Developing New Ideas: Spin-outs, Spinoffs or Internal Divisions

Radoslawa Nikolowa[*†]

May 2011

Abstract

This paper offers a theory of how ideas generated by the employees of a firm are implemented. An idea can be developed in an independent new firm created by the employee (spin-out), or benefit from an investment by the parent employer and be implemented in an internal division or in a spinoff. Employees privately observe the value of their ideas, hence keeping those with good ones comes at a cost of increased wages for all employees. Developing an idea in a spinoff whose performance is verifiable by third parties, allows the principal to offer performance based contracts, mitigates the agency problem and improves the efficiency in the parent's core activity. However, when the fraction of bright ideas is small the overall increase in wages may lead the firm to let the employees with good ideas leave and innovation is implemented in spin-outs. The paper also relates the creation and survival rates of new ventures to the parent's performance. It shows that better performing firms have higher spin-out creation rate and spawn better performing spinoffs and spin-outs.

Keywords: Spinoffs, Idea development, Information asymmetry, Employee allocation

[*]School of Economic and Finance, Queen Mary University of London; r.nikolowa@qmul.ac.uk, Mile end road, London E1 4NS, United Kingdom; tel. +44(0)2078823996

[†]The paper has benefited from helpful comments by Daniel Ferreira, Luis Garicano, and Michael Raith. A previous version of the paper has circulated under the title "Spinoffs". The usual disclaimer applies.

1 Introduction

The generation and development of new ideas is an important driver for economic growth. New ideas can emerge in different ways but many of them are created by employees within existing firms. The aim of this paper is to offer a theory of how these ideas are implemented and analyze how the development decision is related to the characteristics of the industry, of the parent firm and of the innovation.

An employee with an idea can leave the firm and create a new independent venture (spin-out) to implement it. The evidence suggests that many of the new ideas implemented in new ventures are generated while the employee works for a parent firm in the same industry. Bhide (1994) highlights that *'71% of all founders*[1] *had replicated or modified an idea encountered through previous employment'*. In the sample studied by Gompers, Lerner and Scharfstein (2005) 45% of all venture capital backed startups are spawned by public companies. Alternatively, the parent firm can be involved in the idea's development[2], and implements it in an internal division or in a new venture created by and related to the parent firm (spinoff[3]).

The paper addresses three questions. First, why an employee chooses to leave his employer and develop his idea in a spin-out. In particular, I focus on the drivers of inefficient spin-outs. Second, what determines the parent firm's choice to implement an employee's idea in a division or in a spinoff. Finally, how the performance of the parent employer affects its likelihood of spin-out and spinoff creation, and their survival rate.

I consider that, firm's employees independently of each other come up with ideas (projects): a new technology, a new production process, a new product for a niche market, and s.o. For each employee, the parent employer decides whether to keep him or not, and if kept whether to let him develop his idea (in a division or in a spinoff) or allocate him to the firm's core activity. In the latter case the project is not implemented. An idea in the same industry and geographical location as the parent firm carries the potential for

[1]The sample: 100 founders of the 1989 Inc 500 fastest growing private companies.

[2]An example of such involvement are the corporate venturing programs. Those programs are financing both external or internal projects. In the latter case the program's aim was to allow the employees to develop their innovations while relying on the company for financial, legal and marketing support.

[3]In the finance literature,a spinoff is created when a public company distributes its equity ownership in a subsidiary to its shareholders, the parent shareholders receive a subsidiary stock in proportion to their ownership in the parent firm. In the model the term spinoff is used in a broader sense.

synergies if the parent employer is involved in its implementation: economies of scale or scope, easier access to clients or suppliers, access to used by the parent firm technology or expertise, tax advantages[4]. Hence, I assume that the parent firm can contribute to the performance of the new idea by allocating to it some of its resources. The allocation of resources to a new idea has an opportunity cost, and the amount to be allocated depends on the employer's incentives to invest. When such synergy exists in a frictionless world there is no room for spin-outs and spinoffs and all ideas are developed internally in divisions of the firm. The friction analyzed in the paper is an information asymmetry between an employee and the employer about the value of an idea. Since the employee is the one who comes up with the idea, it is assumed that he has a better knowledge of what his idea exactly is and for the potential benefits it could create if successfully implemented.

In order to keep the employees with good ideas the parent firm needs to increase their reward up to the level of their outside opportunity, *i.e.* what they could expect if the project is developed in a spin-out. However, a high wage offer for the innovative activity makes it more attractive for the employees with bad ideas and requires a higher reward in order to keep them in the core activity of the firm where they are more valuable. If a good idea is developed in a division of the parent employer and since the profits of the division are difficult to disentangle from the overall profits of the firm, the principal can only offer a lump sum payment to an employee with a good idea. The principal can also implement the employee's idea in a spinoff. The profit of the spinoff, as a separate unit, is easier to assess by third parties and the principal offers a contract based on the employee's performance. This makes the innovative activity less attractive to the employees with bad ideas and decreases their rents. The downside is that now the principal only receives a share of the spinoff's profit and his incentives to invest are lower. Spinning off new ideas allows the firm to mitigate the adverse selection problem and hence increases the profit of the core activity. Nevertheless, the employees with bad ideas continue to capture some rents. If there is a small fraction of good ideas it is in the employer's interest to allow the employees to leave and create new ventures. Therefore, spin-outs arise because keeping the employees with good ideas increases the overall wage cost of the firm.

The development of an idea in a spinoff is credible only if the profit of the spinoff is

[4]For the last point see Bankman and Gilson (1999).

not lower than the profit that the employee would create if allocated to the core activity. This implies that a firm with higher returns in its core activity creates better performing spinoffs. The profit of the spinoff depends on the parent firm's investment. When the returns in the core activity are high, the parent firm needs stronger incentives to invest in the spinoff's activity and thus decreases the employee's performance based reward. Since the principal is basing a lower part of the reward on the idea's performance the employees with bad ideas capture higher rents, which in turn increases the cost of keeping the agents with good projects. Therefore, firms with higher returns in their core activity have a higher likelihood of spin-out creation. It is also shown that those spin-outs have a higher survival rate.

Spin-out creation has attracted a substantial attention both in terms of theoretical and empirical analysis. In what follows, I will discuss the existing theories in order to clarify the contribution of the current paper, the empirical evidence and how the paper's results relate to it are discussed in section 5. One strand of the theoretical literature explains employees' departures as efficient outcomes (Pakes and Nitzan (1983), Klepper and Sleeper (2005), Cassiman and Ueda (2006) among others), the idea is less valuable if developed by the parent employer than in independent new venture.

A second strand, which this paper is more closely related to, aims to explain the existence of inefficient spin-outs. Hellmann (2007) shows that when the employees face a multitasking problem – work on the firm's core activity or innovate, committing *ex ante* not to develop employees' ideas and allow them to leave the firm *ex post*, reduces the incentives to innovate and increases the employee's effort in the core activity. In my paper, the information asymmetry is about the value of the idea and not about the employee's effort. Furthermore, the existence of spinoffs is socially inefficient but it corresponds to the optimal choice for the firm.

Anton and Yao (1995) study[5] the problem of an employee who privately observes an idea and may either reveal it to the firm or develop it in a spin-out, which directly competes with the incumbent firm. The rationale for spin-outs is due to the possibility for the firm to steal the idea and develop it on his own, without the employee. Hence,

[5]The vocabulary used in this paper differs from the one in Anton and Yao (1995), in their article: the employee can develop the idea independently in a start-up, with the parent firm in a spin-off, or the parent firm can implement an alternative internal idea rather than the idea of the employee.

spin-outs will be prevented if the gains from avoiding competition for the incumbent firm are sufficiently high. In this paper there is no possibility to trade ideas, the idea's creator is critical for its implementation and what is driving the spinoffs is the fact that due to the adverse selection keeping the agents with good ideas increases the overall wage cost for the company.

Amador and Landier (2003) study the implementation of employees' ideas within corporations or by venture capitalists when the entrepreneurs are more optimistic about the quality of their ideas. The trade-off is between lower implementation cost if the idea is developed internally (by the parent employer), but also reduced contractual flexibility due to the impossibility to write performance based contract when the company finances the new project.

Differently from the previous papers rather than considering only the two extreme cases of internal (division of the firm) versus external (spin-out) development of the new idea, I allow the parent firm to develop the employee's idea in a spinoff. Hence, I show that even if we enlarge the contractual set of the company, this is not enough for preventing the creation of spin-outs.

The paper also emphasizes the problem of talent allocation between core and innovative activity. As a consequence the performance of the firm's core activity affects both the rate of spinoff and spin-out creations, and their likelihood of success. Hence, we can also relate the spawning rate of a firm to the life cycle of its main activity.

