Reputation Capital, Financial Capital, and Transition to Entrepreneurial Activity[1]

Frédéric Loss and Antoine Renucci

Laboratoire d'Econométrie, CNAM and DRM-CEREG, Université Paris-Dauphine

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Abstract

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[1] This paper is a revised version of Chapter 4 of Frédéric Loss' Ph.D. dissertation. We are grateful to Bruno Jullien, Denis Gromb and Thibaud Vergé for their numerous suggestions. We also want to thank Pierre Batteau, Bruno Biais, Gilles Chemla, Antoine Gentier, Carole Haritchabalet, Estelle Malavolti, Laetitia Malavolti, Javier Ortega, Myron Slovin, Marie Sushka, Jean Tirole, Laurent Villanova, Wilfried Zantman who commented one of the first versions of this paper that was circulated as well as participants to the 2007 ESEM in Budapest.
Corresponding author: Antoine Renucci, CEREG, Université Paris-Dauphine, Place du Maréchal de Lattre de Tassigny, 75775, Paris Cedex 16, antoine.renucci@dauphine.fr

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Understanding how employees become entrepreneurs is important for economic reasons. It is also essential for the employees themselves and the firms they work with. Indeed, the objective of becoming entrepreneurs quite plausibly influences the employees' current behavior. Moreover, a large fraction of the labor force aims at becoming entrepreneurs[1], and recent research has shown that a vast majority of new entrepreneurs in high-tech and the service industries were previously employed by established firms.[2]

Our study starts from the premise that credit constraints are an important impediment to the transition to entrepreneurship. We study the interaction between two potential remedies would-be entrepreneurs use to alleviate credit constraints: Personal funding and professional reputation.[3] Specifically, we explore how these two antidotes to credit-rationing interact. We examine how employees aspiring to become entrepreneurs choose a job to try and accumulate (or maintain) reputation capital and financial capital. We demonstrate that these two objectives can conflict with each other. We show that the employees' optimal strategies depend on their initial reputation capital. Finally, we show that employees who can choose the project they work on are less likely to become entrepreneurs than the scientists who can choose the firm they work for.

Throughout this paper, we adopt a broad definition of entrepreneurship: An entrepreneur hereafter refers to an individual who is residual claimant of the cash-flows that his labor generates. We consider industries where talent can be transferred from an employee activity to an entrepreneurial activity and the capital required to start a business venture is large.[4] Engineers establishing firms in high-tech industries, self-employed doctors, lawyers, accountants and consultants fit our definition and these

[1] For instance, according to a 1997/1998 International Social Survey Progamme, self-employment was a goal for 70% of Americans, 60% of Germans, 45% of British people and 42% of French people (Blanchflower, Oswald and Stutzer, 2000).

[2] See Burt (2000), Burton, Sorensen and Beckman (2002), and Gompers, Lerner and Scharfstein (2005).

[3] There is ample evidence that firms are credit constrainted (see the seminal papers of Evans and Jovanovic (1989), and Evans and Leighton (1989). The importance of professional reputation has been evidenced by the role of social networks including venture capitalists, engineers, entrepreneurs, and academic scientists in allocating labor and capital throughout Silicon Valley and Route 128 (Granovetter, 1973; Castilla, Hwang, Granovetter and Granovetter, 2000).

[4] Start-ups in the information technology or biotechnology industries require millions of dollars of investment (Gompers and Lerner, 1999)). Medical or legal practices are sold several times the annual net profit generated. Note that professional industries alone account for about 20% of firm creations every year in the United States.

qualifications.

Our model is as follows. Consider a risk-neutral, wealthless scientist, whose *exact* talent is unknown to all credit and labor market participants, himself included. However, the scientist has developed a professional reputation, e.g., through his track record of scientific publications, patents, etc. In a first stage, the scientist is an employee. His output depends on talent, effort exerted, and a randon element on which the employee has no contol on. The scientist faces the choice to work for a "transparent" firm or an "opaque" firm. Working for a transparent firm generates an output that depends principally on the scientist's talent. The labor and credit markets, which observe output, use this accurate information to update the scientist's reputation. In contrast, working for an opaque firm generates an output that depends principally on the randon element on which the employee has no contol on. It thus generates less accurate information about the scientist's talent, and in turn, less updating of reputation. The scientist receives a wage equal to his expected output. All labor and credit market participants observe the scientist's choice of firm, the output, anticipate the effort exerted, and use this information to revise the scientist's reputation at the end of the employment period. In a second stage, the scientist faces the opportunity to start a business venture. A financial investment is required to determine whether the venture is viable. The venture is viable only if the scientist abstains from pursuing personal objectives, which creates scope for credit constraints. If viable, the venture's value depends on the scientist's talent.

Consider the second stage. The scientist has accumulated wealth and reputation capital. Accumulated wealth reduces the need for external finance, and thus relaxes the credit constraint, making it more likely that the venture be funded, for a given reputation capital. Reputation capital also relaxes the credit constraint. Indeed, the higher the scientist's reputation, the larger the venture's value, if viable. In turn, the larger the difference in the entrepreneur's revenue between pursuing personal objectives and maximizing profits. It fosters incentives, and thus helps to relax the credit constraint, for a given level of wealth. Hence, wealth and reputation capital are substitute remedies to credit constraints.

Now consider the first stage. As an employee, the scientist seeks to accumulate financial capital (i.e., wages) and reputation capital to mitigate credit constraints in the second stage. However, these two goals can conflict. The intuition is as follows. Suppose that the scientist's initial reputation capital is sufficiently good to allow him to start the business venture if the status quo persists. In that case, the scientist favors no further updating of his reputation, which is achieved by opting for an opaque firm. However, while opacity helps him maintain his good reputation, it reduces his ability to accumulate wealth. Indeed, since the market cannot use output to update the scientist's reputation, the scientist faces fewer incentives to increase output, which reduces his wage. The scientist opts for the opaque firm when the loss in financial capital is lower than the gains from maintaining a good reputation.

Suppose instead that the scientist's initial reputation capital is insufficient to allow him to start the business venture if the status quo persists. Working for a transparent firm has two benefits. It gives him the opportunity to let the market update his reputation and to accumulate more financial capital (i.e., larger wages).

Alternatively, consider that the scientist can *secretly* affect the transparency level of his activity as an employee. We model this by assuming that, *once employed*, the scientist can choose to work on a transparent or an opaque project. Since the scientist's choice is secret, it does not affect the scientist's wage, nor the markets' updating rule. Hence, when making a choice, the scientist only considers the information released to the markets. Choosing an opaque project cannot be an equilibrium for a scientist whose initial reputation is good. Indeed, whatever the choice anticipated by the market, a good scientist is better off opting for the project whose output depends principally on his talent, i.e., the transparent project. It makes the status quo more likely. However, by allowing the market to learn information regarding his talent, the scientist places his reputation at higher risk than in the choice-of-firm case, which makes him less likely to become an entrepreneur. By contrast, a scientist whose initial reputation capital is low chooses an opaque project in equilibrium since, whatever the choice anticipated by the market, it makes the status quo less likely: Running an opaque project increases the chances that the output is high. By forgoing some financial capital, the scientist is again less likely to become an entrepreneur.

This paper focuses on an issue that has received little attention by research on the determinants of the transition to entrepreneurship, i.e., the interaction between financial capital and reputational capital. Other determinants have been studied: Personal attributes such as age, risk tolerance, education, race, gender, experience and knowledge of the market, exposure of employees to role models or innovations, as well as external factors such as government incentives, labor market issues, both empirically and theoretically.[5]

The impact of financial capital alone has been studied (see Harris and Raviv (1991) for a survey). Our contribution to this literature is to examine a dynamic model where wealth is determined endogenously and interacts with reputation, which is essential to the understanding of how transition occurs in industries where human capital is critical. At the empirical level, credit rationing has first been widely documented as a problem that prevents employees from becoming entrepreneurs.[6] It is all the more striking as the capital required to start most businesses in the United States is relatively low (Meyer, 1990; Bhidé, 2000). Recent papers challenge the view that credit-rationing is a severe impediment to business creation on the grounds that factors like ability or alertness that lead people to become entrepreneurs are also factors that lead them to become rich in the first place.[7] However, these papers consider all types of entrepreneurs ranging from the owner of a pizzeria to the founder of Intel, whereas

[5] For empirical papers, see Evans and Leighton (1989), Romanelli (1989), Meyer (1990), Gilson (1999), Burt (2000), Dunn and Holtz-Eakin (2000), Shane (2000), Burton, Beckman and Sorensen (2002), Hellmann (2004), Hurst and Lusardi (2004), Sorensen (2004, 2005), Dobrev and Barnett (2005) and Gompers, Lerner and Scharfstein (2005). For theoretical research, see Jovanovic (1979, 1982), Evans and Jovanovic (1989), and Gromb and Scharfstein (2002).

[6] See Evans and Jovanovic, 1989; Evans and Leighton, 1989; Meyer, 1990; Blanchflower and Oswald, 1990; Holtz-Eakin, Joulfaian and Rosen, 1994; Audretsch and Vivarelli, 1995; Fairlie, 1999; Quadrini, 1999; and Gentry and Hubbard, 2001.

[7] See Hurst and Lusardi (2004), Petrova (2005), Francis and Demilrap (2006). However, Hurst and Lusardi (2004) obtain the standard positive relation between wealth and the probability of transition to entrepreneurship when examining professional industries (medical, legal, accounting, and management consulting industries).

we focus on businesses that require large investments. In such ventures at least, founders invest their personal wealth, a phenomenon that would not be observed in the absence of credit-rationing.

