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Job-Back Guarantees

Frédéric Palomino
HEC Paris (GREGHEC)

Eloic-Anil Peyrache
HEC Paris (GREGHEC)

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Financial Markets Group, London School of Economics and Political Science, LSE, UK
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Haute Etudes Commerciales, HEC, France
Baltic International Center for Economic Policy Studies, BICEPS, Latvia
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Indian School of Business, ISB, India
Tilburg University, UTIL.CER, Netherlands
University of Southern Switzerland, USI, Switzerland
The Institute of Physics, IBP, Serbia

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Frédéric PALOMINO
HEC Paris (GREGHEC) †

Eloïc-Anil PEYRACHE
HEC Paris (GREGHEC)‡

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Abstract

Starting a business being a risky activity, we analyze two channels through which the financing parties can contractually provide insurance to a risk-averse potential entrepreneur even if he can finance the project on his own. The first one is given by the allocation over the cash-flow rights. We show that, for given expected value of the project and level of risk-aversion, full financing of the project by the financing institution, joint-financing with the agent or entrepreneurship can be implemented in equilibrium. This critically depends on the magnitude of the agency costs. The second channel lies in the offer of a job-back guarantee where, in case of failure of the project, the agent is secured a position at the same financial conditions as prior to the start of the project. We then propose a mechanism design approach which, in a world where the entrepreneurs are risk averse, provides a rationale for such a guarantee. We analyze how such an insurance affects the financial contract and the incentives to become entrepreneur. We finally discuss some economic implications of a mandatory job-back guarantee policy.

Keywords: Risk-aversion, Intrapreneurship, Entrepreneurship, Job-Back Guarantee.

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†HEC School of Management, Paris, Finance and Economics department, 1, rue de la Libération - 78351, Jouy en Josas Cedex, France. E-mail: palomino@hec.fr

‡HEC School of Management, Paris, Finance and Economics department, 1, rue de la Libération - 78351, Jouy en Josas Cedex, France. E-mail: Peyrache@hec.fr

Non-Technical Summary

All agents with innovative ideas do not always become entrepreneur. A commonly acknowledged and widely analyzed reason is that agents are wealth constrained and do not find investors to finance their project. While we do not want to dismiss the importance of adverse selection regarding borrowers, according to the last Survey on Business Owners of the Census Bureau, 69.9% of businesses were started with less that ten thousand dollars, 42% of individual proprietorships were started with no borrowed capital and, finally, 52.1% of businesses operated from a private residence when first established. All this suggests that a large fraction of businesses started on a very small scale which did not require outside investors' contributions.

Another rationale for not becoming entrepreneur stems from the fact that starting a business is risky. According to Cooper, Wood and Dunkelberg (1988), less than 50% of businesses last more than five years. While the management literature has long recognized the impact of risk on the decision to become entrepreneur or intrapreneur, the current economic literature on entrepreneurship mainly assumes that would-be entrepreneurs are risk-neutral agents who approach investors because they are wealth constrained.

The objective of this paper is to analyze, in a simple framework, the development and the financing structure of projects when potential entrepreneurs (the agents) are risk averse. In order to circumvent well-known issues relating to capital constraints, we assume that agents are sufficiently wealthy to finance projects on their own. Nevertheless, they may not be willing to do so for risk-sharing purpose. As a matter of fact, they face a trade-off. They can become entrepreneur, get the full return on their project but, at the same time, bear all risks. Alternatively, they can contract with a third party (the company the agent currently works for, a bank, a venture capitalist...) and share both returns and risks. Finally, they could decide to keep their job and work for a riskless wage.

At the contracting stage, these financing institutions have *standard* instruments to solve for the traditional incentive-*vs*-insurance trade-off. They can impact the reward structure of the agent throughout the share financed by each party and the allocation of cashflow rights over the invention. Importantly, the concern for risk allows us to consider the use of another type of insurance at the contracting stage: the offer of a *job-back guarantee*. Such an option ensures the agent that, over a certain period of time, a position is secured for him by the financing parties. The importance of such a guarantee is not new to practitioners. In his guidelines for intrapreneurial systems, Pinchott (1985) states that among the contingencies to be anticipated are, precisely, the conditions under which the intrapreneurial units should be reintegrated into existing business units. Hisrich, Peters and Sheperd (2005, Chapter 2) advocate that offering such a guarantee is often the norm in the United States. However, some companies such as Xerox do not provide such a guarantee to their employees. In France, since 1985, offering such a guarantee is mandatory and firms have to reintegrate their employees within the two years following their leave (labour Code, Art L 122-32-12 and followings).

To our knowledge, job back guarantees have received no attention from economists. We consider two puzzles related to the offer of such guarantees. First, as they provide additional insurance to agents, they modify the insurance-vs-incentives trade-off and should increase the expected cost of providing incentives. This naturally raises the question of the optimality of such a mechanism for the principal. Second, there are many examples of job-back guarantee offered by firms formerly employing the new-born entrepreneur but not of external investors making such a contractual offer. The question is then to understand why it is so and, relatedly, whether such a contract can be replicated by external financing parties. In this article, we derive the optimal

contract and investigate conditions under which offering such a guarantee to employees is optimal for the financing institution. In addition to providing a rationale for the offer of a job back guarantee, our entrepreneurial model can also be used to study several issues of interest to economists and policy analysts. Extending the base model, we show that the offer of a job-back guarantee can strictly increase the investment of agents in generating ideas and that, in the case of heterogenous agents, leaving firms full discretion over the offer of job-back guarantees increases the informational efficiency of the labor market. These last two results have interesting welfare consequences.

1 Introduction

All agents with innovative ideas do not always become entrepreneur. A commonly acknowledged and widely analyzed reason is that agents are wealth constrained and do not find investors to finance their project. While we do not want to dismiss the importance of adverse selection regarding borrowers, according to the last Survey on Business Owners of the Census Bureau, 69.9% of businesses were started with less that ten thousand dollars, 42% of individual proprietorships were started with no borrowed capital and, finally, 52.1% of businesses operated from a private residence when first established. All this suggests that a large fraction of businesses started on a very small scale which did not require outside investors' contributions.

Another rationale for not becoming entrepreneur stems from the fact that starting a business is risky. According to Cooper, Wood and Dunkelberg (1988), less than 50% of businesses last more than five years. While the management literature has long recognized the impact of risk on the decision to become entrepreneur or intrapreneur (See Hirisch, Peters and Sheperd (2005, Chapter 1)), the current economic literature on entrepreneurship mainly assumes that would-be entrepreneurs are risk-neutral agents who approach investors because they are wealth constrained.[1]

The objective of this paper is to analyze, in a simple framework, the development and the financing structure of projects when potential entrepreneurs (the agents) are risk averse. In order to circumvent well-known issues relating to capital constraints, we assume that agents are sufficiently wealthy to finance projects on their own.[2] Nevertheless, they may not be willing to do so for risk-sharing purpose. As a matter of fact, they face a trade-off. They can become entrepreneur, get the full return on their project but, at the same time, bear all risks. Alternatively, they can contract with a third party (the company the agent currently works for, a bank, a venture capitalist...) and share both returns and risks. Finally, they could decide to keep their job and work for a riskless wage.

At the contracting stage, these financing institutions have *standard* instruments to solve for the traditional incentive-*vs*-insurance trade-off. They can impact the reward structure of the agent throughout the share financed by each party and the allocation of cashflow rights over

[1] See, Anton and Yao (1994), Aghion and Tirole (1994), Gertner, Scharfstein and Stein (1994), Hellman (1998, 2004), Gromb and Scharfstein (2002), Rajan and Zingales (2002), Amador and Landier (2004), Biais and Perotti (2004), Arping (2005).