The paper is also related to the literature aiming to explain the empirically documented[6] positive stock price reaction around the announcement of a spinoff. Aron (1991) argues that spinning-off an activity allows to tie a manager's performance to the market valuation for that activity. Hence, the possibility of spinoff increases the manager's incentives even if the spinoff rarely occurs. Nanda and Narayanan (1999) show that when there are information asymmetries about the value of the firm, between the firm and the investors, undervalued firms would spin off an activity in order to increase their market value before raising capital. In the present paper developing an idea in a spinoff mitigates the internal information asymmetry and differently from the previous articles translates into an increased efficiency of the core activity, which is not the one spined off by the firm.

[6]The empirical evidence is discussed in Section 5.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 discusses the internal allocation of an employee and presents the trade-offs related to the development of an idea in a division or in a spinoff. Section 4 demonstrates that inefficient spin-outs may be created in equilibrium and links the likelihood of creation and survival of spin-outs to the performance of the parent firm. Section 5 summarizes and discussed the main finding of the paper in light of the existing empirical evidence. Section 6 concludes. Proofs are relegated to the Appendix.

2 Model

2.1 Framework

A firm employs agents in a production activity (core activity hereafter) requiring some managerial ability. An employee's managerial ability is denoted θ ($\theta \leq 1$) and the expected surplus from an employee with ability θ working in the core activity is $b\theta$. b is the exogenous return to talent in the core activity of the firm, it can be affected by changes in the degree of competition, and change over the life-cycle of a product or activity.

At the beginning of the period of interest a continuum of employees with mass one have innovative ideas (projects) which if successfully implemented generates a cash flow β. The cash flow in case of success can be high (good idea) $\overline{\beta}$ with probability q, or low (bad idea) $\underline{\beta}$ with probability $(1-q)$. The outcome in case of failure is zero.

A new idea may be a new product, a new production process or an insight of how to conquer a niche market not served by the parent firm, it is an innovative activity in a broad sense. The employee who comes up with the idea has better information about its value than the employer. For simplicity but without loss of generality it is assumed that the employee perfectly observes the idea's quality β, while the employer only knows the distribution of good and bad ideas. The property right of an idea cannot be guaranteed *ex ante* (before the idea is implemented) and ideas cannot be traded. Hence the employee who comes up with the idea is the only one to be able to implement it.

Whether an idea will be a success depends on the managerial ability of the agent

who implements it[7]. An employee with ability θ succeeds and creates the cash flow β with probability θ. Holmes and Schmitz (1996) show that both the value of the idea and the managerial ability of the entrepreneur matter, and need to be considered to explain evolutions in the failure and sale of small businesses.

The primer interest of the paper is to determine under what circumstances new ideas will be implemented in a division of the parent firm (internal innovation), in a new venture created by the parent employer (spinoff) or in a completely independent firm (spin-out) created by the employee.

The expected profit of an employee θ with an idea β who decides to create a new firm[8] is $\beta\theta + B$. B is the agent's private benefit, it captures the increase in utility from being self-employed and is independent of the quality of the idea or its likelihood of success. This assumption is in line with a growing empirical evidence[9] documenting that self employed are more satisfied with their jobs. Furthermore, Hamilton (2000) shows that the self-employed are willing to forego income in exchange for being independent.

If the parent firm is involved in the development of the idea, it can contribute to the profits created by the new project, by allocating some additional non-contractible resources to it. The parent firm's investment (synergy[10]) S affects the probability of success or the returns of the new idea. The synergy has an opportunity cost $C(S) = \frac{cS^2}{2}$, and it is assumed that for a given S the cost is the same independently of the resources being allocated to a division of the firm or to a spinoff. This assumption rules out pure cost considerations as driving forces of one of the organizational forms and focuses the analysis on the role played by the information asymmetry on the decision to develop a new idea in a division or in a spinoff. The expected total surplus from developing an idea with the participation of the parent firm is $S\beta\theta - C(S)$. The optimal level of synergy is: $S = \frac{\overline{\beta}\theta}{c}$, so developing the idea with the involvement of the parent firm creates at most:

[7]The idea that a successful entrepreneur needs to be a good innovator and a good manager is in the spirit of Lazear (2005), who depicts the entrepreneur as Jack of all trades.

[8]The question of the employee's incentives to exert effort is set aside, however the trade-offs that this considerations would bring are discussed in Section 3.3.

[9]See for example Blanchflower and Oswald (1998), Blanchflower (2000), Blanchflower, Oswald and Stutzer (2001), and Benz and Frey (2008).

[10]I refer to it as a synergy because the parent firm has an advantage compared to other firms in investing in the employee's project. This advantage arises because the project is related to the activity of the firm, or because the employee has acquired some specific human capital that allows him to better use the parent firm's investment than the help of an alternative investor.

$\frac{(\overline{\beta}\theta)^2}{2c}$.

The difference between the division of the firm and the spinoff lies in the ability of third parties to assess the project's performance. If a project is developed in a division, then the revenue it creates is part of the total revenue of the parent firm. Isolating and assessing the performance of a specific division is difficult (costly) for third parties and the employer cannot offer a contract based on the project's performance. However, if a new idea is developed in a spinoff, since it is an independent unit its revenue is easier to assess by third parties and a performance based contract can be offered. For example if the principal wants to offer a compensation tied to the market performance of the firm: if a project is developed in a spinoff then the market evaluation of the spinoff reflects the market valuation for the project only, while if it is implemented in a division, the market valuation reflects the performance of the firm as a whole.

An employee who implements his idea – internally or in a new venture – is replaced by a new hire in the core activity of the firm. New hires have an average ability of m, with $\theta > m$. An employee who has been in the firm has acquired a (firm specific) human capital that outsiders do not have. The outside wage (*i.e.* if an employee is hired by a different employer) for all employees is normalized to zero. Therefore, the outside opportunity of an employee with a good (*resp.* bad) idea is $\overline{\beta}\theta + B$ (*resp.* $\underline{\beta}\theta + B$). The focus of the paper is on how the ideas of firm's employees are developed I do not consider the possibility for the outsiders (not employed by the firm) to innovate, their outside opportunity is zero. Allocating an employee to the innovative activity has an opportunity cost which depends on the quality of the available labor.

Assumption 1.

i) $\frac{\overline{\beta}^2\theta^2}{2c} > \overline{\beta}\theta + B$

ii) $\frac{\underline{\beta}^2\theta^2}{2c} < \underline{\beta}\theta + B$

iii) $b\theta - \overline{\beta}\theta - B \geq bm - r$

The focus of the paper is to analyze the driving forces for inefficient spin-outs. Hence, the first condition of the Assumption states that the optimal investment by the parent

firm is high enough to make it profitable to develop the project internally. If this condition does not hold, good ideas are always optimally developed in spin-outs.

The second and third conditions state respectively that it is never profitable to develop the bad ideas in the firm but it is always profitable to keep an agent in the core activity. Therefore, the focus of the analysis is on whether or not the good ideas will be developed and if yes if it will be in relation with the parent employer or in an independent new venture. Considering the cases where conditions (ii) and (iii) of Assumption 1 do not hold would extend the analysis to the internal development of bad ideas, without affecting the results of the paper.

The timing of the employment relationship is the following:

- an employee discovers the value of his idea;
- the principal decides how to allocate the employees between the core and the innovative activity (spinoff or division of the firm) and offers the corresponding menu of contracts;
- each employee decides to accept or not the contract and to stay in the firm or leave and create a new venture;
- the vacancies in the core activity – due to departures or relocation of employees to the innovative activity – are filled with new hires;
- the parent firm invests in the new activity whenever developed in a division of the firm or in a spinoff;
- outcomes are realized and the contracts are executed.

2.2 The symmetric information case

As a benchmark, let us consider the case of symmetric information, *i.e.* the employer observes the quality of the employee's idea. In order to prevent an employee with a good (*resp.* bad) idea from leaving the firm the reward offered by the employer is $\overline{\beta}\theta + B$ (*resp.* $\underline{\beta}\theta + B$). When the quality of the idea is common knowledge it is in the employer's interest to offer an upfront fixed wage that satisfies the employee's participation constraint. Indeed

by doing so the employer becomes residual claimant and in the case a good idea is implemented he chooses the optimal investment $S = \frac{\overline{\beta}\theta}{c}$.

For the remainder of the paper I adopt the following notation: $\overline{b} \equiv \frac{\frac{(\overline{\beta}\theta)^2}{2c}}{\theta - m}$.

Lemma 1.