Finally, our paper is related to the literature that studies career concerns or reputation.[8] Career concerns usually take the form of wage variations.[9] A first insight of our paper is to investigate a different type of career concerns, namely, transition to entrepreneurship. A second insight is to relate labor market issues to credit market issues since the employee-entrepreneur transition is impeded by credit rationing. A third insight is to model the interaction between two decisions, choices of effort and choices of firms or projects, that have been so far treated separately (e.g., Holmström, 1982, 1999).

The paper proceeds as follows. Section II presents the model. Section III characterizes the conditions under which a scientist can establish a firm. Section IV examines the scientist's choice of employer and Section V the scientist's choice of project. Section VI discusses robustness issues. Section VII concludes. All proofs are in the Appendix.

II. The Model

We consider a two-period model with a competitive labor market consisting of firms and scientists, and a competitive credit market, consisting of entrepreneurs and lenders. All parties are risk-neutral. The discount rate is equal to 0 as in Tirole (2005)[10].

II.A. Choice of Firm

At the beginning of the first period, the scientist is endowed with talent but has no personal wealth.

[8] Dewatripont, Jewitt and Tirole (1999) provide a general and extensive treatment of the career concerns literature. Hirshleifer (1993) provides a survey on the literature about reputation. We do not consider the entrepreneur's reputation to repay funds borrowed from financial intermediaries, which makes our paper different from that of Diamond (1989).

[9] See Holmström (1982, 1999), Narayanan (1985a, 1985b), Holmström and Ricart I Costa (1986), Scharfstein and Stein (1990), Hermalin (1993), and DeMarzo and Duffie (1995).

[10] A strictly positive discount rate would not change qualitatively the results but would complicate the analysis.

The scientist looks for an employer (a firm). When employed by a firm, the scientist's output is

$$\pi(\theta, r_c, e) = \theta + r_c + e, \tag{1}$$

where θ is the scientist's talent, r_c is a random variable which depends on the choice of firm, and e is the effort exerted by the scientist. Let $\pi(\theta, r_c, e)$ be denoted π_c henceforth. The scientist's precise talent θ is unknown to (labor and credit) market participants, including the scientist himself, like in Jovanovic (1982) and Holmström (1982, 1999). It is common knowledge that θ is drawn from the distribution $N(\mathrm{E}(\theta); \sigma_\theta^2)$, where $\mathrm{E}(\theta) \geq 0$ is the scientist's *initial* reputation, denoted In. There exists two types of firms, $\mathcal{T}$-firms (or simply $\mathcal{T}$ in what follows) and $\mathcal{O}$-firms (or simply $\mathcal{O}$), where $\mathcal{T}$ stands for transparent and $\mathcal{O}$ stands for opaque. Whatever period is considered, working for $\mathcal{T}$ yields random output, $r_\mathcal{T}$, drawn from the distribution $N(0; \sigma_\mathcal{T}^2)$, while working for $\mathcal{O}$ yields $r_\mathcal{O} \sim N(0; \sigma_\mathcal{O}^2)$. Opaque firms add more noise to the scientist's output than transparent firms in the sense that $\sigma_\mathcal{O}^2 > \sigma_\mathcal{T}^2$ (with $\sigma_\mathcal{T}^2 > \underline{\sigma_\mathcal{T}^2}$, where $\underline{\sigma_\mathcal{T}^2}$ is specified in the Appendix). However, the choice of firm has no *direct* impact on expected output, that is, $\mathrm{E}(r_\mathcal{O})$ $=\mathrm{E}(r_\mathcal{T}) = 0$. Once employed, the scientist exerts an unobservable effort e which translates into additional output e and costs him $\psi(e) = \frac{k}{2}e^2$ (with $k > \underline{k}$, specified in the Appendix). The output is observable by everyone. However, we do not use it in an employer-employee formal compensation contract for several reasons. First and foremost, the explicit incentives that confront executives in large firms are weak (Jensen and Murphy, 1990) even though the use of explicit incentives is widespread (Murphy, 1998; Gibbons and Murphy, 1992). Indeed, there exist natural restraints on the use of explicit incentives, in particular the difficulty of verifying the output of each employee. Second, some regulated industries, government agencies (notably those in charge with developing military innovations), and universities (which house scientific laboratories) are prevented from or avoid resorting to explicit incentive schemes. Thus, the employee is paid a fixed wage W at the end of the first period. This wage is equal to his expected output since the market is competitive, and fixed at the beginning of the period[11]. The scientist saves the first-period wage. During the first period, the scientist imagines a new technology which is potentially more profitable than existing ones.

In the second period, the scientist can continue to work as an employee like in Holmström (1982, 1999). Again, he is paid a fixed wage, this time equal to his second-period expected output (see (1)). Alternatively, the scientist can try to become an entrepreneur, that is, set up his own firm based on a new technology[12]. Entrepreneurs are protected by limited liability. Starting a business venture requires a financial investment I to fund R&D expenditures in order to learn whether the new technology is viable[13]. If so, the new technology yields a net present value (NPV) equal to $\delta \overset{d}{=} \Delta - I > \underline{\delta} > 0$, where $\underline{\delta}$ is specified in the Appendix. The cash-flows obtained at the end of the second period depend on the scientist's talent[14]. Specifically,

$$\begin{aligned} \Pi(\theta, \Delta) &= \theta + \Delta \text{ if new technology is viable} \\ &= 0 \text{ otherwise.} \end{aligned} \tag{2}$$

The scientist influences the probability that the new technology is viable. If the scientist maximizes profits, the new technology is viable with probability 1[15]. In contrast, if the scientist pursues personal

[11] Note that fixed wages are not the consequence of a desire to protect workers from fluctuations in their incomes, since all participants are risk-neutral in our setting. Hence, we do not take part to the controversy that first opposed Knight (1921) to Schumpeter (1934). Knight, and Kihlstrom and Laffont (1979), view the entrepreneur as performing the "peculiar twofold function of (a) exercising responsible control and (b) securing the owners of productive services against uncertainty and fluctuation in their incomes" (Kihlstrom and Laffont (1979), page 746). In contrast, Schumpeter (quoted by Kihlstrom and Laffont (1979) on page 745) asserts that "the entrepreneur is never a risk bearer," but an innovator.

[12] We analyse in the last section of the paper the case where the scientist can steal existing technology in order to establish his own firm. It turns out to always be a dominated solution.

[13] Although our model takes the example of a scientist willing to capitalize on an innovation, it can accommodate both the definitions of entrepreneurs of Baumol (1986), who views entrepreneurs as individuals who respond to the opportunities of creating new products, and Rosen (1983) who considers entrepreneurship as "exploiting the new opportunities that inventions provide, more in the form of marketing and developing them for the widespread use in the economy than developing the knowledge itself."

[14] Talent is transferable from employee activity to entrepreneurial activity in our model. However, we do not mean to suggest that there are no intrinsic differences between employees and entrepreneurs. Entrepreneurs may have a comparative disadvantage in a single skill, but more balanced talents that span a variety of different skills (Lazear, 2002). As evidenced above, it does not prevent many employees from becoming entrepreneurs.

[15] It is without loss of generality: Since scientists are protected by limited liability, inducing them to maximize the cash-flows requires the design of an incentive mechanism even if the fact that implementing the new technology turns out not to be feasible perfectly reveals that the scientist shirked. The reason is that the latter cannot be sent to jail.

objectives (for example, by not allocating time properly across different tasks, or by hiring family members with poor qualifications), the probability decreases to q (with $q < 1$) while the scientist receives a private benefit whose monetary equivalent, $B > \underline{B}$ (specified in the Appendix), is sufficiently high to make the problem interesting, like in Holmström and Tirole (1997). Talent aside, the starting of a business venture requires profit maximization in order to be profitable in the sense that

$$q\Delta - I + B < 0. \tag{3}$$

II.B. Choice of Project

Alternatively, consider a scientist who has to choose privately between a transparent project (a $\mathcal{T}$-project, or simply $\mathcal{T}$ in what follows) and an opaque project (an $\mathcal{O}$-project or simply $\mathcal{O}$ in what follows)[16]. This assumption best describes the situation of a scientist with industry- and job-specific background, and responsible for some important decisions. Again, this choice drives the level of noise r_c in the scientist's output given by (1). However, the timing of the model is modified with respect to the previous subsection in the sense that the scientist's choice now takes place *after* the scientist is hired. Otherwise, the structure of the model is identical to the one described in Subsection II. A.

II.C. Benchmark

In absence of moral hazard in the second period, the scientist would always maximize profits. Since $\delta > 0$ he would start the business venture whatever his initial reputation. In this context, the choice

[16] Examples of transparent projects are abundant (see Hirshleifer, 1993, for a discussion). Ventures whose outcomes are resolved soon rather than in the distant future are informative actions. In the latter case, the outcome that arrives at an interim date is a very noisy measure of the final outcome. Taking part to a transversal project whose success depends on a team's capability rather than on an individual's sole performances is an opaque action. Advancing the arrival of news regarding the success of a product by increasing the expenditures that enable the development of the product is more informative an action than increasing basic research activity. Ventures whose outcomes are outside the manager's control, for example a foreign investment subject to political risk, are opaque actions. Indeed, such projects tend to provide less resolution of uncertainty about the talent of the manager than projects whose outcomes depend less on external factors than on the manager's talent.

of firm or project would be irrelevant. In the absence of moral hazard in the first period, the scientist would exert the first-best effort.

In the next section , we determine the conditions under which a scientist can start a business venture when moral hazard in the second-period causes credit-rationing.

