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by Martin Ruckes, Thomas Rønde

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# Dynamic Incentives in Organizations: Success and Inertia

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## Abstract

We present a dynamic model in which an employee of a firm searches for business projects in a changing environment. It is costly to induce the employee who found a successful project in the past period to search for a new project. Past success can therefore result in profit-reducing corporate inertia. Still, when the firm chooses to counteract the reluctance to search by increasing the power of the incentives, it stimulates initial search efforts and results in higher profits. Corporate restructuring and increasing the employee's authority over time are means to alleviate inertia but may undermine initial search incentives.

**JEL Codes:** *L2, M12, M54, O31, O32.*

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# 1 Introduction

Innovation is a main source of competitive advantage and a key determinant of survival in many industries. Innovation may, however, require costly adjustments within the organization, and it may therefore be difficult to motivate employees to embrace change and actively pursue innovation (Henderson and Clark, 1990; Henderson 1993). Empirical evidence suggests that successful firms are particularly prone to maintaining the status quo for too long, and that they thereby miss out on new business opportunities; see Chesbrough, 2003, and the references cited therein.

In this paper we develop a simple dynamic principal-agent model to analyze the tension between success and innovation. In the first period a firm hires an employee to search for and implement an innovation, that we will call a “project.” If the employee does not find a profitable project, she will search again for a project in the second period. The situation is different if the employee finds a successful project in the first period. Then, if there is a non-negligible probability that the first-period project will continue to be successful, she will be reluctant to invest effort in searching for a new project. Thus, success represents an obstacle to innovation caused by moral hazard. This is consistent with the argument in the organization literature that past investments in current competencies prevent firms from adopting competence-destroying innovations (Leonard-Barton, 1992; Levinthal and March, 1993; Tushman and Anderson, 1986).

An example of the type of problem that we address in this paper is provided by Tripsas and Gavetti (2000), who give a detailed account of Polaroid’s difficulties in the transition from analog to digital imaging. By the 1970s Polaroid had developed a very profitable instant photography business centered on three core ideas: i) long-term and large-scale R&D projects, ii) the value of paper prints and high picture quality, and iii) third-degree price discrimination, where cameras were sold cheaply and complementary prints were expensive. This business model turned out to be ill-suited for the digital imaging business, which is characterized by rapid innovation cycles, profit margins on cameras rather than prints, and consumers who place limited value on the superior quality and tangible nature of a conventional photo. While the management at Polaroid invested heavily in digital technology, they refused to change the underlying business model based on the three core ideas. This led to a near-failure of the company’s digital imaging business, and it took until 1998 for Polaroid to radically change its strategy. Apparently, the change came too late: on October 11, 2001, Polaroid Corporation filed for Chapter 11 bankruptcy protection and almost all of the company’s assets were sold off. It is, of course, unclear whether Polaroid would

have ever been able to successfully make the transition to digital imaging, but the management's reluctance to give up the existing business model and search for one better suited to the new environment certainly added to Polaroid's difficulties.

While the causes of inertial tendencies in successful firms have been studied extensively, there is very little work on the role of economic incentives in facilitating change. Indeed, Kaplan and Henderson (2005) argue that the organization literature and the economics literature on incentives belong to different domains and that bringing them together represents an important challenge. We contribute to this line of research by identifying a mechanism that explains why monetary incentives are ineffective in promoting change in successful firms. In the analysis we adopt the assumption that the parties contract only on the project outcome, for example, because the management does not observe the details of the project. Introducing a monetary bonus to stimulate searching has the undesired effect of also increasing the employee's payoff from not searching because the first-period project may continue to be successful. We show that this increases the informational rents that the firm has to pay to the employee to induce searching. Note that this problem is particularly pronounced in successful firms because their first period projects are more likely to also be profitable in the second period than those of unsuccessful firms. This provides a rather different view of the problem of using monetary incentives to mediate change than the perspective adopted by Kaplan and Henderson (2005) who argue that the changes in the environment that elicit the need to transform the organization also make it difficult for management to design efficient incentive schemes.

The increased cost of inducing search activities following first-period success can trigger one of two different reactions from the firm: either it will increase performance-based salaries to encourage the employee to conduct a search or it will refrain from offering monetary-based incentives. The former option creates a larger economic rent for the employee. Thus, the firm frequently does not elicit search activities even when this means that the joint second-period surplus will be lower than that reached in the case of first-period failure. We refer to this excessive reliance on the first-period project as *inertia*. It is shown that the low salary level associated with inertia reduces the employee's first-period search efforts and diminishes total firm profits.

As a means of preventing inertia, we first discuss several forms of organizational change, such as the restructuring of tasks, job rotation and intermittent employee replacement. For example, job rotation in the second period forces all employees, including those who were successful in the

first period, to look for a profitable project in their new area of responsibility. We show that the firm can benefit from job rotation in the second period but that the optimal policy is not always time-consistent. Indeed, there are circumstances in which the optimal policy is not to rotate jobs, even when doing so would boost second-period profits. Therefore, a firm risks changing its organizational structure too often, thereby undermining employee incentives to search in the first period.

In an extension of the model we analyze an alternative policy that counteracts inertial tendencies by delegating part of the authority over project choice to the employee, a decision that increases her private benefits from the project. For example, the employee may be given the opportunity to learn a new technology, pursue a project in which she has intrinsic interest, or enjoy other perks. The analysis shows that the delegation of authority takes on a different role in each period. In the second period, the firm delegates more authority to the employee to reduce the cost of inducing search activity. However, as with job rotation, this may undermine the employee's incentives to search in the first period. This problem can be alleviated by delegating a sufficient level of authority to the employee in the first period as to increase the second-period wage in case of success. While this decreases second-period profits, it serves as an additional reward for success for the employee which, in turn, increases the first-period search efforts and the firm's total profits.

Our paper is related to several bodies of literature in both economics and management. Boyer and Robert (2006) also consider a two-period principal-agent model. In the first period a project is implemented, and in the second period an alternative project becomes available. If the profitability of the alternative project is private information to either the agent or the principal, making use of the information can result in additional rents to the agent.<sup>1</sup> For that reason, the principal may decide not to use the information and to continue the first-period project instead; this outcome is defined as inertia. As in this paper, inertia arises as the result of the principal's attempt to reduce the agent's informational rents. However, Boyer and Robert's model cannot capture why successful firms are particularly vulnerable to inertia. Furthermore, the authors do not discuss organizational solutions to the problem of inertia.

Scholars in evolutionary economics have extensively investigated cognitive reasons for inertia within organizations. Nelson and Winter (1982) and Dosi (1982), among others, have stressed how scientists and engineers tend to myopically focus on existing technological trajectories and

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<sup>1</sup>This can happen either because the principal has to commit to not exploiting the information or because the agent has to be given incentives to reveal that information.

paradigms, overlooking opportunities that may lie outside their search scope. While the latter is undoubtedly an important motivating force behind organizational inertia, our model provides a complementary explanation based on an agency problem.

The decision to adopt a major innovation has important redistribution effects within the organization. The economics literature has argued that such decisions are liable to influence activities by the involved parties (Meyer et al., 1992; Milgrom, 1988; Milgrom and Roberts, 1988). Such efforts divert resources from more productive uses, slow down the decision-making process, and sometimes prevent organizational change altogether (Schaefer, 1998). Furthermore, the parties negatively affected by the introduction of the innovation may try to improve the existing technology to convince decision-makers to keep supporting it and to thereby maintain the status quo (Rotemberg and Saloner, 1995; Fosfuri and Rønne, 2009). Again, because our model does not build on intra-organizational conflict, we offer an alternative explanation for inertia.

More generally, our analysis is related to the literatures on dynamic moral hazard and on delegation. In dynamic models of moral hazard, the incentives in a given period depend on past outcomes during the employment relationship - for example, to provide inter-temporal insurance to the agent (Rogerson, 1985), to take changes in the agent's wealth into account (Fudenberg et al., 1990), or to match outside offers that reflect the available information regarding the agent's ability (Holmström, 1999); see Bolton and Dewatripont (2005) for an excellent exposition of this literature. A key difference between this literature and our approach is that past success in our model increases the agent's payoff from shirking even for fixed monetary incentives. Our paper is also related to the literature on delegation and endogenous information acquisition in agency relationships. Starting with the seminal contribution of Aghion and Tirole (1997), a number of papers have studied how, for example, delegation of authority to the agent or of veto-rights to the principal can ensure the dual purpose of efficient ex-ante acquisition and ex-post use of information (Szalay, 2005; Liu, 2005; Mylovanov, 2008). Here we abstract from problems related to the efficient ex-post use of information and focus solely on the role of delegation for information acquisition. However, unlike in the aforementioned literature, we do this in a dynamic context.