- *If $b > \overline{b}$ any employee with ability θ works in the core activity of the firm.*
- *If $b \leq \overline{b}$, an employee θ with a good idea develops it in a division of the firm, and an employee θ with a bad idea works in the core activity.*

Since from Assumption 1 the surplus created by a new idea developed internally is larger than the surplus of a spin-out, under symmetric information there are no ideas implemented in spin-outs or spinoffs. If the idea is valuable enough compared to the core activity then it is developed in an internal division, if not all employees continue to work in the core activity. Hereafter, I refer to the case where $b > \overline{b}$ as being a non-innovative regime, since new ideas are not valuable enough and the optimal allocation of talent consists in keeping the employees in the core activity. The case where $b \leq \overline{b}$ is an innovative regime. Whether a firm is in the innovative or non-innovative regime is determined by the characteristics of the activity and the industry. If the environment changes fast and the rents in a given activity are quickly dissipated, then the firm is more likely to be in the innovative regime. This will also be the case if the competition is stronger.

In what follows we will see that when the information is asymmetric inefficient spin-outs and spinoffs are created in equilibrium. The principal decides to keep or not an employee and how to allocate the employees who are retained. His decision is studied in two steps. First, in Section 3, I present the optimal internal allocation for an employee. Then in Section 4, I discuss the trade-offs related to the choice of keeping or not an employee.

3 Internal allocation of the employees

In this section, the focus is on the principal's decision to allocate an employee to the core or innovative (division or spinoff) activity, assuming that the employee is valuable enough to be kept in the firm.

3.1 Efficient internal investment

The value of an idea is irrelevant for the employee's performance in the core activity. So to keep an agent with a good idea in the core activity the principal can only offer a fixed wage that matches the employee's outside opportunity: $\overline{\beta}\theta + B$. Since the employer does not observe the quality of the employee's idea, he cannot prevent an agent with a bad idea ($\underline{\beta}$) from claiming that his idea is good ($\overline{\beta}$). Whenever the principal wants to keep the employees with good projects in the core activity, it is impossible to separate agents with good and bad ideas and he offers a unique wage $\overline{\beta}\theta + B$ to all employees. The resulting expected profit is:

$$\Pi^c = b\theta - \overline{\beta}\theta - B \tag{1}$$

If the good ideas are developed in a division of the parent firm and since the performance is not *ex post* verifiable, the employer can only offer a lump sum payment to the employees with good ideas: $\overline{\beta}\theta + B$. The employer is residual claimant of the innovative activity, therefore he chooses the optimal level of investment $S = \dfrac{\overline{\beta}\theta}{c}$. To prevent the agents with bad ideas from implementing them, the principal must offer $\overline{\beta}\theta + B$ in the core activity as well, and his expected profit is:

$$\Pi^d = q(\frac{\overline{\beta}^2\theta^2}{2c} + bm) + (1-q)b\theta - \overline{\beta}\theta - B \tag{2}$$

Finally, if the good ideas are developed in spinoffs, the principal can offer a contract based on the cash flow realized by a project. He offers a linear contract $W = \alpha y + w$, where y is the cash flow and w is the fixed wage paid upfront by the principal. The menu of contracts $\{(\overline{\alpha}, \overline{w}), \underline{w}\}$ is such that the good ideas are developed in spinoffs while the

agents with bad ideas continue to work in the core activity[11]. The principal maximizes the total expected profit:

$$\max_{\overline{\alpha},\overline{w},\underline{w},S} \Pi^{spin} = q(bm + (1-\overline{\alpha})\overline{\beta}\theta S - \overline{w} - \frac{cS^2}{2}) + (1-q)(b\theta - \underline{w}) \tag{3}$$

subject to

$$\begin{cases} \overline{\alpha}\overline{\beta}S\theta + \overline{w} \geq \overline{\beta}\theta + B & \overline{IR} \\ \underline{w} \geq \underline{\beta}\theta + B & \underline{IR} \\ \overline{\alpha}\overline{\beta}S\theta + \overline{w} \geq \underline{w} & \overline{IC} \\ \underline{w} \geq \overline{\alpha}\underline{\beta}S\theta + \overline{w} & \underline{IC} \\ (1-\overline{\alpha})\overline{\beta}\theta - cS = 0 & IC_P \\ \underline{w} \geq 0, \overline{w} \geq 0, \overline{\alpha} \geq 0 & LL \end{cases} \tag{4}$$

Equations $\overline{IR}$ and $\underline{IR}$ are the participation constraints of an agent with a good and a bad idea, respectively. Equations $\overline{IC}$ and $\underline{IC}$ are the incentive compatibility constraints, they guarantee that the employees with good ideas choose to develop them in spinoffs ($\overline{IC}$), while those with bad ideas continue to work in the core activity ($\underline{IC}$).

Since the principal's investment in the innovative activity is not verifiable, he cannot commit *ex ante* to the amount of resources that will be allocated to a spinoff firm. *Ex post* – once the contracts have been accepted – he chooses the investment that maximizes the expected profit of the spinoff: $(1-\overline{\alpha})\overline{\beta}\theta S - \overline{w} - \frac{cS^2}{2}$, and equation IC_P is the principal's incentive compatibility constraint. Finally, employees are wealth constrained and their rewards cannot be negative. The resulting optimal menu of contracts is characterized below:

Lemma 2. *If the principal decides to develop the new ideas in spinoffs he offers:*

$$\begin{cases} \overline{\alpha} = \min\left\{\frac{(\overline{\beta}-\underline{\beta})(1-q)}{2(1-q)(\overline{\beta}-\underline{\beta}) + q\overline{\beta}}; \frac{1}{2}\left(1 - \sqrt{1 - \frac{4(\overline{\beta}\theta + B)}{\frac{\overline{\beta}^2\theta^2}{c}}}\right)\right\} \\ \overline{w} = \max\left\{0; \overline{\beta}\theta + B - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}^2\theta^2}{c}\right\} \end{cases}$$

$$\underline{w} = \overline{w} + \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\underline{\beta}\theta^2}{c}$$

[11] From Assumption 1 it is always better to allocate the employees with bad ideas to the core activity of the firm, and $\underline{w}$ is the fixed wage offered in the core activity.

A performance based reward in the innovative activity makes it less attractive for the employees with bad ideas – compared to the case where the employee receives a lump sum for developing his idea internally – and the principal can offer a lower fixed wage to the employees with bad ideas for keeping them in the core activity. Consequently, it is in the principal's interest to reduce the fixed reward $\overline{w}$ to zero and offer a share of the revenue ($\overline{\alpha}$) that satisfies the employee's participation constraint. Increasing $\overline{\alpha}$ decreases the parent's incentives to invest and therefore the spinoff's cash flow. Such contract is only possible if the cost parameter of the investment is sufficiently low (*i.e.* if the equilibrium synergy is high enough). Otherwise, the participation constraint of the employees with good ideas does not hold, the principal offers a positive fixed wage $\overline{w}$ that satisfies with equality the participation constraint and chooses $\overline{\alpha}$ by trading off the following effects: at one side a higher share decreases the informational rent of the employees with bad ideas but at the other side it reduces the principal's incentives to invest in the spinoff thus decreasing the expected profit of the latter. When the fraction of good ideas increases (*i.e.* q is higher), it becomes more valuable to guarantee strong incentives to the principal and decrease $\overline{\alpha}$.

The spinoff increases the expected profit of the parent firm by reducing the information rent of the employees with bad ideas. From *ex ante* prospective the principal is always better off if a new idea is developed in a spinoff rather than in a division of the firm.

Once the contracts have been selected, if the principal cannot commit *ex ante* to an employee's job allocation, there may be room for mutual improvement and hence renegotiation of the contract. However if there is room for renegotiation, it is anticipated by the employees and the menu of contracts defined in Lemma 2 does not allow to separate the agents with good and bad ideas. So a separation contract needs to satisfy the following renegotiation proof condition:

$$(1-\overline{\alpha}^2)\frac{\overline{\beta}^2\theta^2}{2c} - \overline{w} \geq \max\{\frac{\overline{\beta}^2\theta^2}{2c}; b\theta - bm\} \tag{5}$$

This condition states that the expected surplus when an employee θ works in a spinoff is not lower than the expected surplus when he is allocated to a division of the firm or to the core activity. To say it differently, to be credible the spinoff needs to be *ex post*

optimal. When a new idea is developed in a division of the firm the principal is residual claimant and the unit creates the maximum surplus. If the project is developed in a spinoff, the parent firm's incentives to invest are lower and so is the created surplus. Therefore, implementing new ideas in spinoffs is always optimal from *ex ante* but never is from *ex post* prospective.

Lemma 3.

- *If* $b > \overline{b}$ *an employee is allocated to the core activity.*
- *If* $b \leq \overline{b}$ *an employee with a good idea develops it in a division of the firm, an employee with a bad idea works in the core activity.*

If spinoffs are not *ex post* optimal they are not credible and they are not adopted in equilibrium. The principal's internal allocation decision is between the core activity and developing the new idea in a division of the firm. Note that this decision[12] is not affected by the information asymmetry. However the information asymmetry affects the cost related to keeping the employees with good ideas, because the employer now pays an informational rent to the agents with bad ideas.

