

Contracts and Conflict in Organizations

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September 4, 2009

Abstract

In many organizations, the way that incentive problems are alleviated is not via contracts, but rather who is hired. This paper offers a theory of targeted hiring, and how its role changes as contracting becomes poorer.

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1 Introduction

Agency theory has largely been about using compensation to align interests. Yet pay is often a very poor way of providing incentives, and a more relevant tool in many settings is instead who to hire. This paper shows how hiring can reduce agency issues, and how its role changes as it becomes more difficult to contract on performance. Specifically, the focus is on the endogenous creation of conflict in organizations as a response to poor contracting, where this conflict takes the form of a principal hiring people whose objectives differ from hers and each others.

An example might be useful. I have served on a number of search committees for university Deans. These committees spent (literally) no time on how the Dean should be paid given the obvious problems in finding and aggregating an appropriate set of measures. Instead, much of its concern was on scrutinizing the background and previous activities of the candidates, as these were felt to be indicative of issues that they would emphasize on the job. Some might be better at fostering research, while others seemed more interesting in fundraising or keeping students and alumni happy. Finding the “right” person on this spectrum was how these committees alleviated some agency concerns.¹

The principal point of the paper is that whenever jobs are specialized, workers should generally not share the objectives of their employer. Furthermore, this divergence depends on the ability to contract on performance. To understand the intuition for the results, consider a firm that has two different objectives, say, service provision to clients and cost control. Tasks are somewhat specialized in that some jobs primarily involve looking after clients, whereas others worry about costs. The institution has two choices - who to hire, and how to pay them. Assume that potential hires have attributes that affect their willingness to exert effort on these dimensions (service and costs) but that on the frontier, these “skills” are substitutes. (So, for instance, social workers are more likely to be concerned with service provision than cost control, whereas an accountant may care more about cost issues.) Additionally, the firm has an imperfect measure of performance that can be used to reward agents.

Section 2 begins by constructing a simple model of hiring biased agents - those whose incentives do not align with those of the principal - *but only as a response to poor contracting*. To put it simply, an implication of being unable to contract on output is that the principal hires agents unlike himself in terms of desired outcomes, but instead are excessively focused on a subset of what the firm does. So for example, the difficulty in measuring the output of a social services provider results in agencies hiring social workers whose objective is excessively to serve their clients even though they are insufficiently motivated to control the costs of doing so.² Simple though this

¹Similar tradeoffs arise when choosing someone to run a government department, charitable institution, police department, company board, or - indeed - country. As a good example of these issues, see Golden, 2000, for a discussion of how changing senior government officials during the Reagan administration changed policy.

²In a survey on the preferences of social workers, Robert Peabody, 1964, notes that “by far the

observation is, it illustrates a cost to using hiring as a tool to alleviate agency concerns - namely, the endogenous hiring of those who disproportionately care about one aspect of their job. Furthermore, this problem gets worse as contracting disimproves.

The ideas proposed here are based on two premises. First, workers exert effort for reasons beyond contracted payments.³ Second, who firms hire affects what they do. The avenue proposed here for why workers vary in their willingness to exert effort is “professionalism” - a commonly stated reason in the literature on motivation. According to Wilson, 1989, “professionals are those employees who receive some significant portion of their incentives from organized groups of fellow practitioners located outside the agency” (p.60). It seems uncontentious to posit that individual have professions - social workers, lawyers, academic economists, etc. What is less clear is how this affects behavior.⁴ Perhaps because it is most familiar to economists, I focus on a career concerns source of motivation, where market wages depend on prior performance. That effort is exerted to affect external perceptions is well known from the career concerns literature, such as as Holmstrom, 1999, and Gibbons and Murphy, 1994. The innovation here is that the external constituency may not share the objectives of the principal. So, for example, a lawyer in the federal government may exert effort based on the prospect of getting a job in the private legal sector. Using this lens, it is shown that who is hired affects what they do, with the implications outlined above.

The divergence in objectives between workers and their employers described above becomes of more interest when workers interact. Section 3 addresses how this tendency towards divergence changes with such interaction. Initially consider a case where one party has a *discrete* idea that could benefit the “other” activity, but at some cost to his primary activity.⁵ When cooperation across employees is important,

most dominant organizational goal perceived as important..is service to clientele” (p.66), where 83 percent of survey respondents view such service as important, compared to only 9 percent who see “obligation to taxpayers” or “assistance to the public in general” as important concerns affecting their decisions. Derthick, 1979, also provides some evidence on such conflicts for social workers when they were asked by the SSA to be instrumental in denying coverage to applicants.

³There is a large empirical literature on why workers often do far more than would be predicted by the standard economic model of agency. Much of this literature is in public administration or political science (such as Goodsell, 1998, and Brehm and Gates, 1997). As an extreme case, note that the US Post Office has ontime delivery rates of mail in the region of 98%, and in less than 3% of cases do government official fail to give enough benefits to welfare recipients (Goodsell, 1998). This is surely not because these organizations tie pay to the performance of their employees - in many of these settings, pay is pretty much independent of performance.

⁴A number of mechanisms have been proposed in the literature. First, professional training inculcates norms of behavior into individuals, where enforcement is largely internal - so, for instance, social workers are taught to care for the welfare of their clients and not doing so leads to a sense of guilt or failure. Second, peer pressure from fellow professionals may enforce certain behavior, such as where a soldier puts herself in the face of danger so as not to look bad in front of other soldiers. Finally, there is the career concerns route taken here.

⁵So, for example, a lawyer at the FTC may have information useful to the economists about bringing a case against a firm, or a social worker has information on clients making false claims.

I show that firms with poor contracting opportunities face an additional tradeoff - between *capture* and *fiefdoms*.

Begin by considering the case where contracting is good - then it is simple to induce cooperation as monetary incentives are strong and “professional” objectives are aligned. However, remember from above that firms respond to poor contracting not only reducing monetary incentives but also by hiring agents with traits that lead them to largely be interested only in increasing the output of “their” primary activity. Both of these make cooperation less likely - formally, there is a point at which it is no longer feasible without changing either compensation or who is hired. In this case, the firm hires an agent with preferences to carry out the *other* activity. I call this phenomenon *capture*, as the institution increasingly takes on the skills required for one of the two tasks, even though it makes the agent who is needed to cooperate less willing to exert effort on her own task.⁶ This tendency towards capture becomes stronger as contracting opportunities initially gets worse.

However, the optimal response to the possibility of interaction need not be capture. As contacting on performance continues to get worse, the cost of inducing cooperation - in terms of who is hired - can become too great, and the firm discretely changes by hiring very biased agents in both tasks. This has the advantage that they work hard on their own tasks, but at the cost of giving up on cooperation. This outcome I term *fiefdoms*, as it results in highly motivated agents in each position, yet where their motivations are so divergent from each other than they will not carry out activities that increase the common good.⁷

The next section of the paper addresses the case where each lobbys for resources in a more continuous fashion. Such rent seeking activity characterizes many institutions. In this case, I show that outcomes change more continuously than above, where monetary and “intrinsic” incentives are either substitutes over the whole relevant parameter space, or are complements over the whole parameter space. In the case where lobbying costs are high, I show that the limiting outcome to deter lobbying is where both agents look relatively similar, even though their jobs are very different. In this sense, the paper offers a theory of *indifferent* agents - where they care almost as much about the other’s task as their own - but one where the form of indifference

⁶So for instance, if interactions between a faculty and a dean are sufficiently important, it may necessary to hire a faculty-friendly dean, even if it involves the dean ignoring important aspects of the job. Or consider staffing the National Highway Traffic Safety Administration, whose charge is to reduce accidents. For a long period of time, the predominant practice of the NHTSA was to hire engineers, using their professional interest in finding scientific solutions to reduce accidents. This gave rise to significant criticism of the agency where it always sought engineering solutions to safety problems (such as better seat belts, air bags, etc.) to the detriment of changing (for example) attitudes towards dangerous driving. See Pruitt, 1979, for details.

⁷As an example of this, note (i) the discussion of the Federal Trade Commission in Wilson (p.61), where the preferences of the economists hired were often at variance of those of the lawyers, with resulting tension, or (ii) Goldner’s, 2000, description of the standoff between Reagan political appointees and the staff of the Equal Employment and Opportunities Commission.

is endogenously chosen by the principal.

Two issues are necessary for the results above. First, agents exert effort for reasons other than contracted pay, and second, that there is variation in these motivations. Professionalism is but one source of such motivations. Another commonly cited source of motivation is “intrinsic motivation”, where people inherently value the outcomes of their actions.⁸ Section 5 shows that the results above continue to hold with this other exogenous source of motivation.

All the observations above simply identify the kinds of workers that institutions would like to hire. Section 6 deals with their ability to recruit such workers when identification of talents is costly. In such settings, where workers know their motivations better than does their potential employer, what kinds of workers are ultimately matched to firms? The simple point of this section is that whether firms recruit their desired workers depends critically on the technology for identifying talent. When identification of talent occurs via costly state verification - such as interviews or testing - firms that cannot contract well on output have the greatest reason to incur these costs, as they rely a great deal on these other incentives. Those firms that can contract well on output have less to gain from finding the right employee, and do not incur these costs. Hence, with costly state verification, those who contract poorly ultimately match best as they pay the investigation costs. By contrast, when self-selection by workers generates supply of applicants, the opposite happens and it is those who can easily contract on output who recruit closest to their needs. Remember that those who contract poorly rely heavily on finding the person with the right “intrinsic” incentives. However, those who have the *least* intrinsic incentives are actually the most attracted to the job, as they gain most rents. As a result, they end up attracting a particularly poor sample of agents, and so lose most when self-selection generates supply of applicants. Hence, supply interacts with demand in an ambiguous way.

Section 2 begins by building the benchmark model that shows the tradeoffs between hiring and monetary incentives. Following this, Section 3 illustrates how interaction across activities leads to the notions of capture, fiefdom, and indifference that are the choices facing firms that cannot contract well on output. In each of these sections, various simplifying assumptions are made regarding contracts and technology. These are relaxed in Sections 4 and 7, which show that the insights are generally robust to other assumptions. Section 5 extends the insights to other sources of motivation, while Section 6 highlights problems that arise when workers hold private information on their motivation.

⁸Teachers caring about their students, computer programmers enjoying their work, social workers empathizing with their clients, and soldiers fighting for a cause, would be obvious examples here.

2 The Model

An institution carries out two activities, A and B . For concreteness, let A be the provision of service to clients, and B be cost control. As an input to these objectives, it hires agents who provides effort on two inputs (tasks), 1 and 2. Let effort on task i be given by e_i , $i = 1, 2$, where to keep matters simple, the costs of effort on task i is $\frac{e_i^2}{2}$.