The paper is organized as follows: Section 2 presents the basic model, defines inertia and explains when it arises, and discusses ways to reduce it. Section 3 analyzes a dynamic policy of delegation, and Section 4 offers concluding remarks.



## 2 A Model of Organizational Inertia

Consider a simple dynamic model of moral hazard where the agency problem in each period is formulated as a search process similar to the one used in Aghion and Tirole (1997). In each of two periods,  $t = 1, 2$ , a firm can pursue one of infinitely many ex-ante identical projects with a duration of one period. The projects that we have in mind represent a significant innovation. They are not limited to new products but also include improvements to the production process, marketing, or distribution systems. In each period only one of the projects is of positive value. This project is denoted by  $x_t^*$ . All other projects yield non-positive values for the firm.

An employee is hired for two periods to acquire information in order to identify  $x_t^*$  and to implement the project if a project is pursued. Unlike in Aghion and Tirole (1997), the management of the firm is thus assumed to not be involved in the search process; e.g., because they do not have the time or the ability required to do this. The employee's information acquisition yields a signal about  $x_t^*$ ,  $\tilde{x}_t$ . The signal is correct with probability  $q_t$  and incorrect with probability  $1 - q_t$ . If the signal is incorrect, each of these projects with non-positive value is signalled with equal probability. Because there are infinitely many projects, each of these projects is signalled with probability zero, allowing us to abstract from learning from past failed projects. Acquiring information is costly for the employee, and her private cost  $\frac{1}{2}\gamma q_t^2$  is increasing in the expected quality of the signal. The owners of the firm observe the outcome of the project but neither the exact nature of the project nor the search intensity  $q_t$ .

After the project is selected, the employee observes whether the project is of positive value or not. A project that is of non-positive value for the firm also is of non-positive value for the employee. She has no interest in pursuing such a project and reveals the value of the project truthfully. The project is then scaled down to a minimum (a switch to a different project is impossible at this stage), and the firm and the employee each receive a payoff of zero. If the project of positive value is selected, it is fully implemented. The value of a fully implemented profitable project in period  $t$  is  $B_t > 0$ ,  $t = 1, 2$ . A certain fraction of this value,  $(1 - \theta)B_t$ , cannot be extracted by the firm but instead is privately appropriated by the employee. The employee's benefit can be monetary or non-monetary in nature. For example, if implementing and running the project involves an additional moral hazard problem,  $(1 - \theta)B_t$  could be an informational rent that the firm pays to the employee in order to realize the gross value  $B_t$ . Alternatively, it could be that the employee runs the project in the way that is best for her career rather than doing what is in the best interest of the firm's owners. We assume that the employee's private

benefit is not the largest portion of the project value,  $\theta \in [0.5, 1]$ .

The project that has positive value in period 1 may not be the positive value project in period 2. The optimal projects in the two periods are not identical with probability  $\alpha \in [0, 1]$ . Hence,  $\alpha$  characterizes the volatility of the firm's environment. We can think of it as the probability of a change in consumer preferences or the technology frontier that requires a major redirection of the firm's activities. (We will refer to  $\alpha$  as the 'volatility' of the firm's environment or the 'external pressure' on a firm that has implemented a profitable project.) In other words, with probability  $\alpha$  there exists a project in period 2 that wipes out the rent from the effort made in the previous period. This specification captures the important economic effect of significant innovations in that they reduce the value of current competencies and require employees to invest in building up new ones.

We assume that the firm and the employee are unable write a two-period incentive contract. It is usually not possible to contract directly on the value created by an employee because firm profits derive from many sources and result from team production. Instead, the firm and the employee can contract on indicators of performance such as sales, market share or level of customer satisfaction. This makes it difficult to design a well-functioning incentive scheme in a changing environment as the relevant performance indicators can change in a way that cannot be foreseen *ex ante*.<sup>2</sup> As a consequence, we focus here on a situation wherein the possibility of writing short-term contracts are good whereas long-term incentive contracting is impossible.<sup>3</sup> In particular, it is assumed that the firm at the beginning of each period offers a contract to the employee that specifies a salary supplement in the event of success. However, it is not possible to contract on the exact nature of the project because this is private information to the employee or not verifiable in court.

Finally, it is assumed that all players are risk-neutral and that the employee is wealth-constrained in every period and has a reservation utility equal to zero. This implies in particular that any first-period salary awarded to the employee is consumed before the start of the second period. The following restriction on  $\gamma$  is imposed to exclude corner solutions in the employee's choice of  $q_t$ :

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<sup>2</sup>For example, the appropriate weights of the individual performance metrics that measure project success can vary with difficult-to-predict changes in the demand structure or input prices.

<sup>3</sup>Also, the longer the time period between an employee's action and the determination of her performance, the more business activities take place in the interim. This increases the opportunities for the firm to misrepresent the employee's performance and limits the effectiveness of contracting.

**A.1.**  $\gamma \geq B_1, B_2$ .

## 2.1 The Second Period

### 2.1.1 Failure in the First Period

We now solve the game backwards starting with the second period. At the beginning of the second period, there are two possible states of nature: the first period project was a success ( $s$ ), i.e.  $x_1^*$  was implemented, or the selected project was a failure ( $f$ ). We denote the employee's optimal search intensity in the second period by  $q_2^j$ , where  $j \in \{s, f\}$  indicates the first period outcome.

Suppose that the first-period project was a failure, so that the employee does not know  $x_1^*$ . When choosing how precise a signal to acquire, the employee solves:

$$\max_{q_2} \left\{ q_2 ((1 - \theta) B_2 + w_2) - \frac{1}{2} \gamma (q_2)^2 \right\} \Rightarrow q_2^f(w_2) = \frac{1}{\gamma} ((1 - \theta) B_2 + w_2).$$

Because the parties contract period by period, the salary contract offered maximizes second period profits:

$$\max_{w_2} \left\{ (\theta B_2 - w_2^f) \frac{1}{\gamma} ((1 - \theta) B_2 + w_2^f) \right\} \Rightarrow w_2^f = \frac{1}{2} (2\theta - 1) B_2 \text{ and } q_2^f(w_2^f) = \frac{B_2}{2\gamma}.$$

Except for the limiting case of  $\theta = 1/2$ , the firm always specifies a strictly positive performance-based salary supplement to increase the employee's search intensity. The resulting effort level is independent of  $\theta$ . The expected second-period profit of the firm and utility of the employee are, respectively:

$$E(\pi_2|f) = \frac{B_2^2}{4\gamma}, \tag{1}$$

$$E(U_2|f) = \frac{B_2^2}{8\gamma}. \tag{2}$$

For future reference, let us define the salary that maximizes aggregate surplus (utility plus profits):

$$\max_{w_2} \left\{ q_2(w_2) B_2 - \frac{1}{2} \gamma (q_2(w_2))^2 \right\} \Rightarrow \hat{w}_2^f = \theta B_2.$$

This salary solves the agency problem by turning the employee into the de facto owner of the firm. The firm does not offer this salary bonus in equilibrium,  $w_2^f < \hat{w}_2^f$ , because the employee is unable to compensate the firm for the cash flow rights – e.g., in the form of a negative fixed salary.

### 2.1.2 Success in the First Period

Consider now the problem of an employee who was successful in the first period and knows  $x_1^*$ . The employee receives a signal  $\tilde{x}_2$ . This signal indicates the optimal project in the second period with probability  $q_2$ . If  $\tilde{x}_2 = x_1^*$ , the employee knows that  $x_1^*$  is optimal in the second period.<sup>4</sup> Instead, if  $\tilde{x}_2 \neq x_1^*$ , the employee has conflicting signals and follows the one of higher quality. Therefore, she switches from project  $x_1^*$  to  $\tilde{x}_2$  if and only if  $q_2 \geq (1 - \alpha)$ , where  $(1 - \alpha)$  is the probability that  $x_1^*$  remains the profitable project.