Since developing new ideas in spinoffs is *ex ante* optimal the principal it is in the principal's interest to find a way to commit not to reallocate agents with good ideas from a spinoff to an internal division. In what follows, I first consider the possibility for the principal to commit to inefficient internal investments thus making the spinoff becoming efficient, then I discuss other mechanisms that make the spinoffs *ex post* efficient.

3.2 Commitment to inefficient internal investments

I assume that the parent firm can *ex ante* commit to inefficient budget rules for new projects developed in internal divisions. To say it differently the firm endogenously increases the cost of the synergy when a new project is developed internally. With this commitment[13] the firm eliminates the risk of reallocating an employee and his idea from

[12]Recall that the focus is on the internal allocation, the decision to keep or not an employee is discussed in Section 4.

[13]Hellmann (2007) offers a different rationale for *ex ante* commitment by the parent firm. In his case the firm commits to not developing innovative projects at all. In a multitasking setting, such commitment

a spinoff to a division of the firm. The non-renegotiation constraint (5) rewrites:

$$(1-\overline{\alpha}^2)\frac{\overline{\beta}^2\theta^2}{2c} \geq b\theta - bm \tag{6}$$

Proposition 1. *If the principal can commit not to finance new ideas in internal divisions then:*

- *If $b > \overline{b}$ an employee is kept in the core activity of the firm.*
- *If $b < \overline{b}$ an employee with a good idea develops it in a spinoff, an employee with a bad idea continues to work in the core activity of the firm.*

In this setting with homogeneous synergy costs, the spinoff is always the most profitable way of implementing new ideas for the parent firm.

In order to simplify the exposition of the following results, and without loss of generality in the remainder of the paper I focus on the cases where the synergy is not too strong[14]:

Assumption 2. $2(\overline{\beta}\theta + B) \geq \dfrac{\overline{\beta}^2\theta^2}{2c}$

Proposition 2. *If $b \leq \overline{b}$, the optimal menu of contracts is:*

$$\begin{cases} \overline{\alpha} = \min\left\{\sqrt{\dfrac{\frac{\overline{\beta}^2\theta^2}{2c} - b\theta + bm}{\frac{\overline{\beta}^2\theta^2}{2c}}}, \dfrac{(1-q)(\overline{\beta}-\underline{\beta})}{(1-q)2(\overline{\beta}-\underline{\beta}) + q\overline{\beta}}\right\} \\ \overline{w} = \overline{\beta}\theta + B - \dfrac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}^2\theta^2}{c} \end{cases}$$

$$\underline{w} = \overline{\beta}\theta + B - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}(\overline{\beta}-\underline{\beta})\theta^2}{c}$$

Since the expected surplus of the spinoff must not be lower than the surplus created by allocating the employee to the core activity, the returns in the core activity may dictate the incentive intensity of an employee's reward in a spinoff. In particular, when the returns in the core activity are high (*i.e.* high b), a higher surplus is needed in the innovative activity, which in turn requires a higher investment by the parent firm.

reduces the employee's incentives to work on the innovative activity and hence increases the effort in the core activity. In his paper the possibility to commit *ex ante* is critical for the existence of spinouts. In the present work, even if the principal cannot commit to a narrow business strategy, other mechanisms (discussed in Section 3.3) can lead to an *ex post* efficiency of the spinoffs and their adoption in equilibrium.

[14]The full solution of the problem is derived in Appendix 8.3.

Hence, for high values of b, the parent firm decreases the performance based reward of the employee (*i.e.* $\overline{\alpha}$ decreases and $\overline{w}$ increases), invests more and the spinoff performs better. The downside is that the agents with bad ideas who work in the core activity capture higher rents. As the firm's performance in the core activity decreases the firm can extract some of these rents and reduce the inefficiency created by the information asymmetry.

3.3 Spinoff creation without *ex ante* commitment

As discussed above, spinoffs are credible as far as they are *ex post* optimal. We saw that the parent firm may endogenously increase the cost of the synergy when a project is developed in a division. Hereafter, I discuss other mechanisms that lead to this optimality and guarantee that spinoffs are credibly adopted in equilibrium.

In order to set aside pure cost considerations at the origin of the principal's organizational choice in implementing the new idea, I have assumed that the cost of the investment is the same independently of whether the idea is developed in a division or a spinoff. However these costs may differ, depending on how diversified is the firm, how close the new idea is to its existing products, whether or not there are complementarities among production processes. In some firms the cost of the internal investment may be lower, in other firms it could be the opposite. In the latter case, if the cost differential is sufficiently high, spinoffs can be *ex post* optimal and hence adopted without *ex ante* commitment. Then, firms with lower internal investment cost would be spawning better performing spinoffs. The intuition is that those firms create higher surplus by developing an idea in a division, and since the profit of the spinoff needs to be higher than or equal to the profit of the division, the parent firm must leave a lower share to the employee, invest more in the spinoff and hence increase its profit.

An alternative source of *ex post* efficiency for the spinoff can arise if the successful implementation of a new idea requires some investment (effort) from both the parent firm and the employee. Then developing the idea in a spinoff and offering a performance based reward to the employee would decrease the parent firm's investment but at the other side it would increase the employee's effort. Depending on the relative importance of the efforts for the success of the idea, the surplus created by the spinoff could exceed the one

of developing the idea in a division. This implies that when the relative importance of the employee's effort is higher the idea is more likely to be developed in a spinoff.

It is worth noting that in these two cases, spinning off the development of an idea increases the profits of both the innovative and the core activity.

4 Spin-outs

I now analyze the principal's decision to keep or not an employee, first in the innovative and then in the non-innovative regime.

4.1 Innovative regime and spin-outs creation

The expected profit[15] of the parent firm when the agent's idea is developed in a spinoff is:

$$\Pi^{spin} = q\Big(\frac{(1-\overline{\alpha})^2\overline{\beta}^2\theta^2}{2c} - \overline{w} + bm\Big) + (1-q)(b\theta - \underline{w}) \tag{7}$$

where $\overline{\alpha}$, $\overline{w}$ and $\underline{w}$ are as defined in Proposition 2.

Keeping the employees with good ideas comes at a cost, namely increased wages for all employees. Therefore, letting the employees with good ideas leave and create spin-outs, may be beneficial for the parent firm. The principal's payoff in this case writes:

$$\Pi^{star} = qbm + (1-q)(b\theta - \underline{\beta}\theta - B) \tag{8}$$

Proposition 3. *In the innovative regime ($b \leq \overline{b}$):*

i) If $q \leq \tilde{q}$ (where $\tilde{q} \equiv \dfrac{(\overline{\beta}-\underline{\beta})\theta(1-\overline{\alpha}(1-\overline{\alpha})\frac{\overline{\beta}\theta}{c})}{\frac{(1-\overline{\alpha})^2\overline{\beta}^2\theta^2}{2c} + \overline{\alpha}(1-\overline{\alpha})\frac{\overline{\beta}\underline{\beta}\theta^2}{c} - \underline{\beta}\theta - B}$) the agents with good ideas leave the firm and develop their ideas in independent units (spin-outs).

ii) If $q > \tilde{q}$ the good ideas are developed in spinoffs.

[15] The expected profit when good ideas are developed in divisions of the firm is a special case for $\overline{\alpha} = 0$

Developing an employee's idea internally creates an extra profit at the cost of increasing the wages of the employees with bad ideas. The benefit from keeping an employee with a good idea is $q\Big(\frac{(1-\overline{\alpha}^2)(\overline{\beta}\theta)^2}{2c} - \overline{\beta}\theta - B\Big)$, and the additional cost is $(1-q)\theta(\overline{\beta}-\underline{\beta})\Big(1 - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}\Big)$. When the fraction of good ideas is low the cost exceeds the benefit and the parent firm is better off if the employees with good ideas leave. As a result, spin-outs are more likely in environments where the probability for an employee to have a good idea is low. This probability may depend on the employee's characteristics, on the organizational and managerial choices of the employer, and on the characteristics of the activity and will be further discussed in Section 5. The level of returns (b) in the core activity of the parent firm affects the threshold value $\tilde{q}$ and hence the likelihood of spin-out creation.

Proposition 4. *The threshold value $\tilde{q}$ below which employees with good ideas leave the firm increases with the returns to talent in the core activity (b).* $\dfrac{\partial \tilde{q}}{\partial b} \geq 0$

The consequence of this result is that firms with higher returns in the core activity are more likely to breath spin-outs. The intuition is the following. For high values of b, the parent firm decreases the performance based reward of the employee (*i.e.* offers a contract with a lower α). This makes the innovative activity more attractive for the employees with bad ideas and requires a higher wage to keep them away from it. Therefore the cost of keeping the good ideas is higher. As b decreases, α becomes higher, the rent of the employees with bad ideas decreases and so does the cost of keeping the employees with good ideas. Hence, spin-outs become less likely.

