# DYNAMIC INCENTIVES IN ORGANIZATIONS: SUCCESS AND INERTIA*

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We present a two-period model in which an employee searches for business projects in a changing environment. An employee who discovers a profitable project in period 1 is reluctant to search again in period 2 because the old project may continue to be profitable. Management's response to this inertial tendency is either to increase the financial incentives to encourage searching or to accept no searching. The former response increases search efforts and total profits; the latter response has the opposite results. Inertia can be removed by restructuring the firm in period 2, but this may create a time-inconsistency problem.

## 1 Introduction

Innovation is a major source of competitive advantage and a key determinant of firm survival in many industries. Still, empirical evidence suggests that firms tend to maintain the status quo for too long, thereby losing market shares and missing out on new business opportunities. These inertial tendencies appear to be more pronounced in successful firms, and business history is fraught with examples of market leaders that failed as market conditions took a critical turn; see Chesbrough (2003) and the references cited therein.

One question surrounding the notion of inertia is why firms appear to be unable or unwilling to provide contractual or organizational incentives for employees to look for new business opportunities. Kaplan and Henderson (2005) argue that firms' incentive schemes are multi-faceted and require careful thought and adjustment to the environment. Thus, a change in the environment that calls for a new strategy may cause existing incentive systems to be less effective managerial instruments. This appears to apply especially

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to incentive systems designed to motivate innovation which tend to be more complex than the schemes aimed at running existing assets well (Manso, 2011). While these are important observations, the contractual challenges are not tied naturally to past success.

In this paper, we offer an agency-based explanation for why firms with records of success are particular prone to experiencing inertial tendencies among their employees and why monetary incentives may be ineffective for facilitating change. In contrast to most of the existing literature, we take a dynamic perspective on inertia. We show that inertial tendencies among employees are costly to the firm *ex post*, but that their cost may be outweighed by the higher levels of effort provided *ex ante*.

We develop a simple, two-period principal–agent model in which the firm's management hires an employee for two periods to search for and to implement a project in each period. Management neither observes the employee's search process nor the details of the project, so the only incentive scheme available is payment of a bonus to the employee if the project is successful. The firm operates in a changing environment, which makes it difficult to design robust, long-term incentive schemes. Hence, incentives are offered on a period-by-period basis.

Success in the first period creates the tendency for the firm to stay on the current course of action in the second period. The underlying reason is a moral hazard problem, which is particular to successful firms: since the current project may continue to be successful, it is tempting for the employee to continue with this project rather than to invest effort in searching for a new one. Note that monetary incentives are ineffective in resolving this agency problem since a bonus increases the pay-off both from searching for a new project and from staying with the old one. *Inertia* is said to arise whenever this moral hazard problem reduces profit in the second period compared with a benchmark in which it is possible to tie project choice to employee search.[1]

We show that circumstances exist when the employee's possibility to reemploy a previously successful project exacerbates the agency problem and causes inertia. Management reacts to this problem in one of two ways: either to encourage searching by offering a higher bonus or refraining completely from incentivizing search efforts. These two possible reactions have very different implications for the parties involved. If searching is encouraged, search efforts are stimulated, but not only in the second period. The employee foresees that first-period success results in higher-powered incentives and greater informational rents in the second period compared with failure and, thus, exerts higher search effort also in the first period. The employee's

[1]Thus, our definition of inertia captures the existence of an inertial tendency inside the firm, independently of how this tendency is manifested in the choices made by principal and agent.

reluctance to search again commits management to offering a higher reward for second-period success, which results in higher total pay-offs to employee and firm compared with the benchmark. However, if it is too costly to incentivize searching, search efforts in both periods are reduced, leading to lower total pay-offs to employee and firm. This illustrates how focusing only on the negative effects of inertia *ex post* may miss important dynamic effects that appear *ex ante*.

Management also may employ organizational measures in order to manage inertia and to improve profit. We show that allowing the employee to appropriate a larger fraction of the project value as private benefits, e.g. through limiting monitoring of how projects are run, increases the parameter space in which reluctance to search becomes a beneficial commitment device for management. Another set of measures, aimed at removing inertia completely, includes 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 search for a profitable project in their new area of responsibility. While restructuring increases second-period profit by removing inertia, it increases overall profit only if inertia results in no searching in the second period. Then management may face a time-inconsistency problem and may try to find ways to commit to not restructuring.

The paper is organized as follows. Below we discuss the related literature. Section 2 presents the basic model. In Sections 3 and 4 the model is solved, inertia is defined, and the consequences of inertia are discussed. Different ways of responding to inertia—and the hazards of doing so—are discussed in Section 5. Alternative contracting assumptions are discussed in Section 6, and Section 7 offers some concluding remarks.

### *1.1 Related Literature*

Various works in industrial organization, organizational theory and management strategy identify reasons why established firms may fail to pursue and adopt innovation (Hill and Rothaermel, 2003). In the industrial organization literature, the focus is on market competition, and it has been argued that an incumbent firm has less incentive to invest in product innovation because the new product will replace the old one (Arrow, 1962; Reinganum, 1983). Organizational theorists, however, stress that structures and routines, which improve performance in a stable environment, are difficult to alter in the face of environmental change (Hannan and Freeman, 1984) and reduce the scope of search (Cyert and March, 1963; Nelson and Winter, 1982). Furthermore, even if an innovation is identified, the decision to adopt it has important redistributional effects within the organization and, thus, is liable to creating time-consuming and costly influence activities (Pfeffer, 1982; Meyer *et al.*, 1992). Finally, the strategy literature emphasizes that incumbent firms' relationships with suppliers and customers may cause them to miss disruptive technologies that initially appear to be of no interest to current customers or which require different suppliers (Christensen, 1997).

These theories of inertia tend to focus on the point in time when the inertial tendencies already exist inside the firm. We would argue that inertia is a phenomenon that is inherently dynamic and should be analyzed in a dynamic framework. With the notable exception of Boyer and Robert (2006), we are not aware of other formal analyses that address the dynamic aspects of innovation and inertia. Boyer and Robert (2006) consider a two-period model in which a project is chosen in the first period. In the second period, a more profitable project becomes available, but because its implementation might result in additional rents to the agent, the principal may decide to continue with the first-period project. This outcome is defined as inertia. However, their model cannot capture why successful firms are particularly prone to experiencing inertia. Also, the authors do not discuss organizational solutions to manage inertia.

