Abstract

We explore the evolution of a firm’s organization and performance. The owner and her employee play an infinitely repeated trust game in which the owner benefits from delegation only if the employee honors her trust by choosing her preferred project. The owner, however, cannot observe whether this project is available. We characterize the optimal relational contract and highlight two implications. First, profits decline over time as the firm’s organization evolves from flexibility to rigidity. Second, which type of rigid organization the firm converges to—and thus its long run profitability—is determined by random events in its early history.
1 Introduction

“A good relationship takes time” is popular advice among both consultants and therapists. It is based on the view that relationships are built on trust and that trust develops over time. Once partners trust each other, they can motivate cooperation by rewarding good behavior today with the promise to take various actions in the future.

At some point, however, the future becomes the present and yesterday’s promises become today’s legacy costs. A relationship can then get bogged down by the need to fulfill the very promises that ensured its success early on. Time therefore need not be the friend of a good relationship. Instead, it can be its foe, as many clients of the before-mentioned experts will attest.

Take, for instance, the relationship between General Motors and the United Auto Workers union. Early on in their relationship, GM got the UAW to make concessions by promising to adopt labor-friendly policies in the future. One example was the promise to pay laid-off workers almost full wages long after their jobs were eliminated, a policy that became known as the “Jobs Bank.” During the crisis in the US automobile industry in the early 2000s, analysts viewed such promises as a major obstacle for a turnaround. At the time, The Wall Street Journal reported:

“The Jobs Bank is a legacy of the early 1980s, when then-Chairman Roger B. Smith was embarking on a strategy to automate GM’s North American factories. In a recent interview, UAW President Ron Gettelfinger [...] said the Jobs Bank originally was a company proposal, aimed at convincing UAW leaders not to oppose new technology. "The idea was, ‘You help us get productive and we’ll bring work in’" to occupy the displaced workers, Mr. Gettelfinger said. But that decision came back to haunt the company in later years as it began to embrace Toyota’s methods of car making [...]. But the Jobs Bank never got redefined. Instead, after fighting a series of costly strikes with the UAW in the mid-1990s, GM management concluded it was better to build a harmonious relationship than provoke fights. The bank has survived successive rounds of contract bargaining, including the most recent round in 2003.”

This paper is motivated by the observation that relationships can get bogged down by the need to fulfill the promises that ensured their success early on. We show that the transition of promises into legacy costs is a natural feature of optimally managed relationships between firms and their employees. And we show that this feature has implications for the evolution of firms that differ sharply from those that are based on the standard intuition that ‘good relationships take time.’

0 See, for instance, “The Curse Of Promises Past–Legacy Costs” and “Now For The Reckoning-Corporate America’s Legacy Costs” (both in The Economist, 15 October 2005). See also “Troubled Legacy: How U.S. Auto Industry Finds Itself Stalled By Its Own History” (The Wall Street Journal, 7 January 2006) from which the following quote is taken.
Specifically, we examine an infinitely repeated game between the owner of a firm and her employee. In the stage game, both parties first decide whether to enter the relationship. If both do enter, the owner can centralize decision making, in which case she chooses a status quo project herself. Or she can delegate decision making, in which case the employee can either choose his preferred project or, if available, the owner’s. The payoffs are such that each party prefers his or her preferred project to the status quo and the status quo to the other parties’ preferred project. The stage game is therefore essentially a standard trust game. The only significant difference to a standard trust game is that the owner’s preferred project may not be available and that only the employee knows whether it is available. If the employee chooses his preferred project, the owner therefore does not know whether he betrayed her trust or simply had no choice.

How should the owner motivate the employee to honor her trust? If she were able to use monetary transfers, she could do so easily by paying the employee a bonus whenever he chooses her preferred project. In practice, however, the owners and managers of firms face limits in their ability to use transfers to motivate decision making. This is why Holmstrom (1984), and the literature on delegation that builds on his work, abstract from transfers entirely (for surveys, see, for instance, Bolton and Dewatripont (2013) and Gibbons, Matouschek, and Roberts (2013)).

Even if transfers are not feasible, though, the owners and managers of firms should be able to motivate decision making through other means. As Prendergast and Stole (1999) observed, for instance: "A striking characteristic of work life is that one cannot reward individuals in cash for some things, but can compensate them in other ways" (Prendergast and Stole 1999, p.1007). Similarly, Cyert and March (1963) observed some fifty years ago that "a significant number of [payments within organizations] are in the form of policy commitments" (Cyert and March 1963, p. 35) and argued that these policy commitments are a crucial feature of firms. In our setting, in particular, the owner can motivate the employee by promising him more or less discretion in the future. The key question then is how the relationship evolves if the owner can rely on such policy commitments to motivate the employee.

To answer this question, we characterize the optimal relational contract, that is, the Perfect Public Equilibrium that maximizes the owner’s expected payoff. We show that the owner finds it optimal to start out by delegating to the employee with the understanding that he chooses her preferred project whenever it is available. To motivate the employee to honor her trust, the owner rewards him for choosing her preferred project with an increase in his continuation payoff, and she punishes him for choosing his preferred project with a reduction in his continuation payoff. This initial phase continues until the continuation payoff crosses one of two thresholds. If it crosses the
lower threshold, the owner either centralizes decision making forever, or the relationship terminates all together. If, instead, it crosses the upper threshold, the owner delegates to the employee forever and accepts that he will then always choose his preferred project. In the long run, an active relationship is therefore in one of two steady states: permanent centralization or decentralization.

A key feature of the optimal relational contract is that the owner delays rewards and punishments for as long as possible. And when she can delay them no longer, she administers them permanently and thus with maximum force. The optimal relational contract is therefore different from the well-known class of equilibria in Green and Porter (1984) in which the parties alternate between reward and punishment phases. To see why such equilibria are not optimal in our setting, notice that both rewards and punishments distort decision making. The threat to retract a previously promised reward, and the promise to retract a previously threatened punishment, however, do not impose any additional distortions, yet they motivate the employee just the same. Delay therefore allows the owner to motivate the manager more efficiently.

The optimal delay in rewards and punishments has implications for the evolution for the firm’s organization and performance to which we turn next.

**Inertia and Decline** A key implication of the model is that the firm’s performance declines over time. In particular, at the beginning of the relationship, the owner is able to motivate the employee by making promises about his future discretion. At some point, however, she has to live up to those promises and either make the decisions herself or let the employee make whatever decisions he wants. In either case, decisions no longer reflect the employee’s information, the firm becomes inertial, and its performance declines.

We obtain this result in a setting that abstracts from the many reasons for why a firm’s profits may increase over time, such as learning-by-doing. We abstract from such well-known factors to highlight that there are forces that work in the opposite direction. And we do so because an understanding of such opposing forces may help explain why business history is littered with established firms that failed to adapt. Bower and Christensen (1996), for instance, observed that "One of the most consistent patterns in business is the failure of leading companies to stay at the top of their industries when technologies or markets change" and then list Goodyear, Firestone, Xerox, and Bucyrus-Erie as examples. Similarly, Kreps (1996) argued that "It is widely held that organizations exhibit substantial inertia in what they do and how they do it (Hannan and Freeman, 1984). In the face of changing external circumstances, organizations adapt poorly or not at all; the economy and/or market evolves as much or more through changes in the population of live organizations than through changes in the organizations that are alive" (Kreps 1996, p.577). Our
model points to the use of policy commitments as a source of inertia. It suggests that the inertia of established firms is the result of the commitments that allowed these firms to adapt when they were still young. The flexibility of young firms, and the inertia of established ones, are then two sides of the same coin.

A difference between our model and some of the standard examples of firms that failed to adapt is that in our model the firm only fails to adapt to information that is privately observed by the employee. In some of the standard examples, in contrast, firms failed to adapt to information even when it was publicly available (Schaefer 1998). Sears, for instance, only closed its troubled catalog business after analysts had recommended they do so for many years (Scussel 1991). We explore this issue in our main extension by allowing for a publicly observable project to become available at a random time. We show that even though the owner always finds it optimal to adopt this project if it becomes available early on, she may not do so if the relationship is already in one of its steady states. The inertia of established firms therefore also applies to publicly available information.

