Incentive Differences of Public and Private Firms

Fan Zhang*

Department of Economics
Northwestern University

August 19, 2004

Abstract

I use a multi-tasking model of work organization to study the differences in the power of incentives in public and private firms. Workers exert individual effort, which is susceptible to peformance manipulation, and cooperative effort, which is unobservable to the firm. Public and private firms are assumed to differ in their objectives: the private firm maximizes only profits while the public firm cares about its workers' utility in addition to profits.

Thus, even when private information is one-dimensional, it may affect how rents are obtained via *multiple* activities that the workers undertake. In such situations, the relative degrees of heterogeneity in how these activities affect workers' preferences is crucial in determining how public firms incentivize its workers relative to private firms. In particular, public firms may offer stronger incentives than private firms under certain plausible conditions.

1 Introduction

It is a widely held belief and well documented phenomenon that worker incentives are weaker in the public sector than the private sector. But is this result robust to the different ways in which workers can obtain rents from their private information? Is this finding consistent with firms' optimizing behavior? For example, might it be attributable to differences in the objectives of public and private firms? Are there informational reasons for such differences? Or, is it possible that heterogeneity in corporate culture explains some of the observed

*I would like to thank Federico Boffa, Arijit Mukherjee, Alessandro Pavan, and Scott Schaefer for helpful discussions and comments. All errors are mine. Email: f-zhang3@northwestern.edu.

differences in the strengths of incentive schemes? These are some of the questions which I hope to address in this paper.

First, a comment on the terminology is in order. Some authors (e.g. Baker (2000)) uses the word "public" to describe firms whose stocks are publicly traded and for whom the total value of equity (easily contractible) is the objective to be maximized. On the other hand, the word "private" is sometimes used to describe privately held firms, non-profit organizations, or government agencies, all of which face the problem of non-contractibility in the performance measures available to them. In this paper, however, these two terms are used with the reversed interpretations. I denote as private those firms which care solely about profit. When I speak of public firms, I especially have in mind government agencies.

There has been theoretical and empirical evidence supporting the belief that public sector workers face weaker incentives than their private sector counterparts. For example, Delfgaauw and Dur (2002) theorize that privatization leads to stronger monetary incentives for workers. The weaker incentives for public sector workers in their model arise from the exercise of monopsonistic power in the labor market, which is lacking in the competitive environment that comes about with privatization. Burgess and Metcalfe (1999) find that performance-related pay was less common in the public sector than the private sector in Great Britain in 1990.

Some evidence suggests that the weaker incentives of the public sector are suboptimal (e.g., Burgess and Metcalfe (1999)). Alternatively, the incentive differences of public and private firms may be due to differences in their objectives and informational concerns. Corneo and Rob (2001) adopt this view and show that, in a multi-tasking environment, public firms optimally offer weaker incentives than private firms because while the latter is only concerned with profits, the former's objective function also incorporates the informational rents of its workers. For other studies on how multi-tasking affects incentives, see, for example, Holmstrom and Milgrom (1991) or Itoh (1991).

On the other hand, there are plausible explanations for why managers in public firms might earn higher wages than those in private firms. One such explanation put forth by Roomkin and Weisbrod (1999) is that managers of nonprofit companies earn higher wages than for-profit managers because nonprofit firms face constraints that limit the distribution of profits to managers, so they must pay in excess of the private firms. Also, incomplete enforcement of nondistribution constraints could mean the concealment of profits as labor compensation. These explanations notwithstanding, Roomkin and Weisbrod point out that nonprofit managers could well earn less in total compensation than for-profit managers if the "labor donation" theory of wages applies: managers might be willing to work for nonprofit firms at lower wages because they derive utility from working for organizations that have some particular objectives in common, such as the provision of public goods. Previous findings cited in their paper suggest that private sector workers earn as much as 15% to 59% more than public sector workers. Evidence from the hospital industry also suggests that top management bonuses (piece-rates) were significantly higher at for-profit institutions than

nonprofit ones (Roomkin and Weisbrod, Table 4).

Finally, the theory of corporate culture can be brought to bear on the issue of incentive differences in public versus private firms. Corporate culture has traditionally been modeled in one of two ways. Some view corporate culture as the level of cooperation among the workers of a firm (e.g., Rob and Zemsky (2002)). Others see corporate culture as defining the shared beliefs and assumptions of the workers of a firm (e.g., Van den Steen (2003), Wilson (1989)). These models offer markedly different explanations for what is corporate culture, so it is a challenge to find similarities in their implications for the causes of incentive differences in firms.

In this paper, I adopt the former view of corporate culture as the level of cooperation found in a firm. In particular, I modify Corneo and Rob (2001)'s model to include the possibility of individual performance manipulation. The main result of this paper is that, contrary to Corneo and Rob's finding, the private firm does not necessarily offer stronger incentives than the public firm.[1,2] In particular, this is true if we assume that workers differ more in their aversion to individual performance manipulation than in their preference for cooperation. (See Section 5.3 for alternative explanations of why private firms might offer weaker incentives than public firms.).

Of course, many other theories exist for why public firms offer weaker incentives than private firms. The following line of reasoning is among the most prominent of them. Because public firms often answer to several different principals with different objectives, the incentives they face may offset each other and result in overall weak incentives. For more on explanations that stress common agency and multiple missions, see Dixit (1997), (2002), and Dewatripont, Jewitt, and Tirole (1996)b. Wilson (1989)'s survey of U.S. government agencies also offers some stylized facts consistent with these theoretical predictions.

The rest of this paper is organized as follows. Section 2 introduces the basic environment, including the preferences of the workers and the objectives of the public and private firms. Differences in incentives are studied in Section 3, and an application of the model to differing costs of individual performance manipulation is considered in Section 4. Finally, Section 5 contains a brief summary, some criticisms, and alternative explanations regarding the incentive differences of public and private firms.

[1] Corneo and Rob's main result that private incentives are stronger is in line with an observation of Holmstrom (1999), for it implies the existence of a higher level of cooperation in public firms than in private firms. As Holmstrom points out, "...the much-lamented lack of individual initiative in bureaucratic firms should be seen as an essential element in providing incentives for cooperative activities," p. 76.

