Managerial Attention and Worker Engagement

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PRELIMINARY AND INCOMPLETE – DO NOT CIRCULATE

Abstract

We study a dynamic agency problem with two-sided moral hazard: the worker chooses whether to exert effort or shirk; the manager chooses whether to invest in paying attention to the worker's performance. In equilibrium the worker uses past recognition to infer managerial attention. An engagement trap arises: absent recent recognition, both worker effort and managerial investment decrease, making a return to high productivity less likely as time passes. In a sample of ex-ante identical firms, firm performance, managerial quality, and worker engagement display heterogeneity across firms, positive correlation, and persistence over time.

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1 Introduction

Performance differences across firms are sizable and persistent. A growing number of studies point to managerial practices as a main driver.[1] Bloom and Van Reenen (2007) find that higher-quality management practices are associated with higher productivity, profitability, and survival rates. Bloom et al. (2013) provide free consulting services to randomly chosen plants and find that adopting these practices raises productivity. The role of managers and different components of management is also stressed in Ichniowski, Shaw, and Prennushi (1997), Bushnell and Wolfram (2009), Bloom and Van Reenen (2010), and Kaplan, Klebanov, and Sorensen (2012) among others; see Gibbons and Henderson (2013) for a survey.

At the same time, psychologists find that worker engagement is important for firm productivity. Employee engagement is positively related to individual performance (Warr, 1999; Judge et al., 2001); moreover, at the organizational and unit-business level, there is a significant link between aggregate measures of worker engagement and outcomes such as employee turnover, customer satisfaction, accidents, productivity, and profits (Ostroff, 1992; Ryan, Schmit, and Johnson, 1996; Harter, Hayes, and Schmidt, 2002).[2] Notably, some of the items comprising engagement measures concern workers' perceptions of managerial practices. For example, whether workers believe to be given "recognition or praise for doing good work" affects their engagement (Harter, Hayes, and Schmidt, 2002, p. 269).

This paper studies firms' ability to raise productivity by using better managerial practices and increasing worker engagement. Can firms improve their management practices? Can they improve worker engagement? What is the relationship between the two? We provide a model where these two phenomena are interlinked and explore the dynamic interaction between them. Our theory offers an explanation for why performance differences across firms are highly persistent in the data: while good managerial practices can allow to increase worker engagement and productivity, firms may fall into an "engagement trap" where low worker engagement and poor management reinforce each other.

Our model features two-sided moral hazard: on the one hand, workers choose whether to exert effort or shirk; on the other hand, the manager chooses whether to invest in paying attention to workers' performance. A worker's level of engagement depends on his belief about the manager's attention. Our focus on managerial attention is motivated by the observation — dating back to at least Simon (1945) and Drucker (1966) — that managers'

[1] For a discussion of the different possible determinants of productivity differences across firms, see the survey by Syverson (2011).

[2] Recent work suggests that this link is indeed a causal one from worker engagement to firm performance; see for example Bockerman and Ilmakunnas (2012).

time and attention are limited and how managers choose to allocate these scarce resources is central to organizations. In this sense, the paper relates to Geanakoplos and Milgrom (1991) and other work on organizations under cognitive limits,[3] although we address quite different issues. In particular, while this literature is concerned with the coordination of agents under no conflicting interests, we consider managers' attention to monitoring and the interaction with the provision of effort incentives. Our study of attention as a main component of management is also related to recent empirical work on the time use of managers and firm productivity, including Bandiera et al. (2011) and Bandiera, Prat, and Sadun (2012).

More specifically, we consider the following continuous-time model. At each time, a myopic agent privately chooses effort which generates unobservable output for a principal.[4] The principal's managerial attention can be either low or high. We model managerial attention as capital: the principal can invest at some cost to transform a low managerial attention technology into a high technology, and a high technology may "break" at any point and become low. The agent observes neither managerial attention nor investment directly. Learning about effort and managerial attention occurs through public Poisson signals whose arrival rate is positive if attention is high and the agent exerts effort, and it is zero otherwise. When a signal arrives, we say that "recognition" occurs. The agent receives a constant bonus payment each time there is recognition; the principal does not bear the cost of this bonus directly.[5] Naturally, in this setting, the agent's incentive to exert effort depends not only on the bonus but also on his engagement, which we define as the agent's belief that the principal's managerial attention is high.

There are three main features that our model tries to capture. First, workers are engaged and exert effort if they believe that they will be recognized for their work. Recognition may entail a monetary payment or some other form of reward or praise that is valued by the workers. Second, managers cannot increase worker engagement by simply recognizing workers continuously or at random times. Credible recognition is costly: it requires that managers invest in paying attention to workers' performance. Managers need to have in place a control system to recognize workers' performance along the lines of the human resource management practices identified by Bloom and Van Reenen (2007). Finally, managerial attention is not directly observable, and managers can prove to have high attention to recognize good per-

[3]See for example Radner (1993), Bolton and Dewatripont (1994), Van Zandt (1999, 2003), Garicano (2000), and Dessein, Galeotti, and Santos (2013). Garicano and Prat (2011) provide a survey.

[4]We think of output as some good or service whose quality is difficult to measure, or for which the agent's contribution to the final product is difficult to determine. As it is often the case in the real world, the agent is thus not directly compensated as a function of output.

[5]For example, assume that the principal makes payments to a bonus pool or to a fund at each time, and the fund then pays the bonus to the agent when recognition occurs. We make this assumption to study the problem of managerial attention separately from that of enforcement of payments.

formance only when performance is indeed good. If workers' engagement and effort are low, an investment in recognizing good work is likely to go unnoticed.

In a benchmark setting where the principal's managerial attention is observable, trade requires that the principal maintain high attention; otherwise the agent is not willing to put in effort. The principal invests in fixing her attention technology each time it breaks if and only if the gain from the investment is larger than the cost. The gain is the output generated when the agent exerts effort; the cost depends on the probability that a high attention technology again breaks. We consider parameters such that, when attention is observable, it is optimal for the principal to always invest.

Turning to unobservable managerial attention, we characterize the unique efficient equilibrium when beliefs are continuous in the absence of public events.[6] The agent's engagement here is a function of recognition (or the absence of recognition) and the agent's belief about the principal's investment. Because recognition fully reveals that the principal's managerial attention is high, the agent's engagement jumps up to one when recognition occurs. We show that in the equilibrium, engagement then decreases continuously over time until recognition again occurs. The agent exerts effort with probability one while engagement is high; once engagement becomes low, the probability that the agent exerts effort decreases continuously with the time that has passed since the last recognition. As for the principal's investment, following recognition the principal does not invest while engagement and effort are high, as she has little to gain from being again revealed to be a high-managerial-attention type. When the agent's effort begins to decline, the principal uses a mixed strategy, with a probability of investment that is also decreasing over time. The relationship can then fall into an engagement trap, where effort and investment decline so long as recognition does not occur, and as a consequence the probability of recognition also goes down over time.

We contrast the dynamics of our model with those that arise in a setting where the principal monitors *bad* performance rather than *good* performance. That is, suppose that recognition can occur only if the principal's attention is high and the agent does *not* exert effort. The agent is punished whenever there is recognition. We show that in equilibrium the agent exerts effort with probability one while engagement is high and with some constant probability once engagement becomes low. Similarly, the principal either does not invest or invests with a constant probability. The model is thus essentially static. More importantly, here the probability of recognition increases and remains constant when the agent's effort jumps down, so an engagement trap does not arise.

The implications for firm productivity are immediate. Monitoring systems based on re-

[6]Note: We will study equilibria where beliefs can be discontinuous in a future version of this paper.

ward result in persistent heterogeneity in firm performance. Investment and recognition decrease as productivity goes down, making a return to high productivity less likely. Instead, systems based on punishment do not give rise to traps, as low-performing firms are the ones with the higher chances of obtaining recognition and increasing performance. Our analysis thus predicts more persistent performance differences among ex-ante identical firms in industries where rewards are a better instrument to incentivize workers than punishment. One example is continuous process innovation, where high managerial attention is needed to recognize and reward workers' small innovations.

The paper is related to other models where persistent performance differences arise among seemingly identical organizations (see the survey by Gibbons and Henderson, 2013). For example, Chassang (2010) considers a model where a party cannot observe her partner's cost of cooperating in a given period, but can learn to predict this cost as the parties gain common experience. Because learning is costly, the parties may choose to stop learning before it is complete, and the efficiency of the relationship can depend on the history. In Li and Matouschek (2012), a principal's cost of making contingent payments to an agent depends on a shock that is the principal's private information. As bad shocks accumulate, the agent's effort goes down, and if the principal is liquidity constrained, a recovery becomes more difficult. Callander and Matouschek (2013) propose a theory where managers learn about the quality of different managerial practices by trial and error. If managerial actions are complementary, differences in the quality of practices across firms are persistent.