**Persistent Performance Differences** The model also speaks to the observation that there are large and persistent performance differences across firms within narrowly defined industries (for a survey see, for instance, Syverson (2011)). In particular, the model implies that random differences in the early experiences of firms lead to persistent differences in how these firms allocate decision rights. And these persistent differences in how firms allocate decision rights, in turn, lead to persistent differences in their performance levels.

The result that random differences in the early experiences of firms lead to persistent differences in the allocation of decision rights is consistent with the widely held view that firms’ organizational structures depend on their histories. To once again quote David Kreps: "Organizational policies/procedures tend to be derived from the early history of the organization (Stinchcombe, 1965; Hannan and Freeman, 1977) and to be derived (or at least crystallized out of) specific noteworthy events in the early history of the organization (Schein, 1983)" (Kreps 1996, p. 577).

The result that persistent organizational differences lead to persistent performance differences, in turn, is consistent with recent empirical evidence that finds a causal relationship between organizational practices and performance (see, in particular, Bloom et. al. (2007, 2013) and, for a survey, Gibbons and Henderson (2012)). This evidence, however, raises the question of why less successful firms don’t simply imitate the organizational practices of their more successful rivals. After all, such practices are not protected by patents. What then are the barriers to imitation? Our model shows that a firm’s history can be one such barrier, as it determines the set of practices that the firm can adopt without having to fear retaliation from its employees. One firm may, for
instance, be able to centralize decision making without triggering resentment among its employees. In another, and seemingly identical firm, however, employees may view decentralization as their reward for previous sacrifices. This reasoning is also reflected in the GM example, in which the UAW viewed the Jobs Bank as a reward for previous concessions which, in turn, constrained GMs ability to imitate Toyota’s production techniques in the 1990s. As the article observed, "[...] GM management concluded it was better to build a harmonious relationship than provoke fights."

2 The Model

A risk-neutral principal and a risk-neutral agent are in an infinitely repeated relationship. Time is discrete and we denote it by \( t = \{1, 2, \ldots \} \). We first describe the stage game and then move on to the repeated game. In the description of the stage game, we omit time subscripts for convenience.

**Stage Game** At the beginning of the stage game, the principal and the agent simultaneously decide whether to enter the relationship. We denote their entry decisions by \( e_j \in \{0, 1\} \) for \( j = P, A \), where \( e_j = 1 \) denotes entry. If at least one party decides not to enter, both realize a zero payoff and time moves on to the next period.

If, instead, both parties do decide to enter, the principal next decides whether to delegate the right to choose a project to the agent. We denote the delegation decision by \( d \in \{0, 1\} \), where \( d = 1 \) denotes delegation. Moreover, we denote both projects and project choices by \( k \) and the principal’s and the agent’s stage game payoffs, conditional on both parties having entered the relationship, by \( \Pi (k) \) and \( U (k) \).

If the principal decides not to delegate to the agent, she chooses a safe project \( k = S \) that generates payoffs \( \Pi (S) = U (S) = a > 0 \). If, instead, the principal does delegate to the agent, the agent can choose between up to two projects. One of these projects is the agent’s preferred project \( k = A \) and the other is the principal’s preferred project \( k = P \). The agent’s preferred project gives the agent a payoff \( U (A) = B \) and the principal a payoff \( \Pi (A) = b \), where \( B > a > b > 0 \). Analogously, the principal’s preferred project gives the principal a payoff \( \Pi (P) = B \) and the agent a payoff \( U (P) = b \). Delegation therefore takes the form of a trust game in which the principal only benefits from delegation if she can trust the agent to choose her preferred project. The assumption that payoffs are symmetric facilitates the exposition but it is not important for our results. We summarize the stage game payoffs in Figure 1.

The key feature of the game is that the principal’s preferred project is not always available and that only the agent can observe whether it is available. The principal therefore cannot distinguish
a betrayal of her trust from a lack of opportunity to cooperate. In particular, the principal’s preferred project is only available with probability $p \in (0, 1)$, where the availability is independent across periods. Other than the availability of the principal’s preferred project, all information is publicly observable.

Finally, after the parties have realized their payoffs, they observe the realization $x$ of a public randomization device, after which time moves on to the next period.

**The Repeated Game** The principal and the agent have a common discount factor $\delta \in (0, 1)$. At the beginning of any period $t$ the principal’s expected payoff is given by

$$\pi_t = (1 - \delta) E_t \left[ \sum_{\tau=t}^{\infty} \delta^{\tau-t} e_{P,t} e_{A,t} \Pi (k_t) \right]$$

and the agent’s expected payoff is given by

$$u_t = (1 - \delta) E_t \left[ \sum_{\tau=t}^{\infty} \delta^{\tau-t} e_{P,t} e_{A,t} U (k_t) \right].$$

Note that we multiply the right-hand side of each expression by $(1 - \delta)$ to express payoffs as per-period averages.

We follow the literature on imperfect public monitoring and define a relational contract as a pure-strategy Perfect Public Equilibrium (henceforth PPE) in which the principal and the agent play public strategies and, following every history, the strategies are a Nash Equilibrium. Public strategies are strategies in which the players condition their actions only on publicly available information. In particular, the agent’s strategy does not depend on her past private information. Our restriction to pure strategy is without loss of generality because our game has only one-sided private information and is therefore a game with the product structure (see, for instance, p.310 in Mailath and Samuelson (2006)). In this case, there is no need to consider private strategies since every sequential equilibrium outcome is also a PPE outcome (see, for instance, p.330 in Mailath and Samuelson (2006)).

Formally, let $h_{t+1} = \{e_{P,\tau}, e_{A,\tau}, d_\tau, k_\tau, x_\tau\}_{\tau=1}^{t}$ denote the public history at the beginning of any period $t + 1$ and let $H_{t+1}$ denote the set of period $t + 1$ public histories. Note that $H_1 = \Phi$. A public strategy for the principal is a sequence of functions $\{E_{P,t}, D_t, K_{P,t}\}_{t=1}^{\infty}$, where $E_{P,t} : H_t \rightarrow \{0, 1\}, D_t : H_t \cup \{e_{P,\tau}, e_{A,\tau}\} \rightarrow \{0, 1\}, K_{P,t} : H_t \cup \{e_{P,\tau}, e_{A,\tau}, d_t\} \rightarrow \mathcal{K}_P$, and where $\mathcal{K}_P = \{S\}$ is the set of projects available to the principal. Similarly, a public strategy for the agent is a sequence of functions $\{E_{A,t}, K_{A,t}\}_{t=1}^{\infty}$, where $E_{A,t} : H_t \rightarrow \{0, 1\}$ and $K_t : H_t \cup \{e_{P,\tau}, e_{A,\tau}, d_t\} \rightarrow \mathcal{K}_{A,t}$, and where $\mathcal{K}_{A,t} \in \{\{A\}, \{A, P\}\}$ is the set of projects available to the agent.
We define an "optimal relational contract" as a PPE that maximizes the principal’s average per-period payoff. Our goal is to characterize the set of optimal relational contracts.

3 Benchmarks

The model we just described makes three key assumptions: (i.) the stage game is infinitely repeated, (ii.) the principal cannot observe the projects that are available to the agent, and (iii.) transfers are not feasible. We will see below that all three assumptions are crucial for our results. To highlight the role of these assumptions, and to get familiar with the model, we start by considering three benchmarks in which we relax each of the three assumptions in turn.

The Static Game  Suppose first that the parties play the stage game only once. The game they play is then essentially a trust game. We say "essentially" because it differs from the standard version of a trust game in two ways. First, before the principal and the agent play the trust game, each has the opportunity to opt out. We allow the parties to opt out since employees can always leave their firms and managers can typically fire their workers. Because the parties can opt out, there is an equilibrium in which neither party enters the relationship. We will see below that, in the repeated game, the parties use this equilibrium to deter publicly observable deviations, such as the principal not delegating to the agent when she is supposed to do so.

The second difference between the stage game and a standard trust game is that the principal cannot observe the actions that are available to the agent. If the game is played only once, this difference is irrelevant since the agent will always betray the principal’s trust, no matter what the principal can observe. Anticipating this behavior by the agent, the principal does not trust the agent in the first place. The second equilibrium of the static game is therefore one in which both parties enter the relationship and the principal does not delegate to the agent. This, of course, corresponds to the equilibrium of a standard trust game. And it captures, albeit in a stark way, the view that a principal is more likely to delegate to an agent if she can trust him not to take advantage of his delegated powers.