The firm decides whether to induce the employee to search for a new project or not. Suppose first that the firm induces searching. Then, the employee's utility when searching,  $\frac{1}{2\gamma}(w_2 + (1 - \theta)B_2)^2$ , has to be weakly higher than when not searching,  $(1 - \alpha)(w_2 + (1 - \theta)B_2)$ . This implies that the firm's maximization problem is

$$\begin{aligned} \max_{w_2} & \left\{ (\theta B_2 - w_2) \frac{1}{\gamma} (w_2 + (1 - \theta)B_2) \right\} \\ \text{s.t.} & \frac{1}{2\gamma} (w_2 + (1 - \theta)B_2)^2 \geq (1 - \alpha)(w_2 + (1 - \theta)B_2), \end{aligned} \quad (3)$$

$$\frac{1}{\gamma} (w_2 + (1 - \theta)B_2) \geq (1 - \alpha). \quad (4)$$

The search constraint (3) ensures that the employee does find it optimal to search. Constraint (4) implies that the employee chooses  $\tilde{x}_2$  whenever  $\tilde{x}_2 \neq x_1^*$ . Multiplying both sides of (4) by the positive value  $(w_2 + (1 - \theta)B_2)$  reveals that it is always less restrictive than the search constraint (3) and is therefore not binding. Solving the problem yields:

$$\begin{aligned} w_{2,A}^s &= \begin{cases} 2\gamma(1 - \alpha) - (1 - \theta)B_2 & \text{for } (1 - \alpha) \geq \frac{B_2}{4\gamma}, \\ \frac{1}{2}(2\theta - 1)B_2 & \text{otherwise.} \end{cases} \\ q_{2,A}^s &= \begin{cases} 2(1 - \alpha) & \text{for } (1 - \alpha) \geq \frac{B_2}{4\gamma}, \\ \frac{1}{2\gamma}B_2 & \text{otherwise.} \end{cases} \end{aligned}$$

The search constraint is only binding if  $x_1^*$  is sufficiently likely to be successful also in period 2,  $(1 - \alpha) \geq B_2/4\gamma$ . When the search constraint is binding, the firm increases the salary bonus  $w_{2,A}^s$  above  $w_2^f$  in order to generate searching. The expected profits and utility are:

$$\begin{aligned} E(\pi_{2,A}|s) &= \begin{cases} (B_2 - 2\gamma(1 - \alpha))2(1 - \alpha) & \text{for } (1 - \alpha) \geq \frac{B_2}{4\gamma}, \\ \frac{B_2^2}{4\gamma} & \text{otherwise.} \end{cases} \\ E(U_{2,A}|s) &= \begin{cases} 2\gamma(1 - \alpha)^2 & \text{for } (1 - \alpha) \geq \frac{B_2}{4\gamma}, \\ \frac{B_2^2}{8\gamma} & \text{otherwise.} \end{cases} \end{aligned}$$

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<sup>4</sup>If  $\tilde{x}_2 \neq x_1^*$ , the probability of receiving the signal  $x_1^*$  is zero because there is an infinite number of non-positive value projects, that are all equally likely to be signalled. Therefore, we have that  $\Pr(\tilde{x}_2 = x_1^* | \tilde{x}_2 \neq x_1^*) = 0$ .

The alternative option for the firm is not to encourage searching and to set  $w_{2,B}^s = 0$ . Then, we have:

$$q_{2,B}^s = \begin{cases} 0 & \text{for } (1 - \alpha) \geq \frac{1}{2\gamma}(1 - \theta)B_2, \\ \frac{1}{\gamma}B_2(1 - \theta) & \text{otherwise.} \end{cases}$$

When the probability that the successful first-period project continues to be profitable – i.e.  $(1 - \alpha)$  – is low the employee’s private benefit suffices to induce search. Otherwise, the employee does not engage in search. This implies:

$$\begin{aligned} E(\pi_{2,B}|s) &= \begin{cases} \theta B_2(1 - \alpha) & \text{for } (1 - \alpha) \geq \frac{1}{2\gamma}(1 - \theta)B_2, \\ \frac{1}{\gamma}\theta B_2^2(1 - \theta) & \text{otherwise.} \end{cases} \\ E(U_{2,B}|s) &= \begin{cases} (1 - \theta)B_2(1 - \alpha) & \text{for } (1 - \alpha) \geq \frac{1}{2\gamma}(1 - \theta)B_2, \\ \frac{1}{2\gamma}(1 - \theta)^2 B_2^2 & \text{otherwise.} \end{cases} \end{aligned}$$

The following lemma compares these two solutions from the perspective of the firm:

**Lemma 1** *The optimal wage in the second period following a success is:*

$$w_2^s = \begin{cases} 0 & \text{for } (1 - \alpha) \geq (2 - \theta)\frac{B_2}{4\gamma}, \\ 2\gamma(1 - \alpha) - (1 - \theta)B_2 & \text{for } (2 - \theta)\frac{B_2}{4\gamma} > (1 - \alpha) \geq \frac{B_2}{4\gamma}, \\ \frac{1}{2}(2\theta - 1)B_2 & \text{otherwise.} \end{cases}$$

**Proof.** Follows directly from comparing  $E(\pi_{2,A}|s)$  and  $E(\pi_{2,B}|s)$ . ■

In a very stable environment – i.e.  $(1 - \alpha)$  high – providing search incentives is too expensive relative to its benefits, and the firm sets  $w_2^s = 0$ . In an environment of some volatility,  $(1 - \alpha) \in \left((2 - \theta)\frac{B_2}{4\gamma}, \frac{B_2}{4\gamma}\right)$ , the firm induces searching by just satisfying the employee’s search constraint. Finally, in a highly volatile environment,  $(1 - \alpha)$  low, neither the firm nor the employee has an interest in recycling the last period’s project in the hope of continued success. Therefore, the search constraint is not binding, and both the performance-based salary and the employee’s search intensity are identical to that in the case of first-period failure.

The second period profits and utility in case of success are:

$$E(\pi_2|s) = \begin{cases} (1 - \alpha)\theta B_2 & \text{for } 1 - \alpha \geq (2 - \theta)\frac{B_2}{4\gamma}, \\ 2(B_2 - 2\gamma(1 - \alpha))(1 - \alpha) & \text{for } (2 - \theta)\frac{B_2}{4\gamma} > 1 - \alpha \geq \frac{B_2}{4\gamma}, \\ \frac{B_2^2}{4\gamma} & \text{otherwise.} \end{cases} \quad (5)$$

$$E(U_2|s) = \begin{cases} (1 - \alpha)(1 - \theta)B_2 & \text{for } 1 - \alpha \geq (2 - \theta)\frac{B_2}{4\gamma}, \\ 2\gamma(1 - \alpha)^2 & \text{for } (2 - \theta)\frac{B_2}{4\gamma} > 1 - \alpha \geq \frac{B_2}{4\gamma}, \\ \frac{B_2^2}{8\gamma} & \text{otherwise.} \end{cases} \quad (6)$$

Let us again derive the salary that maximizes the second-period surplus. It is straightforward to show that it is optimal that the employee either searches with the same intensity as in the case of failure or does not search at all. Comparing these two alternatives yields:

$$\widehat{w}_2^s = \begin{cases} 0 & \text{for } (1 - \alpha) \geq \frac{B_2}{2\gamma}, \\ \theta B_2 & \text{otherwise.} \end{cases}$$

## 2.2 The First Period

In the first period, the employee maximizes her expected two-period utility when choosing the effort:

$$\max_{q_1} \left\{ q_1 (w_1 + E(U_2|s) + (1 - \theta)B_1) + (1 - q_1)E(U_2|f) - \frac{1}{2}\gamma (q_1)^2 \right\},$$

which implies that

$$q_1^*(w_1) = \frac{1}{\gamma}(w_1 + \Delta E(U_2) + (1 - \theta)B_1),$$

where  $\Delta E(U_2) \equiv E(U_2|s) - E(U_2|f)$  is derived from equations (2) and (6).

