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Aligning Ambition and Incentives

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Aligning Ambition and Incentives*

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Abstract

Labor turnover creates longer term career concerns incentives that motivate employees in addition to the short term monetary incentives provided by the current employer. We analyze how these incentives interact and derive implications for the design of incentive contracts and organizational choice. The main insights stem from a trade-off between 'good monetary incentives' and 'good reputational incentives'. We show that the principal optimally designs contracts to create ambiguity about agents' abilities. This may make it optimal to contract on relative performance measures, even though the extant rationales for such schemes are absent. Linking the structure of contracts to organizational design, we show that it can be optimal for the principal to adopt an opaque organization where performance is not verifiable, despite the constraints that this imposes on contracts.

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1 Introduction

Switching employers has become a normal part of careers. Around 2.6 percent of US employees make such moves each month (Fallick and Fleischman 2004), and the average white male holds seven different full-time jobs during the first ten years of his career (Topel and Ward 1992).[1] People therefore look beyond their current job, and try to increase their perceived ability in the market place. This creates longer term career concerns incentives that motivate employees in addition to the short term monetary incentives provided by their current employer. A worker cares not only about how much he can earn in his current position (i.e. the monetary rewards from the current employer), but also about how much he will be able to earn in future jobs. The wage offers that an individual can hope to secure when searching for new employment opportunities depend on what beliefs prospective employers form about the ability of the job applicant, i.e. on his labor market 'reputation'. One of the factors that influence this reputation is information about past employment relations. For this reason, the worker's current employer can create incentives not only through the monetary rewards that she offers him, but also by influencing what the labor market will learn about the worker. We analyze how these sources of incentives interact, and ask what the consequences of high labor turnover are for the design of incentive contracts and the organizational choice of firms. To model this process, we use a two-period setup with two types of agents (talented/ordinary), who are risk neutral but wealth and credit constrained. Agents join a risk neutral principal in the first period, and contracts are publicly observable. The output of an agent depends both on his ability and on his unobservable effort. Payments to an agent in the first period are hard evidence that he can disclose to potential employers. In the second period, agents leave the principal to enter the labor market, and earnings depend on the market belief about the agent's ability.

The first part of the paper analyzes the situation where the labor market cannot look inside the firm for which an agent is currently working (output produced by an agent is not publicly observable). To form beliefs about the ability of an agent, the market instead relies on the outcome of the first-period contract (payments from the current employer that the agent can disclose when applying for a job). Our base model assumes that the principal can contract on output, i.e. credibly promise output-contingent wages. To illustrate our purpose, suppose that each agent works on a task yielding an outcome that is highly informative about his ability: if the labor market were able to directly observe the agent's first-period output, it would learn whether he is talented or not. The market, however, does not have direct access to this information, and only observes the payments arising

[1] Corresponding figures for the UK and Germany are four and three jobs, respectively (Dustmann and Pereira 2008).

from the the first-period incentive scheme. As the contract between the agent and the principal fixes the rules that link first-period output to what the market actually sees, the market can 'decode' this information: by 'inverting' the compensation formula it can back out what the output could have been. How much the market learns from this exercise depends on how 'tight' the link is between contractual outcome and output, i.e. on the design of the contract.

If, for example, the agent is paid according to a piece rate, each output level leads to a distinct transfer. In other words, the market knows as much as if it directly observed output. As such a contract reveals the ability of the agent – regardless of whether he produces high or low output – all incentives for effort in the first period have to come from monetary transfers. Instead, the principal may offer a contract that does not perfectly reveal ability. For example, she can 'reward' a talented agent for high output with a distinct transfer that reveals his ability, and 'punish' him for low output with a transfer that an ordinary agent could also receive, thus lowering the perceived ability in the labor market. In other words, the contract introduces ambiguity about the agent's ability in a way that gives him an additional motive to put in effort: his reputation increases with output.

These reputational incentives allow the principal to scale back the monetary incentives that she offers. On the other hand, we show that introducing noise into the link between contractual outcome and the underlying output realization increases the *total* cost of implementing effort (the sum of reputational and monetary incentives needed). Thus, a trade-off between 'good monetary incentives' and 'good reputational incentives' arises. The principal, however, cares only about her own *monetary* cost of implementing effort. Intuitively, she gains from a contract that creates reputational incentives when reputation matters very much to the agent, i.e when the second-period wages vary strongly with market beliefs. It turns out that even when reputation matters less, the principal can fine-tune contracts to balance the costs and benefits of introducing noise into what the market learns. Our first main result captures this: optimal contracts are never perfectly revealing of the agent's ability. The reputational incentives created by maintaining some ambiguity about the agent's ability always outweigh the increase in total implementation cost this causes.

Our second main result is that relative performance measures offer additional flexibility in shaping the agent's reputational incentives and therefore can strictly increase profits. We show that relative performance contracts can be optimal, even though the previously known reasons for the optimality of such schemes are absent in our model (see the literature review below). This previews the results from the first part of the paper (Section 2).

In the second part of the paper (Section 3) we turn to settings which do not meet the ideal circumstances of the base model. We consider the role of organizational design when performance measures that are not observable by outsiders are, by extension, not verifiable. In an *opaque* organization (where outsiders cannot observe output) the principal therefore cannot credibly promise to offer rewards that vary with the agent's own (noncontractible) output. The reason is that she would always claim ex post that the agent produced just that output which gives rise to the lowest possible pay under the agreement. However, the principal can commit to disbursing a fixed bonus pool independent of the agents' output levels (e.g. the total wage bill of a firm can be verified from company accounts), and make the *share* that an individual agent receives from this pool conditional on his performance relative to others (Malcomson 1984). For example, agents may compete in a rank-order tournament for the entire bonus pool allocated to a department in the firm. Because a talented agent is more likely to win than an ordinary agent, the market expects the winner to be more able than the loser. This drives a wedge between the future earnings of winner and loser, and creates reputational incentives. Adopting instead a *transparent* organization (output is observable by the market) enables the principal to offer output-contingent transfers. But this also takes away the possibility of shaping reputational incentives because the market no longer needs to 'decode' the contractual outcome to learn about output. If output is informative about ability (the case we discussed above) no reputational incentives arise. We show that this ability to shape reputational incetives can make it optimal for the principal to adopt an opaque organization, despite the restrictions on contracting that this imposes. The underlying trade-off is similar to the one in the first part of the paper. Indeed, there the principal can, in some sense, make her organization transparent by offering an 'invertible' contract, and opaque by deliberately not distinguishing transfers across some output states.

The agenda of the paper is as follows. We first discuss the related literature. Then Section 2 introduces the base model and analyzes the trade-off between explicit and reputational incentives when output is not publicly observable but contractible. In Section 3 we show how organizational design affects reputational incentives when output is contractible only if it is publicly verifiable. Furthermore, we discuss how our findings relate to employment practices such as up-or-out contracts in the professional service industry, administrative constraints on wage increases and internal labor markets. The final section presents conclusions. All proofs are in the appendix.

Related Literature

The vast literature on incentives in organizations examines explicit incentive schemes and the role of workers' career concerns.[2] The links between the two are explored by Gibbons and Murphy (1992) and Meyer and Vickers (1997), who follow the seminal work of Holmström (1982/99) in assuming that market participants are symmetrically informed. But sequential contracting often involves *asymmetric* learning (e.g. Waldman, 1984a, 1990, Greenwald 1986, Ricart I Costa 1988, Bernhardt 1995). If a principal has private information about agents' abilities, the explicit compensation scheme not only directly affects incentives, but also provides the market with signals that affect agents' reputation. Zábojník and Bernhardt (2001) model such an effect. A worker's investment in human capital is subject to a permanent shock, which is privately observed by the firm. The firm commits to ranking workers by their realized human capital. This creates reputational incentives because the market expects the human capital shock for the tournament winner to be larger than that for the next highest in rank, etc. Our paper helps understand how the dual role of explicit incentives (transfer/signal) affects contract design.

We contribute to organization theory and the theory of the firm[3] by showing that the informational boundaries of the firm matter for incentives. Most closely related are models where the principal can commit to a policy for disclosing information about agents (Albano and Leaver 2004, Calzolari and Pavan 2006, Mukherjee in press), and the literature on how firms use corporate actions to convey information to financial markets (e.g. Hayes and Schaefer 2005).

Moreover, our results provide a new rationale for relative performance contracts, and thus contribute to the contract theory literature. To this end, we exclude from our model the reasons for such contracts that the literature has identified. First, correlation between stochastic components in the outputs of different agents can be used to insure risk-averse agents against common performance shocks (e.g. Holmström 1979, Lazear and Rosen 1981, Green and Stokey 1983, Nalebuff and Stiglitz 1983, Mookherjee 1984). Second, relative performance contracts help internalize production externalities (e.g. Itoh 1991). Third, such contracts create better incentives when agents can monitor each others' efforts (Ma 1988, Che and Yoo 2001, Laffont and Rey 2001). Fourth, if agents with other-regarding preferences interact, relative performance schemes permit exploiting the dependence of an agent's utility on other agents' transfers (Itoh 2004, Englmaier and Wambach 2005, Biel 2008).

[2]For surveys see Gibbons and Waldman (1999) and Borland (1992).

[3]For surveys see Holmström and Tirole (1989), Holmström and Roberts (1998), and Williamson (2002).