Our model shares some central features or assumptions with a number of papers in different strands of the literature. The source of inertia in our model is essentially a sunk cost problem: if the employee has searched for and found a successful project in the first period, she has an incentive to try to save on search costs in the second period. A similar sunk cost problem arises when the employee invests her reputation in promoting the current project (Prendergast and Stole, 1996).

In our model, we follow Kaplan and Henderson (2005) and assume that underlying uncertainty regarding the environment prevents long-term contracting. We extend this argument by providing a fully specified model to analyze the implications of this assumption. Several studies explore different sources of contractual incompleteness that arise in an innovation context and how they affect the management of innovation. Manso (2011) shows that, under conventional incentive schemes, the high probabilities of failure associated with innovation make these projects unattractive for employees. Similarly, if the innovation falls outside the available performance measures, employees may prefer standard tasks that can be measured using existing performance indicators (Holmström, 1989; Hellmann and Thiele, 2011).

The literature on dynamic moral hazard problems shows that the optimal incentive scheme in a given period depends on past outcomes during the employment relationship (Rogerson, 1985; Fudenberg *et al.*, 1990). Our framework differs from the standard moral hazard framework since high performance by the employee exacerbates the moral hazard problem in the next period. A general result in this literature is that deferred compensation can be an efficient way to provide effort incentives to employees, and in Section 6 we discuss why deferred compensation may also serve to avoid costly inertia.

## 2 A Model of Organizational Inertia

### 2.1 Players

The management of a firm—the principal—hires an employee—the agent—for two periods, $t = 1, 2$, to search for and implement profitable projects. Management and employee are risk-neutral[2] and respectively maximize expected profit and utility. For simplicity, we set the common discount factor to 1. The employee is credit and wealth constrained, so all compensation payments must be non-negative. This is also the case in period 2 where any first-period salary awarded to the employee is assumed to be consumed before the start of the period.

### 2.2 Projects

In each of the two periods the employee pursues one from a continuum of projects with a duration of one period. The projects we envisage represent significant levels of innovation. They are not limited to new products but include changes to production process, or marketing or distribution systems.

While the projects appear identical *ex ante*, in period $t$ only one of the projects is profitable with a value normalized to 1. This project is denoted $x_t^*$. All other projects are of zero value. The profitable project in period 1 may also be the profitable project in period 2. The optimal projects in both periods are identical with the probability $\alpha \in [0, 1]$. One can envisage the complementary probability $(1 - \alpha)$ as the probability of a change in consumer preferences or the technology frontier that requires major redirection of the firm's activities. In the following, we refer to the level of $\alpha$ as the degree of stability of the firm's environment.

We assume that management cannot extract the entire value of a profitable project; a fraction $(1 - \theta)$ of this value is appropriated privately by the employee. The employee's benefit can be monetary or non-monetary in nature. For example, if running the project involves an additional moral hazard problem, $(1 - \theta)$ could be an informational rent that is paid to the employee in order to realize the gross value of 1. Alternatively, it could be that the employee runs the project in the way that benefits her career rather maximizing the firm's profit. In order to reduce the number of case distinctions, but without loss of insight, it is assumed that $\theta \in (\frac{2}{3}, 1)$. Thus, the major part of the project value is non-private.

### 2.3 Project Search

The employee is hired in each period in order to identify $x_t^*$ and to implement the project. Management is assumed not to be involved in the search process;

[2] The assumed risk-neutrality of the employee is not crucial for the results.

for example, because it does not have the required time or ability. The employee's search effort 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 the projects of zero value is signaled with equal probability. Because there is a continuum of projects, each of those projects is signaled with probability zero. Acquiring information is costly for the employee. Her private cost $\frac{1}{2}\gamma q_t^2$ is increasing in the expected quality of the signal. We assume that $\gamma \geq 1$ in order to exclude corner solutions in the employee's choice of $q_t$. Notice that an employee who identified $x_1^*$ has two signals about the identity of the profitable project in period 2, $x_1^*$ and $\tilde{x}_2$. These two signals are assumed to be conditionally independent.

### *2.4 Information and Contracting*

The search effort and the details of the implemented project are information private to the employee. Hence, the two parties can contract neither on the search effort exerted nor on the nature of the project. In the second period, this implies that compensation cannot be made contingent on whether the project implemented is the result of a search process and whether it is identical to $x_1^*$.

The profit realized from the project is verifiable and is used as the basis for a performance-sensitive compensation contract. However, the implementation of such a contract requires careful specification and measurement of the individual employee's contribution to profit. Due to events that are unforeseen or difficult to describe, its specification is difficult *ex ante* and/or costly in dynamic environments.[3] This holds especially for the long-term, because such contingencies arise over time and their relevance, therefore, accumulates. To implement these notions in a simple way, we assume that contracting is complete for one period but impossible for two.

Consistent with the above assumptions, management offers to the employee at the beginning of each period, a compensation contract that specifies a non-negative bonus, $w_t$, in the event of strictly positive profit during period $t$. The employee has a reservation utility equal to zero, so management does not need to pay a fixed wage to ensure her participation.

### *2.5 Timing*

The timing of decisions and events is depicted in Fig. 1.

## 3 The Second Period

In this section, we solve for the equilibrium in period 2 when inertia may manifest itself. The focus, therefore, is on the cause and *ex post* consequences

[3]These reasons for contract incompleteness were early emphasized by Williamson (1985) (see also Hart and Moore, 1999; Tirole, 1999).