The paper is also related to continuous-time models of reputation. Faingold and Sannikov (2011) study a model where a firm is either a normal type or a behavioral type committed to a stationary strategy (Kreps and Wilson, 1982; Milgrom and Roberts, 1982), and where consumers observe Brownian signals of the firm's actions. Closer to our setting is Board and Meyer-ter-Vehn (2012), where a firm can invest in product quality and consumers learn about the firm's quality through Poisson signals. These papers however consider moral hazard only on the side of the informed player; moreover, the uninformed player's actions have no effect on learning. Instead, we study a model where there is a dual moral hazard problem, and where both the manager's investment and the workers' effort affect the learning process. Related to our analysis of reward-based versus punishment-based systems, Board and Meyer-ter-Vehn (2012) compare good-news and bad-news learning about firm quality.[7] We note though that learning is always good news about the principal's type in our model; the distinction that we make is between good-news and bad-news learning about the agent's performance.

[7]See also Abreu, Milgrom, and Pearce (1991).

Finally, there is a large literature on monitoring. In particular, a series of early papers study the problem of monitoring or auditing when the monitor cannot commit to a monitoring strategy.[8] Graetz, Reinganum, and Wilde (1986) analyze a simple tax compliance game. Khalil (1997) shows that a principal induces overproduction to increase her incentives to audit an agent's private cost of production ex post. Strausz (1997) considers a moral hazard setting and shows that delegating monitoring to a third party can help a principal to provide incentives for effort and monitoring simultaneously.

2 The model

2.1 Setup

Consider a principal and an agent. Time $t \in [0, \infty)$ is continuous and infinite and the discount rate is $r \geq 0$. At each time t, the agent privately chooses whether to exert effort or shirk, where $\alpha_t \in [0, 1]$ is the probability with which the agent exerts effort and $c > 0$ is the cost of effort. The agent's effort generates an output for the principal that we normalize to be equal to α_t. This output is unobservable to the parties. As mentioned, this captures the idea that either the quality of output or the agent's contribution to final output is difficult to measure, so the agent's compensation cannot directly depend on output.

The principal's managerial attention can be either low or high, $\theta_t \in \{\theta^L, \theta^H\}$. A managerial attention technology θ^H becomes θ^L, i.e. "the technology breaks", with instantaneous transition probability $\gamma > 0$. The principal can transform a technology θ^L into θ^H, i.e. "fix the technology", by investing at cost $F > 0$. The principal's managerial attention technology and her investment decisions are unobservable by the agent. The agent's belief that managerial attention is high at time t is $x_t = Pr(\theta_t = \theta^H) \in [0, 1]$. We refer to x as the agent's level of engagement.

At any time t, a signal is realized — "recognition" occurs — with instantaneous probability $\mu(\alpha_t, \theta_t)$. With the obvious abuse of notation, we let $\mu(\alpha_t, \theta_t) = \mu\alpha_t$ if $\theta_t = \theta^H$ and $\mu(\alpha_t, \theta_t) = 0$ otherwise, where $\mu > 0$. The agent receives a bonus payment $b > 0$ each time there is recognition. To study the problem of managerial attention separately from that of enforcement of payments, we assume that the principal does not bear the cost of this bonus directly. One interpretation is that the principal makes instantaneous payments at each point to a fund, which then pays the bonus b to the agent when recognition occurs. Alternatively, the bonus may represent the agent's intrinsic value for being recognized for

[8] Sappington (1986) and Melumad and Mookherjee (1989) study settings with partial commitment.

his work, where this recognition does not entail a direct cost to the principal. The bonus is exogenous and the agent's wage is normalized to 0.

Both the principal and the agent are risk neutral. The agent is completely myopic and his outside option is not to work.

2.2 Observable attention benchmark

Consider a benchmark where the principal's managerial attention is observable. The equilibrium features trade if the principal invests in managerial attention and the agent exerts effort. We obtain the following result:[9]

Proposition 1 (Observable managerial attention)**.** *Suppose θ_t is observable. A trade equilibrium exists if and only if*

$$\mu b \geq c \quad \textit{and} \quad (\gamma + r)F \leq 1.$$

Proof. The agent is willing to exert effort if and only if $\theta_t = \theta^H$ and $\mu b \geq c$. If the technology breaks at time t, the principal prefers to fix it at t rather than fixing it at time $t + \delta$, for any $\delta \in (0, \infty)$, if and only if

$$\begin{aligned} & \int_0^\delta e^{-(\gamma+r)\tau} d\tau - (1 - e^{-(\gamma+r)\delta})F \geq 0 \\ \iff \quad & \frac{1}{(\gamma + r)}(1 - e^{-(\gamma+r)\delta}) - (1 - e^{-(\gamma+r)\delta})F \geq 0 \\ \iff \quad & \frac{1}{(\gamma + r)} - F \geq 0. \end{aligned}$$

Q.E.D.

When managerial attention is observable, two conditions are required for trade. First, given a high managerial attention, the agent's expected reward for performance must be large enough to compensate the agent for his cost of effort. Second, the principal must have incentives to invest in high managerial attention; otherwise the agent exerts no effort. The principal fixes her managerial attention technology when it breaks if and only if the gain is larger than the cost. The gain is the output that the principal obtains from the agent's effort. As for the cost, the principal takes into account not only the current cost F, but also the probability γ that at any point the technology may break and need to be fixed again.

[9] Trivially, if $\theta_0 = \theta^H$, trade occurs until the technology first breaks even if the second condition given in Proposition 1 is not satisfied. We do not consider such an outcome a trade equilibrium.

Throughout our analysis, we assume that parameters are such that these two conditions are satisfied:

Assumption 1. *A trade equilibrium exists under observable managerial attention:* $\mu b \geq c$ *and* $(\gamma + r)F \leq 1$.

3 Equilibrium characterization

Consider now the case where managerial attention is unobservable. Unlike under observable attention, an equilibrium where the principal invests each time the technology breaks does not exist. If the principal always invests, the agent's belief is $x_t = 1$ for all t, but then the principal has no incentives to invest at cost $F > 0$. In fact, this implies that an equilibrium where the agent's belief is constant and strictly positive does not exist (as any such equilibrium must have $x_t = 1$ for all t), and the unique equilibrium where engagement is constant has $x_t = 0$ for all t. Therefore, under unobservable managerial attention, we look for equilibria with ups and downs in the agent's engagement. Furthermore, note that if the principal invests at some time t, in equilibrium she must be indifferent between investing and not investing at t. The reason is that if the principal has strict incentives to invest at any time t, the agent's belief is $x_t = 1$, but then again the principal prefers to postpone the investment.

The next subsection characterizes the unique efficient equilibrium when beliefs are continuous in observables.

3.1 The solution

Let s be the amount of time that has passed since recognition last occurred. We solve for the unique efficient equilibrium when the agent's belief as a function of s, x_s, is continuous. In other words, the agent's engagement as a function of time is continuous in the absence of public events.[10]

We construct an equilibrium where the principal does not invest if $s < \overline{s}$, for a time $\overline{s} > 0$, and she invests with instantaneous probability $q_s \in (0, \infty)$ if $s \geq \overline{s}$. The agent exerts effort with probability $\alpha_s = 1$ if $s < \overline{s}$ and with probability $\alpha_s \in (0, 1)$ if $s \geq \overline{s}$. The threshold time $\overline{s}$ is thus defined as the time at which the agent's belief x_s reaches the level $\overline{x} \equiv c/(\mu b)$ at which the agent is indifferent between exerting effort and shirking.

[10] This restriction is similar to the one used by Board and Meyer-ter-Vehn (2012) in their model of reputation.

