Property Rights and Market: Employee Privatization as a Cooperative Bargaining Process

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Abstract

The paper presents a game-theoretic model in order to investigate to what extent an employee privatization program of a State owned firm can be feasible under certain assumptions concerning the players' objective functions and the market structure in which the firm operates. The public managers are assumed interested in the firm's value, while the workers aim at maximizing the per capita surplus over the wage. The privatization process is then described as a bargaining process between the government in the role of core investor in the firm's physical assets and the workers of the firm, whose only asset is their personal skill. In the model the market structure in which the firm sells its product is assumed to be imperfectly competitive. After presenting the case of a monopolistic firm, the paper explores what happens if the firm plays a duopoly quantity game. The final section is devoted to introducing to the analysis an x-efficiency cost proportional to the public share of the ownership. (**JEL**: C7, D23, L22, L33, J54)

1 Introduction

Recent theoretical and institutional contributions on the topic of privatization in Central and Eastern Europe (CEE) stress the importance of decentralized, rather than centrally controlled and discretionary, types of privatization (Bogetic (1991), Ben-ner (1993), Pejovich (1993)).[1] The transfer of the firm's ownership from the state to managers and employees, through a negotiated purchase, seems to meet these requirements (Estrin (1991), Ben-ner (1993)). Employee ownership is advocated to allow a somewhat immediate break with government control and an effective governance structure during the transition period (Mygind (1992), Bogetic and Conte (1992)). Another valuable feature is that its implementation does not necessitate a stock exchange in order to allocate the firm's shares and find domestic or foreign funds.[2] Factors against employee privatization schemes include the possibility of reduced investment in physical assets (Blanchard et al.(1991) and Tirole (1991)) and the implicit inequality in the free-transfer version (as compared to the laveraged employee buyouts that also appear to be equitable). At worst then, employee privatization can be seen, particularly for CEE countries, as an intermediate step toward a more complete privatization program (Earle and Estrin (1994)) or, alternatively, as a temporary device to preserve employment.[3]

Obviously, several questions arise: when can this kind of transition process actually be performed freely and when should it be enforced by the political authorities? What are the effects of the economic environment on changes in the firm's property rights and vice versa of different property rights allocations on economic performance?

Two major factors are usually indicated as making an employee privatization more likely to be proposed by public firms' employees to institutional authorities. Firstly, the employees' desire to preserve their workplace when this is jeopardized by a restructuring plan; secondly, particularly under a very low wage rate, the employees' interest in obtaining a higher share of the firm's surplus, including senior workers' human capital investments, which could be wasted under alternative privatization plans. The model presented in this paper mainly deals

[1] For a taxonomy of alternative privatization processes, see among the others, Chilosi (1993). Descriptions of decentralized privatization processes in CEE countries can be found, for instance, in Bokros (1990), Voszka (1994), Grossfeld and Hare (1991) and Johnson-Kroll (1993), respectively for Hungary, Poland and Russia.

[2] For more details on employee privatization schemes see also Ellerman (1990), Estrin (1994), Weitzman (1991) and Weisskopf (1992).

[3] The Western industrial economies have recently witnessed a growing number of public or private company take-overs by employees, usually originated when enterprises are facing impending bankruptcy. For a survey, see Bonin, Jones and Putterman (1993).

with the second of these two factors.[4] The employees' concern in the acquisition of a public firm is modeled as a direct interest in the post-privatization distribution of firm's decision power and surplus. Consequently, the negotiation for the privatization of a previously state-owned firm is described as a bargaining process between the government in the role of core investor in the firm's physical assets, and the workers, whose only asset is their personal skill.[5] The aim of the government is assumed to be that of maximizing the profit and thus the value of the firm.[6] The workers' objective, conversely, is that of maximizing the quasi-rent over a given market wage. The allocation of the firm's property rights between the workers and the government is modelled as a cooperative bargaining process between these two different players. The division of the pie, the firm's property rights and the players' decision power are assumed closely linked so that, when the players bargain on the pie division, they simultaneously decide the firm's ownership structure and the decision power associated with it.

There are several applications of the internal bargaining approach to the question of the organizational form of the firm.[7] Specific models of companies newly privatized as a result of contractual negotiations between a core (public or private) investor and the workers as a group are presented in Bös (1991), Rossini and Scarpa (1991), Bonin (1992). The main innovations of the present work are both the introduction of an assets specificity in the negotiation and the analysis of the bargaining game under different market structures.

In the present model the environment in which the firm sells its product is assumed to be imperfectly competitive. After presenting the monopoly case, the paper explores what happens if the contractual firm plays a duopoly quantity game. Two cases are analyzed: in the first the market competitor of the contractual firm is assumed to be a profit maximizing firm, while in the second the competitor is a labour-managed firm. In both cases the contractual firm is assumed to be leader of a Stackelberg game, while the competitor plays the role of follower.[8] A result obtained is that differences in market structures and in

[4] The appendix briefly presents a different specification of the model that takes into account the employees' interest in preserving a high level of employment.

[5] The public owner of the physical assets - the State or a national investment fund - taken to be financially committed to the firm, can be assumed to be represented by public managers during the negotiation process. Informational problems among the principal (the government) and the agents (the managers) are not taken into account in the present model. A final section of the paper, however, is devoted to introduce an x-inefficiency in the analysis, that can be interpreted as an imperfection in the agents' behaviour due to a lack of correct incentives in the public firm.

[6] In a static analysis the profit of the firm coincides with the value of its shares at the end of the production period.

[7] For a summary of the theoretical literature, see Aoki (1984) and Bonin and Putterman (1987). A model that focusses on firm property rights determination in a bargaining perspective is presented in Dow (1993).

