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"Working in Public and Private Firms"

by

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Working in Public and Private Firms[1]

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Summary

We develop a theoretical framework for comparing incentives, labor productivity and the allocation of effort in public versus private enterprises. We incorporate "socializing", an activity which yields utility for workers and affects a firm's output, into a multitask model of work organization. We establish the two following results. First, the optimal workers' compensation policy displays a larger incentive intensity in the private firm than in the public firm. Second, labor productivity in the private firm may be higher or lower than in the public firm. Both results fit well with the findings of empirical work.

Keywords: Public enterprise, privatization, incentive schemes.

JEL-Classification: L32, L33.

1 Introduction

In political debates and in the popular press, privatization is typically praised as "increasing work incentives" and "increasing productivity." Behind those claims one often finds a property-rights argument à la Alchian and Demsetz (1972): Since, in the case of the public firm, profits belong to "no one," nobody cares about its efficiency. Thus, the public firm is more lax with its workers, which results in lower productivity.

On second reflection, though, it is not so clear why the public firm has fewer reasons to use the instrument that raises productivity in private firms, namely, stricter incentives and, therefore, why one might expect to see any productivity differences between public and private firms. Is the efficient level of worker effort not equally desirable in a public firm? Might the public firm not be able to deliver more to its workers, or to customers of its product, or to taxpayers by raising productivity? Is the manager of the public firm not subject to scrutiny by the popular press, by political authorities, or by the desire to be promoted to more prestigious positions, to the extent that he might not try to deliver productivity gains? In short, the fact that a firm is publicly-owned is no hindrance to using the same instruments that have proved to raise productivity in private firms.[1]

In fact, theoretical work conducted in agency settings with informational asymmetries shows the exact opposite of what proponents of the property-rights doctrine have claimed: A firm's productivity is *higher* when, on top of maximizing profits, the firm tries to appease its workers and/or consumers of its product. In other words, the welfare-maximizing (public) firm uses stricter incentives and is more productive than the profit-maximizing (private) one. Results in this spirit are reported by Laffont and Tirole (1991) and Roemer and Silvestre (1992), in the context of regulation; Maskin (1992), in the context of auctions; and De Fraja (1993), in the context of managerial compensation.

[1] This view is challenged by Shleifer (1998), who argues that, because contracts are incomplete, private firms cannot be mimicked by public firms. Models along these lines have been studies by Hart *et al.* (1997) and Lülfesmann (1999). A more comprehensive view of the distinguishing features of non-profit organizations can be found in Rose-Ackerman (1996).

What is the empirical evidence on productivity and incentives in public versus private firms? On the one hand, empirical studies uniformly find that the incentive intensity, i.e., the extent to which pay is linked to measured performance (e.g., individual output), is stronger in private firms. For example, Martin and Parker (1997, chapter 9) report that in the cases of British Steel, Rolls-Royce, British Airports Authority, British Airways, British Telecom and the National Freight Corporation, privatization led companies to link pay and promotion more closely to various employee performance measures. On the other hand, empirical studies often find the effect of ownership on firm productivity to be ambiguous. Studies like Atkinson and Halvorsen (1986), Boardman and Vining (1989), Martin and Parker (1997, chapter 5) and Yarrow (1986) suggest that cases exist where private ownership does not lead to productivity gains or is even detrimental to productivity. In sum, one observes that work incentives are stronger, but that firm productivity may or may not be higher under private than under public ownership.

This paper addresses these issues, using a slightly different agency formulation. Like in previous formulations we assume that both firms face the same informational (and technological) constraints. Workers are of different types, firms are able to tailor effort to type only via imperfect incentive schemes and, consequently, workers earn informational rents. Like previous formulations we also assume that the private firm maximizes profits, whereas the public firm maximizes welfare, which consists of profits and workers' utilities. However, in contrast with previous formulations we consider multi-task production, as in Holmstrom and Milgrom (1991) or Itoh (1991), where workers divide effort between two kinds of tasks. One task is labelled "individual," whereas the other task is labelled "cooperative."

These two tasks differ along two dimensions. First, the cooperative task delivers some personal benefit, which the individual task does not. The idea is that workers enjoy social interactions which accompany cooperation, or, that as a by-product of these interactions they acquire skills and knowledge, which they are able to use elsewhere.[2] Second, the

[2] The presence of a cooperative task and the way we characterize it should be familiar to anyone who works in profit or nonprofit organizations. There is a vast social psychology literature that discusses how

individual task is more readily observed than the cooperative task. The idea here is that, since a worker works by himself on the individual task, he can readily document his efforts. On the other hand, since a whole group of workers works on the cooperative task, it is hard to document who did what.[3]

When a firm, be it public or private, increases incentives in this environment two effects are triggered. On the one hand, this raises a worker's total effort. On the other hand, the worker shifts effort from the cooperative task into the individual task.[4] Since effort devoted to the cooperative task delivers informational rents, an increase in the incentive intensity decreases informational rents. This is the exact opposite of what happens in previous formulations, where effort choice is one-dimensional and all effort is dedicated to an individual task. In that case, higher incentive intensity *increases* informational rents.

