1. Introduction

In recent years, there has been a widespread consensus in public opinion and among politicians about the benefits of a privatization program involving also goods and services traditionally provided by public firms. Some empirical results seem to confirm this opinion, by showing that in many cases privatization has enhanced the internal efficiency of the firms. Even if the evidence on this matter is not always clear cut (in particular, it is not always clear whether the outcome depends on privatization alone or on other aspects of the reform), it is widely accepted that private property involves stronger incentives to minimize costs. Yet, much remains to be done by economists, since a widely accepted explanation of the economic rationale of privatization is still lacking.

The superiority of private property is commonly ascribed to the fact that, contrary to public firms, a private firm is exposed to competition in the product market, it is vulnerable to takeovers, and it can go bankrupt. Though, it has been observed that in many cases privatization just consists in substituting a private monopoly for a public one; that the effectiveness of takeovers in motivating management is controversial[1]; that most regulated private monopolies are *de facto* protected from bankruptcy.

Another set of explanations refers to the fact that government has less incentives to control the firm, or that it can pursue objectives which are different from social welfare maximization. But once again, it is not clear that the government should be less motivated to exert control than a multitude of dispersed private investors (as is the case for example in a public company); and most of all, it is not clear that a poorly motivated or a not benevolent government should do worse by conducting a public firm than through regulation of a private one[2].

The economic rationale of privatization is difficult to explain because many of the problems which trouble a public firm seem to afflict a private *regulated* firm as well. Often, if this is not recognized it is because the problem is not put at the right level of abstraction. Since in both cases it is the government which sets the objective of the firm, why cannot it do as well with direct control as it can through negotiation at arm's length? For example, why can't the

[1] See Holmström and Tirole (1989) for an account of the different positions on this point. In addition, it is often observed that takeovers exist for public firms as well, in the form of political takeovers.

[2] A more complete list of arguments, referred to as the "common wisdom" on privatization, and the relative counterarguments, can be found in Laffont and Tirole (1993, cap. 17).

government just replicate in a public firm the incentives which the managers would be given in a private firm? Note that by asking such a question we are taking a point of view very similar to that of Coase (1937) with regard to the choice between market and hierarchy; his point was most clearly restated by Williamson (1985, p. 131): "Why can't a large firm do everything that a collection of small firms can do and more?"[3]. Why can't it intervene "selectively" only when it can improve on the decentralized solution, leaving incentives unmodified in all other cases?

The typical situation we have in mind is one in which a firm has to produce a good or service under conditions which are not set by the competition of consumers and producers, but by an explicit agreement with the government, which plays the role of agent on behalf of the consumers. In the extreme we can think of a public good, so that the government plays the role of a monopsonist; but it can as well be the case of a service demanded by individual consumers whose price is subject to regulation. The choice we are dealing with concerns the ownership of the firm producing that good or service: should its capital be entirely public, or should the firm be "privatized", in the sense that capital is (at least partially) provided by private investors? In this paper, we want to identify the relevant trade-offs involved in this institutional choice.

Our approach is one of incomplete contracts: the agreed "contract" between the firm and the government cannot specify all relevant contingency, and the government has to intervene ex post to renegotiate its terms. In the spirit of Sappington and Stiglitz (1987)[4], we will trace the trade-off to the differential ease of an ex-post adaptation of the contract to government's goals in the two cases; as is also stated by Shleifer (1998, p. 141), nationalization "allow[s] the government to change its mind about what it wants to be produced, [...] without having to pay a contractor for changing the terms". While the ease of an ex post adaptation can be beneficial, at the same time it softens the budget constraint of the firm, weakening the incentives to internal efficiency.

The model presented here has much in common with that of Schmidt (1996a), which makes use of the incomplete contracts hypothesis, and identi-

[3] In a sense, this is also the central problem in the debate on market socialism of the 1930s.

[4] Sappington and Stiglitz's fundamental theorem of privatization states that so long as a complete contract is feasible, the delegation to a private firm can achieve first best, and a direct intervention is not necessary; when on the contrary the contract is incomplete, the relation has to be "governed" and a trade-off emerges.

fies a trade-off which is similar to ours[5]. However, some differences have to be stressed.

In Schmidt's model, privatization is described as a commitment by the government not to gain access to information on costs; it is shown that, quite surprisingly, this limitation on information can have a welfare enhancing effect: the managers know that too high costs can translate in a higher probability of closing down and/or in a lower level of production. This is not the case when the government is informed on costs, as it is with public property, since in this case a high cost will be "forgiven" in order to achieve a higher ex post social surplus. This model takes account of the separation of property and control; however, the possibility of imposing an explicit incentive contract to stimulate managers to minimize costs is not considered. In addition, it is exogenously assumed that privatization entails a credible commitment by the government not to accede to information on costs: hence, the difference is traced back to one of information distribution, which can be modified through property allocation. Though well argued, this hypothesis in our opinion is not necessary to explain differences in costs between private and public firms.

Our model is less demanding than that of Schmidt on information, since no difference in the information structures between the two property regimes is imposed by assumption. Moreover, by assuming that the managers have to be motivated with an explicit incentive scheme, it is more directly related to Williamson's claim about selective intervention: how can it be that the government cannot effectively mimic an incentive scheme which is at work in a private firm?

In order to focus on the property issue alone, we will assume that compe-

[5] Within the incomplete contract approach, a different explanation of the privatization trade-off is put forward by Hart, Shleifer and Vishny (1997). Starting from the Grossman-Hart-Moore notion of property (Grossman and Hart, 1986; Hart and Moore, 1990), they hold that a public manager, because he is not the owner of the firm, has relatively weaker incentives to make investments aimed at reducing costs, improving quality or innovating. Though less efficient, public property can still be preferable when the product has non-contractible characteristics (broadly defined as "quality") which are relevant from a social point of view; in this case too much incentives to minimize costs can result in a deterioration along these non-contractible dimensions.