Note as well that the threshold is not the same for employees with different managerial ability θ. In particular, it is lower for more talented agents. This implies that for a given fraction of good ideas, an employee with a lower managerial talent is more likely to develop his idea in a spin-out.

4.2 Non-innovative regime and spin-outs creation

Let us now turn to the principal's decision to keep an employee in the core activity or let him leave the firm and develop his idea. The comparison of the principal's profit when all employees are allocated to the core activity Π^c (equation 1) and the profit when

the employees with good ideas create spin-outs Π^{star} (equation 8) leads to the following condition.

Proposition 5. *In the non innovative regime ($b > \overline{b}$):*

i) If $q \leq \hat{q}$ (where $\hat{q} = \dfrac{(\overline{\beta} - \underline{\beta})\theta}{b\theta - \underline{\beta}\theta - B - bm}$), the employees with good ideas leave the firm and create spin-outs.

ii) If $q > \hat{q}$ the agents with good ideas continue to work in the core activity of the firm.

The gain from keeping the employee is the profit differential in the core activity between an insider and an outsider $q(b\theta - \overline{\beta}\theta - B - bm)$, the cost is the increased wage for the agents with bad ideas $(1-q)(\overline{\beta} - \underline{\beta})\theta$. As before, a lower fraction of good ideas increases the costs, decreases the benefits, and makes the spin-out creation more likely. Therefore, ideas that are not good enough compared to the core activity of the parent firm and would not be developed if the information was symmetric are now developed in spin-outs. There is excessive innovation, compared to the first best.

Proposition 6. *The threshold $\hat{q}$ below which the employees with good ideas leave the firm decreases with the return to talent in the core activity, $\dfrac{\partial \hat{q}}{\partial b} \leq 0$.*

For higher returns in the core activity, the benefit of keeping an insider are higher and spin-outs become less likely. Therefore, in the non innovative regime, firms that perform better in their core activity have a lower likelihood of creating spin-outs.

As in the innovative regime, the threshold value $\hat{q}$ changes for employees with different θ, it decreases with the employee's managerial talent. In both cases the employees with higher ability are more likely to continue working for the parent employer rather than creating a spin-out.

4.3 Parent firm performance and the survival rate of spin-outs

The returns in the core activity affect not only the likelihood of spin-out creation but also the average survival rate of the new ventures. To illustrate this point, I assume that the mass of employees have different commonly known abilities, distributed on the support $[\underline{\theta}, \overline{\theta}]$ ($\underline{\theta}$ and $\overline{\theta}$ are such that the Assumptions 1 and 2 hold).

Since $\tilde{q}$ and $\hat{q}$ decrease with θ, for a given fraction of good ideas there exist thresholds $\tilde{\theta}$ (for $b \leq \overline{b}$) and $\hat{\theta}$ (for $b > \overline{b}$), such that the employees with ability below the thresholds develop their good ideas in spin-outs.

Proposition 7.

i) *For $b \leq \overline{b}$, the threshold of talent below which employees with good ideas leave the firm decreases with b.*

i) *For $b > \overline{b}$, the threshold of talent below which employees with good ideas leave the firm increases with b.*

The impact of the returns in the core activity on those thresholds is non-monotone. In the non innovative regime: as the returns in the core activity decrease, the fraction of spin-outs increases and hence the average quality of the spin-outs created. In this case firms with higher returns in the core activity spawn spin-outs with a lower survival rate. In the innovative regime, a decrease of b reduces the fraction of spin-outs and the average ability of the employees who leave the firm decreases. In the innovative regime the spin-outs of firms with higher performance in the core activity have a higher average probability of success.

5 Discussion

5.1 Main findings of the paper

Before relating the results of the paper to the existing empirical evidence I summarize below the main findings.

1. Developing new ideas in relation with the parent firm requires an increase of the overall wages and the payment of informational rents to the employees with bad ideas. Implementing a project in a spinoff rather than a division of the firm allows the parent firm to decrease the informational rents.

2. By decreasing the informational rents for the employees with bad ideas, the development of new projects in spinoffs improves the efficiency of the core activity.

3. Firms with higher returns in their core activity create better performing spinoffs.

4. Allowing the employees with good ideas to leave the firm and create spin-outs may be profitable for the parent employer if the cost due to the increased wages of the employees with bad ideas is too high compared to the benefit of developing the employee's idea in a division or a spinoff.

5. Spin-outs are more likely when the fraction of good ideas is small.

6. Employees with higher ability are more likely to stay with the parent firm.

7. There is a non-monotone relationship between the returns in the core activity and the likelihood and quality of spin-out creation:

   - In the non-innovative regime: as the returns in the core activity decrease the likelihood of spin-out creation becomes higher, and the average survival rate of the spin-outs increases.

   - In the innovative regime: firms with higher returns in the core activity are more likely to spawn spin-outs, and the average survival rate of the spin-outs is higher.

5.2 Empirical observations

In recent years the growing interest about the origins of new ventures has translated into an increasing number of empirical studies on spinoffs and spin-outs. A particular attention has been devoted to tracing the new ventures and their parents, in order to analyze the rate at which firms spawn new ventures in the same industry and how the performance of the spawned units relates to the performance of the parent firm.

On the first point, papers applied to the automobile (Klepper 2007), disk-drive (Agarwal et al. 2004), and lasers (Klepper and Sleeper 2005) industry show that better performing firms are more likely to spawn spin-outs. This paper offers a theoretical rationale for the link between the performance of the parent firm and the likelihood of spin-out

creation. It shows that the link is not monotone and depends on whether new ideas are valuable enough compared to the core activity of the firm. However, this does not contradict the empirical evidence since it is shown that in fast changing environments where the innovation is sufficiently valuable a better performing parent firm is more likely to spawn new ventures.

Klepper and Sleeper (2005) show that in the laser industry spawning of new ventures is most likely when the firms reach middle age, *i.e.* the spawning likelihood first increases and then decreases over the firm's life-cycle. If we consider that the rents of the firm in its core activity decrease over its life cycle then the theoretical result of the model that the link between performance and spawning of new ventures is non monotone is in line with this empirical finding.

Agarwal et al. (2004) explore the idea of knowledge transmission from the parent employer to their spin-outs and in particular the impact of the parent firm's know how on the likelihood of spin-out creation. They distinguish between technological know how and market pioneering know how, and find that in the disc drive industry, firms that are strong in both types of know how generate fewer external ventures than those that are strong only in one of them. Even though the present paper does not explicitly model a knowledge transmission mechanism, it can be interpreted in that sense. At one side, the quality distribution of the employees' ideas can be affected by the technological know how of the parent firm. Employees working for a firm with a strong technological know how might be more likely to come up with a 'good' idea (*i.e.* in such firms q is higher). At the other side, as mentioned in the presentation of the model, the employee's managerial talent at least partially results from acquiring some firm specific human capital. Employees acquire[16] a higher ability to manage ideas, in firms with stronger market know how. With this reinterpretation of the model, the theoretical predictions are consistent with the empirical findings. Indeed, firms where both talents are high (*i.e.* both θ and q are high) are less likely to spawn new ventures than those where one of the talents is high and the other low.

Concerning the link between the performance of the parent firm and its spawned units, the paper shows that when the innovation is sufficiently valuable then better performing

[16]In Franco and Filson (2006), the employee learns the employer's know how with some probability.

parent employers spawn spinoffs and spin-outs that are more likely to be successful. This is consistent with the evidence for automobiles, semiconductors and disk drives, where better performing parent firms spawn better performing new ventures.

Finally, this paper is also related to the literature studying what drives a firm's decision to keep and develop an activity internally or to spin it off and how this would affect the value of the parent firm and of the spined-off activity. There is substantial evidence of a positive stock price reaction around the announcement of a spinoff[17]. Academics have discussed various explanations for these abnormal returns. Among the reasons provided there is elimination of negative synergies, tax advantages, improved focus, or mitigates the information asymmetry of the market[18]. This paper shows that spinoffs allow the firm to mitigate internal information asymmetry problems, hence improving the performance of the parent firm's core activity and possibly the performance of the spined-off unit[19]. Ahn and Denis (2004) show that spinoffs allow to increase investment efficiency of the pair parent firm plus spinoff and that this increased efficiency at least partially explains the increase in firm value observed at the spinoff announcement.

