff as they distribute all the output to external financiers. As noted above, L entrepreneurs' payoff does not depend on financiers' quality of information.

M entrepreneurs' payoffs can be higher in the case when financiers do not evaluate distant entrepreneurs. When financiers' acquire information, M entrepreneurs may receive more funding than in the case of no information, as some capital originally initially allocated to L entrepreneurs can now be directed to M entrepreneurs. However, M entrepreneurs enjoy a higher rent per unit of capital invested when financiers fund only the closest entrepreneurs. Depending on the relative importance of the increased ability to invest in comparison to the lower expected rent per unit invested, M entrepreneurs may be either worse or better off when information is acquired. Clearly, M entrepreneurs are worse off if parameters are such that they are not funded in the equilibrium with information acquisition.

More importantly, also H entrepreneurs are not necessarily better off in the case of information acquisition than with no information acquisition. Since all firms are funded with no information acquisition, H entrepreneurs benefit from financiers' information acquisition by receiving more capital. Nevertheless, depending on the parameter values, they may be better off when there is no information acquisition. In fact, even if they have to run smaller scale projects, they expect to keep a larger share of the output for each unit invested, like M entrepreneurs.

IV Disclosure and stock exchanges' competition for listings

In the previous section, we have shown that financiers' information on the available investment opportunities –which depends on their incentives to invest in information acquisition– affects dramatically entrepreneurs' payoffs. This suggests that an exchange can compete to attract entrepreneurs by setting disclosure standards that affect the reliability and the cost of information.

To explore this issue, in this section we relax the assumption that financiers learn the true type of the closest entrepreneur and of any entrepreneur they evaluate. We recognize that information acquisition is unlikely to completely overcome information asymmetry and therefore financiers can at best observe a noisy signal of an entrepreneur's productivity. In this context, we analyze how agents' equilibrium payoffs vary with the precision of the signal and the cost of acquiring information. We then explore how an exchange would set disclosure standards affecting the precision of the signal and the cost of information acquisition in order to attract entrepreneurs.[4]

Disclosure affects 1) the cost of acquiring information like in the previous section, and 2) how informative the signal on entrepreneurs' type is. We assume that financiers observe a signal of an entrepreneur's true type: $\sigma \in \{s, \varnothing\}$. With probability t, the signal is fully revealing the entrepreneur's type, $s \in \{L, M, H\}$. With probability of $1 - t$, the signal is not informative, and financiers expect the entrepreneur to have productivity $\overline{A} \equiv \alpha^H A^H + \alpha^M A^M + \alpha^L A^L$, as they cannot update their beliefs. We continue to assume that financiers observe the signal on the closest entrepreneur without cost, but pay τ to be able to invest and observe a signal on a distant entrepreneur. All financiers observe the same signal on a given entrepreneur.

Here the parameter t captures transparency. We analyze how the equilibrium described in Proposition 2 and agent's payoffs vary with t. The equilibrium without information acquisition, described in Proposition 1, does not vary with t as financiers expected return is A^L independently of the firm type.

Similarly to the previous section, there are two types of equilibria with costly information acquisition, in which either only H entrepreneurs are funded, or both H and M entrepreneurs are funded. Proposition 5 describes the equilibrium conditions for $\overline{A} < A^M$, and Proposition 6 describes the equilibrium conditions for $\overline{A} > A^M$.

Proposition 5 *Suppose that i) $\overline{A} < A^M$ ii) acquiring information involves a cost iii) financiers observe an informative signal on an entrepreneur's type with probability t.*

[4] The excercize we propose is similar to Focault and Parlour (2004) who develop a model in which stock exchanges compete for IPO listings. Focault and Parlour however assume that stock exchanges compete by setting listing fees and trading costs. We consider how exchanges can attract entrepreneurs setting disclosure standards.

- *Financiers acquire information and only $H-$type entrepreneurs are funded if and only if*

$$t^2\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right)\geq\frac{\tau}{k-\tau} \tag{4}$$

- *When* $t^2\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right)<\frac{\tau}{k-\tau}$*, financiers acquire information and fund entrepreneurs unless they observe a signal L if and only if*

$$\left(t\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right)+\left(t\left(\alpha^H+\alpha^M\right)\right)^2\left(\frac{A^M}{A^L}-1\right)+(1-t)\left(1+t-2t\alpha^L\right)\left(\frac{\overline{A}}{A^L}-1\right)\geq\frac{\tau}{k-\tau} \tag{5}$$

- *When* $\left(t\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right)+\left(t\left(\alpha^H+\alpha^M\right)\right)^2\left(\frac{A^M}{A^L}-1\right)+(1-t)\left(1+t-2t\alpha^L\right)\left(\frac{\overline{A}}{A^L}-1\right)<\frac{\tau}{k-\tau}$*, financiers do not invest in information acquisition and fund the closest entrepreneur even after observing an L signal if*

$$t\left(1-\alpha^H-\alpha^M\right)kI>g^{-1}\left(A^L\right). \tag{6}$$

An equilibrium with an efficient allocation of capital –in which only H entrepreneurs are funded– is less likely to exists if the signal is relatively more uninformative (t goes down.). Condition (4) in Proposition 5 is more restrictive than the analogous condition (1) in Proposition 2.[5] The difference between H and M entrepreneurs' productivity thus must increase as t goes down for an equilibrium in which only H entrepreneurs are funded to exist.

For a larger range of parameters than in Proposition 2 financiers who acquire information fund entrepreneurs unless they observe a signal L. This implies a loss of efficiency as L entrepreneurs are funded unless the signal reveals their type because (as we prove in the Appendix) the *ex ante* expected return $\overline{A}$ is greater than the return to the traditional technology g in equilibrium. Low transparency decreases financiers' return to capital and entrepreneurs enjoy higher rents for unit of capital invested when lower productivity entrepreneurs are funded.

Even though lower transparency decreases financiers' equilibrium returns, it does not necessarily weaken incentives to acquire information on distant entrepreneurs. To see this, note that (5) can

[5] When t moves to 1, condition (4) in Proposition 5 converges to (1) in Proposition 2.

be re-written as

$$\left(\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right)+\left(\alpha^H+\alpha^M\right)^2\left(\frac{A^M}{A^L}-1\right)\geq\left(\frac{\tau}{k-\tau}-(1-t)\left(1+t-2t\alpha^L\right)\left(\frac{\overline{A}}{A^L}-1\right)\right)\frac{1}{t^2}$$

Condition (5) is less restrictive than condition (2) in Proposition 2 if and only if

$$\frac{\tau}{k-\tau}-\left(1-\frac{2t\alpha^L}{1+t}\right)\left(\frac{\overline{A}}{A^L}-1\right)<0 \tag{7}$$

Clearly, the left hand side of the inequality (7) increases in t, τ, α^L and $\overline{A}$, and decreases in A^L and k. Condition (5) is thus more likely to be satisfied than condition (2) in Proposition 2 if the signal is less precise, the cost of information acquisition is low, the initial capital is large, the *ex ante* expected return offered by an average entrepreneur is high, the probability of encountering a low productivity entrepreneur is small. If all these conditions are satisfied, financiers are more likely to acquire information on distant entrepreneurs.

If condition (7) is satisfied and

$$\left(\frac{\tau}{k-\tau}-(1-t)\left(1+t-2t\alpha^L\right)\left(\frac{\overline{A}}{A^L}-1\right)\right)\frac{1}{t^2}\leq$$

$$\leq\left(\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right)+\left(\alpha^H+\alpha^M\right)^2\left(\frac{A^M}{A^L}-1\right)\leq\frac{\tau}{k-\tau}$$

financiers acquire information on a distant entrepreneur only if the signal is imperfect.

On the other hand, when the cost of information acquisition is high, the initial capital k is low, the signal is more precise (higher t), and the *ex ante* expected productivity $\overline{A}$ is lower relative to the return that an L entrepreneur can offer, (7) is less likely to hold, and therefore (5) is more restrictive than condition (2) in Proposition 2. In this case, financiers are less likely to evaluate distant entrepreneurs when the signal is imperfect.