Since it assumes that the privatized firm is owner-managed, Hart et al.'s model, though very convincing in many respects, is not entirely satisfactorily when applied to large corporations where property and control are separated. Moreover, the authors implicitly assume that all differences in productivity come from differences in the investments in human capital made by the managers, while no role is played by shirking and on-the-job leisure in a more traditional sense, and no room is left for explicit incentives.

tition within the market is not possible (though it is possible to have competition *for* the market); in this way we don't have to face the problem of which interaction exists between public property and the effectiveness of market competition.

The remainder of the paper is organized as follows. In section 2 we introduce our notion of privatization. Section 3 sets up a preliminary version of the model, in which we give a formal representation of the interaction between the firm and the government in a context of incomplete contracts. In section 4 managers' shirking and incentives are introduced in the framework, and the trade-off between private and public property of the firm is finally clarified. Section 5 concludes and suggests some possible extensions of the model.

2. Public *vs.* private property

There is a fundamental difference between investing in a firm as a shareholder and investing and "owning" it as a taxpayer through public property: in the former case one voluntarily becomes an owner and (usually) can stop being so by selling her share in the stock market. This difference, when agents are heterogeneous in wealth, preferences, expectations, implies that only a subset of the population wants to become an owner of a certain privatized firm; this in turn affects the relation between the government and the firm in (at least) two respects.

First, from the point of view of distribution, a money transfer has a very different effect depending on whether property is public or private. Let us consider, in the public property case, the impact of an additional transfer to the firm, which increases correspondingly the firm's profits (we assume that it doesn't affect the costs): the transfer has no distributive content, since the government is also the residual claimant and receives back in the form of profits what it gave as a transfer. Instead, owing to the different identity of the residual claimant, the same transfer in the private case implies a transfer from the overall population of taxpayers to the subset of those who subscribed shares of the firm. This quite obvious observation, as we will see, has relevant consequences for our analysis; due to its distributive effect, fixing the correct amount of transfers between the government and the firm turns out to be a much more relevant issue in the private than in the public case.

Second, the need to attract private capitals constrains and limits the scope of government's intervention into the operation of the firm. This aspect points to the concept of *safeguard*, when the value of an investment is threatened by

the counterpart's opportunism. As Williamson (1975, 1985) has stressed, safeguards are an essential ingredient in long term (hence necessarily incomplete) contracts, when the parties make specific investments and each is vulnerable to the counterpart's opportunistic behavior. Since the government can affect the profitability of the firm through its regulatory activity, the investors need a legally enforced warranty that regulation will not change the conditions of production to their disadvantage, and will not reduce the value of the capital invested.

The typical safeguard embodied in the property rights of the owner of an asset is the norm by which a contract governing a production process employing that asset cannot be changed without the agreement of the owner himself; the owner has veto power on any use of his activity not regulated by the contract, or *residual right of control* (Grossman and Hart, 1986). However, things seem to be less clear cut when we talk of the property of a large corporation: here, as pointed out by many scholars, it is not clear who holds residual rights, and shareholders' rights seem to be very specific. It is even harder to characterize in general terms the content of private shareholders' rights in a firm which is subject to regulation, or is only partially privatized and the government still holds majority or a "golden" share.

Say x is the share of capital in the hands of the government, so that $0 \leq x \leq 1$. If x is reduced below 1, at least starting from a certain $x < 1$ private investors acquire a minimum set of rights: they, or their representatives in the board of directors, should be able to oppose effectively changes in the regulation contract which could compromise the profitability of the capital invested. In other words, it must not be possible for the government/regulator to change the regulation contract unilaterally; the government must not be able to force the firm to accept a revision of the agreed condition when this goes against shareholders' interest. Note that this empowerment of private shareholders, even if limited to veto power, must accompany the inflow of private capitals whatever the exact content of "privatization" is, since otherwise no private investor would accept to put at risk its money in the firm.

In this paper *we define privatization as a change from $x = 1$ to $x < 1$ accompanied by a change in control which gives private investors (who hold a share $1 - x$ of capital) at least the right to refuse a change in regulatory contract which reduces the profitability of their investment*.

We will take the further step of assuming that, with regard to any renegotiation of the regulatory setup, veto right is the *only* right given to shareholders of a privatized firm. This fits well with many cases of privatization in western continental Europe, where the set of rights given away by the gov-

ernment is quite limited; besides, a different assumption on the distribution of contracting power should not alter the internal logic of our argument.

3. Incomplete regulatory contract and renegotiation

3.1. Basic assumptions of the model

In this model we consider three agents:

- the government, which is represented by the regulatory authority in the private property case, and by the minister in the public property case;
- the manager of the firm;
- the shareholders, who intervene only in the private case and whose role is that of applying the penalty and exercise their veto power on contract renewal.

As a first step, we want to focus on the relation between the firm and the government; hence, we will implicitly assume that the managers act in the interest of their firm, and maximize profits. This assumption is clearly unrealistic, and will be removed in the next section, when the "complete" model will be introduced.

We assume that the government acts as an agent of the citizens, and wants to provide a certain amount of goods or services to the consumers, in order to maximize social welfare. Following a well established tradition in the theory of regulation, we will assume that social welfare is represented by a weighted sum of consumers' surplus and the profit of the firm, with more value attached to consumers' surplus than to profit because of distributional considerations[6].

In order to produce, the owner of the production unit (the government itself in the public case, the shareholder in the private case) must make a sunk investment in physical capital; he then has to pay for the operating costs, which include managers' remuneration. We first consider the case in which production is delegated to an (at least partially) privately owned firm.

Before investment is made by the owner of the firm, a detailed contract is signed between the firm and the government, in which aspects and dimensions of production (regarding quality, the timing of goods and services delivery, access discrimination, and every other aspect which is a matter of

[6] For a discussion and justification of this welfare criterion, see for example Caillaud et al. (1988).

concern to the government) are specified, and a payment is agreed conditional on these dimensions. The payment can be a direct transfer from the government, financed through taxes, a price paid by the consumers, or both; what is important is that in a regulated industry the payment to the firm depends on the regulatory contract, and as such it is an object of negotiation. The government acts on behalf of the consumers either if it directly pays the firm or if it contracts a price to be paid by the consumers themselves.