Engagement. To solve for the threshold time $\overline{s}$, consider first the law of motion for the agent's belief x_s. At the time of recognition, $s = 0$, the agent's belief is $x_0 = 1$, since recognition fully reveals that the principal's managerial attention is high. Then, if no recognition occurs, the change in x_s over $[s, s+\delta]$ is given by three sources which are independent in the limit: (i) the possibility that a high managerial attention technology breaks, with instantaneous probability γ; (ii) learning about the principal's managerial attention technology in the absence of recognition, according to Bayes' rule; and (iii) the agent's belief about the principal's investment in fixing a low managerial attention technology. Because in equilibrium the agent's belief about the principal's investment is correct, we can replace this belief with the principal's true instantaneous investment probability, q_s. Thus,

$$\begin{aligned} x_{s+\delta} - x_s &= [(1-\gamma\delta)x_s - x_s] + \left[\frac{x_s(1-\mu\int_0^\delta \alpha_{s+\tau}d\tau)}{x_s(1-\mu\int_0^\delta \alpha_{s+\tau}d\tau)+(1-x_s)} - x_s\right] \\ &\quad + \left[x_s + (1-x_s)\int_0^\delta q_{s+\tau}d\tau - x_s\right] + o(\delta) \\ &= -\gamma\delta x_s - \frac{x_s(1-x_s)\mu\alpha_{s+\overline{\tau}}\delta}{x_s(1-\mu\alpha_{s+\overline{\tau}}\delta)+(1-x_s)} + (1-x_s)q_{s+\overline{\tau}}\delta + o(\delta), \end{aligned}$$

where $\overline{\tau} \in (0, \delta)$ and we have used the first mean value theorem for integration.[11] In the limit as $\delta \to 0$, x_s in the absence of a signal is then governed by the following differential equation:

$$\dot{x}_s = -\gamma x_s - x_s(1-x_s)\mu\alpha_s + (1-x_s)q_s. \tag{1}$$

For $s \leq \overline{s}$, $q_s = 0$ and $\alpha_s = 1$, so the law of motion is

$$\dot{x}_s = -\gamma x_s - x_s(1-x_s)\mu. \tag{2}$$

Solving this differential equation with initial condition $x_0 = 1$ gives

$$x_s = \frac{\gamma+\mu}{e^{(log(\gamma)+(\gamma+\mu)s)}+\mu}.$$

Hence, $\overline{s}$ is given by

$$\begin{aligned} x_{\overline{s}} = \overline{x} \quad &\Longleftrightarrow \quad \frac{\gamma+\mu}{e^{(log(\gamma)+(\gamma+\mu)\overline{s})}+\mu} = \frac{c}{\mu b} \\ &\Longleftrightarrow \quad \overline{s} = \frac{log\left(\frac{(\gamma+\mu)\mu b - \mu c}{\gamma c}\right)}{\gamma+\mu}. \end{aligned} \tag{3}$$

[11] Recall that q_s is bounded in equilibrium as the principal cannot have strict incentives to invest.

Note that $\mu b \geq c$ and thus $\overline{s} \geq 0$.

Investment and effort. Consider next the principal's incentives to invest. The principal's payoff at any point s depends on the principal's managerial attention technology or *type*. Given s, let π_s^H be the principal's expected payoff when her type is $\theta_s = \theta^H$ and π_s^L when her type is $\theta_s = \theta^L$. The principal is willing to invest at s only if

$$\pi_s^L \leq \pi_s^H - F.$$

As mentioned, the principal cannot have strict incentives to invest at any time s; thus, $\pi_s^L \geq \pi_s^H - F$ for all s. Since at any point the principal either does not want to invest or is indifferent between investing and not investing, we can compute her payoff as if she never invested. Hence, the principal's expected payoff at s given θ_s is

$$\pi_s^L = \int_s^\infty e^{-r(\tau-s)}\alpha_\tau d\tau \tag{4}$$

$$\pi_s^H = \int_s^\infty e^{-(\gamma+r)(\tau-s)-\int_s^\tau \mu\alpha_{\tilde{\tau}}d\tilde{\tau}}(\alpha_\tau + \gamma\pi_\tau^L + \mu\alpha_\tau\pi_0^H)d\tau. \tag{5}$$

Let $\Lambda_s \equiv \pi_s^H - \pi_s^L$ denote the value of investing, and $\Psi_s \equiv \pi_0^H - \pi_s^H$ denote the value of recognition. Using (4) and (5), we can write

$$\Lambda_s = \int_s^\infty e^{-(\gamma+r)(\tau-s)}\mu\alpha_\tau\Psi_\tau d\tau. \tag{6}$$

The principal's value of investing in a high managerial attention technology is given by the probability of obtaining recognition before this technology breaks, times the value of recognition.

Consider time $s \geq \overline{s}$ where the principal invests with positive probability. The condition that the principal be indifferent between investing and not investing at s is

$$\Lambda_s = F. \tag{7}$$

The principal must also be indifferent between investing at s and investing at $s+\delta$, for any $\delta \in (0, \infty)$:

$$\int_0^\delta e^{-\int_0^\tau \mu\alpha_{s+\tilde{\tau}}d\tilde{\tau}-r\tau}(\pi_0^H - \pi_{s+\tau}^H)\mu\alpha_{s+\tau}d\tau - F - \int_0^\delta e^{-\int_0^\tau \mu\alpha_{s+\tilde{\tau}}d\tilde{\tau}-r\tau}\gamma F d\tau + e^{-r\delta}F = 0.$$

As $\delta \to 0$, this condition is equivalent to $\dot{\Lambda}_s = 0$. That is, for the principal to be indifferent over a period of time, her expected benefit from investing must be constant over this period. Differentiating (6) and substituting with (7), this condition can be written as

$$\Psi_s \mu \alpha_s = (\gamma + r)F. \tag{8}$$

We use the principal's indifference conditions (7) and (8) to solve for the agent's effort α_s at any time s at which the principal invests. Note that from condition (7), $\Psi_s = \pi_0^H - \pi_s^L - F$, and thus

$$\begin{aligned} \dot{\Psi}_s &= -\dot{\pi}_s^L \\ &= \alpha_s - r\pi_s^L, \end{aligned}$$

where the second equality follows from (4). Using (4), (7), and (8), we obtain a system of two differential equations for $s \geq \overline{s}$:

$$\dot{\Psi}_s = \frac{(\gamma + r)F}{\mu \Psi_s} - r\pi_s^L \tag{9}$$

$$\dot{\pi}_s^L = -\dot{\Psi}_s, \tag{10}$$

with boundary conditions $\Psi_{\overline{s}} = \overline{\Psi}$ and $\pi_{\overline{s}}^L = \overline{\pi}^L$. The values $\overline{\Psi}$ and $\overline{\pi}^L$ are obtained from the solution for $s < \overline{s}$, which we characterize below. Let $\hat{\Psi}_s$ and $\hat{\pi}_s^L$ be the solution to (9)-(10) given these boundary conditions. Then the agent's effort for $s \geq \overline{s}$ is

$$\hat{\alpha}_s = \frac{(\gamma + r)F}{\hat{\Psi}_s \mu}. \tag{11}$$

Finally, using the law of motion for the agent's belief in equation (1) and the agent's effort in equation (11), we solve for the principal's instantaneous probability of investment q_s. Recall that the agent's belief must be constant at $x_s = \overline{x}$ for $s \geq \overline{s}$. Setting $\dot{x}_s = 0$, $x_s = \overline{x}$, and $\alpha_s = \hat{\alpha}_s$ in (1) and solving for q_s yields that the principal's investment for $s \geq \overline{s}$ is

$$\hat{q}_s = \gamma \frac{\overline{x}}{1 - \overline{x}} + \overline{x} \mu \hat{\alpha}_s. \tag{12}$$

The last step is to characterize the dynamics for $s < \overline{s}$. Since here $\alpha_s = 1$, we obtain the

following system of differential equations:

$$\dot{\Lambda}_s = (\gamma + r)\Lambda_s - \mu\Psi_s \tag{13}$$

$$\dot{\Psi}_s = 1 - (\gamma + r)\Lambda_s + \mu\Psi_s - r\pi_s^L \tag{14}$$

$$\dot{\pi}_s^L = -1 + r\pi_s^L, \tag{15}$$

where the boundary conditions are: $\Psi_0 = 0$; $\Lambda_{\overline{s}} = F$; and $\Psi_{\overline{s}} = \frac{(\gamma+r)F}{\mu}$. The first two boundary conditions are straightforward from the definitions and discussion above. To understand the third condition, note that for $s < \overline{s}$, we must have $\Lambda_s < F$, so that the principal has no incentives to invest. Given $\Lambda_{\overline{s}} = F$, this requires $\dot{\Lambda}_s \geq 0$ for $s < \overline{s}$. Now suppose this inequality is strict for s arbitrarily close to $\overline{s}$. Since Λ_s is continuous, it approaches F as s approaches $\overline{s}$. Hence, in the limit as s approaches $\overline{s}$, $\dot{\Lambda}_s > 0$ implies $\mu\Psi_s < (\gamma + r)F$. But then the indifference condition (8) requires that α_s jump up above one at $\overline{s}$. Thus, we must have $\lim_{\varepsilon \to 0} \dot{\Lambda}_{\overline{s}-\varepsilon} = 0$.

This condition on $\dot{\Lambda}_s$ has important implications. First, it implies that the agent's effort is continuous at $\overline{s}$. From (11), we know that effort is also continuous for $s > \overline{s}$. Because the probability with which the agent exerts effort cannot stay at one (as the principal would have no incentives to invest), this means that the agent's effort declines continuously for $s \geq \overline{s}$, converging asymptotically to some constant long-run level $\underline{\alpha} < 1$. Second, using (12), we obtain that the principal's investment q_s jumps at $\overline{s}$ and declines continuously for $s > \overline{s}$. Finally, it follows that the probability of recognition, $\mu x_s \alpha_s$, is also decreasing in s.