6 Conclusion

This paper offered a theoretical explanation of two related questions, what drives inefficient start-ups and what are the trade-offs a firm faces when deciding to develop an activity in an internal division or in a spinoff. It showed that the performance of the firm in its core activity affects both the likelihood of spin-out creation and the performance of spin-outs and spinoffs. In particular, in environments where innovation is valuable, firms with higher returns in their core activity are more likely to spin-out new ventures and both their spin-outs and spinoffs are more successful.

The paper focuses on the stage where new ideas are implemented, thus abstracting from the innovation stage that precedes the development and the post development interaction between the parent firm's activity and the new ventures, spinoffs or spin-outs.

[17]See for example Schipper and Smith (1983), Daley et al. (1997), Desai and Jain (1999) and Krishnaswami and Subramanian (1999) among others.

[18]There is an information asymmetry about teh value of the firm between the firm and the investors.

[19]See Section 3.3.

Naturally those three are not independent and a closer look to the interaction would bring interesting insights. In particular, investigating the *ex post* interaction between the core activity of the parent firm and the innovative activity would at one side affect the development decision and at the other provide a better understanding of intra-industry dynamics.

7 References

Agarwal, R., R. Echambadi, A. Franco, and MB. Sarkar, (2004), "Knowledge Transfer through Inheritance: Spin-out Generation, Growth, and Survival", *Academy of Management Journal*, vol. 47(4), pp. 501-522

Ahn, S. and D. Denis, (2004), "Internal capital markets and investment policy: evidence from corporate spinoffs", *Journal of Financial Economics*, vol. 71, pp. 489-516

Amador, M., and A. Landier, 2003, "Entrepreneurial Pressure and Innovation", Mimeo, Stern School of Business

Anton, J., and D. Yao, (1995), "Start-ups, Spin-offs, and Internal Projects", *Journal of Law, Economics and Organization*, vol. 11(2), pp. 362-378.

Aron, D. (1991), "Using the Capital Market as a Monitor: Corporate Spinoffs in an Agency Framework", *Rand Journal of Economics*, vol. 22(4), pp. 505-518

Bankman, J. and R. Gillson (1999), "Why Start-ups?", *Stanford Law Review*, vol. 51, pp. 289-308.

Benz, M. and B. Frey (2008), "Being Independent is a Great Thing: Subjective Evaluations of Self-Employment and Hierarchy", *Economica*, vol. 75, pp. 362–383

Bhide, A. (1994), "How entrepreneurs craft strategies that work", *Harvard Business Review*, vol. March-April, pp. 150-161.

Blanchflower, D. (2000), "Self-employment in OECD countries", *Labour Economics*, vol. 7, pp. 471-505

Blanchflower, D. and A. Oswald (1998), "What Makes an Entrepreneur?", *Journal of Labor Economics*, vol. 16, pp. 26-60

Blanchflower, D., A. Oswald and A. Stutzer (2001), *Latent Entrepreneurship across Nations*, *European Economic Review*, vol. 45, pp. 680-691.

Cassiman, B. and M. Ueda, (2006),"Optimal Project Rejection and New Firm Start-Ups", *Management Science*, vol. 52, pp. 262-275

Daley, L., Mehrotra, V., and R. Sivakumar, (1997), "Corporate focus and value creation: evidence from spin-offs", *Journal of Financial Economics*, vol. 45, pp. 257-281

Desai, H. and P. Jain, (1999), "Firm performance and focus: long-run stock market performance following spin-offs", *Journal of Financial Economics*, vol. 54, pp. 75-101

Franco, A., and D. Filson (2006), "Spin-outs: Knowledge Diffusion through Employee Mobility", *Rand Journal of Economics*, vol. 37, pp. 841-860

Gompers, P., J. Lerner, and D. Scharfstein (2005), "Entrepreneurial Spawning: Public Corporations and the Genesis of New Ventures: 1986-1999", *The Journal of Finance*, vol. 60(2), pp. 577-614.

Hamilton, B. (2000), "Does Entrepreneurship Pay? An Empirical Analysis of Returns to Self-Employment", *Journal of Political Economy*, vol. 108, pp. 604-632

Hellmann, T (2007), "When Do Employees Become Entrepreneurs?", *Management Science*, vol. 53, pp. 919-933

Holmes, J. and J. A. Schmitz, (1996), "Managerial Tenure, Business Age, and Small Business Turnover", *Journal of Labor Economics*, vol. 14, pp. 79-99

Klepper, S. (2007), "Disagreements, Spinoffs, and the Evolution of Detroit as the Capital of the U.S. Automobile Industry", *Management Science*, vol. 53(4), pp. 616-631

Klepper, S. and S. Sleeper, (2005), "Entry by Spin-offs", *Management Science*, vol. 51(8), pp. 1291-1306

Krishnaswami, S. and V. Subramaniam, (1999), "Information asymmetry, valuation, and the corporate spin-off decision", *Journal of Financial Economics*, vol. 53 , pp. 73-112

Lazear, E. (2005), "Entrepreneurship", *Journal of Labor Economics*, vol. 23, pp. 649-680.

Nanda, V. and M.P. Narayanan, (1999), "Disentangling Value: Financing Needs, Firm Scope and Divestitures", *Journal of Financial Intermediation*,

vol. 8, pp. 174-204.

Pakes, A. and S. Nitzan, (1983), "Optimum Contract for Research Personnel, Research Employment and Establishment of Rival Enterprises", *Journal of Labor Economics*, vol. 1(4), pp. 345-365.

Schipper, K. and A. Smith, (1983), "Effects of recontracting on shareholder wealth: the case of voluntary spin-offs", *Journal of Financial Economics*, vol. 12, pp. 437-467

8 Appendix

8.1 Proof of Lemma 1

By assumption it is optimal to always allocate the agents with bad ideas to the core activity of the firm. The expected profit from allocating an employee with a good idea to the core activity is: $\pi^c = b\theta - \overline{\beta}\theta - B$, the expected profit if the employee's idea is developed in a division of the firm is: $\pi^d = \dfrac{\overline{\beta}^2\theta^2}{2c} - \overline{\beta}\theta - B + bm$. The threshold value of Lemma 1 obtains for $\pi^c = \pi^d$.

8.2 Proof of Lemma 2

The principal maximizes the profit:

$$\max_{\overline{\alpha},\overline{w},\underline{w},S} \Pi = q(bm + (1-\overline{\alpha})\overline{\beta}\theta S - \overline{w} - \frac{cS^2}{2}) + (1-q)(b\theta - \underline{w}) \tag{9}$$

subject to

$$\begin{cases} \overline{\alpha}\overline{\beta}S\theta + \overline{w} \geq \overline{\beta}\theta + B & \overline{IR} \\ \underline{w} \geq \underline{\beta}\theta + B & \underline{IR} \\ \overline{\alpha}\overline{\beta}S\theta + \overline{w} \geq \underline{w} & \overline{IC} \\ \underline{w} \geq \overline{\alpha}\underline{\beta}S\theta + \overline{w} & \underline{IC} \\ (1-\overline{\alpha})\overline{\beta}\theta - cS = 0 & IC_P \\ \underline{w} \geq 0, \overline{w} \geq 0 & LL \end{cases} \tag{10}$$

S is given by the principal's incentive compatibility constraint (IC_P):

$$S = \frac{(1-\overline{\alpha})\overline{\beta}\theta}{c} \tag{11}$$

A higher $\underline{w}$ decreases the profit and makes the $\overline{IC}$ constraint more difficult to satisfy. The principal chooses the lowest possible $\underline{w}$, satisfying $\underline{IR}$ and $\underline{IC}$.

$\overline{IC}$ rewrites:

$$\overline{\alpha}\overline{\beta}\theta S + \overline{w} \geq \max\{\underline{\beta}\theta + B, \overline{\alpha}\underline{\beta}\theta S + \overline{w}\}$$

If $\overline{IR}$ holds, then the inequity above is always satisfied.

If the binding constraint is $\underline{IR}$, *i.e.* $\underline{w} = \underline{\beta}\theta + B$, then the profit is decreasing with respect to $\overline{\alpha}$ and the principal offers $(\overline{\alpha} = 0, \overline{w} = \overline{\beta}\theta + B)$. However with a menu of contracts $(\overline{\alpha} = 0, \overline{w} = \overline{\beta}\theta + B, \underline{w} = \underline{\beta}\theta + B)$ does not satisfy $\underline{IC}$. Hence there is no a menu contracts where $\underline{IR}$ is binding and $\underline{IC}$ is satisfied. $\underline{IC}$ is the binding constraint.