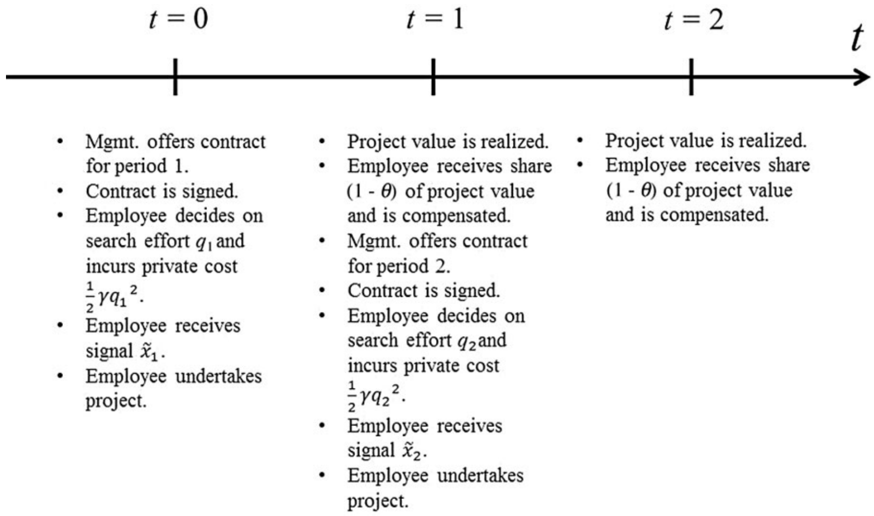


FIG. 1. Timing of Events and Decisions

of inertia. Rather than solving separately for the equilibrium in the subgames following first-period success and failure, we analyze a slightly more general set-up that encompasses both subgames.

In the first period the employee has implemented a project $\tilde{x}_1$ that is known to be identical to $x_2^*$ with probability $\beta$. In addition, she receives a signal $\tilde{x}_2$ that is conditionally independent of the signal $\tilde{x}_1$ and that correctly indicates $x_2^*$ with probability $q_2$.

Suppose that the employee searches for a new project, because she plans to implement a project based on the signal $\tilde{x}_2$. When choosing her search effort, the employee maximizes:

$$q_2[(1-\theta)+w_2]-\frac{1}{2}\gamma q_2^2$$

trading off her expected benefit from searching—in the form of an exogenous share of the project value, $(1-\theta)$, and a bonus if successful, $w_2$—with her private search cost. Note however that any signal $\tilde{x}_2$ that indicates the successful project with a probability $q_2$ below $\beta$ is worthless, because the employee ignores it when selecting among projects. Thus, the employee either refrains from searching, which implies an expected utility of $\beta[w_2 + (1-\theta)]$, or exerts sufficient search effort to ensure that $q_2$ is greater than $\beta$. The following lemma compares these two options.

*Lemma 1:* Suppose the employee knows a project $\tilde{x}_1$ that is identical to $x_2^*$ with probability $\beta$. If the following condition holds:

$$\frac{w_2 + (1-\theta)}{2\gamma} \geq \beta \qquad (1)$$

the employee exerts the effort $q_2(w_2) = [w_2 + (1-\theta)]/\gamma$ and implements the project $\tilde{x}_2$. Otherwise, the employee does not search, $q_2 = 0$, and implements the project $x_1^*$.

Notice that if $\beta$ is sufficiently large, $\beta \geq (1-\theta)/2\gamma$, the wage necessary to induce searching is increasing in $\beta$.

### *3.1 Benchmark: Verifiable Project Search*

The novel feature of our framework is the employee's possibility to implement $\tilde{x}_1$ again, in period 2, without searching. Before turning to the full model, let us consider a benchmark case where this possibility is removed. In particular, we assume management is able to verify the signal from the new search process, $\tilde{x}_2$.[4] Then management contractually can tie the choice of project to the source of information. Specifically, management is able to stipulate in the contract that the project $\tilde{x}_2$ is implemented in period 2. We still assume that the employee's search effort cannot be verified.

By allowing management to specify that $\tilde{x}_2$ is selected, the impact of $\tilde{x}_1$ on second period project choice and, therefore, on the employee's search incentive is eliminated. Technically, this removes the search constraint (1) from management's problem. Management identifies the optimal contract by comparing two arrangements: first, $\tilde{x}_2$ is selected and $w_2$ maximizes the expected profit $(\theta - w_2)q_2(w_2)$, and second, $\tilde{x}_1$ is selected again and $w_2 = 0$.

The following lemma summarizes the optimal contract and the pay-offs in the benchmark case.

*Lemma 2:* (Benchmark) Suppose that it is possible to verify the signal from the second-period search process, $\tilde{x}_2$. If $\beta \leq 1/\theta 4\gamma$, the optimal contract stipulates that $\tilde{x}_2$ is implemented in period 2 and specifies $w_2^{\mathrm{b}} = \frac{1}{2}(2\theta - 1)$. Otherwise, the optimal contract does not tie project selection in period 2 to $\tilde{x}_2$ and specifies $w_2^{\mathrm{b}} = 0$. Second period profit and utility are:

$$\pi_2^{\mathrm{b}}(\beta) = \begin{cases} \dfrac{1}{4\gamma} & \text{for} \quad \beta \leq \dfrac{1}{\theta 4\gamma} \\ \beta\theta & \text{otherwise} \end{cases} \qquad (2)$$

[4]This requires not only management but also a court of law must be able to evaluate the employee's arguments in support of the project choice, and to judge whether these arguments contain new information.

$$u_2^{b}(\beta)=\begin{cases}\dfrac{1}{8\gamma} & \text{for} \quad \beta\le\dfrac{1}{\theta 4\gamma}\\ \beta(1-\theta) & \text{otherwise}\end{cases} \tag{3}$$

The optimal contract stipulates that the signal generated by searching determines the project chosen in period 2 for low values of $\beta$. For high values of $\beta$, the first-period project is likely to be the successful project in period 2. It is not profitable to induce the employee to exert sufficient effort that the signal $\tilde{x}_2$ is more informative about the optimal project than $\tilde{x}_1$. Therefore, the contract does not specify that project choice is tied to $\tilde{x}_2$ and sets a zero bonus in case of project success. It is then not optimal for the employee to search for a new project.