The firm maximizes two-period profits, taking the employee's effort choice into account:

$$\max_{w_1} \{q_1^*(w_1)(\theta B_1 + E(\pi_2|s) - w_1) + (1 - q_1^*(w_1))E(\pi_2|f)\},$$

which yields

$$w_1^* = \frac{1}{2}((2\theta - 1)B_1 + \Delta E(\pi_2) - \Delta E(U_2)),$$

where  $\Delta E(\pi_2) \equiv E(\pi_2|s) - E(\pi_2|f)$  is derived from equations (1) and (5). Hence,  $q_1^* = \frac{1}{2\gamma}(B_1 + \Delta E(\pi_2) + \Delta E(U_2))$ .

Using  $q_1^*$ , we obtain that the total expected profits,  $E(\Pi)$ , are:

$$E(\Pi) = \frac{1}{4\gamma}(B_1 + \Delta E(S_2))^2 + E(\pi_2|f) \text{ where } \Delta E(S_2) \equiv \Delta E(\pi_2) + \Delta E(U_2). \quad (7)$$

The firm's total expected profits are a strictly increasing function in the aggregate period 2 surplus after a success in period 1. The reason for this result is that the firm is able to extract all rents that accrue to the employee in period 2 following first-period success. More precisely, if success results in a higher utility in period 2, the firm can reduce the period 1 salary without diluting the employee's incentive to search.

### 2.3 Searching and Inertia

We are interested in identifying the inefficiencies that arise from first-period success, and we characterize situations in which first period success reduces the aggregate surplus in the second period. As described above, a lower second-period surplus is not only detrimental to welfare; it also decreases the total expected profits of the firm. Thus, the owners of the firm and a hypothetical social planner would share an interest in maximizing second-period surplus.

**Proposition 1** *Comparing the outcomes in the second period following first period success and failure:*

- i) For  $(1 - \alpha) \leq \frac{B_2}{4\gamma}$ ,  $\hat{w}_2^s = \hat{w}_2^f > w_2^f = w_2^s$  and  $\Delta E(S_2) = 0$ .
- ii) For  $\frac{B_2}{4\gamma} < (1 - \alpha) \leq \frac{(2-\theta)B_2}{4\gamma}$ ,  $\hat{w}_2^s = \hat{w}_2^f > w_2^s > w_2^f$  and  $\Delta E(S_2) \geq 0$ .
- iii) For  $\frac{(2-\theta)B_2}{4\gamma} < (1 - \alpha) < \frac{3B_2}{8\gamma}$ ,  $\hat{w}_2^s = \hat{w}_2^f > w_2^f > w_2^s$  and  $\Delta E(S_2) < 0$ .
- iv) Otherwise,  $\hat{w}_2^s \geq w_2^s$ ,  $\hat{w}_2^f > w_2^f$ , and  $\Delta E(S_2) \geq 0$ .

Hence, for any  $\theta > 1/2$  there exists a non-empty set of values for  $\alpha$  such that the second-period surplus is smaller after first-period success. Any such loss in surplus results from the absence of search effort by the employee in the second period and therefore from excessive reliance on the project implemented in period one.

**Proof.** Comparing the expressions for  $\hat{w}_2^s$ ,  $\hat{w}_2^f$ ,  $w_2^f$  and  $w_2^s$  yields the result regarding the relative sizes of those variables. The sign of  $\Delta E(S_2)$  follows from comparing  $E(\pi_2|s) + E(U_2|s)$  to  $E(U_2|f) + E(\pi_2|f)$ . Following first-period success, searching is induced for parameter regimes i) and ii), see Lemma 1 and the expression for  $q_{2,B}^s$ , whereas following first period-failure, the employee searches for any  $\alpha$ . Thus, the negative value of  $\Delta E(S_2)$  in regime iii) is a consequence of the lack of searching following success. ■

Because a reduced second period surplus following success is caused by a lack of searching and the excessive reliance on the first-period project, we refer to these circumstances as ‘inertia’. The source of inertia is a commitment problem on the part of the firm. While the firm would like to commit to maximizing the aggregate second-period surplus, it considers only second-period profits when choosing the second-period salary,  $w_2^s$ . The problem for the firm is that if it introduces a positive bonus  $w_2^s$  to induce searching, the alternative of not searching also becomes more attractive to the employee; see equation (3). This, in turn, implies that the firm cannot induce searching without increasing the employee’s informational rents. These rents represent a cost of searching in terms of second-period profits, but not in terms of second-period surplus and, accordingly, total profits. In a relatively stable environment, this cost is sufficiently large

that the firm chooses not to induce searching.

In a more volatile environment, case ii) in Proposition 1, the search constraint is still binding, but the firm chooses to induce searching. Here, unlike the previous case, first period success increases second period surplus and profits. Due to the search constraint binding, it holds  $w_2^s > w_2^f$ . Hence  $w_2^s$  is closer to the salary bonus that maximizes second-period surplus than  $w_2^f$ , which results in  $\Delta E(S_2) > 0$ .<sup>5</sup> Here, the employee's reluctance to search for a new project benefits the firm by alleviating the firm's commitment problem.

Finally, in a very volatile environment, case i) in Proposition 1, period 1 success does not influence second-period search, and  $\Delta E(S_2) = 0$ . By contrast, in case iv) where the environment is very stable, the firm optimally chooses not to induce search to save on search costs. Here, a successful period 1 project represents valuable information to the firm, and  $\Delta E(S_2) > 0$ .

### 2.3.1 Industry Evolution

Problems of inertia are often associated with established firms that are operating in stagnating or declining markets or market segments (Tripsas and Gavetti, 2000; Sull, 1999). Let us therefore briefly discuss how our model can be interpreted in the context of industry evolution. The industry life cycle is typically characterized by rapid technological progress and growing market size initially, followed by a slowdown in the innovation rate and stagnating or declining market size (Abernathy and Utterback, 1975; Klepper, 1996).

To capture these life cycle characteristics, consider an industry where the value of a successful project is  $B_t$  and the rate of innovation is  $\alpha_t$ . An innovation is as above an event that makes the previous period's successful project obsolete. Here,  $t$  is the period and  $t \in \{1, \dots, \infty\}$ . We assume that  $\alpha_t < \alpha_{t-1}$  and  $B_{t+1} - B_t \geq 0$  for  $t \leq \bar{t}$  and  $B_{t+1} - B_t < 0$  for  $t > \bar{t}$  for some finite  $\bar{t}$ . The firm exists forever and hires employees that live for two periods. In every period the firm has a young employee in period 1 of her working life and an old employee in period 2 who work independently of each other. Thus, in each period  $t$ , the firm faces a situation when hiring a young employee who may be reluctant to search in  $t+1$  as described by our model with  $B_1 = B_t$ ,  $B_2 = B_{t+1}$ , and  $\alpha = \alpha_{t+1}$ .

Suppose that innovation is initially sufficiently rapid to avoid any inertial tendencies but ceases eventually:  $1 - \alpha_1 \leq \frac{B_1}{4\gamma}$  and  $1 - \alpha_t > \frac{3B_t}{8\gamma}$  for all  $t$  greater than some finite  $\tilde{t}$ . From Proposition

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<sup>5</sup>Note that the firm never goes as far as to pay a bonus that exceeds  $\hat{w}_2^s$ . The equilibrium salary bonus  $w_2^s$  is bounded from above by  $\frac{1}{2}\theta B_2$ .



It follows that a successful old employee will search in period 2 at the beginning of the firm's existence but not late in its life. (The young workers always search because they cannot rely on previous projects). As long as  $\alpha_t$  and  $B_t$  evolve in a smooth fashion, the firm will go through three transitory phases between  $t = 1$  and  $t = \tilde{t}$ : first a phase of constant incentives and searching. Then, there is a phase of higher-powered incentives that increase over time to induce searching followed by a phase of inertia.

The emergence of inertia depends not only on the rate of innovation but also on developments in market size. To see this, consider two industries,  $A$  and  $B$ , that have the same rate of innovation,  $\{\alpha_t\}_{t=1}^{\infty}$ . The market size of industry  $A$  at date  $t$  is  $B_t$  whereas the market size of industry  $B$  is  $\gamma^{t-1}B_t$ ,  $\gamma > 1$ . Because the market size of industry  $B$  is larger than that of industry  $A$ , it follows immediately from Proposition 1 that it takes longer for a firm in industry  $B$  to experience difficulty motivating a successful employee to search for new opportunities. A higher rate of innovation would have a similar effect for a given evolution of market size,  $\{B_t\}_{t=1}^{\infty}$ . Dynamic industries with a high rate of innovation and fast market growth are in this sense less prone to inertia than are less dynamic industries. The example is mainly suggestive, and a more satisfactory model would include more firms and would link  $\alpha_t$  and  $B_t$  through explicit R&D decisions. Regardless, the implications of our model appear to be in line with common findings in the literature.