When the signal is imprecise, not only low productivity entrepreneurs are more likely to receive funding, but all types of entrepreneurs also can extract higher rents per unit of capital invested. To illustrate this, consider the case in which financiers encounter two H entrepreneurs, but only one signal is informative. The only credible return that an entrepreneur of unknown type can offer is $\overline{A}$. The H entrepreneur whose type has been revealed by the signal has no incentive to offer a return higher than $\overline{A}$ to attract capital.[6] The H entrepreneur thus receive a positive rent per unit of capital invested. This is in sharp contrast with the case in which both signals are informative. In this case, Bertrand competition leads the two entrepreneurs to offer return A^H per unit of capital invested. So the rent of the two H entrepreneurs is zero. For this reason even H entrepreneurs may prefer a level of disclosure that makes information costly and the signal imperfect.

Lastly, note that condition (6) is more restrictive than (3) in Proposition 2, as $t < 1$. This implies that with an imperfect signal, financiers are less likely to fund L entrepreneurs when they do not acquire information on distant entrepreneurs.

The Proposition 6 describes the equilibrium when $\overline{A} > A^M$.

Proposition 6 *Suppose $\overline{A} > A^M$. When it is costly to acquire information and information is imprecise, financiers' decision on information acquisition and capital allocations are as follows:*

- *Financiers acquire information and only $H-$type entrepreneurs are funded if and only if*

$$t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - \overline{A}}{A^M}\right) + \left(1 - t + t\alpha^H\right)^2 \left(\frac{\overline{A}}{A^M} - 1\right) \geq \frac{\tau}{k - \tau} \tag{8}$$

- *When $t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - \overline{A}}{A^M}\right) + \left(1 - t + t\alpha^H\right)^2 \left(\frac{\overline{A}}{A^M} - 1\right) < \frac{\tau}{k-\tau}$, financiers acquire information and fund entrepreneurs unless they observe a signal L if and only if*

$$t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - A^M}{A^L}\right) + \left(1 - t\alpha^L\right)^2 \left(\frac{A^M}{A^L} - 1\right) + (1-t)\left(1 - t + 2t\alpha^H\right)\left(\frac{\overline{A} - A^M}{A^L}\right) \geq \frac{\tau}{k - \tau} \tag{9}$$

- *When $t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - A^M}{A^L}\right) + \left(1 - t\alpha^L\right)^2 \left(\frac{A^M}{A^L} - 1\right) + (1-t)\left(1 - t + 2t\alpha^H\right)\left(\frac{\overline{A} - A^M}{A^L}\right) < \frac{\tau}{k-\tau}$, financiers do not invest in information acquisition and fund the closest entrepreneur even after observing an L signal if*

$$t\left(1 - \alpha^H - \alpha^M\right) kI > g^{-1}\left(A^L\right).$$

Proposition 5 and 6 imply that the signal's precision and financiers' willingness to acquire information may have a large effect on entrepreneurial rents. A stock exchange can thus succeed in

[6] In the Appendix, we prove that $\overline{A} > g$ in equilibrium.

attracting entrepreneurs' new equity issues by setting a level of disclosure that maximizes entrepreneurs' payoffs. We show that in this way a dominant stock exchange emerges in equilibrium. Note that an exchange that attracts all H entrepreneurs attracts all entrepreneurs' types in equilibrium. This follows readily from the fact that knowing that all high-quality entrepreneurs are listed in a given exchange, financiers expect higher payoffs from investigating investment opportunities in such an exchange rather than in exchanges where the proportion of M and L entrepreneurs is higher. Hence, if an exchange can attract all (or a higher proportion of) high-quality entrepreneurs, it attracts all financiers as well. Lower quality entrepreneurs thus have no other choice than migrating to such an exchange if they want to attract funding.

This implies that a stock exchange that sets t and τ to maximize the payoff of H entrepreneurs attracts all entrepreneurs and all financiers. First, consider the case in which H entrepreneurs are better off with no information acquisition. In this case, the exchange can attracts all entrepreneurs and consequently all financiers by setting t so high and/or τ so low that financiers have no incentive to acquire information.

Second, assume that H entrepreneurs are better off in the region in which financiers acquire information and fund both H and M entrepreneurs. In this case the stock exchange has to set t in a way that (5) is satisfied but (4) is not, if $\overline{A} > A^M$ (similarly, if $\overline{A} > A^M$, t must be such that (9) is satisfied but (8) is not).

Note that a stock exchange has no incentive to increase to set disclosure at the level that t is such that only H entrepreneurs are satisfied (formally, this implies that (4) or (8) are satisfied) as this would drive to zero entrepreneurial rents.

V Empirical implications

In this section we discuss our theory's implications and the empirical evidence that appears to be consistent with these implications.

Implication 1. Allocation of capital based on personal connections is efficient at early stages of development.

Allocation of capital based on personal connections is widespread at early stages of development. For instance, 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, investors bought bank stocks as favoritism guaranteed investors high and steady earnings. Local banks thus fueled the region economic growth and development. As the century progressed, bank performance declined and to attract savers banks started to issue deposits and developed new credit standards for evaluating the creditworthiness of 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 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 investors (banks in this context) to acquire information on distant investment opportunities.

Favoritism in capital allocation is not restricted to New England in the early ninetieth century as there is plenty of evidence that banks in other parts of the United States and in Britain engaged in similar behavior during this period and that this practice is widespread in emerging markets (Lamoreaux, 1996).

Favoritism does not affect only bank lending. Business groups consisting of legally independent firms that are bound together by formal and informal ties are often thought to be drivers of economic growth in the early phase of development of a country and to hamper further development later on (Khanna and Yafeh, 2006). Business groups may be thought as a way to allocate funding to close entrepreneurs without recurring to information acquisition. As our model shows, this leads to an efficient allocation of investment in early phases of development when saving is low; but it decreases investment aggregate productivity below the optimal level as saving increases.

Implication 2. Financial liberalizations are followed by an improvement in transparency.

High productivity entrepreneurs have an incentive to voluntarily increase disclosure only if they anticipate that this brings a large increase in investment. This generates the following empirical implication. Firms should disclose more after financial liberalization because of the possibility of attracting large amounts of capital from foreign investors. We are not aware of any empirical work testing this implication that is particular to our model. It appears however that such an implication would be testable.

There exists indirect empirical evidence in support of the implication of the model. When companies cross-list in a foreign exchange, especially if in the U.S., they voluntarily commit to disclose more. Pagano Roell and Zechner (2002) show that this decision is concomitant to raising more capital, as our model suggests.

Implication 3. Financiers' expected return is higher when competition for external funds is strongest.

This implication is consistent with the findings of Lowry and Schwert (2002) and Beneviste Ljungqvist, Willhelm and Yu (2003) who show that financiers have larger initial returns on IPOs during "hot" markets. In other words, financiers are offered new equity issues at better prices when they have more alternative investment opportunities. This is consistent with the mechanism of our model that suggests that competition for attracting external funds is an important determinant of investors' returns.[7]

Implication 4. Transparency and investor protection spur information production and improve capital allocation.

Our model implies that economic agents are more inclined to produce information when this is cheaper, more precise and reliable. Hence we should observe that in countries where firms (voluntarily or involuntarily) disclose more, more firm-specific information is available. This is consistent with the findings of Morck, Yeung and Yu (2000) who show that the firm-specific return variation is positively correlated with investor protection and propose that investor protection promotes information acquisitions. Durnev, Morck, Yeung and Zarowin (2003) also show that firm-specific return variation is indeed associated with future earnings, indicating that more information about future performance is incorporated in current stock returns. Fox, Durnev, Morck and Yeung (2003) further document that improvements in mandatory disclosure effectively increase price accurateness. Finally, Durnev, Morck and Yeung (2004) find that the firm-specific variation in stock returns is positively associated to a measure of economic efficiency of corporate investment, which is again consistent with the mechanism suggested by our model.