2 Explicit Incentives and Career Concerns Incentives

2.1 The Model

Players. A principal ('she') offers contracts to two agents ('he') to work for her during one period. Ability differs for the two agents: we refer to the agent with higher ability $\theta = H$ as *talented*, and to the other one with lower ability $\theta = L$ as *ordinary*. Both agents' working lives last for two periods, and they have outside options providing life-time utility $u = 0$. Below we will also point out results for the *single-agent case*, where the principal has equal chance of contracting with each type of agent. An agent who contracts with the principal in period 1 then faces contracting opportunities with other principals (*the labor market for experienced agents*) in period 2. These principals do not know who is the talented agent and who the ordinary one – only the fact that there is heterogeneity among the agents is common knowledge. All parties are risk neutral, but agents are subject to wealth and credit constraints that prevent negative transfers. Discount rates are normalized to one.

Technology. An agent of type $\theta \in \{L, H\}$ who works for the principal in period 1 can achieve one of two (possibly type-dependent) output levels: a low one ($q_{\theta l}$) and a high one ($q_{\theta h}$). Each agent's output depends only on his *own* effort and type. High output requires that the agent exerts unobservable effort $(e = 1)$:

$$Prob\,(\tilde{q} = q_{\theta h}|\, e = 1) = P_\theta \quad > \quad Prob\,(\tilde{q} = q_{\theta h}|\, e = 0) = 0, \qquad \theta \in \{L, H\},$$

with $1 > P_H > P_L > 0$. That is, the talented agent has a larger productivity of effort than the ordinary one. Effort causes a utility cost of $c(e = 1) = \psi$, and $c(e = 0) = 0$. The revenue for the principal equals the output produced by the agents. In period 2, agents leave the first principal and face new contracting opportunities in a competitive labor market for experienced agents. We assume that such an *experienced* agent works on different tasks, where the expected revenue k_θ he generates is an increasing function of ability: $k_H > k_L > 0$. Let $\Delta\, k \equiv k_H - k_L$ denote the productivity gap for experienced agents.[4]

Contracts. In the base model we analyze the case where the output produced by agents is not publicly observable by labor market participants but nevertheless contractible.[5]

[4] The specification is adopted for analytical simplicity. It could be replaced by any formulation where the agent's utility from a second-period contract is increasing in his expected type. This is, of course, the precondition for career concerns in the first period to have any meaning.

[5] For example, the principal is committed to the contract because, in case of breach, the agent could call upon a court of law to verify output and impose a large penalty on the principal. We analyze in Section 3 the alternative case where such an audit is not possible and output that is not publicly observable is, by extension, also unverifiable.

Assumption 1: *Agents' first-period outputs are contractible but not publicly observable.*

Contracts map possible output realizations $\tilde{q} \in Q$ for each of the two agents to monetary transfers $t \in \mathbb{R}_+$. To differentiate between situations in which identical monetary transfers are given, the principal can use distinguishing messages $m \in M$. Messages in the form of reference letters, job titles, honorific rewards and medals are often observed in employment relations. In our context such messages serve as 'tie breakers' for the technical purpose of guaranteeing existence of equilibrium.[6] To summarize, a contract fixes the *transfer/message* (t/m) pairs that the agents receive for each possible realization of outputs. The transfer component may simply be "no money" ($t = 0$), and the message component may simply be "no message" ($m = \emptyset$). Transfers $t > 0$ and messages $m \neq \emptyset$ in a t/m pair received by an agent are assumed to be *hard evidence.*

Timing. Agents are initially privately informed about their own type. At the beginning of period 1 the principal offers contracts. If an agent rejects, he receives the outside utility $u = 0$. If he accepts, the market observes the contract and he then chooses his effort level, which is not observable by any other party. At the end of period 1 output realizes, agents receive t/m pairs as stipulated in the contract, and the relation with the first principal ends. In period 2, agents who worked for the first principal enter the market for experienced labor, where future employers meet at most one of the agents. The labor market forms beliefs $\beta(t, m)$ about the probability of an agent who discloses t/m pair (t, m) being of ordinary ability. His second-period wage thus is equal to the market's expectation about his ability:[7] $E[k_\theta|t, m] = \beta(t, m)\, k_L + [1 - \beta(t, m)]\ k_H$.

We analyze this model using the concept of Perfect Bayesian Equilibrium, restricting attention to contracts that get both types of agents to exert effort in equilibrium. Thus, all contracts yield the same expected first-period output:

$$\bar{q} \equiv q_{Hl} + P_H\,(q_{Hh} - q_{Hl}) + q_{Ll} + P_L\,(q_{Lh} - q_{Ll}), \tag{1}$$

In the single-agent case, expected first-period output is $\bar{q}/2$. The following sufficient condition guarantees that is always optimal to implement effort (see footnote 11):

Assumption 2: $q_{Lh} - q_{Ll} \geq 2\,\psi/P_L$.

Belief formation. A contract maps agents' outputs to *transfer/message* (t/m) pairs, and thus induces a distribution over t/m pairs that may be observed at the end of the first period on the

[6] Alternatively, one could introduce a discrete grid of transfers – which however makes the derivations messy.

[7] To avoid cumbersome notation, we do not index this expectation by the first-period contract.

equilibrium path. For such t/m pairs, the market uses Bayes' rule to form beliefs about the probability of facing an ordinary individual. As transfers $t > 0$ and messages $m \neq \emptyset$ are hard evidence, the agent cannot lie about what t/m pair he received.[8] However, the agent could potentially conceal the transfer (i.e. show $t = 0$) or the message component of it (i.e. show $m = \emptyset$), or conceal both. We assume that the labor market assigns to anyone who shows up with an incomplete or non-equilibrium t/m pair the worst belief associated with an equilibrium t/m pair. This makes full disclosure by the agent optimal.

A t/m pair serves two purposes: giving a direct monetary transfer and providing a signal to the labor market. Its value to an agent therefore does not only depend on the monetary component, but also on its impact on market beliefs regarding his ability. To capture this, we call *perceived transfer* the sum of the direct monetary value t and the reputation $E[k_\theta|t, m]$ associated with the t/m pair. Note, however, that the setup is not a signaling game: when the principal chooses the contract at the beginning of period 1 she has the same information as the labor market. What this contract choice does is to fix an information system for the market in period 2. The contract sets the link between output realizations and contractual outcomes by stipulating for each possible output realization the t/m pair that an agent receives. In other words, once the contract is in place the principal has no further active role to play and just executes the rules laid out in the contract.[9] Hence, the contract transforms the distribution over output states (which are not observed by the market) into a distribution over t/m pairs observed by the market on the equilibrium path. Based on the t/m pair for an agent, the labor market then makes inference about the underlying first-period output realization to learn about the agent's ability. Given the above model structure, the expected life-time utility that an agent faces when deciding on his effort level e in the first period therefore depends on the t/m pairs in the contract as follows:

$$U(e) = \underbrace{\underbrace{E[t|e]}_{\substack{\text{expected first-period monetary} \\ \text{transfer, given effort } e}} + \underbrace{E\left[E[k_\theta|t, m]|e\right]}_{\substack{\text{expected second-period earnings,} \\ \text{given effort } e}}}_{\text{expected perceived transfer, given effort } e} - c(e). \tag{2}$$

[8] This assumption can also be found in the literature on persuasion and communication games: see among others, Grossman (1981), Milgrom (1981), Okuno-Fujiwara, Postlewaite, and Suzumura (1990), Shin (1994b, 1994a), and Koessler (2004).

[9] We discuss in Section 2.3 the effect that the possibility of renegotiation with the agent, i.e an 'active' role for the principal after the contract design stage, would have.

2.2 Analysis

Suppose first that possible output realizations $\tilde{q} \in Q \equiv \{q_{Ll}, q_{Lh}, q_{Hl}, q_{Hh}\}$ are distinct, i.e. $q_{Ll} < q_{Lh} \neq q_{Hl} < q_{Hh}$. The question we ask is: given that the technology generates an output signal that is perfectly informative about the agent's ability, does the principal want to reveal this through the t/m pairs for the agent? Or will she rather design contracts to add noise to the information ultimately received by the market? In a second step, we then consider settings where the technology itself already generates noisy output signals, and ask whether the principal designs contracts to add *additional* noise.

When technology generates an output signal that is perfectly informative about the agent's ability, the market tries to learn whether the agent is talented or not by 'inverting' the compensation formula to back out what output could have been. In designing contracts the principal anticipates the market beliefs that t/m pairs will induce. Perfectly revealing t/m pairs lead the market to believe with certainty that they are facing a particular type of agent. If all t/m pairs in a contract are perfectly revealing, we have what we call a *perfectly revealing contract*. With such a contract, the principal would in fact choose the most finely grained information system for the labor market: each output level leads to a distinct t/m pair, and thus the market knows as much as if it directly observed output. To establish a benchmark we look first at the polar case of a perfectly revealing contract.