We make an assumption of *contract incompleteness*: some actions which are observable to the contracting parties are not publicly verifiable (and hence cannot be specified in a contract). We consider that the production process takes place during two periods, whose initial dates are indicated by t_0 and t_1 respectively. Some of the relevant variables are not observable before t_1; moreover, even after t_1 they will not be publicly verifiable, and therefore it is not possible to specify their value in a contract so that actions or payment can be made conditional to these variables[7].

As studies in the economics of institutions have emphasized (Williamson, 1985; Grossman and Hart, 1986), when contracts are incomplete, renegotiation can take place. Some aspects of the contract can be specified only once the relation is running, when the government and the production unit are "locked" in a bilateral monopoly; it follows that the setting of the new contract is not a trivial process, and entails a bargaining process which could result to be very costly.

In particular, in our two period horizon, we assume that in the second period there is the opportunity to increase welfare by changing some of the dimensions of the produced services. Since this change was not and could not be foreseen in the original contract, a new agreement has to be reached between the government and the firm in order to adapt to the new circumstances which have arisen; the parties must negotiate an additional payment to cover the larger cost of the production change.

To state this in a more precise way, we introduce the following variables:

- W_0 and C_0 are the expected social benefits and costs corresponding to the course of action which is specified in the initial contract, *when this contract is not renegotiated*. T_0 is the income accruing to the firm. C_0 include the cost of capital, which is assumed to be the same for the government and for private investors.

- W_1, C_1 and T_1, correspondingly, are the additional expected benefit, cost

[7] This might depend on the presence of unforeseen contingencies, or equivalently on the cost of specifying correctly every future contingency in an enforceable contract

and transfer coming from the renegotiation of the contract which takes place in t_1. The values of W_1 and C_1 are not known in t_0; they are known to the parties in t_1, though they are not verifiable by a third party.

It is important to specify which of these variables are observable and which are not. We assume that the total cost for the firm, denoted by C, is ex post observable and verifiable, but if there has been recontracting it is not possible for a third party to observe separately the values of C_0 and C_1. T_0 and T_1 are assumed to be verifiable.

The profit of the firm is $(T_0 - C_0) + (T_1 - C_1)$ with renegotiation, $T_0 - C_0$ otherwise. Let x be the share of the firm stocks owned by the government, with $0 \leq x < 1$ in the case of privatization, and let $\bar{\alpha}$ be the weight attached to the profit earned by the private shareholders in the social welfare function, with $0 \leq \bar{\alpha} < 1$ because of distributional considerations (where the weight attached to consumers' welfare is one). Hence, the profit of the firm enters the payoff function of a benevolent government weighed with a coefficient $\alpha = x + (1 - x)\bar{\alpha}$, with $0 \leq \alpha < 1$ in the case of privatization, and $\alpha = 1$ if the firm is public ($x = 1$). Therefore, the payoff of the government is given by

$$(W_0 - T_0) + \alpha(T_0 - C_0) + (W_1 - T_1) + \alpha(T_1 - C_1) \tag{1}$$

if renegotiation takes place, and

$$(W_0 - T_0) + \alpha(T_0 - C_0) \tag{2}$$

if it does not.

T_0 will be chosen in t_0 so that the expected cost is covered. T_1 cannot be chosen before t_1, when the cost C_1 and the corresponding change in the course of action required by the firm can be set. Both values depend on the outcome of negotiation between the parties. Since we have assumed that in t_0, before the investment has been made, there is competition among symmetric potential producers, T_0 will be set so that the expected profit of the firm π_0 is zero. The expected profit in t_0 is

$$\pi_0 = T_0 - C_0 + \pi_1 \tag{3}$$

where π_1 is the expected increment (or decrement) in profit which follows the renegotiation of the contract in t_1. If we assume that in the first stage, when sunk investment are not yet made, there is competition among potential producers for the right to produce, then it must be $\pi_0 = 0$, and we have

$$T_0 = C_0 + \pi_1. \tag{4}$$

We now turn to the renegotiation process in t_1.

3.2. Renegotiation and the cost of private property

Changes in property affects how T_1 is set in t_1. The value of T_1 determines how the surplus $W_1 - C_1$ is shared between the firm and the government.

We have said that private property requires that the firm is given veto power on all decision concerning the contract between the firm and the government. This veto power has a cost, because any contract change has to be renegotiated: negotiation is costly, and the potential total surplus is partly wasted during bargaining or because of bargaining.

There are several ways formally to include negotiation costs in our model. As a general point, bargaining can be costly because each party is engaged in actions aimed merely at increasing his/her share of the surplus; in order to modify the distribution, the bargaining parties waste resources, so that the total surplus is reduced in size. These costs can take the forms of a delayed and/or missed agreement on a mutually beneficial change[8].

Another source of costs comes from the incentive that the prospect of a negotiation creates to enhance the value of the reservation option, in order to increase contractual force. Note that if the parties in the end reach an agreement, this investment is just wasted effort from the point of view of value creation. Yet, the firm can choose to invest in order to obtain a higher payoff.

We will include bargaining costs in our model in the simplest way, by assuming that the parties have symmetric information and one of them can commit to a take-it-ore-leave proposal. By leaving aside incomplete information, we are restricting our attention to those bargaining processes which are ex post efficient, in the sense that the parties do reach an agreement whenever there is a positive net surplus to share; we leave apart delays and missed agreements. Bargaining costs are in the form of inefficient investment made before negotiation and aimed at affecting bargaining outcome. In addition, we make the following assumptions:

(B1) The government can commit to a take-it-or-leave offer on an additional payment T_1; if the firm doesn't accept, the negotiation stops and the contract stays unchanged. This means that the government has all of the bargaining power. We have already commented on this assumption in section 2.