### 2.3.2 Reducing Inertia: Restructuring

The analysis shows that the effect of past success depends crucially on whether the employee's reluctance to searching results in higher or lower powered incentives compared to the case of period 1 failure. Here, we will discuss some examples of real life policies that can be used to prevent inertia and identify the challenges of implementing them effectively.

Because insufficient external pressure may result in inertia, it is natural to complement it with pressure from within the firm. One means of providing such pressure is to reorganize the firm in the second period in a way that includes a change in individual tasks and responsibilities. Reorganization forces the employees to find a way to accomplish their new tasks efficiently and to invest in acquiring information in the second period. In our framework, a reorganization can thus be understood as an activity that renders the probability that a project can be reemployed in the second period equal to zero. Hence, for the employee it is as if  $\alpha = 1$ .<sup>6</sup>

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<sup>6</sup>We assume that a reorganization does not introduce any costs or benefits except those arising endogenously

Alternatively, instead of reorganizing tasks, the firm can maintain a constant assignment of tasks to positions, but rotate employees between positions. Yet another possibility is to hire new employees every period. While these instruments place their focus on personnel rather than task rearrangements, they also place employees in situations in which they cannot rely on their past experience. Therefore, if one abstracts from transaction costs, they have identical implications to a reorganization.<sup>7</sup> In the following, we use the term ‘restructuring’ to refer to all three instruments.

Restructuring is optimally applied only if there is inertia, that is if and only if  $\Delta E(S_2) < 0$ . However, due to the lack of commitment, it is not necessarily applied in a time-consistent manner: the firm has an incentive to restructure in the second period whenever  $\Delta E(\pi_2) < 0$ . This time-consistency problem arises because the decision to restructure ignores any effects that the anticipated restructuring decision has on the employee’s first period effort.<sup>8</sup> The following proposition identifies the inefficiencies that are eliminated and introduced when a restructuring instrument is available.

**Proposition 2** *Suppose that the firm uses a policy of inducing searching by restructuring if and only if  $\Delta E(\pi_2) < 0 \Leftrightarrow (1 - \alpha) \in \left(\frac{B_2}{4\gamma}, \frac{B_2}{4\gamma\theta}\right)$ . Then, this has the following effects on total profits:*

- i) The policy increases total profits for  $(1 - \alpha) \in \left(\frac{(2-\theta)B_2}{4\gamma}, \min\left(\frac{3B_2}{8\gamma}, \frac{B_2}{4\gamma\theta}\right)\right)$ .*
- ii) The policy reduces total profits for  $(1 - \alpha) \in \left(\frac{B_2}{4\gamma}, \frac{(2-\theta)B_2}{4\gamma}\right)$  as well as for  $(\theta, 1 - \alpha) \in \left(\frac{1}{2}, \frac{2}{3}\right) \times \left(\frac{3B_2}{8\gamma}, \frac{B_2}{4\gamma\theta}\right)$ .*

Restructuring is an effective way to avoid inertia. There are, however, parameters for which the instrument is applied inefficiently by the firm. This happens when a restructuring increases the firm’s second-period profit but at the cost of reducing total surplus. The firm’s gain from

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due to the information being destroyed or created. The introduction of an explicit cost does not provide any additional insights because it reduces the incentives to reorganize in a straightforward manner.

<sup>7</sup>Job rotation is commonly viewed as a policy intended to facilitate employee learning (Campion et al., 1994). Our analysis is consistent with this explanation but stresses that job rotation not only provides new possibilities for employees to learn but also increases the need for it.

<sup>8</sup>The tension between the firm’s ex-post efficient decisions and employee’s ex-ante incentives to invest in the employment relationship appears in many different forms in the literature on dynamic incentives and organizational economics. For example, Gertner et al. (1994) explain why it may be optimal for multi-project firms not to reallocate funds to the most profitable project in order to increase the employees’ initial investments in entrepreneurial activities; Cremer (1995) shows that firms may choose not to observe an employee’s ability, at the cost of inefficient hiring decisions, in order to promote the employee’s initial efforts to become successful; Carillo and Gromb (2007) argue that firms may adopt a rigid corporate culture. Doing so increases the organization’s cost of adapting to changes in the environment, to encourage the employees’ culture-specific investments.

restructuring is less than the employee's loss either because the environment is stable, and the firm would pay a high but welfare enhancing wage supplement to induce search, or because the employee derives a high expected private benefit from continuing the successful project. The former (latter) possibility corresponds to the first (second) case in Proposition 2, part ii). The problem for the firm is that an employee foreseeing a suboptimal policy of restructuring reacts by lowering her first period effort, reducing total firm profits.<sup>9</sup>

Because firms may also apply restructuring measures in cases when doing so reduces total firm profits, firms may have an incentive to commit to not applying such measures. The firm may try to secure commitment power by increasing the cost of restructuring. To make both reorganization and job rotation more costly, a firm can, for example, choose an employment structure that is dominated by specialists rather than generalists. Predominantly hiring specialists entails higher costs of employee re-training when their tasks change.<sup>10</sup> In the context of employment duration, the firm may be able to commit to not replacing successful employees after the first period by offering severance pay. Another possibility is to include the continuation of employment directly as a part of the reward for success, a solution that resembles the academic system of tenure. This explanation of tenure is in the spirit of McPherson and Winston (1983) who argue that the tenure system protects the highly specific human capital investment made by academics.

### 3 Dynamic Delegation

In this section we analyze a dynamic policy that prevents inertial tendencies by delegating more authority over the project choice to the employee. For example, the employee might be given the opportunity to learn a new technology, to pursue a project in which she has intrinsic interest, or to enjoy other perquisites. We argue that this instrument can be superior to a monetary bonus, because the reward is conditional on searching. For example, the employee only learns a new technology if she undertakes a new project that uses it.

To formalize these notions, consider the following variation of the model: in period  $t$  a successful project pays  $\theta_t B_t$  to the firm as profits and  $(1 - \theta_t) B_t$  to the employee in the form of private

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<sup>9</sup>This can be seen in the following way: A suboptimal restructuring policy changes  $\Delta E(S_2) > 0$  to  $\Delta E(S_2) = 0$ . It follows then immediately from  $q_1^*$  and  $E(\Pi)$  that the first period effort and total profits are reduced.

<sup>10</sup>Some evidence in support of this notion is found by Eriksson and Ortega (2006) who show that the use of job rotation is negatively correlated with the heterogeneity of the firm's workforce.

benefits. We assume without loss of insight that the value of the market is constant,  $B_1 = B_2 = B$ . At the beginning of each period the firm is able to choose the period's  $\theta_t$ . We interpret  $\theta_t$  as the degree of authority over project choice that is delegated to the employee in period  $t$ ,  $\theta_t \in [\underline{\theta}, \bar{\theta}]$ . An employee who enjoys more authority is able to implement a project in the way that suits her interests better.<sup>11</sup> Note that the degree of authority does not affect the total surplus that a project generates, only its distribution.

We restrict the firm's delegation choices by assuming the following:

$$\mathbf{A.2.} \quad 1 - \frac{(1-\underline{\theta})^2 B}{2\gamma(1-\alpha)} > \bar{\theta} > \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}.$$

Assumption A.2. implies that, through the use of delegation, the firm can make a successful employee search at the wage  $w_2^f$  (the second inequality) but not at the wage 0 (the first inequality). The assumption is not crucial for the results but reduces the number of cases that need to be considered in the analysis.

In order to focus on circumstances where inertia is an issue, we assume:

$$\mathbf{A.3.} \quad \frac{(2-\underline{\theta})B}{4\gamma} < (1-\alpha) < \frac{3B}{8\gamma}.$$

Assumption A.3 and Proposition 1 imply together that the firm experiences inertia if  $\theta_1 = \theta_2 = \theta$  for all  $\theta \in [\underline{\theta}, \bar{\theta}]$ . Hence, if it is possible for the firm to prevent inertia, this is due to the policy of delegation of authority that is used.