Incentive provision with a perfectly revealing contract (Contract 1). Consider Contract 1 that conditions only on an individual agent's output and stipulates distinct t/m pairs for each output state: $[(t_{Hh}, m_{Hh}), (t_{Hl}, m_{Hl}), (t_{Lh}, m_{Lh}), (t_{Ll}, m_{Ll})]$. To induce both types of agents to exert effort, t/m pairs must satisfy the following incentive constraints: for $\theta = L, H$,

$$P_\theta \, [t_{\theta h} + k_\theta] + (1 - P_\theta) \, [t_{\theta l} + k_\theta] - \psi \geq t_{\theta l} + k_\theta, \quad \Leftrightarrow \quad t_{\theta h} - t_{\theta l} \geq \frac{\psi}{P_\theta}. \tag{3}$$

Because the contract is perfectly revealing, the anticipated second-period wage k_θ has no impact on incentives. Given that $k_L > 0$, the limited liability constraint binds, and thus agents receive a rent.[10] Hence, the optimal t/m pairs are given by $(t_{Hh} = \psi/P_H, m_{Hh})$, $(t_{Lh} = \psi/P_L, m_{Lh})$, $(t_{Hl} = 0, m_{Hl})$, and $(t_{Ll} = 0, m_{Ll})$, where messages $m_{Ll} \neq m_{Hl}$ distinguish the two low output realizations. Because transfers $t_{Hh} \neq t_{Lh}$, the messages m_{Hh} and m_{Lh} do not play any role and can therefore take any form. As shown in Table 1, no reputational incentives arise and the principal has to rely

[10] The case where individual rationality constraints can bind does not add economic insight but greatly complicates expressions (see our related working paper Koch and Peyrache 2005b).

output	**t/m pair**	$\mathbf{E}\left[\mathbf{k}_\theta \middle| \mathbf{t}, \mathbf{m}\right]$		
		A perfectly revealing contract (Contract 1)		
q_{Hh}	(t_{Hh}, m_{Hh})	k_H		} no reputational incentives
q_{Hl}	$(0, m_{Hl})$	k_H		
q_{Lh}	(t_{Lh}, m_{Lh})	k_L		} no reputational incentives
q_{Ll}	$(0, m_{Ll})$	k_L		
		A contract with two performance standards (Contract 2)		
q_{Hh}	(t_{Hh}, m_{Hh})	k_H		↕ reputational incentives
q_{Hl}	} $(t_{Hl,Lh}, m_{Hl,Lh})$	$E\left[k_\theta \middle| t_{Hl,Lh}, m_{Hl,Lh}\right]$	$< k_H$	
q_{Lh}			$> k_L$	
q_{Ll}	$(0, m_{Ll})$	k_L		↕ reputational incentives

Table 1: Perfectly revealing contract vs performance standard contract

exclusively on monetary incentives, incurring an expected implementation cost of ψ for each agent. Even with multiple agents, perfectly revealing contracts that condition transfers on all agents' outputs do no better: agents are risk neutral and their outputs are independent random variables (Holmström 1979). The implementation cost is exactly the one incurred in a static model, were Contract 1 would be the optimal contract.[11]

Can it be optimal for the principal to not always reveal agents' types, and if so, under what circumstances? The answer turns out to be sharp, yielding our first main result:

Proposition 1

Perfectly revealing contracts are never optimal.

The proof in Appendix A is by construction: for all parameter values we show that there exists an imperfectly revealing contract with strictly higher expected profits than the best perfectly revealing contract (Contract 1).

To build intuition for the result, consider first the impact of making it harder for the market to distinguish a talented and an ordinary agent. A talented agent then would expect to earn less in the second period because his ability is not perfectly revealed to the labor market. Conversely, an

[11] This yields the sufficient condition in Assumption 2, $q_{Lh} - q_{Ll} \geq 2\,\psi / P_L$: The expected cost of implementing effort for both agents is bounded above by $2\,\psi$, and the gain in expected output from making the ordinary agent exert effort is $P_L\,(q_{Lh} - q_{Ll})$.

ordinary agent would expect to earn more than if his lacking talent was perfectly clear. For incentive purposes it would be good if the principal could punish the talented agent for relatively low output by making his talent shine through less clearly than if he did well; and to reward the ordinary agent for relatively high output by making him look better than he does when he produces a poor result. The following contract does just that and helps understand the driving forces of Proposition 1.

A CONTRACT WITH TWO PERFORMANCE STANDARDS (CONTRACT 2). While Contract 1 has a one-to-one mapping from output states to t/m pairs, Contract 2 sets only two performance standards: $\min\{q_{Lh}, q_{Hl}\}$ and q_{Hh}, leading to the following contract structure: $[(t_{Hh}, m_{Hh}), (t_{Hl,Lh}, m_{Hl,Lh}), (t_{Ll} = 0, m_{Ll})]$. Table 1 illustrates the effect that the contract structure has on reputational incentives:

- In the lowest output state q_{Ll}, the t/m pair reveals to the market that the agent is ordinary. So the agent's anticipated second-period earnings are $E[k_\theta | t_{Ll}, m_{Ll}] = k_L$. With higher output q_{Lh} the agent reaches the first performance standard and the t/m pair makes him undistinguishable from a talented agent who produced output q_{Hl}. As a result, the market attaches some probability to him being talented and some to him being ordinary, so $k_H > E[k_\theta | t_{Hl,Lh}, m_{Hl,Lh}] > k_L$. In other words, the contract rewards an ordinary agent for higher output by adding noise to the information that the labor market gets, and thus creates a reputational gain from increasing output.

- In the highest output state q_{Hh}, the t/m pair reveals to the market that the agent is talented, so $E[k_\theta | t_{Hh}, m_{Hh}] = k_H$. With lower output q_{Hh} the agent falls short of the top performance standard and he ends up getting the same transfer $(t_{Hl,Lh}, m_{Hl,Lh})$ as an ordinary agent would get with output q_{Lh}. As this t/m pair adds noise to what the market learns, the agent looks forward to a lower second-period wage than if he had managed to produce the higher output q_{Hh}: $E[k_\theta | t_{Hl,Lh}, m_{Hl,Lh}] < k_H$. Hence, Contract 2 creates a reputational gain from increasing output also for a talented agent.

What are the implications of these reputational incentives for the expected compensation bill that the principal has to foot? The incentive constraints now become: for $\theta = L, H$,

$$\underbrace{t(q_{\theta h}) - t(q_{\theta l})}_{\text{monetary incentives}} \geq \frac{\psi}{P_\theta} - \underbrace{\left\{ E\left[k_\theta | \, t(q_{\theta h}), m(q_{\theta h})\right] - E\left[k_\theta | \, t(q_{\theta l}), m(q_{\theta l})\right] \right\}}_{\text{reputational incentives}}. \tag{4}$$

On the one hand, the reputational incentives that arise allow the principal to lower monetary incentives, as can be seen from (4). On the other hand, pooling two t/m pairs in one intermediate performance bracket forces the principal to pay the monetary transfer $t_{Hl,Lh}$ also to a talented agent after low output. A side effect of creating reputational incentives therefore is that the *total* implementation cost (the sum of monetary and reputational incentives needed to implement effort) increases relative to the perfectly revealing Contract 1. What matters to the principal however is the own *monetary* cost of implementing effort. To see whether it can be profitable to adopt Contract 2 rather than perfectly revealing Contract 1 we need to look in more detail at the payoffs. Specifically, Contract 2 generates the following reputational incentives for the talented agent

$$E\left[k_\theta|t_{Hh}, m_{Hh}\right] - E\left[k_\theta|t_{Hl,Lh}, m_{Hl,Lh}\right] = \frac{P_L}{1-P_H+P_L}\,\Delta\, k, \tag{5}$$

and for the ordinary agent

$$E\left[k_\theta|t_{Hl,Lh}, m_{Hl,Lh}\right] - E\left[k_\theta|0, m_{Ll}\right] = \frac{1-P_H}{1-P_H+P_L}\,\Delta\, k. \tag{6}$$

Taking into account the limited liability constraints, the principal optimally sets $t_{Hl,Lh} = \max\left\{\frac{\psi}{P_L} - \frac{1-P_H}{1-P_H+P_L}\,\Delta\, k, 0\right\}$ and $t_{Hh} = \max\left\{t_{Hl,Lh} + \frac{\psi}{P_H} - \frac{P_L}{1-P_H+P_L}\,\Delta\, k, 0\right\}$. So the contract has an expected monetary implementation cost for both agents of $P_H\, t_{Hh} + (1-P_H+P_L)\, t_{Hl,Lh}$. This is decreasing in the experienced agents' productivity gap, $\Delta\, k$. If $\Delta\, k$ is sufficiently large[12] the principal can even get agents to exert effort at no cost: then $t_{Hh} = t_{Hl,Lh} = t_{Ll} = 0$ creates the required incentives despite a flat monetary scheme.[13] In contrast, Contract 1 clearly dominates for $\Delta\, k = 0$. Invoking the intermediate value theorem, it is immediate that there exists a threshold[14] such that, for $\Delta\, k$ exceeding it, the performance standard Contract 2 dominates Contract 1.

Our previous discussion showed two driving forces. First, altering the *structure* of a contract allows adding noise to what the market learns, and this affects the two things that an agent cares about: the expected monetary transfer from the principal and the expected future wage. Creating ambiguity about the output that agents produced however comes at the cost of increasing the total incentives (monetary plus reputational incentives) needed to implement effort. Second, the principal can gain by moving away from a perfectly revealing contract when there is sufficient heterogeneity in the agents' second-period productivities: Contract 2 dominates Contract 1 if $\Delta\, k$ is high. The proof in Appendix A makes use of a similar type of contract that distinguishes only between 'low' and 'high' output (Contract 3 with $[(t_{Hh,Lh}, m_{Hh,Lh}), (t_{Hl,Ll} = 0, m_{Hl,Ll})]$). It, too, does better than Contract 1 only if $\Delta\, k$ is high. We leave these details for the appendix and turn instead to the

[12] $\Delta\, k \geq \max\left\{\frac{1-P_H+P_L}{P_L\, P_H}\,\psi, \frac{1-P_H+P_L}{P_L\,(1-P_H)}\,\psi\right\}$.