There is an asymmetry between the two tasks, where workers are primarily charged with one of the two activities. I focus initially on the agent who is specialized primarily in activity A , considering another agent largely specialized in B below. Specifically, all effort by that agent on task 1 increases the returns solely of activity A . By contrast, effort on task 2 has a shared benefit. A fraction x of effort on task 2 benefits activity A , while the remaining $(1 - x)$ benefits activity B .⁹ Hence, tasks are partially specialized, as reflected by the parameter x . To avoid the possibility of corner solutions, I assume $x < \frac{1}{2}$.

Output in each activity (A and B) depends not just on efforts, but also the abilities of the agent. Reflecting the fact that the firm produces two outputs, the agent has two abilities - those in area A and area B - given by m_A and m_B respectively, and output produced is the sum of this ability, total effort on the activity, and noise:

$$y_i = \frac{m_i}{2} + \tilde{e}_i + \epsilon_i, i = A, B, \quad (1)$$

where \tilde{e}_i is the total effort exerted on that activity.¹⁰ Remember from the description above, all the agent's e_1 increases output on A , as does a fraction x of e_2 . Hence $\tilde{e}_A = e_1 + xe_2$, and $\tilde{e}_B = (1 - x)e_2$. The distribution of ϵ_i is assumed to be Normal with mean 0 and variance σ_ϵ^2 and the noise terms are uncorrelated with each other. The objective of the firm is to maximize the sum of the two outputs, net of wage costs.

There are two reasons to exert effort in the model: (i) pay for performance contracts, and (ii) reputational incentives. I describe each in turn.

I: Contracts Available performance measures are imperfect. Following Baker (1992), I assume that the principal can observe an unbiased but imperfect signal of total effort:

$$\tilde{y} = (1 + D)e_1 + (1 - D)e_2, \quad (2)$$

where D takes on value δ and $-\delta$ with equal probability. (I ignore agent subscripts for simplicity.)

The parameter δ thus measures the extent to which effort can be effectively contracted upon, and is privately observed by (only) the agent after contracts are signed.

⁹The most natural interpretation of this is that activity 2 involves cost containment which has benefits across the entire organization as cost savings are shared.

¹⁰The $\frac{1}{2}$ on the abilities is simply a normalization: its role will be clear below.

At one extreme, $\delta = 0$ and performance measures are perfect while at the other extreme $\delta = \infty$, they are useless. This abstract contracting technology is used simply to illustrate distortions while retaining the inherent symmetry of the problem. The firm can condition the agent's pay on observed output \tilde{y} . For ease of exposition, I consider linear contracts where the agent is given a fraction of output, $\beta\tilde{y}$ and a fixed payment.¹¹

II: Ability and Career Concerns Firms cannot perfectly observe the abilities of workers. Instead there is symmetric uncertainty, where at the point where the agents are hired, the distribution of m_i is assumed by all to be Normal with mean μ_i , and variance σ_0^2 . The firm can select agents with different perceived ability subject to a constraint that

$$\mu_A + \mu_B = M \tag{3}$$

Agents vary in their perceived ability according to (3), and the firm can costlessly choose an agent anywhere along this frontier.¹² Conditional on an initial choice of expected abilities, true abilities are uncorrelated with each other.

Career concerns models are premised on the assumption that observed performance reflects ability, which is reflected in future wages. To model this, assume that there is another (undiscounted) period - period 2 - in which the agent will be employed.

The agent may change firms for period 2 based on observed outputs. The reason for this is that firms vary in how they use skills: specifically, let firms be indexed by τ , where a firm of type τ values ability A at τm_A and ability B at $(1 - \tau)m_B$. All other assumptions are unchanged re productivity. τ has a natural support of 0 to 1 so at the two extremes, the firms use only one of the two skills, whereas all others use at least some of each.¹³ Further assume that in the second period, there is efficient matching of workers to jobs and the agent's reservation wage is her expected productivity in the most efficient match.

The market observes y_A and y_B and updates its perception of the agent's abilities to $\hat{\mu}_A$ and $\hat{\mu}_B$ respectively.¹⁴ As the agent matches efficiently, she will be employed in the firm where most surplus is created, including whatever surplus is created through incentive payments in that period.

The usual one dimensional career concerns model of ability implies that the worker's wage depends on perceived ability. The natural extension of this here is that

¹¹Optimal contracts are considered in Section 7.

¹²The assumption of perfect substitutability between the two abilities is relaxed in Section 4. Note also that \tilde{y} is an unbiased measure of total output given this assumption.

¹³The firm being studied here values each ability equally (and hence the $\frac{1}{2}$ multiplying the abilities in (1)). The equal weighting of abilities is purely for illustration - I generalize it in Section 4.

¹⁴For other recent work on how career concerns affect incentives in similar settings, see Dewatripont et al, 2003.

this wage depends on some function of perceptions of both abilities. The assumption of efficient matching makes this relationship between wages and perceptions very simple, as seen in Lemma 1.

Lemma 1 *The agent's utility in period 2 is $\max\{\hat{\mu}_A, \hat{\mu}_B\}$ and a constant independent of ability.*

Hence, all that matters for future pay is which ability is higher. Effort is exerted in period 1 to maximize both contemporaneous monetary payments and these future wages. Note that Lemma 1 characterizes wages conditional on the realizations of first period output. When choosing effort, the agent must therefore take expectations of the future wages characterized by Lemma 1.

For notational convenience, let $\mu = \mu_A - \mu_B$, and $\hat{\mu} = \hat{\mu}_A - \hat{\mu}_B$ be the difference in expected abilities before and after observing first period output. These will be the shorthand for bias in what follows. For the career incentives in Lemma 1, all that matters is which ability is higher and so the agent estimates the likelihood that $\hat{\mu} > 0$. Routine calculation shows that the distribution of $\hat{\mu}$ is Normal with mean μ and variance $2\sigma_0^2 + 2\sigma_\epsilon$. Let $\Phi(\cdot)$ be a normal distribution with mean 0 and variance $2\sigma_0^2 + 2\sigma_\epsilon$. Then the probability that $\hat{\mu} > 0$ - i.e., that skill A determines pay in period 2 - is given by $1 - \Phi(-\frac{\mu}{s})$ where $s = \frac{\sigma_0^2}{\sigma_0^2 + \sigma_\epsilon}$, and the probability that his reservation wage is determined by B ($\hat{\mu} \leq 0$) is given by $\Phi(-\frac{\mu}{s})$.

It is worthwhile pausing here, as $[1 - \Phi(-\frac{\mu}{s})]$ and $\Phi(-\frac{\mu}{s})$ provide the key to the insights below. When the firm chooses a worker whose μ is high, that worker is perceived to have greater talent in activity A than in B . This is relevant here only because this makes activity A the most likely *next* employer, and so the agent orientates her efforts more in that direction, to the detriment of activity B .

Conditional on a second period match, the marginal value of a unit increase in the relevant first period output on second period wages is s , as is familiar in models of career concerns. As a result, modulo a constant¹⁵, the reservation wage of the agent in period 2 - when exerting effort in period 1 - is given by

$$[1 - \Phi(-\frac{\mu}{s})]sy_A + \Phi(-\frac{\mu}{s})sy_B \quad (4)$$

The agent's choice of effort Consider the incentives of the agent in period one, including marginal incentive payments of β .¹⁶ Ignoring constants, the agent chooses effort in the first period to maximize

$$\max_{\{e_1(D), e_2(D)\}} \beta \tilde{y} + [1 - \Phi(-\frac{\mu}{s})]sy_A + \Phi(-\frac{\mu}{s})sy_B - \frac{e_1^2}{2} - \frac{e_2^2}{2}. \quad (5)$$

¹⁵The constant includes the expectation of outputs of A and B with negative signs, and so the market is not fooled in equilibrium.

¹⁶Note that some monetary contracts are always necessary to induce efficiency as the career incentives can never sum to more than $s < 1$.

so equilibrium efforts are

$$e_1(D) = s[1 - \Phi(-\frac{\mu}{s})] + (1 + D)\beta, \quad (6)$$

and

$$e_2(D) = xs[1 - \Phi(-\frac{\mu}{s})] + (1 - x)s\Phi(-\frac{\mu}{s}) + (1 - D)\beta. \quad (7)$$

The monetary part of this is familiar- agents exert effort to increase pay, where the parameter D induces a distortion as in Baker, 1992. Less familiar are the terms involving Φ . $1 - \Phi(-\frac{\mu}{s})$ is the probability of A being the next employer, and $\Phi(-\frac{\mu}{s})$ is the likelihood that the next employer uses B instead. To see the relevant tradeoff, note that

$$\frac{de_1(D)}{d\mu} = \phi(-\frac{\mu}{s}) > 0, \quad (8)$$

and

$$\frac{de_2(D)}{d\mu} = (2x - 1)\phi(-\frac{\mu}{s}) < 0, \quad (9)$$

where ϕ is the density function of Φ . Equations (8) and (9) provide the foundation for the results that follow: raising μ increases effort on task 1 but decreases it on task 2. The key for the result below, however, is that increasing μ increases the sum of the two efforts: $\frac{d[e_1(D)+e_2(D)]}{d\mu} = 2x\phi(-\frac{\mu}{s}) > 0$, but only because $x > 0$, i.e., because tasks are specialized. However, while total effort rises with bias, it does so in an unbalanced way, as the agent is spending too much time on task 1 to the detriment of task 2. When the firm can contract well on output, it need not incur this unbalancing cost to get efficient effort, and so does not want biased agents. By contrast, when performance measures are poor, the firm has no other way of increasing effort, and so hires more biased agents.

Before describing the outcomes of the model, it is worthwhile outlining a benchmark where the agent shares the relative preferences of principal. This arises when the agent values each output equally, namely when $\mu = 0$. I refer to this agent as unbiased. Career incentives then give the worker a reason to exert effort of $\frac{s}{2}$ on each task - as there is an equal chance of each skill affecting future wages. In the absence of any contracting distortions, the firm could then “top up” incentives by offering $\beta = 1 - \frac{s}{2}$, and so the agent exerts efficient effort on each task.

Proposition 1 *The optimal choice of agent and monetary incentives are given by*

$$1 - \Phi(-\frac{\mu^*}{s}) = \min\{1, \frac{2x(1 - \beta^*) - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2)}\} \geq \frac{1}{2}, \quad (10)$$

and

$$\beta^* = \frac{2 - (1 + x)s + 2xs\Phi(-\frac{\mu^*}{s})}{2(1 + \sigma^2)} \leq 1 - \frac{s}{2}, \quad (11)$$

where $\sigma^2 = \text{var}(D) = \frac{(1+\delta)^2 + (1-\delta)^2 - 1}{2}$.

Now consider the optimal choice of agent and contract. When contracting is perfect ($\sigma^2 = 0$), (10) implies that $\Phi(-\frac{\mu^*}{s}) = \frac{1}{2}$ or $\mu^* = 0$. In words, when contracting is perfect, the agent hired shares the preferences of the principal.¹⁷ However, for any positive σ^2 , monetary contracts fall, and in response, $1 - \Phi(-\frac{\mu^*}{s}) > \frac{1}{2}$, so that the agent is biased. Furthermore, increases in σ^2 (weakly) increase μ^* : hence, bias arises as a response to the inability to contract.