The rest of the model remains unchanged.

### 3.1 Second Period

As before we proceed backwards and start with the analysis of period 2. Suppose first that the employee was unsuccessful in the first period. Then, the employee is offered a bonus  $w_2^f = (2\theta_2 - 1)/2$ . This results in an effort of  $B/2\gamma$ , which leads to the following expected payoffs:

$$\begin{aligned} E(\pi_2|f) &= \frac{B^2}{4\gamma}, \\ E(U_2|f) &= \frac{B^2}{8\gamma}. \end{aligned}$$

The expected payoffs do not depend on the degree of authority, and any  $\theta_2 \in [\underline{\theta}, \bar{\theta}]$  is optimal.

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<sup>11</sup>Our analysis does therefore not apply to delegation of authority over decisions regarding matters like working hours or dress code that affect the employee's private benefits in the same way irrespective of the project chosen.

If the firm experiences first-period success, the firm can either decide to continue the period 1 project or to induce searching. If it does not encourage searching, it offers the wage  $w_2^s = 0$ . In the region considered, the employee then chooses not to search and to propose the period 1 project again. The resulting profits are  $(1 - \alpha)\theta_1 B$ . Instead, if the employee is encouraged to search, the utility from searching for a new project must be greater than or equal to the utility from not searching. The firm's problem is therefore:

$$\max_{(w, \theta_2)} \left\{ (\theta_2 B - w_2) \frac{1}{\gamma} (w_2 + (1 - \theta_2)B) \right\}$$

$$s.t. \quad \frac{1}{2\gamma} (w_2 + (1 - \theta_2)B)^2 \geq (1 - \alpha)(w_2 + (1 - \theta_1)B), \quad (8)$$

$$\theta_2 \in [\underline{\theta}, \bar{\theta}], \quad (9)$$

where inequality (8) ensures searching. Note that this search constraint specifies that the employee's utility in case of searching is a function of  $\theta_2$  whereas her utility depends on  $\theta_1$  when she does not search. More authority over the project choice, corresponding to a lower value of  $\theta_2$ , relaxes the search constraint (8), because it is more attractive for the employee to invest efforts in finding a new project.

The following lemma characterizes the solution to this problem.

**Lemma 2** *If the firm chooses to induce a successful employee to search in the second period,  $\theta_2 = \underline{\theta}$  is an optimal level of authority. The wage offered to the employee is:*

$$w_2^s(\theta_1) = \begin{cases} (1 - \alpha)\gamma - B(1 - \underline{\theta}) + \frac{\sqrt{(1 - \alpha)\gamma((1 - \alpha)\gamma - 2B(\theta_1 - \underline{\theta}))}}{\frac{(2\underline{\theta} - 1)B}{2}} & \text{if } (1 - \alpha) \leq \frac{B}{4\gamma(1 - 2(\theta_1 - \underline{\theta}))} \\ \text{otherwise} & \end{cases}$$

**Proof:** In appendix. ■

Suppose first that the firm can relax the search constraint (8) completely by choosing  $\theta_2$  sufficiently low. Any value of  $\theta_2$  that achieves this, including  $\theta_2 = \underline{\theta}$ , is then optimal. The reason is that the choice of  $\theta_2$  does not affect the total surplus generated by the project. So long as the search constraint is not binding, it is thus of no consequence to the firm whether the reward for success consists of private benefits or a monetary bonus. Instead, if the search constraint binds in the solution, it is strictly optimal to let the employee enjoy as much authority as possible,  $\theta_2 = \underline{\theta}$ . This minimizes the wage  $w_2^s(\theta_1)$  that the firm has to offer by relaxing the search constraint.

Using the delegation of authority to provide incentives has the advantage that the reward is conditional on the employee searching. Increasing the employee's authority in the second period is thus a more efficient way for the firm to relax the search constraint than offering a larger monetary bonus. Note also that the choice to allow the employee to pursue her favorite project is not a cause of success as in Aghion and Tirole (1997). Indeed, in a one-period version of our model profits would be independent of  $\theta$ . Rather, the delegation of authority is a consequence of success and serves to maintain the company's success.

We are now ready to study the firm's decision whether to induce search or not in the second period.

**Lemma 3** *If  $\underline{\theta} < \frac{2}{3}$  and  $\frac{(2-\underline{\theta})B}{4\gamma} < (1-\alpha) < \frac{(1+\underline{\theta}-\sqrt{\underline{\theta}(2+\underline{\theta})})B}{4\gamma}$ , there exists a non-empty set  $(\tilde{\theta}_L, \tilde{\theta}_H) \subset \left(\underline{\theta}, \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}\right)$  such that the firm induces a successful employee to search in the second period if and only if  $\theta_1 \in (\tilde{\theta}_L, \tilde{\theta}_H)$ .*

**Proof:** In appendix. ■

Figure 1 illustrates the expected profits as a function of  $\theta_1$  both when the employee is induced to search and when she is not. In the example illustrated, it is optimal to encourage the employee to search for  $\theta_1 \in (\tilde{\theta}_L = 0.5716, \tilde{\theta}_H = 0.6748)$ . There are several things to notice from the figure. First, because we consider a region wherein inertia would arise in the base model, a successful firm does not induce searching if  $\theta_1 = \theta_2 = \underline{\theta}$ . Hence,  $\pi_2^S(\underline{\theta}) < (1-\alpha)\underline{\theta}B$  in the figure. Secondly, the less autonomy the employee is granted in the first period, the more the search constraint can be relaxed in the second period by choosing  $\theta_2 = \underline{\theta}$  and the lower is the wage  $w_2^s(\theta_1)$ . However, the marginal value of reducing  $w_2^s(\theta_1)$  is decreasing, which explains why  $\pi_2^S(\theta_1)$  is increasing but concave in  $\theta_1$ . Therefore, because the profits from maintaining a successful project are linearly increasing in  $\theta_1$ , the firm induces searching for intermediate values of  $\theta_1$ .

An increase in the volatility of the environment increases the profits from searching because a successful employee is less reluctant to search and reduces the profits from no searching. Hence, an increase in  $\alpha$  shifts  $(1-\alpha)\theta_1 B$  down and  $\pi_2^S(\theta_1)$  up in Figure 1, expanding the set  $\theta_1 \in (\tilde{\theta}_L, \tilde{\theta}_H)$  for which searching is encouraged. Similarly, a decrease in  $\alpha$  reduces the set of  $\theta_1$  for which the firm encourages the employee to search, possibly to the point where search is unprofitable for all  $\theta_1 \in [\underline{\theta}, \bar{\theta}]$ .

**Proposition 3** *If the conditions in Lemma 3 are fulfilled and  $\theta_1 \in (\tilde{\theta}_L, \tilde{\theta}_H)$ , the firm does not suffer from inertia. Otherwise, inertia arises in the second period.*