[13] Technically, three distinct messages ($m_{Hh} \neq m_{Hl,Lh} \neq m_{Ll}$) guarantee existence of an equilibrium by serving as a means of distinguishing the identical monetary transfers in terms of the reputation that they confer.

[14] The exact threshold is $\frac{1+P_L-P_H}{P_L\,(1-P_H)}\,\psi$.

remaining question: How can the principal gain from adding noise to what the market learns in situations where Δk is low? It turns out that the trick is to 'leverage' reputation by increasing the reputational incentives for one type of agent at the expense of those for the other type. We explain the intuition with the help of the following contract.

Leveraging reputation (Contract 4). We now explain how the principal can further enhance the reputational incentives for the talented agent by 'leveraging' reputation from the ordinary agent. Consider a contract that reveals the ability of an agent when he does well, but makes it impossible for the market to distinguish a talented agent who did poorly from an ordinary agent who did poorly. The latter can be achieved by having both situations with poor performance lead the same t/m pair $t_{Hl,Ll} = 0, m_{Hl,Ll}$.[15] This gives Contract 4: $[(t_{Hh}, m_{Hh}), (t_{Lh}, m_{Lh}), (t_{Hl,Ll} = 0, m_{Hl,Ll})]$.

- Reputational incentives arise because moving from the low-output state to the (perfectly revealing) high-output state increases second-period earnings for the talented agent from $E[k_\theta|0, m_{Hl,Ll}] \in (k_L, k_H)$ to the higher level k_H.

- The ordinary agent faces *reputational* disincentives: moving from the low-output state to the (perfectly revealing) high-output state decreases his second-period earnings from $E[k_\theta|0, m_{Hl,Ll}] \in (k_L, k_H)$ to the lower level k_L.

On balance, the extra incentives for one type of agent however outweigh the disincentives created for the other type of agent. The details are shown in the proof of Proposition 1 in Appendix A) and we focus here on the intuition. The principal is more likely to pay a monetary transfer to the talented agent than to the ordinary one ($P_H > P_L$). That is why the extra reputational incentives for the talented agent obtained by 'leveraging' reputation leads to a net reduction in the overall expected monetary transfers: the expected savings on monetary incentives for the talented agent are higher than the expected additional payments that are needed to compensate for the reputational disincentives for the ordinary agent. As shown in the appendix, the implementation cost for 'low' values of Δk[16] is given by $2\psi - \frac{P_H - P_L}{2 - P_H - P_L}\Delta k$. This is less than the implementation cost of Contract 1. Thus, Contract 4 outperforms perfectly revealing contracts for such low values of Δk.[17] In fact,

[15] Hence, the difference with the structure of perfectly revealing Contract 1 is that the principal does not give distinct messages to distinguish the two low-output states which both have the same zero monetary transfer: $m_{Hl} = m_{Ll} \equiv m_{Hl,Ll}$.

[16] 'Low' means values of Δk for which all monetary transfers under Contract 4 have to be strictly positive to provide adequate incentives.

[17] For 'high' values of Δk, the required monetary transfers to the talented agent can drop to zero, which creates discontinuities in the payoff function. For the full analysis see the proof of Proposition 1.

the threshold level of Δk up to which Contract 4 dominates Contract 1 is actually low enough to cover the cases where Contracts 2 and 3 discussed above do not do the job. From this we conclude that it is always possible to find some contract that gives the principal a strictly higher expected profit than the best perfectly revealing contract (Contract 1).

The preceding analysis demonstrates that the principal has two currencies with which she can reward agents: cash and reputation. At the contract design stage, she decides how output realizations map into different combinations of cash (t) and reputation ($E[k_\theta|t, m]$). As we have seen, their levels however cannot be set independently of each other. A trade-off between 'good monetary incentives' and 'good reputational incentives' arises. Proposition 1 tells us that the principal never wants to perfectly reveal the agents' types, and therefore puts in place a contract that leads to a *coarse* information system for the labor market. In other words, there is no 'corner solution' where agents' types are revealed for sure: putting reputation at stake is always part of the incentive mix.
From a theoretical point of view, Proposition 1 is related to Meyer and Vickers (1997) and Dewatripont et al. (1999), who show that in a career concerns model incentives may increase as the signal structure becomes coarser. Interestingly, in Calzolari and Pavan's (2006) sequential contracting model with pure asymmetric information, the first principal also does not fully disclose information, as this would eliminate all information rents in the second contractual relationship. In our moral hazard model, perfectly revealing contracts would eliminate all first-period reputational incentives. In both models, partial information revelation thus permits the principal to shift part of the agents' rents. The way this works in our model is, for instance, to 'take away' through the contract reputation from a talented agent when his output turns out to be low and 'give a boost' in reputation to an ordinary agent when his output turns out to be high. This creates reputational incentives at no cost to the principal or future employers: employers in the second-period labor market have correct beliefs about the distribution of agents' types for a given t/m pair, and thus make zero expected profits. Instead, limited liability rents for talented agents are reduced by shifting them partly to ordinary agents, and partly to the principal in the form of reputational incentives that reduce the wage bill.

A question that arises is what exactly the optimal contract looks like. For the single-agent case, where the principal is equally likely to hire the ordinary or the talented agent, it turns out that either Contract 2, 3, or 4 is an optimal (deterministic)[18] contract, depending on the parameter

[18]That is, contracts cannot assign lotteries over t/m pairs. In practice, randomizations may be difficult to verify by

values. We state this result without proof. The derivation requires simple but tedious comparisons of profits contract by contract, which we present in our working paper Koch and Peyrache (2005a). Our purpose here is instead to derive economically relevant features that optimal contracts share. Proposition 1 gives one such feature: the principal designs contracts to add noise to the t/m signal ultimately received by the market when technology is a bijection between ability and output, i.e. when observing the output directly would perfectly reveal the agent's type. Hence, it is natural to ask what happens if output already is a noisy signal about the agent's type. One would expect that if the technology creates the 'right' amount of ambiguity, further garbling of information is not optimal. This is indeed straightforward to show using our analysis for the single-agent case above, and considering a case where only two output levels $q_{Hh} = q_{Lh} > q_{Hl} = q_{Ll}$ are possible. Relative to the situation with perfectly informative output, the set of incentive compatible candidate contracts is narrowed down to a singleton set: Contract 3. The contract reveals which of the two possible output states occurred. The alternative of paying a fixed wage (pooling transfers across output states) provides no incentives. The same principle applies more generally: start with the candidate contracts under perfectly informative output and compare the ones that remain feasible with the noisy technology. For example, if $Q = \{q_{Hh}, q_{Lh}, q_{Hl} = q_{Ll}\}$ only Contracts 3 and 4 are candidate contracts. The former adds noise by pooling output states q_{Hh} and q_{Lh}, while the latter reveals the underlying output states. Comparing profits, Appendix B shows that, in this particular setting, adding noise through contract design is optimal if and only if $\Delta k \geq \frac{2-P_H-P_L}{P_L\,(1-PL)}\,\psi$.

The above analysis led to the general conclusion that optimal contracts are never perfectly revealing, and it provided insights into the structure of optimal contracts for the single agent setting. Even though the contracts discussed above condition on the agent's own output only, i.e. are individual performance measure (IPM) contracts, they permit to *indirectly* link the incentives of different types of agents by pooling t/m pairs across output states. In a multi-agent setting the principal has yet more flexibility: she can also *directly* link the incentives of agents through a relative performance measure (RPM) contract, conditioning transfers to a single agent on the vector of all agents' performances. In our setup with two agents, the principal can influence reputational incentives through the t/m pairs set for each agent in each of the four possible joint output states $\{q_{Hl}, q_{Hh}\} \times \{q_{Ll}, q_{Lh}\}$.[19] For example, if the talented agent produces low output the t/m pair he receives when the other agent produces low output may be different from that received when

a third-party or court of law.

[19] An RPM contract can have up to eight distinct t/m pairs rather than only a maximum of four in an IPM contract.

the other agent produces high output. This additional flexibility sometimes allows the principal to strictly increase profits relative to those achievable with IPM contracts only. Note that it is impossible to find RPM contracts that *always* strictly dominate IPM contracts: some of the latter have zero implementation cost for sufficiently large Δk. Obviously they themselves then are optimal contracts. The next result summarizes this.

Proposition 2

There exist non-degenerate parameter ranges where relative performance measure (RPM) contracts are strictly more profitable than individual performance measure (IPM) contracts.

The proof in the appendix shows this possibility result using the noisy technology case $Q = \{q_{Hh}, q_{Lh}, q_{Hl} = q_{Ll}\}$. For $\Delta k < \frac{2-P_H-P_L}{P_L\,(1-PL)}\,\psi$, the following simple bonus scheme based on relative performance strictly outperforms any IPM contract: it gives both agents the same reward when they both produce high output, and provides a type-dependent bonus to the high achiever if only one agent produces high output. The case with perfectly informative output is similar but rather tedious (see our working paper Koch and Peyrache 2005a). What is remarkable about Proposition 2 is that RPM contracts can strictly outperform IPM contracts, even though the assumptions in our model were deliberately chosen so that the previously known reasons for the optimality of RPM contracts are absent (see Section 1). The result thus provides a new rationale for the use of relative performance contracts. In other words, there are situations in which a contract based on individual performance only does not create sufficiently strong incentives, and then some RPM contract is the optimal contract. Otherwise, some IPM contract can deliver the same profits as the profit maximizing RPM contract and both are optimal.