So far, I have focused on solely the incentives of the agent whose job is specialized towards activity A . Call her agent a . Yet another agent's tasks may be specialized towards B . To see how specialization of tasks in this way affects organizations, consider an agent, b , who is the mirror image of the agent considered above, where the parameter x represents how her activities are specialized towards B . Then the optimal choice of that agent is $-\mu^*$. Hence, as contracting becomes poorer, the firm hires workers with very divergent preferences.¹⁸

The outcome with two specialized agents is described in Figure 1, where equilibrium pairs of β^* and μ^* are plotted by the hashed line. The point $\mu^* = 0, \beta^* = 1 - \frac{s}{2}$ is the outcome when there are no contracting distortions. As σ increases, the equilibrium pairs of incentives and preferences are plotted, with the negative slope reflecting the substitutability of monetary and other incentives.

This completes the description of the basic model. It offers an intuitively plausible outcome - where professional and monetary incentives are substitutes - yet there is a cost to relying on the professional motivation as efforts become unbalanced. Its novelty is in offering a tradeoff for firms that find contracting on output to be difficult, namely, it hires agents whose preferences closely align with the task they primarily carry out, but at the cost of having them ignore other aspects of their jobs.

3 Interaction

Thus far, the model has the seeds of a theory of conflict within firms, where as outcomes become harder to contract on, the divergence in objectives between the two agents grows at a rate $\frac{2d\mu^*}{d\sigma^2} \geq 0$. The purpose of this section is to show that when there are other forms of interaction between activities, the choice of the principal becomes more complicated, and can result in the creation of *fiefdoms*, *capture*, or *indifference*. I do this in two ways - first, by considering the possibility of discrete cooperation by one party, and second, by addressing the possibility of lobbying for

¹⁷It is worth noting that this is the unique outcome, so it is not the case when incentive contracting is efficient, who to hire is irrelevant. The reason is that the principal only observes aggregate output, not the individual components, so there remains an issue of ensuring the output is produced in the optimal fashion.

¹⁸So, to give an example, it would suggest a department of social work where the social workers spend time helping clients, but have little time for the objectives of their supervisors to save on costs. See Brehm and Gates, 1997, for evidence on the resulting distrust between social workers and their superiors, who they feel are only interested in the "bottom line".

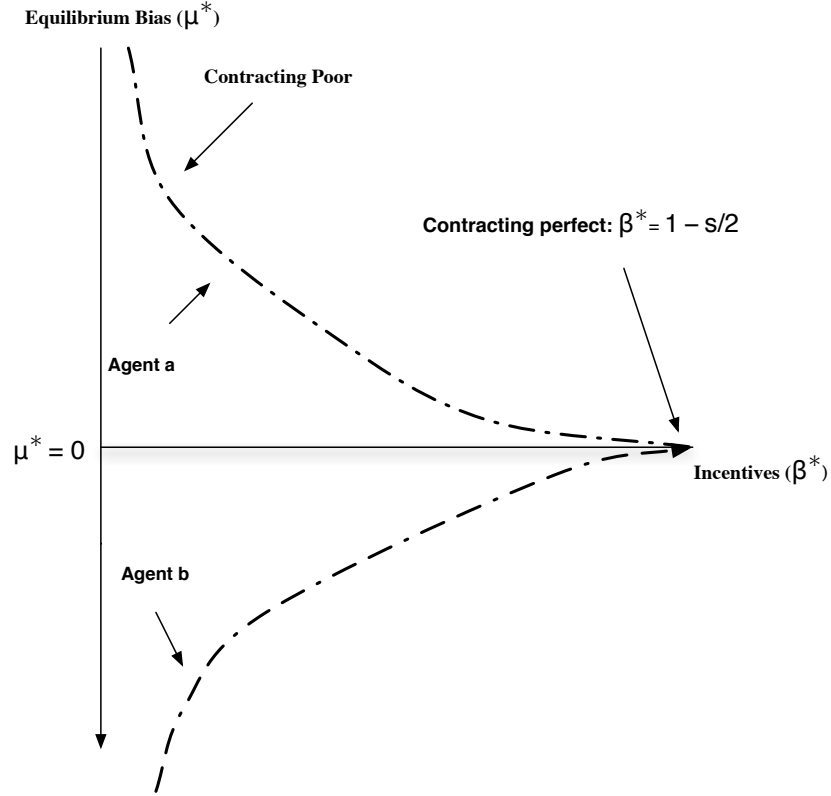


Figure 1: **Equilibrium Bias as σ changes.**

resources by both agents.

3.1 Discrete Cooperation

Assume now that there is an unobserved discrete activity that one party, agent a , can engage in that benefits the other party's primary output, B , at some cost to A . This activity increases the output of activity B by π_B at a cost of reducing the output of activity A by κ_A . It is assumed that $\pi_B > \kappa_A$ so the principal would like this cooperative activity carried out. Agent a is critical for the implementation of that idea and the labor market does not observe whether the activity has been carried out or not - technically, I assume that the market does not know of the activity's existence, so that it continues to use the same updating rule. These profits are included in the contracted measure of output \tilde{y} , so that the agent has reason to cooperate for monetary reasons. For simplicity, it is assumed that this decision to cooperate arises before D is observed.

There is now an additional incentive constraint, namely, that if the firm wishes

this activity carried out, the agent must want to do so. Remember that for career reasons, agent a values an increase in y_A at $[1 - \Phi(\cdot)]s$ and y_B at $\Phi(\cdot)s$. Hence the agent only cooperates if

$$\beta(\pi_B - \kappa_A) + s\Phi(\cdot)\pi_B - s[1 - \Phi(\cdot)]\kappa_A \geq 0, \quad (12)$$

which defines the critical value of $\mu(\beta)$, called $\underline{\mu}(\beta)$, above which the agent refuses to cooperate:

$$\Phi\left(-\frac{\underline{\mu}}{s}\right) = \frac{-\beta(\pi_B - \kappa_A) + \kappa_A}{\pi_B + \kappa_A}. \quad (13)$$

There are two relevant issues that arise from (13). First, there is a limit to how biased the agent can be if the principal wishes to induce cooperation. Second, this limit depends on β : the better is contacting, the less need is there to distort hiring to induce efficiency. This second insight yields Proposition 2 below.

Proposition 2 *The relationship between the ability to contact and agent bias is non-monotonic in σ^2 the following way:*

- If $\sigma^2 < \sigma_1^2$, then the principal chooses $\tilde{\mu}$ and $\tilde{\beta}$ as in (11) and (10), and the agent cooperates. In this region, $\frac{d\tilde{\mu}}{d\sigma} > 0$ and $\frac{d\tilde{\beta}}{d\sigma} < 0$
- If $\sigma_1^2 < \sigma^2 < \sigma_2^2$, then (13) binds, $\tilde{\beta} > \beta^*$, $\tilde{\mu} < \mu^*$, and the agent cooperates. In this region, $\frac{d\tilde{\beta}}{d\sigma} < 0$ but $\frac{d\tilde{\mu}}{d\sigma} < 0$
- If $\sigma^2 > \sigma_2^2$, then the principal chooses $\tilde{\mu}$ and $\tilde{\beta}$ as in (11) and (10), and the agent does not cooperate. In this region, $\frac{d\tilde{\mu}}{d\sigma} > 0$ and $\frac{d\tilde{\beta}}{d\sigma} < 0$.
- Let $S(\beta(\sigma^2), \mu(\sigma^2))$ define equilibrium surplus. Then σ_2^2 is finite if and only if $S(0, \mu_0) - S(0, \mu_1) \geq \pi_B - \kappa_A$, where $[1 - \Phi(-\frac{\mu_0}{s})] = \frac{2x - (2x-1)(1-x)}{s(1-(2x-1)^2)}$ and $1 - \Phi(\frac{\mu_1}{s}) = \frac{\pi_B}{\pi_B + \kappa_A}$.

This proposition is easily explained and has an economically plausible interpretation. When contracting is good (σ^2 low), the agent has good incentives to cooperate as she has enough monetary incentive to do so, and, in any case, has close enough preferences to the principal. In this range, as contracts become less efficient, the principal responds by choosing more biased agents just as before. However, as contracting gets worse, the previously optimal contract no longer induces the agent to cooperate: this arises when $\underline{\mu}(\beta^*) = \mu^*(\beta^*)$ or

$$\Phi\left(-\frac{\mu^*}{s}\right) = \frac{-\beta^*(\pi_B - \kappa_A) + \kappa_A}{\pi_B + \kappa_A}. \quad (14)$$

This is uniquely defined so let σ_1^2 be the level of difficulty of contracting at which (14) arises. At this point, further movements up the (μ^*, β^*) frontier in Figure 2 cause the

cooperation constraint to be violated because of lower monetary incentives and more biased agents.

Two issues then arise - (i) does the principal want to induce cooperation at this level of incentives? and (ii) how can she do so? The answer to the first question is yes at σ_1^2 , for the reason that benefits to inducing cooperation at that point are first order but the costs from marginally distorting effort away from μ^* and β^* are second order. Hence there is some range over which the firm will induce the agent to cooperate by satisfying (12). It follows that the firm will choose to have (12) bind. When the cooperation constraint binds, note that

$$\frac{d\Phi(.)}{d\beta} = \frac{\pi_B - \kappa_A}{\pi_B + \kappa_A} > 0. \quad (15)$$

In words, as it becomes more and more difficult to contract on output, it becomes harder to induce cooperation - to counteract this, the principal responds by choosing *less* biased agents, the opposite of the previous section. It is in this sense that the model exhibits *capture* by one group, where an agent specialized in A has preferences that get closer to those of agent b .

Yet there is a third possible outcome. This arises when the cost of inducing cooperation becomes too large to make it worthwhile. Specifically, let surplus produced be defined by $S(\beta, \mu)$, where these depend on efforts as in (6) and (7). Then, $S(\beta^*(\sigma^2), \mu^*(\sigma^2))$ is the surplus when the cooperation issue is ignored, and $S(\tilde{\beta}(\sigma^2), \tilde{\mu}(\sigma^2))$ is the surplus produced from effort if choices are distorted to ensure cooperation occurs. Then if it exists, define σ_2^2 by

$$S(\beta^*(\sigma_2^2), \mu^*(\sigma_2^2)) = S(\tilde{\beta}(\sigma_2^2), \tilde{\mu}(\sigma_2^2)) + \pi_B - \kappa_A. \quad (16)$$

At σ_2^2 , the value of cooperation just matches the cost of distorting both incentives and hiring to induce cooperation. Up to that point, the firm strictly prefers to induce the agent to cooperate. This is no longer true beyond σ_2^2 , and the firm discretely shifts by (i) reducing monetary incentives, and (ii) hiring agents with very biased preferences. Proposition 2 provides a necessary and sufficient condition for this region to exist. In this region, which I term *fiefdom*, each division holds diametrically opposed preferences to each others and does not cooperate. Note that such endogenous creation of fiefdoms arises for those institutions that are least able to contract on output.