From this observation the main result of our paper follows. The public firm chooses *weaker* incentives than the private firm. The reason is that the public firm attaches positive weight to workers' rents, and informational rents increase when incentive intensity decreases. In this way our model resolves the "paradox" posed by previous agency formulations of the public versus the private firm - where incentives are weaker in the private firm. In essence, what the addition of a cooperative task does is to reverse the usual tradeoff between effort and informational rents, and, thereby, reverse the ranking of incentives.

We also show that although incentives are stronger in the private firm, productivity need not be higher. That depends on properties of the production function and the distribution over worker types. If the marginal productivity of the cooperative task is especially large or if the distribution over consumer types is sufficiently dispersed (so that workers enjoy large informational rents) the public firm may very well exhibit higher

social interactions affect job satisfaction, see Smith *et al.* (1983), and several empirical assessments of this phenomenon in the economics literature; see, for example, Clark (1996) and Drago and Gravey (1998).

[3] Some empirical and anecdotal evidence in support of this idea is found in the organizational behavior literature; see Deckop *et al.* (1999). Some of Holmstrom and Milgrom (1991)'s results pertain exactly to this scenario, namely, to differential monitoring ability.

[4] The latter follows from the fact that stronger incentives increase the opportunity cost for cooperating since cooperation is unobserved and, hence, not monetarily rewarded, while individual production is observed and monetarily rewarded.

productivity. It is worth stressing, though, that the private firm is always more profitable. This follows "by construction," since the private firm is presumed to maximize profits. Therefore, if the public firm exhibits greater productivity, then it pays higher wages, and the extra wages it pays exceed the extra productivity it derives from its workers. In that sense, the incentive choice of the publicly-owned firm can be construed as "paying too much for productivity."

The paper proceeds as follows. In the next section we set up the model. In section 3 we solve the workers' maximization programs. In section 4 we solve the private and the public firm's program and compare incentive intensities in the two firms. In section 5 we expand our model. Section 6 concludes.

2 The basic model

The firm employs a continuum of workers, whose measure is one. Each worker chooses how much effort, x, to devote to an individual task, and how much effort, y, to devote to a cooperative task. Let e denote the total effort, $e \equiv x + y$.

The objective of each worker is to maximize her utility. Each worker is identified by a type-parameter, θ. The value of θ is private information to the worker, and indexes the utility she gets from cooperation. Let $g(y;\theta)$ denote the utility to a type-θ worker from exerting y units of cooperative effort. We assume that g is twice continuously differentiable, and denote its partial derivatives by g_1, g_{12}, etc. We assume that g satisfies $g(0;\theta) = 0$ for all θ. For strictly positive values of y we assume that both the utility, g, and the marginal utility, g_1, of cooperation are strictly increasing in θ: $g_2, g_{12} > 0$. The function $g(\bullet;\bullet)$ also satisfies $g_1(0;\theta) = \infty$ and $g_1(\infty;\theta) = 0$ for all θ, and is strictly increasing and strictly concave in y: $g_1 > 0 > g_{11}$.

The (overall) utility of a type-θ worker as a function of wage and efforts is:

$$u = w - c(e) + g(y;\theta), \tag{1}$$

where w is the wage, $c(\bullet)$ is the disutility of total effort, and $g(\bullet;\bullet)$ is, as noted, the utility from performing the cooperative task. The function $c(\bullet)$ is twice continuously differentiable, strictly increasing and strictly convex with $c(0) = c'(0) = 0$, and $c'(\infty) = \infty$.

The type-parameter θ is distributed across workers according to the c.d.f. $H(\theta)$. The support of H is $[\underline{\theta}, \overline{\theta}]$ with $-\infty < \underline{\theta} < \overline{\theta} < \infty$. We denote the effort choices of a type-θ worker by $x(\theta)$ and $y(\theta)$, and the effort choices across workers by X and Y, where $X \equiv x(\bullet)$ and $Y \equiv y(\bullet)$, i.e., X is the function $x(\theta)$ as θ varies over $[\underline{\theta}, \overline{\theta}]$.