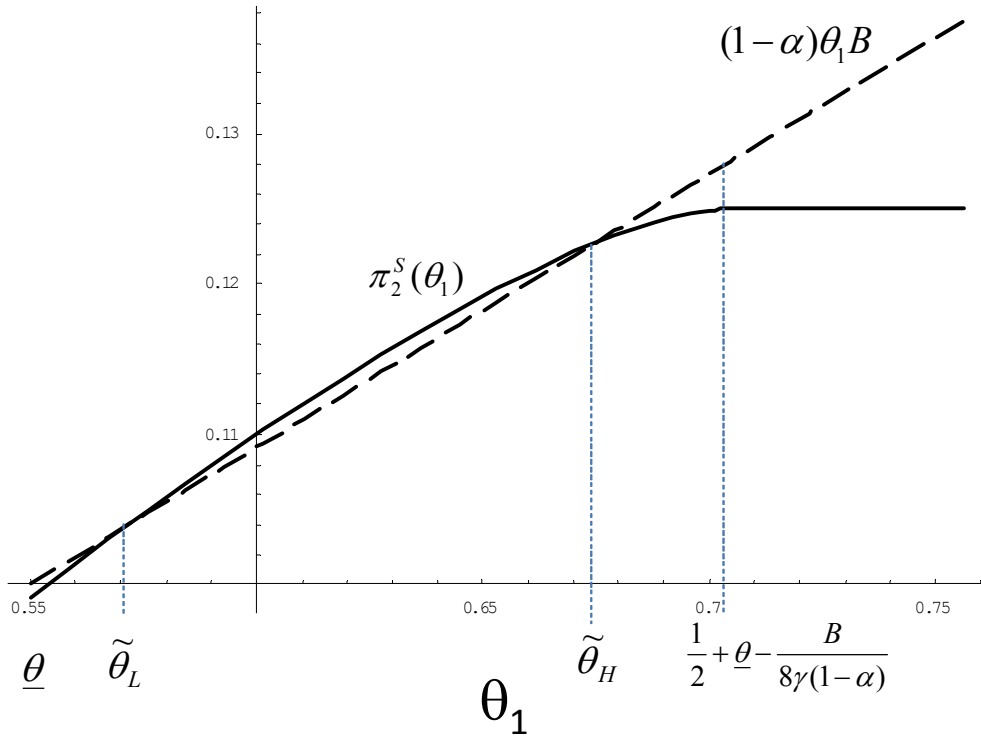


Figure 1: The profit functions when search is induced ( $\pi_2^S(\theta_1)$ , indicated by the solid line) and when it is not ( $(1-\alpha)\theta_1 B$ , indicated by the dashed line) for  $B = 1$ ,  $\gamma = 2$ ,  $(1-\alpha) = 0.1819$ , and  $\underline{\theta} = 0.55$ .

**Proof:** In appendix. ■

If the firm can ensure searching in the second period through the use of delegation, inertia will not arise. The intuition is that the firm will use a combination of delegation and monetary incentives to ensure that searching is profitable for both the firm and the employee. A successful employee is offered a higher reward for success than is an unsuccessful employee, which results in a higher second-period surplus following success.

### 3.2 The First Period

The analysis of the firm's decisions in period 2 shows that the allocation of authority in period 1 can serve as a commitment device. Consider again the example illustrated in Figure 1. Here, the firm can commit either to inducing searching in period 2 by choosing  $\theta_1 \in (\tilde{\theta}_L, \tilde{\theta}_H)$  or to preventing searching by choosing a value of  $\theta_1$  that lies outside of this interval.

The first period choice of monetary bonus can be analyzed as in the base model. Inserting the optimal first period bonus, the total two-period profits of the firm can be written as:

$$E(\Pi) = \frac{1}{4\gamma} (B + E(S_2(\theta_1)|s) - E(S_2|f))^2 + E(\pi_2|f), \quad (10)$$

where  $E(S_2(\theta_1)|s)$  and  $E(S_2|f)$  are the social surplus in the second period given first-period success and failure, respectively. Note that the choice of authority in the first period only affects social welfare in case of success. Also,  $\theta_2$  has been suppressed in the notation because it follows from Lemma 2 that the firm optimally chooses  $\theta_2 = \underline{\theta}$ . From (10), it is immediate that the firm chooses  $\theta_1$  as to maximize  $E(S_2(\theta_1)|s)$ . The following proposition characterizes the solution to this problem.

**Proposition 4** *If the conditions in Lemma 3 are met, the firm chooses the lowest value of  $\theta_1$  for which a successful employee is induced to search,  $\tilde{\theta}_L$ . Otherwise, the choice of  $\theta_1$  does not affect the firm's expected total profits.*

**Proof:** In appendix. ■

Proposition 4 shows how the firm can choose  $\theta_1$  strategically to commit to a more efficient contract in period 2. In particular, the firm chooses the lowest possible value of  $\theta_1$  that still results in search in the second period in the event of first-period success. The intuition is that a low value  $\theta_1$  makes it harder to encourage a successful employee to search, because the current



project is associated with high private benefits. The firm must therefore offer a higher salary  $w_2^s(\theta_1)$  to make the employee search. As discussed above, this decreases second-period profits but increases both second-period surplus and total profits.

Taken together, Lemma 3 and Proposition 4 identify two distinct roles for employee authority in the two periods. The firm has an incentive to increase the employee's authority in the second period to reduce her reluctance to search. However, like the restructuring discussed in Section 3, this may undermine the employee's incentives to search in period 1. Foreseeing that the employee will be granted maximal authority over the project choice in period 2, the firm already increases the employee's authority in period 1. By deliberately making it costly to induce search activity following a success, the firm commits to a high-powered incentive scheme that increases the employee's first-period search efforts and the firm's total profits.

In our approach, we have considered restructuring and the dynamic delegation of authority to be separate ways of overcoming inertia. An immediate implication of our analysis is that if the delegation of authority can resolve the inertia problem, it is a better policy for the firm than restructuring. The reason is that the delegation of authority serves as an additional reward for success, thereby increasing the employee's initial search efforts and the firm's total profits. In spite of the positive effects of delegation, firms face a commitment problem if they have both policies available simultaneously. Indeed, firms would restructure in period 2 as soon as period 1 success resulted in a reluctance to search (i.e., a binding search constraint). The possibility of restructuring would therefore remove the use of delegation because delegation is more costly for the firm from a period 2 perspective. It is thus important that a commitment not to restructure be in place before the benefits of delegation can be reaped.

## 4 Concluding Remarks

In this paper we develop a simple principal-agent model to analyze the inertial tendencies that result from success. An employee who discovered a successful project in the previous period is reluctant to invest effort in searching for a new project, because the old project may be successful again. We argue that monetary incentives are not necessarily an effective tool for inducing search in this situation. The problem for the firm is that a bonus for good performance, intended to encourage searching, also increases the employee's payoff from not searching. This problem is particularly pronounced in an environment that is sufficiently volatile to make searching worthwhile but stable enough to exacerbate the agency problem.

The firm's reaction to a successful employee's reluctance to search for a new project will be either to increase the power of the incentive scheme or to abandon the search altogether. We show that these two reactions have very different implications for total profits. High-powered incentives serve as an additional reward for success, which increases the employee's initial search efforts and the firm's total profits. However, if the search is abandoned due to the severity of the agency problem, total profits are reduced.

We argue that restructuring in the form of reorganization, job rotation or short-term employment forces the employees to search in the second period, but may create a time-consistency problem. In particular, these policies may increase second-period profits, but still decrease total profits because initial search efforts are undermined. Firms may therefore have an incentive to commit to not restructuring – e.g. by making hiring or investment decisions that increase the cost of restructuring the firm. Another possibility is to delegate more authority over project choice to the employee, which increases the attractiveness of searching. While it may limit inertial tendencies, this policy also creates the problem of reduced initial search activity. However, this problem can be alleviated by granting some authority to the employee already in the first period.

An interesting issue relates to the interpretation of the volatility parameter  $\alpha$  as competitive pressure. Building on the analysis of managerial incentives and product market competition presented in Schmidt (1997), we conjecture that competition introduces an effect that works against inertial tendencies. Search efforts are strategic substitutes if profits are the performance measure used in the incentive contract because higher effort in a competing firm reduces the expected profit resulting from one's own effort. Therefore, if the employee of one firm stops searching, the employees of the competitors will react by increasing the intensity of their search efforts. In terms of the current model, search inactivity triggers an increase in  $\alpha$ , which makes it harder to sustain inertia as an equilibrium outcome. We leave this and other issues as avenues for future research.