The outcome of this section is described in Figure 2 for the case where fiefdoms arise. At both extremes the outcome is exactly as in Figure 1 because (i) when contracting is very good, there is no reason not to cooperate, and (ii) when contracting is very poor, the cost of inducing cooperation is too high, and so the firm does not do so. It is in the intermediate range where the outcome differs. In this region, less efficient contracting causes agents to become less biased, as it is the most efficient way to induce cooperation. Yet this is costly to effort exerted on the primary task: hence at some point (σ_2^2) the firm discretely switches back to the equilibrium of the last section though it involved no cooperation.

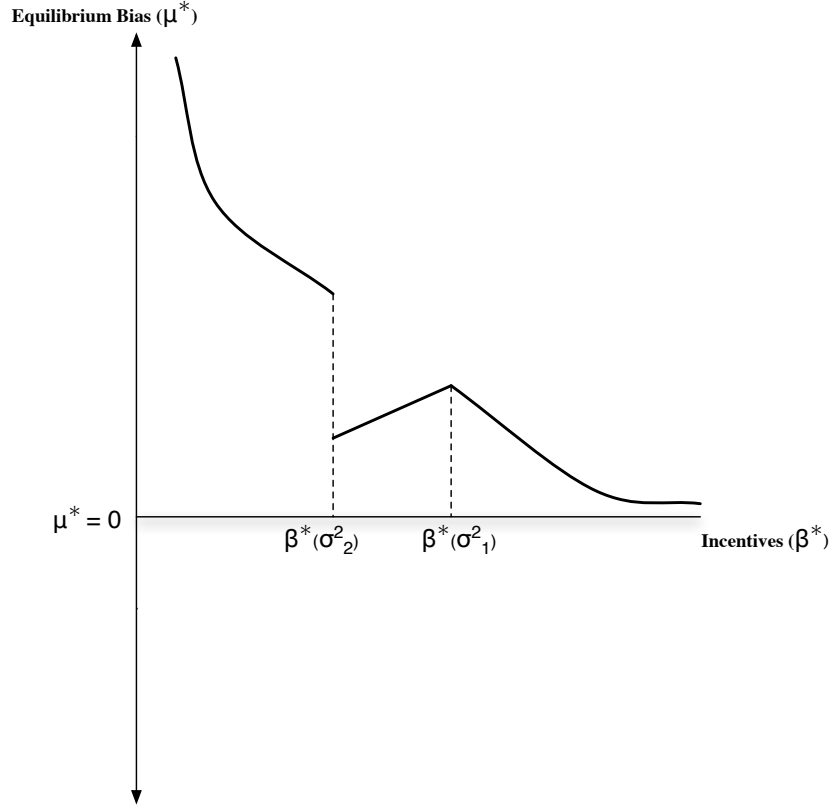


Figure 2: **Equilibrium Bias With Discrete Cooperation.**

3.2 Continuous Lobbying

Organizations are inherently political, with a common characteristic being inefficient lobbying for more resources. In this section, I consider the impact of allowing such lobbying on the equilibrium choice of contracts and preferences. Here it is shown that the outcomes vary more continuously than above. At a more general level, in this and the previous section, another cost to specializing agents was added to the basic model. In the last example, that cost was discrete - the agent would discretely choose not to cooperate at some point. It is that discreteness that caused the unambiguous move towards capture. More generally, the effect of such activities on hiring depends on the marginal benefit of the efficient activity (more effort on the primary task) relative to that of the marginal cost on the “other” task. This is shown here by considering another activity - called lobbying - where marginal costs are more continuous.

Specifically, both agents now have access to a technology that can inefficiently transfer resources to his primary activity at the expense of the other activity. Specifically, agent a chooses an intensity of lobbying l , which increases y_A by $\lambda_A l$ but reduces

y_B by $\lambda_B l$, where $\lambda_A < \lambda_B$. Lobbying involves a personal cost $\frac{kl^2}{2}$. (Agent b 's incentives are the mirror image.) These effects on output are observed in the contracted output \tilde{y} . Once again, I assume that the market chooses the same updating rule as in the basic model. Given the separability of costs, lobbying activities are chosen to maximize:

$$[1 - \Phi(-\frac{\mu}{s})]s\lambda_A l - \Phi(-\frac{\mu}{s})s\lambda_B l - \frac{kl^2}{2} + \beta(\lambda_A - \lambda_B)l, \quad (17)$$

yielding the first order condition

$$kl^*(\beta, \mu_A) \geq s\lambda_A - \Phi(-\frac{\mu}{s})s(\lambda_A + \lambda_B) + \beta(\lambda_A - \lambda_B). \quad (18)$$

where (18) binds if the right hand side is positive and l^* is zero otherwise. This condition is intuitive - at the first best level described above, when $\Phi = \frac{1}{2}$ and $\beta = 1 - \frac{s}{2}$, then $l^* = 0$. In words, when incentives are high, and agents are not biased, they value maximizing aggregate output, and so do not lobby. However, when the constraint above binds, then lobbying is increasing in agent bias and decreasing in monetary incentives.

Proposition 3 Define σ_3^2 implicitly by $\Phi(-\frac{\mu^*(\sigma_3^2)}{s}) = \frac{s\lambda_A - \beta^*(\sigma_3^2)(\lambda_A - \lambda_B)}{s(\lambda_A + \lambda_B)}$, where μ^* and $\Phi(-\frac{\mu^*}{s})$ are defined in (11) and (10). The relationship between the ability to contract and agent bias varies with σ^2 in the following way:

- If $\sigma^2 \leq \sigma_3^2$, then the principal chooses μ and β as in (11) and (10), and there is no lobbying.
- If $\sigma^2 > \sigma_3^2$, then agents become more (less) biased as σ^2 increases if and only if $2x > (\leq) \frac{\lambda_B^2 - \lambda_A^2}{k}$.

The first part of this is hardly surprising - if measurement is sufficiently good, lobbying does not arise and so nothing changes from the basic model. However, at some point (σ_3^2), agents begin to lobby under the old contract. When the lobbying constraint binds, it is shown in the Appendix that

$$1 - \Phi(-\frac{\mu^{***}}{s}) = \frac{\gamma - (2x - \frac{\lambda_B^2 - \lambda_A^2}{k})\beta^{***}}{s(1 - (2x - 1)^2 - 2s(\lambda_A + \lambda_B)^2)} \quad (19)$$

where $\gamma = 2x - s(1 - x)(2x - 1) - \frac{(\lambda_A + \lambda_B)(1 + 2s\lambda_A)}{k} + \frac{(\lambda_B^2 - \lambda_A^2)}{k}$. Therefore the effect of reduced reduced monetary incentives on optimal bias is now linear - caused by the quadratic cost assumption - but can increase or decrease depending on parameter values. In particular, if $2x > \frac{\lambda_B^2 - \lambda_A^2}{k}$, then as contracting becomes poorer, agents become more biased, while if $2x \leq \frac{\lambda_B^2 - \lambda_A^2}{k}$, institutions with less ability to contract on output will result in less biased agents. The intuition here is straightforward - when

the marginal cost of lobbying (normalized by its responsiveness to incentives: $\frac{\lambda_B^2 - \lambda_A^2}{k}$) is large, the efficient outcome is to deter that activity by choosing less biased agents when contracting is poorer, but if the cost of lower effort (the x term) is high, then this is reversed.

Many institutions use close to no formal pay for performance as the incentives for dysfunctional responses are so large. How then can incentives for lobbying be deterred? The only way to deter lobbying ($l^* = 0$) when $\beta^* = 0$ is to choose agent a whose type is no more biased than

$$1 - \Phi\left(-\frac{\mu^{***}}{s}\right) = \frac{\lambda_B}{\lambda_A + \lambda_B} > \frac{1}{2}, \quad (20)$$

while agent b has type $\frac{\lambda_A}{\lambda_A + \lambda_B}$. Note that this will be the solution chosen by the principal as $k \rightarrow 0$, as otherwise the costs of lobbying become very large.

This last observation offers a view of agent selection rather different from that in previous sections, in that it is not capture by one group but rather both agents have preferences that move towards $\mu = 0$. Instead, it offers a notion of *indifferent* agents, where despite poor contracting, the principal hires agents to carry out specialized jobs whose preferences look close to his. It is in this sense that the agents are indifferent - as they care little more about their own task than the others.

The outcome here is described in Figure 3. Here once the lobbying constraint binds, at σ_3^2 , the outcomes change in a more continuous way, and can either decline or increase (albeit more slowly than without lobbying) than in the benchmark model.

4 Ability

So far, hiring matters only because it affects agent incentives. If there were no career concerns (if $s = 0$ for example), the firm would be indifferent about who to hire. This arises because - on the demand side - the technology in (1) means that holding effort fixed, the firm values both abilities equally, and - on the supply side - (3) implies that expected abilities are perfect substitutes. In this section, I relax both assumptions to allow for possible direct effects on productivity.

4.1 Ability and Specialization

One of the primary motivations for the paper is that tasks tend to be specialized in firms. So, for example, I primarily do research and my dean primarily deals with alumni, students, and large donors. The reflection of this in the model is the parameter x , where $y_A = e_1 + xe_2 + \frac{m_A}{2} + \epsilon_A$, and $y_B = (1 - x)e_2 + \frac{m_A}{2} + \epsilon_B$. Hence as x rises, the agent's actions primarily affect activity A . Yet if my efforts primarily affect research, shouldn't my abilities do likewise? So far, I have ignored this.