The firm's production technology is $F(X, Y)$, and the firm's total output is Z:

$$Z = F(X, Y). \tag{2}$$

As discussed in the introduction the firm is unable to monitor the cooperative effort of a worker, but is able to monitor her individual effort. We capture this idea via the assumption that $x(\theta)$ is observed without noise, while $y(\theta)$ is not observed at all.[5]

The firm chooses a linear wage policy, (a, b), meaning the wage it pays its workers consists of a base salary, b, and an effort-related bonus, $ax(\theta)$:

$$w(\theta) = b + ax(\theta), \tag{3}$$

where a is the piece rate, or, the "incentive intensity."

Restricting attention to linear schemes may be justified on administrative or practical grounds, as discussed in detail by Chamley *et al.* (1989). Alternatively, Holmstrom and Milgrom (1987) have shown that the optimal incentive contract in an environment with risk aversion, noise, and dynamic production boils down to a linear contract of a reduced-form static model. Our analysis may be seen as being conducted in such a reduced-form setting.

Firms choose their wage policies to maximize their objective functions. The objective

[5] A more general formulation is one where x and y are observed with noise, with the x-observation being more noisy than the y-observation. We worked out the details of this more general formulation in Corneo and Rob (2001) and showed, under certain restrictions, that the results we report here are still valid.

function of a private firm is its profit,

$$\Pi = Z - \int w(\theta) dH(\theta), \tag{4}$$

where the unit price of output has been normalized to one. The objective function of a public firm is social welfare, S. We initially assume that social welfare is defined as the sum of the firm's profits and its workers' sum-of-utilities,[6] namely:

$$S = \Pi + \int u(\theta) dH(\theta). \tag{5}$$

This objective function is fairly standard in the public-economics literature.[7] Traditionally, it has been justified based on political-economy type arguments. For instance, Downs (1957) argues that the probability that a worker of a public firm votes for the incumbent management increases with the rent she receives. An even more direct reason is "revolving doors" or "group altruism." In particular, in European countries, the top management of public firms often includes former trade-union leaders and labor-party officials, who are likely to favor workers.

Empirically, several studies have established that public firms pay a wage premium compared to private firms operating in the same industry, which one is then able to interpret as coming from the maximization of an objective function like (5).[8] See, for example, Foster *et al.* (1984), Gregory (1990), Preston (1988); or, more recently, Mocan and Tekin (2000).

[6] The model yields similar results if profits and workers' utilities enter the objective function of the public firm with different weights.

Another generalization, which we pursue below, is to incorporate consumers' surplus in the objective function of the public firm.

[7] For example, Laffont and Tirole (1991) posit this objective function. Bös (1994) discusses more comprehensively the objectives of public firms.

[8] There is no contradiction between paying a wage premium, and using weaker incentive which, as we prove below, is what the public firm does. The former refers to the overall wage, whereas the latter refers to one part of the overall wage (namely, it is the performance-based part of the wage).

3 Effort choices

When selecting its wage policy, (a, b), the firm has to take into account the effect the wage policy has on a worker's effort choice. A type-θ worker solves the following problem:

$$\max_{x,y}\{b + ax - c(x + y) + g(y; \theta)\}. \tag{6}$$

The first-order conditions for an interior solution are:

$$c'(e^*) = a = g_1(y^*; \theta). \tag{7}$$

Given that $g_1(0, \theta) = \infty$ for all θ, we get an interior solution for y, $y^* > 0$, as long as $a > 0$. And, if a is sufficiently large, $a > \overline{a}$, we get an interior solution for x, too. The cutoff value, $\overline{a}$, is determined as follows. For every θ there exists a y, call it $\overline{y}(\theta)$, so that $c'(\overline{y}) = g_1(\overline{y}; \theta)$. Then $\overline{a} \equiv c'(\overline{y}(\overline{\theta})) = Max_\theta\{c'(\overline{y}(\theta))\}$. We focus from this point onwards on $a > \overline{a}$, and show later when $a > \overline{a}$ is indeed compatible with the maximization of firms' objectives.

The LHS of (7) shows that e^* is the same for all θ's. Also, since $c(\bullet)$ is strictly convex, the LHS can be inverted to yield $e^*(a)$, which expresses the dependence of total effort on the incentive intensity, a. Likewise, since $g(y; \theta)$ is strictly concave in y, the RHS condition can be inverted to yield $y^*(a, \theta)$. The optimal level of individual effort is the residual $x^*(a, \theta) \equiv e^*(a) - y^*(a, \theta)$. We denote the optimal effort choices across workers by the functions $X^*(a), Y^*(a)$, i.e., $X^*(a) \equiv x^*(a, \bullet)$.