[2] It should be noted that Corneo and Rob do show that when workers' private information is about cost of effort rather than cooperative utility, public firms offer stronger incentives than private firms. In this paper, however, I assume that workers have private information about not only their preference for cooperation but also their disutility from individual performance manipulation. Therefore, one may view the environment of the present paper as a hybrid of the environment in the main part of Corneo and Rob's model with the alternative environment they envision in which private information is (only) about cost of effort.

2 A Model

Consider an economy with two firms, a public firm and a private firm. Each firm employs a continuum of workers of measure one. The objective of the private firm is to maximize profits while the public firm seeks to maximize profits and the utility of its workers. Both firms produce a homogeneous final good and have the same production technology that requires two kinds of labor inputs, which are supplied by the workers.

The workers are risk neutral with preferences similar to those in Corneo and Rob (2001), except I allow for manipulation of the performance measure for individual effort.[3] Specifically, each worker chooses a triple $(x, y, m) \in R^3_+$ where x is the amount of effort devoted to an individual task, y is the amount of effort devoted to a cooperative task, and m is the amount of socially wasteful manipulation of observed individual effort (m is socially wasteful because it does not contribute to the firm's output). The specific way in which the worker can manipulate the performance measure of his individual task will be discussed shortly. The total amount of socially useful effort exerted is then $e := x + y$. Workers' types, θ, are privately observed and drawn from a commonly known distribution H with support $[\underline{\theta}, \overline{\theta}]$, where $-\infty < \underline{\theta} < \overline{\theta} < \infty$. A type-$\theta$ worker seeks to maximize his utility,

$$u := w - c(x + y) - d(m, \theta) + g(y, \theta),$$

where w is the wage, $c(x + y)$ is the disutility of total useful effort, $d(m, \theta)$ is the disutility of individual performance manipulation, and $g(y, \theta)$ is the utility from performing the cooperative task. I make the following assumptions on the utility function of each worker.

Assumption 1 *(i)* $c(\cdot)$ *is twice continuously differentiable with* $c' > 0, c'' > 0, c(0) = c'(0) = 0$, *and* $c'(\infty) = \infty$.

(ii) $d(\cdot, \cdot)$ *is twice continuously differentiable with* $d(0, \theta) = 0\ \forall\theta$, $d_2 < 0$ *and* $d_{12} < 0$ $\forall m > 0$, $d_1(0, \theta) = 0$ *and* $d_1(\infty, \theta) = \infty\ \forall\theta$, *and* $d_1 > 0, d_{11} > 0$.

(iii) $g(\cdot, \cdot)$ *is twice continuously differentiable with* $g(0, \theta) = 0\ \forall\theta$, $g_2 > 0$ *and* $g_{12} > 0$ $\forall y > 0$, $g_1(0, \theta) = \infty$ *and* $g_1(\infty, \theta) = 0\ \forall\theta$, *and* $g_1 > 0, g_{11} < 0$.

In particular, these assumptions imply that for every worker, useful total effort and wasteful manipulative effort are both increasingly costly, in absolute levels and on the margin. A higher type worker experiences larger gains from cooperative effort and those gains are larger on the margin as well. Utility from cooperative effort is increasing in and exhibits diminishing returns in the amount of cooperative effort. Finally, manipulating individual effor is less costly for higher type workers both in absolute levels and on the margin.[4]

[3] To make transparent the differences between this paper and that of Corneo and Rob, I will keep with their notation whenever possible.

[4] For example, workers with higher $\theta's$ are more capable at everything they do, be it cooperating or shirking. Alternatively, d_2 and d_{12} might both be positive, i.e., workers who derive more utility from cooperation also experience more disutility from performance manipulation. This alternative assumption implies Assumption 2(i) and hence stronger private incentives.

Firms are unable to observe the workers' types. Each firm's production technology is characterized by a production function f such that $f(x(\theta), y(\theta))$ units of output is produced when a type-θ worker chooses $(x(\theta), y(\theta), m(\theta))$. (It is assumed that public and private firms have the same production technology, for otherwise differences in incentives may simply be attributed to technological differences.) It is natural to assume that both individual and cooperative effort are productive in the sense that $f_x > 0$ and $f_y > 0$. The firm's total output is

$$Z := \int f(x(\theta), y(\theta)) dH(\theta).$$

A worker's choice of cooperative effort is uncontractible because it is either unobservable to the firm or not verifiable to a court. This is a reasonable assumption since it is often very difficult to disentangle the individual contributions to a group project. As in Holmstrom (1999), the firm's observation of individual effort is subject to manipulation in the sense that only $\hat{x}(\theta) := x(\theta) + m(\theta)$ is verifiable (and hence contractible) but neither $x(\theta)$ nor $m(\theta)$ individually. For example, in an computer software company, x might represent the amount of time a programmer devotes to programming (in solitude), where as m might represent the amount of time that he spends chatting with friends online. Since both activities involve typing on the keyboard, a supervisor who makes cursory inspections of workers at their cubicles would only be able to determine the total number of hours a worker spends at his work station $(x + m)$ and find it difficult to determine exactly how many hours of programming was completed.

Therefore, the wage offered by the firm is assumed to only depend on $\hat{x}$:

$$w(\theta) = b + a\hat{x}(\theta) = b + a[x(\theta) + m(\theta)],$$

where a is the piece rate or "incentive intensity" and b is the base salary. The restriction to linear compensation schemes can be justified by reasons such commonality and administrative tractability. Alternatively, linear incentives might be the result of a (more complex) environment in which there is noise, risk aversion, and dynamic production, as demonstrated by Holmstrom and Milgrom (1987).

To summarize, the timing is as follows.

1. Each worker privately observes his realization of θ.
2. Each firm offers the workers a single contract (a, b).
3. Each worker accepts or rejects the contract.
4. Conditional on acceptance, each worker chooses (x, y, m) (which, in general, depend on θ and (a, b)).
5. Payoffs are realized.