To capture this possibility, I now add a symmetry between specialization in efforts and abilities, where the parameter x affects not only the marginal effect of increasing

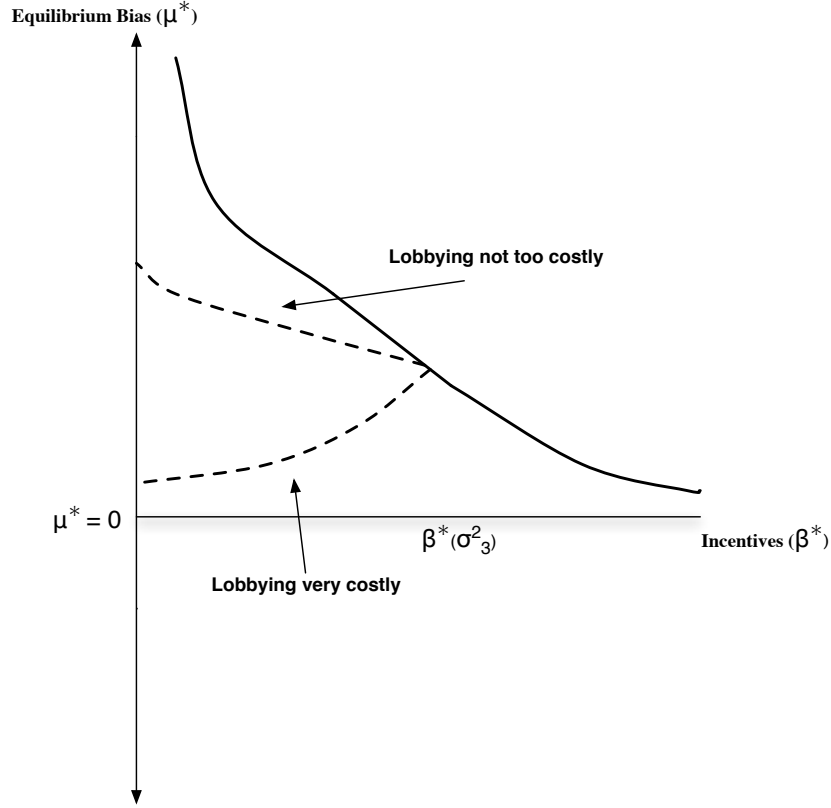


Figure 3: **Equilibrium Bias With Lobbying.**

efforts, but also the marginal effect of ability. Specifically, assume now that output is no longer given by (1) but rather

$$y_A = \tilde{e}_A + (1 + x)\left(\frac{m_A}{2} + \epsilon_A\right), \quad (21)$$

and

$$y_B = \tilde{e}_B + (1 - x)\left(\frac{m_B}{2} + \epsilon_B\right). \quad (22)$$

This technology is now symmetric in its treatment of ability and effort - in words, if efforts have a biased effect on output, now ability does likewise.¹⁹ The import

¹⁹There is one issue that is ignored here concerning learning. Specifically, by multiplying the error terms by x , it ignores the possibility that speed of learning may be faster for one ability than the other. This is ignored here because my interest in this paper is not in instances where it is easier to provide incentives on one task than the other. Instead, I retain symmetry across tasks throughout the paper in order to avoid the obvious insight that when one task is easier than the other to provide incentives on, hiring should be weighted towards those who will exert effort on the other task without monetary incentives.

of this is extension that there is now an additional reason to bias hiring - namely, even if efforts are zero, the agent should be biased towards that task at which she is specialized as that ability matters more. Straightforward calculations reveal that the optimal choice of contract is still given by (11) but the optimal choice of agent is now given by

$$1 - \Phi\left(-\frac{\mu^*}{s}\right) = \min\left\{1, \frac{2x(1 - \beta^*) + \frac{x}{2\phi\left(-\frac{\mu^*}{s}\right)s} - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2)}\right\}. \quad (23)$$

This has only one change from the basic model's outcome - the $\frac{x}{2\phi\left(-\frac{\mu^*}{s}\right)s}$ term was previously not relevant. This term offers an additional reason for bias because ability has a greater direct effect on A than on B (though x). Hence if ability has no effect on effort (because $s = 0$: see (6) and (7)), then the firm would hire the most biased agent available. It remains the case that this bias arises even in the limit where $\sigma^2 = 0$.²⁰ Subject to these caveats, though, the results of the paper are robust to this extension as all comparative statics remain unchanged.²¹

4.2 Ability Frontier

The other way in which there can be a direct effect of ability on expected productivity is if the frontier of expected ability does not involve perfect substitution. Assume now that instead of (3), the frontier of expected ability is given by $\mu_B = -f(\mu_B)$ where $f' > 0$. Hence the abilities need not be perfect substitutes. With such imperfect substitution, there is now the possibility that equilibria can jump discretely when parameters are perturbed. This is not the central focus of the paper, so I ignore it here by assuming that marginal changes can be imputed in the usual first order approach. If this is the case, the equilibrium contract is still characterized by (11), but the optimal worker hired is now given by

$$1 - \Phi\left(-\frac{\mu^*}{s}\right) = \min\left\{1, \frac{2x(1 - \beta^*) + \frac{2(1-f'(\mu^*))}{s\phi\left(-\frac{\mu^*}{s}\right)} - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2)}\right\}. \quad (24)$$

A simple way to interpret this is that, ignoring incentive effects, the firm would choose μ_1 where $f'(\mu_1) = 1$. (This can be simply seen from (24) when $s = 0$.) The comparative statics of the model then arise around this benchmark. It is also the case that bias continues to arise in the limit where $\sigma^2 \rightarrow 0$: here the agent remains biased towards whichever side of $\mu^* = 0$ that μ_1 lies. However, the comparative statics of the model remain unchanged.

²⁰It is also the case here that the first best is not attained in the limit here, and there are unbalanced efforts between the two tasks. This arises because the firm cannot separately identify y_A and y_B . When they can, the limiting case involved first best efforts, but agents remain biased towards their primary task.

²¹Note also that agent a is, in effect, working in a firm of type $\tau = x$, so the equal weighting assumption in (1) is simply for illustration.

5 Other Preferences

Other than the “2-skills” model above, I have been relatively agnostic on how firms choose agents based on preferences. Sometimes this takes the form of hiring based on profession, educational background, or prior career - this is the closest in spirit to the formal model. So, for instance, should a doctor run a hospital, or someone with a financial background? In these instances, the “profession” model seems apposite. Yet in many cases, the source of incentives is intrinsic, such as where social workers simply care about their clients, and so on. To model this, now ignore all career concerns issues, but instead assume that agents have exogenous preferences to increase output. Specifically, they have an observed “type” (μ_A, μ_B) such that aside from the contractual payments offered by the firm, they value (y_A, y_B) at $\mu_A y_A + \mu_B y_B$, where $\mu_i \geq 0$.²² If that distribution of (μ_A, μ_B) includes the point $(1, 1)$, then the first best is attainable by simply choosing that individual and offering no payment based on output - in that case they would choose $e_i^* = 1$ and the problem is solved. I ignore this trivial solution by assuming that there exists no such individual and preferences are characterized by the line $\mu_A + \mu_B = s$, where $s < 2$. Consider agent a who has type (μ_A, μ_B) with marginal pay of β . She chooses efforts of

$$e_1(D) = \mu_A + (1 + D)\beta, \quad (25)$$

and

$$e_2(D) = x\mu_A + (1 - x)\mu_B + (1 + D)\beta. \quad (26)$$

Assume that the principal maximizes the standard notion of surplus: $E[e_1 + e_2 - \frac{e_1^2}{2} - \frac{e_2^2}{2}]$.²³ Straightforward calculations (see Appendix) yield the efficient level of incentives and preferences, μ_A^* and β^* , where

$$\mu_A^* = \min\left\{s, \frac{2x(1 - \beta^*) - (2x - 1)(1 - x)s}{1 + (2x - 1)^2}\right\} \geq \frac{s}{2}, \quad (27)$$

²²Sometimes such information comes from direct observation of agent’s actions. In other cases, relevant information can come from other activities that candidates engage in. For example, during the Reagan administration, potential political appointees were asked about their membership in societies that they felt were relevant for determining allegiance to that administration’s preferences, both positive (Federalist Society) and negative (the Sierra Club). While this is new to the agency literature, the notion that matching preferences to the needs of employers is already well established in studies on efficiency in the public sector. Specifically, there is a field of research in public administration called “representative democracy” which deals with the idea that - since compensation cannot be used to align incentives effectively - the bureaucracy of the U.S. should resemble the population of the country in terms of education, voting behavior, and attitudes to social issues. See Goodsell, 2004, for details.

²³This assumption is less straightforward than in the last section. Here it is implicitly assumed that although the agent cares about output, she does not consider it when computing her reservation utility. The interpretation of why this might be the case, described in Prendergast, 2007, is that they should ignore their contributions on the wage they will accept if they believe that the next person in line for the job - should they turn it down - will have the same preferences as they do.

and

$$\beta^* = \frac{1 - x\mu_A^* - (1-x)\frac{s}{2}}{1 + \sigma^2} \leq 1 - \frac{s}{2}, \quad (28)$$

where $\sigma^2 = \text{var}(D) = \frac{(1+\delta)^2 + (1-\delta)^2 - 1}{2}$.

Given the simple mapping to the previous section, it is not surprising that the comparative statics of the model are similar to above, with agents unbiased only if contracting is perfect, and with equilibrium bias becoming stronger as contracting becomes more difficult. Hence the results of the previous section easily extend to these other preferences.

6 Supply of Agents

Thus far, I have considered only which kinds of workers firms would like to hire, by simply assuming that the firm can identify type without cost. Yet this is often not true. This section is concerned with the case where workers know more about their own types than do potential employers.

I consider two cases where such identification is costly. The central message of this section is that which firms ultimately match closest to their needs depends critically on which case is relevant. I begin by considering a situation where all workers would like the position - to ignore self-selection - but where firms incur a fixed cost of identifying talents. Here it is shown that firms who contract most poorly on output are willing to incur this cost, as their benefits are greater, whereas those who can contract well on output are less concerned about who they hire, and so do not incur those costs. Hence, if the technology for identifying talents is costly state verification, the least able to contract on performance ultimately match better to workers. By contrast, when firms rely on workers to self-select, the opposite is true, as those who contract poorly on output find it relatively more difficult to select desired workers. In this case, it is those who contract well on output who end up matching better.

In this section, workers are assumed to know their μ_i 's but firms do not. I illustrate issues associated with such private information using the simplified model of Section 5, where agents value (y_A, y_B) at $\mu_A y_A + \mu_B y_B$, and the optimal choice of worker and contract given by (27) and (28). I do this for two reasons. First, it is hard to imagine how agents would have private information on their professions, yet easier to see it when it comes to intrinsic motivation. Second, the career concerns model I have used so far involves learning about types based on all observed information. Such learning becomes very complicated when there is asymmetric information, and no longer take the familiar linear form. As this is not the central interest of this section, I instead illustrate the supply issues with the exogenous preference model above. I also assume here that $E\mu = 0$ in the population of applicants.