By differentiation of the first-order conditions, (7), we get the following properties:

$$c''(e^*)\frac{\partial e^*}{\partial a} = 1 \Longrightarrow \frac{\partial e^*}{\partial a} = \frac{1}{c''(e^*)} > 0.$$

$$g_{11}\frac{\partial y^*}{\partial a} = 1 \Longrightarrow \frac{\partial y^*}{\partial a} = \frac{1}{g_{11}} < 0.$$

$$c''(e^*)\frac{\partial e^*}{\partial \theta} = 0 \Longrightarrow \frac{\partial e^*}{\partial \theta} = 0.$$

$$g_{11}\frac{\partial y^*}{\partial \theta} + g_{12} = 0 \Longrightarrow \frac{\partial y^*}{\partial \theta} = \frac{-g_{12}}{g_{11}} > 0.$$

$$u(\theta) \equiv b + ax^*(a, \theta) - c[x^*(a, \theta) + y^*(a, \theta)] + g(y^*(a, \theta); \theta) \Longrightarrow$$

$$u'(\theta) = ax_2^*(a,\theta) - c'(e^*)[x_2^*(a,\theta) + y_2^*(a,\theta)] + g_1 y_2^*(a,\theta) + g_2 = g_2 > 0,$$

where $u(\theta)$ is maximized utility of a type-θ worker and where, to conserve on notation, we suppress the dependence of u on (a,b). The last line represents total differentiation of u with respect to θ (in fact, the last line is just an application of the envelope theorem). Therefore, we have:

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

(ii) A higher value of θ increases cooperative effort and decreases individual effort. Total effort remains unchanged.

(iii) For given values of (a,b), maximized utility is increasing in θ. ■

4 The main result

We now set up the firms' objective functions, and compare their optimal wage policies. We normalize the reservation utility of workers to be zero.[9] We assume that both the private and the public firm must deliver at least this reservation utility, i.e.,

$$u(\theta) \geq 0, \qquad \theta \in [\underline{\theta}, \overline{\theta}]. \tag{8}$$

Since, by Lemma 1, u is increasing in θ, it suffices to require the participation constraint, (8), at $\theta = \underline{\theta}$. Also, since the objective of the private firm is to maximize its profit, it sets the base salary, b, at the lowest possible level which is consistent with $u(\underline{\theta}) = 0$. By (1), $u(\underline{\theta}) = 0$ is equivalent to:

$$b = c(e^*(a)) - g(y^*(a,\underline{\theta}); \underline{\theta}) - ax^*(a,\underline{\theta}).$$

Therefore, the private firm's wage bill is:

$$W(a) \equiv \int_{\underline{\theta}}^{\overline{\theta}} [b + ax^*(a,\theta)] dH(\theta) =$$

[9] The reservation utility can be interpreted as the value of being unemployed, in which case $x = y = w = 0$, so that $\overline{u} = 0$.

$$c(e^*(a)) - g(y^*(a,\underline{\theta});\underline{\theta}) - a\int_{\underline{\theta}}^{\overline{\theta}}[x^*(a,\underline{\theta}) - x^*(a,\theta)]dH(\theta).$$

Let the firm's output, under the incentive intensity a, be $G(a)$:

$$G(a) \equiv F(X^*(a), Y^*(a)). \tag{9}$$

Then, substituting into the firm's profit, (4), the objective of the private firm can be expressed as a function of the incentive intensity, a, alone:

$$\Pi(a) = G(a) - W(a) = \tag{10}$$

$$G(a) - c(e^*(a)) + g(y^*(a,\underline{\theta});\underline{\theta}) + a\int_{\underline{\theta}}^{\overline{\theta}}[x^*(a,\underline{\theta}) - x^*(a,\theta)]dH(\theta).$$

On the other hand, substituting (1) into (5), the objective of the public firm is:

$$S(a) = G(a) - c(e^*(a)) + \int_{\underline{\theta}}^{\overline{\theta}} g(y^*(a,\theta);\theta)dH(\theta). \tag{11}$$

The public firm maximizes this function, with respect to a and b, subject to the participation constraints:

$$u(\theta) = b + ax^*(a,\theta) - c(e^*(a)) + g(y^*(a,\theta);\theta) \geq 0,\ \theta \in [\underline{\theta}, \overline{\theta}]. \tag{12}$$

Given (11) and (12), it is optimal for the public firm to select the incentive intensity, a, at the unconstrained maximum of (11) and then set the base salary, b, so that (12) are satisfied.

We now state and prove our main Proposition.

Proposition 2 *Assume $\Pi(a)$ and $S(a)$ are continuously differentiable, and Π is strictly concave. Denote the points at which they attain maxima by a^{pr} and a^{pu} respectively. Then:*

(i) The incentive intensity is higher under the optimal wage-policy of the private firm than under the optimal wage-policy of the public firm, $a^{pr} > a^{pu}$.