The Game with Public Information  Suppose now that the stage game is infinitely repeated, as in our main model. In contrast to our main model, however, suppose that the principal can observe the projects that are available to the agent. In the Appendix we show that the optimal relational contract then depends on whether the discount factor is above a critical value that lies strictly between zero and one. If the discount factor is below the critical value, the principal
cannot do better than to centralize in every period. If it is above the critical value, however, the principal can do better by having both parties play standard trigger strategies. Under these strategies, the principal starts out by delegating to the agent with the understanding that he will choose the principal’s preferred project whenever it is available. The principal will continue to do so unless the agent ever violates this understanding, in which case she opts out of the relationship in all future periods. In response, the agent chooses the principal’s preferred project whenever it is available. In the game with public information, there therefore always exists an optimal relational contract that is stationary and does not involve any punishment on the equilibrium path. We will see below that this is not the case in our main model, in which the principal cannot observe the projects that are available to the agent.

The Game with Transfers Suppose now that the principal cannot observe the projects that are available to the agent, as in our main model. In contrast to our main model, however, suppose that the principal can use monetary transfers to motivate the agent. In particular, suppose that at the beginning of the stage game, the principal can make a take-it-or-leave-it offer to the agent in which she can contractually commit to a fixed wage and promise to pay a bonus. In the Appendix we show that, as in the game with public information, the optimal relational contract depends on whether the discount rate is above a critical value that lies strictly between zero and one. If the discount rate lies below the critical value, the principal cannot do better than to centralize in every period. If it lies above the critical value, however, the principal can do better by having both parties play standard trigger strategies. The principal again starts out by delegating to the agent. In contrast to the game with public information, however, she now offers to "pay" him a wage equal to $-B$ and promises to pay him a bonus equal to $(B - b)$ whenever he chooses the principal’s preferred project. In response, the agent accepts the offer and chooses the principal’s preferred project whenever it is available, unless the principal ever reneges on her promise to pay the bonus, in which case the agent opts out of the relationship in every future period. In the game with transfers, as in the game with public information, there therefore always exists an optimal relational contract that is stationary and does not involve any punishment on the equilibrium path. As mentioned above, this is not the case in our main model, in which the principal cannot rely on transfers to motivate the agent.
4 Preliminaries

In this section, we characterize the PPE payoff set. We first list the constraints that payoffs have to satisfy to be in the PPE payoff set. In Section 4.2 we then derive a constrained maximization problem that characterizes the payoff frontier and show that it fully determines the optimal relational contract. In Section 5 we can then characterize the optimal relational contract by solving this problem.

4.1 The Constraints

We denote the PPE payoff set by \( \mathcal{E} \). Any payoff pair \((u, \pi) \in \mathcal{E}\) is either generated by pure actions or by randomization between two equilibrium payoff pairs that are each generated by pure actions. There are four sets of pure actions. First, both parties enter the relationship after which the principal delegates to the agent with the understanding that he chooses the principal’s preferred project whenever it is available. We call this set of actions "cooperative delegation" and denote it by \( D_C \). Second, both parties enter the relationship after which the principal delegates to the agent with the understanding that he can always choose his preferred project. We call this action "uncooperative delegation" and denote it by \( D_U \). Third, both parties enter the relationship after which the principal centralizes and chooses the safe project. We call this action "centralization" and denote it by \( C \). Finally, neither party enters the relationship. We call this set of actions "exit" and denote it by \( E \). In the remainder of this section we first discuss the constraints that have to be satisfied for a payoff pair \((u, \pi) \in \mathcal{E}\) to be generated by one of these four sets of pure actions. We then conclude the section by stating the constraint that has to be satisfied if the payoff pair is generated by randomization.

Centralization  A payoff pair \((u, \pi)\) can be supported by centralization if the following constraints are satisfied.

(i.) Feasibility: For the continuation payoffs to be feasible, they also need to be PPE payoffs. The continuation payoffs \(u_C\) and \(\pi_C\) that the parties realize under centralization therefore have to satisfy the self-enforcement constraint

\[(u_C, \pi_C) \in \mathcal{E}. \tag{SE_C}\]

(ii.) No Deviation: To ensure that neither party deviates, we need to consider both off- and on-schedule deviations. Off-schedule deviations are deviations that both parties can observe. There is no loss of generality in assuming that if an off-schedule deviation occurs, the parties terminate
the relationship by opting out in all future periods, as this is the worst possible equilibrium that gives each party its minmax payoff.

The principal and the agent can deviate off-schedule by opting out of the relationship. If either party does so, he or she realizes a zero payoff this period and in all future periods. Since the payoffs from the three projects are strictly positive, the parties therefore do not have an incentive to deviate off-schedule by opting out of the relationship.

The principal could also deviate off-schedule by delegating. There is no loss of generality in assuming that the agent will then choose his preferred project. By deviating, the principal would therefore reduce her current payoff from $a$ to $b < a$, after which she would make a zero payoff in all future periods. The principal therefore never wants to deviate off-schedule by delegating.

On-schedule deviations are deviations that are privately observed. Since the principal does not have any private information, and the agent does not get to choose a project, there are no on-schedule deviations in the case of centralization.

(iii.) Promise Keeping: Finally, the consistency of the PPE payoff decomposition requires that the parties’ payoffs are equal to the weighted sum of current and future payoffs. The promise-keeping constraints

$$\pi = (1 - \delta) a + \delta \pi_C$$  \hspace{1cm} (PK_C^P)$$

and

$$u = (1 - \delta) a + \delta u_C$$  \hspace{1cm} (PK_C^A)$$

ensure that this is the case.

Cooperative Delegation  A payoff pair $(u, \pi)$ can be supported by cooperative delegation if the following constraints are satisfied.

(i.) Feasibility: For the continuation payoffs to be feasible, they also need to be PPE payoffs. Let $(u_\ell, \pi_\ell)$ denote the parties’ continuation payoffs if the agent chooses his preferred project and let $(u_h, \pi_h)$ denote their payoffs if he chooses the principal’s preferred project. The self-enforcement constraint is then given by

$$(u_h, \pi_h), (u_\ell, \pi_\ell) \in \mathcal{E},$$  \hspace{1cm} (SE_{DC})$$

where $\mathcal{E}$ is the PPE payoff set.

(ii.) No Deviation: As in the case of centralization, the principal and the agent never want to deviate off-schedule by opting out of the relationship since doing so gives them a zero payoff. The principal may, however, want to deviate off-schedule by not delegating to the agent, in which case
she realizes payoff \( a \) this period and a zero payoff in all future periods. To ensure that she does not want to do so, the reneging constraint
\[
p [(1 - \delta) B + \delta \pi_h] + (1 - p) [(1 - \delta) b + \delta \pi_l] \geq (1 - \delta) a \tag{NR_{D_C}}
\]
has to be satisfied.

Since the principal does not have any private information, she cannot engage in any on-schedule deviations. The agent, however, may choose his preferred project when the principal’s preferred project is available. To ensure that he does not want to do so, the incentive constraint
\[
(1 - \delta) b + \delta u_h \geq (1 - \delta) B + \delta u_\ell \tag{IC_{D_C}}
\]
has to be satisfied.

(iii.) Promise Keeping: The promise-keeping constraints are now given by
\[
\pi = p [(1 - \delta) B + \delta \pi_h] + (1 - p) [(1 - \delta) b + \delta \pi_l] \tag{PK^P_{D_C}}
\]
and
\[
u = p [(1 - \delta) b + \delta u_h] + (1 - p) [(1 - \delta) B + \delta u_\ell]. \tag{PK^A_{D_C}}
\]

**Uncooperative Delegation** A payoff pair \((u, \pi)\) can be supported by uncooperative delegation if the following constraints are satisfied.

(i.) Feasibility: We denote the continuation payoffs under uncooperative delegation by \((u_{DU}, \pi_{DU})\).