[8] Here the purpose is to describe two possible scenarios of Central and Eastern European countries' market competition in which the public firm plays a dominant role.

the type of competitor affect the bargaining solution by changing the payoff the firm obtains in the market.
Finally the model introduces an x-inefficiency cost the firm bears during the production process assumed to vary with the ownership arrangement decided at the contractual stage of the analysis. The assumption is that this cost is proportional to the final share of ownership detained by the government.[9]

Before characterizing the formal structure of the analysis a note of caution is needed on how to interpret the results of the model. In what follows, the assumptions regarding the behaviour of the agents participating in the bargaining game are abstracted from legal constraints that, differing in each country, might drastically affect the formal results of the analysis. The purpose of the paper is therefore that of studying, through a very stylized framework, some of the formal conditions under which an employee-privatization process in CEE countries could arise as a result of a cooperative negotiation between workers and institutional owners of the firm.

Section 2 introduces the model, while section 3 presents the main findings of the analysis. Section 4 describes some results obtained by applying the model respectively to monopoly and duopoly types of market structure. Section 5 is devoted to introducing an x-efficiency cost in the model. Section 6 discusses and concludes the paper.

2 The model

The aim of this section is to model the privatization of a public firm as a cooperative game. The two parties (workers and public investor) are assumed to negotiate over the firm's ownership structure. In this simplified framework, the ownership confers the right to take the relevant firm's decisions and specifically the right to chose the quantity to deliver in the market. The firm's ownership also affects how the firm's profit (or loss) is divided between players once the product is sold in the market. The main concern of this analysis is thus how these two major firm's decisions interact: which results can be obtained when the privatization decision (that is an ownership distribution decision) and the market decision are jointly considered.

The use of the Nash 's cooperative solution seems to be sensible to model the purposes of the CEE governments in adopting the massive privatization plans. The objective of the privatization is both to maximize the production surplus of the firms, making them profitable, and to hold the value of the firm positive. For the workers the objective is to increase their remuneration by

[9] An exogenous x-inefficiency cost for the public firms is assumed, for instance, in Selten (1986). This assumption though presented in a 'reduced form', represents the absence of correct managerial incentives under public ownership as compared with a private self-managed form of firm's ownership.

extracting a share of the total surplus even when this implies becoming partial or complete owners of the firm. It is assumed here that the chance of becoming owners increases in accordance which each party's initial commitment to the firm, measured by the level of investments at the beginning of the game that affects each party's reservation payoffs in case of negotiation fallback. This feature enables the model to represent the firm's final ownership as dependent on the nature of previous accumulation of human and physical assets by each group of negotiators.

2.1 The bargaining game

Bargaining takes place between two different players within the firm: the employees ($i = \ell$) and the physical asset investor, the government, ($i = k$). Both these players are assumed committed to the firm, since they made an investment I_i, $(i = \ell, k)$ before the bargaining game.[10] This investment could be thought of as an expenditure on specialized job training for the workers, andas a fixed cost associated with the factory for the government. Let $I = \sum_{i=l}^{k} I_i$ denote the total investment in physical and human assets and let the investment of the two coalitions be *sunk* at a certain degree σ_i, $(i = \ell, k)$, $\sigma_i \in [0, 1]$. The value of σ_i is assumed to represent the degree to which each investment is specific to the firm.[11]

The solution concept used to solve the bargaining game is the Nash cooperative equilibrium, where the two parties are assumed to maximize the product of their incremental utilities, i.e. the utilities obtained over their respective reservation utilities (i.e. what they obtain in case of negotiation failure). Let us characterize the nature of these utilities.

Following Ward's (1958) tradition, it is assumed that the utility of the workers' coalition is exactly represented by the value added per worker. This means that the workers have a preference for an egalitarian distribution of the surplus amongst members of the workers' coalition, once the value of physical and human investment is repaid.[12] In fact, the per capita value-added can be written as:

$$U_\ell (V (L)) = \frac{p (Q (L)) Q (L) - \sum_{i=l}^{k} I_i}{L} \tag{1}$$

[10] In the present analysis the firm's decision to enter the market and the players' investments decisions are assumed given at the beginning of the game. An analysis of players' *ex ante* investment decisions for the determination of the firm's property rights is contained, for instance, in Hart and Moore (1990). An extended game-theoretic treatment of the strategic fixed cost choice for value-added maximizing and profit maximizing firms can be found in Neary and Ulph (1994).

[11] We refer to the specificity of an asset for a contractual relationship between two intra-firm coalitions in the sense of Klein and al. (1978) and Williamson (1985).

[12] If the workers become owners of the firm, they have to repay the government's investment. The type of employee ownership scheme represented here is thus not one of free transfer but an internally-financed employee buyout.

where L is the number of workers sharing the firm's surplus, $p(Q)$ is an inverse demand curve assumed twice differentiable with respect to the output Q and downward sloping, and I_k is the physical firm's investment. Moreover, in what follows, let us assume for simplicity that the firm produces the output Q with a short-run technology using only labour $Q(L) = L$, and the investment $I = \sum_{i=l}^{k} I_i$. The expression (1) represents what the workers would maximize in the case in which the government was excluded by the firm's decision process after its complete privatization. Note also that for the workers, aiming at maximizing (1) is like maximizing $U_l(V(L)) = w + \pi(L)/L$, where w is the given market wage and $\pi(L)$ is the profit gained by the firm in the market. What the workers bargain, therefore, is the net surplus over the given market wage.[13]

The utility of the government, conversely, can be represented by the value and thus by the profit of the firm, i.e. the total revenue once a given wage w for each worker and the total fixed costs I are repaid:[14]

$$U_k(\pi(Q)) = p(Q)Q - wQ - \sum_{i=l}^{k} I_i \tag{2}$$

The different formalization of the two coalitions' utilities is related to the different possible outcomes of the negotiation. Let θ and $(1-\theta)$ be the final weights given by the two coalitions respectively to (1) and (2) during the bargaining game. If the public investor prevails in the bargaining game and the weight given to the profit maximization is one, he is able to maximize the firm's value over its physical assets. If this weight is zero, the firm will be identical to a per capita value-added maximizing firm, and all the rent over the fixed cost will be equally shared among workers. Moreover, if $\theta \in [0, 1]$, the surplus can be expected to be distributed between the two players, according to the value of θ.