[2] Such an assumption is used for example in Grossman-Hart (1986) and Hart-Moore (1988).

the invention. Importantly, the concern for risk allows us to consider the use of another type of insurance at the contracting stage: the offer of a *job-back guarantee*. Such an option ensures the agent that, over a certain period of time, a position is secured for him by the financing parties. The importance of such a guarantee is not new to practitioners. In his guidelines for intrapreneurial systems, Pinchott (1985) states that among the contingencies to be anticipated are, precisely, the conditions under which the intrapreneurial units should be reintegrated into existing business units. Hisrich, Peters and Sheperd (2005, Chapter 2) advocate that offering such a guarantee is often the norm in the United States. However, some companies such as Xerox do not provide such a guarantee to their employees.[3] In France, since 1985, offering such a guarantee is mandatory and firms have to reintegrate their employees within the two years following their leave (labour Code, Art L 122-32-12 and followings).[4]

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The paper is organized as follows. The rest of the introduction reviews the related literature. Section 2 presents the model with an employee who owns the property rights over his project

[3]Xerox employees forming a venture with Xerox Technology Venture are not guaranteed a job in the mother company if the venture fails.

[4]Interestingly, for projects that they co-finance, firms such as France Telecom or Alcatel extend the duration over which the guarantee can be exerted beyond the legal duration.

and is not financially constrained. Section 3 derives the optimal contract. Section 4 discusses the results and extends the analysis by *(i)* endogenizing the generation of ideas and *(ii)* considering heterogenous employees. Finally, Section 5 offers a conclusion.

Related Literature

Kihlstrom and Laffont (1979) consider a general equilibrium model where production needs entrepreneurs who take risks and standard laborers who receive riskless wages. Among other things, they tend to formalize the work of Knight (1921) by showing that, in equilibrium, more risk averse agents become laborers whereas the less risk averse ones become entrepreneurs. Contrary to their work, we do not consider any comparative statics on the level of risk aversion but, instead, analyze the contractual arrangement and the structure of insurance that can be offered by the financing party. Barnejee and Newman (1993) propose a model of occupational choice based on capital market imperfections. Because of such imperfections, agents only borrow limited amounts and, consequently, the pattern of occupational choice is primarily determined by the distribution of wealth. Depending on the labor market conditions and on their wealth, agents then either become self-employed or laborers.

Later, several models of entrepreneurship using various developments in informational economics have been proposed. The models of Gromb and Scharstein (2003) and Landier (2005) both share the feature that the market's perception of failure is crucial to the understanding of entrepreneurship. Landier (2005) considers that the capital and labor market cannot distinguish between good and bad second-time entrepreneur. Depending on the beliefs of the capital market regarding the status of these second timers, funding can then become more or less expensive. Whereas Landier (2005) defines entrepreneurship as starting a new project, Gromb and Scharfstein (2003) focus more on organizational aspects. If the project is developed through an independent business, the contract will be high-powered but few information is gathered on the ability of agents. In contrast, in an integrated firm, the contract is low-powered but the firm has an informational advantage that allows her to correctly select the most skilled agent to run alternative projects. Anton and Yao (1994), Hellman (2004) and Amador and Landier (2004) study, in different frameworks, conditions under which employees with innovative ideas become entrepreneur or remain employees. Anton and Yao (1994) consider an adverse selection model where the firm does not know, ex-ante, whether the employee has discovered an innovation or not. They study under what conditions the employee develops the project internally or becomes entrepreneur. Hellman

(2004) proposes a multi-tasks incentive model and shows that the organisational structure under which projects are developed (i.e., inside or outside the firm) depends on the entrepreneurial environment (i.e., the attractiveness of developing an innovation with outside resources) and the allocation of intellectual property rights. Finally, Amador and Landier (2004) study a situation in which managers are overconfident and firms cannot write contracts based solely on the cash flows generated by the project of the manager. A key difference between these three models and ours is that they all consider risk-neutral agents.

2 The model

We consider a pure-moral-hazard three-period model. At the end of period 1, while working for firm F (*she*), an employee E (*he*) comes out with plans of a project which requires an investment $I > 0$. The project can end up being a success by generating a revenue $v > 0$ over periods 2 and 3 or a failure yielding 0.[5] The probability of success or failure of the project depends on the magnitude of the effort $e \in \{0, 1\}$ exerted by E. If $e = 0$, the probability of success is $p_0 \geq 0$ while if $e = 1$, the probability of success is $p_1 > p_0$. We denote $\Delta p \equiv p_1 - p_0$. Increasing the probability of success by Δp costs c. In the rest of the paper, we assume that $p_0 v < I < p_1 v - c$. That is, the project is profitable if and only if effort is exerted. Firm F is risk-neutral and, therefore, aims at maximizing her expected profit. On the contrary, E is risk-averse with a utility function satisfying the usual conditions $u' > 0$, $u(0) = 0$ and $u'' \leq 0$. Moreover, we assume that u is quasi-linear in cost and denote $g \equiv u^{-1}$. In the core of the paper, we mainly consider that firm F acts as the principal who can finance part of the project. In section 3.4, we provide results for the case in which financing is provided by alternative institutions.

Our aim is to analyze how risk-aversion and moral hazard affect the structure of financing of the project, the allocation of cash-flow rights and the offer of a job-back guarantee. To do so, we depart from any liquidity constraint considerations by assuming that the agent E is endowed with sufficient wealth (W) to fully finance his project. For the sake of simplicity, we assume that, if he finances the project on his own, all his wealth is invested in the project ($W = I$). Moreover, he owns all the property rights over the project. That is, in absence of contractual arrangements with firm F, agent E has all the freedom to develop the project by himself and become entrepreneur. In the rest of the paper, we define as entrepreneur an agent who fully

[5] In the core of the paper, we assume that the firm and the employee would undertake the project at the same scale. However, our results go through if we consider a variable project scale. This case is developed in Appendix.

finances the project and receives all associated cash flow rights. Whenever the project is (at least partially) financed by the firm, the latter has all the bargaining power when designing the financial (incentive) contract and then makes a take-it-or-leave-it offer to the employee. E's strategy space is then rather simple since his only choice is whether to keep all cashflow rights over his project by becoming entrepreneur, accept to share financing and returns, or finally abandon the project and earn a riskless wage. His decision ultimately depends on the contract proposed by F. They are of course many factors that can influence such a choice. In this paper, we take the value of the project in case of success and the magnitude of agency costs as key determinants of the decision of each parties. In contrast, the level of risk aversion is taken as given.[6]

As stated above, there are two channels through which the financing party can offer some insurance to the agent. First, given that there are only two verifiable final outcomes - success or failure - F can play on the transfers (t_h in case of success and t_l in case of failure) offered to E. Hence, the problem of the firm boils down to solving the traditional trade-off between providing the incentives to exert effort and insuring the agent. Our approach is then very much of a mechanism design type. However, the transfers to the agent also have a simple *financial contract* interpretation. Indeed, one can interpret the contract as an allocation over cash and stocks. Whenever $t_l > 0$, F fully finances the project and, in exchange of the property rights over the invention, commits to transfer cash (t_l) and a bonus $t_h - t_l$ in case of success. In contrast, if $t_l \in (-I, 0)$, the firm and its employee set up a joint venture by sharing the burden of the investment in the project. It is only when the wealth constraint is binding ($t_l = -I$) that E fully finances the project. Our concern for risk allows us to add a second dimension to the incentive contract through the offer of a *job-back guarantee*. This ultimately affects the traditional incentives-*vs*-insurance trade-off.

Let us now detail slightly more the model. We denote by ω the flow of wage E can expect each period while staying in the firm (F). If E develops the project, F hires an agent in order to fill in E's empty seat. In case E fails and is reintegrated, he can generate some output of value $q > 0$ during the last period. To make things interesting, we impose such an option to be ex post costly to the firm. Formally, it boils down to the following assumption.[7]

[6] See Kihlstrom and Laffont (1979) for more on this aspect.

[7] Reversing such inequality would make the threat of not getting a position back not renegotiation-proof.

Assumption 1 $q < \omega$.