The distinction between private and public firms, both risk neutral, is the objective of the firm. A private firm chooses its wage policy (a, b) to maximize profits,

$$\Pi = Z - \int w(\theta) dH(\theta),$$

where the unit price of output is normalized to one. On the other hand, a public firm chooses its wage policy to maximize social welfare, S, defined in terms of profits and the utility of its workers:

$$S = \Pi + \int u(\theta) dH(\theta),$$

where $u(\theta)$ is the indirect utility of a type-θ worker. This objective function is commonly used in the public economics literature, e.g., Laffont and Tirole (1986). One justification for such an objective function is the idea of revolving doors: If the senior managers of public firms include former union leaders, then they are likely to care about the welfare of the workers in addition to profits.

2.1 Workers

A type-θ worker who faces an incentive scheme (a, b) solves the following problem:

$$\max_{(x,y,m) \in R^3_+} \{b + a \cdot [x + m] - c(x + y) - d(m, \theta) + g(y, \theta)\}$$

The first-order necessary conditions for an interior solution are:[5]

$$x \ : \ a = c'(e^*) \tag{1}$$
$$y \ : \ g_1(y^*, \theta) = c'(e^*) \tag{2}$$
$$m \ : \ a = d_1(m^*, \theta) \tag{3}$$

where $e = x + y$. As $c'' > 0$, (1) can be inverted to yield the optimal amount of total useful effort level, $e^*(a)$, which depends on the incentive intensity but not the worker's type. Also, as $g_{11} < 0$, (2) can be inverted to yield the optimal level of cooperative effort, $y^*(a, \theta)$. Then the optimal level of individual effort is $x^*(a, \theta) := e^*(a) - y^*(a, \theta)$. Finally, as $d_{11} > 0$, (3) can be inverted to yield the optimal level of wasteful manipulative effort, $m^*(a, \theta)$.

The following result is essentially the analogous one of Corneo and Rob extended to the present case by allowing for wasteful individual performance manipulation.

Lemma 1 *(i) A higher incentive intensity, a, leads to more total useful effort, less cooperative effort, more individual effort, and more wasteful effort.*

[5] The interiority of the solution follows from primitive assumptions we have made about $g(\cdot, \cdot), c(\cdot)$, and $d(\cdot, \cdot)$.

(ii) Workers with higher types, θ, exert more cooperative effort, less individual effort, and more wasteful effort. Total useful effort remains unchanged.

(iii) For any given wage policy (a, b), indirect utility is increasing in θ.

Proof. (i) Differentiating (1)-(3) with respect to a, we have

$$\frac{\partial e^*}{\partial a} = \frac{1}{c''(e^*)} > 0, \frac{\partial y^*}{\partial a} = \frac{1}{g_{11}} < 0, \frac{\partial x^*}{\partial a} = \frac{\partial e^*}{\partial a} - \frac{\partial y^*}{\partial a} > 0, \text{ and } \frac{\partial m^*}{\partial a} = \frac{1}{d_{11}} > 0.$$

(ii) Differentiating (1)-(3) with respect to θ, we have

$$\frac{\partial e^*}{\partial \theta} = 0, \frac{\partial y^*}{\partial \theta} = \frac{-g_{12}}{g_{11}} > 0, \frac{\partial x^*}{\partial \theta} = \frac{\partial e^*}{\partial \theta} - \frac{\partial y^*}{\partial \theta} < 0, \text{ and } \frac{\partial m^*}{\partial \theta} = \frac{-d_{12}}{d_{11}} > 0.$$

(iii) For any given wage policy (a, b), maximized utility, with its dependence on (a, b) suppressed, can be written as

$$u(\theta) := b + a \cdot [x^*(a, \theta) + m^*(a, \theta)] - c(e^*(a)) - d(m^*(a, \theta), \theta) + g(y^*(a, \theta), \theta).$$

Therefore, using equations (1)-(3) again and parts (i)-(ii) above,

$$u'(\theta) = a \cdot [x_2^*(a, \theta) + m_2^*(a, \theta)] - d_1 m_2^*(a, \theta) - d_2 + g_1 y_2^*(a, \theta) + g_2 = -d_2 + g_2 > 0$$

■

2.2 Firms

In order for a worker to accept a wage offer (a, b) (from either a public or private firm), he must obtain at least his reservation utility, which is normalized to be zero. By Lemma 1, u is increasing in θ. Therefore, a firm need only to be concern with the participation of the lowest type worker.

A private firm maximizes its profits, which can be shown to be decreasing in the worker's utility $u(\theta)$, so it chooses the base rate b to be the lowest possible level which is consistent with participation indifference of the lowest type worker:[6]

$$u(\underline{\theta}) = 0 \Rightarrow b = c(e^*(a)) + d(m^*(a, \underline{\theta}), \underline{\theta}) - g(y^*(a; \underline{\theta}), \underline{\theta}) - a[x^*(a, \underline{\theta}) + m^*(a, \underline{\theta})].$$

Therefore, the total wages paid is:

$$\begin{aligned} & \int \{b + a[x^*(a, \theta) + m^*(a, \theta)]\} dH(\theta) \\ = \; & c(e^*(a)) + d(m^*(a, \underline{\theta}), \underline{\theta}) - g(y^*(a, \underline{\theta}), \theta) \\ & -a \int [x^*(a, \underline{\theta}) - x^*(a, \theta)] dH(\theta) - a \int [m^*(a, \underline{\theta}) - m^*(a, \theta)] dH(\theta) \\ = \; & : W(a). \end{aligned} \tag{4}$$

[6]It is assumed that the both firms find it profitable to hire all types of workers.