The simplified program writes:

$$\max_{\overline{\alpha},\overline{w}} \Pi = q(bm + (1-\overline{\alpha})^2 \frac{\overline{\beta}^2\theta^2}{2c} - \overline{w}) + (1-q)(b\theta - \overline{w} - \overline{\alpha}(1-\overline{\alpha})\frac{\overline{\beta}\underline{\beta}\theta^2}{c}) \tag{12}$$

subject to

$$\begin{cases} \overline{\beta}\theta + B - \overline{\alpha}(1-\overline{\alpha})\dfrac{\overline{\beta}^2\theta^2}{c} - \overline{w} \leq 0 & \overline{IR} \\ -\overline{w} \leq 0 & LL \end{cases} \tag{13}$$

The resulting optimal contract is:

- $\overline{\alpha} = \min\left\{\dfrac{(\overline{\beta}-\underline{\beta})(1-q)}{2(1-q)(\overline{\beta}-\underline{\beta}) + q\overline{\beta}}, \left(\dfrac{1}{2} - \dfrac{1}{2}\sqrt{1 - \dfrac{4(\overline{\beta}\theta + B)}{\frac{\overline{\beta}^2\theta^2}{c}}}\right)\right\}$
- $\overline{w} = \max\left\{0, \overline{\beta}\theta + B - \overline{\alpha}(1-\overline{\alpha})\dfrac{\overline{\beta}^2\theta^2}{c}\right\}$

$4(\overline{\beta}\theta + B) \geq \dfrac{\overline{\beta}^2\theta^2}{c}$ (*i.e.* the condition of Assumption 2) is a sufficient condition under which the optimal contract is $\left(\overline{\alpha} = \dfrac{(\overline{\beta}-\underline{\beta})(1-q)}{2(1-q)(\overline{\beta}-\underline{\beta}) + q\overline{\beta}}, \overline{w} = \overline{\beta}\theta + B - \overline{\alpha}(1-\overline{\alpha})\dfrac{\overline{\beta}^2\theta^2}{c}\right)$

8.3 Proof of Proposition 2

The principal maximizes the following programme:

$$\max_{\overline{\alpha},\overline{w},\underline{w},S} \Pi = q(bm + (1-\overline{\alpha})\overline{\beta}\theta S - \overline{w} - \frac{cS^2}{2}) + (1-q)(b\theta - \underline{w}) \tag{14}$$

subject to

$$(15)\qquad \begin{cases} \overline{\alpha}\overline{\beta}S\theta + \overline{w} \geq \overline{\beta}\theta + B & \overline{IR} \\ \underline{w} \geq \underline{\beta}\theta + B & \underline{IR} \\ \overline{\alpha}\overline{\beta}S\theta + \overline{w} \geq \underline{w} & \overline{IC} \\ \underline{w} \geq \overline{\alpha}\underline{\beta}S\theta + \overline{w} & \underline{IC} \\ (1-\overline{\alpha})\overline{\beta}\theta - cS = 0 & IC_P \\ S\overline{\beta}\theta - \frac{cS^2}{2} \geq b\theta - bm & RP \\ \underline{w} \geq 0, \overline{w} \geq 0 & LL \end{cases}$$

RP is the renegotiation proof constraint.

$$(16)\qquad \max_{\overline{\alpha},\overline{w}} \Pi = q(bm + (1-\overline{\alpha})^2\frac{\overline{\beta}^2\theta^2}{2c} - \overline{w}) + (1-q)(b\theta - \overline{w} - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\underline{\beta}\theta^2}{c})$$

subject to

$$(17)\qquad \begin{cases} \overline{\alpha}(1-\overline{\alpha})\frac{\overline{\beta}^2\theta^2}{c} + \overline{w} \geq \overline{\beta}\theta + B & \overline{IR} \\ \frac{(1-\overline{\alpha}^2)\overline{\beta}^2\theta^2}{2c} \geq b\theta - bm & RP \\ \overline{w} \geq 0 & LL \end{cases}$$

The optimal contract is:

$$\overline{\alpha} = \min\Big\{\sqrt{1 - \frac{b\theta - bm}{\frac{\overline{\beta}^2\theta^2}{2c}}}, \frac{(1-q)(\overline{\beta} - \underline{\beta})}{(1-q)2(\overline{\beta} - \underline{\beta}) + q\overline{\beta}}, \frac{1}{2}\Big(1 - \sqrt{1 - \frac{4(\overline{\beta}\theta + B)}{\frac{\overline{\beta}^2\theta^2}{c}}}\Big)\Big\}$$

$$\overline{w} = \max\Big\{0, \overline{\beta}\theta + B - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}^2\theta^2}{c}\Big\}$$

8.4 Proof of Proposition 3

The threshold value is obtained from the comparison of the expected profit of the parent firm when the good ideas are developed in spin-outs:

$$(18)\qquad \Pi^{star} = qbm + (1-q)(b\theta - \underline{\beta}\theta - B)$$

and the expected profit when developed in spinoffs:

$$(19)\quad \Pi^{spin} = q(bm + (1-\overline{\alpha}^2)\frac{\overline{\beta}^2\theta^2}{2c} - \overline{\beta}\theta - B) + (1-q)(b\theta - \overline{\beta}\theta - B + \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}(\overline{\beta}-\underline{\beta})\theta^2}{c})$$

where $\overline{\alpha}$ is as defined in Proposition 2.

8.5 Proof of Proposition 5

The threshold value is obtained from the comparison of the expected profit of the parent firm when the good ideas are developed in spin-outs:

$$(20)\qquad \Pi^{star} = qbm + (1-q)(b\theta - \underline{\beta}\theta - B)$$

and the expected profit when the employees with good ideas continue to work in the core activity:

$$(21)\qquad \Pi^{c} = b\theta - \overline{\beta}\theta - B$$

8.6 Proofs of Propositions 4 and 6

Proof that $\frac{\partial \tilde{q}}{\partial b} \geq 0$ $\tilde{q}$ is given by the following condition:

$$(22)\qquad \Pi^{spin} = \Pi^{star}$$

This after simplification rewrites as follows:

$$(23)\qquad q(1-\overline{\alpha}^2)\frac{\overline{\beta}^2\theta^2}{2c} + (1-q)\frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}(\overline{\beta}-\underline{\beta})\theta^2}{c} = (1-q)(\overline{\beta}-\underline{\beta})\theta + q(\overline{\beta}\theta + B)$$

Both sides of this equation are linear and increasing with respect to q, indeed:

$$(24)\qquad \begin{aligned} \frac{\partial LHS}{\partial q} &= \frac{\overline{\beta}\theta^2}{2c}(\overline{\beta}(1-\overline{\alpha})^2 + 2\overline{\alpha}(1-\overline{\alpha})\underline{\beta}) \\ &> 0 \end{aligned}$$

$$\frac{\partial RHS}{\partial q} = \underline{\beta}\theta + B > 0 \tag{25}$$

For $q = 0$ $RHS > LHS$, for $q = 1$ $RHS < LHS$.

For a given q, if b changes it affects $\overline{\alpha}$, when $\overline{\alpha} = \sqrt{\frac{\frac{\overline{\beta}^2\theta^2}{2c} - b\theta + bm}{\frac{\overline{\beta}^2\theta^2}{2c}}}$ and hence affects the LHS of equation (23).

$$\frac{\partial \overline{\alpha}}{\partial b} < 0$$

$$\frac{\partial LHS}{\partial \overline{\alpha}} = -\frac{\overline{\alpha}\overline{\beta}^2\theta^2 q}{c} + (1-q)\frac{(1-2\overline{\alpha})\overline{\beta}(\overline{\beta} - \underline{\beta})\theta^2}{2} \tag{26}$$

Hence $\frac{\partial LHS}{\partial \overline{\alpha}} > 0$ if $\overline{\alpha} < \frac{(1-q)(\overline{\beta} - \underline{\beta})}{2(1-q)(\overline{\beta} - \underline{\beta}) + q\overline{\beta}}$. Since $\overline{\alpha} = \min\{\sqrt{\frac{\frac{\overline{\beta}^2\theta^2}{2c} - b\theta + bm}{\frac{\overline{\beta}^2\theta^2}{2c}}}, \frac{(1-q)(\overline{\beta} - \underline{\beta})}{2(1-q)(\overline{\beta} - \underline{\beta}) + q\overline{\beta}}\}$, and I consider the case where $\overline{\alpha} = \sqrt{\frac{\frac{\overline{\beta}^2\theta^2}{2c} - b\theta + bm}{\frac{\overline{\beta}^2\theta^2}{2c}}}$, then $\frac{\partial LHS}{\partial \overline{\alpha}} > 0$ and $\frac{\partial LHS}{\partial b} = \frac{\partial LHS}{\partial \overline{\alpha}}\frac{\partial \overline{\alpha}}{\partial b} < 0$. From Figure 1, it is immediate to see that an increase of b increases $\tilde{q}$, *i.e.* spin-outs become more likely.