Using the solution to (13)-(15), we compute $\overline{\Psi}$ and $\overline{\pi}^L$, and these are then used as initial conditions to solve the system (9)-(10). These solutions characterize the equilibrium.

Uniqueness. We show that the equilibrium characterized above is the unique continuous equilibrium where engagement never falls strictly below the threshold $\overline{x} = c/(\mu b)$.

It is straightforward to see that there is no equilibrium where x_s is always strictly above $\overline{x}$: if $x_s > \overline{x}$ for all s, the principal would not want to invest, but then x_s would eventually fall below $\overline{x}$. Moreover, note that the principal cannot invest continuously over a period of time $[s', s' + \delta]$ where $x_{s'} > \overline{x}$. Suppose by contradiction that she did. Then condition (8) would hold for $s \in [s', s' + \delta]$ with $\alpha_s = 1$, implying $\Psi_s = (\gamma + r)F/\mu$ for $s \in [s', s' + \delta]$. Substituting in equation (9) and setting $\dot{\Psi}_s = 0$, this implies

$$1 = r\pi_s^L.$$

But this means that the action never falls below one, leading again to a contradiction. It thus follows that any continuous equilibrium where x_s never falls strictly below $\overline{x}$ must coincide with our equilibrium.

We obtain the following result:

Proposition 2. *The unique continuous equilibrium where engagement never falls strictly below $\overline{x}$ is characterized by equations (1), (3), (11), and (12). In this equilibrium, if the time that has passed since recognition is $s < \overline{s}$, the agent exerts effort and the principal does not invest. For $s \geq \overline{s}$, the agent exerts effort with probability $\hat{\alpha}_s \in (0,1)$ and the principal invests with instantaneous probability $\hat{q}_s \in (0,\infty)$. Effort $\hat{\alpha}_s$ decreases continuously for $s \geq \overline{s}$. Investment $\hat{q}_s$ jumps at $\overline{s}$ and decreases continuously for $s > \overline{s}$. The probability of recognition, $\mu x_s \hat{\alpha}_s$, is continuously decreasing in s.*

Figure 1 illustrates the equilibrium. When the agent is highly engaged — i.e. the agent's belief that managerial attention is high is relatively high — the principal's gain from being revealed to be a high-managerial-attention type is small. Following recognition, there is thus a period of time during which the agent exerts effort and the principal does not invest. During this period, engagement declines because the probability that the principal's managerial attention technology has broken and become low increases as time passes without recognition. Eventually, engagement becomes low enough that the principal must start investing to prevent the agent from shirking. From this time on and so long as recognition does not occur, the principal's investment and the agent's effort decrease continuously towards a low constant level, and so does the probability of obtaining recognition. Therefore, low worker engagement and poor managerial practices reinforce each other, and the relationship's chances of returning to high engagement and high productivity decline as performance continues to go down.

Our results have direct implications for firm performance. Performance is positively correlated with worker engagement and with worker recognition. Moreover, investment in managerial attention is inverse U-shaped in performance, with lower levels of investment when performance is either relatively high or relatively low. This low investment at low performance levels leads to the engagement trap, where engagement is low and performance continues to go down. In a sample of ex-ante identical firms, we find that firm performance, managerial quality, and worker engagement display heterogeneity across firms, positive correlation, and persistence over time.

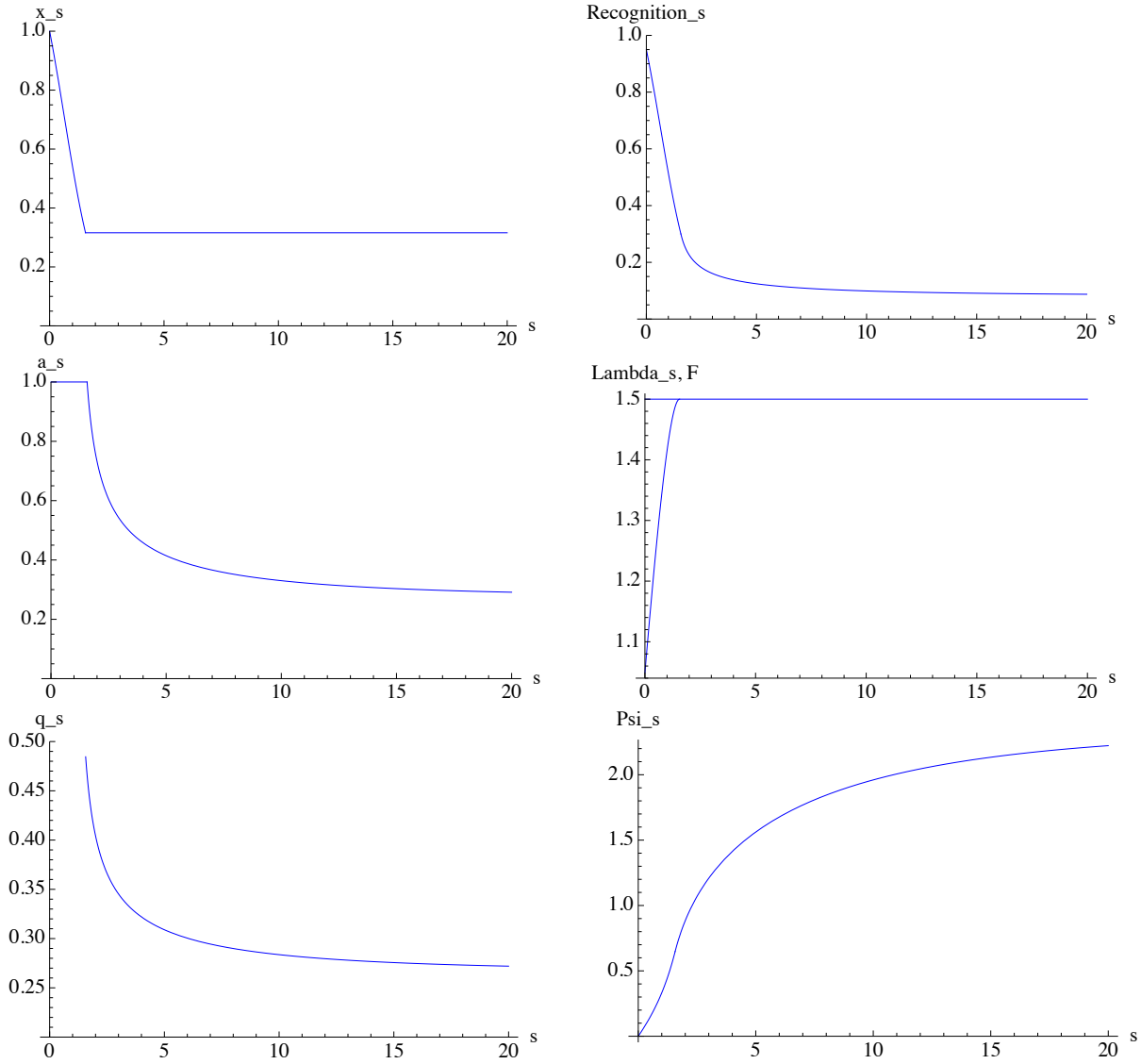


Figure 1 – Equilibrium dynamics.

Corollary 1. *In the equilibrium of Proposition 2, productivity is positively correlated with engagement and recognition, and investment in managerial attention is inverse U-shaped in productivity. The equilibrium gives rise to persistent performance differences among ex-ante identical firms.*

3.2 Existence and efficiency

Existence. We show that a continuous equilibrium always exists. Specifically, we show that if our equilibrium (characterized by (1), (3), (11), and (12) above) does not exist, an equilibrium where the principal never invests exists.

The argument is as follows. Fix the agent's belief to be as if the principal never invested. That is, x_s is governed by equation (2) for $s \in [0, \overline{s}]$ and it falls below $\overline{x}$ at $\overline{s}$, where $\overline{s}$ is given by (3). The agent's effort is then $\alpha_s = 1$ for $s \in [0, \overline{s}]$ and $\alpha_s = 0$ for $s > \overline{s}$. Call this path of effort $\tilde{\alpha}$. Given $\overline{s}$, it is straightforward to compute the low and high type's payoffs under no investment in this case. Let these payoffs be denoted by $\pi_s^H(\tilde{\alpha})$ and $\pi_s^L(\tilde{\alpha})$, and let $\Psi_s(\tilde{\alpha}) \equiv \pi_0^H(\tilde{\alpha}) - \pi_s^H(\tilde{\alpha})$ and $\Lambda_s(\tilde{\alpha}) \equiv \pi_s^H(\tilde{\alpha}) - \pi_s^L(\tilde{\alpha})$, where

$$\Lambda_s(\tilde{\alpha}) = \int_s^{\overline{s}} e^{-(r+\gamma)(\tau - s)} \mu \Psi_s(\tilde{\alpha}) d\tau. \tag{16}$$

The there are two possibilities: (i) there exists $\tilde{s} \in [0, \overline{s}]$ such that $\Lambda_{\tilde{s}}(\tilde{\alpha}) \geq F$, or (ii) for all $s \in [0, \overline{s}]$, $\Lambda_s(\tilde{\alpha}) < F$. In case (ii), it is obvious that a continuous equilibrium with no investment exists. Hence, all we need to show is that our equilibrium exists in case (i).