Let $G(a) := \int f(x^*(a,\theta), y^*(a,\theta))dH(\theta)$ denote the firm's output when it provides incentive intensity a and workers respond optimally. Then, we can write the private firm's objective as

$$\Pi(a) = G(a) - W(a) \tag{5}$$

The public firm's objective can be written as

$$\begin{aligned} & G(a) - \int \{b + a[x^*(a,\theta) + m^*(a,\theta)]\} dH(\theta) + \int u(\theta) dH(\theta) \\ = \; & G(a) - c(e^*(a)) + \int [g(y^*(a,\theta),\theta) - d(m^*(a,\theta),\theta)] dH(\theta) \\ = \; & : S(a). \end{aligned} \tag{6}$$

The public firm maximizes $S(a)$ with respect to (a, b), subject to the participation constraints

$$u(\theta) = b + a \cdot [x^*(a,\theta) + m^*(a,\theta)] - c(e^*(a)) - d(m^*(a,\theta),\theta) + g(y^*(a,\theta),\theta) \geq 0, \forall \theta \in [\underline{\theta}, \overline{\theta}]. \tag{7}$$

Thus, it is optimal for the public firm to choose the incentive intensity a to maximize (6) and then set the base salary b so that (7) is satisfied.[7]

3 Main Results

The subsequent analysis will be aided by one of the following two mutually exclusive assumptions.

Assumption 2 *Suppose either (i)* $-\frac{g_{12}(y,\theta)}{g_{11}(y,\theta)} > -\frac{d_{12}(m,\theta)}{d_{11}(m,\theta)}$ *or (ii)* $-\frac{g_{12}(y,\theta)}{g_{11}(y,\theta)} < -\frac{d_{12}(m,\theta)}{d_{11}(m,\theta)}$.

Assumption 2(i) says that workers differ more in their preference for cooperation than in their aversion to individual performance manipulation. Assumption 2(ii) has the opposite analogous interpretation. To better understand the interpretation of these assumptions, see the remark that follows the proof of the proposition.

Proposition 1 *Assume* $\Pi(a)$ *and* $S(a)$ *are continuously differentiable, and* $\Pi(a)$ *is strictly concave.*[8] *Let* a^{pr} *and* a^{pu} *denote the maximizers of* Π *and* S*, respectively. Then, given Assumption 2(i) (Assumption 2(ii)):*

(i) The incentive intensity of the private firm's optimal wage policy is higher (lower) than that of the public firm's optimal wage policy: $a^{pr} > a^{pu} (a^{pr} < a^{pu})$.

[7] Since the base rate b cancels out from the public firm's objective function $S(a)$, any b which satisfies (7) is optimal.

[8] Strict concavity of $\Pi(a)$ can be assured if we make further primitive assumptions on the the curvatures of the functions f, g, c, and d.

(ii) Total useful effort is higher (lower) in the private firm.

(iii) Cooperation among workers is higher (lower) in the public firm.

(iv) Total wasteful manipulative effort is higher (lower) in the private firm.

Proof. We prove Part (i); parts (ii)-(iv) then follow from Lemma 1(i). Using (4)-(6), we have

$$\begin{aligned}
\Delta(a) \quad : \quad & = \Pi(a) - S(a) \\
= \quad & [G(a) - W(a)] - \left[G(a) - c(e^*(a)) + \int [g(y^*(a,\theta),\theta) - d(m^*(a,\theta),\theta)]dH(\theta)\right] \\
= \quad & -W(a) + c(e^*(a)) - \int [g(y^*(a,\theta),\theta) - d(m^*(a,\theta),\theta)]dH(\theta) \\
= \quad & g(y^*(a,\underline{\theta}),\underline{\theta}) - d(m^*(a,\underline{\theta}),\underline{\theta}) + a\int [x^*(a,\underline{\theta}) - x^*(a,\theta)]dH(\theta) \\
& -a\int [m^*(a,\theta) - m^*(a,\underline{\theta})]dH(\theta) - \int [g(y^*(a,\theta),\theta) - d(m^*(a,\theta),\theta)]dH(\theta) \\
= \quad & a\int [y^*(a,\theta) - y^*(a,\underline{\theta})]dH(\theta) - \int [g(y^*(a,\theta),\theta) - g(y^*(a,\underline{\theta}),\underline{\theta})]dH(\theta) \\
& + \int d(m^*(a,\theta),\theta) - d(m^*(a,\underline{\theta}),\underline{\theta})]dH(\theta) - a\int [m^*(a,\theta) - m^*(a,\underline{\theta})]dH(\theta)
\end{aligned}$$

where the last equality follows from using the identity $e^* = x^* + y^*$ to replace x^* by y^*.

Thus, using (1)-(3),

$$\begin{aligned}
\Delta'(a) \quad = \quad & \int [y^*(a,\theta) - y^*(a,\underline{\theta})]dH(\theta) + a\int [y_1^*(a,\theta) - y_1^*(a,\underline{\theta})]dH(\theta) \\
& - \int [\underbrace{g_1(y^*(a,\theta),\theta)}_{a} y_1^*(a,\theta) - \underbrace{g_1(y^*(a,\underline{\theta}),\underline{\theta})}_{a} y_1^*(a,\underline{\theta})]dH(\theta) \\
& + \int [\underbrace{d_1(m^*(a,\theta),\theta)}_{a} m_1^*(a,\theta) - \underbrace{d_1(m^*(a,\underline{\theta}))}_{a} m_1^*(a,\underline{\theta})]dH(\theta) \\
& -a\int [m_1^*(a,\theta) - m_1^*(a,\underline{\theta})]dH(\theta) - \int [m^*(a,\theta) - m^*(a,\underline{\theta})]dH(\theta) \\
= \quad & \int [y^*(a,\theta) - y^*(a,\underline{\theta})]dH(\theta) - \int [m^*(a,\theta) - m^*(a,\underline{\theta})]dH(\theta). \qquad (8)
\end{aligned}$$