6.1 Costly Recruiting

The first extension here is to assume that there is a fixed cost $k > 0$ that firms incur to identify their desired type of agent, μ_i , but where workers do not self-select because they all earn rents.²⁴ The firm then decides whether to spend these resources and attract a desired type, or else randomly select an agent. Remember that $S(\beta^*(\sigma^2), \mu^*(\sigma^2))$ denotes the surplus obtained by the principal above. Then by recruiting that desired type, the firm gains utility of $S(\beta^*, \mu^*) - k$. Alternatively, they can not incur this cost and randomly hire. This has three effects. First, on average they hire type $\mu = 0$. Second, as they hire this type on average, they offer a contract of $\beta = \frac{1-\frac{s}{2}}{1+\sigma^2}$, as on average intrinsic incentives are $\frac{s}{2}$ - see (28). Third, there is variation in the motivation of workers hired - some have types greater than $\mu = 0$ while others have less. The convexity of the cost function means that this variation is costly to the firm. Let σ_μ^2 be the variance of the distribution of supply of worker types. Then the firm's utility from randomly selecting agents is easily shown to be $S(\frac{1-\frac{s}{2}}{1+\sigma^2}, \frac{s}{2}) - (1 + (2x - 1)^2)\sigma_\mu^2$. The firm then uses targeted hiring only if

$$S(\beta^*, \mu^*) - k \geq S(\frac{1-\frac{s}{2}}{1+\sigma^2}, \frac{s}{2}) - (1 + (2x - 1)^2)\sigma_\mu^2. \quad (29)$$

$S(\beta^*, \mu^*) - S(\frac{1-\frac{s}{2}}{1+\sigma^2}, \frac{s}{2})$ is increasing in the inability to contract on output, σ^2 . The reason is intuitive. When contracting is good, the desired agent is close to $\mu^* = 0$, the same type as is hired on average by randomly hiring. As contracting on output becomes worse, the firm optimally hires more specialized agents, and so random hiring results in a hire far from the desired agent. Additionally, the ability to compensate for random hiring - by offering large pay for performance - becomes attenuated as contracts become more costly. As a result, the relative merits of targeted versus random hiring cross once in σ^2 space, as seen in Proposition 4.

Proposition 4 *Assume that it costs firms k to identify the type of its candidate employees and that all workers earn rents from the job. Then:*

- *If $k < (1 + (2x - 1)^2)\sigma_\mu^2$, the firm always targets hiring.*
- *If $k \geq (1 + (2x - 1)^2)\sigma_\mu^2$, then for all $\sigma^2 < \sigma^{2**}$, the firm hires randomly, but targets hiring on $(\beta^*(\sigma^2), \mu^*(\sigma^2))$ for all $\sigma^2 \geq \sigma^{2**}$, where σ^{2**} is finite if $S(0, \mu^*(\infty)) - k > S(0, 0) - (1 + (2x - 1)^2)\sigma_\mu^2$.*

The reason for this section is simple - to capture another intuition about the role of hiring as contracting varies. Specifically, when contracting is good, it is not difficult to orient the actions of agents as pay for performance is not so costly. Hence, who cares who is hired? This section formalizes this, simply showing that firms in good

²⁴I continue to assume that the firm maximizes surplus here.

contracting environments are content to devote little resources to recruiting, whereas those who find contracting difficult will be willing to incur costs to find the right person.

The outcome is described in Figure 4, where those who can contract well randomly hire workers, whereas those who cannot target hiring.

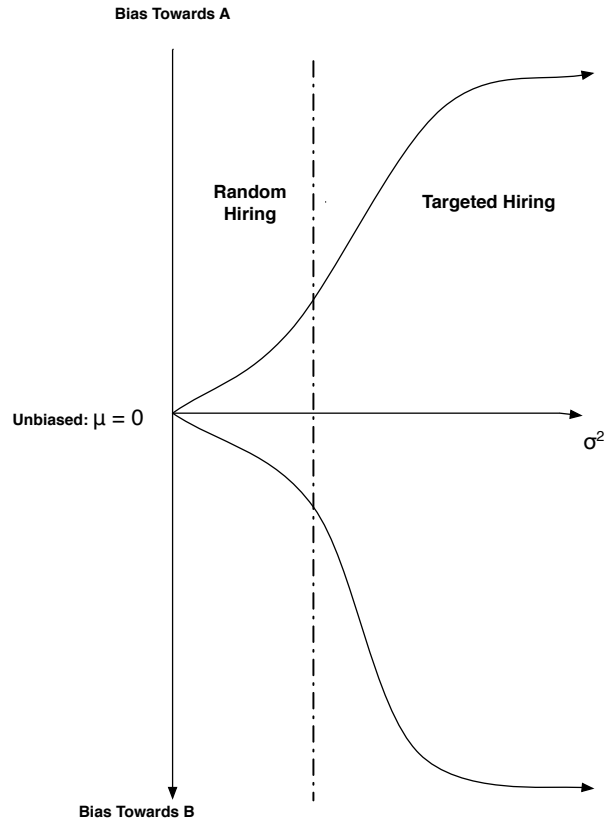


Figure 4: Costly State Verification

6.2 Self-Selection

The results of the last subsection arise because the demand for information on worker characteristics is greater when contracting is poorer. Hence, institutions that cannot contract on output that have more intrinsically motivated workers on average. This section shows that this outcome is overturned when the technology for identifying talents is not “costly state verification” but rather self-selection.

Once again, assume that potential workers know μ but the firm does not. Unlike the previous section, now assume that the firm can choose β and a fixed payment that determines who applies for the position, and where they randomly hire from that

applicant pool. The central issue below is how well those instruments target hiring towards desired workers. Two issues generate the results below. First, firms rely on some form of intrinsic motivation, but workers must ultimately be compensated for effort costs though higher total compensation. This compensation is especially attractive to those who exert little effort, as they make rents, so all firms suffer from selection issues. Second, those who cannot contract on performance *rely most* on such intrinsic willingness to exert effort, and so are most harmed by this selection problem. This is why the results are overturned from the previous section.

To see this, note that the expected utility of an agent (ignoring constants) in equilibrium is given by $EU = E[\beta[y_A + y_B] - \frac{e_1^2}{2} - \frac{e_2^2}{2}]$. By simple substitution, this can also be stated for a worker of type μ_A as

$$EU(\mu_A) = \beta[2\beta + (1-x)s + 2x\mu_A] - \frac{((1+\delta)\beta + \mu_A)^2}{4} - \frac{((1-\delta)\beta + \mu_A)^2}{4} - \frac{((1+\delta)\beta + (2x-1)\mu_A + (1-x)s)^2}{4} - \frac{((1-\delta)\beta + (2x-1)\mu_A + (1-x)s)^2}{4}. \quad (30)$$

The agent will apply for this position so long as it weakly exceeds her reservation utility, normalized to 0. Of more interest is how it changes with type. Differentiation of this utility with respect to μ_A yields

$$\frac{dEU}{d\mu_A} = -[1 + (2x-1)^2]\mu_A - (2x-1)(1-x)s, \quad (31)$$

so that worker utility is maximized at

$$\hat{\mu}_A = \frac{(1-2x)(1-x)s}{1+(2x-1)^2} \leq \frac{s}{2}, \quad (32)$$

$\hat{\mu}_A$ is the agent who exerts *least* effort costs among all possible agents. This is the central problem with self-selection here - because workers are not residual claimants, and the firm has to compensate the desired agent for more effort, those who shirk most earn greatest rents. Furthermore, the agent who likes the job most is never the one chosen by the firm (as $\hat{\mu}_A \leq \frac{s}{2}$).

To see this, consider the case where the firm offers the same contract as in Section 5 - by offering β^* as in (28) and a fixed payment such that its preferred type just earns her reservation utility. Then all workers in a range apply for the position, where μ_A^* is at one end of the range, and $\underline{\mu}_A < \hat{\mu}_A$ at the other end - or the boundary point $\mu_A = 0$. Thus far, this simply says that self-selection has costs to firms. Furthermore, the relationship between the value of the job and worker type is independent of contracts - β does not appear in (31): agent utility is (i) quadratic in μ_A around $\hat{\mu}_A$ and (ii) independent of β . Hence, the firm attracts a symmetric range of individuals around $\hat{\mu}_A$. As a result, the choice of worker is only affected by the fixed payment.

Yet this does not imply that the ability to contract has no effect on the cost of self-selection. To see this (ignoring the boundary conditions), note that the difference between the firm's desired agent and the agent who gains most from the job is

$$\mu_A^* - \hat{\mu}_A = \frac{2x(1 - \beta^*)}{1 + (2x - 1)^2}, \quad (33)$$

which is decreasing in β . Hence, as monetary contracting improves, *the divergence between the firm's desired type and the worker optimum gets smaller*. This is the reason why better contracting improves self-selection.

This section illustrates that self-selection is less costly for those firms that contract better. But if the difference in utility that different workers get is independent of β , how can that be the case? The reason is an indirect one. Specifically, firms that cannot contract well rely on intrinsic motivation to get effort exerted. But those workers who exert such intrinsic effort have to be compensated for doing so, which is done through generous fixed pay. However, such generous fixed pay offers greatest rents to those who exert least effort. As a result, firms who cannot contract on output have the greatest problem with selection issues, as these are the ones that rely on intrinsic motivation most. By contrast, those who contract well on output don't want those who have strong intrinsic incentives (as it results in unbalanced efforts), and so the fixed component of pay is low, and hence selection concerns are muted.

This is illustrated in Figure 5. The top portion of this is as before, and illustrates the firm's desired worker. However, any contract that attracts here, also attracts all workers in a symmetric range around $\hat{\mu}_A$. But this range is lower when $\mu_A^* - \hat{\mu}_A$ is small, and hence the costs of self-selection are lower for firms that can contract well.

Remember that with costly verification of talents, firms that contract poorly on output targeted hiring better, as they place more value on finding the right person. The opposite is true here in that selection is worse for institutions that cannot contract well on performance. This does not arise because they care less about who they hire, but rather because what makes jobs attractive to those that they want to hire also makes it very attractive to those who have little incentive to work hard. As a result, the effect of supply issues on hiring depends critically on the mechanism for identifying talent.

7 Robustness

7.1 Contracting on Individual Output

The model thus far only allows contracting on aggregate output. As a result, the only way to orient the agent towards one activity over the other is to change who you hire. But couldn't this be done instead by contracting on the individual components of output, thus eliminating the need for the hiring practices outlined above? In order to identify the robustness of the insights, a natural extension would be to allow

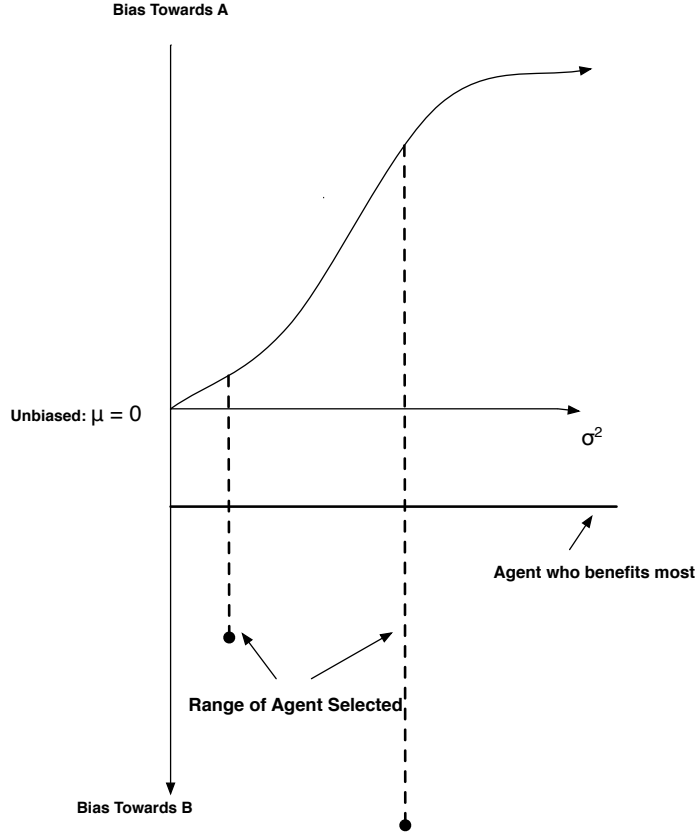


Figure 5: **Self Selection**

contracting on the individual efforts. To address this, assume that in addition to contracting on \tilde{y} , the principal can observe an imperfect measure of y_i , $i = 1, 2$, given by

$$\tilde{y}_i = (1 + \delta_i)e_i, \quad (34)$$

where δ_i takes on a values δ^* and $-\delta^*$ with equal probability. (So, for example, noisy information could be obtained both on the quality of service provision to customers, in addition to the costs of doing so.) Let $\eta^2 = \text{var}(\delta^*) = \frac{(1+\delta^*)^2 + (1-\delta^*)^2 - 1}{2}$. The δ_i variables are uncorrelated with each other and with the distortion on the aggregate signal, δ .²⁵