The self-enforcement constraint is then given by
\[
(u_{DU}, \pi_{DU}) \in \mathcal{E}. \tag{SE_{DU}}
\]

(ii.) No Deviation: As in the case of cooperative delegation, the principal and the agent never want to deviate off-schedule by opting out of the relationship since doing so gives them a zero payoff both this period and in all future periods. The principal may, however, want to deviate off-schedule by not delegating to the agent. To ensure that she does not want to do so, the reneging constraint
\[
(1 - \delta) b + \delta \pi_{DU} \geq (1 - \delta) a. \tag{NR_{DU}}
\]
has to be satisfied.

(iii.) Promise Keeping: The promise-keeping constraints are now given by
\[
\pi = (1 - \delta) b + \delta \pi_{DU}. \tag{PK^P_{DU}}
\]
for the principal and
\[
u = (1 - \delta) B + \delta u_{DU} \tag{PK^A_{DU}}
\]
for the agent.
Exit A payoff pair \((u, \pi)\) can be supported by exit if the following constraints are satisfied.

(i.) Feasibility: We denote the continuation payoffs under centralization by \((u_E, \pi_E)\). The self-enforcement constraint is then given by

\[
(u_E, \pi_E) \in \mathcal{E}. \tag{SE_E}
\]

(ii.) No Deviation: The principal and the agent can deviate off-schedule by entering the relationship. If the principal or the agent does so, he or she realizes a zero payoff this period and in all future periods. The parties therefore do not have an incentive to deviate by entering the relationship. There are no other off- or on-schedule deviations in this case

(iii.) Promise Keeping: The promise-keeping constraints are now given by

\[
\pi = \delta \pi_E \tag{PK^p_E}
\]

for the principal and

\[
u = \delta u_E. \tag{PK^a_E}
\]

for the agent.

Randomization Finally, a payoff pair \((u, \pi)\) can be supported by randomization. In this case, there exist two distinct PPE payoffs \((u_i, \pi_i) \in \mathcal{E}, i = 1, 2\) such that

\[
(u, \pi) = \alpha (u_1, \pi_1) + (1 - \alpha) (u_2, \pi_2)
\]

for some \(\alpha \in (0, 1)\).

4.2 The Constrained Maximization Problem

We now use the techniques developed by Abreu, Pearce, and Stacchetti (1990) to characterize the PPE payoff set and, in particular, its frontier.

For this purpose, we define the payoff frontier as

\[
\pi(u) \equiv \sup \{ \pi' : (u, \pi') \in \mathcal{E} \},
\]

where \(\mathcal{E}\) is the PPE payoff set. We also define

\[
u = \inf \{ u : (u, \pi) \in \mathcal{E} \}
\]

and

\[
\overline{u} = \sup \{ u : (u, \pi) \in \mathcal{E} \}
\]
as the smallest and the largest PPE payoff for the agent.

We can now state our first lemma, which establishes several properties of the PPE payoff set.

LEMMA 1. The PPE payoff set $\mathcal{E}$ has the following properties: (i.) it is compact, (ii.) $\pi(u)$ is concave, (iii.) the payoff pair $(u, \pi)$ belongs to $\mathcal{E}$ if and only if $u \in [0, B]$ and $\pi \in [bu/B, \pi(u)]$.

The first part of the lemma shows that the PPE payoff set is compact. This result follows immediately from the assumption that there is only a finite number of actions. And it implies that for any $u \in [u, \bar{u}]$ the payoff pair $(u, \pi(u))$ is in the PPE payoff set. The second part of the lemma shows that the payoff frontier is concave, which follows directly from the availability of a public randomization device. Finally, the third part shows that the smallest PPE payoff for the agent is zero and the largest is $B$. It also shows that, for any $u \in [0, B]$, the smallest PPE payoff for the principal is $bu/B$ and that, for any $\pi \in [bu/B, \pi(u)]$, the payoff pair $(u, \pi)$ is in the PPE payoff set.

A key implication of the first lemma is that to describe the PPE payoff set, we only need to characterize its frontier. To do so, we need to determine, for each $(u, \pi(u)) \in \mathcal{E}$, whether it is supported a pure action $j \in \{C, D_C, D_U, E\}$ or by randomization. Moreover, if it is supported by a pure action $j$, we need to specify the associated continuation payoffs. The next lemma characterizes the principal’s continuation payoff for any of the agent’s continuation payoffs, regardless of the actions that the parties take.

LEMMA 2. For any $(u, \pi(u))$, the continuation payoffs are also on the frontier.

The lemma shows that payoffs on the frontier are sequentially optimal. This is the case since the principal’s actions are publicly observable. It is therefore not necessary to punish her by moving below the PPE frontier. This feature of our model is similar to Spear and Srivastava (1987) and the first part of Levin (2003) in which the principal’s actions are also publicly observable. In contrast, joint punishments are necessary when multiple parties have private information as, for instance, in Green and Porter (1984), Athey and Bagwell (2001), and the second part of Levin (2003).

Having characterized the principal’s continuation payoff for any of the agent’s continuation payoffs in the previous lemma, we now state the agent’s continuation payoffs associated with each action in the next lemma.

LEMMA 3. For any payoff pair $(u, \pi(u))$ on the frontier, the agent’s continuation payoffs satisfy the following conditions:

(i.) If the payoff pair is supported by centralization, the agent’s continuation payoff satisfy

$$
\delta u_C(u) = u - (1 - \delta) a.
$$
(ii.) If the payoff pair is supported by cooperative delegation, the agent’s continuation payoff can be chosen to satisfy

\[ \delta u_\ell (u) = u - (1 - \delta) B \]

and

\[ \delta u_h (u) = u - (1 - \delta) b. \]

(iii.) If the payoff pair is supported by uncooperative delegation, the agent’s continuation payoff satisfy

\[ \delta u_{DU} (u) = u - (1 - \delta) B. \]

(iv.) If the payoff pair is supported by exit, the agent’s continuation payoff satisfy

\[ \delta u_E (u) = u. \]

In the cases of centralization, uncooperative delegation, and exit, the agent’s continuation payoffs follow directly from the promise-keeping constraints \( PK_C^A \) and \( PK_{DU}^A \). In the case of cooperative delegation, instead, the agent’s continuation payoffs follow directly from combining the promise-keeping constraints with the agent’s incentive constraint \( IC_{DC}^A \), where we take the incentive constraint to be binding. To see that we can do so, suppose that the incentive constraint is not binding. We can then reduce \( u_h \) and increase \( u_\ell \) in such a way that \( u \) remains the same, and all the relevant constraints continue to be satisfied. Since the PPE frontier is concave, such a change makes the principal weakly better off.

Next we can use Lemmas 2 and 3 to derive explicit expressions for the principal’s expected payoff for a given action and a given expected payoff for the agent. For this purpose, let \( \pi_j (u) \) for \( j \in \{C, DC, DU, E\} \) be the highest payoff to the principal given action \( j \) and agent’s payoff \( u \). We then have

\[ \pi_C (u) = (1 - \delta) a + \delta \pi (u_C (u)), \]

\[ \pi_{DC} (u) = p \left[ (1 - \delta) B + \delta \pi (u_h (u)) \right] + (1 - p) \left[ (1 - \delta) b + \delta \pi (u_\ell (u)) \right], \]

\[ \pi_{DU} (u) = (1 - \delta) b + \delta \pi (u_{DU} (u)), \]

and

\[ \pi_E (u) = \delta \pi (u_E (u)). \]

We can now state the next lemma which describes the constrained maximization problem that characterizes the payoff frontier.
LEMMA 4: The PPE frontier $\pi (u)$ is the unique function that solves the following problem. For all $u \in [0, B]$

$$\pi (u) = \max_{q_j \geq 0, u_j \in [0,B]} \sum_{j \in \{C_D, D_U, E\}} q_j \pi_j (u_j)$$

such that

$$\sum_{j \in \{C_D, D_U, E\}} q_j = 1$$

and

$$\sum_{j \in \{C_D, D_U, E\}} q_j u_j = u.$$

The lemma shows that any payoff pair on the frontier is generated either by a pure action $j$—in which case the weight $q_j$ is equal to one—or by randomization—in which case $q_j$ is less than one. We obtain the frontier by choosing the weights optimally. Notice that the frontier can be thought of as a fixed point to an operator. We show in the proof that the fixed point is unique even though the operator is not a contraction mapping. In the next section, we solve the problem in the lemma to characterize the PPE frontier and thus the optimal relational contract.