[8] This will be the case in incomplete information bargaining games, in which the outside option of a party is unknown to the counterpart; in this context, a party can use its veto power and refuse the other party's proposal in order to signal his/her commitment to a better distribution of the surplus bargaining costs: bargaining costs can be interpreted as the costs needed to make one's statement credible in face of the counterpart (Kennan and Wilson, 1993).

(B2) To produce the good or service, the manager of the firm can choose among different technologies[9], which perform differently depending on whether the contract is renegotiated or not. Let us call a "rigid" technology one that minimizes the cost of producing in accordance to what was initially agreed on, but leaves little room for welfare improving and/or cost reducing changes in the regulatory contract; in formal term, we have that by choosing a more rigid technology, the manager decreases C_0 and at the same time increases C_1 and/or decreases W_1.
Let $\bar{C}_0$, $\bar{C}_1$ and $\bar{W}_1$ be the (expected) values of (respectively) C_0, C_1 and W_1 when the least rigid technology among those available is adopted. We assume that, by choosing a more rigid technology, C_0 can be reduced below $\bar{C}_0$, but to a unitary decrease of C_0 corresponds an increase of b_c in C_1 and a decrease of b_w in W_1, with $b_c + b_w > 1$. In other terms, if we denote by η the difference $\bar{C}_0 - C_0$, we have that $C_1 = \bar{C}_1 + b_c\eta$ and $W_1 = \bar{W}_1 - b_w\eta$; η can then be interpreted as an index of rigidity of the technology (the higher is η, the more rigid is the technology). We represent the choice of the technology by the manager (whose utility is not directly affected by this choice) as the choice of a value of η within the closed interval $[0, \bar{\eta}]$. Moreover, we assume that this value is ex post observable by the parties but not ex ante contractable.

Because of the assumption (B1), the government will see its proposal accepted provided that a payoff at least as great as the default option is granted to the firm.

The default option payoff for the firm as a function of η is

$$T_0 - C_0 = T_0 - \bar{C}_0 + \eta, \tag{5}$$

while if the alternative is accepted the payoff is

$$(T_0 - C_0) + (T_1 - C_1) = T_0 + T_1 - \bar{C}_0 + \eta - \bar{C}_1 - b_c\eta. \tag{6}$$

Since η can be observed, the government will offer to the firm a transfer T_1 such that (5) and (6) are equalized. We find that

$$T_1 = C_1 = \bar{C}_1 + b_c\eta, \tag{7}$$

or $\pi_1 = 0$. Due to its bargaining power, the government can get the whole surplus coming from the change, leaving the firm to its reservation profit,

[9] Remember that at this stage we are making the hypothesis that the manager acts in the interest of the firm, i. e. she maximizes profits.

which is represented by (5). Being its payoff positively related to η, the firm will increase this value as much as it is possible (less flexible technology), making the adaptation to the new environment less attractive. The maximum possible value of η, i. e. $\bar{\eta}$, will be chosen.

The payoff of the government is

$$W_0 - T_0 + \alpha(T_0 - C_0) \tag{8}$$

if the change is not made, and

$$W_0 - T_0 + W_1 - T_1 + \alpha(T_0 - C_0 + T_1 - C_1) = \\ W_0 - T_0 + \alpha(T_0 - C_0) + \bar{W}_1 - \bar{C}_1 - \beta\eta \tag{9}$$

if it is made, where $\beta = b_c + b_w > 1$. Adaptation will take place only if

$$\bar{W}_1 - \bar{C}_1 - \beta\eta > 0. \tag{10}$$

We define $S = \bar{W}_1 - \bar{C}_1$, and indicate with $F(.)$ the cumulative probability function of S, so that $F(s) = Prob\{S \leq s\}$; $F(.)$ is commonly known to the parties in t_0. The expected payoff of the government is then

$$W_0 - T_0 + \alpha(T_0 - C_0) + G(\eta), \tag{11}$$

where

$$G(\eta) \equiv \int_{\beta\eta}^{+\infty} [s - \beta\eta] dF(s) \tag{12}$$

is the conditional expectation of $\bar{W}_1 - \bar{C}_1 - \beta\eta$ given that (10) is satisfied (and therefore the change is made).

If η were contractable in advance, the government would choose the values of T_0 and η which maximize (11), subject to (5) being positive (otherwise the firm would not participate in t_0). Substituting from the participation constraint, the expected payoff becomes

$$W_0 - \bar{C}_0 + \eta + G(\eta) \tag{13}$$

which must be maximized with respect to η over the interval $[0, \bar{\eta}]$.

Since

$$G(0) = \int_0^{+\infty} s dF(s). \tag{14}$$

we have

$$G(0) - G(\eta) - \eta = \int_0^{\beta\eta} s dF(s) + \beta\eta(1 - F(\beta\eta)) - \eta. \tag{15}$$

Note that a sufficient condition for (15) to be positive is that

$$F(\beta\eta) < \frac{\beta - 1}{\beta}; \tag{16}$$

this happens when S has a small probability to be less than $\beta\eta$, i. e. when the returns from adaptation in t_1 are likely to be large. We restrict our attention to the case in which (16) holds for all $0 \leq \eta \leq \bar{\eta}$: in this case, the expected payoff of the government is maximized when $\eta = 0$. This is the socially optimal value of η if this value could be contracted in advance (i. e. in the *first best* optimum). Note that an increase of η reduces the probability that a change is advantageous.

We have seen that when η is not ex ante contractable, a privatized firm sets $\eta = \bar{\eta}$, and in t_0 the government pays $T_0 = \bar{C}_0 - \bar{\eta}$. Hence, there is a welfare loss associated with privatization, which is represented by

$$G(0) - G(\bar{\eta}) - \bar{\eta}; \tag{17}$$

since this loss depends on the fact that the firm wants to improve its bargaining position in t_1, it can be interpreted as a measure of the *bargaining costs* suffered when production is decentralized to a firm which has veto power on contract renewal.

3.3. Public property

When property is public, renegotiation is not needed any more to change the contract; the government can unilaterally change the production plans of the firm, and in doing so it needn't worry to make this change acceptable.