We like to think of w as representing a measure of the human capital (general and firm specific) of the employee and $w - q$ as representing the duplication/misallocation cost incurred by the firm once she reintegrates E.[8] In period 3, the employee can always get a wage of ω_0 if he gets a job on the external labor market. We consider that

Assumption 2 $\omega_0 < \omega$.

Following our initial interpretation, the difference $\Delta\omega = \omega - \omega_0$ can be interpreted as the level of firm-specific human capital of the employee. The larger it is, the larger the decrease in wage the employee faces if he switches from the firm he currently works for to another firm. As an alternative interpretation, we implicitly assume that the labor market is competitive.

To complete the description of the model, we set, as a tie-breaking rule, that whenever E is sold the project in the contract proposed by the firm, he decides to become entrepreneur.

We can now compute the reservation utility of the agent, which depends on his willingness to develop the project outside the firm. In the core of the paper, we place ourselves in a setting where offering such a guarantee is not mandatory.[9] Since a financing institution has no incentives to provide such a guarantee to an entrepreneur (given that $q < \omega$), the outside option of the agent is given by $\max\{p_1 u(v) + (1-p_1)u(\omega_0) - c, u(I + 2\,\omega)\}$. To make our analysis relevant, we ensure that E prefers to become entrepreneur rather than remaining a laborer earning a riskless wage.[10] That is,

Assumption 3 $p_1 u(v) + (1 - p_1)u(\omega_0) - c > u(I + 2\,\omega)$.

Finally, we consider that any entrepreneur prefers to exert effort rather than being inactive on his project.[11] This boils down to

[8] This is the case whenever the employee has been replaced in the first place or that he is allocated to a new task for which he is not as productive as he used to be prior to leaving the firm.

[9] We discuss the implications a mandatory job back guarantee in Section 4.

[10] It can be obtained if E is endowed with all property rights over the project once he decides to become entrepreneur and when risk-aversion is not too severe. Reversing such assumption would not affect the general qualitative results of the paper. A full analysis is available from the authors upon request.

[11] We discuss the impact of reversing such assumption in Section 4.

Assumption 4 $v \geq g(u(\omega_0) + \frac{c}{\Delta p})$.

To summarize, the timing of the game played between E and F is the following. At the end of date 1, E comes up with an idea that is worth v in case of success for the owner of the rights of the project. At date 2, F makes a take-it-or-leave-it contract offer to E, who can either accept the offer, refuse it and become an entrepreneur or, finally, abandon the project. According to the payment scheme, effort is then implemented. If the project succeeds, E keeps on working on it in period 3. If it fails, E looks for a job whenever he has not been offered a job-back guarantee.

3 Optimal Contract

We successively distinguish two settings. We first conduct the analysis by assuming that F does not offer any *job-back guarantee* to E and, consequently, can only sell insurance through the project cash-flows. We then derive conditions under which the different structures of financing emerge at equilibrium. In a second step, we allow the firm to enrich the contractual arrangement by adding the offer of a job-back guarantee and we analyze how this affects both the incentive contract and E's decision. Finally, we analyze the incentives of F to indeed offer a job-back guarantee to her employee.

The general program of the firm is to maximize

$$\Pi(t_h, t_l) = p_1(v - t_h) + (1 - p_1)((q - \omega)1_G - t_l) - I \tag{1}$$

subject to

$$p_1\, u(I + t_h) + (1 - p_1)\, u(I + t_l + \omega\, 1_G + \omega_0(1 - 1_G)) - c \geq \bar{U} \tag{2}$$

$$u(I + t_h) - u(I + t_l + \omega\, 1_G + \omega_0(1 - 1_G)) \geq \frac{c}{\Delta p} \tag{3}$$

$$t_l \geq -W \quad (\equiv -I) \tag{4}$$

$$\Pi(t_h, t_l) \geq 0 \tag{5}$$

where 1_G is the indicator function, i.e., $1_G = \begin{cases} 1 & \text{if the guarantee is offered} \\ 0 & \text{if the guarantee is not offered} \end{cases}$

Equations (2) and (3) respectively describe the individual rationality (IR) constraint and the incentive compatibility (IC) constraint. Equation (4) is the wealth constraint (WC) of the

employee stating that, in case of failure of the project, his maximum loss is limited to his initial wealth. Finally, constraint (5) just entails that the firm finances the project if it expects to make a positive profit.

Before analyzing in details the case of risk-aversion, let us first consider, as a benchmark, a setting in which the employee would be risk neutral. We would get the following result.

Lemma 1 *Whenever E is risk neutral, he always becomes entrepreneur.*

This result comes at no surprise since there is no gains from trade between E and F. Under risk-neutrality, receiving insurance through a lower spread in the payoffs is of no value to the agent. Moreover, given that the agent has no willingness to pay for insurance through cash-flows it follows from assumption 1 that F has no incentive to offer a job-back guarantee to the agent. The latter will then develop his project on his own and get the full return.

3.1 Contractual Insurance based on Project Cash-Flows

We now return to a setting with risk-averse employees. A key element in the remaining of our analysis lies in the value of the ratio $\rho \equiv \frac{p_0}{p_1}$. Since $\rho \equiv 1 -$ *likelihood ratio*, it can be interpreted as a measure of the agency costs between E and F where the larger ρ, the larger the agency costs. Solving the program (1)-(5) with $1_G = 0$, we get the following result.

Lemma 2 *There exists a function $\bar{\rho}_e(v, \omega_0)$ such that if $\rho < \bar{\rho}_e(v, \omega_0)$, then the firm offers the contract C^-*

$$t_h = g\left(\bar{U} + (1 - p_0)\frac{c}{\Delta p}\right) - I \tag{6}$$

$$t_l = g\left(\bar{U} - p_0\frac{c}{\Delta p}\right) - I - w_0 > -I. \tag{7}$$

Otherwise E becomes entrepreneur.

Proof: See Appendix.

Importantly, the contract specified above is derived from the fact that both the IR and IC constraints must be binding and that the wealth constraint must be slack at equilibrium. Our result that the wealth constraint is not binding directly stems from the fact that whenever $t_l = -I$ then it must be the case that $t_h \geq v$ for the IR constraint to be satisfied. If that

were true then, when $1_G = 0$, we would get $\Pi(t_l, t_h) \leq 0$ which would contradict condition 5. Now suppose that, in equilibrium, the IR constraint is binding but that, in contrast, the IC constraint is slack. Then, due to risk-aversion, there would exist a profitable deviation that consists in increasing the transfer in the low state while decreasing more than proportionally the transfer in the high state. This would again constitute a contradiction. Analyzing further the pair (t_l, t_h), we can now derive conditions under which the different forms of financing take place.

Proposition 1 *There exists a function $\hat{\rho}_e(v, \omega_0)$ such that, for all v, $\hat{\rho}_e(v, \omega_0) < \bar{\rho}_e(v, \omega_0)$ and*

- *If $\rho < \hat{\rho}_e(v, \omega_0)$, E transfers full property rights over the project to F and receives a fixed wage plus a bonus in case of success.*
- *If $\hat{\rho}_e(v, \omega_0) < \rho < \bar{\rho}_e(v, \omega_0)$, then E and F set up a joint venture (i.e, $t_l \in (-I, 0)$).*

Otherwise, E keeps full property rights over the project by becoming entrepreneur.

Proof: See Appendix.

The proposition states that the critical criteria in developing an idea are both the value generated by the project and the ability of the principal to provide the right incentives to the innovator. Assuming, contrary to most of the literature, that the agent is endowed with sufficient wealth to finance the project on his own, allows us to analyze how parties will share both the burden of the initial investment and returns. We then show that all types of property rights structure may emerge at equilibrium. As a matter of fact, the smaller ρ, the easier it is to disentangle luck from effort in case of success. That is, the smaller ρ, the cheaper it is for the firm to offer the right incentives to exert effort. Therefore, whenever agency costs are low (the likelihood ratio is high), F fully finances the project. If agency costs take intermediate values then the firm and the employee set up a joint venture, i.e., both participate to the financing of the project. Finally, if agency costs are high (the likelihood ratio is low), offering an incentive contract is too costly and F refuses to participate to the financing of the project. In the latter case, E becomes entrepreneur.