Notice that both integrals are strictly positive ($y_2^* > 0$ and $m_2^* > 0$). If Assumption 2(i) holds, then, recalling the proof of Lemma 1(ii), we have

$$\begin{aligned}
\frac{d}{d\theta}\{y^*(a,\theta) - m^*(a,\theta)\} \quad = \quad & y_2^*(a,\theta) - m_2^*(a,\theta) = -\frac{g_{12}(y^*,\theta)}{g_{11}(y^*,\theta)} + \frac{d_{12}(m^*,\theta)}{d_{11}(m^*,\theta)} > 0 \\
\Rightarrow \quad & y^*(a,\theta) - m^*(a,\theta) > y^*(a,\underline{\theta}) - m^*(a,\underline{\theta}) \\
\Rightarrow \quad & y^*(a,\theta) - y^*(a,\underline{\theta}) > m^*(a,\theta) - m^*(a,\underline{\theta})
\end{aligned}$$

for all $\theta > \underline{\theta}$. Therefore, the first integrand in (8) is strictly greater than the second integrand, and so $\Delta'(a) > 0$. Similarly, if Assumption 2(ii) were satisfied instead, then $\Delta'(a) < 0$. Thus, because a^{pu} maximizes $S(a)$ and a^{pr} maximizes $\Pi(a) = S(a) + \Delta(a)$, we have

$$\Pi'(a^{pr}) = S'(a^{pr}) + \Delta'(a^{pr}) = 0 = S'(a^{pu}) = \Pi'(a^{pu}) - \Delta'(a^{pu}) < (>)\Pi'(a^{pu})$$

so that $a^{pr} > a^{pu}$ ($a^{pr} < a^{pu}$) by the strict concavity of Π. ■

Remark 1 *In light of the dependence of the sign of expression (8) on whether case (i) or (ii) of Assumption 2 holds, it makes sense to interpret Assumption 2 as a statement about the relative heterogeneity in the workers' preference for cooperation (as expressed by the first integral in (8)) and their aversion to (or propensity for) individual performance manipulation (which is captured by the second integral in (8)).*

The intuition for the result that $a^{pr} > a^{pu}$ is straightforward. The private firm seeks to maximize profits alone while the public firm also cares about the well-being of its workers, i.e. their informational rents. Because workers earn informational rents on the cooperative task y, the private firm chooses a higher incentive intensity a in order to induce higher x and lower y, thus minimizing rents.[9] Alternatively, the public firm chooses a lower a precisely because that leads to lower x and higher y, thus generating more rents for its workers, something about which only the public firm cares (to maximize). Notice that this reasoning implicitly assumes the savings in workers' rents for the the private firm from a larger a are sufficient to outweigh the greater individual performance manipulation that is induced by a stronger incentive intensity, or that the gains in rents for the public firm from a smaller a are large enough to outweigh the production loss from lower individual effort. In other words, this argument assumes that workers differ more in their preference for cooperation than in their aversion to individual performance manipulation, i.e., Assumption 2(i).

If the reverse were true, i.e., Assumption 2(ii), then we find that $a^{pr} < a^{pu}$, which is also not surprising. When workers differ less in their preference for cooperation than in their aversion to individual performance manipulation, the private firm substitutes cooperative effort for individual effort: it chooses a lower incentive intensity a in order to induce lower x (thus avoiding costly individual performance manipulation by workers) and consequently higher y. The public firm, on the other hand, prefers to substitute away from cooperative effort and toward individual effort: it chooses a higher a because the concern for workers' rent from cooperative effort is diminished by the lack of heterogeneity in workers' tastes for

[9] Note that $\Delta(a) = \Pi(a) - S(a) = -\int u(\theta)dH(\theta)$, so increasing $\Delta(a)$ decreases workers' informational rents. When Assumption 2(i) holds, $\Delta(\cdot)$ is strictly increasing. Therefore, the private firm chooses a higher a so that $\Delta(a)$ is higher and hence workers' rents are lower.

cooperation.[10,11]

Notice that Proposition 1(iii) implies that the corporate culture in public firms could be more or less cooperative than that of private firms, depending on whether Assumption 2(i) or 2(ii) is satisfied.

The next result illustrates how incentive differences between public and private firms translate into differences in output.

Proposition 2 *Assumption 2(ii) implies that the public firm has higher output than the private firm:* $Z^{pu} > Z^{pr}$.[12,13]

Proof. By Proposition 1(i), Assumption 2(ii) implies $a^{pu} > a^{pr}$. If $Z^{pu} \leq Z^{pr}$, then the public firm can lower its piece rate from a^{pu} to a^{pr}, thereby increasing its output (from Z^{pu} to Z^{pr}) and lowering its wage bill. To see that this indeed increases the public firm's objective

[10] Another perspective on the first result of this proposition is as follows. Workers obtain informational rents through effort exerted in both the cooperative task (y) and in manipulating the individual performance measure (m). Each of these two types of rents is greater when there is more heterogeneity among workers' preferences with respect to that dimension of effort. A firm's choice of incentive intensity is then chosen optimally to reflect its (dis)regard for workers' rents. The private firm wishes to minimize workers rents, where as the public firm wishes to maximize workers' rents (and profits).

When Assumption 2(i) (Assumption 2(ii)) is satisfied, workers are more (less) heterogeneous in their preference for cooperation than in their aversion to individual performance manipulation, and therefore earn more (less) rents through cooperative effort than individual performance manipulation. Thus, for example when Assumption 2(ii) is satisfied, the rent-minimizing private firm has a greater concern for reducing individual performance manipulation than inducing greater individual effort (and hence less cooperative effort). It accomplishes this by choosing weaker incentives (for the individual task). Under Assumption 2(ii), the public firm finds it more efficient to give informational rents to its workers by allowing performance manipulation than inducing cooperative effort, and so it chooses stronger (individual) incentives in this case. (This also provides a possible explanation for why public firms may rationally tolerate more performance manipulation than private firms.)

[11] In fact, the finding that public incentives are stronger than private ones is supported with the following simpler model. Remove cooperative effort from the model so that the worker's utility is given by $u = b + a(x+m) - c(x) - d(m,\theta)$, where $c(\cdot)$ and $d(\cdot)$ are as before. (This model can be thought of as the limit of $\frac{d_2}{g_2}, \frac{d_{12}}{g_{12}} \to \infty$.) Then, it's easy to show that $\Delta'(a) = -\int [m^*(a,\theta) - m^*(a,\underline{\theta})] dH(\theta) < 0$, and so concavity of $\Pi(\cdot)$ implies $a^{pu} > a^{pr}$. (This result is analogous to the one obtained by Corneo and Rob in their alternative model with private information on cost of effort.) However, the point here is that when workers have private information about more than one aspect of their preferences, it may still be the case that public incentives are stronger than private ones.