To explain the idea, let $\tilde{s}(\tilde{\alpha}) \in [0, \overline{s}] = \arg\max_s \Lambda_s(\tilde{\alpha})$. (Note such $\tilde{s}(\tilde{\alpha})$ always exists.) Since $\Lambda_{\tilde{s}(\tilde{\alpha})}(\tilde{\alpha}) = F$ is non-generic, assume $\Lambda_{\tilde{s}(\tilde{\alpha})}(\tilde{\alpha}) > F$. Note that the principal has strict incentives to invest, which cannot occur in equilibrium. We show that our equilibrium can always be constructed in this case.

Note that $\tilde{s}(\tilde{\alpha}) \in (0, \overline{s})$, since at $s = 0$, $\Psi_0(\tilde{\alpha}) = 0$, and thus $\Lambda_s(\tilde{\alpha})$ in (16) is equal to zero at either $s = 0$ or $s = \overline{s}$. Intuitively, as s goes to zero, the benefit from recognition goes to zero, while as s goes to $\overline{s}$, the chances of obtaining recognition in such little period of time go to zero. Moreover, it follows that we can define $s^*(\tilde{\alpha}) = \min\{s : \Lambda_s(\tilde{\alpha}) = F\}$. Note that $s^*(\tilde{\alpha})$ exists and is strictly less than $\tilde{s}(\tilde{\alpha})$.

Now consider a different path of effort for $s > \overline{s}$. To illustrate the idea, consider the profile α' defined as $\alpha'_s = 1$ for $s \in [0, \overline{s}]$ and $\alpha'_s = \overline{\alpha}' \in [0, 1]$ for $s > \overline{s}$. At one extreme, if $\overline{\alpha}' = 1$, then the principal would never invest. At the other extreme, if $\overline{\alpha}' = 0$, investment

incentives are as just described. Then we can show that there exists $\overline{\alpha}'$ such that

$$s^*(\alpha') = \overline{s}.$$

That is, by adjusting $\overline{\alpha}'$, we can ensure that the principal does not want to invest at $s < \overline{s}$ and she is indifferent exactly at $\overline{s}$. Given this profile α', the principal's investment benefit at $\overline{s}$ is $\Lambda_{\overline{s}}(\alpha') = F$ and the associated benefit from recognition is $\Psi_{\overline{s}}(\alpha')$. The last step is to note that given the discount rate r, from the perspective of $\overline{s}$, there is an infinite number of infinite (non-constant) sequences of future effort and associated recognition benefit functions that give the principal the same incentives to invest at $\overline{s}$ as the profile α'. Therefore, we can choose the sequence $\hat{\alpha}$ such that

$$\mu \Psi_s(\hat{\alpha}) \hat{\alpha}_s = (\gamma + r) F$$

for all $s \geq \overline{s}$, which is our equilibrium.

Efficiency. We show that if our equilibrium exists, it is the unique efficient continuous equilibrium. By Proposition 2, our equilibrium is the unique continuous equilibrium where engagement never falls below $\overline{x}$. Consider an equilibrium where x_s falls strictly below $\overline{x}$ at some time s. In any such equilibrium with x_s continuous, once x_s falls below $\overline{x}$, there is a "breakdown", i.e., the relationship goes into an absorbing state where the principal never invests and the agent never exerts effort. The reason is that once x_s is below $\overline{x}$, x_s cannot increase continuously all the way to a level above $\overline{x}$; since $x_s < \overline{x}$ implies $\alpha_s = 0$, the principal would have strict incentives not to invest when $x_s < \overline{x}$ and would instead wait until $x_s \geq \overline{x}$. Finally, using the analysis above, we can show that if our equilibrium exists, then it dominates this equilibrium with a breakdown.

Proposition 3. *A continuous equilibrium always exists. If the equilibrium characterized by (1), (3), (11), and (12) exists, it is the unique efficient continuous equilibrium. If this equilibrium does not exist, an equilibrium where the principal never invests exists.*

Proof. See Appendix A. *Q.E.D.*

3.3 Comparative statics

We study how the efficient continuous equilibrium described above varies with parameters. Consider the threshold time $\overline{s}$ at which the principal starts investing. We find the following result:

Proposition 4. *The threshold time $\overline{s}$ is increasing in b, decreasing in c and γ, non-monotonic with respect to μ, and independent of F.*

Proof. See Appendix A. *Q.E.D.*

These comparative statics are illustrated in Figure 2 and Figure 3.[12] The intuition for the comparative static with respect to the bonus is straightforward: if the agent's reward for recognition b is higher, the threshold belief at which the agent becomes indifferent, $\overline{x} = c/\mu b$, is smaller. That is, the agent is willing to work for lower levels of engagement. This means that the principal can enjoy high effort by the agent for a longer period of time without investing, and thus the threshold time $\overline{s}$ at which the principal starts investing is larger. The intuition for the cost of effort c is similar. As for the probability with which the principal's managerial attention technology breaks, γ, the result is due to the fact that, in the absence of recognition, the agent updates his belief down faster if the principal's attention is less persistent. Hence, the threshold belief $\overline{x}$ is reached more quickly and as a result $\overline{s}$ is smaller.

The comparative static with respect to the probability of recognition given high managerial attention and effort, μ, is more interesting. As shown in Figure 3, the relationship between $\overline{s}$ and μ is non-monotonic. On the one hand, the larger is μ, the lower is the threshold belief $\overline{x}$, as the agent's incentives to exert effort are higher given a higher probability of recognition. On the other hand, the larger is μ, the faster the agent updates his belief down when recognition does not occur. Consequently, as μ increases, $\overline{s}$ first increases as the incentive effect pushes $\overline{x}$ down, but then it goes down as the updating effect makes x_s decline and reach $\overline{x}$ more quickly.

The figures also show how the paths of effort and investment for $s \geq \overline{s}$ depend on parameters. We can formally characterize the long-run level of effort, $\underline{\alpha}$, in the limit of no discounting. As the discount rate r approaches zero, $r\pi_s^L$ becomes equal to the long-run effort level. Using this, we simplify the systems of differential equations (9)-(10) and (13)-(15) to obtain closed-form solutions. The agent's effort in the long run as r goes to zero is

$$\underline{\alpha} = \frac{\mu(\mu + \gamma(\gamma+\mu)\overline{s}) - F\gamma(\gamma+\mu)^2 - \mu^2 e^{-(\gamma+\mu)\overline{s}}}{\mu(\mu + \gamma(\gamma+\mu)\overline{s}) - \mu^2 e^{-(\gamma+\mu)\overline{s}}}. \tag{17}$$

Since $\overline{s}$ does not depend on the cost of investment F, the comparative static with respect to F is immediate. As is intuitive, the long-run level of effort $\underline{\alpha}$ is decreasing in F, approaching

[12] We do not show the comparative static with respect to c as it follows a similar pattern, though with the opposite sign, as for b.