5 The Optimal Relational Contract

In this section we characterize the optimal relational contract, that is, the PPE that maximizes the principal’s expected payoff. For this purpose, we first characterize the payoff frontier by solving the constrained-maximization problem in Lemma 4.

LEMMA 5. There exist two cut-off levels $u_{CD} \in (a, \delta a + (1 - \delta) B)$ and $\tilde{u}_{CD} = (1 - \delta) b + \delta B$ such that the PPE payoff frontier $\pi (u)$ is divided into four regions:

(i.) For $u \in [0, a]$, $\pi (u) = u$, and $(u, \pi (u))$ is supported by randomization between exit and centralization.

(ii.) For $u \in [a, u_{CD}]$, $\pi (u) = ((u_{CD} - u) a + (u - a) \pi (u_{CD})) / (u_{CD} - a)$ and $(u, \pi (u))$ is supported by randomization between centralization and cooperative delegation.

(iii.) For $u \in [u_{CD}, \tilde{u}_{CD}]$, $\pi (u) = \pi_{CD} (u)$, and $(u, \pi (u))$ is supported by cooperative delegation.

(iv.) For $u \in [\tilde{u}_{CD}, B]$, $\pi (u) = ((B - u) \pi (\tilde{u}_{CD}) + (u - \tilde{u}_{CD}) b) / (B - \tilde{u}_{CD})$ and $(u, \pi (u))$ is supported by randomization between cooperative and uncooperative delegation.

We illustrate the lemma in Figure 1. The lemma shows that the payoff frontier is divided into four regions. In three of these four regions, payoffs are supported by randomization and, as a result, the payoff frontier is linear. In any such region, payoffs can be supported by multiple types
of randomizations. Since for all such randomizations payoffs end up at one of the endpoints of the region eventually, we assume that the parties randomize between the endpoints immediately. In the remaining region, payoffs are supported by pure actions and the payoff frontier is concave.

Figure Y: This figure illustrates the feasible stage-game payoffs, the PPE payoff frontier, and the actions that support each point on the frontier. The dotted linear segments are supported by public randomization between their two endpoints, and this public randomization occurs at the end of the period.

We can now describe the optimal relational contract and how it evolves over time.

**Proposition 1.** First period: The agent’s and the principal’s payoffs are given by \( u^* \in [\underline{u}_{CD}, \bar{u}_{CD}] \) and \( \pi(u^*) = \pi_{D_c}(u^*) \). The parties engage in cooperative delegation. If the agent chooses the principal’s preferred project, his continuation payoff is given by

\[
    u_h(u^*) = (u^* - (1 - \delta)b) / \delta > u^*.
\]

If, instead, the agent chooses his own preferred project, his continuation payoff is given by

\[
    u_\ell(u^*) = (u^* - (1 - \delta)B) / \delta < u^*.
\]

Subsequent periods: The agent’s and the principal’s payoffs are given by \( u \in \{0, a\} \cup [\underline{u}_{CD}, \bar{u}_{CD}] \cup \{B\} \) and \( \pi(u) \). Their actions and continuation payoffs depend on what region \( u \) is in:
(i.) If \( u = 0 \), the parties exit. The agent’s continuation payoff is given by \( u_E(0) = 0 \).

(ii.) If \( u = a \), the parties engage in centralization. The agent’s continuation payoff is given by \( u_C(a) = a \).

(iii.) If \( u \in [\underline{u}_{CD}, \bar{u}_{CD}] \), the parties engage in cooperative delegation. If the agent chooses the principal’s preferred project, his continuation payoff is given by \( u_h(u) > u \). If, instead, the agent chooses his own preferred project, his continuation payoff is given by \( u_\ell(u) < u \).

(iv.) If \( u = B \), the parties engage in uncooperative delegation. The agent’s continuation payoff is given by \( u_{DU}(B) = B \).

The proposition shows that the principal starts out by engaging in cooperative delegation. To motivate the agent to choose her preferred project whenever it is available, the principal increases his continuation value whenever he chooses her preferred project and she decreases his continuation value whenever he does not.

To see how the principal optimally increases the agent’s continuation value, suppose the agent chooses the principal’s preferred project for a number of consecutive periods. The principal then continues to engage in cooperative delegation, and the agent’s continuation value continues to increase, until the parties reach a period in which the continuation value passes the threshold \( \bar{u}_{CD} \). At the end of that period, the parties engage in randomization to determine their actions in the following period. Depending on the outcome of this randomization, the principal either continues to engage in cooperative delegation or she moves to uncooperative delegation, that is, she allows the agent to choose his preferred project even if her preferred project is available. Finally, once the principal has moved to uncooperative delegation, she stays there in all subsequent periods.

To see how the principal optimally decreases the agent’s continuation value, suppose instead that the agent chooses his own preferred project for a number of consecutive periods. The principal then continues to engage in cooperative delegation, and the agent’s continuation value continues to decrease, until the parties reach a period in which the continuation value falls below the threshold \( \underline{u}_{CD} \). At the end of that period, the parties engage in one of two types of randomization to determine their actions in the following period. If \( u \in [a, \bar{u}_{CD}] \), the principal either continues to engage in cooperative delegation or she moves to centralization. And if, instead, \( u \in [0, a) \), the principal either moves to centralization or she exits the relationship in the next period. Finally, once the principal has moved to either centralization or exit, she stays there in all subsequent periods.

A key feature of the optimal relational contract is that once the principal chooses an action other than cooperative delegation, she takes that action in all future periods. It is therefore not
optimal for the parties to cycle between reward and punishment phases, as in the well known class of equilibria that Green and Porter (1984) first introduced. To see why such equilibria are not optimal, notice that both rewards—letting the agent choose his preferred project even when the principal’s is available—and punishments—opting out or centralizing—are costly for the principal. As mentioned in the introduction, however, the threat to retract a previously promised reward, and the promise to retract a previously threatened punishment, do not impose any costs on the principal, yet they motivate the agent just the same. Delaying rewards and punishments therefore creates an additional and costless tool that the principal can use to motivate the agent. Because of this benefit, the principal wants to delay them as much as she can.

The above proposition leaves open two questions about the long-run outcome of the relationship. First, does the principal always end up administering a punishment or reward? And if she ever does administer a punishment, does it take the form of termination or centralization? The next proposition answers these questions.

**PROPOSITION 2:** *In the optimal relational contract, the principal chooses cooperative delegation for the first $\tau$ periods, where $\tau$ is random and finite with probability one. Moreover, there exists a threshold $p^*$ such that the relationship never terminates if $p \leq p^*$. If, instead, $p > p^*$, punishment can take the form of either termination or centralization, depending on the history of the relationship.*

The proposition shows that the answer to the first question—whether the principal always ends up administering a punishment or reward—is yes. And it shows that the answer to the second question—whether the punishment takes the form of termination or centralization—is that it depends on the probability $p$ that the principal’s preferred project is available. Having characterized the optimal relational contract, we now turn to its implications, which we already sketched and discussed in the introduction.

The first implication is that the principal’s payoff declines over time, even if the relationship does not terminate. In particular, the principal’s first period payoff $\pi(u^*)$ is strictly larger than the payoffs that the principal realizes once the relationship has converged to permanent centralization—in which case the principal makes $a < \pi(u^*)$—or permanent delegation—in which case she makes $b < \pi(u^*)$. The principal’s payoff declines over time, because the firm gets worse at using the agent’s information. And the firm gets worse at using the agent’s information because, eventually, the principal either has to reward the agent—by letting him choose any project—or punish him—by choosing a project herself. In either case, the firm’s decision no longer reflect the agent’s information.
The second implication is that the organizational structure that the firm converges to, and thus the long run payoff that the principal realizes, depend on random events in the firm’s early history. In particular, whether the firm converges to permanent centralization—in which case the principal’s payoff is given by \( a \)—or whether it converges to permanent decentralization—in which case it is given by \( b < a \)—depends on the randomly determined availability of projects in the periods before the firm converges to either organization. The model therefore generates persistent organizational differences that, in turn, generate persistent performance differences across seemingly identical firms.