Implication 5. Exchanges fail to attract entrepreneurs if disclosure requirements become too demanding.

[7] In this respect we provide an explanation, alternative to prospect theory (Loughran and Ritter, 2002), for why entrepreneurs are generally content to leave money on the table during hot issues.

This implication of the model is consistent with the post Sarbanes-Oxley empirical evidence. The Sarbanes-Oxley Act, introduced in 2002, considerably increased disclosure requirements for companies listed in U.S. stock exchanges. Marosi and Massoud (2006) show that as a consequence an increasing number of foreign firms has decided to exit the U.S. security market by deregistering. Over the 2001-2005 period, the number of exchange listed ADRs outstanding dropped from 610 to 487. At the same time, the London Stock Exchange with lower financial disclosure has had success in attracting foreign listings (Economist, 2006).

This empirical evidence confirms the implication of our model that an exchange may fail to attract listings if disclosure standards are set too high.

VI Conclusions

This paper explains under which conditions favoritism emerges as an equilibrium mechanism for the allocation of capital. It shows that markets in which financiers acquire information and fund distant investment opportunities are unnecessary for reaching an efficient capital allocation at early stages of development when the initial saving is low. As an economy accumulates capital, acquisition of information on distant investment opportunities becomes crucial for achieving an efficient allocation of investment. Nevertheless, entrepreneurs may not have an incentive to join exchanges that require higher disclosure standards because they enjoy higher rents when financiers have information only on a limited sets of investment opportunities.

Our model can explain why favoritism seems to spur growth in developing economies and to hamper the performance of more developed countries. Additionally, it can explain why exchanges tend to lose listed companies and fail to attract new listings if they set disclosure standards too high.

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A Appendix

A Proof of Proposition 1

In equilibrium, funding an entrepreneur and investing in the traditional technology must have the same return. Otherwise, some financiers would find it optimal to deviate. This implies: $g(\omega_1) = A^L$. No financier thus has incentive to deviate. In particular, no financier would have an incentive to evaluate other entrepreneurs because the expected return is only A^L. This implies that funding all three types of entrepreneurs is an equilibrium. It remains to be shown that neither funding only H type nor funding only H and M types of entrepreneurs can be an equilibrium.

Suppose funding only H type entrepreneurs is an equilibrium. Then, Bertrand competition leads to an entrepreneur offering the return of the traditional technology instead of A^H if he is found to be H type. This suggests that there exists $\Omega \equiv \omega + \left(1-\alpha^H\right)\left(I - \frac{\omega}{k}\right)k$ so that $g(\Omega) = \alpha^H g(\Omega) + \left(1-\alpha^H\right) g(\Omega)$. That is, the return to the traditional technology must be the same as the return of evaluating an entrepreneur and funding him only if he is H type. For this to be an equilibrium, we need $\Omega < \omega_1$. From the definition of Ω readily follows that $\Omega > \left(1-\alpha^H\right)kI$. The assumption on parameters stated in Proposition 1 implies that: $\left(1-\alpha^H\right)kI > \omega_1 = g^{-1}\left(A^L\right)$. Hence, the inequality $\Omega < \omega_1$ can never be satisfied. This implies that the only equilibrium with no information acquisition involves that all entrepreneurs are funded in equilibrium. Therefore it can never be optimal to fund $H-$type entrepreneurs only. Similarly, we prove that the parameters condition in Proposition 1 implies that it can never be optimal to fund only $M-$type entrepreneurs.

B Proof of Lemma 1

Equilibrium where a subset of financiers evaluates two entrepreneurs and when both type H and type M firms can be funded.

In equilibrium some financiers may find it optimal not to acquire information and invest either in the closest entrepreneur or in the traditional technology. The entrepreneur, aware of the alternative investment opportunities of the investor, offers at most the return of the traditional technology, g.

In an equilibrium in which both H and M entrepreneurs are funded, $A^M \geqslant g$. Hence, H and M entrepreneurs will receive funding by financiers who do not acquire information and offer return g. If the closest entrepreneur is $L-$type, the financier invest in the traditional technology.

A financier acquiring costly information may receive the following signals:

- Both firms are type H, with probability of $\left(\alpha^H, \alpha^H\right)$. In this case, due to the competition, both firms are offering return of $A^H > g$ and receive the same amount of funds.
- One firm is type H and the other is type M, with probability of $\left(\alpha^H, \alpha^M\right)$ and $\left(\alpha^M, \alpha^H\right)$. In this case, both firms are offering return of A^M (since type H firm has no incentive to offer $A^H > A^M \geqslant g$) and are funded.
- One firm is type H and the other is type L, with probability of $\left(\alpha^H, \alpha^L\right)$ and $\left(\alpha^L, \alpha^H\right)$. In this case, type H firm offers $g > A^L$ and is funded. Type L firm is not funded (it cannot offer g).
- One firm is type M and the other is type L, with probability of $\left(\alpha^M, \alpha^L\right)$ and $\left(\alpha^L, \alpha^M\right)$. In this case, type M firm offers $g > A^L$ and is funded. Type L firm is not funded (it cannot offer g).

Notice also that with a probability $\left(\alpha^L\right)^2$, an investor learns that both firms are (L, L) and invests in the traditional technology.

So the capital poured into the traditional technology should be

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

where ω_2 is the capital invested into the traditional technology from investors who choose not to acquire information about the distant entrepreneur and who find the closest entrepreneur is of type L. The equilibrium return of investors who do not acquire information is always $g\left(\Omega_2\right)$.

The expected return from acquiring information and funding type H and M entrepreneurs only should be

$$\left(\alpha^H\right)^2 A^H + \left(2\alpha^H \alpha^M + \left(\alpha^M\right)^2\right) A^M + \left(2\alpha^H \alpha^L\right) g\left(\Omega_2\right) + \left(2\alpha^M \alpha^L\right) g\left(\Omega_2\right) + \left(\alpha^L\right)^2 g\left(\Omega_2\right) \quad (10)$$

Note that in (10), the first component is when an investor learns both signals are (H, H), and type H firms are offering return of $A^H > g(\Omega_2)$. The second component is when an investor learns signals are (H, M), (M, M) or (M, H), and both firms are offering $A^M > g(\Omega_2)$. The third component is when an investor learns signals are (H, L) or (L, H), and firm H offers $g(\Omega_2)$. The forth component is when an investor learns signals are (M, L) or (L, M), and firm M offers $g(\Omega_2)$. The last component is when an investor learns signals are (L, L) and invests his capital into the traditional technology for a return $g(\Omega_2)$.