2.3 Discussion

Past performance contains information about an agent's ability that is not directly visible to the labor market. A contract based on this performance therefore creates an information system. Hence, compensation schemes affect effort incentives both directly – through monetary transfers – and indirectly – by controlling the flow of information regarding the agent's past performance to the labor market. This leads to a trade-off between 'good monetary incentives' (low total implementation cost) and 'good reputational incentives'. For the principal it is optimal to maintain some ambiguity about the agent's ability, if necessary by designing contracts to add noise to the underlying output distribution (Proposition 1). The principal chooses contracts in such a way that, for at least one type of agent, the reputation derived from using transfer/message pairs as a signal in the labor market is increasing in the output that he produces. Basing transfers on relative performance measures (i.e. exploiting the *joint* distribution of outputs across agents) provides additional flexibility in fine tuning the reputational incentives created by a contract, and can therefore be strictly more profitable than contracts based on individual performance measures only (Proposition 2). Our analysis thus offers a novel explanation for relative performance contracts. Moreover, it helps understand why observed pay-for-performance sensitivities tend to be lower than predicted by theoretical models of explicit incentives (e.g. Baker et al. 1988): contracts give rise to reputational incentives so that effort is implemented even with relatively flat monetary incentives.

Two problems may arise that we have thus far assumed away. First, it may be costly for a court of law to verify that the contract has been followed to the letter. This does not pose a problem for the agent: he observes output and can thus turn to the court in case of breach of contract. So a clause stipulating that the principal pays for the costs of the court, in addition to some possible penalty, suffices to guarantee that the principal will never unilaterally breach the contract. However, the principal and the agent may mutually agree to deviate from the t/m pair stipulated by the contract. For example, an agent might offer to give up a monetary transfer that he is entitled to in exchange for a t/m pair with a lower monetary transfer but a high reputational value. Clearly, the principal would not refuse this offer. If renegotiation opportunities exist, contracts only give rise to a credible information system if t/m pairs are designed in such a way that the contracting parties never will be able to agree to renegotiate. In our working paper Koch and Peyrache (2005a) we show that our results above are robust to introducing such renegotiation proofness constraints.

The second potential problem is that, in practice, performance measures which are not observable by outsiders may, by extension, also not be verifiable by a court of law. The next section addresses this case.

3 Organizational Choices and Career Concerns Incentives

The ideal circumstances of Section 2 are often not met: "in many employment situations, information about an agent's output is asymmetric in the sense that the agent cannot verify the principal's observation of it" (Malcomson 1984, p.487). Then the principal cannot credibly promise transfers of different magnitudes contingent on output. She will always claim ex post that the agent produced just that output which leads to the lowest transfer. However, Malcomson (1984) argues that the principal can commit to a fixed overall level of payout independent of workers' outputs (e.g. the total wage bill of a firm can be verified from company accounts). He shows that by fixing ex ante the *bonus pool*, the principal can announce some allocation rule that determines the *share* that an individual worker receives from the bonus pool conditional on his performance relative to others. For example, the principal may split the bonus pool into a number of 'prizes' that are awarded based on the ordinal rank of workers' performances.[20] Such a Lazear and Rosen (1981)-style rank-order tournament is credible: the bonus pool has to be disbursed irrespective of realized performance measures (which are not publicly observable); misstating the order of performance measures would not reduce payments and merely hurt incentives. Similarly, other output-dependent allocation rules are credible because they do not change the fact that the principal has to pay out the bonus pool that she committed to.

Another way to overcome the credibility problem is through organizational measures that enable outsiders to verify agents' performance. Channels through which a firm can influence what outsiders learn are the decision whether to send an employee to work on the site of a client or do the work in-house (e.g. see Loveman and O'Connell's (1995) case study); promotion announcements and assignment of job titles (e.g. Waldman 1984a, 1990, Zábojník and Bernhardt 2001); what tasks to assign an employee to (Ortega 2003); whether projects are associated with a named individual, or only with a team or department (e.g. Jeon 1996, Massa et al. 2006, Bar-Isaac, 2007).[21]

Do firms benefit from such organizational measures, and what are the consequences for incentives? To address these questions, we modify the base model from Section 2 as follows. Before contract offers are made, the principal chooses an organizational form: either a *transparent organization*, where agents' outputs can be contracted upon, or an *opaque organization*, where agents' outputs cannot be directly contracted upon and the principal needs to commit to a the sum of transfers (bonus pool) ex ante. Depending on this choice, the labor market in the second period observes output (transparent organization) or not (opaque organization). Thus, we replace Assumption 1 from Section 2.1 with

[20] See also MacLeod (2003), Baiman and Rajan (1995) and Rajan and Reichelstein (2006). Bonus pools may depend on verifiable indicators, such as accounting earnings or the firm's stock price. Baiman and Rajan (1995) give examples of incentive plans implemented by firms and note typical features (p.558): "First, there are multiple individuals covered by each plan. Second, the method of determining the total amount of the bonus pool is based on an explicit formula (usually involving accounting earnings) and is agreed-upon ex ante. Third, the manner in which the bonus pool is allocated among the covered individuals is not previously agreed-upon, but rather is left to the discretion of the compensation committee."

[21] Additional factors might be the visibility of the demographic group that an employee belongs to (Milgrom and Oster 1987, Burguet et al. 2002) or the sector of activity (Acemoglu et al. 2008).

Assumption 1': *The principal chooses an organizational form. In a transparent organization, the principal can contract on agents' publicly observable first-period outputs. In an opaque organization, agents' first-period outputs are neither publicly observable nor verifiable, and the principal can only commit to a bonus pool.*

We will see that the insights from this setting are closely related to those from Section 2. Again, we show our results based on the case where output is informative about the agent's type, i.e. possible output realizations $\tilde{q} \in Q \equiv \{q_{Ll}, q_{Lh}, q_{Hl}, q_{Hh}\}$ are distinct, so $q_{Ll} < q_{Lh} \neq q_{Hl} < q_{Hh}$.

3.1 Transparent Organization

In a transparent organization performance is publicly observable and, given our production technology, the second period labor market learns the agents' types. Hence, IPM contract C corresponding to Contract 1 from Section 2.2 is optimal, because it minimizes implementation costs if the agent's type is revealed. The principal's expected profit with two agents under a transparent organization with contract C therefore is $\Pi_C = \bar{q} - 2\,\psi$. The expected profit in the single-agent setting is simply $\Pi_C/2$. In a static model this organizational form and contract would be optimal.

3.2 Opaque Organization

As described above, committing to a fixed bonus pool is the only credible way to provide incentives in an opaque organization. As before, a contract is a mapping from outputs to t/m pairs, but now backed up with a pre-committed total payout. To illustrate this, let us first briefly consider the case where each agent is assigned a separate bonus pool (which also covers the single-agent case). The individual performance measure (IPM) contracts that we have seen in Section 2 all have a corresponding bonus pool contract in an opaque organization: to be credible, the bonus pool in the latter has to be set equal to the *highest* possible monetary transfer in the former. For example, to create the same reputational incentives as under Contract 2 of Section 2 requires a bonus pool of t_{Hh}. That is, the agent would receive the entire sum if he was talented and successful, i.e. produced output q_{Hh}. With output q_{Hl} or q_{Lh} he would get $t_{Hl,Lh}$, and nothing otherwise. If there is any remainder in the agent's bonus pool it is paid to a third party – as in MacLeod's (2003) static single-agent model.

It turns out that Proposition 1 carries over to both the single- and multiple-agent settings with an opaque organization – even though the principal can here only contract on output by committing to a bonus pool. A principal who – for whatever reason – operates an opaque organization never offers a perfectly revealing contract.

Corollary 1

In an opaque organization (non-verifiable output), perfectly revealing contracts are never optimal.

The proof in the appendix involves a simple comparison of IPM bonus pool contracts.

In practice, rather than setting a separate bonus pool for each agent, such schemes usually cover many individuals (see footnote 20). Hence, the 'third parties' who receive the remainder of the bonus pool include other agents working for the principal. This kind of bonus pool contracts thus are relative performance measure (RPM) contracts. In our two-agent model, for each of the possible joint output states $\{q_1, q_2\} \in Q^2$ such an RPM bonus pool contract specifies a distribution of the fixed prize sum, say Z, i.e. the probability with which agent 1 receives monetary transfer $t_1 \in [0, Z]$ and agent 2 receives $t_2 \in [0, Z - t_1]$.

A prominent example of such an RPM bonus pool contract is a rank-order tournament: the agent with the highest output is named *winner* and receives an *explicit bonus* B^e. In the following we will analyze this contract in more detail to illustrate how reputational incentives can be created in an opaque organization and then consider the consequences that this has for organizational choice. We maintain the setting where technology is perfectly informative about the agents' type to keep the presentation clear and simple.[22] Also, to make the problem interesting, we assume that $q_{Hh} > q_{Lh} > q_{Hl} > q_{Ll}$, which means that the talented agent does not win the tournament for sure.

Assumption 3: $q_{Hh} > q_{Lh} > q_{Hl} > q_{Ll}$.