Also, and related, the model suggests an explanation for why some under-performing firms do not copy the organizational practices of their more successful rivals, even though such practices are not protected by patents. In particular, it suggests that such firms may not imitate their more successful rivals since their seemingly inefficient organizations are either a reward for past successes or a punishment for past failures. In either case, employees would view the adoption of a different organizational structure as the violation of a mutual understanding and punish the firm accordingly. This suggests that a firm’s history can serve as a barrier to organizational imitation.

6 Failure to Adapt to Public Information

In the previous section, we showed that when the agent must be motivated to use his private information in the principal’s interest, the relationship eventually evolves into a situation in which the agent ceases doing so. The firm’s early success and its eventual inertia are two sides of the same coin. To an outsider observing such a firm, the remedies the firm should pursue to stay ahead should not be obvious.

Yet the failures of many leading firms appear blatant and therefore puzzling to outsiders. Why did Kodak not pursue the digital camera market that it pioneered? Why did IBM suppress the growth of its own successful PC division in the 1980s? Such questions may of course be prompted by hindsight bias: the folly of Kodak and IBM may only have been obvious years later. Or, in the context of our baseline model, perhaps the opportunities presented by digital photography were only obvious to Kodak’s already successful film division, who preferred to continue to pursue film rather than digital. But of course, new entrants into the photography market such as Sony immediately pursued digital.

In this section, we show that the forces of inertia developed in the previous section can also slow or prevent a firm’s move to adopt a publicly known and centrally implementable project. To do so, consider the following extension of the model described in Section 2. There are two phases.
In phase 1, which we refer to as the pre-opportunity phase, the stage game is the same as in the baseline model, but with one exception. At the end of each period, immediately before the outcome of the public randomization device, a new project may become permanently available to the principal. In particular, with probability \( q \), the game permanently transitions to phase 2, the post-opportunity phase, in which a new project can be chosen by the principal if she does not delegate to the agent. That is, in the post-opportunity phase, the set of actions available to the principal if she does not delegate is \( \mathcal{K}_{P,t} = \{S, N\} \). The payoffs from the new project are given by \((\tilde{u}_N, \tilde{\pi}_N)\). With probability \(1 - q\), the game remains in phase 1. Whether the game is in phase 1 or phase 2 is commonly known.

To make the analysis interesting, we assume that \( \tilde{\pi}_N > \pi^* \), where \( \pi^* \) is the principal’s highest equilibrium payoff in the baseline model. This implies that the new project is sufficiently profitable that if it were available at the beginning of period 1, the principal would choose to implement it in each period rather than delegating decision making to the agent. We further assume that \( \tilde{u}_N \in (\underline{u}_{CD}, \bar{u}_{CD}) \) and \( \tilde{\pi}_N \leq \pi(\bar{u}_N) + D \) for some \( D > 0 \). The first condition provides a tension between incentive provision and choice of the new project when it becomes available. The second condition ensures that the new project is not so profitable that it will be chosen no matter when after it becomes available.

As in the baseline model, we solve for the game using recursive methods. The primary technical complication is that the game is now a random game rather than a repeated game. As such, there are now two PPE frontiers to be characterized: we denote by \( \pi_1(\cdot) \) and \( \pi_2(\cdot) \) the frontiers in phases 1 and 2. Since the game never transitions from phase 2 to phase 1, this allows us first to characterize \( \pi_2(\cdot) \) and then use this characterization, in turn, to characterize \( \pi_1(\cdot) \).

Define \( \pi_{i,j}(u), i = 1, 2, j \in \{C, D_C, D_U, E, N\} \) to be the maximal payoff of the principal in phase \( i \) when action \( j \) is chosen in the stage game and the agent is promised an expected utility of \( u. j = N \) denotes the pure action in which both players enter, the principal does not delegate, and the principal chooses the new project instead of the safe project. Of course, \( j = N \) is only feasible in phase 2. As in the baseline model, \( \pi_{i,j}(u) = \pi_i(u) \) implies that the PPE payoff pair \((u, \pi_i(u))\) in phase \( i \) can be supported by action \( j \).

The analysis for \( \pi_2(u) \), the payoff frontier in phase 2, is therefore similar to the baseline model. We formally characterize \( \pi_2(u) \) in Lemma 6 in the appendix, but we illustrate the results graphically in Figure X below. In this figure, we compare \( \pi_2(u) \) to \( \pi(u) \), the PPE payoff frontier of the baseline model. \( \pi_2(u) \) has six regions: regions 1, 2, and 6 are analogous to the corresponding regions of \( \pi(u) \). The region in which cooperative delegation is supported is now split into two disjoint regions.
that surround region 4, in which the new project is chosen with positive probability. \( \pi_2 (u) \) contains the point \((\bar{u}_N, \bar{\pi}_N)\), but it is not simply the convex hull of \((\bar{u}_N, \bar{\pi}_N) \cup \{\pi(u) : u \in [0, B]\}\). Because the payoffs associated with the new project lie above the payoff frontier of the baseline model, the principal chooses the new project with positive probability within \((\bar{u}_N, \bar{u}_N)\). By doing so, the principal obtains a higher payoff within this region than in the baseline model. Moreover, the gains from the new action in this region spill over to the entire interval \((a, B)\), because when the agent’s payoff lies within \((a, B)\), there is positive probability in the future that his continuation payoff will fall in \((\bar{u}_N, \bar{u}_N)\). As a result, \( \pi_2 (u) \) is higher than \( \pi (u) \) for all \( u \in (a, B) \).

Figure X: This figure illustrates the PPE payoff frontier for the baseline model and the PPE payoff frontier as well as the actions that support each point on the frontier for phase 2 of the current extension.

Having characterized the PPE payoff frontier of the post-opportunity game, we now study the properties of the pre-opportunity game. To support each point on the frontier, \( \pi_1 (u) \), we have to specify an action and a pair of continuation payoffs: one in the pre-opportunity PPE payoff set, and one in the the post-opportunity PPE payoff set (or, if the action is cooperative delegation, we have to specify a pair of points in each PPE payoff set—one point corresponding to each realization of
the agent’s project choice). Lemma 7 in the appendix formally characterizes the shape of the pre-opportunity frontier as well as the actions and the associated pairs (or quadruplets) of continuation payoffs that support each point on the frontier. Figure W below illustrates the frontier $\pi_1(u)$ and the actions that support each point on the frontier.

Figure W: This figure illustrates the PPE payoff frontiers for the baseline model and for phases 1 and 2 of the current extension. It also describes the actions that support each point on the phase-1 frontier.

As in the baseline model, the principal’s continuation payoffs always lie on the payoff frontier in each phase. In contrast to the baseline model, however, there are no explicit expressions for the agent’s continuation payoffs. Rather, they are pinned down by the following two conditions. First, their expected value is determined by the promise-keeping conditions. Second, we have $\pi'_1(u_{1,j}(u)) = \pi'_2(u_{2,j}(u))$ for $j \in \{C, E, h, \ell\}$ for points $u$ at which the payoff frontiers are differentiable. For the values $u$ at which the payoff frontiers are not differentiable, the right derivative of the agent’s continuation payoff associated with one phase must be larger than the left derivative of his continuation payoff in the other phase. This is because, a fixed average continuation payoff should be optimally allocated across the two phases. At an optimum, it cannot be the case that it is beneficial to increase one continuation payoff and decrease the other. These properties allow us to study how the relationship adapts to the public arrival of the new project. Denote $T$ as the
(random) period following which the new project becomes available. Proposition 3 states our main result. Denote $h^T$ as the history of public outcomes up to period $T$.

**PROPOSITION 3:** For each $\tilde{u}_N$,

1. There exists a $\pi(\tilde{u}_N)$ such that for all $\tilde{\pi}_N \in (\pi(\tilde{u}_N), \pi(\tilde{u}_N))$, there exists a history $h^T$ such that $\Pr(u_T = \tilde{u}_N|h^T) < 1$.

2. There exists a $\tilde{\pi}(\tilde{u}_N) \leq \pi(\tilde{u}_N)$ such that for all $\tilde{\pi}_N \in (\pi(\tilde{u}_N), \pi(\tilde{u}_N))$, there exists history of path $h^T$ such that $\Pr(u_t = \tilde{u}_N|h^T) = 0$ for all $t \geq T$.