In equilibrium, the expected dollar return from acquiring information and funding type H and M entrepreneurs should be at least as large as the expected dollar return from not acquiring information and expecting return: $g(\Omega_2)k$. Clearly, if the expected return from acquiring information is strictly larger, $\omega_2 = 0$. Formally, the expected return of acquiring information must be such that:

$$\begin{aligned}&\left[\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\alpha^M + \left(\alpha^M\right)^2\right) A^M + \left(2\alpha^H\alpha^L\right) g(\Omega_2) + \left(2\alpha^M\alpha^L\right) g(\Omega_2) + \left(\alpha^L\right)^2 g(\Omega_2)\right](k-\tau) \\ \geqslant\ & g(\Omega_2)k\end{aligned}$$

which is equivalent to

$$\left[\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\alpha^M + \left(\alpha^M\right)^2\right) A^M\right](k-\tau) \geqslant \left[k - \left(1 - \left(\alpha^H + \alpha^M\right)^2\right)(k-\tau)\right] g(\Omega_2)$$

That is,

$$g(\Omega_2) \leqslant \frac{\left[\left(\alpha^H\right)^2 A^H + \left(2\alpha^H\alpha^M + \left(\alpha^M\right)^2\right) A^M\right](k-\tau)}{k - \left(1 - \left(\alpha^H + \alpha^M\right)^2\right)(k-\tau)}$$

This is an equilibrium because financiers who acquire information and evaluate one more entrepreneur have no incentive to deviate by not acquiring information as such kind of deviation still guarantees the same or a lower payoff. The $\frac{\omega_2}{k}$ financiers who do not acquire information do so only if this guarantees exactly the same expected payoff. The previous equilibrium is dominant from the point of view of financiers' equilibrium return if it guarantees a larger payoff than the equilibrium without information acquisition:

$$\frac{\left[\left(\alpha^{H}\right)^{2}A^{H}+\left(2\alpha^{H}\alpha^{M}+\left(\alpha^{M}\right)^{2}\right)A^{M}\right](k-\tau)}{k-\left(1-\left(\alpha^{H}+\alpha^{M}\right)^{2}\right)(k-\tau)}>A^{L}. \tag{11}$$

Additionally, M entrepreneurs must be able to offer a return $g(\Omega_2)$. Hence the following inequality must also be satisfied:

$$\frac{\left[\left(\alpha^{H}\right)^{2}A^{H}+\left(2\alpha^{H}\alpha^{M}+\left(\alpha^{M}\right)^{2}\right)A^{M}\right](k-\tau)}{k-\left(1-\left(\alpha^{H}+\alpha^{M}\right)^{2}\right)(k-\tau)}<A^{M} \tag{12}$$

Equilibrium where a subset of financiers acquire information but only fund firms that are of type H.

Now suppose only type H firms are funded. Like before, in equilibrium some financiers may find it optimal not to acquire information and invest either in the closest entrepreneur or in the traditional technology. The entrepreneur, aware of the alternative investment opportunities of the investor, offers at most the return of the traditional technology, g. In an equilibrium in which only H entrepreneurs are funded, $A^H > g > A^M$. Hence, only H entrepreneurs receive funding by financiers who do not acquire information and offer return g. If the closest entrepreneur is L or M type, the financier invests in the traditional technology.

A financier acquiring costly information may receive the following signals and returns:

- Both firms are type H, with probability of $\left(\alpha^H, \alpha^H\right)$. In this case, due to the competition, both firms are offering return of $A^H > g$, and are funded.

- One firm is type H and the other is type M, with probability of $\left(\alpha^H, \alpha^M\right)$ and $\left(\alpha^M, \alpha^H\right)$. In this case, type H firm offers $g > A^M$ and is funded. Type M firm is not funded (it cannot offer g).

- One firm is type H and the other is type L, with probability of $\left(\alpha^H, \alpha^L\right)$ and $\left(\alpha^L, \alpha^H\right)$. In this case, type H firm offers $g > A^L$ and is funded. Type L firm is not funded (it cannot offer g).

Notice also that with a probability $\left(\alpha^L\right)^2$, an investor learns both signals are (L, L); with a probability of $2\alpha^M\alpha^L$, an investor learns both signals are (M, L) or (L, M); and with a probability of $\left(\alpha^M\right)^2$, an investor learns both signals are (M, M). In each of these cases, he invests in the traditional technology. So the capital poured into the traditional technology should be

$$\Omega_3 = (\alpha^M + \alpha^L)\omega_3 + \left[\left(\alpha^M\right)^2 + 2\alpha^M\alpha^L + \left(\alpha^L\right)^2\right]\left(I - \frac{\omega_3}{k}\right)(k - \tau) \tag{13}$$

where ω_3 is the capital invested into the traditional technology by those investors who choose not to acquire information and who find out the closest entrepreneur is either type M or type L.

In equilibrium, the expected payoff of acquiring information and funding type H firm only must be at least as large as the return of investing in the traditional technology. So

$$\left(\left(\alpha^H\right)^2 A^H + \left(1 - \left(\alpha^H\right)^2\right) g\left(\Omega_3\right)\right)(k - \tau) \geqslant g\left(\Omega_3\right) k$$

This implies that

$$g\left(\Omega_3\right) \leqslant \frac{\left(\alpha^H\right)^2 A^H (k - \tau)}{k - (k - \tau)\left(1 - \left(\alpha^H\right)^2\right)}.$$

Note that also in this case, if the previous inequality is strictly satisfied, $\omega_3 = 0$.

This equilibrium dominates the equilibrium where only one entrepreneur is evaluated and no information is acquired if and only if

$$\frac{\left(\alpha^H\right)^2 A^H (k - \tau)}{k - (k - \tau)\left(1 - \left(\alpha^H\right)^2\right)} \geq A^L$$

That is, the equilibrium of information acquisition and funding type H firm only is dominating no-information acquisition if and only if

$$\frac{\left(\alpha^H\right)^2 A^H (k - \tau)}{k - (k - \tau)\left(1 - \left(\alpha^H\right)^2\right)} \geq A^M, \tag{14}$$

which implies that it must be optimal not to fund $M-$type entrepreneurs. This condition in turn implies that acquiring information is preferable to the equilibrium with no information acquisition which only guarantees a return of A^L.

Additionally, this can be an equilibrium only if it is feasible for $H-$type entrepreneurs to offer return $g(\Omega_3)$. A sufficient condition for this is:

$$\frac{\left(\alpha^H\right)^2 A^H (k-\tau)}{k-(k-\tau)\left(1-\left(\alpha^H\right)^2\right)} \leqslant A^H \tag{15}$$

C Proof of Proposition 2

The proof of Proposition 2 is obtained in three steps.

First step. To show that $\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right) \geq \frac{\tau}{k-\tau}$ ensures that the strategy of acquiring information and funding only H entrepreneurs is feasible and preferred over the strategy of no information acquisition we need to show that, $A^M \leq g(\Omega_3) \leq A^H$. So the following condition must be satisfied:

$$A^M \leq \frac{\left(\alpha^H\right)^2 A^H (k-\tau)}{k-(k-\tau)\left(1-\left(\alpha^H\right)^2\right)} \leq A^H$$

Since $\frac{\left(\alpha^H\right)^2 A^H (k-\tau)}{k-(k-\tau)\left(1-\left(\alpha^H\right)^2\right)} \leq A^H$ can be re-written as $\left(\alpha^H\right)^2 (k-\tau) < \tau + \left(\alpha^H\right)^2 (k-\tau)$, $\tau > 0$ ensures that the inequality always holds.

In addition, $\frac{\left(\alpha^H\right)^2 A^H (k-\tau)}{k-(k-\tau)\left(1-\left(\alpha^H\right)^2\right)} \geq A^M$ is equivalent to $\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right)\left(\frac{k}{\tau}-1\right) \geq 1$.

Last, $g(\omega_1) = A^L < A^M \leq \frac{\left(\alpha^H\right)^2 A^H (k-\tau)}{k-(k-\tau)\left(1-\left(\alpha^H\right)^2\right)}$ indicates that this equilibrium strategy always dominates the strategy of no information acquisition.