In modelling the symmetric Nash cooperative equilibrium, the two parties are assumed to have reservation utilities - i.e. the payoffs they receive in case of negotiation failure - different from zero.[15] The failure of the negotiation means here that every agreement on how to distribute the ownership and the surplus among the players has been unsuccessful. Let us define the reservation utilities respectively, as:

[13] A comprehensive treatment of labour-managed firms' behaviour can be found, for instance, in Vanek (1970) and Bonin and Putterman (1987).

[14] Note that the public firm is not assumed to remunerate the human capital investment. This is why the workers are relatively interested in the firm's privatization.

[15] For this standard interpretation of the threat point see, for instance, Binmore et al. (1986).

$$\left\{ \overline{U}_\ell = w + \frac{(1-\sigma_\ell)\, I_\ell}{L^\circ},\ \overline{U}_k = (1-\sigma_k)\, I_k \right\} \tag{3}$$

where w is the market wage, while L° is a given fixed number of workers participating at the negotiation.

With this modelling of the disagreement point as $d = \left(\overline{U}_\ell, \overline{U}_k\right)$, there are two different assumptions:

i) Only non-marginal workers participate in the bargaining game, that is, the workers that certainly would find a job in the market in case of negotiation breakdown. They would obtain a given wage w plus an amount over the wage equal to the non firm-specific part of their investment, i.e. that tradable in the market;[16]

ii) In the case of negotiation failure, the asset investor can sell in the market only the non specific and tradable part of his investment $(1-\sigma_k)\, I_k$, while there is no positive reservation profit on his asset.

The government's reservation utility in (3) simply describes the public investor's necessity to reach an agreement with the workers, that is, the unavailability of alternative private investors. The choices available to the government are thus those of either holding the firm public, or proceeding with an employee privatization, or at worst, selling the firm's physical asset. The table 2 shows the firm's objective and the players'payoff in the extremes cases of the bargaining.

Cases	Objectives	Gov.'s Payoff	Work.'s Payoff
Public Firm	$U_k(\pi(Q))$	$I_k+(P\cdot Q-wQ-I_\ell-I_k)$	$w+\frac{I_\ell}{Q}$
Employee-Priv.	$U_\ell(V(Q))$	I_k	$w+\frac{I_\ell}{Q}+\frac{(PQ-wQ-I_k)}{Q}$
Bargaining Failure	-	$(1-\sigma_k)\cdot I_k$	$w+\frac{(1-\sigma_\ell)I_\ell}{Q^\circ}$

Tab.2.1 - Objectives adopted and Players payoffs in the different cases.

Now let us characterize the maximization problem the firm faces during the negotiation. As described above, what the two bargaining parties aim at maximizing are the relative incremental utilities that they can obtain by participating in the production process of the firm. We want to assume here that this surplus depends critically on the final allocation of the firm's ownership, since the latter affects the decision power of the firm and then the quantity offered in the market, via the final objective function of the firm. If $\theta \in [0,1]$ indicates the ownership distribution between the two coalitions, ($\theta = 1$ if the ownership is in

[16] Note that the specific investment in human capital is assumed to be equal for each worker. Note also that we have implicitly assumed a market wage that does not take into account the specific value of the workers' job training. This is equal to assume a labour market imperfection, as due, for instance, to imperfect workers' mobility.

the hands of the government and $\theta = 0$ if the ownership is equally distributed among the workers), the two parties solve the following problem:

$$\begin{aligned}
\underset{\theta}{Max}\ N\left(Q\left(\theta\right)\right) &= \left(U_k\left(\pi\left(Q\left(\theta\right)\right)\right)-\overline{U}_k\right)\cdot\left(U_\ell\left(V\left(Q\left(\theta\right)\right)\right)-\overline{U}_\ell\right) \\
s.t.\ \theta &\in \left[0,1\right],\ U_i \geq \overline{U}_i,\ \left(i=\ell,k\right)
\end{aligned}$$

where $U_i\ (i = \ell, k)$ depends on $\pi\left(Q\right)$and $V\left(Q\right)$, respectively profit and per worker value added, that are the corresponding objective functions of the two coalitions. These two functions depend on the ownership distribution θ through the quantity (and then the labour) the firm selects in equilibrium. In this way the players select the ownership distribution θ in an indirect way, by taking into account the corresponding effect of θ on the output offered in the market.

Before deriving the first order conditions of the problem (4), we must be sure that always, at an optimal value of θ, the disagreement point lies inside the set of the permissible outcomes, that is, $U_i \geq \overline{U}_i$, $\left(i = \ell, k\right)$. In order to respect this constraint, it is sufficient to assume an interval for $I = \sum_{i=k}^{\ell} I_i$, $I \in \left(0, \overline{I}\right]$, where:

$$\left\{\overline{I} \mid \forall\sigma_i \in [0,1] \text{ and } \forall\alpha_\ell \in [0,1)\,, \forall\alpha_k \in (0,1]\ ,\ \sum_{i=k}^{\ell}\alpha_i = 1, U_i \geq \overline{U}_i, (i=\ell,k)\right\}$$

where σ_i is the degree of specificity of assets, while α_i is the share of total investment borne by type of each player. From the formalization of the reservation utilities (3), it is possible to derive this interval for I as $I \in \left(0, \frac{Q(P(Q)-w)}{2}\right]$. Note also that within this interval , $\pi(Q) \geq 0$, and $V(Q) \geq w > 0$.[17]

Now, by constructing the Lagrangian function of the problem (4)[18], we have the following first order conditions for an interior solution ($\theta \in (0,1)$):[19]

$$\frac{\left(U_k\left(\pi\left(Q\left(\theta\right)\right)\right)-\overline{U}_k\right)}{\left(U_\ell\left(V\left(Q\left(\theta\right)\right)\right)-\overline{U}_\ell\right)} = -\frac{\partial\left(U_k\left(\pi\left(Q\left(\theta\right)\right)\right)-\overline{U}_k\right)/\partial Q}{\partial\left(U_\ell\left(V\left(Q\left(\theta\right)\right)\right)-\overline{U}_\ell\right)/\partial Q} \tag{4}$$

[17]The conditions introduced make sure that the firm's fixed cost is never equal to zero otherwise for a pure labour-managed firm the equilibrium quantity decision is trivially satisfied ($Q^* = 0$), (see, for instance, Cremer and Crèmer (1992)). Moreover, when the profit obtained by the firm goes to zero there is no more difference between the behaviour of labour-managed and profit maximizing firms (see, for instance, Drèze (1989)).