3.2 Offer of a job-back guarantee

We now allow the firm to offer the guarantee to E that he will be reintegrated in case of failure of the project, i.e., $1_G = 1$. By doing so, F potentially affects the standard insurance vs incentives trade-off and , therefore, could modify the contract she offers to E in the first place. To make a distinction with the contracts derived above, we denote by (t'_h, t'_l) the transfers associated to the contract with job-back guarantee.

Two cases must be distinguished. First, it is straightforward to see that if the transfer in case of failure under the "no-guarantee" setting is such that $t_l - (\omega - \omega_0) > -I$, then E retains some cash after the financing round. F can then act as a standard insurance company by simply selling the insurance to E that, in case of failure, he will receive a premium $\omega - \omega_0$ compared to its opportunities on the labor market. That is, F simply sets $t'_l = t_l - (\omega - \omega_0)$ and the results of the previous section remain naturally unchanged. Stated differently, any time $v > g\left(u(w_0) + \frac{u(\omega)-u(w_0)}{p_1} + \frac{c}{\Delta p}\right)$, the wealth constraint of E will be slack and a way to "sell" the guarantee is for the principal to increase the share that is financed by the employee in the first place. However, as in absence of the guarantee, the IR and IC constraints remain binding. The agent is then indifferent between returning in F or accepting a job on the outside market. This directly stems from the fact that we assumed that F had all the bargaining power at the contracting stage.

Let us now turn to the case where this indifference cannot hold because the wealth constraint of E would not be satisfied. Indeed whenever $t_l - (\omega - \omega_0) < -I$ (or, $v < g\left(u(w_0) + \frac{u(\omega)-u(w_0)}{p_1} + \frac{c}{\Delta p}\right)$), F cannot fully transfer the burden of the guarantee to E by proposing a larger stake in case of a joint-venture. By doing so, the wealth constraint of E would be violated. The following lemma details the structure of the contract when a job-back guarantee is offered.

Lemma 3 *Let* $\bar{v}_1 = g\left(u(\omega) + \frac{c}{\Delta p}\right)$ *and* $\bar{v}_2 = g\left(u(w_0) + \frac{u(\omega)-u(w_0)}{p_1} + \frac{c}{\Delta p}\right)$. *Then whenever*

- $v > \bar{v}_2$, *then* $\exists\, \bar{\rho}(v, q, \omega)$ *such that* $\forall\, \rho < \bar{\rho}(v, q, \omega)$, *the firm offers contract* C_1^+

$$t'_{h,1} \equiv t_h = g\left(\bar{U} + (1-p_0)\frac{c}{\Delta p}\right) - I \tag{8}$$

$$t'_{l,1} \equiv t_l - (\omega - \omega_0) = g\left(\bar{U} - p_0\frac{c}{\Delta p}\right) - I - \omega \tag{9}$$

- $v \in [\bar{v}_1, \bar{v}_2]$ *then* $\exists\, \bar{\rho}'(v,q,\omega)$ *such that* $\forall\, \rho < \bar{\rho}'(v,q,\omega)$, *the firm offers contract* C_2^+

$$t'_{h,2} = g\left(u(\omega) + \frac{c}{\Delta p}\right) - I \quad (10)$$

$$t'_{l,2} = -I \quad (11)$$

Otherwise, E becomes entrepreneur.

Proof: See Appendix.

Before turning to the determination of the optimal contract, let us first provide some comparisons regarding the relative costs of providing incentives. Given that the final wealth of the agent in the low state under contract C_2^+ is $\omega - I$ (with $\omega - I > g\left(\bar{U} - p_0 \frac{c}{\Delta p}\right) - I - \omega$) then, for the IC constraint to be satisfied under this contract, it must be that $t'_{h,2} > t_h$. That is, the expected cost of providing incentive for effort is larger under C_2^+ than under C^-. This is a direct implication of the incentive compatibility requirement. Indeed, by offering the job-back guarantee to the agent, the firm increases agent's wealth in the low state which has a major impact on the related level of utility. To keep incentives to exert effort, the firm needs to increase the level of utility in the high state. Moreover, given decreasing marginal utility, this can become very costly to the principal.

3.3 Optimal Contract

It now remains to analyze under what conditions F is indeed willing to insure the agent along these two dimensions. As a first illustration of the problem faced by the firm, consider the case $v > \bar{v}_2$ for which F can make the agent pay for the guarantee at no cost. Then it is straightforward to see that whenever the project is jointly financed (ρ takes intermediate values) a necessary condition for the employee to receive the guarantee is that $q > \omega_0$. Indeed, the additional net return compared to the *no-guarantee* setting is that the share financed by F decreases by $\omega - \omega_0$. In contrast, the additional cost stems from the reintegration and is given by $\omega - q$. Given that F is risk-neutral, the inequality then directly follows.

When $v \in (\bar{v}_1, \bar{v}_2)$, E's wealth constraint binds and the financing institution has to leave him some additional rent (with respect to the contract without guarantee, namely C^-). As highlighted above, it follows that offering the guarantee is more expensive in the case $v \in (\bar{v}_1, \bar{v}_2)$ than in the case $v > \bar{v}_2$ and, naturally, $q > \omega_0$ remains a necessary condition for the job-back guarantee to be offered. Hence, we have the following lemma.

Lemma 4 *If $q < \omega_0$, the job-back guarantee is not offered.*

Let us now denote by $\bar{q}(\omega, v)$ the solution of $H(q, \omega, v) \equiv \pi^G - \pi^{NG} = 0$. It is key for the following result to observe that $\bar{q}(\omega, \bar{v}_2) = \omega_0$ and that $\bar{q}(\omega, v)$ is decreasing with v. Indeed, note that whenever $v = \bar{v}_2$, the guarantee is fully sold to E. As described above, F then receives, conditionally on failure of the project, $\omega - \omega_0$ from the agent but has to incur a cost of $\omega - q$. It directly follows that $\bar{q}(\omega, \bar{v}_2) = \omega_0$. The second statement stems from standard differentiation with $\frac{d\bar{q}}{dv} = -\frac{\frac{\partial H}{\partial v}}{\frac{\partial H}{\partial \bar{q}}} < 0$. Finally, as functions $\bar{\rho}(v, q, \omega)$ and $\bar{\rho}'(v, q, \omega)$ are increasing in q, we are now equipped to state the following proposition.

Proposition 2 *If $q < \omega_0$, then F offers C^- if and only if $\rho < \bar{\rho}_e(v, \omega_0)$. If $q > \omega_0$ and*

(i) $v < \bar{v}_1$, *then F offers C^- if and only if $\rho < \bar{\rho}_e(v, \omega_0)$.*

(ii) $v \in [\bar{v}_1, \bar{v}_2]$, *then* $\begin{cases} \text{if } q > \bar{q}(\omega, v) \quad \text{then} \quad F \text{ offers } C_2^+ \text{ if and only if } \rho < \bar{\rho}(v, q, \omega) \\ \text{if } q < \bar{q}(\omega, v) \quad \text{then} \quad F \text{ offers } C^- \text{ if and only if } \rho < \bar{\rho}_e(v, \omega_0) \end{cases}$

(iii) $v > \bar{v}_2$ *then, F offers C_1^+ if and only if $\rho < \bar{\rho}'(v, q, \omega)$.*

In all remaining cases, E becomes Entrepreneur.

Proof: See Appendix.