Second step. We prove that the strategy of acquiring information and fund both H and M firms is feasible if and only if

$$\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right) \leq \frac{\tau}{k-\tau}$$

and preferred over the strategy of no information acquisition if

$$\left(\alpha^{H}+\alpha^{M}\right)^{2}\left(\frac{A^{M}}{A^{L}}-1\right)+\left(\alpha^{H}\right)^{2}A^{H}\left(\frac{A^{H}-A^{M}}{A^{L}}\right)\geq\frac{\tau}{k-\tau}$$

To do so, notice $g\left(\omega_{1}\right)=A^{L}<g\left(\Omega_{2}\right)\leq A^{M}$ ensures that acquiring information and funding type H and M entrepreneurs is feasible and preferred over no information acquisition. The second inequality, $g\left(\Omega_{2}\right)\leq A^{M}$, is equivalent to

$$\frac{\left[\left(\alpha^{H}\right)^{2}A^{H}+\left(2\alpha^{H}\alpha^{M}+\left(\alpha^{M}\right)^{2}\right)A^{M}\right](k-\tau)}{k-(k-\tau)\left(1-\left(\alpha^{H}+\alpha^{M}\right)^{2}\right)}\leq A^{M}$$

So the second inequality can be re-written as

$$\left(\alpha^{H}\right)^{2}\left(A^{H}-A^{M}\right)(k-\tau)+A^{M}(k-\tau)\left(\alpha^{H}+\alpha^{M}\right)^{2}\leq A^{M}\tau+A^{M}(k-\tau)\left(\alpha^{H}+\alpha^{M}\right)^{2}$$

or

$$\left(\alpha^{H}\right)^{2}\left(\frac{A^{H}}{A^{M}}-1\right)\leq\frac{\tau}{k-\tau}$$

The first inequality, $g\left(\omega_{1}\right)=A^{L}<g\left(\Omega_{2}\right)$, is equivalent to

$$\left(\alpha^{H}\right)^{2}A^{H}+\left(2\alpha^{H}\alpha^{M}+\left(\alpha^{M}\right)^{2}\right)A^{M}\geq A^{L}\left(\frac{\tau}{k-\tau}+\left(\alpha^{H}+\alpha^{M}\right)^{2}\right)$$

So the first inequality can be re-written as

$$\left(\alpha^{H}\right)^{2}A^{H}+\left(2\alpha^{H}\alpha^{M}+\left(\alpha^{M}\right)^{2}\right)A^{M}>\left(\alpha^{H}+\alpha^{M}\right)^{2}A^{M}\geq A^{L}\left(\frac{\tau}{k-\tau}+\left(\alpha^{H}+\alpha^{M}\right)^{2}\right)$$

or

$$\left(\alpha^{H}+\alpha^{M}\right)^{2}\left(\frac{A^{M}}{A^{L}}-1\right)+\left(\alpha^{H}\right)^{2}A^{H}\left(\frac{A^{H}-A^{M}}{A^{L}}\right)\geq\frac{\tau}{k-\tau}$$

This completes the proof of the second step.

Third step. The first two steps imply that the equilibria with information acquisition in which either both H and M entrepreneurs or only H entrepreneurs are funded are mutually exclusive and give conditions for the existence of an equilibrium with information acquisition.

D Proof of Proposition 5.

We follow the same logic of Lemma 1 and derived the financiers' funding decisions and the expected returns to their capital allocation under costly information acquisition.[8] As in Proposition 2, there are two types of equilibria with information acquisition. We first examine the equilibrium where only H entrepreneurs are funded. We then examine the equilibrium where both H and M entrepreneurs are funded. Finally, we consider the additional case in which entrepreneurs are funded even if the signal is not informative.

Financiers' expected payoffs from acquiring information depend crucially on the distribution of entrepreneurs' types.

First, let's consider the case in which $\overline{A} < A^M$.

First step. Expected payoffs.

Information acquisition and funding H entrepreneurs only. To fund H entrepreneur only, it must be the case that the return to the traditional technology is more attractive than the return to investing in type M entrepreneurs. That is, $A^M < g(\Omega_4) \leq A^H$.

When external financiers evaluate the close and the distant entrepreneurs, the two signals can be both informative, both uninformative, and one being informative and the other being not.

When both signals are informative, with probability $t^2 \left(\alpha^H\right)^2$, financiers encounter two H entrepreneurs. In this case, both entrepreneurs are funded and, under Bertrand competition, offer the same return of A^H per unit of capital invested to the external financiers.

There are also two scenarios where an H entrepreneur receives funding but offers the return of the traditional technology g instead of A^H. One is when the signal about himself is informative, but the signal about the other entrepreneur is not. The other is when both the signals about the two entrepreneurs are informative, but the other entrepreneur is revealed as an either M or L entrepreneur. The probability of the former is $2t(1-t)\alpha^H$, and the probability of the latter is $t^2\alpha^H\left(\alpha^M + \alpha^L\right)$.

In equilibrium, the expected payoff of spending τ to acquire information and funding only type

[8] A technical appendix Table, available upon request from the authors, provides on payoffs and equilibrium returns.

H entrepreneurs must be at least as large as the return from investing directly into the traditional technology. So

$$\left(t^2 \left(\alpha^H\right)^2 A^H + (1 - t^2 \left(\alpha^H\right)^2) g\left(\Omega_4\right)\right)(k - \tau) \geqslant g\left(\Omega_4\right) k,$$

where

$$\Omega_4 \equiv \left(t(\alpha^M + \alpha^L) + (1-t)\right)\omega_4 + \left(t\left(\alpha^M + \alpha^L\right) + (1-t)\right)^2 \left(I - \frac{\omega_4}{k}\right)(k - \tau)$$

is the total amount of capital invested in the traditional technology.

Note that Ω_4 includes $\left(t(\alpha^M + \alpha^L) + (1-t)\right)\omega_4$, the capital contributed by financiers who do not acquire information about the distant entrepreneur and evaluate only the close entrepreneur. When either the signal is not informative, or the signal reveals that the close entrepreneur is not an H entrepreneur, financiers direct their endowment to the traditional technology.

Ω_4 also includes the capital from financiers who acquire information about a distant entrepreneur, but end up funding neither the close nor the distant entrepreneur. With probability $(1-t)^2$, neither of the two signals is informative. With probability $2(1-t)t(\alpha^M + \alpha^L)$, one signal is informative that the entrepreneur is either M or L type, but the other signal is not informative. With probability $t^2\left(\alpha^M + \alpha^L\right)^2$, both signals are informative about entrepreneurs being not H type. So the total probability that financiers evaluate two entrepreneurs but fund none of the two is $(1-t)^2 + 2(1-t)t(\alpha^M + \alpha^L) + t^2\left(\alpha^M + \alpha^L\right)^2$, or $\left(t\left(\alpha^M + \alpha^L\right) + (1-t)\right)^2$.

Information acquisition and funding both H and M entrepreneurs. To fund both H and M entrepreneurs, it must be that the return to the traditional technology is less attractive than the return to investing in type M entrepreneurs. That is, $A^L < g\left(\Omega_5\right) \leq A^M$.

When both signals are informative, with probability $t^2\left(\alpha^H\right)^2$, external financiers encounter and fund two entrepreneurs of type H. Bertrand competition between the two H entrepreneurs leads to a return of A^H being offered per unit of capital invested. With probability $t^2\left(\alpha^M\right)^2$, external financiers encounter and fund two entrepreneurs of type M. Similarly, both entrepreneurs offer A^M as a return. With probability $2t^2\alpha^H\alpha^M$, the two signals reveal that one entrepreneur is type H and the other is type M. Type H entrepreneur has no incentive to offer any return higher than A^M. That is, the H entrepreneur is funded (while the M entrepreneur is funded only by financiers that have not evaluated a distant entrepreneur), but the lack of competition leads the H entrepreneur to offer a return of A^M for per capital invested. With probability $2t^2\alpha^L\left(\alpha^H+\alpha^M\right)$, an H entrepreneur competes with an L entrepreneur and an M entrepreneur competes with an L entrepreneur. Since the L entrepreneur can only afford a return of $A^L < g\left(\Omega_5\right)$, neither H nor H has incentive to offer a return higher than $g\left(\Omega_5\right)$ to attract capital from external financiers. With probability $t^2\left(\alpha^L\right)^2$, financiers learn that both entrepreneurs are of type L and invest in the traditional technology for a return $g\left(\Omega_5\right)$. L entrepreneurs receive no funding.

When neither signal is informative (the case of $(1-t, 1-t)$), both entrepreneurs, regardless their types, can only offer credibly the return $\overline{A}$. Since financiers cannot distinguish their type, they are funded if $\overline{A} \geq g\left(\Omega_5\right)$.