### 3.2 *The Equilibrium Contract*

We now turn to the full problem where management has to take account of the search constraint (1). One possible solution is to incentivize the employee to search for a new project. Then management maximizes firm profit, $(\theta - w_2)q_2(w_2)$, subject to the search constraint (1). The alternative is not to encourage searching and to set $w_2 = 0$. Comparing these two solutions yields the following equilibrium contract and pay-offs:

*Lemma 3:* The optimal wage in the second period is:

$$w_2(\beta)=\begin{cases}\dfrac{2\theta-1}{2} & \text{for} \quad \dfrac{1}{4\gamma}\ge\beta\\ 2\gamma\beta-(1-\theta) & \text{for} \quad \dfrac{1}{4\gamma}<\beta\le\dfrac{2-\theta}{4\gamma}\\ 0 & \text{otherwise}\end{cases} \tag{4}$$

The second period profit and utility are:

$$\pi_2(\beta)=\begin{cases}\dfrac{1}{4\gamma} & \text{for} \quad \dfrac{1}{4\gamma}\ge\beta\\ 2(1-2\gamma\beta)\beta & \text{for} \quad \dfrac{1}{4\gamma}<\beta\le\dfrac{2-\theta}{4\gamma}\\ \beta\theta & \text{otherwise}\end{cases} \tag{5}$$

$$u_2(\beta)=\begin{cases}\dfrac{1}{8\gamma} & \text{for} \quad \dfrac{1}{4\gamma}\ge\beta\\ 2\gamma\beta^2 & \text{for} \quad \dfrac{1}{4\gamma}<\beta\le\dfrac{2-\theta}{4\gamma}\\ \beta(1-\theta) & \text{otherwise}\end{cases} \tag{6}$$

The equilibrium contract is almost identical to the benchmark, except for two cases. First, for $1/4\gamma < \beta \leq (2-\theta)/4\gamma$ the search constraint (1) binds in the solution, and management optimally increases the bonus relative to the one in the benchmark case in order to incentivize searching. Second, for $(2-\theta)/4\gamma < \beta \leq 1/\theta 4\gamma$ the option of proposing $x_1^*$ without searching is so attractive for the employee that the cost of inducing search effort outweighs the associated benefit. Hence, there is searching in the benchmark case but not in the full model where the set of feasible contracts is more restricted.

We can now formally define inertia within our framework:

*Definition 1:* Inertia arises for $\beta \in (1/4\gamma, 1/\theta 4\gamma)$ where profit in the second period is reduced relative to the benchmark because of the employee's possibility to implement $\tilde{x}_1$ without searching for a new project.

In other words, according to our definition, inertia arises whenever the search constraint (1) affects the equilibrium outcome and results in lower profit in the second period.[5] When $\beta \leq (2-\theta)/4\gamma$, the signal created by the first-period project is sufficiently imprecise to leave the employee's search incentives unaffected in equilibrium. In contrast, when $\beta > 1/\theta 4\gamma$, the signal obtained through the first-period project is relatively precise and the profit from implementing $x_1^*$ again is high. Specifically, the profit is higher than the profit that would result from the employee's search effort even were her search incentives not impaired by the knowledge of $x_1^*$. In that case, there is no inertia even though search is not undertaken in equilibrium.

The region of inertia diminishes in $\theta$ and disappears for $\theta = 1$.[6] To see why, note from equation (5) that profit is independent of $\theta$ if searching by the employee is induced but increasing in $\theta$ if no searching is induced. Therefore, no searching becomes a more attractive option for management as $\theta$ increases, which reduces the importance of the search constraint (1) and diminishes the region of the parameter space in which inertia occurs.[7]

Lemma 3 allows us to relate the two first-period outcomes, project failure and project success, to the occurrence of inertia. If the project failed in the first period, then $\tilde{x}_1 \neq x_1^*$ and $\beta = 0$; the project implemented in the first period fails with probability 1 in the second period. This implies that there

[5]There is always a reluctance to exert search effort in principal–agent models of this type because the employee carries the full cost of searching, but receives only a share of the benefit from searching. However, the definition of inertia identifies the additional inertial tendency that arises in our model because of the employee's possibility to propose $x_1^*$ without searching.

[6]Note that while the region of inertia decreases in $\theta$, this does not carry over to the overall level of agency cost as measured by the difference between the first-best and the second-best effort. The first-best effort is independent of $\theta$, but an increase in $\theta$ may either increase, decrease or not affect the second-best effort depending on $\beta$ (see also footnote 5).

[7]Inertia disappears for $\theta = 1$, i.e. in the absence of private benefits of the employee. This is specific to the concrete model assumptions. For example, there exist alternative effort cost functions that generate inertia even for $\theta = 1$.

is no inertia after first-period failure. Using the pay-offs in Lemma 3, second-period bonus, firm profit and employee utility are given, respectively, by $w_2^{\mathrm{f}} = (2\theta - 1)/2$, $\pi_2^{\mathrm{f}} = 1/4\gamma$ and $u_2^{\mathrm{f}} = 1/4\gamma$. Superscripts 'f' indicate first-period failure.

If instead the project is successful, then $\tilde{x}_1 = x_1^*$ and $\beta = \alpha$. Inertia arises for stable, but not overly stable firm environments. Second-period bonus, profit and utility are given in Lemma 3 and are denoted by $w_2^{\mathrm{s}}(\alpha)$, $\pi_2^{\mathrm{s}}(\alpha)$ and $u_2^{\mathrm{s}}(\alpha)$ respectively. Superscripts 's' indicate first-period success.

Since our primary interest is the effects of inertia, in the following we focus on parameters where first-period success leads to inertia in the subsequent period:

*Assumption 1:*

$$\alpha \in \left( \frac{1}{4\gamma}, \frac{1}{\theta 4\gamma} \right)$$

## 4 The First Period

Solving the game backwards in order to find the Subgame Perfect Nash Equilibrium, we turn to the first-period decisions.

The employee considers the total (i.e. two-period) utility when choosing $q_1$. Hence, her first-period problem is:

$$\max_{q_1} \left\{ q_1 \left[ w_1 + (1-\theta) + u_2^{\mathrm{s}}(\alpha) \right] + (1-q_1) u_2^{\mathrm{f}} - \frac{1}{2} \gamma q_1^2 \right\}$$

which implies a search effort of:

$$q_1(w_1) = \frac{1}{\gamma} \left[ w_1 + (1-\theta) + \left( u_2^{\mathrm{s}}(\alpha) - u_2^{\mathrm{f}} \right) \right]$$

Not surprisingly, all else being equal, the higher the additional second-period utility that comes with success, $\left( u_2^{\mathrm{s}}(\alpha) - u_2^{\mathrm{f}} \right)$, the higher the employee's first-period search effort.