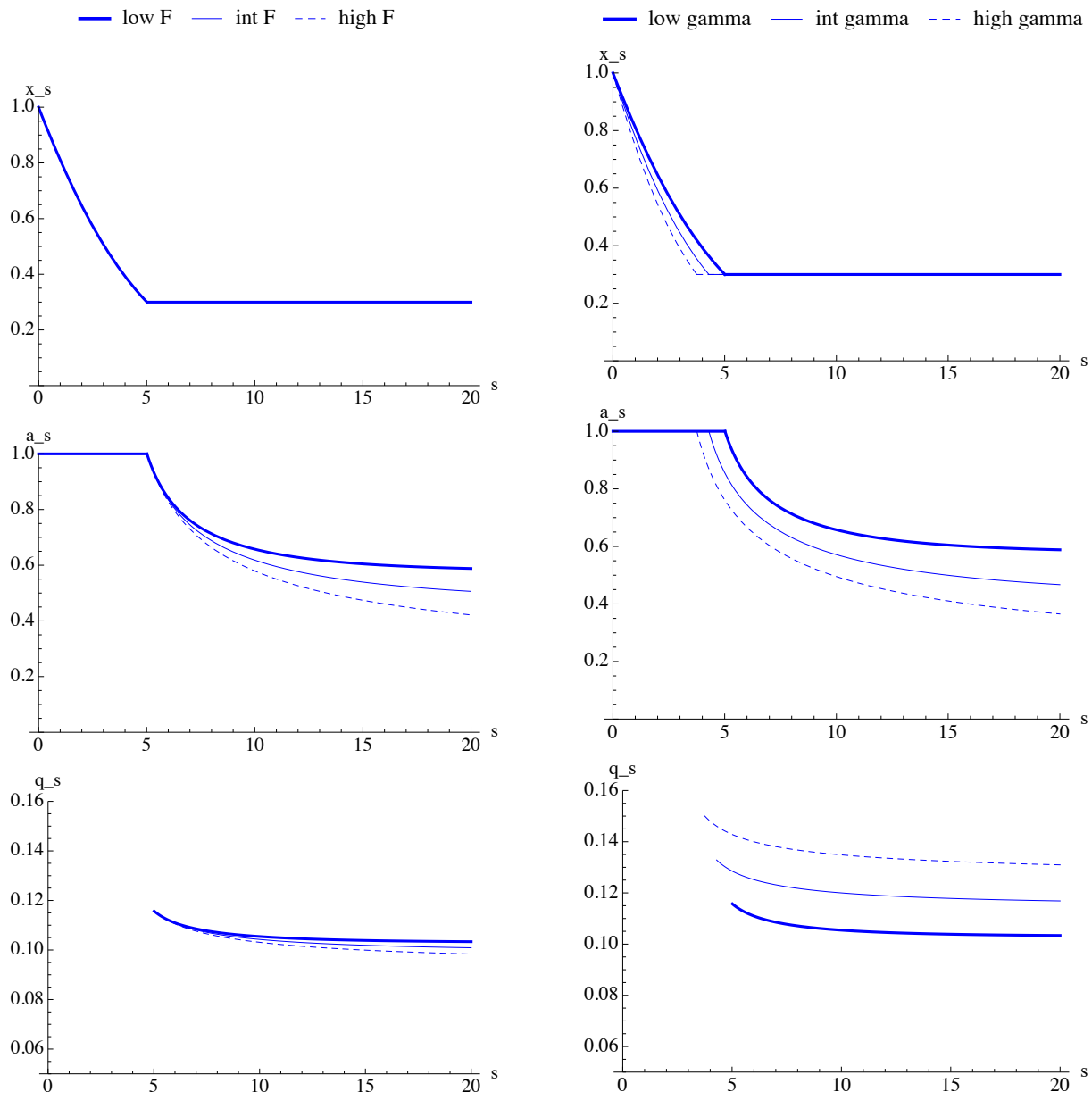


Figure 2 – Comparative statics with respect to F and γ.

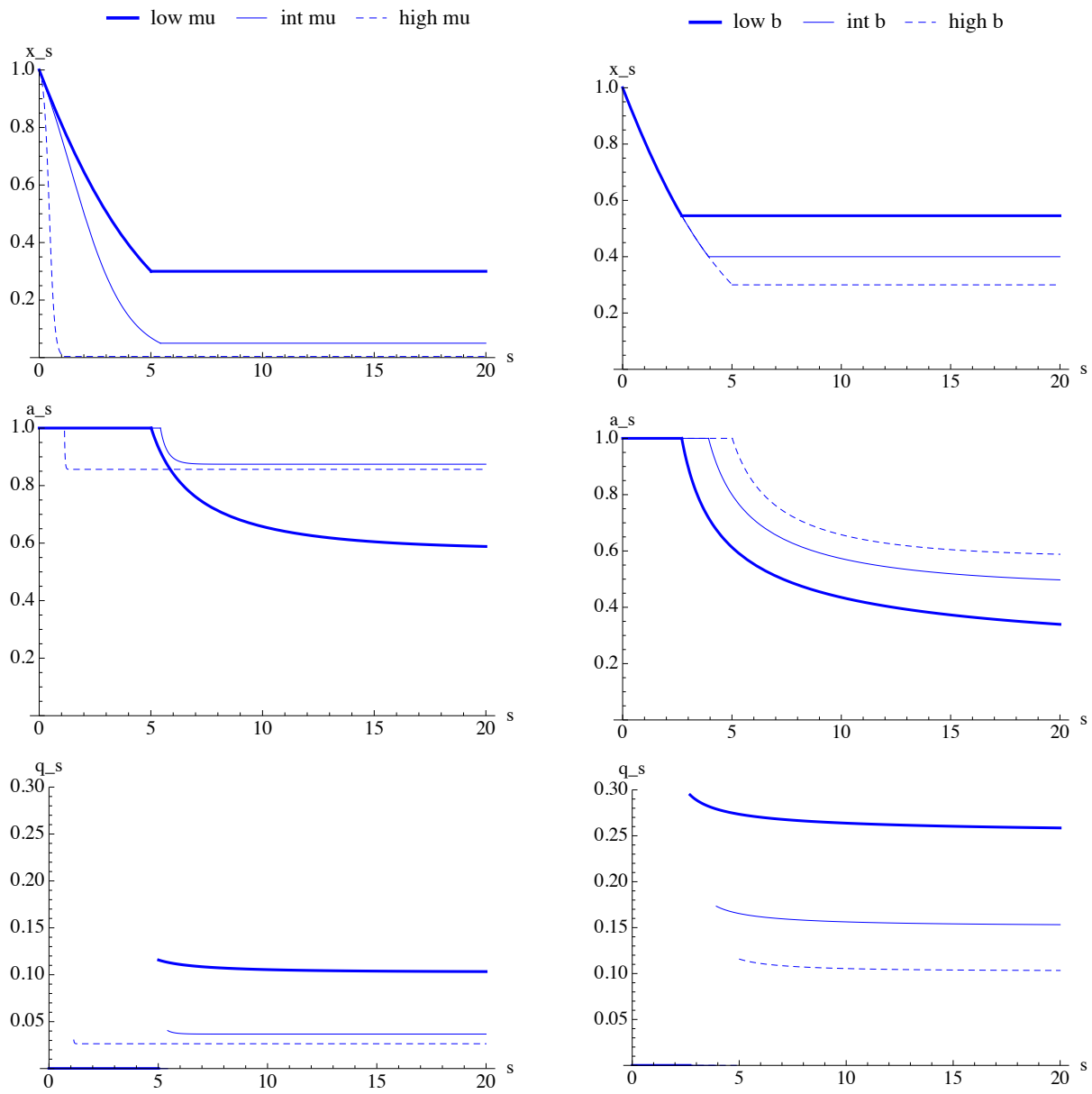


Figure 3 – Comparative statics with respect to μ and b.

one as F goes to zero and becoming zero for F high enough.[13] Substituting $\overline{s}$ from equation (3), we can compute the comparative statics of $\underline{\alpha}$ with respect to the other parameters:

Proposition 5. *Let the discount rate r be arbitrarily close to zero. The long-run level of effort $\underline{\alpha}$ is decreasing in F, γ, and c, increasing in b, and non-monotonic with respect to μ.*

Proof. See Appendix A. *Q.E.D.*

As in the case of the threshold time $\overline{s}$, we find that the relationship between the long-run level of effort $\underline{\alpha}$ and the probability of recognition μ is ambiguous. Figure 3 illustrates this.

4 Monitoring bad performance

Consider a setting where the principal monitors *bad* performance rather than *good* performance. Specifically, take the model of Section 2 but now assume that the instantaneous probability of recognition is $\mu(\alpha_t, \theta_t) = \mu(1 - \alpha_t)$ if $\theta_t = \theta^H$, and $\mu(\alpha_t, \theta_t) = 0$ otherwise (where $\mu > 0$). The agent receives a punishment $-b < 0$ each time recognition occurs. It is straightforward that the benchmark with observable managerial attention is the same as under good-performance monitoring. How does the analysis with unobservable managerial attention change?

Let s be the amount of time since recognition last occurred. As in the main model, the agent's belief jumps to one when there is recognition, i.e. $x_0 = 1$. Then if no recognition occurs, the law of motion for the agent's belief is

$$\dot{x}_s = -\gamma x_s - x_s(1 - x_s)\mu(1 - \alpha_s) + (1 - x_s)q_s. \tag{18}$$

Note that at any time s at which $x_s > \overline{x}$, the agent's effort is $\alpha_s = 1$ and thus the probability of recognition is zero. Hence, for $x_s > \overline{x}$, the principal does not invest, and the law of motion for the agent's belief is

$$\dot{x}_s = -\gamma x_s.$$

The solution to this differential equation with initial condition $x_0 = 1$ is $x_s = e^{-\gamma s}$. As before, let $\overline{s}$ be the time at which the agent's belief reaches $\overline{x} = c/(\mu b)$:

$$x_{\overline{s}} = \overline{x} \quad \Longleftrightarrow \quad \overline{s} = \frac{log(\mu b/c)}{\gamma}.$$

[13] If F is high enough so that $\underline{\alpha}$ becomes negative, a continuous equilibrium where the principal invests does no exist.