Part (i.) shows that when the principal’s payoff associated with the new project is not too high, the parties may not choose the new project immediately when it becomes available. Notice that if the new project were available at the beginning of the relationship, the principal would choose it with probability one. However, since the new project becomes available stochastically, its adoption is affected by the history of the play in phase 1. In particular, if the agent has chosen the principal’s preferred project sufficiently often in the pre-opportunity phase (so that his continuation payoff exceeds $\tilde{u}_N$), then adopting the new project can hurt the agent’s payoff. Therefore, to motivate the agent in phase 1, the principal may promise not to choose the new project with probability one when it becomes available.

Similarly, the relationship may not adapt immediate when the action has chosen his own preferred project sufficiently often in the pre-opportunity phase (so that his continuation payoff falls below $\tilde{u}_N$). This is perhaps somewhat surprising, because both parties would be better off if they chose the new project. Notice, however, that if the principal always chooses the new project when it is available, then the principal limits her ability to punish the agent, limiting his motivation. Promises used to motivate cooperative behavior in phase one therefore may spill over into phase two, leading to long-run inefficiencies.

Finally, Part (ii.) shows that when the principal’s payoff for the new project is sufficiently close to the payoff frontier of the baseline model, the parties may in fact never adapt and choose the new project when it becomes available. This happens when the agent’s continuation payoff either falls to $a$, so that the relationship settles into permanent centralization, or when it climbs to $B$, so that the relationship settles into entrenchment. When the gain from the new project is sufficiently small, the cost of forgoing the option value to adapt and choose the new project is small relative to its benefit in motivating the agent. In this case, the principal may sometimes "commit" not to choose the new project when it becomes available.
7 Extensions

In this section, we examine two of the assumptions that our main results are based on. The first is that no transfers are allowed between the principal and the agent. The second is that the safe project is fleeting: when the principal delegates to the agent, the agent cannot choose the safe project.

7.1 Transfers from Principal to Agent

Suppose that at the end of period $t$, the principal can pay the agent a non-negative transfer $w_t \geq 0$ contingent upon the agent’s project choice. The relational contract therefore specifies a bonus scheme and an action to be taken in each period. Denote by $\pi_T (u)$ the PPE payoff frontier of this extended game with transfers. The main result in this section is that allowing transfers from the principal to the agent does not affect the results of Propositions 2 or 3.

**PROPOSITION 4:** $\pi_T (u) = \pi (u)$. Moreover, the optimal relational contract specified in the game with no transfers is also an optimal relational contract when transfers from the principal to the agent are allowed.

In the baseline model, the agent is rewarded for choosing the principal’s preferred project through an increase in the probability that he will be able to choose his own project indefinitely in the future. When the agent chooses his own preferred project, he is punished through an increase in the probability that the safe action will be chosen indefinitely in the future. Since both cooperative delegation and uncooperative delegation yield a total surplus of $b + B$ in each period, rewards are simply a reallocation of total surplus from the principal to the agent, while punishments actually result in a decrease in total surplus.

If unrestricted transfers from the agent to the principal were allowed, then surplus-destroying punishments could be avoided by requiring such transfers when the agent chooses his own preferred project. Consequently, the principal would be indifferent between rewarding the agent through increases in his continuation payoff or through monetary transfers. However, when unrestricted transfers from the agent to the principal are not possible, punishment requires surplus destruction, and it requires more surplus destruction the lower is the agent’s continuation payoff, because the payoff frontier is concave. Conversely punishments are less costly the greater is the agent’s continuation payoff, and it follows that rewarding the agent with an increase in his continuation payoff is preferable to rewarding him with money.

This result is obtained in part because total surplus under the agent’s preferred action is the
same as under the principal’s preferred action. If, instead, payoffs for the agent’s preferred action are \((B_A, b_A)\) and for the principal’s preferred action are \((b_B, B_B)\) with total surplus lower under the agent’s preferred action (i.e., \(B_A + b_A < B_P + b_P\)), then rewarding the agent with an increase in his continuation payoff results in surplus destruction. If transfers are costly, so that it costs the principal \(1 + \kappa\) dollars to transfer 1 dollar to the agent, then as long as \(1 + \kappa \geq \frac{B_P - b_A}{B_A - b_P}\), monetary transfers will not be used in an optimal relational contract.

7.2 Safe Project Always Available

In the baseline model, whenever the principal delegates to the agent, the agent does not have the option of choosing the safe project. That is, the set of projects that the agent can choose from in period \(t\) is \(K_{A,t} \in \{\{A\}, \{A, P\}\}\). As a result, punishment takes the form of centralization: the principal does not delegate, and the principal chooses the safe project. But if the agent has the option to choose the safe project, then punishment may instead take the form of constrained delegation in which the principal delegates to the agent with the understanding that if the principal’s preferred project is not available, the agent will choose the safe project rather than his own preferred project.

Formally, suppose that \(K_{A,t} \in \{\{S, A\}, \{S, A, P\}\}\), where \(\Pr[K_{A,t} = \{S, A, P\}] = p\). There are now five sets of actions that may be used in equilibrium. In addition to "cooperative delegation," "uncooperative delegation," "centralization," and "exit," the players may also choose "constrained delegation," in which the principal delegates to the agent with the understanding that the agent will choose the principal’s preferred project whenever it is available and will choose the safe project otherwise. We denote constrained delegation by \(j = CDD\). When parties engage in constrained delegation, and the agent’s promised utility is \(u\), the promise-keeping constraint is

\[
\begin{align*}
  u &= (1 - p) ((1 - \delta) a + \delta u_{CDD,\ell}(u)) + p ((1 - \delta) b + \delta u_{CDD,h}(u)),
\end{align*}
\]

and the agent will choose the principal’s preferred project whenever it is available as long as

\[
(1 - \delta) b + \delta u_{CDD,h}(u) \geq (1 - \delta) a + \delta u_{CDD,\ell}(u).
\]

Consequently, continuation payoffs can be chosen to make this inequality hold with equality:

\[
\begin{align*}
  \delta u_{CDD,\ell}(u) &= u - (1 - \delta) a \\
  \delta u_{CDD,h}(u) &= u - (1 - \delta) b.
\end{align*}
\]

We denote the PPE payoff frontier of this extended game by \(\pi_S(u)\). Lemma 7 in the appendix characterizes the frontier of the game when the safe project is always available, and figure W below illustrates a number of its properties.
Figure W: These figures illustrate the PPE payoff frontiers for the baseline model and for the extended model in which the safe project can be chosen by the agent. They also describe the actions that support each point on the frontier. The figure on the left illustrates the PPE frontier and actions for the case in which constrained delegation is chosen in the first period. The figure on the right illustrates the PPE frontier and actions for the case in which cooperative delegation is chosen in the first period.

Delegating to the agent with the understanding that the agent will choose the safe project whenever the principal’s preferred project is not available yields higher profits for the principal than centralization does. As a result, the PPE payoff frontier lies above the point \((a, a)\), and centralization will never be chosen in equilibrium. The frontier consists of five regions. In the first region, the parties randomize between exit and constrained delegation in the next period. In the second region, parties engage in constrained delegation. In the third region, parties randomize between constrained delegation and cooperative delegation in the next period. In the fourth region, parties engage in cooperative delegation, and in the fifth region, they randomize between cooperative delegation and uncooperative delegation. It may be the case that the highest point on the frontier lies in region 2 or in region 4, depending on the parameters of the model.

We can now describe the optimal relational contract and how it evolves over time.

**PROPOSITION 5.** When delegative control is allowed, the optimal relational contract satisfies the following.

**First period:** The agent’s and the principal’s payoffs are given by \(u^* \in [\underline{u}_{CDD}, \bar{u}_{CDD}] \cup [\underline{u}_{CD}, \bar{u}_{CD}]\) and \(\pi(u^*) = \max\{\pi_{DCD}(u), \pi_{DCC}(u^*)\}\). The parties engage in either delegative control
or cooperative delegation. In either case, if the agent chooses the principal’s preferred project, his continuation payoff increases and drops otherwise.