[12] This result also holds when we remove cooperative effort from the model; see the footnote above.

[13] It is not clear that the analogous result, $Z^{pr} > Z^{pu}$, can be established in the environment of this paper. Evidently, from Proposition 2, Assumption 2(i) is necessary if $Z^{pr} \geq Z^{pu}$ is to hold, and so $a^{pr} > a^{pu}$ by Proposition 1. Then, assuming $Z^{pr} < Z^{pu}$ (for the sake of contradiction) would imply $G'(a) < 0$. Next, we want to argue that the private firm can increase its objective, $\Pi(a) = G(a) - W(a)$, by lowering its piece-rate from a^{pr} to a^{pu}. So we want to show that $\Pi'(a) < 0$. Now $\Pi'(a) = G'(a) - W'(a) \leq -W'(a)$. But it is easy to show that $W'(a) = \phi - \rho$ where $\phi = a\int [x_1^*(a,\theta) + m_1^*(a,\theta)] dH(\theta)$ and $\rho = \int \{[x^*(a,\underline{\theta}) - x^*(a,\theta)] + [m^*(a,\underline{\theta}) - m^*(a,\theta)]\} dH(\theta)$. Lemma 1 implies $\phi > 0$, but Assumption 2(i) implies $\rho > 0$ as well. Thus the sign of $W'(a)$, and hence $\Pi'(a)$, is not clearly determined.

$S(a)$, we differentiate (6) to get

$$S'(a) = G'(a) - c'(e^*(a))e^{*\prime}(a) + \int [g_1(y^*(a,\theta),\theta)y_1^*(a,\theta) - d_1(m^*(a,\theta),\theta)m_1^*(a,\theta)]dH.$$

Since $Z^i := G(a^i), \forall i \in \{pu, pr\}$, $Z^{pu} \leq Z^{pr}$ would imply that $G'(a) \leq 0$. Then, because Lemma 1(i) implies that all other terms in $S'(a)$ are negative, we have $S'(a) < 0$, so that the public firm can do better by choosing a^{pr} than a^{pu}. ■

This result is another difference between this paper and Corneo and Rob (2001), for they show that the public firm is *less* productive than the private firm if either $G(a)$ or $W(a)$ is increasing over (a^{pu}, a^{pr}).

4 Different Performance Manipulation Costs

As an application of the previous analysis, consider the following scenario. Suppose that the costs associated with manipulating the individual performance measure in private and public firms are different. In particular, assume that it is less costly for public firm workers to manipulate individual performance, or more difficult for the public firm to measure individual performance. (For example, think of the United States Postal Service (USPS) versus United Parcel Service (UPS).) These differences in disutility of manipulative effort can be readily interpreted as greater ease in taking credit for other people's work as one's own in the public sector, or greater ease in getting away with individual performance manipulation in the public sector.[14]

In this scenario, it is reasonable to expect the public firm to offer weaker incentives. We show that this is indeed the case when workers differ less in their aversion to individual performance manipulation than in their preference for cooperation.

Suppose that a type-θ worker who exerts m units of effort manipulating the individual performance measure experiences a disutility of $d^{pu}(m,\theta)$ if he works in the public firm and $d^{pr}(m,\theta)$ if he works in the private firm.

Assumption 3 *Suppose we have* $\forall(m,\theta)$, $(i) : d_1^{pu}(m,\theta) < d_1^{pr}(m,\theta)$ *and* $(ii) : d_{11}^{pu}(m,\theta) < d_{11}^{pr}(m,\theta)$.

That is, it is more costly (on the first and second order) to manipulate the individual performance measure in the private firm than in the public firm. Then the following two results obtain.

Lemma 2 *Assumption 3(i) implies that public firm workers exert more effort in manipulating the individual performance measure than do private firm workers.*

[14] For example, the public firm might have a lower probability of detecting performance manipulation, or the private firm might impose a harsher punishment for detection of performance manipulation.

Proof. By Assumption 3(i), and the first-order conditions for the optimal levels of m for workers in the public and private firms, we have

$$d_1^{pr}(m^{pu}(a,\theta),\theta) > d_1^{pu}(m^{pu}(a,\theta),\theta) = a = d_1^{pr}(m^{pr}(a,\theta),\theta).$$

Therefore, $d_{11}^{pr}(m,\theta) > 0$ implies $m^{pu}(a,\theta) > m^{pr}(a,\theta)$ for all θ, i.e., a worker of any type would exert more effort manipulating his individual performance measure if he works in a public firm than if he works in a private firm (for any level of incentives a). ■

The above result is actually not necessary to establish the next Proposition, but it is useful in providing some intuition.

Proposition 3 *Assume $\Pi(a)$ and $S(a)$ are continuously differentiable, and $\Pi(a)$ is strictly concave. Then Assumption 2(i) and Assumption 3(ii) imply that the public firm offers weaker incentives than the private firm.*

Proof. The proof is very similar to that of Proposition 1. First, notice that because public and private firm workers do not differ in their cost of total effort ($c(x+y)$) or utility from cooperation ($g(y,\theta)$), the choices of x and y for any worker will be independent of what type of firm he works in. Therefore, keeping in mind the different costs of individual performance manipulation in public and private firms, (4)-(6) implies

$$\begin{aligned}
\Delta(a) &= \Pi(a) - S(a) \\
&= \left[\begin{array}{c} G(a) - c(e(a)) - d^{pr}(m^{pr}(a,\underline{\theta}),\underline{\theta}) + g(y(a,\underline{\theta}),\theta) \\ +a\int[x(a,\underline{\theta}) - x(a,\theta)]dH(\theta) + a\int[m^{pr}(a,\underline{\theta}) - m^{pr}(a,\theta)]dH(\theta) \end{array}\right] \\
&\quad - \left[G(a) - c(e(a)) + \int[g(y(a,\theta),\theta) - d^{pu}(m^{pu}(a,\theta),\theta)]dH(\theta)\right] \\
&= a\int[y(a,\theta) - y(a,\underline{\theta})]dH(\theta) - \int[g(y(a,\theta),\theta) - g(y(a,\underline{\theta}),\underline{\theta})]dH(\theta) \\
&\quad + a\int[m^{pr}(a,\underline{\theta}) - m^{pr}(a,\theta)]dH(\theta) + \int[d^{pu}(m^{pu}(a,\theta),\theta) - d^{pr}(m^{pr}(a,\underline{\theta}),\underline{\theta})]dH(\theta).
\end{aligned}$$