For $s \geq \overline{s}$, the agent exerts effort with probability $\alpha_s \in (0,1)$ and the principal invests with instantaneous probability $q_s \in (0,\infty)$. The principal must be indifferent between investing and not investing, and between investing now and later. Following the same steps as above, the two conditions are:

$$\Lambda_s = F \tag{19}$$

$$\Psi_s \mu(1-\alpha_s) = (\gamma + r)F. \tag{20}$$

Unlike in the main model, condition (20) now shows that the agent's effort and the principal's recognition benefit must move in the same direction for the principal's investment benefit to be constant. But then note that the agent's effort α_s cannot be decreasing, as that would imply that $\dot{\Psi}_s = \alpha_s - r\pi_s^L > 0$ and hence the principal's investment benefit would be increasing. Analogously, α_s cannot be increasing, as then $\dot{\Psi}_s = \alpha_s - r\pi_s^L < 0$ and the principal's investment benefit would be decreasing. Hence, α_s and Ψ_s must be constant for $s \geq \overline{s}$. Denote these constant values by $\overline{\alpha}$ and $\overline{\Psi}$ respectively. Note that

$$\pi_0^H = \int_0^{\overline{s}} e^{-(r+\gamma)\tau}(1+\gamma\pi_\tau^L)d\tau + e^{-(r+\gamma)\overline{s}}\pi_{\overline{s}}^H,$$

where $\pi_{\overline{s}}^H = F + \pi_{\overline{s}}^L$ and for $s \leq \overline{s}$,

$$\pi_s^L = \frac{1 - e^{-r(\overline{s}-s)}(1-\overline{\alpha})}{r}.$$

Hence, using these expressions, the equilibrium is simply characterized by the following two equations:

$$\overline{\Psi} = \frac{(\gamma+r)F}{\mu(1-\overline{\alpha})} \tag{21}$$

$$\overline{\Psi} = \pi_0^H - \left(F + \frac{\overline{\alpha}}{r}\right). \tag{22}$$

Finally, using (18), the principal's investment for $s \geq \overline{s}$ is constant and equal to

$$\overline{q} = \gamma \frac{\overline{x}}{1-\overline{x}} + \overline{x}\mu(1-\overline{\alpha}).$$

Figure 4 illustrates the equilibrium for the same parameter values used in Figure 1. We stress two important differences. First, under bad-performance monitoring the equilibrium is essentially static, while it is dynamic under good-performance monitoring. Second, un-

der bad-performance monitoring the probability of recognition is zero when performance is high, and it is positive and constant for lower levels of performance. Unlike under good-performance monitoring, there is no trap here: low-productivity firms are actually the ones with the higher chances of obtaining recognition and thus jumping up to high levels of engagement and productivity. Therefore, a prediction of our analysis is that there will be more persistent performance differences among ex-ante identical firms in industries where rewards are a better instrument to incentivize effort than punishment.

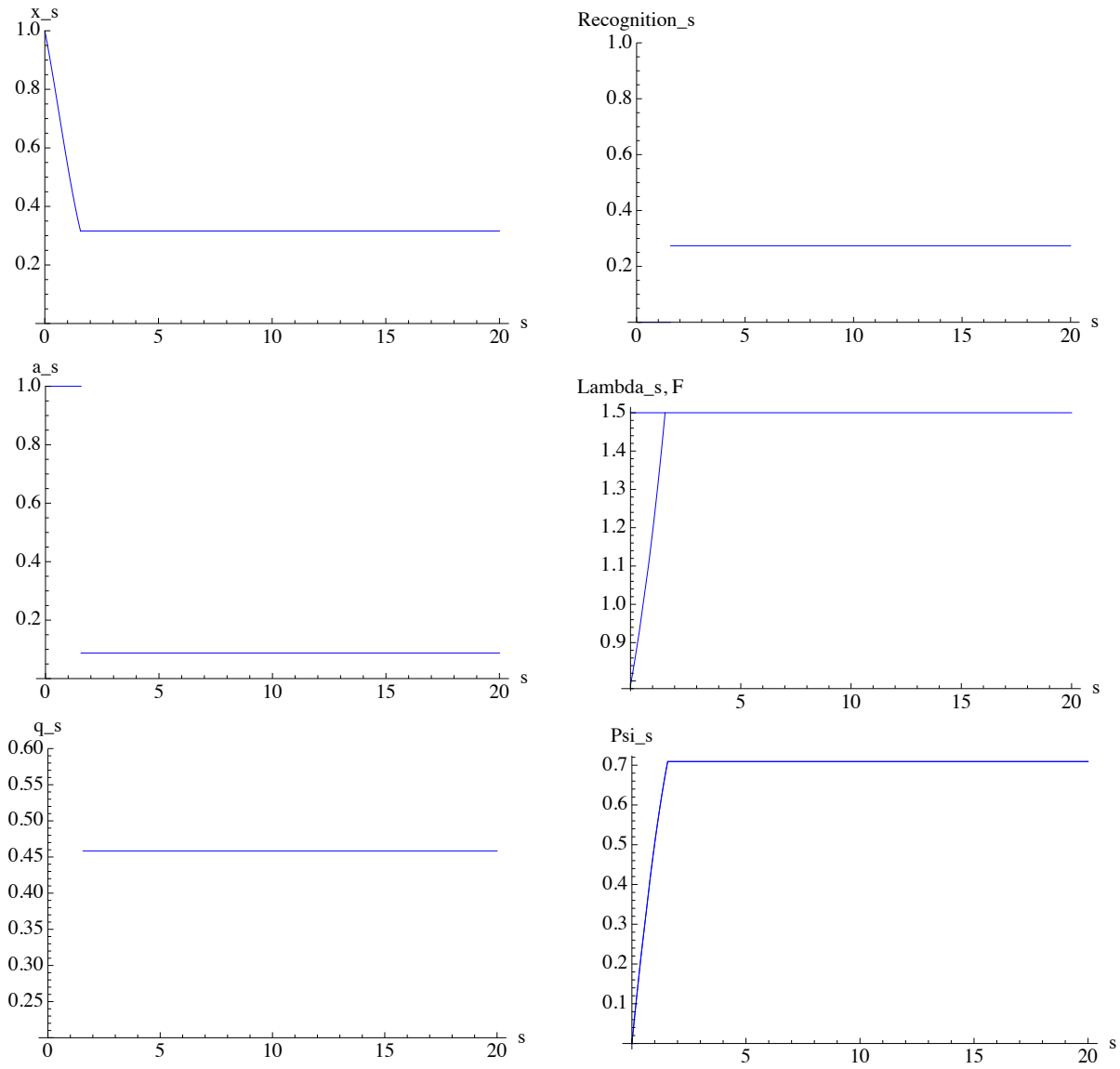


Figure 4 – Equilibrium under bad-performance monitoring.

Appendix

A Proofs

A.1 Proof of Proposition 4

The comparative statics with respect to b, c, and γ are computed as follows:

$$\begin{aligned}
\frac{\partial \overline{s}(\gamma,\mu,b,c)}{\partial b} &= \frac{1}{b(\gamma+\mu)-c} \geq 0, \\
\frac{\partial \overline{s}(\gamma,\mu,b,c)}{\partial c} &= \frac{b}{c(c-b(\gamma+\mu))} \leq 0, \\
\frac{\partial \overline{s}(\gamma,\mu,b,c)}{\partial \gamma} &= -\frac{\frac{\mu}{\gamma}-\frac{c}{b(\gamma+\mu)-c}+log\left(\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}\right)}{(\gamma+\mu)^2} \leq 0,
\end{aligned}$$

where we have used the fact that by assumption $\mu b \geq c$.

The comparative static with respect to μ is given by

$$\frac{\partial \overline{s}(\gamma,\mu,b,c)}{\partial \mu} = \frac{2+\frac{\gamma}{\mu}+\frac{c}{b(\gamma+\mu)-c}-log\left(\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}\right)}{(\gamma+\mu)^2}.$$

This expression is positive for small enough μ but negative when μ becomes sufficiently large.

A.2 Proof of Proposition 5

[To be completed - explain how simplify problem when r goes to zero and give closed-form solutions for this case.]