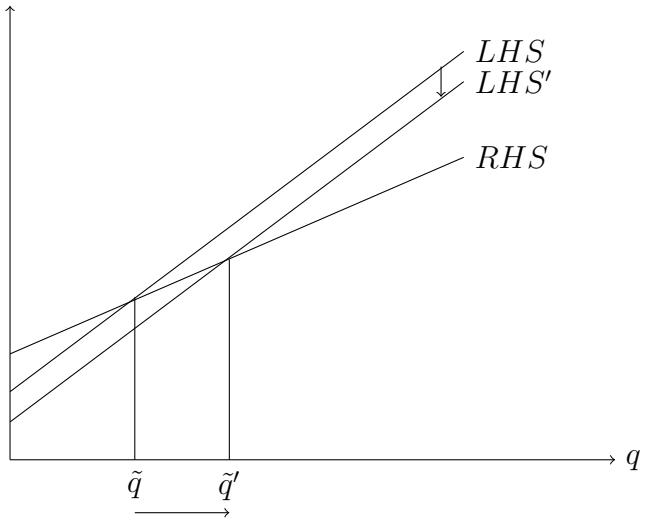

Figure 1: Impact of b on $\tilde{q}$

If $\overline{\alpha} = \frac{(1-q)(\overline{\beta} - \underline{\beta})}{2(1-q)(\overline{\beta} - \underline{\beta}) + q\overline{\beta}}$, $\overline{\alpha}$ does not depend on b, and $\frac{\partial \tilde{q}}{\partial b} = 0$.

Proof that $\dfrac{\partial \hat{q}}{\partial b} < 0$

$$\hat{q} = \frac{(\overline{\beta} - \underline{\beta})\theta}{b\theta - \underline{\beta}\theta - B - bm}$$

Since $b\theta > bm$, it is immediate to see that $\dfrac{\partial \hat{q}}{\partial b} < 0$.

8.7 Proof of proposition 7

Proof that $\dfrac{\partial \tilde{\theta}}{\partial b} \geq 0$

$$\frac{d\tilde{q}}{d\theta} = \frac{\partial \tilde{q}}{\partial \theta} + \frac{\partial \tilde{q}}{\partial \overline{\alpha}} \frac{\partial \overline{\alpha}}{\partial \theta} \tag{27}$$

As shown in Section 8.6, $\dfrac{\partial \tilde{q}}{\partial \overline{\alpha}} \leq 0$. Since $\dfrac{\partial \overline{\alpha}}{\partial \theta} \geq 0$, $\dfrac{\partial \tilde{q}}{\partial \overline{\alpha}} \frac{\partial \overline{\alpha}}{\partial \theta} \leq 0$

$$\begin{aligned} \frac{\partial \tilde{q}}{\partial \theta} \propto \ & \Big(1 - \frac{2\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}\Big)\Big(\frac{(1-\overline{\alpha})^2(\overline{\beta}\theta)^2}{2c} + \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\underline{\beta}\theta^2}{c} - \underline{\beta}\theta - B\Big) \\ & -\Big(\theta - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta^2}{c}\Big)\Big(\frac{(1-\overline{\alpha})^2\overline{\beta}^2 2\theta}{2c} + \frac{2\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\underline{\beta}\theta}{c} - \underline{\beta}\Big) \end{aligned} \tag{28}$$

After simplification:

$$\frac{\partial \tilde{q}}{\partial \theta} = \frac{(\overline{\beta} - \underline{\beta})\Big(-B - \frac{(1-\overline{\alpha})^2(\overline{\beta}\theta)^2}{2c} + \frac{2\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}B\Big)}{\Big(\frac{(1-\overline{\alpha})^2(\overline{\beta}\theta)^2}{2c} + \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\underline{\beta}\theta^2}{c} - \underline{\beta}\theta - B\Big)^2} \tag{29}$$

The sign of the derivative depends on the sign of
$\Big(-B - \dfrac{(1-\overline{\alpha})^2(\overline{\beta}\theta)^2}{2c} + \dfrac{2\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}B\Big)$.

From the renegotiation proof constraint (RP) and condition (iii) of Assumption 1:

$$\frac{(1-\overline{\alpha})^2(\overline{\beta}\theta)^2}{2c} \geq \overline{\beta}\theta + B - \frac{\overline{\alpha}(1-\overline{\alpha})(\overline{\beta}\theta)^2}{c}$$

It follows that:

$$\begin{aligned} -B - \frac{(1-\overline{\alpha})^2(\overline{\beta}\theta)^2}{2c} + \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}B &\leq -B - \overline{\beta}\theta - B + \frac{\overline{\alpha}(1-\overline{\alpha})(\overline{\beta}\theta)^2}{c} + \frac{2\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}B \\ &\leq -\overline{\beta}\theta(1 - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}) - 2B(1 - \frac{\overline{\alpha}(1-\overline{\alpha})\overline{\beta}\theta}{c}) \\ &\leq 0 \end{aligned}$$

This implies that $\dfrac{\partial \tilde{q}}{\partial \theta} < 0$.

The threshold value $\tilde{q}$ decreases with θ. So for a given q, there is a value $\tilde{\theta}$, given by $q = \tilde{q}(\tilde{\theta})$ (see Figure 2), such that the employees with good ideas and ability $\theta \leq \tilde{\theta}$ leave the firm and create spin-outs, while those with ability $\theta > \tilde{\theta}$ work in spinoffs.

As shown in Section 8.6, for a given θ, if b increases $\tilde{q}$ increases. As illustrated on Figure 2, a higher b shifts $\tilde{q}$ to $\tilde{q}'$ and hence increases the threshold value $\tilde{\theta}$. The consequence of this is that the expected ability of those who leave the firm is higher.

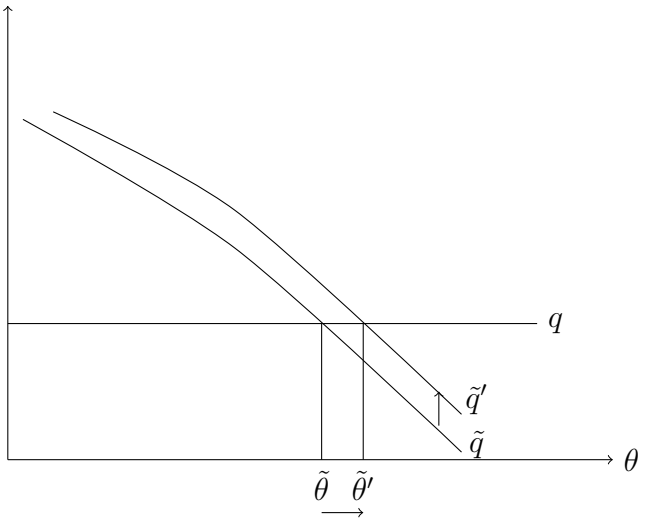

Figure 2: Impact of b on $\tilde{\theta}$

Proof that $\dfrac{\partial \hat{\theta}}{\partial b} \geq 0$

$$\frac{\partial \hat{q}}{\partial \theta} = \frac{-\underline{\beta}\theta - B - bm}{(b\theta - \underline{\beta}\theta - B - bm)^2}(\overline{\beta} - \underline{\beta}) < 0 \tag{30}$$

For a given q, there is a value $\hat{\theta}$, given by $q = \hat{q}(\hat{\theta})$, such that employees with good ideas and ability $\theta \leq \hat{\theta}$ create spin-outs, while those with ability $\theta > \hat{\theta}$ continue to work in the

core activity of the parent firm.

As shown in Section 8.6, for a given θ, if b increases $\hat{q}$ decreases. From the graph below, this decreases $\hat{\theta}$

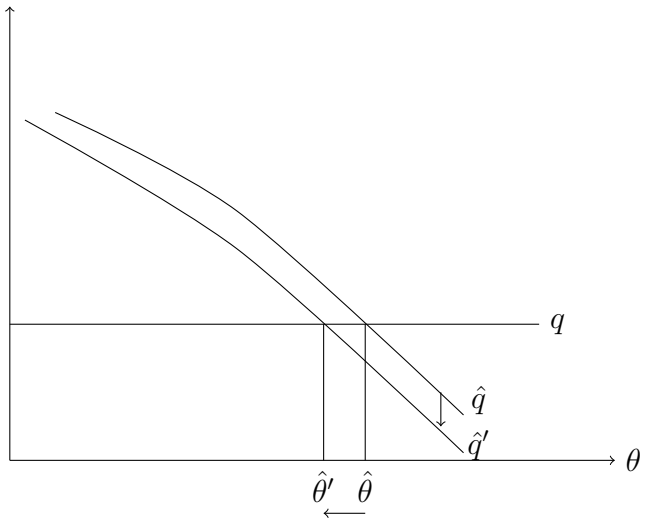

Figure 3: Impact of b on $\hat{\theta}$