**Subsequent periods:** The agent’s and the principal’s payoffs are given by $u \in [u_{CDD}, \bar{u}_{CD}] \cup \{u_{CD}, \bar{u}_{CD}\} \cup \{B\}$ and $\pi(u)$. Their actions and continuation payoffs depend on what region $u$ is in:

(i.) If $u = 0$, the parties exit. The agent’s continuation payoff is given by $u_E(0) = 0$.

(ii.) If $u \in [u_{CDD}, \bar{u}_{CDD}]$, the parties engage in constrained delegation. If the agent chooses the principal’s preferred project, his continuation payoff is given by $u_{D}^{CD}(u) > u$. If, instead, control is used, his continuation payoff is given by $u_{D}^{C}(u) < u$.

(iii.) If $u \in [u_{CD}, \bar{u}_{CD}]$, the parties engage in cooperative delegation. If the agent chooses the principal’s preferred project, his continuation payoff is given by $u_{h}^{CD}(u) > u$. If, instead, the agent chooses his own preferred project, his continuation payoff is given by $u_{l}^{CD}(u) < u$.

(iv.) If $u = B$, the parties engage in uncooperative delegation. The agent’s continuation payoff is given by $u_{D_{U}}(B) = B$.

The proposition shows that the principal starts out by engaging in either constrained delegation or cooperative delegation. As in the baseline model, to motivate the agent to choose her preferred project whenever it is available, the principal increases his continuation value whenever he chooses her preferred project, and she decreases his continuation value when he chooses his own preferred project (under cooperative delegation) or the safe project (under constrained delegation). The short-run dynamics are similar whether the optimal relational contract begins with constrained delegation or with cooperative delegation.

When the agent is able to choose the safe project, the principal has two tools available to punish the agent. Under cooperative delegation, if the agent has chosen his own preferred project sufficiently often, his continuation payoff falls, and eventually the principal has to alter his choice of project in order to reduce the agent’s per-period payoff. She does so by effectively restricting the set of projects that the agent can choose from and removing the agent’s preferred project from this set. Reduced discretion can therefore be a punishment for poor performance under cooperative delegation.

Similarly, under constrained delegation, if the agent has chosen the safe project sufficiently often, his continuation payoff falls. Eventually, the principal has to punish the agent, and she does so by choosing exit with some positive probability. If the agent has chosen the principal’s preferred project sufficiently often, his continuation payoff increases, and the principal eventually rewards him with increased discretion, allowing him to choose his own preferred project when her preferred
project is not available. Finally, as in the baseline model, the possibility of the relationship moving into uncooperative delegation serves as a potential reward for the agent. We now describe the long-run dynamics in the following proposition.

PROPOSITION 6: In the optimal relational contract, the principal chooses either cooperative delegation or constrained delegation for the first $\tau$ periods, where $\tau$ is random and finite with probability one. For $t > \tau$, the relationship results in either termination or entrenchment, depending on the history of the relationship. Both possibilities occur with positive probability for all $p \in (0, 1)$.

Proposition 6 shows that, as in the baseline model, the relationship eventually settles into one of two steady states: termination or entrenchment. Since centralization is never chosen in equilibrium, the relationship can never settle into permanent centralization.

8 Conclusions

We conclude by offering an alternative interpretation of our model and relating it to recent work on the interaction between trust, organization, and performance. In particular, Bloom et. al. (2012) provide empirical evidence that an increase in the degree of trust within a firm causes the firm to be more decentralized which, in turn, has a positive effect on its performance. This result provides a challenge to the large theoretical literature on delegation which has mostly, if not entirely, abstracted from trust as a determinant for the allocation of decision rights. Specifically, it raises the questions of what determines the degree of trust within a firm and how do trust and the allocation of decision rights interact and evolve over time. As Bloom et. al. (2012) observe at the end of their paper: "we have considered trust as being exogenously endowed on firms and countries due to long-run effects of history and culture (such as religion). But corporate cultures do change over time, and modeling the endogenous evolution of trust and incentives to invest in it would be a fascinating avenue for future research."

Our model is well-suited to address these issues since we model delegation explicitly as a trust game. The common view that a good relationship takes time suggests that, within active relationships, both trust and an employee’s discretion increase over time. This may well be the case if there is uncertainty about the employee’s trustworthiness. Our model, however, shows that if there is no such uncertainty, and employees are known to be selfish, trust may decrease over time, while discretion may actually increase.

Even though this may at first seem counter-intuitive, it follows directly from our discussion above. In particular, we saw above that the owner starts out trusting the employee or, to be
more precise, trusting that her policy commitments will induce the selfish employee to act in her interest. Eventually, however, the owner has to either reward the employee by giving him more discretion—and letting him choose his preferred project—or punish him by taking away his discretion entirely—and choosing a project herself. In either case, the owner no longer trusts the employee to act in her interest. Trust therefore unambiguously declines over time. Yet, the employee’s discretion will actually increase whenever the owner has to reward him for his trustworthiness early on. This suggests that the interaction between trust and discretion and their evolution over time depend crucially on whether there is uncertainty about the employees’ types or about their actions.
Appendix (Incomplete)

LEMMA 6: There exist four cutoffs $u_{CD}, \tilde{u}_{CD}, u_{N}, \tilde{u}_{N}$ such that the PPE payoff frontier $\pi_2(u)$ is divided into six regions:

(i.) For $u \in [0, a]$, $\pi_2(u) = u$ and $(u, \pi_2(u))$ is supported by randomization between exit and centralization.

(ii.) For $u \in [u_{CD}, \tilde{u}_{CD}]$, $\pi_2(u) = \left( (u_{CD} - u) a + (u - a) \pi_2(u_{CD}) \right) / (u_{CD} - a)$ and $(u, \pi_2(u))$ is supported by randomization between centralization and cooperative delegation.

(iii.) For $u \in [u_{CD}, u_{N}]$, $\pi_2(u) = \pi_{2,DC}(u)$ and $(u, \pi_2(u))$ is supported by cooperative delegation.

(iv - a.) For $u \in [u_{N}, \tilde{u}_{N}]$, $\pi_2(u) = \left( (\tilde{u}_{N} - u) \pi_2(u_{N}) + (u - u_{N}) \tilde{\pi}_{N} \right) / (\tilde{u}_{N} - u_{N})$ and $(u, \pi_2(u))$ is supported by a randomization between cooperative delegation and the new project.

(iv - b.) For $u \in [\tilde{u}_{N}, \tilde{u}_{CD}]$, $\pi_2(u) = \left( (\tilde{u}_{N} - u) \tilde{\pi}_{N} + (u - \tilde{u}_{N}) \pi_2(u_{N}) \right) / (\tilde{u}_{N} - \tilde{u}_{N})$ and $(u, \pi_2(u))$ is supported by a randomization between cooperative delegation and the new project.

(v.) For $u \in [\tilde{u}_{N}, \tilde{u}_{CD}]$, $\pi_2(u) = \pi_{2,DC}(u)$ and $(u, \pi_2(u))$ is supported by cooperative delegation.

(vi.) For $u \in [\tilde{u}_{CD}, B]$, $\pi_2(u) = \left( (B - u) \pi_2(\tilde{u}_{CD}) + (u - \tilde{u}_{CD}) b \right) / (B - \tilde{u}_{CD})$ and $(u, \pi_2(u))$ is supported by a randomization between cooperative and uncooperative delegation.

LEMMA 7: The PPE frontier $\pi(u)$ can be divided into five regions.

$\pi(u) = \begin{cases} 
\frac{u \pi(u_{CD})}{u_{CD}(u)} & \text{if } u \in [0, u_{CD}); \\
\frac{\left( (u_{DC} - u) \pi(\tilde{u}_{CD}) + (u - \tilde{u}_{CD}) \pi(u_{DC}) \right)}{\pi_{DC}(u)} & \text{if } u \in [\tilde{u}_{CD}, u_{DC}); \\
\frac{(B - u) \pi(\tilde{u}_{DC}) + (u - \tilde{u}_{DC}) b}{(B - \tilde{u}_{DC})} & \text{if } u \in [\tilde{u}_{DC}, B],
\end{cases}$

where $u_{CD} \geq (1 - \delta) a$ and $\tilde{u}_{DC} = (1 - \delta) b + \delta B$. 

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