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

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

Proof. Using (10) and (11), the difference, Δ, between Π and S is expressed as follows:

$$\Delta(a) \equiv \Pi(a) - S(a), \tag{13}$$

where

$$\Delta(a) \equiv a \int_{\underline{\theta}}^{\overline{\theta}} [y^*(a,\theta) - y^*(a,\underline{\theta})] dH(\theta) - \int_{\underline{\theta}}^{\overline{\theta}} [g(y^*(a,\theta);\theta) - g(y^*(a,\underline{\theta});\underline{\theta})] dH(\theta).$$

(In deriving the last expression we replaced x^* by y^*, using the identity $x^* + y^* = e^*$).

The optimal incentive intensity in the private firm, a^{pr}, satisfies the first-order condition:

$$\Pi'(a^{pr}) = S'(a^{pr}) + \Delta'(a^{pr}) = 0. \tag{14}$$

On the other hand, the optimal incentive intensity in the public firm, a^{pu}, satisfies:

$$S'(a^{pu}) = 0. \tag{15}$$

In order to compare (14) and (15), we use (7) and the envelope theorem to show:

$$\Delta'(a) = \int_{\underline{\theta}}^{\overline{\theta}} [y^*(a,\theta) - y^*(a,\underline{\theta})] dH(\theta) > 0, \text{ all } a > 0. \tag{16}$$

Equations (13), (14) and (15), combined with the concavity of $\Pi(a)$ imply that $a^{pr} > a^{pu}$. Parts (ii) and (iii) follow now from Lemma 1, part (i). ■

The intuition behind Proposition 2 is that a negatively affects informational rents,[10] which, as Appendix A shows, are given by Δ. As a increases, x also increases but y decreases. And, since workers earn informational rents on y, an increase in a decreases informational rents. It follows then that the private firm chooses a larger a, because it tries to lower informational rents. Or, equivalently, the public firm chooses a smaller a since that generates more informational rents and the public firm derives benefit from

[10] The type-parameter θ is private information to workers; hence workers with a higher θ get higher utility, i.e., they collect informational rents.

such rents.[11] By contrast in previous agency formulations of the public firm, informational rents *increase* in incentives, which implies that the public firm chooses stricter incentives.

To be more precise the comparison between incentives hinges on three factors: Differing objective functions, non-trivial private information, and a *particular* type of private information. If any of these three factors is missing we may no longer get the result, or, we may even get the opposite result. The following variations of our model make this point clear.

1. Heterogeneity of worker types. If the interval $[\underline{\theta}, \overline{\theta}]$ were degenerate, informational rents and $\Delta'(a)$ would be 0, and a^{pr} would equal a^{pu}. In fact, in that case the objective functions of the private and the public firms would be equal. The public firm still cares about the utility of its workers; however, with one worker type and risk neutrality, the most efficient action is to maximize profit and then divide it between the firm and the workers in whatever manner is desired. This is no longer the case when there are many worker types. Thus if we keep all elements of the model intact but relax heterogeneity (i.e., eliminate private information) the result no longer holds.

2. Private information affects actual behavior and, thus, creates informational rents, $g_{12} > 0$. If g_{12} were 0, say, $g(y;\theta) = y+\theta$, and θ were different for different workers, $y^*(a, \theta)$ would be constant in θ and the integrand in (16) would be 0. If $g_{12} = 0$, the informational problem is non-existent since all workers make the same choice of y (even though workers are heterogenous). Again we have $a^{pr} = a^{pu}$. This shows that, for Proposition 2 to hold, private information has to be manifested in actual behavior.

3. Private information is of a different type. Consider a g which is independent of θ, $g(y)$, but re-introduce private information via workers' cost of effort, $c(e;\theta)$ (the same thing can be accomplished with differential productivity rather than differential cost of effort). Apart from that, θ still exhibits heterogeneity and workers still enjoy the

[11] The private firm also cares about its workers' welfare because of the participation constraints and because higher cooperative utility diminishes the need to make monetary compensation. Thus, workers' welfare figures into the private firm's maximization program as well. Nonetheless, these considerations affect the public firm, too, and, on top of that, workers' welfare appears directly in the public firm objective, but not in the private firm's objective.

socializing activity. Then, as we show in Appendix B, the private firm chooses *weaker* incentives. Thus, it matters what *kind* of private information is being postulated.

More generally what we have shown is that when $\Delta'(a) < 0$ the private firm chooses stricter incentives. And, multi-tasking plus private information on the cooperative task is one way of getting $\Delta'(a) < 0$. However, there may very well be other ways of getting $\Delta'(a) < 0$, and the same result applies.