Management's first-period maximization problem also has a two-period perspective and can be written as:

$$\max_{w_1} \left\{ q_1(w_1) \left( \theta - w_1 + \pi_2^{\mathrm{s}}(\alpha) \right) + (1 - q_1(w_1)) \pi_2^{\mathrm{f}} \right\}$$

which implies an optimal first-period wage of:

$$w_1(\alpha) = \frac{1}{2} \left[ (2\theta - 1) + \left( \pi_2^{\mathrm{s}}(\alpha) - \pi_2^{\mathrm{f}} \right) - \left( u_2^{\mathrm{s}}(\alpha) - u_2^{\mathrm{f}} \right) \right]$$

The first-period bonus is positively associated with the additional second-period profit that is generated by success, $\left( \pi_2^{\mathrm{s}}(\alpha) - \pi_2^{\mathrm{f}} \right)$. However, the optimal bonus is decreasing in $(u_2^s(\alpha)-u_2^f)$, as $w_1$ and $(u_2^s(\alpha)-u_2^f)$ are substitutes in providing incentives.

Inserting $w_1(\alpha)$ into the profit and utility functions yields total profit $\Pi(\alpha)$ and total utility $U(\alpha)$ in equilibrium:

$$\Pi(\alpha)=\frac{1}{4\gamma}\left[1+(\pi_2^s(\alpha)-\pi_2^f)+(u_2^s(\alpha)-u_2^f)\right]^2+\pi_2^f \tag{7}$$

$$U(\alpha)=\frac{1}{8\gamma}\left[1+(\pi_2^s(\alpha)-\pi_2^f)+(u_2^s(\alpha)-u_2^f)\right]^2+u_2^f \tag{8}$$

At first glance, it might seem surprising that each party benefits from a *ceteris paribus* increase in the *other* party's second-period pay-off in the case of first-period success. Total employee utility increases in $\pi_2^s(\alpha)$, because a higher $\pi_2^s(\alpha)$ enhances management's willingness to incentivize first-period search effort. Total profit increases in $u_2^s(\alpha)$, because the employee's first-period search effort is increasing in $u_2^s(\alpha)$. As a consequence management takes account of the employee's utility, and is willing to sacrifice some of its second-period profit so long as doing so increases the second-period surplus, $\pi_2^s(\alpha)+u_2^s(\alpha)$.

### 4.1 *Inertia*

The *ex ante* effects of inertia can be evaluated by comparing the total equilibrium and benchmark pay-offs. Solving for the first-period decisions in the same way as above, total benchmark pay-offs can be derived as:

$$\Pi^b(\alpha)=\frac{1}{4\gamma}\left[1+(\pi_2^b(\alpha)-\pi_2^f)+(u_2^b(\alpha)-u_2^f)\right]^2+\pi_2^f \tag{9}$$

$$U^b(\alpha)=\frac{1}{8\gamma}\left[1+(\pi_2^b(\alpha)-\pi_2^f)+(u_2^b(\alpha)-u_2^f)\right]^2+u_2^f \tag{10}$$

Comparing $\Pi^b(\alpha)$ and $\Pi(\alpha)$ shows that:

$$\Pi(\alpha)\geq\Pi^b(\alpha)\Leftrightarrow\Delta S_2(\alpha)\geq 0 \tag{11}$$

where $\Delta S_2(\alpha):=\pi_2^s(\alpha)+u_2^s(\alpha)-(\pi_2^b(\alpha)+u_2^b(\alpha))$. Hence, the effect of inertia on total profit and utility can be evaluated by comparing the second-period surplus in case of first-period success in equilibrium to the benchmark case. Note that any pure redistributional effects of inertia are inconsequential from an *ex ante* perspective.

In the following proposition, equation (11) is used to establish the *ex ante* effects of inertia.

*Proposition 1:* The effect of inertia on the players' total pay-offs:

(i) For $1/4\gamma < \alpha \leq (2-\theta)/4\gamma$, inertia increases employee utility and firm profit. It results in higher first-period and second-period search efforts compared with the benchmark.

(ii) For $(2-\theta)/4\gamma < \alpha < 1/4\theta\gamma$, inertia decreases employee utility and firm profit. It results in lower first-period and second-period search efforts compared with the benchmark.

Proposition 1 shows that inertia has very different consequences depending on the degree of stability of the environment and the ensuing reaction of management to the inertial tendency that arises following first-period success.

In case (i) of the proposition, the degree of stability is sufficiently high for inertia to arise, but still low enough to make it profitable for management to induce searching. Inertia, therefore, results in a higher bonus in the second period. Interestingly, this stimulates search efforts not just in the second period. The employee foresees that first-period success will result in higher-powered incentives and higher informational rents in the second period compared with the benchmark case and, thus, exerts a higher effort also in the first period. Inertia brings the search effort closer to the one that a hypothetical owner-manager (who maximizes total surplus) would choose, and results in larger total surplus compared with the benchmark, $\Delta S_2(\alpha) \geq 0$.[8] The employee and management share this additional surplus—and both benefit from inertia. This illustrates how inertia can serve as a commitment device for management to offer higher-powered incentives with higher informational rents. Because the level of search effort is positively related to innovation, the presence of (not too strong) inertial tendencies may not only generate additional profit but also spur innovation. Thus, focusing exclusively on the negative effect of inertia on second period profit may ignore important dynamic effects.

In case (ii), the inertial tendency is sufficiently strong that it is not profitable for management to induce searching in the second period. However, searching would be total surplus enhancing since the employee would enjoy additional informational rents—rents that management does not internalize in deciding about the incentive scheme in the second period. The choice not to induce searching undermines the employee's first-period search effort. Hence, inertia results in lower search efforts in both periods as well as a reduction in total surplus compared with the benchmark. Since employee and shareholders split the loss in total surplus, inertia is costly. Here, management is hurt by its inability to commit to inducing searching in

[8]There is a general problem in the model of underinvestment in effort resulting from the moral hazard problem and management's inability to extract the employee's informational rents. Total surplus, therefore, is increasing in the search effort in the relevant range.