III. Starting a Business Venture

A scientist, i, willing to start a business venture and whose first-period salary $\left(W^i\right)$- hence his savings -is lower than the required investment (I) needs external finance[17]. At that time, his initial reputation, In^i, has been updated. The updated reputation, denoted Up^i, is the assessment that the market makes about the scientist's talent. The market takes into account the output related to the first-period, π_c^i and the first-period equilibrium effort, e_c^{i*}[18]. The market also takes into account the choice of firm made by the scientist- then the updated reputation is $\mathbb{E}\left(\theta \mid \pi_c^i, e_c^{i*}, c\right)$- or the equilibrium choice of project- then the updated reputation is $\mathbb{E}\left(\theta \mid \pi_c^i, e_c^{i*}, c^*\right)$. Provided that the scientist's updated reputation satisfies

$$q \ \left[Up^i + \Delta\right] \geq I \Leftrightarrow Up^i \geq \frac{I}{q} - \Delta, \tag{4}$$

the starting of a business venture can be, in expectation, profitable even if the scientist does not maximize profit. However, (3) implies that the scientist would then obtain a higher revenue as an employee. Thus, it is worth starting a business venture only when profit is maximized. In expectation, competitive investors must receive $I - W^i$ in order to provide funds. Hence, the scientist's incentive compatibility constraint writes

$$Up^i + \Delta - \left(I - W^i\right) \geq q \ \left[Up^i + \Delta - \left(I - W^i\right)\right] + B. \tag{5}$$

[17] From this section on, we index what is pertaining to the scientist under consideration by i in order to contrast it with what is independent of the specific scientist under consideration.

[18] The subscript c refers to the choice between the transparent and the opaque alternative. In the case of a choice of project, it thus refers to an equilibrium choice c^*. However, in order to simplify the notations we still use the subscript c.

Reorganizing (5) shows that a scientist whose wage is lower than the required investment can become an entrepreneur if and only if

$$Up^i \geq \underline{Up_c^i} \stackrel{d}{=} \frac{B}{1-q} - \delta - W_c^i, \tag{6}$$

where the reputation threshold and the wage are indexed by c in order to capture that the wage and in turn the reputation threshold depend on the choice of firm or project (see below). Equation (6) implies that contributing talent is essential to overcoming the credit rationing problem when $\underline{Up_c^i} > 0$, or $W_c^i < \frac{B}{1-q} - \delta$. The intuition is that the better the scientist's reputation, the larger the difference in the venture's value between pursuing personal objectives and maximizing profits, which fosters incentives. This result stands in contrast to the benchmark case, where professional reputation is useless since, whatever the scientist's initial reputation, the business venture is profitable. Quite intuitively, the reputation threshold is all the more reduced as the new technology is attractive (i.e., as δ is high), and rises with the magnitude (B) of the moral hazard problem. Equation (6) leads to the following proposition.

Proposition 1 *Reputation and financial capital are substitutes in overcoming the credit rationing problem.*

A scientist's reputation can be estimated, for example with the methodology used in Zuckner et ali (1998), by counting the number of scientific publications and citations rates of authors. Thus, one can separate scientists endowed with differing reputations. Proposition 1 implies that after controlling for exogenous personel wealth (e.g., inheritences), one should observe that "star" scientists are less credit rationed than "ordinary" scientists.

Since effort is costly, unobservable, and does not increase the first-period wage (which is fixed at the beginning of the period), the scientist works only to influence favorably the learning process regarding talent, and in turn the second-period expected gains. The latter are equal to

$$\Pr\left(Up^i \geq \underline{Up_c^i}\right) \times \mathbb{E}_{\pi_c^i}\left[Up^i + \delta \mid Up^i \geq \underline{Up_c^i}\right] + \Pr\left(Up^i < \underline{Up_c^i}\right) \times \mathbb{E}_{\pi_c^i}\left[Up^i \mid Up^i < \underline{Up_c^i}\right], \quad (7)$$

where $\mathrm{E}_{\pi_c^i}$ means that the expectation is taken with respect to π_c^i. The first part of (7) is the product of the probability that the scientist starts his business during the second period and his expected gain in such a case. The latter is equal to the updated reputation of the scientist conditional on the fact that this updated reputation is sufficient to start the business venture, plus δ, the NPV of the new technology. The second part of (7) is the product of the probability that the scientist remains an employee and his expected wage in such a case. The expected wage reduces to the updated reputation conditional on the fact that this reputation is insufficient to start the business venture since the scientist exerts no effort during the second period when working as an employee (career concerns are then absent).

Overall, the scientist exerts effort so as to maximize the second-period expected gains given by (7) minus the first-period cost of effort, $\psi\left(e^i\right)$. Assuming an interior solution like in Dewatripont et al. (1999), the first-order condition for an equilibrium satisfies

$$f_c(\mathcal{A}_c^i)\left(\delta + \sigma_\theta^2 \frac{f_c(\mathcal{A}_c^i)}{1 - F_c(\mathcal{A}_c^i)}\right) + \left(\frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_c^2} F_c(\mathcal{A}_c^i) + \left(In^i - \underline{Up_c^i}\right) f_c(\mathcal{A}_c^i)\right) = ke_c^{i^*}, \quad (8)$$

where $f_c\left(\ \right)$ and $F_c\left(\ \right)$ respectively denote the density function and the cumulative distribution function of π_c^i[19]. We denote $\mathcal{A}_c^i \stackrel{d}{=} \mathbb{E}\left(\pi_c^i\right) - \frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^2}\left(In^i - \underline{Up_c^i}\right)$ the smallest value of π_c^i allowing the scientist to start the business venture. The first (respectively the second) term in (8) is derived from the first (respectively the second) term in (7). Regarding second-period expected gains, the scientist can, by increasing his effort raise (i) the probability to become an entrepreneur and (ii) the expected wage if transition to entrepreneurship is impossible at the end of the first period. Let us determine how the

[19] Note that the second term in (8) is positive. We refer the reader to the appendix for a proof.

effort exerted is related to the choice of firm or project. The bedrock of the analysis is to recognize that the updating process is impaired when σ_c^2 increases in the sense that output becomes less informative about talent. Then, exerting effort has a less positive impact on the revision of reputation, which has two consequences. First, it reduces the incentives to exert effort in order to increase the probability of becoming an entrepreneur. Second, keeping probabilities constant, it reduces the incentives to exert effort in order to increase the wage. However, probabilities are not held constant across choices. Indeed, consider that $In^i < \underline{Up_c^i}$ so that the status quo would not allow the scientist to start a business venture. Then, keeping effort constant, an increase in σ_c^2 reduces the probability of transition to entrepreneurship, and accordingly increases the probability to remain an employee. Hence, a scientist with an insufficient reputation faces additional incentives to exert effort in order to obtain a better wage in the second period when σ_c^2 increases since the probability of such an outcome rises. This effect goes into the opposite direction to the general decrease in incentives described above. However, since $\delta > \underline{\delta}$, the fall in incentives to exert effort in order to increase the probability to become an entrepreneur and get δ dominates. Hence, insufficient-reputation scientists exert less effort when σ_c^2 increases. When initial reputation is such that $In^i \geq \underline{Up_c^i}$, that is, when the status quo would be favorable to the scientist, raising σ_c^2 increases the probability of transition to entrepreneurship, and accordingly decreases the probability to stay an employee and get the wage W_c^i. Thus, sufficient-reputation scientists unambiguously exert less effort when σ_c^2 increases- all effects go into the same direction. These results are summarized below.

Lemma 1 *The equilibrium effort e_c^{i*} is increasing in the level of transparency $\frac{1}{\sigma_c^2}$.*

We can rephrase Lemma 1 in terms of choice of firm or project and say that the scientist exerts less effort when choosing $\mathcal{O}$ rather than $\mathcal{T}$. A consequence is thus that the scientist's output is lower when opting for $\mathcal{O}$. In turn, the scientist earns a lower wage, which diminishes the financial capital the scientist can contribute to the business venture in the next period, so that more reputation is needed (see Proposition 1). We summarize this result in the next proposition.

Proposition 2 *A scientist needs a lower updated reputation in order to start a business venture when opting for* $\mathcal{T}$ *rather than for* $\mathcal{O}$ *in the first period:* $\underline{Up^i_{\mathcal{T}}} < \underline{Up^i_{\mathcal{O}}}$.

The next Lemma identifies scientists whose initial reputation equals the reputation threshold.

Lemma 2 *For a given* σ^2_θ*, and* $c = \mathcal{O}, \mathcal{T}$*,*

(i) There is a unique scientist $\widehat{i_c}$ *characterized by* $In^{\widehat{i_c}} = \underline{Up^{\widehat{i_c}}_c}$*. Let* $\underline{Up_c}$ *denote this threshold.*

(ii) $In^i > \underline{Up_c}$ *implies that* $In^i > \underline{Up^i_c}$ *and* $In^i < \underline{Up_c}$ *implies that* $In^i < \underline{Up^i_c}$.

(iii) $\underline{Up_{\mathcal{O}}} > \underline{Up_{\mathcal{T}}}$.

Let us now compare the conditions that allow the scientists to start a business venture according to their initial reputation.

Lemma 3 *For a given* σ^2_θ *and* $c = \mathcal{O}, \mathcal{T}$*,*

(i) $In^j > In^i > \underline{Up_c}$ *implies that* $\left|In^j - \underline{Up^j_c}\right| > \left|In^i - \underline{Up^i_c}\right|$,

(ii) $In^j < In^i < \underline{Up_c}$ *implies that* $\left|In^j - \underline{Up^j_c}\right| > \left|In^i - \underline{Up^i_c}\right|$.

Combining Lemma 2 and Lemma 3 allows us to distinguish between three categories of scientists. Scientists characterized by $In^i < \underline{Up_{\mathcal{T}}}$ will not become entrepreneurs if the status quo in terms of reputation persists. Scientists characterized by $In^i \geq \underline{Up_{\mathcal{O}}}$ will become entrepreneurs if the status quo persists. For scientists characterized by $\underline{Up_{\mathcal{T}}} \leq In^i < \underline{Up_{\mathcal{O}}}$, the relation between the status quo and the possibility to become entrepreneurs depends on which reputation threshold is relevant, that is, on the choice of firm actually made or the equilibrium choice of project. In the next section, we examine the choice of firm.