[18]See, for details, the appendix .

[19]The value of $\frac{dQ}{d\theta}$, is always positive (see lemma 1) and can be ruled out by the expression (5).

This is a standard result for which, at the interior bargaining solution point, the elasticity of substitution of the net utilities of the two coalitions is equal to their relative contractual power (here, assuming players' symmetry the bargaining power ratio is equal to one), adjusted for the strict concavity of the utility frontier (depending here by the assumption on the demand function).[20]

Before giving a consistent interpretation of the expressions obtained above, we need to assume a given relationship between the firm's output Q and the ownership distribution θ. What it is required is a function $Q(\theta) : [0,1] \rightarrow \Re_+$. It is then necessary to analyze the behavior of the firm in the product market.

2.2 The market game

Let us start this section by characterizing the generic objective function adopted by the firm in the market. The most obvious way to proceed is by building this function as a linear combination of the two negotiators' objective functions (1) and (2), with corresponding weights θ and $(1-\theta)$:

$$\Phi(Q,\theta) = \theta \cdot U_k(\pi(Q)) + (1-\theta) \cdot U_\ell(V(Q)) \tag{5}$$

In the above formulation, the distribution of the firm's ownership θ and $(1-\theta)$, respectively to the public investor and the workers, cooperatively decided according to (4), is assumed to have a direct impact on the firm's decision-making process in the product market. A basic way to look at the expression (6) is that the two coalitions jointly delegate a manager to decide the production level of the firm. This manager simply maximizes the utility functions of the coalitions with respect to the quantity, according to the weight θ decided during the cooperative stage of the analysis. The problem solved by the manager is, thus:

$$\underset{Q\in[0,\infty)}{Max}\, \Phi(Q,\theta) = \theta \cdot U_k(\pi(Q)) + (1-\theta) \cdot U_\ell(V(Q)) \tag{6}$$

whose first order condition is simply given by:[21]

$$\frac{\partial U_k(\pi(Q))/\partial Q}{\partial U_\ell(V(Q))/\partial Q} = -\frac{(1-\theta)}{\theta} \tag{7}$$

The meaning of the expression (8) is that the firm's objective function is maximized when the ratio between marginal contributions of the specific objective functions is equal to the ratio between shares of ownership detained by

[20] For this result see, for instance, Svejnar (1982).

[21] Second order conditions are met by the strict concavity of $\pi(Q)$and $V(Q)$ and of their linear combination (6).

each player.
Now we present a lemma that syntethizes some comparative statics results relevant for the following analysis.

Lemma 1 *The equilibrium quantity is always increased by an increase of the share of public ownership θ, within the interval $\theta \in [0,1]$, and by an increase of the level of physical asset investment I_k within the interval $\theta \in [0,1)$.*

Proof. Totally differentiating the expression (8), the following result is obtained:

$$\frac{dQ^*}{d\theta} = -\frac{\partial S/\partial\theta}{\partial S/\partial Q}$$

where S is the entire expression (8), treated as an implicit function of Q and θ. Since second order condition is met (see footnote 19), the sign of the RHS denominator is negative and all the RHS expression has the sign of its numerator. Thus:

$$\mathrm{Si}\,gn\ \frac{dQ^*}{d\theta} = \mathrm{Si}\,gn\ \frac{\partial S}{\partial\theta} = \mathrm{Si}\,gn\ \left(\frac{\partial U_k\left(\pi\left(Q^*\right)\right)}{\partial Q} - \frac{\partial U_\ell\left(V\left(Q^*\right)\right)}{\partial Q}\right)$$

Now, we need to prove that for $\theta \in (0,1)$, $\frac{\partial U_k(\pi(Q^*))}{\partial Q} > 0$ and $\frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$, while for $\theta = 0$, $\frac{\partial U_k(\pi(Q^*))}{\partial Q} > 0$, $\frac{\partial U_\ell(V(Q^*))}{\partial Q} = 0$, and for $\theta = 1$, $\frac{\partial U_k(\pi(Q^*))}{\partial Q} = 0$, $\frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$.

Let us assume first that $\theta \in (0,1)$. Since in this case θ and $(1-\theta)$ are greater than zero, the left hand side of expression (8) is lesser than zero. This means, that:

$$\mathrm{Si}\,gn\ \frac{\partial U_k\left(\pi\left(Q^*\right)\right)}{\partial Q} \neq \mathrm{Si}\,gn\ \frac{\partial U_\ell\left(V\left(Q^*\right)\right)}{\partial Q}$$