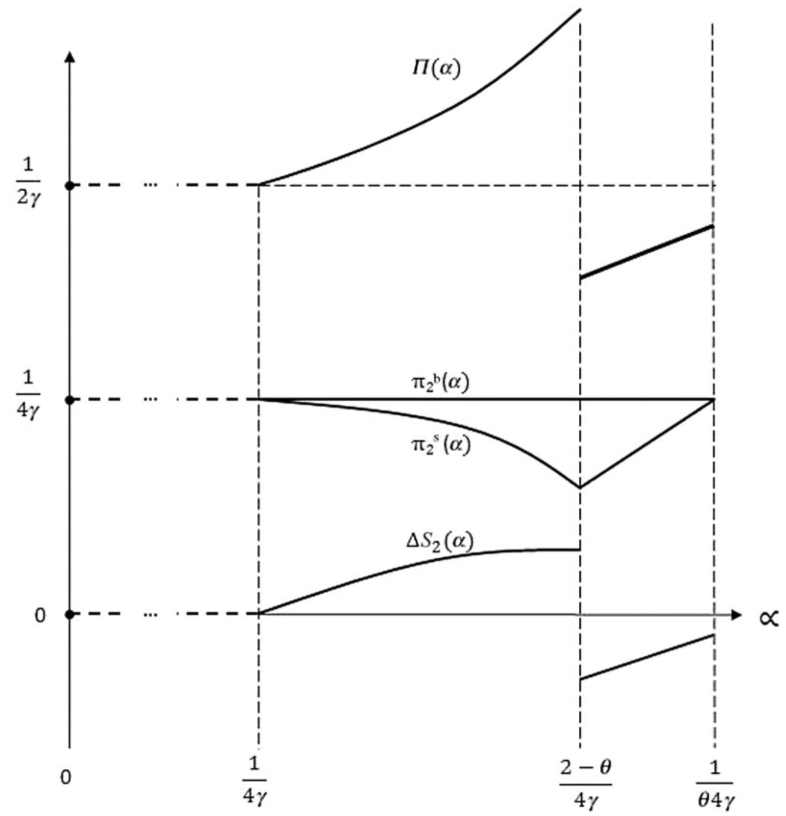


FIG. 2. The Possibly Dramatic Differences in Total Profit for the Two Inertia Regimes
The figure depicts the total profit, $\Pi(\alpha)$, the second-period profit, $\pi_2^s(\alpha)$, and the difference in second-period surplus in the equilibrium and in the benchmark cases, $\Delta S_2(\alpha)$, as a function of $\alpha$.

the second period. Innovation suffers in the period in which inertia arises, and also the first-period success rate is compromised in anticipation of inertia.

Figure 2 illustrates the possibly dramatic differences in total profit for the two inertia regimes. Because of the opposing effects of inertia on employee search, a small increase in the stability of the environment may lead to a large decrease in profits.

## 5 IMPLICATIONS

### *5.1 The Employee's Ability to Appropriate Benefits*

In the absence of inertia, the firm's expected profit is independent of the employee's ability to appropriate benefits while implementing the project,

$(1 - \theta)$. This is because a lower level of $(1 - \theta)$ can be replaced by an increase in the bonus leaving the firm's profit unchanged. If, on the other hand, inertia is present, the firm's profit depends on $(1 - \theta)$ because its value has an effect on whether search is induced in the second period (see Proposition 1): a higher $(1 - \theta)$ reduces the firm's second-period profit if searching is not induced, making the management more inclined to set a bonus that generates search.

*Proposition 2:* For any $\alpha \in (1/4\gamma, 1/\theta 4\gamma)$, there exist admissible parameters in which the total profit strictly increases if the employee's ability to appropriate rents, $(1 - \theta)$, increases. The opposite does not hold.

Proposition 2 follows from the observation that an increase in $(1 - \theta)$ expands (contracts) the region characterized in Proposition 1 for which inertia increases (decreases) the total pay-off to management and employee. This result has implications for job design. For example, management may limit its monitoring of how the employee runs a project. This increases the employee's ability to expand her personal network and further her career, or to enjoy perquisites.[9]

An alternative interpretation of $(1 - \theta)$ is that it represents the salary that the employee must be paid to avoid her leaving the firm and implementing the project elsewhere. One implication of Proposition 2, then, is that management may not find it optimal to limit the employee's bargaining power in retention negotiations. This can be achieved, for example, by not including a non-compete clause in the employment contract, or by providing the employee with sole access to critical assets.[10]

### 5.2 *Restructuring*

For the range $(2-\theta)/4\gamma < \alpha \leq 1/\theta 4\gamma$, it is too expensive to provide the employee with monetary incentives to search for a new project. Since the lack of search effort reduces second-period profit, management has an incentive to use non-contractual instruments of incentive provision to induce searching. To do so, management can use its ownership rights to restructure the employee's access to the firm's assets. One way to provide search incentives is to reorganize the firm in the second period in such a way that the employees' individual tasks and responsibilities change. Reorganization forces employees to find ways to accomplish their new tasks efficiently and to invest in acquiring information in the second period. Thus,

[9]In arguing that granting the employee more autonomy alleviates the firm's commitment problem and results in higher-powered incentives, the model complements arguments that emphasize the incentive effects of autonomy and the possibility to separate different types of employees (see Gambardella *et al*., 2010).

[10]See Feinstein and Stein (1988) for the effect of task assignment on employee bargaining power.

for the given parameter range, the resulting profit is identical to the profit in the benchmark case.[11]

Alternatively, instead of reorganizing tasks, management can maintain constant assignment of tasks to positions, but rotate employees among positions. Another possibility would be to hire new employees every period. While the focus of these instruments is on the person/employee rather than the rearrangement of tasks, they mean that the employee is unable to rely on past experience for the performance of her (new) task. Therefore, if one abstracts from transaction costs, the use of these instruments has identical implications to a reorganization.[12] In the following, we use the term *restructuring* to refer to all three types of instruments.

For the range $1/4\gamma < \alpha \leq (2-\theta)/4\gamma$ management has an incentive to restructure in order to reduce the bonus necessary to induce searching. However, the anticipated restructuring decision reduces the employee's first-period effort and total profit. Thus, the possibility to restructure may cause a time-inconsistency problem for management.

*Proposition 3:* If management can restructure after the first period, it will do so for all parameters where inertia arises, $\alpha \in (1/4\gamma, 1/\theta 4\gamma)$. Restructuring decreases total profit for $1/4\gamma < \alpha \leq (2-\theta)/4\gamma$ but increases it for $(2-\theta)/4\gamma < \alpha < 1/4\theta\gamma$.