IV. Choice of Firm

The scientist chooses to work for the firm which maximizes the sum of his first-period utility

$$W_c^i - \psi\left(e^i\right) \tag{9}$$

and his second period expected utility, given by (7). Since the market correctly anticipates $e_c^{i^*}$, the second-period expected utility can be rewritten as

$$In^i + \Pr\left(Up^i \geq \underline{Up_c^i}\right) \times \delta. \tag{10}$$

Replacing W_c^i by $In^i + e_c^{i^*}$ in (9) and combining with (10) implies that the scientist prefers $\mathcal{O}$ to $\mathcal{T}$ when

$$\left[\left(e_{\mathcal{O}}^{i*} - \psi\left(e_{\mathcal{O}}^{i*}\right)\right) - \left(e_{\mathcal{T}}^{i*} - \psi\left(e_{\mathcal{T}}^{i*}\right)\right)\right] + \left[\Pr\left(Up^i \geq \underline{Up_{\mathcal{O}}^i}\right) - \Pr\left(Up^i \geq \underline{Up_{\mathcal{T}}^i}\right)\right] \times \delta \geq 0. \tag{11}$$

The first term in square brackets in the LHS of (11) represents the difference in first-period utilities when opting for $\mathcal{O}$ instead of $\mathcal{T}$. This term is negative since efforts are lower than the first-best effort- $\sigma_{\mathcal{T}}^2 > \underline{\sigma_{\mathcal{T}}^2}$ -and the deviation is higher when choosing $\mathcal{O}$. Thus, the first-period utility is lower when opting for $\mathcal{O}$. The second term in square brackets in the LHS of (11) represents the difference in the probability of starting the business venture when opting for $\mathcal{O}$ instead of $\mathcal{T}$. Two effects are at work. First, according to Proposition 2, choosing $\mathcal{O}$ imposes on the aspiring entrepreneur to have a higher updated reputation at the beginning of the second period since the choice of $\mathcal{O}$ diminishes the wage, and thus the financial capital available to finance the new venture. In that respect, choosing $\mathcal{O}$ decreases the probability to become an entrepreneur. It is the "cash effect". Besides, we identify a "revision effect". Opting for $\mathcal{O}$ impairs the revision of reputation. It has a positive impact on the probability that the scientist starts a business venture when his initial reputation capital is such that the status quo would allow him to become an entrepreneur. In contrast, opting for $\mathcal{O}$ has a negative impact on the probability that the scientist starts a business venture when his initial reputation capital is such that the status quo would not allow him to become an entrepreneur. The next proposition states the relation that exists between reputation capital, financial capital, and the choice of firm.

Proposition 3 *Trying to preserve one's reputation capital by choosing to work for an $\mathcal{O}$-firm is* not *compatible with accumulating as much financial capital as possible. In contrast, trying to increase one's reputation capital by choosing to work for a $\mathcal{T}$-firm is compatible with accumulating as much financial capital as possible.*

Determining the scientist's choice of firm leads us to distinguish between three cases, depending on initial reputation capital. First consider a scientist characterized by $In^i < \underline{Up_{\mathcal{T}}}$. Opting for $\mathcal{O}$ adversely impacts the probability to start the business venture for two reasons. First, it impairs the revision of reputation, which is detrimental to the scientist. Second, it increases the reputation capital level required to become an entrepreneur (Proposition 2). Hence, it overall decreases the second-period expected utility. Since choosing $\mathcal{O}$ also reduces the first-period utility, the scientist's dominant strategy is to opt for $\mathcal{T}$.

When $\underline{Up_{\mathcal{T}}} \leq In^i < \underline{Up_{\mathcal{O}}}$, the probability to become an entrepreneur is always greater than $\frac{1}{2}$ if the scientist chooses $\mathcal{T}$ and always lower than $\frac{1}{2}$ if the scientist chooses $\mathcal{O}$. Since choosing $\mathcal{O}$ also reduces the first-period utility, the scientist's dominant strategy is again to opt for $\mathcal{T}$.

What changes when $In^i \geq \underline{Up_{\mathcal{O}}}$ is that the status quo in terms of reputation now benefits to the scientist and could make the choice of $\mathcal{O}$ attractive. However, when In^i is sufficiently close to $\underline{Up_{\mathcal{O}}}$, that is, if $\underline{Up_{\mathcal{O}}} \leq In^i \leq \underline{In}$, the scientist still chooses $\mathcal{T}$. When the distance to $\underline{Up_{\mathcal{O}}}$ is very low, choosing $\mathcal{O}$ does not overall increase the probability to become an entrepreneur since the cash effect dominates the revision effect. When the distance is larger, choosing $\mathcal{O}$ overall increases the probability to become an entrepreneur- the revision effect dominates the cash effect -but fails to compensate the loss in first-period utility. This result holds until In^i reaches $\underline{In}$.

If In^i further rises- but does not reach $\overline{In}$ - the scientist chooses $\mathcal{O}$ since it increases sufficiently the probability to become an entrepreneur to compensate the loss in first-period utility.

Finally, if $In^i > \overline{In}$ choosing $\mathcal{O}$ or $\mathcal{T}$ does not significantly modify the probability to become an entrepreneur, which is close to 1. Thus, the scientist only considers his first-period utility, and therefore chooses $\mathcal{T}$. These results are summarized below.

Proposition 4 *For a given σ_θ^2, there exists $\overline{In} > \underline{In} > \underline{Up_{\mathcal{O}}}$ such that scientists characterized by*

(i) $In^i < \underline{In}$ choose a $\mathcal{T}$-firm.

(ii) $\underline{In} \leq In^i < \overline{In}$ choose an $\mathcal{O}$-firm.

(ii) $In^i \geq \overline{In}$ choose a $\mathcal{T}$-firm.

This result stands in contrast to the benchmark case where the choice of firm is irrelevant. It leads to the following empirical implication. Consider students who have just graduated and contemplate becoming entrepreneurs on the long run. Proposition 4 implies that "elite" and "low-reputation" students should choose to work for transparent firms.

Also remark that scientists whose initial reputation capital verifies $\underline{In} \leq In^i < \overline{In}$ choose to try to preserve their reputation capital rather than accumulate as much financial capital as possible, whereas those characterized by either $In^i \geq \overline{In}$ or $\underline{Up_{\mathcal{O}}} \leq In^i < \underline{In}$ choose to accumulate financial capital rather than to preserve their reputation capital. Finally, other scientists (those characterized by $In^i < \underline{Up_{\mathcal{O}}}$) face no trade-off. They both build a reputation and accumulate as much financial capital as possible. The next section considers a choice of project rather than a choice of firm.

V. Choice of Project

In Section IV, we have shown that scientists willing to start a business venture pay attention to the type of firm they work with during their employment period. In this section, we examine the case of scientists who choose between projects of various levels of transparency.

The differences between the two cases are the following. First, by choosing a firm, scientists commit to a level of transparency. Such a commitment is impossible when scientists select a project once employed. It modifies the factors that scientists take into account when making their choice. Since the first-period wage is already fixed when the choice takes place, scientists exclude from the comparison any differences in wages. Second, since the choice of project is not observable by the market, the magnitude of the revision of reputation does not change if scientists deviate from the anticipated equilibrium. Thus, scientists ignore the first-period cost of effort when making their choice: Whatever project is actually chosen, the magnitude of revision is already "locked" so that scientists must exert the proper and anticipated effort.

These two differences imply that when deciding whether to deviate or not, scientists only consider the impact of the projects in terms of information released to the market. In other words, scientists ignore the first-period utility and the "cash" effect that affects probabilities when making the choice of firm to work with. Choosing an $\mathcal{O}$-project is thus an equilibrium if and only if

$$\Pr\left(Up^i \geq \underline{Up^i_{\mathcal{O}}}\right) - \Pr\left(Up^i(\mathcal{O},\mathcal{T}) \geq \underline{Up^i_{\mathcal{O}}}\right) \geq 0,$$

where $Up^i(\mathcal{O},\mathcal{T})$ denote the scientist's updated reputation when the scientist chooses $\mathcal{T}$ whereas the market anticipates $\mathcal{O}$, i.e., when the scientist deviates from equilibrium. Choosing $\mathcal{T}$ is an equilibrium if and only if

$$\Pr\left(Up^i \geq \underline{Up^i_{\mathcal{T}}}\right) - \Pr\left(Up^i(\mathcal{T},\mathcal{O}) \geq \underline{Up^i_{\mathcal{T}}}\right) \geq 0,$$

where $Up^i(\mathcal{T},\mathcal{O})$ denote the scientist's updated reputation when the scientist chooses $\mathcal{O}$ whereas the market anticipates $\mathcal{T}$.

First, consider a scientist characterized by $In^i < \underline{Up_{\mathcal{T}}}$. The status quo is detrimental to him. Assume that the firm anticipates the choice of $\mathcal{O}$ and, accordingly, pays the scientist $W^i_{\mathcal{O}}$. The relevant reputation threshold is then $\underline{Up_{\mathcal{O}}}$. Since $In^i < \underline{Up_{\mathcal{T}}} < \underline{Up_{\mathcal{O}}}$, choosing $\mathcal{O}$ is a dominant strategy. Indeed, it is worth gambling for the scientist even though the market anticipates the choice of $\mathcal{O}$, and accordingly places little weight on the information obtained at the end of the first period to modify priors. Now consider that the market anticipates the choice of $\mathcal{T}$ and pays $W^i_{\mathcal{T}}$. Accordingly, the market places a substantial weight on the information obtained at the end of the first period to modify its priors about scientists. To make the status quo less likely, the scientist gambles, that is, opts for $\mathcal{O}$.