Since $U_\ell\left(V\left(Q^*\right)\right) = \frac{U_k(\pi(Q^*))}{Q} + w$ it ensues that $\frac{\partial U_\ell(V(Q^*))}{\partial Q} = \frac{U_k(\pi)_Q \cdot Q - U_k(\pi)}{Q^2}$, where the subscripts indicates the derivative. For $Q > 0$ the denominator of the expression is positive while observing the numerator it turns out that, if $\frac{\partial U_k(\pi(Q^*))}{\partial Q} < 0$, also $\frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$ (since $U_k\left(\pi\left(Q^*\right)\right) \geq 0$ as far as $I \in \left(0, \overline{I}\right]$). But this contradicts the condition that imposes different signs for the two expressions at the equlibrium quantity. Thus, when $0 < \theta < 1$, $\frac{\partial U_k(\pi(Q^*))}{\partial Q} > 0$, and $\frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$. Now, let us consider the case for $\theta = 0$. From the expression (8) we know that when $\theta = 0$ then $\frac{\partial U_\ell(V(Q^*))}{\partial Q} = 0$. From the fact that $\frac{\partial U_\ell(V(Q^*))}{\partial Q} = \frac{U_k(\pi)_Q \cdot Q - U_k(\pi)}{Q^2}$ it ensues (since $U_k\left(\pi\left(Q^*\right)\right) \geq 0$) that $\frac{\partial U_k(\pi(Q^*))}{\partial Q} > 0$. Finally, for $\theta = 1$, and $\frac{\partial U_k(\pi(Q^*))}{\partial Q} = 0$, from the same expression we derive that $\frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$.

The second part of the lemma, concerning with a change of I_k, is straightforward. Totally differentiating the expression (8) we obtain:

$$\mathrm{Si}\,gn\ \frac{dQ^*}{dI_k} = \mathrm{Si}\,gn\ \frac{\partial S}{\partial I_k} = \mathrm{Si}\,gn\ \left(\theta \frac{\partial^2 U_k\left(\pi\left(Q^*, I_k\right)\right)}{\partial Q \partial I_k} + (1-\theta)\frac{\partial^2 U_\ell\left(V\left(Q^*, I_k\right)\right)}{\partial Q \partial I_k}\right)$$

Using (1) and (2) we notice that $\frac{\partial^2 U_k(\pi(Q^*, I_k))}{\partial Q \partial I_k} = 0$ and $\frac{\partial^2 U_\ell(V(Q^*, I_k))}{\partial Q \partial I_k} > 0$. Thus, whithin the interval $\theta \in [0, 1)$, the sign of $\frac{dQ^*}{dI_k}$ is positive. **(Q.E.D.)**

The results of the lemma are very intuitive. Firstly, increasing θ at the quantity equilibrium point always raises the output, since this increases the weight of the profit function whose derivative is greater or equal to zero and decreases the weight of the value added function, whose derivative is lesser or equal to zero (and they are never both equal to zero). The function $Q^*(\theta) : [0, 1] \rightarrow \Re_+$ is, in fact, monotonically increasing in θ. This result is due to the well known output restrictivity of a per worker value-added maximizing firm (VMF) as compared to a profit maximizing firm (PMF) (Ward (1958)).[22] In the present framework the lemma 1 underlines how in the case of complete or partial employee-privatization the workers' interest in maximizing the per capita utility determines a reduction of the firm's output. The size of this effect can partially be compensated by a high level of firm's physical asset I_k. Also this result is due to the peculiar objective function of a VMF: when the fixed cost I_k increases, the VMF reacts by raising the number of workers and, from here, the output produced.

This representation of the of the employee-managed firm's market behavior stresses two simple facts. On the one hand, since each worker aims at maximizing his individual value added, a partial or complete employee privatization gives rise to an output restriction as compared with the quantity produced when the firm is public. This feature is included in the model in order to characterize an employee owned firm as having an interest in individual rather than total profit. On the other hand, only the need of repaying a relevant fixed cost pushes rational workers towards higher production levels, with the purpose of sharing its burden among a high number of workers.[23]

In what follows, we firstly present some general results which hold true in every market structure. Secondly we compare, simply assuming a linear demand function, the firm's behaviour under monopoly and mixed duopoly types of market. Finally, we present the most meaningful effects raised in the model by the introduction of a firm's internal costs.

[22] We thank an anonymous referee for this suggestion.The result, however, would also hold with more traditional specifications of government and workers' utility. See the appendix for a different treatment of players' objective functions.

[23] Under a higher I_k , however, it will be more difficult in general for the workers to raise a sufficient cash flow to repay the physical asset and enable the employee privatization.

3 The privatization and the market game

In this section we first state some general results obtained by considering the players' behaviour in the complete game. Bargaining and market decisions are simultaneously taken into account. A first result is concerned with the two extreme cases of complete employee privatization and of a fully public firm.

Proposition 1 *(a) In equilibrium all the ownership can be in the hands of workers' coalition* $(\theta^* = 0)$ *only when* $\left(U_\ell - \overline{U}_\ell\right)$ *, that is, when each worker accepts a payoff equal to his reservation utility. (b) Analogously, in equilibrium, all the ownership can be in the hands of the government* $(\theta^* = 1)$ *only when* $\left(U_k - \overline{U}_k\right)$ *, that is, when the firm's value is equal to the tradable value of the firm's physical assets.*

Proof. (See appendix).

What the above proposition states, in effect, is that in order to obtain all the firm's ownership the players have to renounce all the surplus over their reservation utility. This can happen when the level of I_i is high enough to make a coalition's incremental utility equal to zero. The workers or investor's commitment in term of their investment has to be high enough to make them indifferent between negotiating or accepting the disagreement point. Thus, under the assumptions of the model a complete employee privatization is excluded, because the product of players' net utilities can never be maximized when one of the two is equal to zero. This result, depending on the nature of the cooperative solution, can be restated differently by excluding the extrema of the interval for θ and considering a public firm privatized when $\theta^* = (0 + \varepsilon)$, and completely public when $\theta^* = (1 - \varepsilon)$, where ε is an arbitrarily small number. In this way it remains true that when for instance the workers made a very high investment I_l in job training they are entitled to become owners of the firm $(\theta^* = (0 + \varepsilon))$, since the bargaining solution maximizes the net incremental utilities product when θ is close to zero. Similarly, when the government net gain from bargaining is very low because of the high physical asset cost I_k, the government will not be keen to privatize, preferring to mantain the firm public $(\theta^* = (1 - \varepsilon))$.