There are two cases associated with the scenario when one signal is informative and the other is not.

1. With probability $2t\left(1-t\right)\left(\alpha^H+\alpha^M\right)$, the informative signal reveals the entrepreneur being either type H or type M.

    - In this case, the other entrepreneur, who is associated with the uninformative signal and therefore his type is unknown, can still credibly offer a return $\overline{A}$. So if $\overline{A} > g\left(\Omega_5\right)$, then to compete with the entrepreneur of unknown type, type H or M entrepreneur under the informative signal offers the same return $\overline{A}$ and is funded. The entrepreneur of unknown type is funded by financiers not acquiring information.
    - If $\overline{A} < g\left(\Omega_5\right)$, then the entrepreneur of unknown type is never funded. And the type H or M entrepreneur under the informative signal offers the return of the traditional technology $g\left(\Omega_5\right)$ and is the only one who is funded.

2. With probability $2t\left(1-t\right)\alpha^L$, the informative signal reveals the entrepreneur being type L.

    - In this case, L entrepreneur is never funded. But the other entrepreneur, who is associated with the uninformative signal and therefore his type is unknown, can still credibly offer a return $\overline{A}$. So if $\overline{A} > g\left(\Omega_5\right)$, then the best alternative option for financiers is to invest in the traditional technology. The entrepreneur under the uninformative signal thus offers a return $g\left(\Omega_5\right)$ and receives funding (Note here, only when $\overline{A} > g\left(\Omega_5\right)$, a promised return lower than $\overline{A}$ is credible – again, back to your point earlier "everybody has an incentive to lie offering more than $\bar{A}$, hence entrepreneurs of any type can credibly promise at most $\overline{A}$").

- On the other hand, if $\overline{A} < g(\Omega_5)$, then the entrepreneur of unknown type is never funded, and even if the entrepreneur of the uninformative signal is indeed type H or M and can offer a return of $g(\Omega_5)$, such a promised return is not credible. In the end, no one is funded.

In equilibrium, the expected payoff of spending τ to acquire information and evaluate two entrepreneurs must be at least as large as the return from investing directly into the traditional technology. That is,

$$\left(\begin{array}{c} \left(t\alpha^H\right)^2 A^H + t^2\left(\left(\alpha^M\right)^2 + 2\alpha^H\alpha^M\right)A^M + \left(2t\alpha^L - \left(t\alpha^L\right)^2\right)g\left(\Omega_5\right) \\ +\left(2t\left(1-t\right)\left(\alpha^H+\alpha^M\right) + \left(1-t\right)^2\right)\max\left(g\left(\Omega_5\right), \overline{A}\right) \end{array}\right)(k-\tau) \geqslant g\left(\Omega_5\right)k \quad (16)$$

where Ω_5 is the total amount of capital invested directly in the traditional technology.

Ω_5 is defined as follows:

$$\Omega_5 \equiv t\alpha^L\omega_5 + \left(t\alpha^L\right)^2\left(I - \frac{\omega_5}{k}\right)(k-\tau) \text{ if } \overline{A} > g(\Omega_5);$$

and

$$\Omega_5 \equiv \left[t\alpha^L + (1-t)\right]\omega_5 + \left[\left(t\alpha^L\right)^2 + (1-t)^2 + 2t\alpha^L(1-t)\right]\left(I - \frac{\omega_5}{k}\right)(k-\tau) \text{ if } \overline{A} < g(\Omega_5).$$

Second step. Optimal strategies.

To show that (4) ensures the strategy of acquiring information and funding only H entrepreneurs is feasible and preferred over the strategy of no information acquisition and the strategy of funding both H and M entrepreneurs, we need to show that, $A^M \leq g\left(\Omega_4\right) \leq A^H$, where

$$g\left(\Omega_4\right) \leq \frac{t^2\left(\alpha^H\right)^2 A^H}{\frac{\tau}{k-\tau} + t^2\left(\alpha^H\right)^2}$$

So in equilibrium, the following condition must be satisfied:

$$A^M \leq \frac{t^2 \left(\alpha^H\right)^2}{\frac{\tau}{k-\tau} + t^2 \left(\alpha^H\right)^2} A^H \leq A^H$$

It is trivial that the second inequality is satisfied, as $\frac{\tau}{k-\tau} > 0$. Then $A^M \leq \frac{t^2 \left(\alpha^H\right)^2}{\frac{\tau}{k-\tau} + t^2 \left(\alpha^H\right)^2} A^H$ is equivalent to

$$t^2 \left(\alpha^H\right)^2 \left(\frac{A^H}{A^M} - 1\right) \geq \frac{\tau}{k-\tau} \tag{17}$$

Last, $g\left(\omega_1\right) = A^L < A^M \leq \frac{t^2 \left(\alpha^H\right)^2}{\frac{\tau}{k-\tau} + t^2 \left(\alpha^H\right)^2} A^H$ implies that this equilibrium always dominates the strategy of no information acquisition.

Next, we consider conditions under which funding H and M is an equilibrium strategy.

Suppose $g\left(\Omega_5\right) \leq \overline{A} < A^M$. Then from (16), it is optimal to fund entrepreneurs unless a signal L is observed if and only if

$$A^L \leq \frac{\left(t\alpha^H\right)^2 A^H + t^2 \left(\left(\alpha^M\right)^2 + 2\alpha^H \alpha^M\right) A^M + \left(2t(1-t)\left(\alpha^H + \alpha^M\right) + (1-t)^2\right) \overline{A}}{\frac{k}{k-\tau} - \left(2t\alpha^L - \left(t\alpha^L\right)^2\right)} \leq \overline{A}$$

That is

$$A^L < \frac{t^2 \left(\alpha^H\right)^2 \left(A^H - A^M\right) + t^2 \left(\alpha^H + \alpha^M\right)^2 A^M + \left(2t(1-t)\left(\alpha^H + \alpha^M\right) + (1-t)^2\right) \overline{A}}{\frac{\tau}{k-\tau} + \left(1 - t\alpha^L\right)^2} \leq \overline{A} \tag{18}$$

The second inequality of (18) is equivalent to

$$\left(t\alpha^H\right)^2 \left(A^H - A^M\right) + t^2 \left(\alpha^H + \alpha^M\right)^2 A^M \leq \overline{A} \left(\frac{\tau}{k-\tau} + t^2 \left(1 - \alpha^L\right)^2\right)$$

Since $1 - \alpha^L = \alpha^H + \alpha^M$, simplifying, we have:

$$t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - A^M}{\overline{A}}\right) + t^2 \left(\alpha^H + \alpha^M\right)^2 \left(\frac{A^M}{\overline{A}} - 1\right) \leq \frac{\tau}{k-\tau}. \tag{19}$$

Note that from (16),

$$g(\Omega_5) \leq \frac{\left(t\alpha^H\right)^2 A^H + t^2\left(\left(\alpha^M\right)^2 + 2\alpha^H\alpha^M\right)A^M + \left(2t(1-t)\left(\alpha^H+\alpha^M\right) + (1-t)^2\right)\overline{A}}{\frac{k}{k-\tau} - \left(2t\alpha^L - \left(t\alpha^L\right)^2\right)}$$

So (19) guarantees $g(\Omega_5) \leq \overline{A}$.