Because management finds it *ex post* optimal to apply restructuring measures in cases where doing so reduces total profit, it may have an incentive to commit to not applying such measures. Management may try to secure commitment power by increasing the cost of restructuring. To make both reorganization and job rotation more costly, management can, for example, choose an employment structure that is dominated by specialists rather than generalists. Hiring predominantly specialists entails higher costs of employee re-training when their tasks change.[13] In the context of employment duration, management may be able to commit to not replacing successful employees after the first period by offering severance pay. Another possibility would be to include continued employment into the contract as a part of the reward for success, a solution that resembles the academic system of tenure (McPherson and Winston, 1983).

[11]We assume that a reorganization does not introduce any costs or benefits apart from those arising endogenously due to 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.

[12]Job rotation is a policy commonly thought to facilitate employee learning (Campion *et al.*, 1994). Our analysis is consistent with this explanation, but stresses that while job rotation provides new possibilities for employee learning, it increases the need for learning as well.

[13]Some evidence supporting this notion is provided in Eriksson and Ortega (2006), who show that the use of job rotation is negatively correlated to the heterogeneity of the firm's workforce.

## 6 Discussion: Alternative Contracting Assumptions and Multiple Periods

In this section, we briefly and informally outline the results under two alternative contracting assumptions: two-period contracts and a verifiable change of project. Additionally, to demonstrate the robustness of our result we sketch some implications if we extend the model to three periods. Details of the analyses are available from the authors upon request.

### 6.1 *Optimal Two-period Contract*

Suppose that management is able to commit to a complete, two-period contract where the bonuses for all contingencies are specified in the employment contract at the beginning of period 1. The optimal two-period contract has the following general features:

1. $w_1(\alpha)$ is set low, possibly equal to zero, in order to extract the employee's informational rents.
2. $w_2^s(\alpha)$ is set high, possibly equal to $\theta$ for which the employee becomes the residual claimant.
3. $w_2^f$ is distorted below the bonus level that maximizes the second period profit.

Under the optimal two-period contract, a part of the reward for first-period success is a higher bonus in the second period. As mentioned in the introduction, this is a common result in analyses of dynamic moral hazard problems. The intuition is that deferred compensation provides the employee with an incentive to exert effort in both periods while, at the same time, minimizing the employee's informational rents. Notice also that $w_2^f$ is optimally distorted below the level that maximizes the second-period profit in order to obtain a higher search effort in the first period.[14]

It is interesting that deferred compensation also alleviates the problem of inertia. It turns out that if the wealth constraint does not bind in the first period ($w_1(\alpha) > 0$), an employee who experienced first-period success is rendered the residual claimant in the following period $\left(w_2^s(\alpha) = \theta\right)$. The employee will choose the search effort that maximizes total surplus, and inertia will not arise. However, if the wealth constraint binds ($w_1(\alpha) = 0$), the bonus is reduced $\left(w_2^s(\alpha) < \theta\right)$ in order to increase the firm's share of the surplus created. In this case, the employee's incentive to search for a new project is reduced, and inertia may arise. Therefore, better contracting possibilities reduce, but do not necessarily eliminate inertia.

[14]Formally, starting from the bonus level that maximizes the second-period profit, a marginal decrease in $w_2^f$ results in a first-order increase in first-period profit due to a higher first-period search effort, but in only a second-order decrease in second-period profit. The optimal $w_2^f$ is thus strictly smaller than the level maximizing second-period profit.

### 6.2 *Verifiable Change of Project*

We have assumed that the project details are information private to the employee. Circumstances may exist in which project details are verifiable. In this case, it would be possible to make the bonus payment contingent on whether $x_1^*$ is implemented again, and management could offer a contract that specifies a strictly positive bonus if, and only if, a project different from $x_1^*$ is implemented and is successful. This type of contract relaxes the search constraint, because an employee who has experienced first-period success cannot obtain the bonus without searching again. Thus, region (ii) of Proposition 1 where inertia reduces pay-offs is eliminated. However, region (i) of the proposition, where inertia increases pay-offs, also shrinks. Therefore, the possibility to contract on project details involves a time-inconsistency problem similar to that faced by management in the case of restructuring.

### 6.3 *Three Periods*

In case there are three periods rather than two, both the firm's and the employee's third period actions are described by those of the main model in period 2 and, thus, inertia arises for identical parameters. Anticipating the behavior in the third period affects the employee's search incentives in the period 2 as well as the firm's choice of bonus. For example, for the parameter range of $\alpha$ in which harmful inertia occurs in period 3, the employee anticipates being offered a zero bonus in the following period. This renders it expensive for the firm to motivate second-period searching, which tends to result in a zero bonus offer in that period. The opposite occurs for parameters of $\alpha$ that are associated with beneficial inertia. In other words, the effects of inertia in later periods propagates to earlier periods implying that the model's results are robust to increasing the number of periods studied.

## 7 Concluding Remarks

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

Management's reaction to the employee's reluctance to search is either to increase the power of financial incentives or to give up altogether on encouraging search effort. We show that these two reactions have very different implications for total profit. High-powered incentives serve as additional rewards for success, which increases the employee's search efforts and the firm's total profit. However, if search is abandoned due to the severity of the agency problem, total profit is reduced.

We demonstrate that allowing the employee to appropriate a certain fraction of project surplus, for example, by limiting the monitoring of how the employee runs the project, can be beneficial for the firm because management is more inclined to counter inertial tendencies by offering high-powered incentives. We show also that restructuring, in the form of reorganization, job rotation or short-term employment forces employees to search in the second period, but may create a time-inconsistency problem. In particular, these policies may increase second-period profit, but still decrease total profit because initial search efforts are undermined. Firms, therefore, may have an incentive to commit to not restructuring—for example, by making hiring or investment decisions that increase the cost of restructuring.

An interesting issue that arises from this analysis is the interdependency between firm level decisions and industry effects. In this paper we examined how the stability of the environment influences decision-making inside the firm. The stability of the environment, in turn, is a result of the sum of the decisions made by the firms in the industry, which suggests a theory of inertia and industry evolution. We leave this and other issues to future research.

## Appendix A

### *Proof of Lemma 1*

Suppose that the employee searches for a new project. When choosing her search effort, the employee solves:

$$\max_{q_2}\left\{q_2[(1-\theta)+w_2]-\frac{1}{2}\gamma q_2^2\right\}\Rightarrow \qquad q_2(w_2)=\frac{1}{\gamma}[(1-\theta)+w_2] \tag{A1}$$

The employee searches therefore if and only if:

$$\frac{1}{2\gamma}[w_2+(1-\theta)]^2\geq\beta[w_2+(1-\theta)]$$

where the left-hand side is the expected utility from exerting the search effort $q_2(w_2)$ and the right-hand side is the expected utility from not searching. This condition reduces to equation (1) in Lemma 1. Notice that equation (1) implies that $\tilde{x}_2$ is a more precise signal than $x_1^*$, i.e. $q_2(w_2) > \beta$. Hence, the employee follows $\tilde{x}_2$ if faced with conflicting signals.