The next group of results is obtained by handling the simple comparative statics of the complete game at an interior solution point. It holds, with different intensities, for every assumed f irm's market structure. The proofs of these results, mainly rely on the lemma 1.

Proposition 2 *a) If the firm's physical asset* I_k *owned at the beginning of the game by the government changes, while* $I = \sum_{i=k}^{\ell} I_i$ *belongs to the interval* $\left(0, \overline{I}\right]$ *, the equilibrium value for* θ^* *changes in the same direction, that is, if* I_k *increases thus* $\theta^* \rightarrow 1$*; b) A variation of* w*, the current market wage, determines a change in the same direction of* θ^**, that is, if* w *increases thus* $\theta^* \rightarrow 1$*;*

c) Changes on each player's specificity of investment σ_i, inversely affect their possibility to be firm's owners, that is, if σ_ℓ increase, for a given I_ℓ , $\theta^* \to 1$,while if σ_k increase, for a given I_k, thus $\theta^* \to 0$.

Proof.

Firstly, an internal solution for θ is derived by using the two first order conditions (5) and (8):

$$\theta^* = \frac{\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right)}{\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right) + \left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right)}. \tag{8}$$

All the results of the proposition can be obtained by totally differentiating the expression (9) in the text by I_k, w and σ_i $(i = l, k)$.

Result (a): by treating θ^* as a function of I_k, $\theta^*\left(Q^*\left(I_k\right), I_k\right)$, for $\theta^* \in (0, 1)$, we obtain:

$$\frac{d\theta^*\left(Q^*\left(I_k\right), I_k\right)}{dI_k} = \frac{V_{I_k}\cdot\left(U_k(\pi(Q^*)) - \overline{U}_k\right) - \pi_{I_k}\cdot\left(U_\ell(V(Q^*)) - \overline{U}_\ell\right) + \left(U_\ell(V(Q^*)) - \overline{U}_\ell\right)}{\left(\left(U_k(\pi(Q^*)) - \overline{U}_k\right) + \left(U_\ell(V(Q^*)) - \overline{U}_\ell\right)\right)^2} \tag{9}$$

where the subscripts indicate derivatives. We need to prove that the above expression is positive. The denominator is positive while also the numerator is positive since the third term of the (10) is greater than zero for $\theta^* \in (0, 1)$, while V_{I_k}. and π_{I_k} are lesser than zero with $|V_{I_k}.| < |\pi_{I_k}.|$ and $\left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right) < \left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right)$ when I_k starts to increase.

Result (b):by treating θ^* as a function of w, $\theta^*\left(Q^*\left(w\right), w\right)$, we obtain:

$$\frac{d\theta^*\left(Q^*(w), w\right)}{dw} = \frac{\left(V_Q\cdot Q^*_w - 1\right)\left(U_k(\pi(Q^*)) - \overline{U}_k\right) - \left(\pi_Q\cdot Q^*_w - Q^*\right)\left(U_\ell(V(Q^*)) - \overline{U}_\ell\right)}{\left(\left(U_l(V(Q^*)) - \overline{U}_l\right) + \left(U_\ell(V(Q^*)) - \overline{U}_\ell\right)\right)^2} \tag{10}$$

The numerator of the expression is positive for the following reasons:

i) $V_Q < 0$ (see proof of lemma 1) and sign of Q^*_w = sign of $-\theta^* < 0$ for $\theta \in (0, 1)$ so $V_Q \cdot Q^*_w > 0$ and $V_Q \cdot Q^*_w\left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right) > 0$ in the first term;

ii) $Q^*\left(U_l\left(V\left(Q^*\right)\right) - \overline{U}_l\right) > \left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right)$ since $Q^* > L^\circ$;

iii) $\pi_Q \cdot Q^*_w\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right) < 0$, since $\pi_Q > 0$ (see proof of lemma 1) and $Q^*_w < 0$. Thus

$-\ \pi_Q \cdot Q^*_w\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right)$ at the numerator is positive.

Result (c): Following again the same procedure, we have:

$$\frac{d\theta^*}{d\sigma_\ell} = \frac{\frac{I_\ell}{L^\circ}\cdot\left(U_k(\pi(Q^*)) - \overline{U}_k\right)}{\left(\left(U_\ell(V(Q^*)) - \overline{U}_\ell\right) + \left(U_k(\pi(Q^*)) - \overline{U}_k\right)\right)^2} > 0 \tag{11}$$

and,

$$\frac{d\theta^*}{d\sigma_k} = \frac{-I_k \cdot \left(U_k(\pi(Q^*)) - \overline{U}_k\right)}{\left(\left(U_l(V(Q^*)) - \overline{U}_l\right) + \left(U_k(\pi(Q^*)) - \overline{U}_k\right)\right)^2} < 0 \qquad (12)$$

(Q.E.D.)

Looking at the expression (9) the nature of the final decision taken cooperatively by the two representative players becomes clear. When the surplus of each worker is close to zero - due for instance to a high worker investment I_ℓ - and the firm's value is positive, the employee privatization is possible because while the government is available to privatize to obtain a positive firm's surplus, the workers are open to the possibility of becoming owners in order to get something more, however small, over the market wage and their investment in job training. Alternatively, when the firm's value over its reservation value is close to zero, it does not make sense for the government to privatize, so he will keep the ownership and the control of the firm public. Equal shares of surplus, $\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right) = \left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right)$, from (9) give rise to an equal ownership distribution ($\theta^* = \frac{1}{2}$).

All the results of proposition 2 are obtained by the comparative statics of the expression (9).