Since the government plays both the role of buyer of the goods and services and that of residual claimant, for given costs it is irrelevant which of T_0 or T_1 will be chosen, as long as C doesn't depend on these transfer (we have ruled out incentives at this stage of the analysis). This is clear if we consider the objective function of the government when it is the owner of the firm and the change is not made:

$$(W_0 - T_0) + [T_0 - (\bar{C}_0 - \eta)] = W_0 - \bar{C}_0 + \eta \tag{18}$$

while when the change is made it is

$$(W_0 - T_0 + \bar{W}_1 - b_w\eta - T_1) + [T_0 - (\bar{C}_0 - \eta) + T_1 - (\bar{C}_1 - b_c\eta)] \\ = W_0 + \bar{W}_1 - \bar{C}_0 - \bar{C}_1 - \beta\eta \quad (19)$$

(these are just equations (1) and (2) when $x = 1$).

The choice of η affects only government's payoff, and there's no reason for the manager to choose a value different from the efficient level, $\eta = 0$. When $\eta = 0$, the government payoff corresponds to the first best expressed by equation (14). As we will see, things are different when we take account of the managers' incentive and how these interact with renegotiation in t_1.

It's time to make a first (necessarily incomplete) comparison between public and private property. We have stressed in the introduction that the presence of private shareholders' require that no change in the contract can be made unilaterally by the government without the consent of the firm's owners. But this requirement in turn implies that, in general, the firm has the opportunity to enhance its bargaining power through actions that reduce the total surplus from bargaining.

4. Incentives and managerial efficiency

4.1. Further assumptions

We now remove the hypotheses that the managers act in the interest of their firm. As it is usually done, we assume that the manager can increase her utility by increasing the production cost of the firm.

We will concentrate our attention on the effect of managements' behavior on C_0. Let $C_0 = \bar{C}_0 - \eta + c_0 + c_1$, where c_0 and c_1 are variables under manager's control, which are chosen in t_0 and t_1 (before and after the contract change has been considered) respectively, and such that $0 \leq c_0 \leq \bar{c}_0$ and $0 \leq c_1 \leq \bar{c}_1$. Their values enter manager's utility by increasing it by an amount $\psi(c_0 + c_1)$, with $0 < \psi' < 1$ for all $c_i \in [0, \bar{c}_i]$ and $\psi(0) = 0$. Since a unitary increase in the cost c_i raises the manager's utility by less than one, the social optimal value of c_i is its minimum value, zero.

We assume that the values of c_0 and c_1, though observable by the parties, are not directly contractable; hence, the manager cannot be directly forced to minimize costs. An incentive scheme has to be designed. To avoid *ad hoc* conclusions in the comparison between private and public managers behavior, we assume that, in principle, the same incentive scheme can be adopted

regardless of the property regime. In general, we are assuming that a public firm has in principle the same set of instruments as a private firm to give incentives to its managers: this may be false in many concrete cases, but we must keep such a *ceteris paribus* condition, so that the difference can be found as an endogenous result of the model. Besides, there are no reasons to believe *a priori* that a public manager is less concerned with her career, or that her record affects her market valuation differently. What we will try to do is to give an explanation of why public property should change the owner's ability to give his managers effective incentives.

One important assumption we make is about the form of the incentive scheme. We assume that the manager is motivated to maximize profits by the threat of being sanctioned in case the profit falls under a certain predetermined level. If the firm makes a loss, the manager is fired, or her reputation is compromised, or she is not given a promised monetary reward. Formally, we assume that a penalty P will be applied in response to the realization of a verifiable event which signals an insufficient effort[10].

The problem is that of finding a verifiable variable which reliably signals a low level of effort by the manager. Even if the overall realized cost $C = C_0 + C_1$ is observable and verifiable, it is not possible to set a penalty scheme which states for example that a sanction P is inflicted to the manager if $C > \hat{C}$, since ex ante the cost at the efficient level of effort, and thus the "correct" value of $\hat{C}$, is not known. In t_0, when the incentive scheme is to be set, only the expected value of C_0 is known, but unfortunately it is not possible ex post to verify the realization of C_0 alone.

In order to distinguish the separate effects of C_0 and C_1 on C, and give correct incentives to the managers to minimize C_0, the parties could use the value of the transfer T_1 as a proxy for C_1. We have seen in the previous paragraph that under certain assumption about the negotiation of T_1, we have $T_1 = C_1$[11], so that $T - C$ will coincide with the difference $T_0 - C_0$. Since T_0 is such that it just covers the expected cost, a negative value of $T - C$ reflects an excessive cost of production, and a less than optimal level of effort.

We arrive to the (not surprising) conclusion that a penalty scheme should

[10] We assume a nonlinear incentive contract; though special, this assumption is consistent with the observed shape of incentive contracts offered to managers (see Prendergast, 1999, p. 15). The penalty scheme can be interpreted as the promise of being fired in case of poor performance.

[11] This conclusion depends on the assumption that the government has all contracting power; in a less extreme case, we could well have $T_1 > C_1$. However, our conclusion doesn't change as long as the value of T_1 is in a predictable relation with C_1—hence informative with respect to the latter variable.

depend on the realized profit of the firm. Note that though this reasoning applies both to the public and the private case, there is an important difference between the two solutions: in the public case "profit", though still defined as $T - C$, is different from its private equivalent in the crucial sense that the transfer T is not the outcome of a negotiation between conflicting parties. We will see that this is what makes the public firm residual $T - C$ a much less reliable measure of the performance of the firm with respect to the private firm profit.

To sum up, the incentive scheme will have the following form: a penalty P is inflicted to the manager whenever the final realized cost C exceeds T; otherwise, no penalty is applied. Of course, the penalty has to be large enough to induce the manager to choose the desired level of c: to induce the optimal level of effort, it must be $P > \psi(\bar{c}_0 + \bar{c}_1)$. Calling $P(.)$ the penalty function, we have

$$P(C) = \begin{cases} P & C > T \\ 0 & C \leq T \end{cases} \tag{20}$$

Since the choice of c_0 and c_1 affect manager's utility, we must take account explicitly of manager's participation constraint. If the salary paid to an efficient manager (one who exerts an efficient level of effort) is zero, competition will lower the salary paid to a less efficient manager, and the firm will save an amount M on manager salary, where

$$M = \psi(c_0 + c_1) \tag{21}$$

depends on the equilibrium choices of c_0 and c_1.