Second, consider a scientist characterized by $\underline{Up_{\mathcal{T}}} \leq In^i \leq \underline{Up_{\mathcal{O}}}$. Assume that the firm anticipates the choice of $\mathcal{T}$. Accordingly, the market places a substantial weight on the information obtained at the end of the first period to modify its priors. Once being paid $W^i_{\mathcal{T}}$, the relevant reputation threshold is $\underline{Up_{\mathcal{T}}}$. Since $In^i > \underline{Up_{\mathcal{T}}}$, the status quo is favorable. Thus, the scientist chooses $\mathcal{T}$ since it makes the status quo more likely. An equilibrium where the scientist chooses $\mathcal{O}$ is also possible- see the reason invoked just above -but is dominated by $(\mathcal{T}, W^i_{\mathcal{T}})$, since then both the first-period utility and the probability to start the business venture are higher.

Finally, consider a scientist characterized by $In^i \geq \underline{Up_{\mathcal{O}}}$. The scientist is able to start a business venture if the status quo persists. Choosing $\mathcal{T}$ is a dominant strategy. Indeed, whatever the magnitude of the revision of reputation by the market, the scientist benefits from playing a safe strategy- choosing $\mathcal{T}$- instead of gambling since $\mathcal{T}$ makes the status quo more likely. These results are summarized below.

Proposition 5 *For a given σ^2_θ, scientists characterized by*

(i) $In^i \leq \underline{Up_{\mathcal{T}}}$ realize an $\mathcal{O}$-project.

(ii) $In^i > \underline{Up_{\mathcal{T}}}$ realize a $\mathcal{T}$-project.

Job search theory (starting with Stigler 1962, and Burdett 1978) shows how frictions prevent optimal and instantaneous matching between employees and firms, thus reducing job mobility. These frictions are empirically assessed in Ridder and Van den Berg (2003). Proposition 5 implies that the reduced ability to move from one firm to the other during the employment period should lower the probability to become entrepreneur later. It runs contrary to the idea that frictions on the labor market are correlated with a higher transition rate from employee activity to entrepreneurship. In the next section, we discuss robustness issues.

VI. Robustness Issues

In this section we examine the robustness of our results with respect to alternative assumptions regarding the form of the pay-off derived from entrepreneurship, the case of observability of the chosen project, the type of property rights protecting innovation, some psychological traits of the entrepreneur, the possibility for the entrepreneur to face positive liquidity shocks, and the endogenous attractiveness of the business opportunity.

- **Pay-off from entrepreneurship.** Several recent papers suggest that entrepreneurship may not "pay" financially, and that non-pecuniary reasons could explain the desire to become an entrepreneur (Blanchflower and Oswald, 1990; Hamilton, 2000; Moskowitz and Vissing-Jorgensen, 2002). For instance, being their own boss was the main reason for starting a firm stated by over 21% of survey respondents in the 1992 Economic Census Characteristics of Business Owners. Other non-pecuniary arguments are the ability to control the work schedule, and an increased ego as being an entrepreneur enhances social status. Two remarks are in order here. First, the above studies include industries spanning from services (including beauty shops and barber shops) to manufacturing and retail (Moskowitz and Vissing-Jorgensen, 2002); sometimes even excluding professionals (Hamilton, 2000), whereas we focus on industries where human capital is crucial and profits are potentially large. Second, our results apply provided that transition to entrepreneurship creates a discontinuity in the employee's revenue function, irrespective of the reasons that motivate the employee to become an entrepreneur. Hence Δ can represent the monetary equivalent to the pleasure to run a firm.

- **Observability of the project chosen.** Contrary to the maintained assumption, consider that markets observe the scientists' choice of project. Thus, markets adapt the updating process to this choice. It implies that when deciding whether to deviate or not from equilibrium, scientists consider the impact of the projects in terms of information released to the market *and* cost of effort to be exerted. Scientists characterized by $In^i \geq \underline{Up_{\mathcal{O}}}$ unambiguously choose $\mathcal{O}$. Consider scientists characterized by $\underline{Up_{\mathcal{T}}} \leq In^i < \underline{Up_{\mathcal{O}}}$. Choosing $\mathcal{T}$ is no longer an equilibrium. Indeed, suppose that firms anticipate the choice of $\mathcal{T}$, and pay scientists $W^i_{\mathcal{T}}$ so that the relevant threshold is $\underline{Up_{\mathcal{T}}}$. Opting for $\mathcal{O}$ reduces the revision of reputation and the cost of effort to be exerted. Choosing $\mathcal{O}$ is the equilibrium. Finally, choosing $\mathcal{T}$ is an equilibrium for scientists characterized by $In^i < \underline{Up_{\mathcal{T}}}$ if In^i is not too far from $\underline{Up^i_{\mathcal{T}}}$ since the benefits from facilitating the revision of reputation more than offset the costs of exerting more effort. If otherwise, scientists prefer $\mathcal{O}$. Overall, the same messages remain. Trying to increase one's reputation capital is not always compatible with maximizing the financial capital accumulated. And scientists who choose projects to work on instead of firms to work with are less likely to become entrepreneurs.

- **Intellectual property rights or opportunity to develop innovation as an employee.** In the model, the scientist cannot start the business venture as an entrepreneur by stealing existing technology since the latter is protected by the law. In practice, this assumption hardly holds (see Hyde (1998), and Gilson (1999) for a discussion of the case of California). In that case, the scientist would exert the first-best effort in the second period since he would be residual claimant of the cash-flows. In terms of the model, absent this restriction, the scientist would however prefer starting the venture based on more profitable new technology when $\delta > e^{FB} - \psi(e^{FB})$. Similarly, developing new technology as an employee makes the scientist earn lower profits than starting the business venture as an entrepreneur since incentives to maximize profits are absent in the former case and (3).

- **Optimism.** Recent literature on entrepreneurship (Amador and Landier, 2003, and Landier and Thesmar, 2004) considers that entrepreneurs are optimistic, that is, they overestimate the probability of success of their project or their talent. Postulating that entrepreneurs are optimistic would not modify the conclusion that, when choosing between two alternatives of varying transparency, scientists take into account their position with respect to the reputation thresholds we have identified.

- **Exogenous positive liquidity shocks.** We have so far assumed that the scientist had no wealth at the beginning of the first period. Instead, we endogenized wealth as the result of the scientist's choices. Now, consider the case where the scientist faces a positive liquidity shock (inheritance or increase in housing prices[20], government subsidies or tax exemptions to create firms) before making decisions. In our framework, it would imply a reduction in the level of reputation capital required to start the venture, and in turn could alter the scientist's relative position in terms of reputation vis-a-vis the two thresholds we identified. For instance, a scientist who initially falls between the two thresholds can end up above them after inheriting some wealth, which affects his selection of firm or project. It also implies that two scientists with the same reputation capital can make different choices after receiving different financial endowments. However, although modified, the reputation thresholds remain.

- **Endogenous attractiveness of the business opportunity**. Imagine that the choice of project we consider in this paper reduces to a choice of risk regarding the strategy of the R&D policy of the firm. Strategy $\mathcal{O}$ is riskier than strategy $\mathcal{T}$ in the sense that $\sigma^2_{\mathcal{O}} > \sigma^2_{\mathcal{T}}$. In this framework, the scientist has a call option on the outcome of the R&D policy, where the fraction of the profits that the scientist can appropriate depends on the laws protecting intellectual property or the severity

[20] See Hurst and Lusardi (2004) for a discussion on how housing prices are as close to a natural experiment as one can get, and for a criticism of the use of the receipt of an inheritance to investigate the relation between transition to entrepreneurship and personal wealth.

of non-competition contractual clauses. By discovering some invention or a new way to discover some invention, the scientist benefits from the opportunity to utilize these findings when creating a new firm, and thus benefits from the upside potential of the R&D policy. If the R&D outcome is a failure, the scientist stays with the firm and continues to run the existing technology. The value of this option increases with the volatility of the R&D policy. Reinterpreting our results against the backdrop of this option framework should not alter them qualitatively, but would bias the scientist's choice towards the riskier project.

VII. Concluding Remarks

In this paper, we analyze the intertwined roles of reputation capital and financial capital in the transition from employee activity to entrepreneurial activity when credit is rationed. We examine the case of a prospective entrepreneur who during a first period chooses a firm to work with (or a project to run once employed). This choice is more or less informative regarding talent. Once the choice is made, the prospective entrepreneur exerts an unobservable and costly effort. Without moral hazard, it would always be possible to start the business venture in the second period. Under moral hazard, the aspiring entrepreneur needs a sufficient mix of reputation capital and financial capital to start the business venture. Thus, all prospective entrepreneurs share the common objective of maximizing their reputation capital and their financial capital. However, these two goals can conflict. Opting for the less informative alternative prevents the market from updating reputation efficiently, thus lowers the productivity of the scientist, in turn decreases the wage, and consequently diminishes the financial capital that will be available for the future business venture. Hence, when their reputation capital is high enough, prospective entrepreneurs who have to choose a firm to work with face a trade-off between trying to preserve their reputation capital and trying to accumulate more resources. They opt for the less informative firm when the loss in financial capital this choice implies is limited. Aspiring entrepreneurs with a sufficiently low reputation capital always benefit from choosing the more informative firm, since it allows the market to change its beliefs regarding their talent, and encourages them to work more, allowing them to accumulate the financial resources that later facilitate access to credit. Prospective entrepreneurs who face a project choice instead of a choice of firm are less likely to become entrepreneurs.