The result a) comes from the fact that an increase of I_k increases the reservation utility of the government and reduces both $U_\ell\left(V\left(Q^*\right)\right)$ and $U_k\left(\pi\left(Q^*\right)\right)$. The total effect is that the complete acquisition of the firm becomes more expensive and thus more difficult for the workers and at the margin the privatization is less convenient for the government with respect to the firm's reservation value. One way to explain the result c) is by saying that an increase of w has relatively no effect on workers' reservation utility[24] but reduces both $U_\ell\left(V\left(Q^*\right)\right)$and $U_k\left(\pi\left(Q^*\right)\right)$, (the latter proportionally more since w is multiplied by Q), so the final effect is mainly that the workers have a more decisive tendence to remain employees and the government to have a more complete control over the firm. The result c) is even more intuitive: an increase in the players' investment specificity reduces their reservation utilty and then reduces their share of ownership cooperatively decided through the bargaining game. The idea is that a high specific investment makes the parties less keen to risk a breakdown of the negotiation and thus more disposed to mantain the *status quo*.

To conclude, the main information conveyed by the proposition is that an employee privatization yielded by a government-employees negotiation is more likely to arise under a low level of the firm's physical assets, a low level of the market wage and a *not too specific investment* in job training (even if a large

[24] Since $\left(U_l - \overline{U}_l\right) = w + \frac{\pi}{Q} - w - \frac{(1-\sigma_l)I_l}{L^\circ} = \frac{\pi}{Q} - \frac{(1-\sigma_l)I_l}{L^\circ}$, a variation of market wage w has an effect on U_l but not on $\overline{U}_l$.

investment in job training I_ℓ makes the employee privatization relatively more possible).

4 Employee privatization under different market structures

The present section is principally devoted to analysing how different market structures can affect the bargaining game and then the possibility of an employee privatization taking place through a bilateral negotiation among players. For the sake of tractability and comparability of the results some simplifing assumptions are required.[25] The first assumption is the linearity of the demand function:

$$p(Q) = a - Q \tag{13}$$

where a is the usual parameter expressing the market size, such that $a > w$, and Q is the total quantity of product delivered in the market.

The second simplifying assumption requires the symmetry of players' investments, $I_l = I_k = I_i$ and of their relative specificity σ_i, assumed to be equal for both the parties, $\sigma_l = \sigma_k = \sigma$. Finally, the number of workers admitted to bargaining with the government is always assumed to coincide with the equilibrium number of employees, such that $L^\circ = L^* = Q^*$. This set of assumptions allows us to obtain a relatively simple analitical solution to the problem.

Note that when the firm is monopolistic there is no need to change any feature of the model. For the duopolistic case, we consider two different scenarios. Firstly we assume that the bargaining firm's competitor is a traditional profit maximizing firm, while, in a second case, the competitor firm is assumed to be a pure per worker value-added maximizing firm. The firms' objective functions are reported below respectively for the case of the bargaining firm (always labelled firm 1), the PMF competitor and the VMF:

$$\begin{aligned}
\Phi_1(q_1, q_2) &= \theta\left(\left(a - \sum_{i=1}^{2} q_i\right) q_1 - wq_1 - I_k\right) + (1-\theta)\left(\frac{\left(a - \sum_{i=1}^{2} q_i\right) q_1 - I_k}{q_1}\right) \\
\pi_2(q_1, q_2) &= \left(a - \sum_{i=1}^{2} q_i\right) q_2 - wq_2 - I_k \\
V_2(q_1, q_2) &= \frac{\left(a - \sum_{i=1}^{2} q_i\right) q_2 - I_k}{q_2}
\end{aligned}$$

[25] The main results hold, however, in a more general framework.

where q_i $(i = 1, 2)$ is the output of each firm. Note that for simplicity the level of physical asset required in the market to run a firm is assumed to be the same for all types of firms and equal to I_k. Relegating in the appendix the details about the application of the lemma 1 and of the bargaining game to the duopolistic framework, we firstly report the results obtained for θ^*, $q_1^*(\theta^*)$ and $q_2^*(q_1^*(\theta^*))$ in the three market structures considered (labelled M for the monopoly, PM for the duopoly with a profit maximizing firm and VM for the duopoly with a value added maximizing firm) by assuming that the contractual firm plays as a leader in a Stackelberg game; secondly we summarize in a table the threshold levels of investment I_i, wage w and specificity of investment σ such that θ^*goes respectively to zero and one.

Thus, for the monopoly the equilibrium quantity is:

$$Q^{M*}(\theta^*) = \frac{a - w - \mu}{2} \tag{14}$$

where

$$\mu = \sqrt{4I_i(\sigma - 2) + (w - 1)^2}$$

and the equilibrium ownership distribution $\theta^*$is:

$$\theta^* = \frac{\mu(w - a) + 2I_i(\sigma - 3) + (w - a)^2}{\mu(2\sigma I_i - 4I_i + w^2 - w) + 2I_i(2\sigma w - \sigma - 4w + a) + w(w - a)} \tag{15}$$

For the duopoly with a maximizing firm (PMF) the equilibrium values are:

$$q_1^{PM*}(\theta^*) = \frac{a - w - \nu}{2} \tag{16}$$

$$q_2^{PM*}(q_1^*(\theta^*)) = \frac{a - w + \nu}{2} \tag{17}$$

$$\theta^* = \frac{\nu(w - a) + 2I_i(2\sigma - 5) + (w - a)^2}{\nu(3\sigma I_i - 6I_i + w^2 - w) + I_i(7\sigma w - 3\sigma - 14w + 4a) + w(w - a)^2} \tag{18}$$

where

$$\nu = \sqrt{8I_i(\sigma - 2) + (w - 1)^2}$$

and finally for the duopoly with a per worker value-added maximizing firm (VMF):