Note that the guarantee can still be offered rationally despite that fact that it is ex-post costly to the firm ($q < w$). The logic is the following. As long as v is large enough (namely $v \geq \bar{v}_2$), the burden of the initial investment absent any job-back guarantee is largely supported by the financier. This is a direct implication of both risk-aversion (through a lower spread in transfers) and the need for the principal to satisfy the agent's participation constraint. E then retains a large share of his initial wealth. In case he is offered a job-back guarantee, he has then enough wealth to buy-back the premium he receives if reintegrated in F through, say, an increase of his share of the initial investment. This has no impact on the cost of providing incentives as one can observe when comparing transfers under contracts C^- and C_1^+. Such a statement does not hold anymore whenever $v < \bar{v}_2$. The reason is that, for such values of v, the wealth ω in the low state when the agent received the guarantee is then larger than his wealth $I + t_l + \omega_0$ in the same low state when the contract did not not specified any guarantee offer. The downside of the guarantee for the principal is then twofold. First, the agent cannot fully internalize the cost of his premium while being reintegrated. Second, as the wealth in case of failure increases, the transfer in case of success has to be augmented for the contractual arrangement to remain incentive compatible. That is the expected cost of providing incentives is now larger. Offering

the job-back guarantee can only remain optimal if the cost of reintegration $\omega - q$ decreases. That is, the value q of the output generated following agent's reintegration has to increase as the value of the project v decreases. As stated formally above, $\bar{q}(\omega, v)$ is decreasing with its second argument.

A necessary condition for the optimality of the job-back guarantee is then that, following such an offer, the share that is financed by the entrepreneur increases relative to the *no-guarantee* contract. Note that such a condition cannot be met in the case of risk-neutrality since, as highlighted in lemma 1, insuring the agent through a reduction in the spread between cash-flows is of no value to the entrepreneur.

3.4 Financing by a Third Party

So far we have assumed that the financing party was the firm the agent initially worked for. However, nothing prevents the potential entrepreneur to seek financing support from another type of institution as, say, a bank or a venture capitalist (VC). A natural question to ask is whether such institutions would also insure the agent along the same lines.

Let us denote by q_{vc} the value of the output for the alternative principal in case the agent is offered the guarantee that he will be hired in case of failure. Since only E's general working capital is valuable for such institution and given that, as F, she might face duplication/misallocation costs whenever she committed to hire E, then $q_{vc} \leq \omega_0$. Therefore, as an implication of Lemma 4 we have:

Proposition 3 *There is no financing institution other than F who contractually offers the job-back-guarantee internally.*

This implies that, if a job-back guarantee is ever offered, E will be secured an occupation in F only. Still, this does not prevent the financing of such a guarantee to be outsourced to other institutions. However, for F to accept such a mechanism, she must be compensated by at least $\omega - q$ in case the guarantee is exerted. Following the same reasoning as we developed above, a third party has two different ways of arranging the financing of the guarantee. Whenever $t_l - (\omega - q) > -I$ then the guarantee is fully sold to E either through a transfer of cash to the principal (the external investor) or, equivalently, through an increase in the share of the investment supported by the agent. In contrast, whenever $t_l - (\omega - q) < -I$, the agent becomes cash-constrained to fully buy the insurance.

In the latter case, the financier will never offer the guarantee since it would entail increasing transfers both in the low and high states to keep the contract incentive compatible. This fully mimics the forces at hand in the previous section. The guarantee can be offered only if it is associated with an increased share of the initial investment by E.

It is then a routine matter to show that the maximization problem is then identical to the one we derived in lemma 3. That is, if $v > \bar{v}_2$, the revenues of the third party are $v - t'_{h,1}$ in case of success and $-(t'_{l,1} + I)$ in case of failure. Alternatively, if $v \in [\bar{v}_1, \bar{v}_2]$, the revenues of the alternative principal are $v - t'_{h,2}$ in case of success and $-(t'_{l,2} + I)$ in case of failure. Proposition 2 then remains unchanged which entails that, in absence of frictions, a risk neutral third party can replicate the transfers chosen by F when she acts as the financing party. However, the job-back guarantee cannot be implemented without the participation of F. Moreover, in contrast with a setting where the contract is offered by F, the latter just breaks even and part of the surplus is captured by the external financier.

3.5 Some Comparative Statics

Proposition 2 allows us to make some comparative statics on ω_0 which represents the general human capital of the employee. The larger ω_0, (or the smaller $\Delta\omega$), the lower the wage loss of E while not working for F. Provided that the project is, at least partially, financed by E, we have the following result about the impact of the level of human capital on the financing of the project.

Corollary 1 *Whenever the firm offers the job-back guarantee, the larger the fraction of general human capital, the (weakly) less the employee has to support the burden of the initial investment.*

Proof.

For any given level of total human capital ω, only the transfer in the low state is a function of the level of general human capital ω_0. When the option is offered, $t_l = \max\{h\left(\bar{U} - p_0 \frac{c}{\Delta p}\right) - I - \omega, -I\}$ which derivative with respect to ω_0 is clearly positive or null. ■

Whenever the firm offers the job-back guarantee, a higher level of general human capital only generates some tensions on the outside option of the employee. In order to match the agent's opportunity, the firm has to increase agent's willingness to contract with her. To do, she can increase cash flow rights in case of success or/and in case of failure. But, a risk neutral firm has no incentives to solely increase the transfer in the high state which, given risk aversion,

has only a limited impact on the agent's surplus. This then forces the firm to take a larger stake in the project. Interestingly, there is an additional effect whenever the firm does not offer the job-back guarantee: a higher level of general human capital generates some insurance, the burden of which is not supported by F. This increases E's share in the project without affecting incentives. Comparing the two effects, it turns out that the former is always larger than the latter. As a consequence, a higher level of general human capital is associated with a larger level of entrepreneurship. This is summarized as follows.

Corollary 2 *Everything else being equal, the higher the level of general human capital, the more the employee becomes Entrepreneur.*

Proof.

It is straightforward to check that the expected profit when offering the guarantee is always decreasing in ω_0. Things are however less obvious when considering that the employee does not receive any job-back guarantee since, as stated above, the stake in the project can increase with ω_0. The overall effect on profit is given by the sign of the effect on cost

$$p_1\, g'\left(\bar{U} + (1-p_0)\frac{c}{\Delta p}\right) u'(\omega_0)(1-p_1) + (1-p_1)(g'\left(\bar{U} - p_0\frac{c}{\Delta p}\right) u'(\omega_0)(1-p_1) - 1). \tag{12}$$

From assumption 4, $\left(\bar{U} - p_0\frac{c}{\Delta p}\right) > u(\omega_0)$. It then follows from both the definition and the convexity of $g(.)$ that $g'\left(\bar{U} - p_0\frac{c}{\Delta p}\right) > g'(u(\omega_0)) \equiv \frac{1}{u'(\omega_0)}$ or, equivalently,

$$g'\left(\bar{U} - p_0\frac{c}{\Delta p}\right) u'(\omega_0)(1-p_1) - 1 > -p_1.$$

Similarly, we have $g'\left(\bar{U} + (1-p_0)\frac{c}{\Delta p}\right) > g'(u(\omega_0)) \equiv \frac{1}{u'(\omega_0)}$ and, therefore

$$\left(\bar{U} + (1-p_0)\frac{c}{\Delta p}\right) u'(\omega_0)(1-p_1) > 1 - p_1.$$

It is then a routine matter to show that (12) is always positive. ■

Finally, we make some comparative statics on the circumstances under which the firm indeed offers the guarantee. The result is the following.

Corollary 3 *Everything else being equal, the incentive of the firm to offer the guarantee is non decreasing with v and q and is non increasing with the level of general human capital.*

The first two effects are rather intuitive and the last one directly follows from corollary 2.

4 Discussion and Extensions

At this stage we have provided a framework where the job-back guarantee was one instrument, among others, at the disposal of the financing institution at the contracting stage. However, she was free to use it in the incentive contract of the agent or not. This explained that the outside option of the agent was based on ω_0 and not ω since the financing institution had no interest in offering the guarantee to an entrepreneur. Now, a natural question to ask is whether the offer of such an instrument should be made mandatory as it is in France. The law, as it has been voted in France, can be seen as imposing a *"strongly"*-mandatory job-back guarantee in the sense that, even if the project is totally unrelated to the firm's business and/or she does not take a stake in the project (i.e., the employee becomes entrepreneur), the job-back guarantee has to be offered over a period of two years. In the framework we propose where the agent is endowed with sufficient wealth to invest alone in the project, one can be tempted to assert that a job-back guarantee is welfare enhancing since, by reallocating surpluses, it provides a mean of insuring risk averse agents. This is not necessarily true.