Finally, we take that in all decisions which don't affect her utility, the manager will act in the interest of her principal.

4.2. Incentives in the private property case

In the private case, the incentive scheme $P(C)$ induces an optimal level of effort. To show why this is so, it is necessary to restate precisely the sequence of moves in the game played by the government, the shareholders and the managers (this sequence is also summarized in figure 1).

At the beginning of period t_0, a contract is proposed by the government to the potential shareholders, who decide whether to invest their capital or not. The manager decides whether to participate or not; in the former case she chooses a level of effort (c_0) and a technology η. At the beginning of

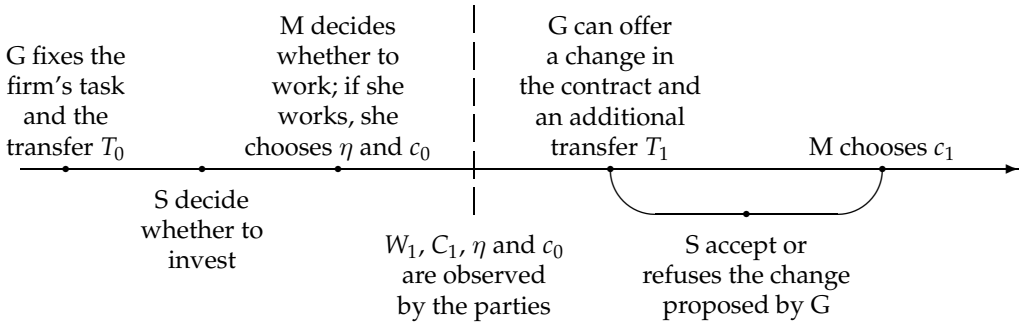

Figure 1. Sequence of moves in the private property case (G=government, S=shareholders, M=manager)

period t_1, the parties know W_1 and C_1 and bargaining may take place over an alternative course of actions (in this case the government makes a take-it-or-leave offer about an additional payment T_1, and the shareholders can accept or refuse it); after that, the manager chooses c_1. At the end of period t_1, the total cost is observed and the incentive scheme is applied.

We have the following:

Proposition 1. In the private property game, the following strategies

- *the government offers $T_0 = \bar{C}_0 - \bar{\eta}$ in t_0, and $T_1 = C_1$ in t_1 as long as $W_1 \geq C_1$;*
- *the shareholders accept the offer and invest their capital in t_0 and accept the proposed change in t_1;*
- *the manager selects $\eta = \bar{\eta}$ and $c_0 = c_1 = 0$.*

constitute a Nash equilibrium.

Proof. The game is one with complete information, and it is solved by backward induction. Let $\Pi(c_1)$ be the final profit of the firm as a function of c_1, and let $\bar{\Pi}$ be its value when $c_1 = \bar{c}_1$, or $\bar{\Pi} = \Pi(\bar{c}_1)$; we have that $\Pi(c_1) = \bar{\Pi} - c_1$. Since the penalty P will be applied whenever $\Pi(c_1) < 0$, it is optimal from the point of view of the manager to exert the necessary level of effort to avoid the penalty when this is possible, and choose the minimum level of effort otherwise; hence, the optimal choice of c_1 is $\bar{\Pi}$ if $0 \leq \bar{\Pi} \leq \bar{c}_1$, and $\bar{c}_1$ otherwise.

Note that the final profit of the firm is a nondecreasing function of $\bar{\Pi}$. Given that a change in the contract increases $\bar{\Pi}$ by the quantity $T_1 - C_1$, it follows that the shareholders will accept the government's proposal in t_1 if and only if $T_1 \geq C_1$. So, in t_1 the government will offer a transfer $T_1 = C_1$

if and only if $W_1 \geq C_1$, just like in the no-incentive case considered in the previous section. The strategies of the shareholders and the government are independent of manager's choices in t_0 and t_1.

Given the optimal strategies in t_1, the expected profit of the firm is zero when

$$0 \leq T_0 - \bar{C}_0 + M + \eta - c_0 \leq \bar{c}_1 \tag{22}$$

while it is equal to $T_0 - \bar{C}_0 + M + \eta - \bar{c}_1 - c_0$ when (22) does not hold.

In t_0, the government fixes T_0 so that the shareholders invest their capital, and the manager chooses the values of η and c_0 that maximize her utility. Note that once again from the point of view of the manager, it is optimal (when it is possible) to choose values of η and c_0 that result in nonnegative profits, in order to avoid the penalty.

We first determine the best reply of the manager as a function of the transfer T_0. Note that in the equilibrium it must be $T_0 \geq \bar{C}_0 - \bar{\eta}$, since otherwise, no matter what the manager decides, the final profit of the firm would be negative, and the shareholders would not participate. So, we have two cases, depending on the value of T_0:

(*a*) When T_0 is so high that $T_0 \geq \bar{C}_0 - M - \bar{\eta} + \bar{c}_1 + \bar{c}_0$, positive profits are compatible with $c_0 = \bar{c}_0$ and $c_1 = \bar{c}_1$; the manager will set $c_0 = \bar{c}_0$ and will be indifferent among all values of η above $\bar{C}_0 + \bar{c}_1 + \bar{c}_0 - T_0$; since the profit of the firm positively depends on η, she will choose $\eta = \bar{\eta}$.

(*b*) When $\bar{C}_0 - M - \bar{\eta} \leq T_0 < \bar{C}_0 - M - \bar{\eta} + \bar{c}_0 + \bar{c}_1$ the manager will find it optimal to set $\eta = \bar{\eta}$, while she will be indifferent among all values of c_0 which satisfy

$$c_0 + c_1 = T_0 - \bar{C}_0 + M + \bar{\eta} \tag{23}$$

for $0 \leq c_1 \leq \bar{c}_1$; in this case the profit of the firm will always be zero.