## Appendix B

### *Proof Lemma 2*

If the management specifies in the contract that project $\tilde{x}_2$ is implemented in period 2, it solves the following problem:

$$\max_{w_2}\{(\theta - w_2)q_2(w_2)\} \Rightarrow w_2^{X} = \frac{1}{2}(2\theta - 1) \qquad \text{and} \qquad q_2(w_2^{X}) = \frac{1}{2\gamma}$$

where equation (A1) has been used.

Due to the quadratic nature of the effort cost function, the resulting effort level $q_2(w_2^{X})$ is independent of $\theta$. The expected second-period firm profit and employee utility are, respectively,

$$\pi_2^{X} = \frac{1}{4\gamma} \qquad \text{and} \qquad u_2^{X} = \frac{1}{8\gamma}$$

Alternatively, the management can choose not to specify whether searching should take place and optimally set $w_2^{Y} = 0$. Then, we have:

$$q_2^{Y} = \begin{cases} 0 & \text{for} \quad \beta \geq \frac{1}{2\gamma}(1-\theta) \\ \frac{1}{\gamma}(1-\theta) & \text{otherwise} \end{cases}$$

This implies:

$$\pi_2^{Y} = \begin{cases} \theta\beta & \text{for} \quad \beta \geq \frac{1}{2\gamma}(1-\theta) \\ \frac{1}{\gamma}\theta(1-\theta) & \text{otherwise} \end{cases} \qquad U_2^{Y} = \begin{cases} (1-\theta)\beta & \text{for} \quad \beta \geq \frac{1}{2\gamma}(1-\theta) \\ \frac{1}{2\gamma}(1-\theta)^2 & \text{otherwise} \end{cases} \tag{A2}$$

Comparing $\pi_2^{X}$ and $\pi_2^{Y}$ yields the benchmark reported in Lemma 2.

## Appendix C

### *Proof of Lemma 3*

Suppose that the management wishes to induce searching. Using equation (A1), the management's maximization problem is:

$$\max_{w_2}\{(\theta - w_2)q_2(w_2)\} \tag{A3}$$

subject to the search constraint (1) from Lemma 1. Solving this problem yields:

$$w_2^{X} = \begin{cases} 2\gamma\beta - (1-\theta) & \text{for} \quad \beta \geq \frac{1}{4\gamma} \\ \frac{1}{2}(2\theta - 1) & \text{otherwise} \end{cases} \qquad q_2^{X} = \begin{cases} 2\beta & \text{for} \quad \beta \geq \frac{1}{4\gamma} \\ \frac{1}{2\gamma} & \text{otherwise} \end{cases}$$

where $\frac{1}{2}(2\theta - 1)$ is the unconstrained solution. The expected firm profit and employee utility are:

$$\pi_2^X = \begin{cases} 2(1-2\gamma\beta)\beta & \text{for} \quad \beta \geq \dfrac{1}{4\gamma} \\ \dfrac{1}{4\gamma} & \text{otherwise} \end{cases} \qquad U_2^X = \begin{cases} 2\gamma\beta^2 & \text{for} \quad \beta \geq \dfrac{1}{4\gamma} \\ \dfrac{1}{8\gamma} & \text{otherwise} \end{cases}$$

The alternative option for the management is not to encourage searching and to optimally set $w_2^Y = 0$. The pay-offs are then given by equation (A2), and the proof follows then directly from comparing $\pi_2^X$ and $\pi_2^Y$.

## Appendix D

### *Proof of Proposition 1*

Consider case (i). Equation (11) shows that inertia increases firm profit and employee utility if and only if $\Delta S_2(\alpha) \geq 0$. In case (i), $\Delta S_2(\alpha) = 2\alpha - 2\gamma\alpha^2 - 3/8\gamma$, which is increasing in $\alpha$ in the region of the parameter space considered. Furthermore, as $\Delta E(S_2) \to 0$ for $\alpha \to 1/4\gamma$, it follows that $\Delta S_2(\alpha) > 0$ for $1/4\gamma < \alpha \leq (2-\theta)/4\gamma$.

Consider the search efforts. The equilibrium search effort in the second period is $q_2(w_2^s) = 2\alpha > 1/2\gamma = q_2(w_2^b)$ as $1/4\gamma < \alpha$. The equilibrium search effort in the first period is $q_1(\alpha) = [1 + (\pi_2^s(\alpha) - \pi_2^f) + (u_2^s(\alpha) - u_2^f)]/2\gamma$. In the benchmark case, the first-period search effort is $q_1^b(\alpha) = [1 + (\pi_2^b(\alpha) - \pi_2^f) + (u_2^b(\alpha) - u_2^f)]/2\gamma$. Since $\Delta S_2(\alpha) > 0$, it follows that $q_1(\alpha) > q_1^b(\alpha) > 0$, which completes the proof for case (i). The proof for case (ii) follows similar steps.

## Appendix E

### *Proof of Proposition 2*

Consider the range of parameters for which inertia arises. Since the second-period pay-offs to the employee and the firm are independent of $(1 - \theta)$ in the benchmark case, the total profit in the benchmark case $\Pi^b(\alpha)$ is also independent of $\alpha$. Hence, the statement regarding cases (i) and (ii) in Proposition 1 implies that the firm's total profit is strictly higher in case (i) than in case (ii). An increase in $(1 - \theta)$ expands the set of remaining parameters for case (i) to obtain. This proves the first part of the proposition. The second part is given, because within cases (i) and (ii), total profit is independent of $(1 - \theta)$.

## Appendix F

### *Proof of Proposition 3*

The management has an incentive to restructuring for all parameters such that inertia arises. If the employee foresees that a restructuring will take place, it is *as if* $\alpha = 0$, and total profit is equal to $\Pi(0) = 1/2\gamma$. Comparing $\Pi(0)$ and $\Pi(\alpha)$ yields the results reported in the proposition.

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