The first inequality of (18) is equivalent to

$$\left(\begin{array}{c} t^2\left(\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right) + t^2\left(\alpha^H+\alpha^M\right)^2\left(\frac{A^M}{A^L}-1\right) \\ +\left(2t(1-t)\left(\alpha^H+\alpha^M\right)+(1-t)^2\right)\left(\frac{\overline{A}}{A^L}-1\right) \end{array}\right) > \frac{\tau}{k-\tau} \tag{20}$$

So (19) and (20) together define the equilibrium condition (18) for the case of $g(\Omega_5) \leq \overline{A}$.

$$\left(\begin{array}{c} t^2\left(\alpha^H\right)^2\left(\frac{A^H-A^M}{\overline{A}}\right) \\ +t^2\left(\alpha^H+\alpha^M\right)^2\left(\frac{A^M}{\overline{A}}-1\right) \end{array}\right) \leq \frac{\tau}{k-\tau} < \left(\begin{array}{c} \left(t\alpha^H\right)^2\left(\frac{A^H-A^M}{A^L}\right) + \left(t\left(\alpha^H+\alpha^M\right)\right)^2\left(\frac{A^M}{A^L}-1\right) \\ +\left(2t(1-t)\left(\alpha^H+\alpha^M\right)+(1-t)^2\right)\left(\frac{\overline{A}}{A^L}-1\right) \end{array}\right) \tag{21}$$

Now suppose that $A^L < \overline{A} \leq g(\Omega_5) < A^M$. Then from (16), funding H and M is optimal if and only if:

$$\overline{A} \leq \frac{\left(t\alpha^H\right)^2 A^H + t^2\left(\left(\alpha^M\right)^2 + 2\alpha^H\alpha^M\right)A^M}{\frac{\tau}{k-\tau} + t^2\left(1-\alpha^L\right)^2} < A^M \tag{22}$$

Since $1-\alpha^L = \alpha^H + \alpha^M$, the second inequality of (22) is equivalent to

$$t^2\left(\alpha^H\right)^2\left(\frac{A^H}{A^M}-1\right) < \frac{\tau}{k-\tau} \tag{23}$$

which is the complement to (17).

The first inequality of (22) is equivalent to

$$t^2\left(\alpha^H\right)^2\left(\frac{A^H-A^M}{\overline{A}}\right) + t^2\left(\alpha^H+\alpha^M\right)^2\left(\frac{A^M}{\overline{A}}-1\right) \geqslant \frac{\tau}{k-\tau} \tag{24}$$

Together (23) and (24) replace the equilibrium condition (22) for $\overline{A} \leq g(\Omega_5) < A^M$:

$$t^2 (\alpha^H)^2 \left(\frac{A^H}{A^M} - 1\right) < \frac{\tau}{k-\tau} \leq t^2 (\alpha^H)^2 \left(\frac{A^H - A^M}{\overline{A}}\right) + t^2 (\alpha^H + \alpha^M)^2 \left(\frac{A^M}{\overline{A}} - 1\right) \tag{25}$$

To summarize, (21) and (25) define a region where funding H and M entrepreneur is an equilibrium strategy. Hence, just like Proposition 2, funding H and M is an equilibrium strategy exactly when the strategy of funding H only is not optimal.

$$t^2 (\alpha^H)^2 \left(\frac{A^H}{A^M} - 1\right) < \frac{\tau}{k-\tau} < \left(\begin{array}{c} (t\alpha^H)^2 \left(\frac{A^H - A^M}{A^L}\right) + \left(t\left(\alpha^H + \alpha^M\right)\right)^2 \left(\frac{A^M}{A^L} - 1\right) \\ + \left(2t(1-t)\left(\alpha^H + \alpha^M\right) + (1-t)^2\right) \left(\frac{\overline{A}}{A^L} - 1\right) \end{array} \right) \tag{26}$$

Note also the second inequality of (26) is equivalent to the first inequality of (18):

$$\frac{t^2 (\alpha^H)^2 (A^H - A^M) + t^2 (\alpha^H + \alpha^M)^2 A^M + \left(2t(1-t)\left(\alpha^H + \alpha^M\right) + (1-t)^2\right) \overline{A}}{\frac{\tau}{k-\tau} + (1 - t\alpha^L)^2} > A^L$$

under which

$$g(\Omega_5) \leq \frac{t^2 (\alpha^H)^2 (A^H - A^M) + t^2 (\alpha^H + \alpha^M)^2 A^M + \left(2t(1-t)\left(\alpha^H + \alpha^M\right) + (1-t)^2\right) \overline{A}}{\frac{\tau}{k-\tau} + (1 - t\alpha^L)^2}$$

If $\frac{\tau}{k-\tau} \geq (t\alpha^H)^2 \left(\frac{A^H - A^M}{A^L}\right) + \left(t\left(\alpha^H + \alpha^M\right)\right)^2 \left(\frac{A^M}{A^L} - 1\right) + \left(2t(1-t)\left(\alpha^H + \alpha^M\right) + (1-t)^2\right) \left(\frac{\overline{A}}{A^L} - 1\right)$, it implies $g(\Omega_5) \leq A^L$. In this case, financiers do not acquire information.

When financiers evaluate the close entrepreneur only, all three types of entrepreneurs are funded if

$$g\left(t\alpha^L kI\right) < A^L$$

That is

$$t\alpha^L kI > g^{-1}\left(A^L\right)$$

This completes the proof of Proposition 5.■

E Proof of Proposition 6

We now consider the case in which $\overline{A} > A^M$.

First step. Expected payoffs.

Information acquisition and funding H entrepreneurs only. The proof of Proposition 6 follows a similar procedure as the proof of Proposition 5. To fund H entrepreneurs only, it must be that the return to the traditional technology is more than the return of investing in M entrepreneurs: $A^M < g(\Omega_7) < A^H$

When both signals are informative, with probability $t^2 (\alpha^H)^2$, financiers encounter two H entrepreneurs and are offered with a return of A^H per capital of funding. With probability $2t^2 (\alpha^M + \alpha^L) \alpha^H$, H entrepreneurs compete with either M or L entrepreneur. Because of lack of competition, only the return of technology $g(\Omega_6)$ is offered. With probability $t^2 (\alpha^M + \alpha^L)^2$, financiers encounter M and L entrepreneurs and invest directly in the traditional technology.

With probability $(1-) t^2$, neither of the two signals is informative. Both entrepreneurs can only offer credibly the return $\overline{A}$. Since financiers cannot distinguish their type, the are funded if $\overline{A} \geq g(\Omega_6)$.

When on signal is informative and the other is not, and the informative signal, with probability $2\alpha^H t (1-t)$, the informative signal reveals the entrepreneur being type H. The entrepreneur under the uninformative signal can only offer credibly the return $\overline{A}$. If $\overline{A} < g(\Omega_6)$, H entrepreneur competes with the traditional technology and offers a return $g(\Omega_6)$ per capital invested and the entrepreneur under the uninformative signal is not funded. If $\overline{A} \geq g(\Omega_6)$, to receive funding, H entrepreneur competes with the entrepreneur of the unknown type and offers a return $\overline{A}$ per capital invested and the entrepreneur under the uninformative signal is not funded. Since financiers cannot distinguish the type of the entrepreneur associated with the uninformative signal, the entrepreneur is funded.

With probability $2t(1-t)(\alpha^M + \alpha^L)$, the informative signal reveals the entrepreneur to be either type M or type L. The entrepreneur under the uninformative signal can only offer $\overline{A}$ if $\overline{A} \leq g(\Omega_6)$ – so neither entrepreneur receives funding and financiers invest directly in the traditional technology. If $\overline{A} > g(\Omega_6)$, then the entrepreneur under the uninformative signal offer $g(\Omega_6)$ instead of $\overline{A}$ credibly, and thus receives funding. The entrepreneur under the informative signal receives no funding.