Our analysis relies on the solution to workers' program being interior, which in turn relies on a being large; see discussion at the beginning of Section 3. Inspecting (9), we now see that if F_1 is sufficiently large, i.e., if effort allocated to the individual task is sufficiently productive, both firms indeed choose a big enough a. If F_1 is not sufficiently large or if we relax the assumption $g_1(0, \theta) = \infty$, we may get a corner solution, where workers choose $x = 0$ or $y = 0$ (but not both). In that case Lemma 1 has to be re-stated with weak, rather than strict, monotonicity. And, correspondingly, Proposition 2 has to be re-stated with weak rather than strict ranking ($a^{pr} \geq a^{pu}$).

Proposition 2 shows that $a^{pr} > a^{pu}$. What can be said about total output - $Z^{pr} = G(a^{pr})$ vs. $Z^{pu} = G(a^{pu})$ - in the private vs. the public firm?

Proposition 3 *If either $G(a)$ or $W(a)$ is increasing over (a^{pu}, a^{pr}), $Z^{pr} > Z^{pu}$.*

Proof. (1) Assume G is increasing. Then the result follows by plugging a into G.

(2) Assume W is increasing, and assume to the contrary that $Z^{pu} \geq Z^{pr}$. Then the private firm can set $a = a^{pu}$ instead of a^{pr}. This will increase its output and decrease the wage bill, i.e., it will increase profits. ■

However, and unlike the situation in traditional private information models (e.g., where the *productivity* of a worker is private information) nothing can be said, in general, about the monotonicity of G or W. In fact, there is nothing to prevent G and W from being downward sloping - at least over some domain - and nothing to prevent a^{pu} and a^{pr} from occurring on this domain.[12] More generally, the following computation shows that W is

[12] Intuitively, in such cases $W'(a) < 0$, which occurs because informational rents decrease in a. So, in such cases, it pays the private firm to sacrifice productivity in return for (significantly) smaller informational rents.

increasing only under certain conditions:

$$W(a) = c(e^*(a)) - g(y^*(a,\underline{\theta});\underline{\theta}) - a\int_{\underline{\theta}}^{\overline{\theta}}[x^*(a,\underline{\theta}) - x^*(a,\theta)]dH(\theta).$$

Therefore,

$$W'(a) = c'e^{*\prime} - g_1 y_1^*(a,\underline{\theta}) - a x_1^*(a,\underline{\theta}) + a\int_{\underline{\theta}}^{\overline{\theta}} x_1^*(a,\theta)dH(\theta) - \int_{\underline{\theta}}^{\overline{\theta}}[x^*(a,\underline{\theta}) - x^*(a,\theta)]dH(\theta).$$

The first three terms are zero because of the first-order conditions, (7), and because $x^* + y^* = e^*$. So W is increasing if and only if:

$$a\int_{\underline{\theta}}^{\overline{\theta}} x_1^*(a,\theta)dH(\theta) > \int_{\underline{\theta}}^{\overline{\theta}}[x^*(a,\underline{\theta}) - x^*(a,\theta)]dH(\theta).$$

This inequality holds if workers are homogenous, or if x^* does not vary too much with θ. Otherwise, there is no reason for this inequality to hold. And, indeed, in Corneo and Rob (2001), we exhibit two numerical examples illustrating the possibility of higher productivity in the public firm.

The result that although the private firm employs stronger wage incentives, its productivity need not to be higher than in the case of the public firm distinguishes our formulation from most previous formulations[13] (where cooperative tasks and the attendant cooperative utility are not part of the formulation). Further, this result is consistent with empirical findings discussed in the introduction. The empirical literature showed, using “before and after” comparisons, that once a public company is privatized it introduces performance-related pay, i.e., it strengthens its incentives; yet, the effect on productivity is ambiguous. Likewise, the empirical literature showed that if we compare, at a given point in time, companies in the same industry, the privately-owned ones exhibit stronger incentives, but not necessarily higher productivity than the publicly-owned ones.

[13] One exception to this is the paper by Francois (2000). He, too, shows that efficiency in the public firm may be superior. In his approach the public firm’s does not respond to (or “make up for”) shirking because it is not a residual claimant. And this is advatageous because it deters workers from shirking. Hence, not being a residual claimant means the public firm has the power of committment, which gives it the usual first-mover advantage.

5 Consumers' Surplus

In the basic model the public firm ignores consumers' surplus when setting its wage policy. This may be interpreted as having the firm sell its output on a competitive market, in which case the firm has no effect on the price and, hence, no effect on consumers' surplus. Alternatively, the firm may be interpreted as a monopolist, in which case the publicly-owned firm is assumed to put zero weight on consumers' surplus. We now consider a more general monopoly case, in which the public firm puts some exogenous weight on consumers' surplus.