Reputation effects and perceived bonus. Suppose that the market anticipates that an explicit bonus B^e implements effort by all agents. Then, the market posteriors for an agent with t/m pairs $(B^e, winner)$ and $(0, loser)$, respectively, are

$$E\left[k_\theta | B^e, winner\right] = \left[P_H + (1 - P_L)\,(1 - P_H)\right] k_H + P_L\,(1 - P_H)\,k_L, \quad (7)$$

$$E\left[k_\theta | 0, loser\right] = \left[P_H + (1 - P_L)\,(1 - P_H)\right] k_L + P_L\,(1 - P_H)\,k_H. \quad (8)$$

The winner receives higher earnings in the second period than the loser, captured by the *reputation gain of winning*

$$R(B^e) \equiv E\left[k_\theta | B^e, winner\right] - E\left[k_\theta | 0, loser\right] = \left[1 - 2\,P_L\,(1 - P_H)\right] \Delta k. \quad (9)$$

The winner's *perceived bonus* B exceeds the *explicit bonus* B^e paid by the principal, because of the reputation gain of winning: $B = B^e + R(B^e)$. To implement effort requires meeting the following

[22] The analysis easily extends to settings with noisy technology as in Section 2.2. Then, reputational incentives may arise even in a transparent organization and, as in Section 2.2, the issue is whether the principal wants to add *more* noise by remaining opaque. See also our working paper Koch and Peyrache (2005b).

incentive constraints for a talented and an ordinary worker, respectively:

$$[P_H + (1 - P_L)\,(1 - P_H)]\,B - \psi \;\geq\; (1 - P_L)\,B, \tag{10}$$

$$P_L\,(1 - P_H)\,B - \psi \;\geq\; 0. \tag{11}$$

Therefore, the perceived bonus has to satisfy

$$B \geq \begin{cases} \overline{B} \equiv \frac{\psi}{P_L\,P_H} & \text{if } P_H \leq 1/2, \\ \underline{B} \equiv \frac{\psi}{P_L\,(1-P_H)} & \text{if } P_H > 1/2. \end{cases} \tag{12}$$

Combining the above results now allows us to pin down the implementation cost: $B^e = \max\big\{\max\big\{\underline{B}, \overline{B}\big\} - R\,(B^e)\,, 0\big\}$. Thus expected profits are $\Pi_T = \bar{q} - \max\big\{\max\big\{\underline{B}, \overline{B}\big\} - R\,(B^e)\,, 0\big\}$.

3.3 Organizational Design

Does the principal gain from making the organization transparent and thus overcoming the limitations on contracts that an opaque organization imposes? On the one hand, IPM contract C in a transparent organization has the minimum *total* implementation cost. A rank-order tournament in an opaque organization requires a higher perceived bonus $\max\{\underline{B}, \bar{B}\} > 2\psi$ for all parameter values. This is intuitive: the tournament has to satisfy both incentive constraints using a single instrument (the bonus). One of these constraints is always slack because the talented agent is more likely to win the bonus than his ordinary colleague. On the other hand, what matters for the principal is the *monetary* implementation cost. As output is perfectly informative about the agent's ability, no reputational incentives arise in the transparent organization.[23] So the total and monetary implementation costs coincide: $2\,\psi$. In an opaque organization with a rank-order tournament, reputational incentives lower the monetary implementation cost to $B^e = \max\big\{\max\{\underline{B}, \bar{B}\} - R(B^e), 0\big\}$. The organizational design thus involves a similar trade-off as in Section 2. It is important to note that the transparent organization does not give the principal more flexibility along *all* dimensions. The flexibility in terms of contracting afforded by transparency comes at the cost that the market receives the maximum amount of information, because output is observable. The advantage of the opaque organization, that the principal is able to 'manage' the amount of information that the market gets, comes at the cost of less flexibility in contracting.

If experienced agents had the same productivity ($\Delta\,k = 0$), there would be a unique wage in the market for experienced workers and reputation would not matter. Indeed, the incentive problem

[23] Regarding alternative technologies, see footnote 22.

would simply reduce to the standard static textbook model, which IPM contract C in a transparent organization solves. By continuity, for small values of Δk a transparent organization is optimal. If however the productivity gap for experienced agents is sufficiently large, the required explicit bonus in the opaque organization with a tournament is lower than the implementation cost in the transparent organization: $B^e = \max\left\{\max\{\underline{B}, \bar{B}\} - R(B^e), 0\right\} < 2\,\psi$. This is summarized in the following result (the proof is relegated to Appendix A).

Proposition 3

Suppose that only publicly observable output is contractible (Assumption 1'). Then there exists a finite threshold $\Delta k'$, such that for any productivity gap $\Delta k > \Delta k'$ an opaque organization with a rank-order tournament that implements effort by all types of agents is strictly more profitable than any contract under a transparent organization.

An interesting link to the static setting of MacLeod (2003) and Rajan and Reichelstein (2006) is that, there too, implementing effort with non-verifiable performance measures (corresponding to our opaque organization) requires an increase in total incentives. As no off-setting reputational incentives are present, non-verifiability imposes an additional agency cost for the principal relative to the situation where performance is contractible (corresponding to our transparent organization). In our setting, however, reputational incentives may actually lower the rents left to agents relative to those in a transparent organization.

3.4 Extensions

To keep the paper concise we made a number of simplifying assumptions. The main insights however carry over to other settings. Our working paper Koch and Peyrache (2005b) analyzes a setting were the principal hires from a pool of job seekers and has the opportunity to screen agents. It also considers type-dependent outside options, and shows that opaque and transparent organizations can co-exist in perfectly competitive labor markets. Appendix C illustrates how the analysis can be extended to allow for staff retention, and that results continue to hold if turnover is sufficiently high.[24] What is crucial is that there is heterogeneity in the employer-to-employer flow of individuals, so that the market has something to learn from the career history of a job seeker. For this, worker-firm separations must occur partly because of reasons not related to workers' abilities – otherwise the well known lemons problem would prevent transitions across employers (Greenwald 1986).

[24] For related models with reputational incentives and staff retention see Koch and Peyrache (2008b, 2008a).

In practice there are several sources of such heterogeneity. First, accumulated human capital may become more valuable outside the current firm at some point in the career.[25] Second, worker-firm matches have random components unrelated to ability (e.g. Lazear 1986, Owan 2004). "Job shopping" for sufficiently high match quality (e.g. Jovanovic 1979) explains high turnover in early career positions (e.g. Farber 1994, Rubinstein and Weiss 2006).[26] Third, exogenous sources may lead to turnover, e.g. relocation may be necessary for family reasons; an individual may simply not get along well with colleagues, or be eager for a change.[27] Fourth, "slot constraints" create turnover when there is a limited number of positions that utilize the human capital of experienced workers (e.g. Waldman 1984b, MacDonald and Markusen 1985, Fee 2006)

3.5 Discussion

The empirical implication of our results is that, in settings where turnover is high and there are important differences in ability across individuals, firms should be less transparent – either because of organizational measures or because contracts are not revealing. Evidence from Massa et al.'s (2006) study of the mutual fund industry fits this pattern. The recent hedge fund boom enhanced outside opportunities for finance professionals and thus fueled turnover. In parallel, between 1993 and 2004 there was a four- to fivefold increase in the number of funds which do not report the names of fund managers. This shift to anonymously "team managed" funds has been most pronounced for asset classes and geographies most affected by the hedge fund boom.

The professional service industry provides another example. The key ingredients in our analysis – i) individuals accumulate transferable human capital, ii) employee turnover, and iii) wealth and credit constraints – approximate conditions in entry-level jobs in this industry. Young professionals are viewed as "free agents" who invest primarily in general human capital (Groysberg and Nanda 2002), and employee turnover can be as high as 25 percent (Maister 2003, p.15). In line with our predictions, human capital intensive professional services tend to avoid public measures of individual performance (e.g. Gilson and Mnookin 1985). Because prestigious firms offer only a small chance of becoming a partner,[28] recruits typically view employment there as stepping stones in their career.

[25] Rosen (1982) argues that a manager's human capital and the scale of resources under control are complements. The implication that better managers should sort into larger firms has received empirical support (e.g. Hayes and Schaefer 1999).

[26] Topel and Ward (1992) document a wage premium for job switchers, consistent with increasing match quality.

[27] There is a large organizational behavior literature on the determinants of the perceived ease and desirability of movement, which builds on the work of March and Simon (1958). See, for example, Price (1999).

[28] An associate of a big New York law firm has roughly 23 percent chance of becoming partner (Spurr 1987, p.523).

Employment in a professional service firm provides young professionals with experience, training, and the cachet of a renowned organization. These credentials help them enter prime positions that they could not have obtained as fast by another route (Maister 2003). The high turnover in professional services and up-or-out policies in this industry[29] are sustained by slot constraints. Positions at the top are limited because the high compensation attained by seniors relies on a delicate balance of the number of seniors and juniors (Maister 2003). Juniors typically perform routine tasks which would not fully utilize the human capital of more experienced professionals. Those who are not promoted are therefore likely to be more productive outside the current firm than inside their old junior positions. They leave to seek greener pastures elsewhere, the remainder climb to the next level and thereby further enhance their outside employment opportunities. Indeed, those who survived in a professional service firm for some time and then leave, generally enter very attractive and highly remunerated positions (Maister 2003). Despite their attractiveness, professional firms do not make recruits pay up front (captured in our model by wealth and credit constraints) and such 'entrance fees' are generally absent from labor markets (Baker et al. 1988, Wang 1997). Instead, as our analysis suggests, firms (partially)[30] extract the individuals' future salary gains through an up-or-out system in conjunction with low pay to young professionals, measured relative to their qualifications (e.g. Rebitzer and Taylor 1995, Tadelis and Levin 2005).