So it is optimal for financiers to acquire information, evaluate two entrepreneurs and only fund H entrepreneurs if

$$\left(\begin{array}{c} \left(t\alpha^H\right)^2 A^H + \left((1-t)^2 + 2\alpha^H t\,(1-t)\right)\max\left(g\left(\Omega_6\right), \overline{A}\right) \\ + \left(2t\left(\alpha^M+\alpha^L\right) - t^2\left(\alpha^M+\alpha^L\right)^2\right) g\left(\Omega_6\right) \end{array}\right)(k-\tau) \geq g\left(\Omega_6\right) k \tag{27}$$

where

$$\Omega_6 \equiv \left(t(\alpha^M+\alpha^L)\right)\omega_6 + t^2\left(\alpha^M+\alpha^L\right)^2\left(I - \frac{\omega_6}{k}\right)(k-\tau) \text{ if } \overline{A} > g(\Omega_6)$$

and

$$\Omega_6 \equiv \left(t(\alpha^M+\alpha^L)+(1-t)\right)\omega_6 + \left(1-t\alpha^H\right)^2\left(I - \frac{\omega_6}{k}\right)(k-\tau) \text{ if } \overline{A} < g(\Omega_6)$$

Information acquisition and funding H and M entrepreneurs. To fund both H and M entrepreneurs, it must be that the return to the traditional technology is less attractive to investing in type M entrepreneurs. That is, $g\left(\Omega_7\right) < A^M < \overline{A} < A^H$. Again, consider the first scenario where both signals are informative. With probability $t^2\left(\alpha^H\right)^2$, financiers encounter two H entrepreneurs and are offered with a return of A^H per capital of funding. With probability $t^2\alpha^H\alpha^M + t^2\left(\alpha^H+\alpha^M\right)\alpha^M$, H entrepreneur competes with M entrepreneur or two M entrepreneurs compete with each other. A return A^M per capital is offered to the external financiers. When either H entrepreneur or M entrepreneur competes with L entrepreneur, a return of $g\left(\Omega_7\right)$ is offered instead of A^Mor $\overline{A}$.

With probability $(1-)\,t^2$, neither of the two signals is informative. Both entrepreneurs can only offer credibly the return $\overline{A}$. Since financiers cannot distinguish their type, the are funded if $\overline{A} \geq g\left(\Omega_7\right)$.

When one signal is informative and the other is not, with probability $2t\,(1-t)\,\alpha^H$, the signal about H entrepreneur is informative. The other entrepreneur of unknown type offers a return $\overline{A}$. And H entrepreneur competes by offering the same. With probability $2t\,(1-t)\,\alpha^M$, the signal about M entrepreneur is informative. The other entrepreneur of unknown type offers a return A^M instead of $\overline{A}$. With probability $2t\,(1-t)\,\alpha^L$, the signal about L entrepreneur is informative. The other entrepreneur of unknown type offers a return $g\left(\Omega_7\right)$ instead of A^M or $\overline{A}$.

So it is optimal for financiers to acquire information, evaluate two entrepreneurs and fund H and M entrepreneurs if

$$\begin{pmatrix} t^2\left(\alpha^H\right)^2 A^H + \left(t^2\left(2\alpha^H\alpha^M + \left(\alpha^M\right)^2\right) + 2\alpha^M t\left(1-t\right)\right) A^M \\ +\left(2t\alpha^L - t^2\left(\alpha^L\right)^2\right) g\left(\Omega_7\right) + \left(\left(1-t\right)^2 + 2\alpha^H t\left(1-t\right)\right)\overline{A} \end{pmatrix} \left(k-\tau\right) \geqslant g\left(\Omega_7\right) k \tag{28}$$

where

$$\Omega_7 \equiv t\alpha^L\omega_7 + \left(t\alpha^L\right)^2\left(I - \frac{\omega_7}{k}\right)\left(k-\tau\right).$$

Step two. Optimal strategies.

Note that funding only H entrepreneurs is feasible and preferred over the strategy of no information acquisition and the strategy of funding both H and M entrepreneurs if $A^M \leq g\left(\Omega_6\right) \leq A^H$. From (27), if $g\left(\Omega_6\right) \leq \overline{A} \leq A^H$, then we have

$$g\left(\Omega_6\right) \leq \frac{\left(t\alpha^H\right)^2 A^H + \left(\left(1-t\right)^2 + 2\alpha^H t\left(1-t\right)\right)\overline{A}}{\frac{\tau}{k-\tau} + \left(t\left(\alpha^M + \alpha^L\right) - 1\right)^2} \tag{29}$$

So in equilibrium, the following condition must be satisfied:

$$A^M \leq \frac{\left(t\alpha^H\right)^2 A^H + \left(\left(1-t\right)^2 + 2\alpha^H t\left(1-t\right)\right)\overline{A}}{\frac{\tau}{k-\tau} + \left(t\left(\alpha^M + \alpha^L\right) - 1\right)^2} \leq A^H \tag{30}$$

Note that the second inequality of (30) holds trivially:

$$\frac{\left(t\alpha^H\right)^2 A^H + \left(\left(1-t\right)^2 + 2\alpha^H t\left(1-t\right)\right)\overline{A}}{\frac{\tau}{k-\tau} + \left(t\left(\alpha^M + \alpha^L\right) - 1\right)^2} < \frac{\left(t\alpha^H\right)^2 A^H + \left(\left(1-t\right)^2 + 2\alpha^H t\left(1-t\right)\right) A^H}{\frac{\tau}{k-\tau} + \left(t\left(\alpha^M + \alpha^L\right) - 1\right)^2} < A^H$$

as $\left(t\alpha^H\right)^2 A^H + \left(\left(1-t\right)^2 + 2\alpha^H t\left(1-t\right)\right) A^H = \left(t\left(\alpha^M + \alpha^L\right) - 1\right)^2 A^H$, $\frac{\tau}{k-\tau} > 0$, and $1 - \alpha^H = \alpha^M + \alpha^L$.

The first inequality of (30) is equivalent to

$$\frac{\tau}{k-\tau} \leq t^2\left(\alpha^H\right)^2\left(\frac{A^H - \overline{A}}{A^M}\right) + \left(1 - t + t\alpha^H\right)^2\left(\frac{\overline{A}}{A^M} - 1\right) \tag{31}$$

Next, from (27), if $A^M \leq \overline{A} \leq g(\Omega_6) \leq A^H$, then we have

$$t^2 \left(\alpha^H\right)^2 A^H \geq g(\Omega_6) \left(\frac{\tau}{k-\tau} + t^2 \left(\alpha^H\right)^2\right)$$

or

$$g(\Omega_6) \leq A^H$$

which is automatically satisfied.

We then consider these conditions under which funding H and M is an equilibrium strategy. Notice that $A^L < g(\Omega_7) \leq A^M < \overline{A} < A^H$, and from (28), we have

$$g(\Omega_7) \leq \frac{t^2 \left(\alpha^H\right)^2 A^H + \left(t^2 \alpha^M \left(2\alpha^H + \alpha^M\right) + 2\alpha^M t(1-t)\right) A^M + \left((1-t)^2 + 2\alpha^H t(1-t)\right) \overline{A}}{\frac{\tau}{k-\tau} + \left(t\alpha^L - 1\right)^2}$$

So that funding H and M is an equilibrium strategy is equivalent to

$$A^L < \frac{t^2 \left(\alpha^H\right)^2 A^H + \left(t^2 \alpha^M \left(2\alpha^H + \alpha^M\right) + 2\alpha^M t(1-t)\right) A^M + \left((1-t)^2 + 2\alpha^H t(1-t)\right) \overline{A}}{\frac{\tau}{k-\tau} + \left(t\alpha^L - 1\right)^2} \leq A^M \tag{32}$$

The second inequality of (32) is equivalent to

$$t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - \overline{A}}{A^M}\right) + \left(1 - t + t\alpha^H\right)^2 \left(\frac{\overline{A}}{A^M} - 1\right) \leq \frac{\tau}{k-\tau}$$

The first inequality of (32) is equivalent to

$$t^2 \left(\alpha^H\right)^2 \left(\frac{A^H - A^M}{A^L}\right) + \left(1 - t\alpha^L\right)^2 \left(\frac{A^M}{A^L} - 1\right) + (1-t)\left(1 - t + 2t\alpha^H\right) \left(\frac{\overline{A} - A^M}{A^L}\right) \geq \frac{\tau}{k-\tau} \tag{33}$$

The remaining part of Proposition 6 is the same as the proof of Proposition 5. This completes the proof. ■