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## A Proof of Lemmata and Propositions

### A.1 Proof of Lemma 2

In the region considered the firm's problem is the absence of searching (assumption A.3.). Thus reducing authority in the second period is not a sensible policy to increase profits. As a result,  $\theta_2 \leq \bar{\theta}$  is not binding. Accordingly, the Lagrangian associated with the firm's problem is:

$$\mathcal{L} = \frac{\theta_2 B - w_2}{\gamma} (w_2 + (1 - \theta_2)B) + \frac{\lambda_1}{2\gamma} \left( (w_2 + (1 - \theta_2)B)^2 - (1 - \alpha)(w_2 + (1 - \theta_1)B) \right) + \lambda_2 (\theta_2 - \underline{\theta}).$$

Thus, the optimality conditions and the complementary slack conditions are:

$$\partial \mathcal{L} / \partial w_2 = \frac{(2\theta_2 - 1)B}{\gamma} - \frac{2w_2}{\gamma} + \lambda_1 \left( \frac{w_2 + (1 - \theta_2)B}{\gamma} - (1 - \alpha) \right) = 0, \quad (\text{A1})$$

$$\partial \mathcal{L} / \partial \theta_2 = \frac{B}{\gamma} ((2w_2 - (2\theta_2 - 1)B) - \lambda_1 (w_2 + (1 - \theta_2)B)) + \lambda_2 = 0, \quad (\text{A2})$$

$$\lambda_2 (\theta_2 - \underline{\theta}) = 0, \quad (\text{A3})$$

$$\lambda_1 \left( \frac{(w_2 + (1 - \theta_2)B)^2}{2\gamma} - (1 - \alpha)(w_2 + (1 - \theta_1)B) \right) = 0. \quad (\text{A4})$$

i) Suppose first that  $\lambda_1 = 0$ . Then, it follows from optimality conditions (A1) and (A2) that the set of candidate solutions consists of pairs  $\theta_2$  and  $w = \frac{(2\theta_2 - 1)B}{2}$  satisfying the search constraint. Furthermore, it follows then from (A2) that  $\lambda_2 = 0$ . Notice that the candidate solutions all give rise to the same profits for the firm. Inserting  $w = \frac{(2\theta_2 - 1)B}{2}$ , the search constraint reduces to

$$\frac{B^2}{8\gamma} \geq (1 - \alpha) \left( \frac{(2\theta_2 - 1)B}{2} + (1 - \theta_1)B \right), \quad (\text{A5})$$

which is relaxed as much as possible for  $\theta_2 = \underline{\theta}$ . Hence, whenever the set of candidate solutions is non-empty, the solution  $\theta_2 = \underline{\theta}$  and  $w = \frac{(2\underline{\theta} - 1)B}{2}$  is a part of it. Plugging  $\theta_2 = \underline{\theta}$  and  $w = \frac{(2\underline{\theta} - 1)B}{2}$  into (A5), we find that a candidate solution for which  $\lambda_1 = 0$  exists for  $\frac{B}{4\gamma(1 - 2(\theta_1 - \underline{\theta}))} \geq 1 - \alpha$ .

ii) Suppose instead that  $\lambda_1 > 0$ . Then, the optimality conditions (A1) and (A2) can be rewritten as:

$$-B(1 - \alpha)\lambda_1 + \lambda_2 = 0,$$

which implies that  $\lambda_2 > 0$ . The complementary slack conditions (A3) and (A4) then imply that  $\theta_2 = \underline{\theta}$  and that the wage is given by the solution to the search constraint for  $\theta_2 = \underline{\theta}$ . Because the search constraint is assumed to be binding, this is a valid solution for  $\frac{B}{4\gamma(1 - 2(\theta_1 - \underline{\theta}))} \leq 1 - \alpha$ .

## A.2 Proof of Lemma 3

From Lemma 2 we have that the expected profits if the firm induces searching are given by:

$$\pi_2^S(\theta_1) = \begin{cases} (\underline{\theta}B - w_2^S(\theta_1)) (w_2^S(\theta_1) + (1 - \underline{\theta})B) \frac{1}{\gamma} & \text{if } \theta_1 \leq \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)} \\ \frac{B^2}{4\gamma} & \text{otherwise} \end{cases}.$$

The function  $\pi_2^S(\theta_1)$  is increasing in  $\theta_1$  for  $\theta_1 \leq \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}$ , because  $(\underline{\theta}B - w_2^S(\theta_1)) (w_2^S(\theta_1) + (1 - \underline{\theta})B) \frac{1}{\gamma}$  is decreasing in  $w_2^S(\theta_1)$  for  $w_2^S(\theta_1) > \frac{(2\underline{\theta}-1)B}{2}$  and  $w_2^S(\theta_1)$  is decreasing in  $\theta_1$ . Calculations show that  $\pi_2^S(\theta_1)$  is concave in  $\theta_1$  for  $\theta_1 \leq \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}$ .

Define  $\varpi(\theta_1) := \pi_2^S(\theta_1) - (1 - \alpha)\theta_1 B$ . Calculations show that  $\varpi(\theta_1)$  is increasing (decreasing) in  $\theta_1$  for  $\theta_1 \leq (>) \hat{\theta} := \underline{\theta} + 2 - \frac{B}{2(1-\alpha)\gamma} - \frac{3(1-\alpha)\gamma}{2B}$  where  $\hat{\theta} < \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}$  in the region of  $(1 - \alpha)$  considered. Thus,  $\varpi(\theta_1)$  exhibits a global maximum for  $\theta_1 = \hat{\theta}$ . It can be verified that  $\varpi(\hat{\theta}) > 0$  for  $(1 - \alpha) < \frac{(1+\underline{\theta}-\sqrt{\underline{\theta}(2+\underline{\theta})})B}{4\gamma}$ . Under assumption A.3. there exists a non-empty region of  $(1 - \alpha)$  for which  $\varpi(\hat{\theta}) > 0$  iff.  $\frac{(1+\underline{\theta}-\sqrt{\underline{\theta}(2+\underline{\theta})})B}{4\gamma} > \frac{(2-\underline{\theta})B}{4\gamma} \iff \underline{\theta} < \frac{2}{3}$ .

Suppose that  $(1 - \alpha) < \frac{(1+\underline{\theta}-\sqrt{\underline{\theta}(2+\underline{\theta})})B}{4\gamma}$  and  $\underline{\theta} < \frac{2}{3}$  such that  $\varpi(\hat{\theta}) > 0$ . Assumption A.3 implies that it is not profitable to induce searching for  $\theta_1 = \theta_2 = \underline{\theta}$ . Hence,  $\varpi(\underline{\theta}) < 0$ . Furthermore, it can be verified that  $\varpi\left(\frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}\right) < 0$  for the values of  $(1 - \alpha)$  considered. It follows then from the concavity and continuity of  $\varpi(\theta_1)$  that there exists a region  $(\tilde{\theta}_L, \tilde{\theta}_H)$  around  $\hat{\theta}$  for which  $\varpi(\theta_1) > 0$ ,  $(\tilde{\theta}_L, \tilde{\theta}_H) \subset \left[\underline{\theta}, \frac{1}{2} + \underline{\theta} - \frac{B}{8\gamma(1-\alpha)}\right]$ . Hence, the firm will encourage a successful employee to search in the second period iff.  $\theta_1 \in (\tilde{\theta}_L, \tilde{\theta}_H)$ .

## A.3 Proof of Proposition 4

Suppose that the conditions in Lemma 3 are fulfilled. Then, there exist  $\theta'$  and  $\theta''$  such that  $\theta_1 = \theta'$  leads to searching in the second period in the case of success whereas  $\theta_1 = \theta''$  does not. Since the firm chooses to induce searching by offering a positive monetary bonus for  $\theta_1 = \theta'$ , we have that  $\pi_2^S(\theta') \geq (1 - \alpha)\theta' B$ . Furthermore, because the employee chooses to search, it must hold that  $U_2^S(\theta') \geq (1 - \alpha)(w + (1 - \theta')B)$  where  $U_2^S(\theta')$  ( $(1 - \alpha)(w + (1 - \theta')B)$ ) is the utility from searching (not searching). Hence, given that  $w \geq 0$ , we have that

$$\begin{aligned} E(S_2(\theta')|s) &= \pi_2^S(\theta') + U_2^S(\theta') \geq (1 - \alpha)B(\theta' + w + (1 - \theta')) \geq (1 - \alpha)B \Leftrightarrow \\ E(S_2(\theta')|s) &\geq (1 - \alpha)B = E(S_2(\theta'')|s). \end{aligned}$$

It follows then from (10) that the firm chooses  $\theta_1$  such that there is search in the second period in the case of success. Furthermore, conditional on the employee searching and  $\theta_2 = \underline{\theta}$ , the social

surplus can be written as:

$$E(S_2(\theta_1)|s) = \frac{((1 - \underline{\theta})B + w_2^S(\theta_1))B}{\gamma} - \frac{((1 - \underline{\theta})B + w_2^S(\theta_1))^2}{2\gamma},$$

where  $w_2^S(\theta_1)$  is the monetary bonus as a function of  $\theta_1$ . As  $\partial E(S_2(\theta_1)|s)/\partial w > 0$  and  $\partial w_2^S(\theta_1)/\partial \theta_1 < 0$ , it follows again from (10) that the optimal choice of  $\theta_1$  for the firm is the minimal value of  $\theta_1$  that induces searching in the second period,  $\tilde{\theta}_L$ .



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