Let $P(Z)$ be the inverse demand function and let $R(Z) \equiv ZP(Z)$ be the corresponding revenue function. Then $R(Z) - \int w(\theta)dH(\theta)$ is the firm's profit. To conserve on notation we continue to call the objective of the private firm Π, and likewise for other functions in this section. The public firm's objective is now:

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

where $C(Z)$ is consumers' surplus, with $C'(Z) = P(Z)$, and γ is the weight attached to consumers' welfare.

The manipulations used in proving Proposition 2 extend to the new scenario: The participation constraint of the lowest type will be binding for the private firm, whereas, for the public firm, a is chosen independently of these constraints, and b is adjusted to satisfy the constraints. The difference between the objectives of the firms is:

$$\begin{aligned} \Delta(a) &= a\int_{\underline{\theta}}^{\overline{\theta}} [y^*(a,\theta);\theta) - y^*(a,\underline{\theta});\underline{\theta})]dH(\theta) \\ &\quad - \int_{\underline{\theta}}^{\overline{\theta}} [g(y^*(a,\theta);\theta) - g(y^*(a,\underline{\theta});\underline{\theta})]dH(\theta) - \gamma C(G(a)). \end{aligned}$$

And, computing the derivative of $\Delta(\bullet)$, yields:

$$\Delta'(a) = \int_{\underline{\theta}}^{\overline{\theta}} [y^*(a,\theta) - y^*(a,\underline{\theta})]dH(\theta) - \gamma P(Z)\int_{\underline{\theta}}^{\overline{\theta}} [F_1\frac{\partial x^*(a,\theta)}{\partial a} + F_2\frac{\partial y^*(a,\theta)}{\partial a}]dH(\theta), \quad (17)$$

where F_1 is the $x(\theta)$-derivative of F, and F_2 is the $y(\theta)$-derivative of F, both evaluated at $(x^*(a,\theta), y^*(a,\theta))$. Proposition 2 shows that the first term is positive; however, since, by Lemma 1, $\frac{\partial x^*(a,\theta)}{\partial a} > 0 > \frac{\partial y^*(a,\theta)}{\partial a}$, the second term cannot be signed - even if F_1, F_2 are assumed to be positive (which is the natural assumption). On the other hand, (17) suggests sufficient conditions under which proposition 2 continues to hold.

Proposition 4 *Proposition 2 continues to hold provided: (i) Output is significantly more sensitive to cooperative effort than to individual effort: $F_2 >> F_1 > 0$. Or, (ii) The weight, γ, on consumer surplus is small.* ■

Conversely, suppose that cooperative effort does not generate any productivity gains ($F_2 = 0$) and that there is only one type of worker ($\bar{\theta} = \underline{\theta}$). By using Equation (17), it is easy to see that the public firm implements a *higher* total effort (and less cooperation) than the private firm - even if workers enjoy cooperating.[14]

6 Conclusion

A common conception in debates about privatization is that public firms are lenient with their workers, that their workers slack off and that, as a result, productivity suffers. A natural way to capture this conception is by means of an agency model with imperfect monitoring. Yet, most agency models fail to deliver this result. In this paper we develop a multi-task agency model, which delivers this result. The main novelty is that socializing is one of the tasks in which workers are engaged. Socializing has two faces. On the one hand, it is an activity which yields utility for the employees. On the other hand, such activity can affect the firm's output to the extent that socializing sparks cooperation and cooperation is productive. With these two elements in place we show that when

[14] Our basic model can also be extended to an endogenous determination of the employment level, see Corneo and Rob (2001). In that set-up the effects derived here are still present. However, the wage policy also affects the quality of applicants, similarly to the adverse selection model by Weiss (1980). This fact may or may not reinforce the tendency for the private firm to choose stronger incentives. An interesting implication of that model concerns the choice of the employment level, for given incentive parameter. Since in both types of firms individuals with high θ are employed first, the principal can alleviate the employees' participation constraint by hiring less workers. Hence, there is an incentive for the private firm to reduce informational rents by employing less workers than its public counterpart.

private information is about socializing behavior, the private firm indeed employs stricter incentives. However, when private information is about the cost or productivity of effort the private firm employs weaker incentives. Hence, multi-tasking and the *type* of private information are useful in understanding the differences in incentives and labor productivity between privately and publicly operated firms.