Appendix

Proof of Lemma 1

First, we determine the scientist's objective function. Note that given (i) $In^i \stackrel{d}{=} \mathrm{E}(\theta^i)$, (ii) $Up^i \stackrel{d}{=} \mathrm{E}(\theta^i \mid \pi_c^i, e_c^{i^*}, c) = In^i + \frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2}\left(\pi_c^i - \mathbb{E}(\pi_c^i)\right)$, (iii) $\pi_c^i \backsim N\left(In^i + e^i; \sigma_\theta^2 + \sigma_c^2\right)$, (iv) $\underline{Up_c^i} = \frac{B}{1-q} - \delta - W_c^i$, and (v) $W_c^i = e_c^{i^*} + In^i$ since the labor market is competitive, we have $Up^i \geq \underline{Up_c^i} \Leftrightarrow \pi_c^i \geq \mathcal{A}_c^i \stackrel{d}{=} \mathrm{E}(\pi_c^i) - \frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^2}\left(In^i - \underline{Up_c^i}\right)$. $\mathcal{A}_c^i$ is thus a function of $e_c^{i^*}$, σ_θ^2, σ_c^2, In^i, δ, and $\frac{B}{1-q}$. Substituting $\mathcal{A}_c^i$ in Eq. (7), we obtain that the scientist's objective is to exert an effort $e_c^{i^*}$ that maximizes

$$\left(1 - \Pr\left(\pi_c^i \leq \mathcal{A}_c^i\right)\right) \times \mathbb{E}_{\pi_c^i}\left[Up^i + \delta \mid \pi_c^i \geq \mathcal{A}_c^i\right] + \Pr\left(\pi_c^i < \mathcal{A}_c^i\right) \times \mathbb{E}_{\pi_c^i}\left[Up^i \mid \pi_c^i < \mathcal{A}_c^i\right] - \frac{k}{2}\left(e^i\right)^2.$$

Next, we determine the scientist's equilibrium effort. Assuming an interior solution, the first-order condition for an equilibrium is

$$\frac{\partial}{\partial e^i}\left[\left(1 - \Pr\left(\pi_c^i \leq \mathcal{A}_c^i\right)\right) \times \mathbb{E}_{\pi_c^i}\left[Up^i + \delta \mid \pi_c^i \geq \mathcal{A}_c^i\right]\right]\Big|_{e^i = e_c^{i^*}} + \frac{\partial}{\partial e^i}\left[\Pr\left(\pi_c^i < \mathcal{A}_c^i\right) \times \mathbb{E}_{\pi_c^i}\left[Up^i \mid \pi_c^i < \mathcal{A}_c^i\right]\right]\Big|_{e^i = e_c^{i^*}} = ke_c^{i^*}. \tag{12}$$

Using the fact that $\frac{\partial}{\partial e^i}\left(\mathbb{E}_{\pi_c^i}\left[Up^i + \delta \mid \pi_c^i \geq \mathcal{A}_c^i\right]\right) = 0$ since the scientist knows the effort he exerted in the first period[21] allows us to rewrite the first term in the LHS of (12) as

$$\frac{\partial}{\partial e^i}\left(1 - \Pr\left(\pi_c^i < \mathcal{A}_c^i\right)\right)\Big|_{e^i = e_c^{i^*}} \times \mathbb{E}_{\pi_c^i}\left[Up^i + \delta \mid \pi_c^i \geq \mathcal{A}_c^i\right]. \tag{13}$$

[21] In contrast, $\frac{\partial}{\partial e^i}\left(1 - \Pr\left(\pi_c < \mathcal{A}_c\right)\right) \neq 0$ since the market does not observe e^i.

Besides,

$$\frac{\partial}{\partial e^i}\left(1-\Pr\left(\pi_c^i<\mathcal{A}_c^i\right)\right)\Big|_{e^i=e_c^{i*}}=-\frac{\partial}{\partial e^i}\int^{\mathcal{A}_c^i}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c\Big|_{e^i=e_c^{i*}}=-\int^{\mathcal{A}_c^i}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c,\qquad(14)$$

where $f_c\left(\ \right)$ denotes the density of π_c^i conditional on e^i (or e_c^{i*}). Since $f_c\left(\pi_c^i\mid e_c^{i*}\right)=\frac{1}{\sqrt{2\Pi}}\frac{1}{\sqrt{\sigma_\theta^2+\sigma_c^2}}\exp(-\frac{1}{2}\frac{\left(\pi_c^i-In^i-e_c^{i*}\right)^2}{\sigma_\theta^2+\sigma_c^2})$, we obtain

$$\frac{\partial}{\partial e^i}\left(1-\Pr\left(\pi_c^i<\mathcal{A}_c^i\right)\right)\Big|_{e^i=e_c^{i*}}=-\int^{\mathcal{A}_c^i}\frac{\pi_c^i-\mathbb{E}(\pi_c^i)}{\sigma_\theta^2+\sigma_c^2}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c=f_c\left(\mathcal{A}_c^i\right).\qquad(15)$$

We also have

$$\begin{aligned}\mathbb{E}_{\pi_c^i}\left[Up^i+\delta\mid\pi_c^i\geq\mathcal{A}_c^i\right]&=\left(\frac{In^i+\delta}{1-F_c\left(\mathcal{A}_c^i\right)}\right)\int_{\mathcal{A}_c^i}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c+\frac{\sigma_\theta^2}{1-F_c\left(\mathcal{A}_c^i\right)}\int_{\mathcal{A}_c^i}\frac{\pi_c^i-\mathbb{E}\left(\pi_c^i\right)}{\sigma_\theta^2+\sigma_c^2}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c\\&=In^i+\delta+\sigma_\theta^2\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}.\end{aligned}$$

Thus, the first term in the LHS of (12) can be rewritten as

$$f_c\left(\mathcal{A}_c^i\right)\left[In^i+\delta+\sigma_\theta^2\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right].\qquad(16)$$

The second term in the LHS in (12) writes

$$\begin{aligned}&\frac{\partial}{\partial e^i}\left[F_c\left(\mathcal{A}_c^i\right)\int^{\mathcal{A}_c^i}\mathbb{E}(\theta^i\mid\pi_c^i,e_c^{i*})\frac{f_c\left(\pi_c^i\mid e_c^{i*}\right)}{F_c\left(\mathcal{A}_c^i\right)}d\pi_c\right]\Big|_{e^i=e_c^{i*}}\\&\text{or}\int^{\mathcal{A}_c^i}In^i\times\frac{\partial f_c\left(\pi_c^i\mid e_c^{i*}\right)}{\partial e^i}d\pi_c+\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2}\int^{\mathcal{A}_c^i}\frac{\left(\pi_c^i-\mathbb{E}(\pi_c^i)\right)^2}{\sigma_\theta^2+\sigma_c^2}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c.\end{aligned}\qquad(17)$$

Since (i) $\int^{\mathcal{A}_c^i}In^i\times\frac{\partial f_c\left(\pi_c^i\mid e_c^{i*}\right)}{\partial e^i}d\pi_c=-In^i\times f_c\left(\mathcal{A}_c^i\right)$ and (ii) $\int^{\mathcal{A}_c^i}\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2}\left(\pi_c^i-\mathbb{E}\left(\pi_c^i\right)\right)f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c=\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2}f_c\left(\mathcal{A}_c^i\right)+\left(In^i-\underline{Up_c^i}\right)f_c\left(\mathcal{A}_c^i\right)$, by integrating by part $\int^{\mathcal{A}_c^i}\frac{\left(\pi_c^i-\mathbb{E}(\pi_c^i)\right)^2}{\sigma_\theta^2+\sigma_c^2}f_c\left(\pi_c^i\mid e_c^{i*}\right)d\pi_c$ [22] and com-

[22] Notice that the second term of (17) implies that the second term of (18) is positive.

puting, we obtain that the second term in the LHS of (12) can be rewritten as

$$-In^i \times f_c\left(\mathcal{A}_c^i\right) + \left(\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2} F_c\left(\mathcal{A}_c^i\right) + \left(In^i - \underline{Up_c^i}\right) f_c\left(\mathcal{A}_c^i\right)\right). \tag{18}$$

Combining (16) and (18) implies that the scientist exerts an effort e_c^{i*} that verifies

$$f_c\left(\mathcal{A}_c^i\right)\left(\delta + \sigma_\theta^2 \frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right) + \left(\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2} F_c\left(\mathcal{A}_c^i\right) + \left(In^i - \underline{Up_c^i}\right) f_c\left(\mathcal{A}_c^i\right)\right) = ke_c^{i*}. \tag{19}$$

Finally, we show that the equilibrium effort decreases in σ_c^2. Differentiating (19) in e_c^{i*} and in σ_c^2 gives

$$\frac{de_c^{i*}}{d\sigma_c^2} = \frac{-\left(\begin{array}{c}\frac{\sigma_\theta^2}{\left(\sigma_\theta^2+\sigma_c^2\right)^2} f_c\left(\mathcal{A}_c^i\right) + f_c\left(\mathcal{A}_c^i\right)\left(In^i - \underline{Up_c^i}\right)\left[\frac{1}{\sigma_\theta^2+\sigma_c^2} + \frac{\left(In^i-\underline{Up_c^i}\right)^2}{\sigma_\theta^4} + \frac{1}{2}\left(\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right)^2\right] \\ +\frac{1}{2} f_c\left(\mathcal{A}_c^i\right)\left(\frac{1}{\sigma_\theta^2+\sigma_c^2} + \frac{\left(In^i-\underline{Up_c^i}\right)^2}{\sigma_\theta^4}\right)\left(\delta + 2\sigma_\theta^2 \frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right)\end{array}\right)}{k + f_c\left(\mathcal{A}_c^i\right)\left[\frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^4}\left(\left(In^i - \underline{Up_c^i}\right)^2 + \left(In^i - \underline{Up_c^i}\right)\left(\delta + 2\sigma_\theta^2 \frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right)\right) + \left(\sigma_\theta^2+\sigma_c^2\right)\frac{f_c\left(\mathcal{A}_c^i\right)^2}{\left(1-F_c\left(\mathcal{A}_c^i\right)\right)^2}\right]}. \tag{20}$$