As before, we can use the facts that $g_1(y(a,\theta),\theta) = g_1(y(a,\underline{\theta}),\underline{\theta}) = a, \forall(a,\theta)$ and $d_1^{pu}(m^{pu}(a,\theta),\theta) = d_1^{pr}(m^{pr}(a,\underline{\theta}),\underline{\theta}) = a, \forall(a,\theta)$ to write $\Delta'(a)$ as follows:

$$\Delta'(a) = \int\{[y(a,\theta) - y(a,\underline{\theta})] - [m(a,\theta) - m(a,\underline{\theta})]\}\,dH(\theta) + a\int[m_1^{pu}(a,\theta) - m_1^{pr}(a,\theta)dH(\theta).$$

Recall from the proof of Proposition 1 that Assumption 2(i) implies the first term above is strictly positive. Because $m_1^i = 1/d_{11}^i$ for $i \in \{pu, pr\}$, Assumption 3(ii) implies the second term is also strictly positive. Hence $\Delta'(a) > 0$, and so exactly the same concavity argument as in the proof of Proposition 1 implies $a^{pr} > a^{pu}$. ■

The intuition for Proposition 3 is as straightforward. The private firm can afford to offer stronger incentives because it realizes that its workers find it more costly to manipulate

their individual performance measure, and therefore, as Lemma 2 shows, they engage in such activities to a lesser degree than workers in the public firm. The way in which Assumption 2(i) contributes to the stronger private incentives is exactly as before. If there is greater worker heterogeneity in their preference for cooperation than in their aversion to individual performance manipulation, then the savings in workers' rents for the private firm from a larger a are sufficient to outweigh the greater individual performance manipulation that is induced by a stronger incentive intensity.

As a final comment, notice that we could just as well have assumed that $d_{11}^{pu} > d_{11}^{pr} > 0$, i.e., it is more costly to manipulate the individual performance measure in the public firm than in the private firm. Then, Assumption 2(ii) would have implied that $\Delta'(a) < 0$ and hence $a^{pu} > a^{pr}$. But casual observation suggests that it is easier to shirk (i.e., manipulate the individual performance measure) in public firms (e.g., government agencies) than in private firms, and so the result of Proposition 3 seems more plausible.

5 Conclusion

5.1 Summary

In this paper, we have shown that the traditional result of worker incentives being weaker in the public sector than the private sector may not be robust to the multiple ways in which workers can obtain rents from their private information. While either stronger private incentives or stronger public incentives can be consistent with firms' optimizing behavior, which sector in fact offers the stronger incentives will depend on the how workers' preferences differ with respect to their private information.

The relative strengths of incentives in public and private firms hinges on the amount of heterogeneity among workers' preference for cooperation and aversion to individual performance manipulation. If workers differ more in their preference from cooperation than in their aversion to individual performance manipulation, then we get the traditional result that private firms offer higher-powered incentives than public firms. The reverse is true, however, if workers differ more in their aversion to individual performance manipulation than in their preference for cooperation. In particular, this implies that corporate culture could be *more* cooperative in private firms than in public firms. Also, under this latter assumption, public firms produce more output than private firms. Finally, private incentives are likely to be stronger if (i) the costs of individual performance manipulation are higher in the private firm and (ii) workers are more heterogeneous with respect to their preference for cooperation than their aversion to individual performance manipulation.

In conclusion, the following lesson is evident from this paper.

Summary 1 *Even when workers' private information is one-dimensional, it may affect how rents are obtained via* ***multiple*** *activities that the workers undertake. In such situations,*

the relative degrees of heterogeneity in how these activities affect workers' preferences is crucial in determining how public firms incentivize its workers relative to private firms. In particular, public firms may offer stronger incentives than private firms under certain plausible conditions.

5.2 Criticisms

Many shortcomings of the models in this paper are evident, and a few of them are listed below. First, it is restrictive to assume that the worker's utility function is of a form that is additively separable in wages, cost of total useful effort, cost of performance manipulation, and cooperative utility. Secondly, firms in real life do not each offer a single contract (a, b) to all workers, but instead screens its workers to some degree with a menu of contracts. Thirdly, it is not clear how to empirically test whether Assumption 2(i) or 2(ii) holds.

Fourthly, and perhaps most obviously, is the very reasonable criticism is that the results of this paper seem to hinge on the particular objective functions specified for the two types of firms. Certainly, more justification is needed for why public firms maximize the sum of profits and workers rents, if that's what they really do.[15] Ultimately, one would like to provide a better foundation for what distinguishes public firms from private firms.

5.3 Alternative Explanations

I have thus far taken the simplistic view of corporate culture as simply the amount of "cooperative effort" exerted by the workers. There are, needless to say, many other possible ways of modeling corporate culture. For example, we could allow for workers to derive higher utility from cooperation in the private sector than public sector. If corporate culture is stronger in a private firm or it is better aligned among the workers of a private firm, then the private firm's workers should have more non-monetary motives to exert effort than public sector workers. The private firm might then be able to offer *weaker* incentives (for individual effort) than public firms, and as a result, possibly *more* cooperation arises in the private firm than in the public firm. However, this result should be derived from more fundamental concepts of corporate culture (e.g., corporate culture as the shared beliefs among the workers of a firm; see Van den Steen (2003)), instead of simply assuming differences in the cooperative utility function g.