Assume indeed that the job-back guarantee is mandatory. How is our base model affected by such a change? The outside option of the agent now becomes $p_1u(v) + (1 - p_1)u(\omega) - c$, instead of $p_1u(v) + (1 - p_1)u(\omega_0) - c$. At the same time, the condition under which the entrepreneur exerts effort on his project becomes $v \geq g(u(\omega) + \frac{c}{\Delta p})$, instead of $v \geq g(u(\omega_0) + \frac{c}{\Delta p})$. That is, the first and direct effect generated by such a guarantee stems from the standard effect that, as insuring the agent against the realization of a bad state of nature, it renders the provision of incentives more costly. Stated differently, for given transfers, incentives for effort decrease. In an agency relation, a principal adapts transfers in consequence but, in case the agent becomes entrepreneur, transfers are given once for all by the characteristics of the project.

Two cases must then be differentiated. Whenever $v \geq g(u(\omega) + \frac{c}{\Delta p})$, the employee still exerts effort while becoming entrepreneur and the analysis above carries on. In contrast, whenever $g(u(\omega) + \frac{c}{\Delta p}) > v > g(u(\omega_0) + \frac{c}{\Delta p})$, then E does not exert effort anymore when becoming entrepreneur. This entails that if F does not offer a contract to E, either the project is abandoned (this happens if $p_0\, u(v) + (1 - p_0)u(\omega) < u(I + 2\omega)$), or E invests in an inefficient project (this happens if $u(I + 2\omega) < p_0\, u(v) + (1 - p_0)u(\omega)$). In either case, a strongly mandatory job-back guarantee has a negative impact on the level of social welfare, either because of inefficient investment or because efficient projects are turned down. In this last case, the larger the spillovers of the initial project on the rest of the economy, the stronger the negative impact of

the job-back-guarantee.

Such a negative welfare effect would have no bite if authorities could at most impose a *"weakly"*-mandatory job-back guarantee where the firm would have to offer the guarantee if and only if she has cash-flow rights in the project. This would eliminate the negative effect on the *entrepreneur*'s incentives to exert effort. Let us now extend our base model in two different directions in order to bring additional insights on the welfare effects of such a guarantee.

4.1 Generation of Ideas

So far, we assumed that ideas emerged ex-nihilo and the offer of a job-back guarantee had no impact on the level of innovation in the economy. Indeed, in our basic setting, the project was either carried out in a joint-venture or by the entrepreneur on his own. However, generating such projects very often requires time and effort. Let us now analyze the impact of a job-back guarantee on the incentives to generate ideas. To address this issue, we extend the analysis of the previous section by adding one period at the beginning of the game. The model then unfolds as follows.

In the first period, upon exerting an effort $e_1 \geq 0$, the employee may get an idea (i.e., the project) worth v if developed successfully. The probability $\nu(.)$ of having an idea is increasing in e_1, with $\nu(0) = 0$, $\nu'(0) = +\infty$, and $\nu''(.) < 0$. The cost of effort is assumed to be equal to e_1. If the research phase is successful, then our base model kicks in in period 2. Otherwise, E remains an employee of F. We suppose that it is too costly for F to write down a contingent contract[12] at the begin of the game and, consequently, he waits until an agent shows up with an idea. We get the following result.

Proposition 4 *A job-back guarantee (weakly) increases the investment in generating projects. Moreover, if $v < \bar{v}_2$, the optimal first-period effort level is independent of the value of the project, while if $v > \bar{v}_2$, the optimal first-period effort level is increasing in the value of the project.*

The proof goes as follows. We solve the model by backward induction. First, assume that the firm never offers the job-back guarantee. In this case, if the employee gets an idea and agency cost are low enough ($\rho < \bar{\rho}_e(v, \omega_0)$), then E and F share the cash flows generated by the project (they set a joint-venture). E's expected utility is then

$$EU(v|\text{JV}) = p_1 u(t_h + I) + (1 - p_1)u(t_l + I + \omega_0) - c.$$

[12]See for example Battigali and Maggi (2004) for more developments on costly contracting.

In contrast, whenever agency cost are too high ($\rho > \bar{\rho}_e(v, \omega_0)$), E keeps full ownership over his project and becomes entrepreneur. His expected utility is then

$$EU(v|\text{entrep}) = p_1 u(v) + (1 - p_1) u(\omega_0) - c.$$

Finally, if he does not get any idea, he keeps his regular job in the firm and his expected utility is

$$EU = u(I + 2\omega).$$

Before proceeding, note that given that the IR constraint is binding at equilibrium, $EU(v|\text{JV}) = EU(v|\text{entrep})$. Therefore, for any ρ, E chooses his effort level e_1 so as to maximize

$$\nu(e) EU(v|\text{JV}) + (1 - \nu(e)) u(I + 2\omega) - e$$

We denote e_1^* the unique solution of this problem. Given that $EU(v|\text{JV})$ is increasing in v, we deduce that e_1^* is increasing in v.

Consider now the case in which the firm offers the job-back guarantee. Observe that, in the optimal contract, E is always at least ensured to receive $EU(v|\text{entrep})$ (when, say, contract C_1^+ is offered), or even more (when contract C_2^+ is optimal). Since E is indifferent between being offered contract C^- and C_1^+, he always chooses the effort level e_1^* when offered C_1^+. However, under contract C_2^+, his rent is larger and, consequently, he chooses effort level in order to maximize

$$EU(v|\text{JV'}) = p_1 u(t'_{h,2} + I) + (1 - p_1) u(t'_{l,2} + I + \omega_0) - c > EU(v|\text{entrep})$$

which results in an effort level e_1^{**} ($\geq e_1^*$). Note that since $t'_{h,2}$ and $t'_{l,2}$ are independent of v, the effort level chosen by the employee is independent of v as long as $v \in [\bar{v}_1, \bar{v}_2]$. This completes the proof.

By providing insurance for the realization of bad state of nature to the agent, the job-back guarantee forces the principal to (weakly) increase the cash-flow rights of the entrepreneur in case of success, making the latter better-off. This is, as analyzed above, costly to the principal but, in a social welfare perspective, this negative impact can be balanced by increasing agents' incentives to generate innovative ideas. Consequently, whenever the project entails large spillovers towards the rest of the society, imposing by law job-back guarantees can enhance social welfare.

4.2 Heterogenous Employees

At this stage, our model was a pure moral hazard model. Suppose now that F has been managing two employees E_G and E_B for some time (1 period) and both of them were receiving a salary of ω while working for F. At one point, they come out with two different ideas that are worth the same expected value (both generate project of value v with probability p_1 whenever effort is exerted and p_0 otherwise). However, we assume that E_G acquired more human capital (general and specific) than E_B while working for F. Formally, it boils down to assuming that E_G would produce some output of value q_G if reintegrated in F whereas E_B would only produce q_B $(< q_G)$. The productivity of E_i is known to the firm but not to the market. We denote by ω_0^i $(i = G, B)$ the wage agent i can expect on the labor market when the latter perfectly forecasts the type of the agent. In contrast, we denote ω_0^{GB} the wage any agent can expect when the market cannot identify perfectly the type of the agent. We have $\omega_0^G > \omega_0^{GB} > \omega_0^B$.

Furthermore, in order to make a clear distinction between the two agents, we consider a setting where $\omega > q_G > \omega_0^G$ and $q_B < \omega_0^B$.[13] For such parameters, offering the guarantee to E_B is never optimal (see Lemma 4). Hence, either E_B becomes entrepreneur (if agency costs are high) or set up a joint-venture (if agency costs are low) but, in either case, never receives the guarantee. In contrast, offering, or not, the guarantee to E_G has some interesting signaling implications. Indeed, whenever the firm does not offer the guarantee, the equilibrium wage on the external market is given by ω_0^{GB}. In contrast, whenever the guarantee is offered to E_G, then the equilibrium wage on the labor market is given by $\omega_0^B < \omega_0^{GB}$, and only type-$B$ agents are on the labor market. The use of a job-back-guarantee then constitutes an instrument that can signal information to the market whenever its usage is totally decentralized.