The comparative static with respect to F is immediate from the analysis in the text. To obtain the comparative statics with respect to the other parameters, substitute $\overline{s}$ from equation (3) into the expression for $\underline{\alpha}$ in equation (17) to obtain:

$$\underline{\alpha} = \frac{(\gamma+\mu)\big[c[F\gamma(\gamma+\mu)-\mu]-b[F\gamma(\gamma+\mu)^2-\mu^2]\big]+\gamma\mu[b(\gamma+\mu)-c]log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]}{\mu\big[(\gamma+\mu)(b\mu-c)+\gamma[b(\gamma+\mu)-c]log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\big]}.$$

Differentiating with respect to γ, b and c yields

$$\begin{aligned}
\frac{\partial \underline{\alpha}(F,\gamma,\mu,b,c)}{\partial \gamma} &= -\frac{F(\gamma+\mu)\left[\begin{array}{c}(\gamma+\mu)(b\mu-c)[b(\gamma+\mu)(4\gamma+\mu)-c(3\gamma+\mu)] \\ +2\gamma^2[c-b(\gamma+\mu)]^2 log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\end{array}\right]}{\mu\left[(\gamma+\mu)(b\mu-c)+\gamma[b(\gamma+\mu)-c]log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\right]^2} \leq 0 \\
\frac{\partial \underline{\alpha}(F,\gamma,\mu,b,c)}{\partial b} &= \frac{bF\gamma^2(\gamma+\mu)^4}{\mu\left[(\gamma+\mu)(b\mu-c)+\gamma[b(\gamma+\mu)-c]log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\right]^2} \geq 0 \\
\frac{\partial \underline{\alpha}(F,\gamma,\mu,b,c)}{\partial c} &= -\frac{b^2F\gamma^2(\gamma+\mu)^4}{c\mu\left[(\gamma+\mu)(b\mu-c)+\gamma[b(\gamma+\mu)-c]log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\right]^2} \leq 0,
\end{aligned}$$

where we have used the fact that by assumption $\mu b \geq c$.

The comparative static with respect to μ is given by

$$\frac{\partial \underline{\alpha}(F,\gamma,\mu,b,c)}{\partial \mu} = \frac{F\gamma^2(\gamma+\mu)\left[\begin{array}{c}(\gamma+\mu)\left[2c^2+b^2(\gamma+\mu)(\gamma+4\mu)-bc(3\gamma+5\mu)\right] \\ +(\gamma-\mu)[c-b(\gamma+\mu)]^2 log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\end{array}\right]}{\mu^2\left[(\gamma+\mu)(b\mu-c)+\gamma[b(\gamma+\mu)-c]log[\frac{\mu(b(\gamma+\mu)-c)}{c\gamma}]\right]^2}.$$

This expression can be positive or negative depending on parameters.

References

Abreu, D., P. Milgrom, and D. Pearce (1991): "Information and Timing in Repeated Partnerships," *Econometrica*, 59, 1713–1733.

Bandiera, O., L. Guiso, A. Prat, and R. Sadun (2011): "What Do CEOs Do?" Working paper.

Bandiera, O., A. Prat, and R. Sadun (2012): "Managerial Capital at the Top: Evidence on CEOs Time Use and Firm Performance in India," Working paper.

Bloom, N., B. Eifert, A. Mahajan, D. McKenzie, and J. Roberts (2013): "Does Management Matter? Evidence from India," *Quarterly Journal of Economics*, 128, 51.

Bloom, N. and J. Van Reenen (2007): "Measuring and Explaining Management Practices across Firms and Countries," *Quarterly Journal of Economics*, 122, 1351–1408.

——— (2010): "Why Do Management Practices Differ across Firms and Countries?" *Journal of Economic Perspectives*, 24, 203–224.

Board, S. and M. Meyer-ter-Vehn (2012): "Reputation for Quality," *Econometrica*, forthcoming.

Bockerman, P. and P. Ilmakunnas (2012): "The Job Satisfaction-Productivity Nexus: A Study Using Matched Survey and Register Data," *Industrial and Labor Relations Review*, 65, 244–262.

Bolton, P. and M. Dewatripont (1994): "The Firm as a Communication Network," *Quarterly Journal of Economics*, 109, 809–839.

Bushnell, J. and C. Wolfram (2009): "The Guy at the Controls: Labor Quality and Power Plant Efficiency," in *International Differences in the Business Practices and Productivity of Firms*, ed. by R. Freeman and K. Shaw, Chicago and London: University of Chicago Press, 79–102.

Callander, S. and N. Matouschek (2013): "A Simple Theory of Growth in a Complicated World," Working paper.

Chassang, S. (2010): "Building Routines: Learning, Cooperation and the Dynamics of Incomplete Relational Contracts," *American Economic Review*, 100, 448–465.

Dessein, W., A. Galeotti, and T. Santos (2013): "Rational Inattention and Organizational Focus," Working paper.

Drucker, P. F. (1966): *The Effective Executive*, New York: Harper & Row.

Faingold, E. and Y. Sannikov (2011): "Reputation in Continuous-Time Games," *Econometrica*, 79, 773–876.

Garicano, L. (2000): "Hierarchy and the Organization of Knowledge in Production," *Journal of Political Economy*, 108, 874–904.

Garicano, L. and A. Prat (2011): "Organizational Economics with Cognitive Costs," Working paper.

Geanakoplos, J. and P. R. Milgrom (1991): "A Theory of Hierarchies Based on Limited Managerial Attention," *Journal of the Japanese and International Economies*, 5, 205–225.

Gibbons, R. and R. Henderson (2013): "What Do Managers Do? Exploring Persistent Performance Differences among Seemingly Similar Enterprises," in *Handbook of Organizational Economics*, ed. by R. Gibbons and J. Roberts, Princeton University Press.

Graetz, M., J. Reinganum, and L. Wilde (1986): "The Tax Compliance Game: Toward an Interactive Theory of Law Enforcement," *Journal of Law, Economics, and Organization*, 2, 1–32.

Harter, J., T. Hayes, and F. Schmidt (2002): "Business-Unit-Level Relationship Between Employee Satisfaction, Employee Engagement, and Business Outcomes: A Meta-Analysis," *Journal of Applied Psychology*, 87, 268–279.

Ichniowski, C., K. Shaw, and G. Prennushi (1997): "he Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines," *American Economic Review*, 87, 291–313.

Judge, T., C. Thoresen, J. Bono, and G. Patton (2001): "The Job Satisfaction–Job Performance Relationship: A Qualitative and Quantitative Review," *Psychological Bulletin*, 127, 376–407.

Kaplan, S., M. Klebanov, and M. Sorensen (2012): "Which CEO Characteristics and Abilities Matter?" *Journal of Finance*, 67, 973–1007.

Khalil, F. (1997): "Auditing without Commitment," *RAND Journal of Economics*, 28, 629–640.

Kreps, D. and R. Wilson (1982): "Reputation and Imperfect Information," *Journal of Economic Theory*, 27, 253–279.

Li, J. and N. Matouschek (2012): "Managing Conflicts in Relational Contracts," *American Economic Review*, forthcoming.

Melumad, N. and D. Mookherjee (1989): "Delegation as Commitment: The Case of Income Tax Audits," *RAND Journal of Economics*, 20, 139–163.

Milgrom, P. R. and J. Roberts (1982): "Predation, Reputation and Entry Deterrence," *Journal of Economic Theory*, 27, 280–312.

Ostroff, C. (1992): "The Relationship Between satisfaction, Attitudes, and Performance: An Organizational Level Analysis," *Journal of Applied Psychology*, 77, 963–974.

Radner, R. (1993): "The Organization of Decentralized Information Processing," *Econometrica*, 62, 11090 – 1146.

Ryan, A., M. Schmit, and R. Johnson (1996): "Attitudes and Effectiveness: Examining Relations at an Organizational Level," *Personnel Psychology*, 49, 853–882.

Sappington, D. (1986): "Commitment to Regulatory Bureaucracy," *Information Economics and Policy*, 2.

Simon, H. T. (1945): *Administrative Behavior*, New York: Macmillan Press.

Strausz, R. (1997): "Delegation of Monitoring in a Principal-Agent Relationship," *Review of Economic Studies*, 64, 337–357.

Syverson, C. (2011): "What Determines Productivity?" *Journal of Economic Literature*, 49, 326–365.

Van Zandt, T. (1999): "Real Time Decentralized Information Processing as a Model of Organizations with Boundedly Rational Agents," *Review of Economic Studies*, 66, 633–658.

——— (2003): "Real Time Resource Allocation with Quadratic Payoffs," Working paper.

Warr, P. (1999): "Well-being and the Workplace," in *Well-being: The Foundations of Hedonic Psychology*, ed. by D. Kahneman, E. Diener, and N. Schwarz, New York: Russell Sage Foundation, 392–412.