Given these replies by the manager, the government must choose T_0 in order to maximize its objective function

$$W_0 - T_0 + G(\eta) + \alpha(T_0 - \bar{C}_0 + M + \eta - c_0 - c_1). \tag{24}$$

under the constraint of shareholders' and manager's participation, or

$$T_0 - \bar{C}_0 + M + \eta - c_0 - c_1 \geq 0 \tag{25}$$

$$M = \psi(c_0 + c_1). \tag{26}$$

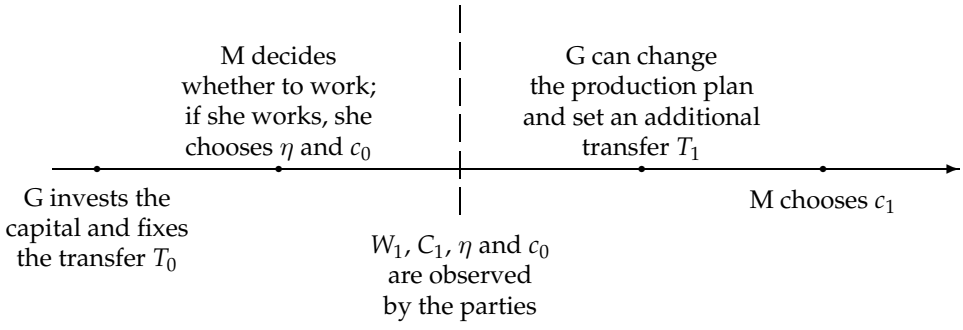

Figure 2. Sequence of moves in the public property case (G=government, M=manager)

In order to identify the Nash equilibrium, we substitute for c_0 and η as resulting from (*a*) and (*b*) in (24) and (25), and consider the minimum possible value of T_0 in either case. We have $T_0 = \bar{C}_0 - \psi(\bar{c}_0 + \bar{c}_1) - \bar{\eta} + \bar{c}_1 + \bar{c}_0$ in case (*a*) and $T_0 = \bar{C}_0 - \bar{\eta}$ in case (*b*). The government's payoff (24) is clearly maximized in the latter case, where the shareholders participate, M is equal to zero, and the manager chooses $c_0 = 0$ and $\eta = \bar{\eta}$. □

In equilibrium, the government's payoff is equal to

$$W_0 + G(\bar{\eta}) + \bar{\eta} - \bar{C}_0, \tag{27}$$

as in the previous section.

4.3. Incentives in the public property case: forgiving a bad performance

We now consider the alternative case of public property. With public property, there is an integration of the roles of owner and regulator.

Here is the sequence of moves of the parties, which is also represented in figure 2. At the beginning of period t_0, the government invests its capital and fixes a payment T_0 to the firm; the manager decides whether to participate or not, and in the former case she chooses a level of effort (c_0) and a technology η. At the beginning of period t_1, the government knows W_1 and C_1, and decides whether to change the production plan to take advantage of the changed environment; an additional payment T_1 to the firm to cover the extra-costs may be fixed; after that, the manager chooses c_1. At the end of period t_1, the total cost is observed and the incentive scheme is applied.

When the roles of regulator and owner of the firm are integrated, there is a degree of freedom in fixing the transfers to the firm, and this is enough to disrupt the credibility of the incentive scheme. Consider the case that in t_1 it is observed that the effort in t_0 has been very low, so that the penalty will be inflicted regardless of the effort in the last part of the production period: the penalty scheme adopted is no longer useful to give proper incentives to the manager; the government is encouraged to revise it in order to make it effective again, and make it work at least from t_1 on[12]. But if this adjustment can be anticipated by the manager, the incentive scheme is no longer able to motivate the manager in t_0.

Note that such a commitment problem exists even if the penalty scheme is formally unchangeable, i. e. if the parties have agreed not to renegotiate it; indeed, the government can *indirectly* change it by setting a higher or lower T_1, and cannot make a credible promise not to do so, and it could give an extra-transfer T_1 even if a change is note necessary, i. e. even when $W_1 < C_1$.

We state precisely this point in

Proposition 2. In the public property game, the following strategies

- *the government sets whatever value of T_0 in t_0 and $T_1 = \bar{C}_0 + \bar{c}_0 - M + \bar{C}_1 - T_0$ in t_1;*
- *the manager selects $\eta = 0$, $c_0 = \bar{c}_0$ in t_0 and $c_1 = 0$ in t_1;*

constitute a Nash equilibrium.

Proof. The proof of this proposition is straightforward. The behavior of the manager in t_1 is the same as in the private case: she will select $c_1 = \bar{\Pi}$ if $0 \leq \bar{\Pi} \leq \bar{c}_1$ and $c_1 = \bar{c}_1$ otherwise, where $\bar{\Pi}$ is the profit of the firm when $c_1 = \bar{c}_1$.

What changes with respect to the previous case is the optimal strategy of the government: whatever the choices in t_0 have been, in t_1 it will be optimal to induce an optimal level of effort by the manager. The government will set T_1 so that

$$\bar{\Pi} = T_0 - \bar{C}_0 + M + (1 - b_c)\eta - c_0 + T_1 - \bar{C}_1 = 0; \tag{28}$$

as a consequence, the only way to avoid the penalty for the manager will be to choose $c_1 = 0$.

[12] Note that this doesn't really depend on the special assumption we have made about the form of the penalty scheme, since an incentive to revise the mechanism once it is in place is present in *any* incentive scheme.

This means that, whatever the parties do in t_0, the final profit of the firm will be zero; as a consequence, the application of the penalty does not depend on the choices of c_0 and η, and the incentive scheme will have no effect on these variable. The manager will select $c_0 = \bar{c}_0$ and $\eta = 0$ (she is indifferent to the value of η, so she will have no reason to make an inefficient choice).