The firm now offers a contract where the wage - modulo a fixed payment - is given

²⁵Allowing covariance between the error terms does not yield any interesting insights. As the costs of effort are independent, correlation between δ_1 and δ_2 changes no results. What does change are the outcomes when there is correlation between the δ_i and D , the aggregate signal, as correlation between the signals exacerbates expected distortions in effort. However, this extension changes results in the obvious way - namely, increased correlation reduces incentives.

by

$$w = \beta_1 \tilde{y}_1 + \beta_2 \tilde{y}_2 + \beta \tilde{y}. \quad (35)$$

Hence the firm can now influence the relative choice of e_1 and e_2 directly through contracts rather than only through the preferences of the agents that they hire.

Straightforward calculations (see Appendix) show that the optimal choices of the two variables considered thus far, namely, β^* and μ^* are given by

$$1 - \Phi\left(-\frac{\mu^*}{s}\right) = \frac{2x(1 - \beta^*) - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2)}. \quad (36)$$

and

$$\beta^* = \frac{\eta^2}{\eta^2 + \sigma^2 + \eta^2 \sigma^2} (1 - s(1 + x) + 2xs\Phi(-\frac{\mu^*}{s})). \quad (37)$$

The equilibrium choice of agent a hired can then be characterized in terms of the exogenous parameters of the model as

$$1 - \Phi\left(-\frac{\mu^*}{s}\right) = \frac{2x(1 - z + zs(1 + x) - 2xsz) - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2) - 2x^2zs}, \quad (38)$$

where $z = \frac{\eta^2}{\eta^2 + \sigma^2 + \eta^2 \sigma^2}$.

The two instruments β and μ vary exactly as above. The previous section is analogous to a case where $\eta^2 = \infty$. But for any $\eta^2 < \infty$, β^* is lower and so equilibrium bias increases. Hence the case considered in the previous section offers least bias, so that contracting on individual outputs strengthens the results.

7.2 Cost of Effort

In the sections above, the costs of effort on the two tasks were assumed to be independent. This was done to simplify the analysis but does not change the essential logic of the paper. To see this, assume that the cost function for effort is now given by $C(e_1, e_2) = \frac{e_1^2}{2} + \zeta e_1 e_2 + \frac{e_2^2}{2}$, where $\zeta < 1$. Hence effort on one task increases the marginal cost of the other effort, as seems reasonable. Straightforward calculations then show that in the basic model of Section 2, the optimal choice of incentives β and agent type μ is given by

$$\beta^* = \frac{2(1 - \zeta^2)(1 - \zeta) - (1 - \zeta)^2 2xs(1 - \Phi(-\frac{\mu^*}{s})) - (1 - \zeta^2)(1 - x)s}{2(1 - \zeta)^2(1 + \sigma^2)}, \quad (39)$$

and

$$1 - \Phi\left(-\frac{\mu^*}{s}\right) = \min\left\{1, \frac{(1 - \zeta^2)(1 - \zeta)2x - (1 - \zeta)^2 2x\beta^* - (1 + \zeta^2)(2x - 1 - 2\zeta)(1 - x)s}{s[(1 - \zeta(2x - 1))^2 + (2x - 1 - \zeta)^2]}\right\}. \quad (40)$$

This equilibrium has exactly the same features as in the basic model. Financial incentives and bias are substitutes, with bias increasing as the ability to contract on output becomes worse. Similarly, the limiting case of perfect contracting still results in the unique outcome of unbiased agents ($\mu^* = 0$) and incentives given by $\beta^* = 1 - \frac{s}{2}$. Hence, the insights extend to the case where the cost functions are not independent in this way.

7.3 State-Contingent Contracts

By assumption, the contracts are not state contingent. The usual interpretation of this is the difficulty of designing mechanisms that can be tailored at the right frequency. In order to identify the robustness of the earlier results, consider a setting where the principal can offer a different monetary²⁶ contract when $D = \delta$ compared to when $D = -\delta$. Call these $\bar{\beta}$ and $\underline{\beta}$ respectively. (This is the optimal contract as there are only two states and there is no other noise in \tilde{y} .) Simple calculations show that if the principal can identify the two states without cost, and contracts can be conditioned on them, then she will choose

$$\bar{\beta}^* = \frac{2 - (1+x)s + 2xs\Phi(-\frac{\mu^*}{s}) - \delta(1-x)s(1 - 2\Phi(-\frac{\mu^*}{s}))}{2(1 + \sigma^2)}, \quad (41)$$

and

$$\underline{\beta}^* = \frac{2 - (1+x)s + 2xs\Phi(-\frac{\mu^*}{s}) + \delta(1-x)s(1 - 2\Phi(-\frac{\mu^*}{s}))}{2(1 + \sigma^2)}, \quad (42)$$

and

$$1 - \Phi(-\frac{\mu^*}{s}) = \min\left\{1, \frac{2x(1 - E\beta^*) - s(1-x)(2x-1) - 2x\delta^2(1-x)}{s(1 + (2x-1)^2 - 4x\delta^2(1-x))}\right\}. \quad (43)$$

This is intuitively sensible - average monetary incentives are unchanged, but now depends on δ , the parameter of contract distortion. When $D = \delta$, the agent has an incentive to increase y_A more than when $D = -\delta$. To compensate for this, monetary contracts decline, as the agent is *already* exerting considerable effort on A , as she is biased in that direction. By contrast, incentives increase when there is an incentive to increase y_B (as effort is lower in that task) when $D = -\delta$. The comparative statics here are as above, where average incentives and bias become substitutes as before. Hence this extension does not change the results of the paper. Furthermore note that there is no truth-telling problem here, as it is trivial to show that the agent prefers $\bar{\beta}^*$ ($\underline{\beta}^*$) when the state is $\delta(-\delta)$ to the other contract, and hence this will be the outcome when contracting is state contingent.

²⁶Another conceivable extension would be where both the type of agent hired and the contract can be conditioned on the state. I do not deal with this because at a practical level, the idea that potential applicants to a firm privately observe contracting distortions seems far-fetched.

8 Conclusion

Perhaps the central problem for the economics literature on agency theory is that in a wide range of situations, tying pay to performance simply does not help. Unfortunately, the literature has been largely silent on what to do in these cases. This paper argues that a useful line of research may be to consider recruitment based on the preferences or skills of potential employees. Here the tradeoffs become somewhat different to normal - in the basic model, the price of not being able to contract on output is that there will be a divergence of preferences across different parts of the organization because the firm may end up hiring workers with (often) radically different interests. When direct interaction between agents was considered, the cost of this is either fiefdoms, where agents refuse to help each other yet are zealous about their own tasks, or capture, where the institution ends up recruiting agents who are (more) similar, even though they carry out very different jobs. As an example, a likely cost of operating say a non-profit institution is the possibility of difficulties in integrating different aspects of what the firms does.²⁷ If nothing else, it at least raises both these issues in these firms, and considers the use of an instrument other than pay as a way of aligning interests.

²⁷In this sense, the existing literature that is closest to this work is Itoh, 1992 , and Dessein, Garicano, and Gertner, 2008. Prendergast, 2007, offers another reason for the biased nature of bureaucrats.

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Proof of Lemma 1: By assumption, there is efficient matching of workers to posts. As no effort is exerted for career concerns reasons, the agent matches to the firm that offers the highest value of

$$(\tau^*(\hat{\mu}_A, \hat{\mu}_B))\hat{\mu}_A + (1 - \tau^*(\hat{\mu}_A, \hat{\mu}_B))\hat{\mu}_B. \quad (44)$$

This has a very simple allocation for the second period - if $\hat{\mu}_A \geq \hat{\mu}_B$, then $\tau^* = 1$, while if $\hat{\mu}_A < \hat{\mu}_B$, then $\tau^* = 0$. But the firm can, of course induce effort exertion by contracting on output. Simple computations show the optimal contract is given by $\tilde{\beta} = \frac{1}{1+\sigma^2}$, where $\sigma^2 = \text{var}(D) = \frac{(1+\delta)^2+(1-\delta)^2-1}{2}$, which is independent of perceived ability. Hence, the agent earns $\max\{\hat{\mu}_A, \hat{\mu}_B\}$ and a constant.

Proof of Proposition 2: The objective of the principal is to maximize output minus wages, which in the usual fashion results in maximizing expected surplus - $E[e_1 + e_2 - \frac{e_1^2}{2} - \frac{e_2^2}{2}]$ - as the agent earns her reservation utility in expectation. The objective of the principal is to choose μ , and β to maximize $E[e_1 + e_2 - \frac{e_1^2}{2} - \frac{e_2^2}{2}]$ subject to (3), (6), (7), and $D = \delta(-\delta)$ with probability $\frac{1}{2}$. By substitution, the principal chooses the agent's type (μ) and the contract (β) to maximize

$$\begin{aligned} & 2\beta + (1+x)s[1 - \Phi(-\frac{\mu}{s})] + (1-x)s[\Phi(-\frac{\mu}{s})] - \frac{((1+\delta)\beta + s[1 - \Phi(-\frac{\mu}{s})])^2}{4} \\ & \quad - \frac{((1-\delta)\beta + s[1 - \Phi(-\frac{\mu}{s})])^2}{4} \\ & \quad - \frac{((1+\delta)\beta + xs[1 - \Phi(-\frac{\mu}{s})] + (1-x)s\Phi(-\frac{\mu}{s}))^2}{4} \\ & \quad - \frac{((1-\delta)\beta + xs[1 - \Phi(-\frac{\mu}{s})] + (1-x)\Phi(-\frac{\mu}{s}))^2}{4}. \quad (45) \end{aligned}$$

Straightforward differentiation yields (11) and (10).