Different levels of exposure to outside offers may also be used to generate incentives within an organization, as Loveman and O'Connell's (1995) case study illustrates. The Indian offices of HLC America perform in-house work and are thus relatively shielded. In the American offices, software engineers are exposed to a competitive labor market which provides frequent job offers, reflected in double digit turnover. The company uses the prospect of transferral to the American offices as reward for its Indian software engineers. A move to the US hence is similar to winning a tournament in our model.

Our results also help understand administrative rules that limit wage gains, and according to Baker et al. (1994, p.913; see also Gibbs and Hendricks 2004). place a "wedge between an employee's pay and what pay would be in an external spot market." They find that those promoted quickly are more likely to leave. This is consistent with the market observing fast promotion, and the existence of administrative rules that prevent the firm from giving workers sufficiently large raises to retain them. Such policies appear puzzling: why should firms limit their scope for exploiting their informational advantage on workers' abilities to retain good employees? Our analysis suggests

[29] A promotion must be decided after some years, e.g. 6-10 years in law firms (Gilson and Mnookin 1989).

[30] Rebitzer and Taylor (1995) provide evidence for substantial employment rents in prestigious large law firms.

that self-imposed constraints can indeed be rational: these guarantee some heterogeneity in the pool of workers who leave positions in the firm, and thus create reputational incentives that lower the wage bill. These benefits may well offset the expected loss from losing a few talented workers. Furthermore, our analysis suggests that reputational incentives may emerge even in internal labor markets which are "shielded from the direct influences of competitive forces in the external market" (Doeringer and Piore 1971, p.2). As the way up in the job ladder is often blocked by a superior, career moves often require switching to other departments. The superior however has privileged information about her subordinates, so job assignments or performance reviews provide other departments with information about employees' abilities. According to our model, a superior can boost effort incentives in her unit by assigning career enhancing jobs or performance ratings based on relative output rather than on perceived ability. Sheridan et al.'s (1990) study of a large public utility company provides evidence that job assignments and the access to networks indeed influence promotion and salary prospects.

4 Conclusion

Reward schemes both provide direct monetary incentives and transmit information to the labor market regarding an employee's ability. This creates a trade-off between 'good monetary incentives' and 'good reputational incentives'. We show that even if the principal can write very fine tuned contracts, she may choose not to. Offering the same transfers for different performance levels allows her to control the flow of information to the market, but also increases the total effort implementation cost. Such ambiguity is optimal because the reputational incentives it creates more than compensate for the increase in total implementation cost. For the same reason, the principal may prefer an opaque organization where performance is not verifiable, despite the constraints that this imposes on contracts. While moving to a transparent organization permits output-contingent transfers, reputational incentives may be reduced or eliminated. In our model, agents produce independently of each other. Nevertheless, relative performance compensation schemes may be optimal because of the additional flexibility that this gives the principal for fine tuning reputational incentives. This result provides a new rationale for the use of such contracts. Moreover, our model helps understand incentives in organizations with high turnover (such as professional services), administrative constraints on compensation, and how career concerns incentives may be created even within internal labor markets.

Appendix

A Proofs

Proof of Proposition 1. Suppose by way of contradiction that a perfectly revealing contract is optimal for some range of parameter values. This implies that there does not exist *any* non-revealing contract that provides the principal with a higher profit than the best perfectly revealing contract. We show below that for all parameter values we can however find an example of a non-revealing contract that is strictly more profitable than the best perfectly revealing contract, thus proving the proposition.

Two-agent setting: The cost minimizing perfectly revealing contract (Contract 1) has expected profit $\Pi_1 = \bar{q} - 2\,\psi$. Perfectly revealing contracts that condition transfers on both agents' outputs do no better: agents are risk neutral and their outputs are independent random variables (Holmström 1979). Therefore, there are no fully revealing RPM contracts that do better than the perfectly revealing IPM Contract 1. We now show that at least one of the two non-revealing Contracts 3 and 4 introduced in Section 2.2 dominates Contract 1. Consider first Contract 4. It reveals agents' types except in the low output states q_{Ll} and q_{Hl}, where $E\left[k_\theta|\, t_{Hl,Ll}, m_{Hl,Ll}\right] = k_L + \frac{1-P_H}{2-P_H-P_L}\,\Delta\, k$. To satisfy the incentive and limited liability constraints,

$$t_{Lh} \;=\; \frac{\psi}{P_L} + \frac{1-P_H}{2-P_H-P_L}\,\Delta\, k \quad \text{and} \quad t_{Hh} = \begin{cases} \frac{\psi}{P_H} - \frac{1-P_L}{2-P_H-P_L}\,\Delta\, k & \text{if } \frac{\Delta\, k}{\psi} < \frac{2-P_H-P_L}{P_H(1-P_L)}, \\ 0 & \text{otherwise.} \end{cases}$$

Comparing profits with fully revealing Contract 1 boils down to comparing the monetary implementation cost of $P_H\, t_{Hh} + P_L\, t_{Lh}$ with that for Contract 1 of 2ψ:

$$\Pi_4 - \Pi_1 \;=\; \begin{cases} \frac{P_H-P_L}{2-P_H-P_L}\Delta\, k & > 0 \quad \text{if} \quad \frac{\Delta\, k}{\psi} < C_1 \equiv \frac{2-P_H-P_L}{P_H(1-P_L)}, \\ \psi - \frac{P_L(1-P_H)}{2-P_H-P_L}\Delta\, k & > 0 \quad \text{if} \quad C_1 \leq \frac{\Delta\, k}{\psi} < C_2 \equiv \frac{2-P_H-P_L}{P_L\,(1-P_H)}, \\ \psi - \frac{P_L(1-P_H)}{2-P_H-P_L}\Delta\, k & \leq 0 \quad \text{if} \quad C_2 \leq \frac{\Delta\, k}{\psi}. \end{cases}$$

Consider now Contract 3. It gives rise to $E\left[k_\theta|\, t_{Hh,Lh}, m_{Hh,Lh}\right] = k_L + \frac{P_H}{P_H+P_L}\,\Delta\, k$, which is greater than $E\left[k_\theta|\, t_{Hl,Ll}, m_{Hl,Ll}\right] = k_L + \frac{1-P_H}{2-P_H-P_L}\,\Delta\, k$. Taking account of the incentive and limited liability constraints, $t_{Hh,Lh} = \max\left\{\frac{\psi}{P_L} - \frac{P_H-P_L}{(P_H+P_L)(2-P_H-P_L)}\,\Delta\, k, 0\right\}$. We now show that Contract 3 dominates Contract 1 for $C_2 \leq \frac{\Delta\, k}{\psi}$ because its monetary implementation cost of $P_H\, t_{Hh} + (1 - P_H + P_L)\, t_{Hl,Lh}$ is lower than that for Contract 1 of 2ψ:

$$\Pi_3 - \Pi_1 \;=\; \begin{cases} -\frac{P_H-P_L}{P_L}\,\psi + \frac{P_H-P_L}{2-P_H-P_L}\,\Delta k & \leq 0 \quad \text{if} \quad \frac{\Delta\, k}{\psi} \leq C_2\,(1-P_H), \\ -\frac{P_H-P_L}{P_L}\,\psi + \frac{P_H-P_L}{2-P_H-P_L}\,\Delta k & > 0 \quad \text{if} \quad C_2\,(1-P_H) < \frac{\Delta\, k}{\psi} < C_3, \\ \psi & > 0 \quad \text{if} \quad \frac{\Delta\, k}{\psi} \geq C_3 \equiv \frac{(P_H+P_L)(2-P_H-P_L)}{P_L(P_H-P_L)}. \end{cases}$$

The result follows because $C_2\,(1-P_H) < C_2$. So $\Pi_3 - \Pi_1 > 0$ for $C_2 \leq \frac{\Delta\, k}{\psi}$ and $\Pi_4 - \Pi_1 > 0$ for $C_2 > \frac{\Delta\, k}{\psi}$.

Single-agent setting: follows directly, because the above profit functions just need to be divided by two.

■

Proof of Proposition 2. Suppose $Q = \{q_{Hh}, q_{Lh}, q_{Hl} = q_{Ll}\}$. From Appendix B it follows that Contract 4 from Section 2.2 is the profit maximizing IPM contract for $\frac{\Delta\, k}{\psi} < C_4 \equiv \frac{2-P_H-P_L}{P_L\,(1-PL)}$. We now construct an RPM contract that strictly dominates Contract 4, and thus all IPM contracts. Consider the following contract.