The choice of T_0 is irrelevant from the point of view of the government, since it has no effect on the choice of the manager, hence on the production cost. □

The final payoff of the government is

$$W_0 - \bar{C}_0 - \bar{c}_0 + \psi(\bar{c}_0) + G(0), \tag{29}$$

which is $\bar{c}_0 + \psi(\bar{c}_0)$ less than the first best. To say which is the second best solution between the public and the private case, we must compare this productive inefficiency with bargaining costs, represented by $G(0) - G(\bar{\eta}) - \bar{\eta}$.

Before we draw some conclusions on the comparative statics of this model, it must be stressed once again the role played by the fact that contracts are incomplete. It is the need to recontract the terms of the relation in t_1 which opens to the parties the possibility to revise their incentive scheme and renege on the initial agreement. Any promise not to renegotiate the incentives, and any penalty applied in case of a revision of the contract, would be ineffective, since the incentive mechanism is changed *indirectly*, via the change in the additional payment due for the contract change. The only credible way to avoid this outcome would be to forbid *any* change in the contract, which would clearly be inadvisable in an uncertain environment.

Indeed, things would be different if the government could commit not to take account of the observed c_0 and to fix a transfer T_1 which depends only on C_1. In this case, the incentive scheme would work just like in the private case; in addition, and differently from the private case, the absence of any negotiation would make the manager choose an efficient η, so that the government would save on bargaining costs and would be able to reach the first best.

5. Conclusions and future research

Our model gives an interpretation of the privatization choice, and checks its formal and logical consistency. In the context described, privatization can be seen as a way to credibly commit not to use the renegotiation in t_1 to renege on the initial penalty scheme. At the same time, it emphasizes the limits and

costs of privatization, which have to be balanced against its benefits. With privatization, adaptation to a new environment is more difficult, sometimes not at all advantageous, even if it would have been optimal in the first best.

It could be useful to underline the logical structure of our argument. On the one side, private ownership constrains the regulatory contract, which must allow veto power on contract renewal to the shareholder. This results in costly negotiation when a subsequent change is needed. On the other side, to make adaptation easier and allow for unilateral changes of the regulatory contract, the government must do without private investors. But this, on turn, limits the power of incentives given to the management, and results in productive inefficiency. The fact that the transfer is negotiated between conflicting parties makes the expectations on its value "harder"; when instead the transfer can be set and revised at no cost, expectations on it are somehow "softer", and so it is the budget constraint as perceived by the managers. A contract with a "privatized" counterpart adds a degree of rigidity to the relation between the government and the firm, a rigidity which is beneficial in that the benchmark for manager evaluation is clearly defined, but might be costly in term of responsiveness to social goals, whose full satisfaction could be precluded or hindered.

Unfortunately, the model is too abstract to give us practical indications on when one option is better than the other. Privatization will be advantageous when renegotiation is cheap relative to the cost of weak incentives, i. e. when

$$G(0) - G(\bar{\eta}) - \bar{\eta} < \bar{c}_0 - \psi(\bar{c}_0) \tag{30}$$

but this is quite a vague conclusion. Even if the cost differential between a public and a private firm could be measured, it is much more difficult to evaluate the terms on the left side of the inequality; on the other hand, our analysis suggests that a comparison which only focuses on production costs would give us an incomplete picture of the costs and benefits associated with the choice to privatize, and would be inevitably biased in favor of the private solution.

Something more can be said in qualitative terms. The convenience of privatization is higher the less the scope for an increase in η. In the model, η measures the degree of rigidity of the technology with respect to a change in the initial contract: renegotiation is costly because it encourages the adoption of a technology which maximizes the prospect of a high return within the terms of the initial agreement, at the expense of a reduced return from an adaptation to new circumstances. Therefore, we expect that nationalization is preferred where the service to be provided is ex ante less defined in its

dimensions, and a precise definition of what is socially desirable cannot be reached from the beginning; it becomes less and less desirable as long as the government is able to specify in detail its objectives and the dimensions of the good or service produced. In other words, public property applies where the government has a preference for flexibility. We could also identify a sort of "cycle of privatization" from earlier stages in which the production is public to later stages when it can conveniently delegated to private units; this seems to be consistent with historical experience.

Even if the model doesn't consider competition among different producers, our theory could be easily made consistent with some stylized facts often observed about privatization and competition. It is commonly claimed that privatization is most effective when the firm operates in a competitive environment: it is where privatization is accompanied by liberalization that the cost differential with public production is higher (Vickers and Yarrow, 1988, 1991).

This could be easily explained within our model. It is a well known result of principal/agents model that when there's competition on the product market, incentive schemes are more effective in containing costs, since comparative performance schemes can be used, and in general more information is available looking at competing firms (Holmström, 1982). This means that the collapse of the incentive scheme due to lack of commitment by the regulator has worse consequences; in formal terms, we would have in this case a higher $\bar{c}_0$, i. e. a higher differential between the cost when incentives work and when they don't. Of course, this aspects would need a more formal analysis (we should amend the model and introduce some form of asymmetric information), and could be the object of future research.

Another aspect to discuss is the hypothesis we have made about government's objective function. In our analysis, government seeks social welfare maximization, and social welfare is equal to a weighted sum of the aggregate consumers' surplus net of the cost weighing on taxpayers and shareholders' profit. However, the only necessary hypothesis on which our explanation rests is that government weighs "its" money more than it weighs the money in the hands of shareholders. This is a central point for our model: the public and the private case are different as long as a positive profit of the firm is different in the two cases from the point of view of the government. Moreover, privatization is a credible commitment not to renege on the initial contract only if profit is more valuable for the government when the firm is public. If we remove the assumption of a benevolent government, our conclusions lose in part their normative content, since it is not necessarily true that a reduc-

tion in the payoff of the government is a social loss. However, a trade-off very similar to that we have emphasized still remains, since some of the relative costs of the two solutions are just waste, in the form of bargaining costs on the one side, and of productive inefficiency on the other.

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