When $In^i \geq \underline{Up_c^i}$, the numerator (respectively the denominator) in (20) is negative (respectively positive), so that $\frac{de_c^*}{d\sigma_c^2} \leq 0$. When $In^i < \underline{Up_c^i}$, the denominator in (20) is positive since $k \geq \underline{k}$ (To Be Specified). Consider the numerator in (20). It is negative for $\delta \geq G\left(In^i - \underline{Up_c^i}\right)$ with

$$G\left(In^i - \underline{Up_c^i}\right) \stackrel{d}{=}$$

$$-2\frac{\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2} F_c\left(\mathcal{A}_c^i\right)}{f_c\left(\mathcal{A}_c^i\right)\left(\frac{1}{\sigma_\theta^2+\sigma_c^2} + \frac{\left(In^i-\underline{Up_c^i}\right)^2}{\sigma_\theta^4}\right)} - 2\frac{\left(In^i - \underline{Up_c^i}\right)\left[\frac{1}{\sigma_\theta^2+\sigma_c^2} + \frac{\left(In^i-\underline{Up_c^i}\right)^2}{\sigma_\theta^4} + \frac{1}{2}\left(\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right)^2\right]}{\frac{1}{\sigma_\theta^2+\sigma_c^2} + \frac{\left(In^i-\underline{Up_c^i}\right)^2}{\sigma_\theta^4}} - 2\sigma_\theta^2 \frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}.$$

Indeed, observe that $G(0) < 0$ and $\lim_{In^i - \underline{Up_c^i} \to -\infty} G\left(In^i - \underline{Up_c^i}\right) < 0$ imply by continuity that when $\left|In^i - \underline{Up_c^i}\right|$ is either low enough or high enough, $G\left(In^i - \underline{Up_c^i}\right) < 0$. Moreover, notice that $G\left(In^i - \underline{Up_c^i}\right) < -\left(In^i - \underline{Up_c^i}\right)\left(2 + \sigma_\theta^2 + \sigma_c^2\right)$. Thus, the maximum of G when $\left|In^i - \underline{Up_c^i}\right|$ takes intermediate values is a finite number. It implies that the numerator in (20) is negative when $\delta \geq \underline{\delta} \overset{d}{=} \max G$. Thus, $\frac{de_c^*}{d\sigma_c^2} \leq 0$ when $\delta > \underline{\delta}$ and $k \geq \underline{k}$.

It establishes Lemma 1.

Proof of Proposition 2

A scientist characterized by $W_c^i < In^i$ can start a business venture if and only if

$$Up^i \geq \underline{Up_c^i} \overset{d}{=} \frac{B}{1-q} - \delta - W_c^i. \tag{21}$$

Since $W_c^i = In^i + e_c^{i^*}$, Eq. (21) implies that $\underline{Up_c^i}$ is decreasing in $e_c^{i^*}$. Lemma 1 implies that $e_{\mathcal{T}}^{i*} > e_{\mathcal{O}}^{i*}$. Thus, a scientist needs a lower reputation capital to start a business venture when opting for $\mathcal{T}$ rather than for $\mathcal{O}$ in the first period: $\underline{Up_{\mathcal{T}}^i} < \underline{Up_{\mathcal{O}}^i}$. It establishes Proposition 2.

Proof of Lemma 2 and Lemma 3

First note that

$$In^i = \underline{Up_c^i} \Leftrightarrow K_c(In^i) \overset{d}{=} 2In^i + e_c^{i*} = \frac{B}{1-q} - \delta, \tag{22}$$

which is obtained by combining (21) and $W_c^i = In^i + e_c^{i*}$.

Second, note that $\frac{dK_c(In^i)}{dIn^i} > 0$ if $k \geq \underline{k}$. Indeed, (22) implies that $\frac{dK_c(In^i)}{dIn^i} = 2 + \frac{de_c^{i*}}{dIn^i}$. Using (19) we obtain

$$\frac{de_c^{i*}}{dIn^i} = -\frac{2f_c\left(\mathcal{A}_c^i\right)\left[\frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^4}\left(In^i - \underline{Up_c^i}\right)\left(\delta + 2\sigma_\theta^2\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)} + \left(In^i - \underline{Up_c^i}\right)\right) + \left(\sigma_\theta^2+\sigma_c^2\right)\left(\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right)^2\right]}{k + f_c\left(\mathcal{A}_c^i\right)\left[\frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^4}\left(\left(In^i - \underline{Up_c^i}\right)^2 + \left(In^i - \underline{Up_c^i}\right)\left(\delta + 2\sigma_\theta^2\frac{f_c\left(\mathcal{A}_c^i\right)}{1-F_c\left(\mathcal{A}_c^i\right)}\right)\right) + \left(\sigma_\theta^2+\sigma_c^2\right)\frac{f_c\left(\mathcal{A}_c^i\right)^2}{\left(1-F_c\left(\mathcal{A}_c^i\right)\right)^2}\right]}, \tag{23}$$

and thus,

$$\frac{dK_c(In^i)}{dIn^i} = \frac{2k}{k + f_c\left(\mathcal{A}_c^i\right)\left[\frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^4}\left(\left(In^i - \underline{Up}_c^i\right)^2 + \left(In^i - \underline{Up}_c^i\right)\left(\delta + 2\sigma_\theta^2 \frac{f_c(\mathcal{A}_c^i)}{1-F_c(\mathcal{A}_c^i)}\right)\right) + \left(\sigma_\theta^2 + \sigma_c^2\right)\frac{f_c(\mathcal{A}_c^i)^2}{(1-F_c(\mathcal{A}_c^i))^2}\right]}. \tag{24}$$

Since, the denominator in (24) corresponds to the denominator in (20), it is positive for $k \geq \underline{k}$.

Third, use (19), compute e_c^{i*} for $In^i = 0$, and note that there always exists B such that

$$K_c(0) < \frac{1}{\sqrt{\sigma_\theta^2 + \sigma_c^2}\sqrt{2\pi}}\left(\delta + \sigma_\theta^2\right) + \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_c^2} < \frac{B}{1-q} - \delta.$$

Thus, for B is high enough $K_c(0) < \frac{B}{1-q} - \delta$.

Since (i) (22) holds, (ii) $K_c(In^i)$ is strictly increasing, (iii) $K_c(0) < \frac{B}{1-q} - \delta$, and (iv), $\lim_{In^i \to +\infty} K_c(In^i) \to +\infty$, there exists a unique scientist $\widehat{i_c}$ characterized by $K_c\left(In^{\widehat{i_c}}\right) = \frac{B}{1-q} - \delta$, or $In^{\widehat{i_c}} = \underline{Up}_c^i \stackrel{d}{=} \underline{Up}_c$. Besides, $In^j > \underline{Up}_c^j$ if $In^j > In^{\widehat{i_c}}$ and $In^j < \underline{Up}_c^j$ if $In^j < In^{\widehat{i_c}}$.

Moreover, Proposition 1 implies that $K_{\mathcal{T}}(In^i) > K_{\mathcal{O}}(In^i)$ and thus $\underline{Up}_{\mathcal{T}} < \underline{Up}_{\mathcal{O}}$.

It establishes the proof of Lemma 2.

Moreover, $In^i - \underline{Up}_c^i = 2In^i + e_c^{i*} + \delta - \frac{B}{1-q}$ implies that $\frac{d\left(In^i - \underline{Up}_c^i\right)}{dIn^i} = 2 + \frac{de_c^{i*}}{dIn^i} > 0$ for $k \geq \underline{k}$. Thus, $\left|In^j - \underline{Up}_c^j\right| > \left|In^i - \underline{Up}_c^i\right|$ if $In^j > In^i > \underline{Up}_c$ $\forall i, j$, and $\left|In^j - \underline{Up}_c^j\right| > \left|In^i - \underline{Up}_c^i\right|$ if $In^j < In^i < \underline{Up}_c$ $\forall i, j$.

It establishes the proof of Lemma 3.

Proof of Proposition 4

First consider the case where $In^i < \underline{Up}_{\mathcal{O}}^i$. Choosing a $\mathcal{T}$-firm maximizes the probability of starting the business venture since

$$\Pr\left(Up^i \geq \underline{Up^i_{\mathcal{T}}}\right) \geq \frac{1}{2} > \Pr\left(Up^i \geq \underline{Up^i_{\mathcal{O}}}\right) \text{ when } \underline{Up^i_{\mathcal{T}}} \leq In^i < \underline{Up^i_{\mathcal{O}}}$$
$$\text{and } \frac{1}{2} > \Pr\left(Up^i \geq \underline{Up^i_{\mathcal{T}}}\right) > \Pr\left(Up^i \geq \underline{Up^i_{\mathcal{O}}}\right) \text{ when } In^i < \underline{Up^i_{\mathcal{T}}}.$$

It also minimizes the inefficiency in terms of effort. Thus, the scientist opts for $\mathcal{T}$.