$\mathbf{RPM_1}$		$\theta = \mathbf{H}$: q_{Hh}	$\theta = \mathbf{H}$: $q_{Hl} = q_{Ll}$
$\theta = \mathbf{L}$	q_{Lh}	$[(t_2, m_2), (t_2, m_2)]$	$[(t_1, m_1), (0, m_3)]$
	$q_{Hl} = q_{Ll}$	$[(0, m_3), (t_2, m_2)]$	$[(0, m_3), (0, m_3)]$

Given that both agents exert effort under RPM_1, beliefs about the agents' types are: $E\left[k_\theta | \, t_1, m_1\right] = k_L$ and $E\left[k_\theta | \, t_2, m_2\right] = k_L + \frac{1}{1+P_L} \Delta k$, $E\left[k_\theta | \, 0, m_3\right] = k_L + \frac{1-P_H}{2-P_H-P_L} \Delta k$. The talented agent's incentive and limited liability constraints imply that

$$t_2 = \begin{cases} \frac{\psi}{P_H} - \frac{(1-P_L)-P_L\,(1-P_H)}{(1+P_L)(2-P_H-P_L)} \Delta k & \text{if } \frac{\Delta k}{\psi} < C_5 \equiv \frac{(1+P_L)(2-P_H-P_L)}{P_H[1-P_L-P_L\,(1-P_H)]}, \\ 0 & \text{otherwise.} \end{cases}$$

The ordinary agent's incentive and limited liability constraints determine t_1:

$$t_1 = \begin{cases} \frac{1-P_L}{P_L(1-P_H)} \psi + \frac{1-P_H}{2-P_H-P_L} \Delta k & \text{if } \frac{\Delta k}{\psi} < C_5, \\ \frac{\psi}{P_L(1-P_H)} - \frac{(P_H-P_L)-(1-P_H)^2}{(1-P_H)(2-P_H-P_L)(1+P_L)} \Delta k & \text{if } C_5 \le \frac{\Delta k}{\psi} \text{ and } C_7 \ge 0, \text{or if } C_5 \le \frac{\Delta k}{\psi} < C_6 \text{ and } C_7 < 0, \\ 0 & \text{if } \frac{\Delta k}{\psi} \ge \max\{C_5, C_6\} \text{ and } C_7 < 0, \end{cases}$$

where $C_6 \equiv \frac{(2-P_H-P_L)(1+P_L)}{P_L\left[(P_H-P_L)-(1-P_H)^2\right]}$ and $C_7 \equiv (1-P_H)^2 - (P_H - P_L)$. Hence, the expected profit for the range $\frac{\Delta k}{\psi} < C_4$ is:[31]

$$\Pi_{RPM_1} = \begin{cases} \bar{q} - 2\psi + \frac{P_H-P_L}{2-P_H-P_L} \Delta k & \text{if } \frac{\Delta k}{\psi} < \min\{C_4, C_5\}, \\ \bar{q} - \psi - \frac{P_L\left[(1-P_H)^2-(P_H-P_L)\right]}{(2-P_H-P_L)\,(1+P_L)} \Delta k & \text{if } C_5 \le \frac{\Delta k}{\psi} < C_4. \end{cases}$$

Next, we compare the profits of RPM_1 and Contract 4 for the range $\frac{\Delta k}{\psi} < C_4$. Note that $C_4 > C_1$. Moreover, since $C_5 - C_1 = \frac{P_L\,(2-P_H-P_L)^2}{P_H\,(1-P_L)(1-2\,P_L+P_L\,P_H)} > 0$ only the following cases have to be considered:

$$\Pi_{RPM_1} - \Pi_4 = \begin{cases} 0 & \text{if } \frac{\Delta k}{\psi} < C_1, \\ -\psi + \frac{P_H(1-P_L)}{2-P_H-P_L} \Delta k \ge 0, & \text{if } C_1 \le \frac{\Delta k}{\psi} < \min\{C_4, C_5\}, \\ \frac{P_H P_L}{1+P_L} \Delta k & \text{if } C_5 \le \frac{\Delta k}{\psi} < C_4. \end{cases}$$

We conclude: RPM_1 strictly dominates Contract 4 – and thus all IPM contracts – for $C_1 < \frac{\Delta k}{\psi} < C_4$. ■

Proof of Corollary 1.

Single-agent case: From Contract 1 in Section 2.2 it follows that a perfectly revealing contract that implements effort by both types of agents requires a bonus pool of at least $\frac{\psi}{P_L}$ per agent. An IPM bonus pool contract corresponding to Contract 3, however, requires only a bonus pool equal to $t_{Hh,Lh} = \max\left\{\frac{\psi}{P_L} - \frac{P_H-P_L}{(P_H+P_L)(2-P_H-P_L)} \Delta k, 0\right\}$ per agent.

Two-agent case: a perfectly revealing contract requires a bonus pool of at least $\frac{\psi}{P_H} + \frac{\psi}{P_L}$. An IPM bonus pool contract corresponding to Contract 4 requires a lower bonus pool: $t_{Hh} + t_{Lh} = \frac{\psi}{P_H} + \frac{\psi}{P_L} - \frac{P_H-P_L}{2-P_H-P_L} \Delta k$.

■

[31] It can easily be shown that C_5 can be either larger or smaller than C_4. Note that $t_1 > 0$ for the range $\frac{\Delta k}{\psi} < C_4$: either $C_7 \ge 0$; or $C_7 < 0$ but then $\max\{C_5, C_6\} > C_4$, as it can easily be shown that $C_6 > C_4$.

Proof of Proposition 3.

C is the profit-maximizing contract under a transparent organization (Section 3.1). For $\Delta k = 0$ we have $\Pi_T - \Pi_C < 0$. For $\Delta k \geq \widehat{\Delta k} \equiv \max\left\{\frac{\psi}{P_L\, P_H\,[1-2\,P_L\,(1-P_H)]}, \frac{\psi}{P_L\,(1-P_H)\,[1-2\,P_L\,(1-P_H)]}\right\}$ reputational incentives alone suffice to implement effort, so $B^e = 0$ and $\Pi_T - \Pi_C = 2\,\psi > 0$. The result follows by the intermediate value theorem because Π_T is monotonically increasing in Δk. ■

B Comparison of Contracts 3 and 4 (Single-Agent Setting)

Given that profits in a single-agent setting are directly obtained from the analysis in a two-agent setting by dividing the profit functions by 2, we get

$$\frac{\Pi_4 - \Pi_3}{2} = \begin{cases} \frac{1}{2}\frac{P_H - P_L}{P_L}\,\psi & > 0 \quad \text{if} \quad \frac{\Delta k}{\psi} < C_1 \equiv \frac{2-P_H-P_L}{P_H(1-P_L)}, \\ \frac{1}{2}\left(\frac{P_H}{P_L}\,\psi - \frac{P_H\,(1-P_L)}{2-P_H-P_L}\,\Delta k\right) & > 0 \quad \text{if} \quad C_1 \leq \frac{\Delta k}{\psi} < C_4 \equiv \frac{2-P_H-P_L}{P_L\,(1-PL)}, \\ \frac{1}{2}\left(\frac{P_H}{P_L}\,\psi - \frac{P_H\,(1-P_L)}{2-P_H-P_L}\,\Delta k\right) & \leq 0 \quad \text{if} \quad C_4 \leq \frac{\Delta k}{\psi} < C_3 \equiv \frac{(P_H+P_L)(2-P_H-P_L)}{P_L(P_H-P_L)}, \\ -\frac{1}{2}\left(\psi + \frac{P_L\,(1-P_H)}{2-P_H-P_L}\,\Delta\, k\right) & < 0 \quad \text{if} \quad C_3 \leq \frac{\Delta k}{\psi}. \end{cases}$$

This uses the fact that $C_3 > C_4 > C_1$.

C Introducing Turnover

This section illustrates how our model can be extended to allow for staff retention. Suppose that after an agent chooses his effort in the first period, both he and the principal observe the match quality. Following Greenwald (1986), we make the following two assumptions: first, the incumbent principal can match outside offers in the second-period labor market; second, a proportion $\mu > 0$ of agents have a poor match and quit their jobs even if a counteroffer is made. What are the implications of this for rank-order tournaments in an opaque organization? Suppose that the market holds the belief that receiving the bonus is a good signal, leading to second-period wage offers $w(\cdot)$ for which $k_H > w\,(B^e, winner) > w\,(B^e, loser) > k_L$. Clearly, when both agents want to quit we are back to the setting in Section 3.2. If however the talented worker is ready to stay with the incumbent principal (probability $1 - \mu$), giving the bonus to the other agent enables the principal to retain the talented agent cheaply by matching the outside offer $w\,(B^e, loser)$. In contrast, if the talented agent is going to quit anyway (probability μ), handing him the bonus if he is the real tournament winner is a best reply. Taking into account this strategy, the respective expected productivities of the winner and the loser become

$$\begin{aligned} E\left[k_\theta | B^e, winner\right] &= \mu \left\{\left[P_H + (1-P_L)\,(1-P_H)\right]\,k_H + P_L\,(1-P_H)\,k_L\right\} + (1-\mu)\,k_L, \\ E\left[k_\theta | B^e, loser\right] &= \mu \left\{\left[P_H + (1-P_L)\,(1-P_H)\right]\,k_L + P_L\,(1-P_H)\,k_H\right\} + (1-\mu)\,k_H. \end{aligned}$$

In sum, with probability μ we are in the same situation as in the model with 100 percent turnover, whereas with probability $1-\mu$ the ordinary agent receives the bonus. The implied reputation gain of winning therefore is $R\,(B^e) = (2\,\mu\,[1-P_L\,(1-P_H)]-1)\,\Delta\,k$. Market beliefs that receiving the bonus is a good signal are consistent with equilibrium only if there is indeed a positive implied reputation gain of winning, i.e. $\mu > \frac{1}{2\,[1-P_L\,(1-P_H)]}$. This turnover threshold is less than $2/3$.[32] From an empirical standpoint, this suggests that in industries where talent is very important (high $\Delta\,k$) enhanced outside opportunities (corresponding to an increase in μ) should lead to more opaque organizations. Massa et al.'s (2006) study of the mutual fund industry discussed in Section 3.5 documents such a situation.

[32] $P_L\,(1-P_H) < P_H\,(1-P_H) \leq 1/4$, so $[1-P_L\,(1-P_H)] > 3/4$.

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