As an illustration, suppose that $v > \bar{v}_2$. We can have two types of separating equilibria. In the first one (Equilibrium 1 hereafter), both types of agents become intrapreneurs, but only type G agents are offered the guarantee, i.e., E_B is offered the contract C^- and E_G is offered contract C_1^+. Additionally, in this equilibrium, investors anticipate to see only type B agents on the labor market. Therefore, agents' reservation utility is identical for both types and given by $p_1 u(v) + (1 - p_1) u(\omega_0^B) - c$. Hence, the cost of providing incentives to exert effort is lower than in a pooling equilibrium. Equilibrium 1 is obtained if $\rho < \bar{\rho}_e(v, \omega_0^B)$. In a second type of separating equilibrium (Equilibrium 2 hereafter), E_B becomes entrepreneur and E_G is offered contract C_1^+.

[13] Relaxing such an assumption would have no bite on the property we discuss and would only increase the number of cases to consider.

Hence, again, only type-B agents are on the labor market in case of failure of the project. Equilibrium 2 is obtained if $\bar{\rho}_e(v, \omega_0^B) < \rho < \bar{\rho}'(v, q_G, \omega)$. Finally, whenever $\rho > \bar{\rho}'(v, q_G, \omega)$, then both agents become entrepreneur.

These results provide an interesting comparison with those of Gromb and Scharfstein (2003). In their paper, setting up a joint venture provides an informational advantage to the firm since it allows her to privately learn the type of the agent and, consequently, to only keep the high skilled one in case the project fails. In contrast, while becoming entrepreneur, an agent who fails cannot signal his quality to the market. Here, if Equilibrium 1 holds, then a contract of intrapreneurship together with the offer of a job-back guarantee provides a way of revealing information to the labor market about agents' type: only E_B looks for a job if the projects fails, since E_G is offered the guarantee to be reintegrated. Conversely, in Equilibrium 2, some information can still be transmitted to the market even if an agent becomes entrepreneur. This stems from the fact that, given that E_G and E_B were primarily employed by F, she is informed of their ability when they submit their projects. As a consequence, E_G is offered a different contractual arrangement that ensures him that he will be reintegrated in case of failure, and only E_B looks for a job if the project fails. Hence, if fully decentralized, the job-back guarantee becomes an additional instrument that firms can use to offer different contracts which, in fine, conveys information to the external labor market.

5 Concluding Remarks

All employees with innovative ideas do not always leave their job and become entrepreneurs. Financial constraints or asymmetric information, as often quoted in the literature, are certainly one type of explanation. However, they cannot constitute the unique reason since many projects start on a very small scale which do not necessarily necessitate external funding. In this article, our starting point was that running a business is undertaking a risky activity making the decisions to start a business costly for risk-averse agents. Our first result is that, even in absence of either private benefits or synergies with the firms' core business, the financing of the project can take several forms: internal development, joint financing, or entrepreneurship.

Analyzing the decision of risk-averse potential entrepreneurs allowed us to consider the use of a widely adopted instrument in contractual arrangements – the offer of a job-back guarantee. We have shown that the offer of such a guarantee is profitable provided that the agent is risk-averse,

is endowed with large enough firm-specific human capital and duplication costs following the reintegration of the entrepreneur are low. This allowed us to disqualify external investors such as banks or venture capitalists as providers of such a guarantee. We then extended the analysis to get some general insights on the effect of making such an offer mandatory. Endogenizing the generation of ideas, we have shown that offering a job-back guarantee can strictly increase the investment in generating ideas. This can have a positive effect on the profit of the firm but, moreover, whenever the project entails large spillovers towards the rest of the society, a mandatory job-back guarantee can also enhance social welfare. However, mandatory guarantees may also have negative effects. Depending on whether the guarantee has to be offered in any case or only when the firm has cash-flow rights in the project, it may generate investments in inefficient projects, abandon of efficient ones, and/or a reduction in the informational efficiency of the labor market.

Appendix A: Proofs

Proof of lemma 2:

Denote by $u^h \equiv u(I + t_h)$ and $u^l \equiv u(I + t_l + \omega_0)$. We can therefore rewrite, $t_h = g(u^h) - I$ and $t_l = g(u^l) - I - \omega_0$. The program above then rewrites as

$$\max p_1(v - g(u^h)) - (1 - p_1)[g(u^l) - \omega_0]$$
$$\text{subject to} \quad (2), (3), (4) \text{ and } (5).$$

First note that wealth constraint (4) cannot be binding since, for the participation to be satisfied, E should receive the full return in case of success. Moreover, let us set aside the profit constraint (5) for the moment and we will check ex post that it is indeed satisfied.

Denote μ and λ the non-negative multipliers associated to constraint (2) and (3), the first-order conditions of the program are given by

$$-p_1\, g'(u^h) + \lambda\, \Delta p + \mu\, p_1 \quad = \quad 0 \tag{13}$$
$$-(1 - p_1)\, g'(u^l) - \lambda\, \Delta p + \mu\, (1 - p_1) \quad = \quad 0. \tag{14}$$

Rearranging terms, we get the standard conditions

$$\frac{1}{u'(t_h)} \quad = \quad \lambda \frac{\Delta p}{p_1} + \mu \tag{15}$$
$$\frac{1}{u'(t_l)} \quad = \quad -\lambda \frac{\Delta p}{1 - p_1} + \mu. \tag{16}$$

Now, multiplying equation (15) by p_1, equation (16) by $(1-p_1)$ and adding the two, we obtain

$$\mu = \frac{p_1}{u'(t_h)} + \frac{1-p_1}{u'(t_l)} > 0 \tag{17}$$

implying that the participation constraint is binding.
Plugging (17) back in (15), we also obtain

$$\lambda = \frac{p_1(1-p_1)}{\Delta p}\left(\frac{1}{u'(t_h)} - \frac{1}{u'(t_l)}\right) > 0 \tag{18}$$

also implying that the incentive compatibility constraint is binding. The shape of transfers directly follows. Now F proposes such a contract if and only if

$$p_1\, v - I \geq p_1\, t_h + (1-p_1)\, t_l. \tag{19}$$

For $v = g\left(u(w_0) + \frac{c}{\Delta p}\right)$, the firm just break even. Moreover, given that the function $g(.)$ is convex, we have, under assumption 4,

$$p_1 g'(u(v))u'(v) > (p_1)^2 g'\left(\bar{U} + (1-p_0)\frac{c}{\Delta p}\right)u'(v) + p_1(1-p_1)g'\left(\bar{U} - p_0\frac{c}{\Delta p}\right)u'(v). \tag{20}$$

That is, for given values of (p_0, p_1, ω_0), the expected profit is increasing in v. Now, let $T(p_0) \equiv p_1 t_h + (1-p_1)t_l$. Observe that $\lim_{p_0 \to p_1} T(p_0) = \infty$, and simple differentiation yields

$$\frac{\partial T}{\partial p_0} = \frac{c}{(\Delta p)^2} p_1(1-p_1)\left[g'(u_h) - g'(u_l)\right] > 0.$$

Then, for any given values of (p_1, v, ω_0), there exists a critical value $\bar{p}_0$ such that $\forall p_0 > \bar{p}_0$, Condition (19) is not satisfied. We denoted $\bar{\rho}_e = \frac{\bar{p}_0}{p_1}$.