Proof of Proposition 2: With the cooperation constraint, the objective of the firm is now to maximize expected surplus, subject to (6), (7), and now (12) if the firm wishes to induce cooperation. Begin by ignoring the cooperation constraint, in which case the firm's choice is given by (11) and (10). Therefore, if either (i) the firm can induce cooperation without changing from (11) and (10) or (ii) does not wish to induce cooperation, the solution remains that given by (11) and (10).

Note that for σ^2 low enough, (12) is satisfied at (11) and (10). To see this, note that as $\sigma^2 \rightarrow 0$, then $\beta^* \rightarrow 1 - \frac{s}{2}$ and $1 - \Phi(-\frac{\mu^*}{s}) \rightarrow \frac{1}{2}$ in which case (12) holds. As β^* and $1 - \Phi(-\frac{\mu^*}{s})$ vary continuously with σ^2 , this implies that there is a range over which the firm does not change its choice of agent with the cooperation constraint. However, as σ^2 increases, then if there exists a point at which $\Phi(-\frac{\mu^*}{s}) = \frac{-\beta^*(\pi_B - \kappa_A) + \kappa_A}{\pi_B - \kappa_A}$, then

the cooperation constraint is violated for all higher values of σ^2 as β^* and $-\mu^*$ are decreasing in σ^2 .

The optimal solution $(\tilde{\beta}, \tilde{\mu})$ then depends on whether the firm wishes to induce cooperation. If it does not, then the solution continues to be characterized by (11) and (10). If it does, then the firm will choose (12) to bind, in which case the firm chooses combinations of $\tilde{\beta}$ and $-\tilde{\mu}$ such that $\frac{d\Phi(\cdot)}{d\beta} = \frac{\pi_B - \kappa_A}{\pi_B + \kappa_A} > 0$. Then if $\frac{d\tilde{\beta}}{d\sigma^2} < 0$, it is the case that $\frac{d\tilde{\mu}}{d\sigma^2} < 0$. But note that when the cooperation constraint binds, $\frac{d\Phi(\cdot)}{d\beta} = \frac{\pi_B - \kappa_A}{\pi_B + \kappa_A} = g > 0$. Then straightforward calculations show that the optimal choice of β is given by

$$\beta = \frac{2 - 2xsg - (1 - sg)s - xs(1 + sg(1 - 2x))}{(1 + \sigma^2)[(1 - sg)^2 + (1 + sg(1 - 2x))^2]} \quad (46)$$

which is decreasing in σ^2 , as required. Hence, if there exists a point where (12) binds, there is a range where β and μ_A^0 decline with σ^2 .

Let the surplus generated by e_1, e_2 be defined by $S(\beta, \mu) = e_1(\beta, \mu) + e_2(\beta, \mu) - \frac{e_1(\beta, \mu)^2}{2} + \frac{e_2(\beta, \mu)^2}{2}$ where e_1 and e_2 are defined in (6) and (7). Then, if it exists, define σ_2 by $S(\beta^*(\sigma_2), \mu^*(\sigma_2)) = S(\tilde{\beta}(\sigma_2), \tilde{\mu}(\sigma_2)) + \pi_B - \kappa_A$. At this point, the benefits of cooperation are just matched by the costs in terms of distorted contracting and hiring. If this condition holds for any σ_2 , it must be the case that $S(\beta^*(\sigma), \mu^*(\sigma)) > S(\tilde{\beta}(\sigma), \tilde{\mu}(\sigma)) + \pi_B - \kappa_A$ for all larger values of σ because for all $\beta > \beta^*$, $\frac{d^2S}{d\beta d\sigma^2} < 0$, and for all $\beta \leq \beta^*$, $\frac{d^2S}{d\beta d\sigma^2} = 0$. Therefore as $\tilde{\beta} > \beta^*$ and $\tilde{\mu} > \mu^*$, $S(\beta^*(\sigma), \mu^*(\sigma)) - S(\tilde{\beta}(\sigma), \tilde{\mu}(\sigma))$ is increasing in σ . As a result, for all $\sigma > \sigma_2$, the firm does not induce cooperation but instead chooses (11) and (10).

Of course, no such value of σ_2^2 may exist. Consider the limiting case as σ^2 tends to ∞ . Then $\beta^* \rightarrow 0$ and $\mu^* \rightarrow \mu_0$, where $[1 - \Phi(-\frac{\mu_0}{s})] = \frac{2x - (2x-1)(1-x)}{s(1 - (2x-1)^2)}$. This is the optimal level of bias implemented if no cooperation arises. Similarly consider the return to inducing cooperation as σ^2 tends to ∞ . As $\beta^* \rightarrow 0$, $\tilde{\mu} \rightarrow \mu_1$, where $1 - \Phi(\frac{\mu_1}{s}) = \frac{\pi_B}{\pi_B + \kappa_A}$. A necessary and sufficient condition for fiefdom to exist is then

$$S(0, \mu_0) - S(0, \mu_1) \geq \pi_B - \kappa_A. \quad (47)$$

Proof of Proposition 4: The solution characterized in Section 2 continues to hold if the agents do not lobby. However, the lobbying constraint binds at $\mu^*(\sigma_1), \beta^*(\sigma_1)$ where

$$\Phi\left(-\frac{\mu^*(\sigma_1)}{s}\right) = \frac{s\lambda_A - \beta^*(\sigma_1)(\lambda_A - \lambda_B)}{s(\lambda_A + \lambda_B)}. \quad (48)$$

When the lobbying constraint binds, the firm maximizes expected surplus, which

us is now given by

$$\begin{aligned}
& 2\beta + (1+x)s[1 - \Phi(-\frac{\mu}{s})] + (1-x)s(\Phi(-\frac{\mu}{s})) - \frac{((1+\delta)\beta + s[1 - \Phi(-\frac{\mu}{s})])^2}{4} \\
& \quad - \frac{((1-\delta)\beta + s[1 - \Phi(-\frac{\mu}{s})])^2}{4} \\
& \quad - \frac{((1+\delta)\beta + xs[1 - \Phi(-\frac{\mu}{s})] + (1-x)s\Phi(-\frac{\mu}{s}))^2}{4} \\
& \quad - \frac{((1-\delta)\beta + xs[1 - \Phi(-\frac{\mu}{s})] + (1-x)\Phi(-\frac{\mu}{s}))^2}{4} \\
& \quad - (\lambda_B - \lambda_A)l - k\frac{l^2}{2}, \quad (49)
\end{aligned}$$

subject to (3), (6), (7), and $D = \delta(-\delta)$ with probability $\frac{1}{2}$, and l characterized by (18) holding with equality. Maximizing this yields optimal level of incentives and preferences are given by

$$1 - \Phi(-\frac{\mu^*}{s}) = \frac{2x(1 - \beta^*) - (1-x)(2x-1) - (\lambda_A + \lambda_B)(kl^* + \lambda_B - \lambda_A)}{1 - (2x-1)^2}, \quad (50)$$

and

$$\beta^* = \frac{1 - (1+x)s + 2xs\Phi(-\frac{\mu^*}{s}) + (\lambda_B - \lambda_A)(kl^* + \lambda_B - \lambda_A)}{1 + \sigma^2}. \quad (51)$$

As l^* is a function of β , substitution is necessary to determine the total effect of changing monetary incentives on intrinsic motivation. This is given by

$$1 - \Phi(-\frac{\mu^*}{s}) = \frac{\gamma - (2x - \frac{\lambda_B^2 - \lambda_A^2}{k})\beta^{***}}{s(1 - (2x-1)^2 - 2s(\lambda_A + \lambda_B)^2)} \quad (52)$$

where $\gamma = 2x - s(1-x)(2x-1) - \frac{(\lambda_A + \lambda_B)(1+2s\lambda_A)}{k} + \frac{(\lambda_B^2 - \lambda_A^2)}{k}$. Proposition 4 then follows.

Optimal Contacts in Section 5 The objective of the principal is then to choose μ_A, μ_B , and β to maximize

$$E[e_1 + e_2 - \frac{e_1^2}{2} - \frac{e_2^2}{2}] \quad (53)$$

subject to $\mu_A + \mu_B = s$, (25), (26), $\mu_i \geq 0$, $D = \delta(-\delta)$ with probability $\frac{1}{2}$. By substitution, the principal chooses the agent's type (μ_A) and the contract β to maximize

$$\begin{aligned}
& 2\beta + (1+x)\mu_A + (1-x)(s - \mu_A) - \frac{((1+\delta)\beta + \mu_A)^2}{4} - \frac{((1-\delta)\beta + \mu_A)^2}{4} \\
& \quad - \frac{((1+\delta)\beta + x\mu_A + (1-x)(s - \mu_A))^2}{4} \\
& \quad - \frac{((1-\delta)\beta + x\mu_A + (1-x)(s - \mu_A))^2}{4}. \quad (54)
\end{aligned}$$

Straightforward differentiation yields (27), and (28).

Contracting on Individual Outputs The optimal choice of four relevant variables - $\{\beta_1, \beta_2, \beta, \mu_A\}$ - are simply characterized by

$$\beta_1^* = \frac{1 - s[1 - \Phi(-\frac{\mu^*}{s})] - \beta^*}{1 + \eta^2}, \quad (55)$$

$$\beta_2^* = \frac{1 + (2x - 1)s\Phi(-\frac{\mu^*}{s}) - xs - \beta^*}{1 + \eta^2}, \quad (56)$$

$$\beta^* = \frac{1 - s(1 + x) + 2xs\Phi(-\frac{\mu^*}{s}) - \frac{\beta_1^* + \beta_2^*}{2}}{(1 + \sigma^2)}, \quad (57)$$

and

$$1 - \Phi(-\frac{\mu^*}{s}) = \frac{2x(1 - \beta^*) - s(1 - x)(2x - 1) - \beta_1^* - (2x - 1)\beta_2^*}{s(1 + (2x - 1)^2)}. \quad (58)$$

However, note that from (55) and (56) that $\beta_1^* = (1 - 2x)\beta_2^*$ so (57) and (58) become

$$1 - \Phi(-\frac{\mu^*}{s}) = \frac{2x(1 - \beta^*) - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2)}. \quad (59)$$

and

$$\beta^* = \frac{\eta^2}{\eta^2 + \sigma^2 + \eta^2\sigma^2}(1 - s(1 + x) + 2xs\Phi(\mu_B^{0*} - \mu_A^{0*})). \quad (60)$$

The equilibrium choice of agent a hired can then be characterized in terms of the exogenous parameters of the model by substitution as

$$1 - \Phi(-\frac{\mu^*}{s}) = \frac{2x(1 - z + zs(1 + x) - 2xsz) - s(1 - x)(2x - 1)}{s(1 + (2x - 1)^2) - 2x^2zs}, \quad (61)$$

where $z = \frac{\eta^2}{\eta^2 + \sigma^2 + \eta^2\sigma^2}$, as required.