Incentives differences in public and private firms can also be interpreted in a moral hazard context as follows. Suppose each worker i exerts only one type of effort, x_i, which stochastically affects his contribution to firm output, q_i. Let $F(q_i|x_i)$ be the conditional CDF of worker $i's$ contribution to firm output when he exerts effort x_i. Denote by $\sigma^2_{q|x}$ the

[15] Two particularly relevant papers are Erus and Weisbrod (2003) and Roomkin and Weisbrod (1999), which contain informative discussions of these issues in the context of the hospitals industry.

variance of the signal q conditional on x. From Holmstrom and Milgrom (1991), we know that the optimal piece rate is inversely related to σ^2. Therefore, if working in private firms is more risky than in public firms, in the sense that σ^2 is higher in the private firm, then we would once again expect to see weaker incentives in the private firm than in the public firm.

Dynamic implications of the model in this paper is yet another possible topic for future research. More specifically, we could apply Rob and Zemsky (2002)'s model of how corporate culture evolves over time to the static setup of this paper to model the dynamics of corporate culture and see how it differs in public versus private firms. Do the static results of Propositions 1 and 2 still hold in a dynamic environment? One conjecture is as follows. Suppose private firms are short-sighted and place greater emphasis on short run profits where as public firms care about long run profits. If individual effort drives short run profits where as cooperative effort is essential for long term profitability, then we might expect private firms to offer stronger incentives (for individual effort) and exhibit less cooperation than public firms, and make higher short run profits but lower long run profits than public firms.

In addition, the theory of career concerns becomes relevant when multiple periods are considered. According to this theory, even if current explicit incentives are weak, a worker might still be motivated to exert effort if good performance today improves tomorrow's available contracts. For example, private sector workers might care more about their future employment prospects than public sector workers.[16] If this is the case, then we should expect to see weaker (explicit) incentives in the private sector. See Dewatripont, Jewitt, and Tirole (1996)a&b for more in-depth discussion.

Finally, recall from the introductory paragraph that part of my original intent was to capture an implication in the reverse direction, namely, that differences in corporate culture might explain differences in incentives. One direction for future research is to pursue this conjectured implication, while possibly synthesizing the disparate views of corporate culture in the process.

Most importantly, what must be addressed in the future is the more fundamental question of *what really differentiates public firms from private firms?* This paper questions the robustness of the result that public incentives are always weaker by shedding light on the workers' multiple channels of rent acquisition. But it does not provide a framework for analyzing the factors that underlie the existing differences among different firm ownership structures. Why don't public firms simply replicate what private firms do?[17] If public firms face additional constraints that are not relevant to private firms, then modeling these differences between public and private firms (and their underlying causes) will likely shed more light on the reasons for incentives differences.[18]

[16] Think once again of the USPS versus UPS example.

[17] For example, if workers really find it easier to shirk in public firms than private firms, why don't public firms invest in better monitoring technologies?

[18] See, for example, Roomkin and Weisbrod (1999) for a discussion of the non-distribution constraint that are faced by nonprofit firms.

References

[1] Baker, George, (2000). "Distortion and Risk in Optimal Incentive Contracts." Forthcoming in *Journal of Human Resources*.

[2] Burgess, S. and Metcalfe, P., (1999). "The Use of Incentive Schemes in the Public and Private Sectors: Evidence from British Establishments." CMPO Working Paper Series No. 00/15.

[3] Corneo, G. and Rob, R., (2001). "Working in Public and Private Firms." PIER Working Paper 02-033.

[4] Delfgaauw, J. and Dur, R.A.J., (2002). "From Public Monopsony to Competitive Market: More Efficiency but Higher Prices." Working Paper, Tinbergen Institute, Erasmus University, Rotterdam.

[5] Dewatripont, M., Jewitt, I., and Tirole, J., (1996)a. "The Economics of Career Concerns, Part I: Comparing Information Structures." *Review of Economic Studies*, Vol. 66, pp. 183-198.

[6] Dewatripont, M., Jewitt, I., and Tirole, J., (1996)b. "The Economics of Career Concerns, Part II: Application to Missions and Accountability of Government Agencies." *Review of Economic Studies*, Vol. 66, pp. 199-217.

[7] Dixit, A., (1997). "Power of Incentives in Public vs Private Organizations." *American Economic Review Papers and Proceedings*, Vol. 87, No. 2, pp. 378-382.

[8] Dixit, A., (2002). "Incentives and Organizations in the Public Sector: An Interpretative Review." *Journal of Human Resources*, Vol 37, No. 4, pp. 696-727.

[9] Erus, Burcay and Weisbrod, Burton A., (2003). "Objective Functions and Compensation Structures in Nonprofit and For-Profit Organizations: Evidence from the 'Mixed' Hospital Industry." Forthcoming in *The Governance of Not-for-Profit Firms*, ed. Edward Glaeser, University of Chicago Press.

[10] Holmstrom, B., (1999). "The Firm as a Subeconomy." *Journal of Law, Economics, and Organization*, Vol. 15 No. 1, pp. 74-102.

[11] Holmstrom, B. and Milgrom, P., (1987). "Aggregation and Linearity in the Provision of Intertemporal Incentives." *Econometrica*, Vol 55, pp. 303-328.

[12] Holmstrom, B. and Milgrom, P., (1991). "Multitask Principal-Agent Analysis: Incentive Contracts, Asset Ownership and Job Design." *Journal of Law, Economics, and Organization*, Vol. 7, pp. 24-52.

[13] Itoh, H., (1991). "Incentives to Help in Multi-Agent Situations." *Econometrica*, Vol 59, pp. 611-636.

[14] Laffont, J. and Tirole, J., (1986). "Using Cost Observation to Regulate Firms." *Journal of Political Economy*, Vol. 94, No. 3, pp. 614-641.

[15] Rob, R. and Zemsky, P., (2002). "Social Capital, Corporate Culture, and Incentive Intensity." *RAND Journal of Economics*, Vol. 33 No. 2, pp. 243-257.

[16] Roomkin, Myron and Weisbrod, Burton A., (1999). "Managerial Compensation and Incentives in For-Profit and Nonprofit Hospitals." *Journal of Law, Economics, and Organization*, Vol. 15, No. 3, pp. 750–781.

[17] Van den Steen, E., (2003). " On the Origin and Evolution of Corporate Culture." Working Paper, MIT-Sloan.

[18] Wilson, J.Q., (1989). *Bureaucracy: What Government Agencies Do and Why They Do It,* New York, Basic Books.