It remains to show that when $v < g\left(u(w_0) + \frac{c}{\Delta p}\right)$, then E becomes entrepreneur. To do so, observe that for such a value of v, the wealth constraint of E is binding. Therefore, the contract offered by F is now

$$t_h = g\left(u(\omega_0) + \frac{c}{\Delta p}\right) - I \tag{21}$$

$$t_l = -I \tag{22}$$

However, this contract cannot be profitable since F has to pay more in the high state than the value created through the project. Given assumption 3, E then becomes entrepreneur. □

Proof of Proposition 1

Let $\hat{\rho}_e(v, \omega_0)$ be the implicit function such that $g(\bar{U} - p_0 \frac{c}{\Delta p}) = I + w_0$. For any $\rho < \hat{\rho}_e(v, \omega_0)$, we have $g(\bar{U} - p_0 \frac{c}{\Delta p}) > I + w_0$ and E does not finance the project. Conversely, E does so whenever $\rho > \hat{\rho}_e(v, \omega_0)$. Moreover, by definition, $\bar{\rho}_e(v, \omega_0)$ represents the threshold above which F does not offer any contract to E. Therefore, $\bar{\rho}_e(v, \omega_0)$ is the implicit function defined by

$$p_1 v + (1-p_1) w_0 - p_1 g \left[p_1 u(v) + (1-p_1) u(w_0) + \frac{(1-p_1)c}{p_1(1-\rho)} \right] - (1-p_1) g \left[p_1 u(v) + (1-p_1) u(w_0) - \frac{c}{(1-\rho)} \right] = 0$$

Denote $F(v, \rho)$ the LHS of such equality. Given that $g(.)$ is convex, we have $\partial F / \partial \rho < 0$.
Let us now show that, for given values of the parameters, $\hat{\rho}_e(.) < \bar{\rho}_e(.)$. At $\rho = \hat{\rho}_e(v, \omega_0)$,

$$F(v, \hat{\rho}_e) = p_1 v + (1-p_1) w_0 - p_1 g \left[H \right].$$

where

$$H \equiv u(v) - \frac{(1-p_1)}{p_1} (u(I + w_o) - u(w_0)) < u(v).$$

Then, $F(v, \hat{\rho}_e) > 0$ which, given that $\partial F / \partial \rho < 0$, implies that $\hat{\rho}_e(.) < \bar{\rho}_e(.)$ for all values of the parameters. □

Proof of Lemma 3:

The first part is straightforward since it directly stems from Lemma 2. Note however that the threshold on the magnitude of the agency cost is different from the case without the guarantee since, whenever the option is exerted, E generates some output q. That is the value $\bar{\rho}(v, q, \omega)$ is now such that $p_1 \, v + (1-p_1) q - I = p_1 \, t'_h + (1-p_1)(\, t'_l + \omega) = p_1 \, t_h + (1-p_1) \, (t_l + \omega_0)$. The condition on the value of ρ is obtained exactly as in the proof of lemma 2. More precisely, whenever $q > \omega_0$, then $\bar{\rho}(v, q, \omega) > \bar{\rho}_e(v, \omega_0)$ and, in contrast, whenever $q < \omega_0$, then $\bar{\rho}(v, q, \omega) < \bar{\rho}_e(v, \omega_0)$.
The second part stems from the fact that, in the program of the principal, the IC and the wealth constraints are now binding. These conditions ensure that the IR constraint is slack ($v < g\left(u(w_0) + \frac{u(\omega) - u(w_0)}{p_1} + \frac{c}{\Delta p} \right)$) and that the principal indeed wants to offer a contract ($g\left(u(\omega) + \frac{c}{\Delta p} \right) < v$). The shape of the contract then directly follows. Finally, the value $\bar{\rho}'(v, q, \omega)$ is now defined by $p_1 \, v + (1-p_1) q - I = p_1 \, t'_h + (1-p_1)(\, t'_l + \omega)$. Conditions on the value of ρ are, again, obtained exactly as in the proof of lemma 2. □

Proof of Proposition 2:

We distinguish the following two cases.

Case 1: $q > \omega_0$**.** Suppose first that $v \in [\bar{v}_1, \bar{v}_2]$. By definition, whenever $q > \bar{q}(w, v)$ (resp. $q < \bar{q}(w, v)$), we have $\pi^G > \pi^{NG}$ (resp. $\pi^G < \pi^{NG}$). At the same time, we have shown that $\pi^G > 0$ if and only if $\rho < \bar{\rho}(v, q, \omega)$ whereas $\pi^{NG} > 0$ only if $\rho < \bar{\rho}_e(v, \omega_0)$. The result directly follows. Observe that nothing prevents $\bar{q}(\omega, v)$ from being larger that ω. However, given that we have restricted q to be lower than ω, whenever $\bar{q}(\omega, v) < \omega$, we directly fall under condition where π^{NG} is the relevant profit to consider. Suppose now that $v > \bar{v}_2$. Then $\bar{q}(\omega, v) = \omega_0$ and, in a setting where $q > \omega_0$, only π^G becomes relevant. It is then immediate that F only offers the guarantee whenever $\rho < \bar{\rho}'(v, q, \omega)$. Symmetrically, whenever $v < \bar{v}_1$, then $\pi^G < 0$ and the firm never offers the guarantee. The result then follows from lemma 2.

Case 2: $q < \omega_0$**.** We know from lemma 4 that the guarantee is never offered. The contract directly follows from lemma 2.

6 Appendix B: Variable project scale

In the model, we assumed that a fixed amount I was invested yielding v in case of success. Furthermore, we assume that E had sufficient wealth to self-finance the project. However, it is likely that firms and individuals differ concerning the scale of the investment to make and, very often, agents cannot fully finance their investment. To take this into account and see how our approach easily extends to such setting, we modify the base model of Section 2 as follows. The value of the project depends on the level of investment (I): $v = v(I)$, with $v'(.) > 0$ and $v''(.) < 0$. If the employee becomes entrepreneur, he chooses the project scale so as to maximize

$$p_1 u[v(I) + W - I] + (1 - p_1) u(\omega_0 + W - I) - c.$$

Whenever $p_1(v'(I) - 1)u'[v(I)] - (1 - p_1)u'(\omega_0) > 0$, the optimal project scale whenever E becomes entrepreneur is $I_E^* = W$. Otherwise, I_E^* is the unique solution to

$$p_1(v'(I) - 1)u'[v(I) + W - I] - (1 - p_1)u'(\omega_0 + W - I) = 0.$$

We then have that the investment of the agent is $\min\{W, I_E^*\}$. We deduce that the reservation utility of the employee is

$$\bar{U} = p_1 u[v(I_E^*) + W - I_E^*] + (1 - p_1) U(\omega_0 + W - I_E^*) - c$$

Whenever the firm is involved in the financing of the project, she can choose its scale. So

the optimal investment level chosen by the firm is I_F^* such that $p_1 v'(I_F^*) = 1$. Given that the financing institution is risk-neutral while E is risk-averse, it is straightforward that $I_F^* > I_E^*$. Studying the conditions under which the job-back guarantee is offered, several cases have to be considered. First, assume that $I_E^* < W$. In the absence of job-back guarantees, the firm then proposes the contract $t_l = -I_E^*$ and $t_h = v(I_E^*)$. Considering now the optimal financing scheme, we apply the same reasoning as in the proof of Proposition 2 and deduce that if $-I_E^* - (\omega - \omega_0) > -W$ (case 1), the job-back guarantee is offered if $q > \omega_0$ and agency costs are small enough. If $-I_E^* - (\omega - \omega_0) < -W$ (case 2), the contract with job-back guarantee is $t_l = -W$ and $t_h = g\left(u(\omega) + c/\Delta p\right) - W$, i.e., the firm proposes the contract C_2^+. Similarly, let us assume that $I_E^* = W$. If, in absence of job-back guarantee, the firm chooses a contract such that $t_l = -W$, then the job-back guarantee is never offered. Conversely, if $t_l > -W$, the analysis is similar to cases 1 and 2 above.

This stresses the fact that our results do not hinge on the assumption that the agent is endowed with sufficient wealth to self finance the project, and that there are situations in which E invests all his wealth, partially finances the project and receives a job-back guarantee.

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