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APPENDIX

Appendix A: Informational Rents

The reservation utility of workers is zero. So, informational rents equal the maximized utility of workers facing the wage scheme (a, b). The latter is:

$$\int_{\underline{\theta}}^{\overline{\theta}} u(\theta) dH(\theta) =$$

$$W(a) - c(e^*(a)) + \int_{\underline{\theta}}^{\overline{\theta}} g(y^*(a,\theta);\theta) dH(\theta) =$$

$$\int_{\underline{\theta}}^{\overline{\theta}} \{[g(y^*(a,\theta);\theta) - g(y^*(a,\underline{\theta});\underline{\theta})] - a[y^*(a,\theta);\theta) - y^*(a,\underline{\theta});\underline{\theta})]\} dH(\theta)$$

$$= -\Delta(a).$$

Appendix B: Different Kind of Private Information

Here we retain heterogeneity but assume that private information is on cost rather than on cooperative utility:

$$u = w + g(y) - c(e;\theta).$$

We index workers so that $c_2 < 0$ and $c_{12} < 0$, i.e., the bigger is θ the more industrious the worker. Then, with linear incentives as above, type-θ worker chooses an $e^*(\theta)$ which satisfies $c_1(e;\theta) = a$ and chooses a y so that $g'(y) = a$.

The comparative statics of workers' decision goes as follows:

$$\begin{aligned} 0 &= c_{11}\frac{de}{d\theta} + c_{12} \Rightarrow \frac{de}{d\theta} = \frac{-c_{12}}{c_{11}} > 0. \\ 1 &= c_{11}\frac{de}{da} \Rightarrow \frac{de}{da} = \frac{1}{c_{11}} > 0. \end{aligned}$$

$$\begin{aligned} u(\theta) &= b + ae^*(\theta) - c(e^*(\theta);\theta) + g(y^*) \\ &\Rightarrow u'(\theta) = (a - c_1)\frac{de^*}{d\theta} - c_2 = -c_2 > 0. \end{aligned}$$

Therefore, it suffices to require the participation constraint for the lowest type, $\underline{\theta}$, which implies

$$b = c(e^*(\underline{\theta});\underline{\theta}) - ae^*(\underline{\theta}) - g(y^*).$$

Plugging this into the wage function, we get:

$$W(a) = c(e^*(\underline{\theta})) + a \int_{\underline{\theta}}^{\overline{\theta}} [e^*(\theta) - e^*(\underline{\theta})] dH(\theta) - g(y^*).$$

Therefore,

$$W'(a) = (c_1 - a)\frac{de^*}{da}(\underline{\theta}) + a \int_{\underline{\theta}}^{\overline{\theta}} \frac{de^*}{da} dH(\theta) + \int_{\underline{\theta}}^{\overline{\theta}} [e^*(\theta) - e^*(\underline{\theta})] dH(\theta)$$

$$= a \int_{\underline{\theta}}^{\overline{\theta}} \frac{de^*}{da} dH(\theta) + \int_{\underline{\theta}}^{\overline{\theta}} [e^*(\theta) - e^*(\underline{\theta})] dH(\theta) > 0,$$

because $\frac{de^*}{da}, \frac{de^*}{d\theta} > 0$, as per the comparative statics properties. Thus, $a^{pr} > a^{pu}$ in this case implies $Z^{pr} > Z^{pu}$ and $a^{pr} < a^{pu}$ implies $Z^{pr} < Z^{pu}$; a and Z move in the same direction.

The objective of the private firm is:

$$\begin{aligned}\Pi(a) &= G(a) - W(a) = \\ &G(a) - c(e^*(\underline{\theta})) - a \int_{\underline{\theta}}^{\overline{\theta}} [e^*(\theta) - e^*(\underline{\theta})] dH(\theta) + g(y^*).\end{aligned}$$

On the other hand, the objective of the public firm is:

$$S(a) = G(a) - \int_{\underline{\theta}}^{\overline{\theta}} c(e^*(\theta)) dH(\theta) + g(y^*).$$

Thus,

$$\begin{aligned}\Delta(a) &\equiv \Pi(a) - S(a) = \\ &\int_{\underline{\theta}}^{\overline{\theta}} [c(e^*(\theta)) - c(e^*(\underline{\theta}))] dH(\theta) - a \int_{\underline{\theta}}^{\overline{\theta}} [e^*(\theta) - e^*(\underline{\theta})] dH(\theta),\end{aligned}$$

And,

$$\Delta'(a) = -\int_{\underline{\theta}}^{\overline{\theta}} [e^*(\theta) - e^*(\underline{\theta})] dH(\theta) < 0.$$

So, in this instance, $\Pi(a)$ being concave implies $a^{pr} < a^{pu}$ and $Z^{pr} < Z^{pu}$, which is the opposite of Proposition 2. The reason is that, in an attempt to reduce informational rents to high types, the private firm choose a lower incentive intensity and lower production. This is similar to inefficiency results in other models with private information, for instance, auctions or implicit contracts.