Next, consider the case where $In^i \geq \underline{Up^i_{\mathcal{O}}}$. Differentiate the scientist's expected utility with respect to σ_c^2. Using that $\Pr\left(Up^i \geq \underline{Up^i_c}\right) = 1 - \phi\left(-\frac{\sqrt{\sigma_\theta^2+\sigma_c^2}}{\sigma_\theta^2}\left(In^i - \underline{Up^i_c}\right)\right)$, we obtain

$$\frac{d}{d\sigma_c^2}\left[\left[In^i + \left(e_c^{i*} - \psi\left(e_c^{i*}\right)\right)\right] + \left[In^i + \Pr\left(Up^i \geq \underline{Up^i_c}\right) \times \delta\right]\right]\Big|_{\sigma_c^2=\sigma_{\mathcal{O}}^2} = \tag{25}$$
$$\frac{1}{2}\frac{In^i-\underline{\underline{Up^i_{\mathcal{O}}}}}{\sigma_\theta^2\sqrt{\sigma_\theta^2+\sigma_{\mathcal{O}}^2}}\varphi\left(-\frac{\sqrt{\sigma_\theta^2+\sigma_{\mathcal{O}}^2}}{\sigma_\theta^2}\left(In^i - \underline{Up^i_{\mathcal{O}}}\right)\right) \times \delta + \frac{de^{i*}_{\mathcal{O}}}{d\sigma^2_{\mathcal{O}}}\left[\frac{\sqrt{\sigma_\theta^2+\sigma_{\mathcal{O}}^2}}{\sigma_\theta^2}\varphi\left(-\frac{\sqrt{\sigma_\theta^2+\sigma_c^2}}{\sigma_\theta^2}\left(In^i - \underline{Up^i_{\mathcal{O}}}\right)\right) \times \delta + \left(1 - \frac{k}{2}e^{i*}_{\mathcal{O}}\right)\right].$$

When the sign of the derivative given in (25) is negative (respectively positive), the scientist chooses the $\mathcal{T}$-firm (respectively the $\mathcal{O}$-firm). According to (20), the sign of the derivative given in (25) is negative if

$$\frac{1}{2}\frac{k}{\sigma_\theta^2\sqrt{\sigma_\theta^2+\sigma_{\mathcal{O}}^2}} \leq H\left(In^i - \underline{Up^i_{\mathcal{O}}}\right), \tag{26}$$

where

$$H\left(In^i - \underline{Up^i_{\mathcal{O}}}\right) \overset{d}{=} \left(\begin{array}{c} \frac{\phi}{\left(\sigma_\theta^2+\sigma_{\mathcal{O}}^2\right)^{\frac{3}{2}}\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)} + \frac{\varphi}{\sigma_\theta^2\sqrt{\sigma_\theta^2+\sigma_c^2}} + \\ \frac{1}{2}\frac{\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)^2\sqrt{\sigma_\theta^2+\sigma_c^2}}{\sigma_\theta^6} + \frac{1}{2}\frac{\varphi\delta}{\sigma_\theta^2\sqrt{\sigma_\theta^2+\sigma_c^2}\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)} + \frac{\varphi}{\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)\sqrt{\sigma_\theta^2+\sigma_c^2}}\frac{\varphi}{1-\phi} \end{array}\right)$$
$$+\left(\begin{array}{c} \frac{\sigma_\theta^2}{\left(\sigma_\theta^2+\sigma_{\mathcal{O}}^2\right)^2\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)}\frac{\phi}{\varphi} \\ +\frac{1}{\sigma_\theta^2+\sigma_{\mathcal{O}}^2} + \frac{\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)^2}{\sigma_\theta^4} + \frac{1}{2}\left[\frac{\varphi}{1-\phi}\right]^2 + \frac{1}{2}\left(\frac{1}{\left(\sigma_\theta^2+\sigma_{\mathcal{O}}^2\right)\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)} + \frac{\left(In^i-\underline{Up^i_{\mathcal{O}}}\right)}{\sigma_\theta^4}\right)\left(\delta+2\sigma_\theta^2\right)\frac{\varphi}{1-\phi} \end{array}\right) \times \frac{1-\frac{k}{2}e^*_{\mathcal{O}}}{\delta}$$

and ϕ stands for $\phi\left(-\frac{\sqrt{\sigma_\theta^2+\sigma_c^2}}{\sigma_\theta^2}\left(In^i - \underline{Up^i_{\mathcal{O}}}\right)\right)$ and φ for $\varphi\left(-\frac{\sqrt{\sigma_\theta^2+\sigma_c^2}}{\sigma_\theta^2}\left(In^i - \underline{Up^i_{\mathcal{O}}}\right)\right)$.

Observe that $\lim_{\left(In^i - \underline{Up}^i_{\mathcal{O}}\right)\to 0} H\left(In^i - \underline{Up}^i_{\mathcal{O}}\right) \to +\infty$ and $\lim_{\left(In^i - \underline{Up}^i_{\mathcal{O}}\right)\to +\infty} H\left(In^i - \underline{Up}^i_{\mathcal{O}}\right) \to +\infty$. Moreover, we show that $H\left(In^i - \underline{Up}^i_{\mathcal{O}}\right)$ strictly decreases when $\left(In^i - \underline{Up}^i_{\mathcal{O}}\right)$ takes low values and strictly increases when $\left(In^i - \underline{Up}^i_{\mathcal{O}}\right)$ takes high values[23]. When $\left(In^i - \underline{Up}^i_{\mathcal{O}}\right)$ takes intermediate values, H is bounded above by M, where M is a finite number. Let $\underline{k}$ verify $\frac{1}{2}\frac{\underline{k}}{\sigma_\theta^2\sqrt{\sigma_\theta^2+\sigma_{\mathcal{O}}^2}} > M$.

Since $k \geq \underline{k}$, there exists $\underline{In} > \underline{Up}^i_{\mathcal{O}}$ and $\overline{In} > \underline{In}$ such that the scientist opts for a $\mathcal{T}$-firm when either $\underline{Up}^i_{\mathcal{O}} < In^i < \underline{In}$ or $In^i > \overline{In}$. Conversely, the scientist opts for an $\mathcal{O}$-firm when $\underline{In} < In^i < \overline{In}$.

It establishes the proof of Proposition 4.

Proof of Proposition 5

When the scientist makes his choice of project, the scientist's wage is already fixed. Thus, the scientist ignores the influence of W on the first-period utility and the financial capital available. Since the choice of project is not observable by the market, the scientist also ignores the cost of effort: Revision of reputation by the market depends on the choice the market anticipates, and not on the actual choice of the scientist. To summarize, when making his decision, the scientist only takes into account the impact of the choice of project on the probability of starting the business venture. Let $Up^i(c, \mathcal{O})$ (respectively $Up^i(c, \mathcal{T})$) denote the scientists' updated reputation when choosing the O-project (respectively the T-project) and when the market anticipates c as the choice of project. Scientists prefer $\mathcal{O}$ to $\mathcal{T}$ if

$$\Pr\left(Up^i(c, \mathcal{O}) \geq \underline{Up}^i_c\right) \geq \Pr\left(Up^i(c, \mathcal{T}) \geq \underline{Up}^i_c\right),$$

where $\underline{Up}^i_c$ is the reputation threshold above which starting the business is possible when the choice of project anticipated by the market is c.

[23] The detailed proof is available upon request from the authors.

Since

$$\begin{aligned}
\Pr\left(Up^i(c,\mathcal{O}) \geq \underline{Up^i_c}\right) &= \Pr\left(In^i + \frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_c^2}\left(\pi^i_{\mathcal{O}} - \mathbb{E}(\pi^i_{\mathcal{O}})\right) \geq \underline{Up^i_c}\right) \\
&= 1-\phi\left(-\frac{1}{\sqrt{\sigma_\theta^2+\sigma_{\mathcal{O}}^2}}\frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^2}\left(In^i - \underline{Up^i_{\mathcal{O}}}\right)\right) \\
\text{and } \Pr\left(Up^i(c,\mathcal{T}) \geq \underline{Up^i_c}\right) &= 1-\phi\left(-\frac{1}{\sqrt{\sigma_\theta^2+\sigma_{\mathcal{T}}^2}}\frac{\sigma_\theta^2+\sigma_c^2}{\sigma_\theta^2}\left(In^i - \underline{Up^i_{\mathcal{T}}}\right)\right),
\end{aligned}$$

$\Pr\left(Up^i(c,\mathcal{O}) \geq \underline{Up^i_c}\right) > \Pr\left(Up^i(c,\mathcal{T}) \geq \underline{Up^i_c}\right)$ if $In^i > \underline{Up^i_{\mathcal{O}}}$ and $\Pr\left(Up^i(c,\mathcal{T}) \geq \underline{Up^i_c}\right) > \Pr\left(Up^i(c,\mathcal{O}) \geq \underline{Up^i_c}\right)$ if $In^i < \underline{Up^i_{\mathcal{T}}}$. Thus, choosing the $\mathcal{O}$-project is a dominant strategy for scientists characterized by $In^i > \underline{Up^i_{\mathcal{O}}}$.

On the contrary, choosing the $\mathcal{T}$-project is a dominant strategy for scientists characterized by $In^i < \underline{Up^i_{\mathcal{T}}}$.

Being paid $W^i_{\mathcal{O}}$ and choosing an $\mathcal{O}$-project or being paid $W^i_{\mathcal{T}}$ and choosing an $\mathcal{T}$-project are possible equilibria for scientists characterized by $\underline{Up^i_{\mathcal{T}}} \leq In^i \leq \underline{Up^i_{\mathcal{O}}}$. However, since

$$\mathbb{E}_{\pi^i_{\mathcal{T}}}\left[\Pr\left(Up^i(c,\mathcal{T}) \geq \underline{Up^i_{\mathcal{T}}}\right)\right] = \Pr\left(In^i \geq \underline{Up^i_{\mathcal{T}}}\right) \geq \frac{1}{2} \geq \Pr\left(In^i \geq \underline{Up^i_{\mathcal{O}}}\right) = \mathbb{E}_{\pi^i_{\mathcal{O}}}\left[\Pr\left(Up^i(c,\mathcal{O}) \geq \underline{Up^i_{\mathcal{O}}}\right)\right],$$

the equilibrium $\left(W^i_{\mathcal{O}};\mathcal{O}\text{-project}\right)$ is more efficient than the equilibrium $\left(W^i_{\mathcal{T}};\mathcal{T}\text{-project}\right)$.

Finally, Lemma (**??**) implies that scientists characterized by $In^i \leq \underline{Up_{\mathcal{T}}}$ realize an $\mathcal{O}$-project, whereas those characterized by $In^i > \underline{Up_{\mathcal{T}}}$ realize a $\mathcal{T}$-project.

It establishes the proof of Proposition 5.

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