$$q_1^{VM*}(\theta^*) = \frac{a - w - \xi}{2} \tag{19}$$

$$q_2^{VM*}(q_1^*(\theta^*)) = \sqrt{I_i} \tag{20}$$

$$\theta^* = \frac{\xi\left(\sqrt{I_i}+w-a\right)+2\sigma I_i-5I_i+2\sqrt{I_i}(w-a)+(w-a)^2}{\xi\left(I_i(2\sigma-3)+\sqrt{I_i}(2w-1)+w(w-1)\right)+I_i^{\frac{3}{2}}(4\sigma-7)+I_i(4\sigma w-2\sigma+5w)+\sqrt{I_i}(w-a)(3w-a)+w(w-a)^2} \tag{21}$$

where

$$\xi = \sqrt{I_i(4\sigma-7)+2I_i^{\frac{1}{2}}(w-a)+(w-a)^2}$$

CASES	MONOP.	DUOP. (PM)	DUOP.(VM)
$\underline{I}_i \Rightarrow \theta^* = 0$	$\frac{(w-a)^2}{(\sigma-3)^2}$	$\frac{(w-a)^2}{(2\sigma-5)^2}$	$\frac{(w-a)^2}{(\sigma-4)^2}$
$\overline{I}_i \Rightarrow \theta^* = 1$	$\frac{(w-a)^2}{4(2-\sigma)}$	$\frac{(w-a)^2}{9(2-\sigma)}$	$\frac{(w-a)^2(9-4\sigma)-4(w-a)^2\sqrt{2-\sigma}}{4(2-\sigma)}$
$\underline{w} \Rightarrow \theta^* = 0$	$a-\sqrt{I_i}(3-\sigma)$	$a+2\sqrt{I_i}(2\sigma-5)$	$a+\sqrt{I_i}(\sigma-4)$
$\overline{w} \Rightarrow \theta^* = 1$	$a-2\sqrt{I_i}\sqrt{2-\sigma}$	$a-3\sqrt{I_i}\sqrt{2-\sigma}$	$a-\sqrt{I_i}-2\sqrt{I_i}\sqrt{2-\sigma}$
$\underline{\sigma} \Rightarrow \theta^* = 0$	$\frac{3-(a-w)}{\sqrt{I_i}}$	$\frac{5\sqrt{I_i}+w-a}{2\sqrt{I_i}}$	$\frac{4\sqrt{I_i}+w-a}{\sqrt{I_i}}$
$\overline{\sigma} \Rightarrow \theta^* = 1$	$\frac{8I_i-(a-w)^2}{4I_i}$	$\frac{18I_i-(a-w)^2}{9I_i}$	$\frac{7I_i+2\sqrt{a-w}-(a-w)^2}{4I_i}$

Tab. 5.1 Thresholds level of I_i, w and σ for different market structures.

A very straightforward computation of the threshold levels for I_i, w and σ in the different market structures, shows how the market environment in which the contractual firm operates affects the results of the bargaining game. There exists, in other words, a rank of the threshold levels associated with each different market structure. This rank suggests that more competitive market structures are associated with relatively lower possiblities that the employee privatization takes place. The next proposition expresses this result.

Proposition 3 *Under the assumptions of the model the levels of $\underline{I}_i$, $\underline{w}$ and $\underline{\sigma}$ such that the firm's equilibrium ownership distribution implies a complete $(\theta^* = 0)$ or quasi-complete employee privatization $(\theta^* = 0 + \varepsilon)$ are ranked in the following way: $\underline{I}_i^M > \underline{I}_i^{VM} > \underline{I}_i^{PM}$, $\underline{w}^M > \underline{w}^{VM} > \underline{w}^{PM}$ and $\underline{\sigma}^M > \underline{\sigma}^{VM} >$*

$\underline{\sigma}^{PM}$. *Associating the degree of competition of a market structure with the total equilibrium quantity* $\left(Q^{PM*} > Q^{VM*} > Q^{M*}\right)$, *it ensues that higher degrees of market competition make less possible (when considered in terms of threeshold level of the parameters) that the bargaining game leads to an employee privatization of the firm.*

Proof. See appendix.

The technical explanation of the above proposition is concerned with the different impact that the investment, the wage and the asset specificity have on the bargaining firm's equilibrium revenue. It is clear that the higher the level of competition in the market is, the lower the equilibrium value of the revenue will be. Consequently, the value of the government's net surplus $\left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right)$ is more sensitive to the value of the parameters the higher the degree of competition is. At the same time, because of the peculiar objective function assumed for the workers, the value of the workers' surplus $\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right)$, is less sensitive to the value of parameters and thus to the degree of market competition.[26] When interpreted strategically, what was stated before can be restated by saying that quantity competition reduces the market output and induces the intra-firm coalitions to cooperatively adopt a more aggressive attitude in the market. In a duopolistic market rational players will usually prefer to adopt the profit maximization than the more restrictive per capita value added maximizing objective function. From this point of view, giving a greater weight on the government's objective function becomes a better option in duopoly than in monopoly as compared with the individual profit maximization associated with the workers' ownership.

5 X-inefficiency and privatization

The next step of this paper is to consider how an internal cost borne by the public firm, assumed to vary with the public share of firm's ownership, affects the decision to privatize the firm. The reason for exploring this topic lies in the often debated internal inefficiency of public firms as compared with the possibly higher internal efficiency generally expected from the employee-owned firms.[27] The point of interest is to analyse how this feature, exogenously introduced

[26] The different sensitivity of π and V with respect to a variation of I_k can be found, for instance, in Neary and Ulph (1994). Note that when I_k rises I_ℓ rises as well (for the assumption that $I_k = I_\ell$) reducing the impact on θ^*; the positive effect of I_k on θ^* , however, prevails on the negative effect of I_ℓ.

[27] Surveys on public firms' performances are included, for instance, in Marchand, Pestieau and Tulkens (1984), Bös (1991), Vickers and Yarrow (1991) and Laffont and Tirole (1993). Though usually motivated by insufficient monitor arrangements, sometimes the x-inefficiency of public firms is exogenously introduced as due to "managers' slackness" (see, for instance, Selten (1986) and De Fraja (1991)). Here we follow this second route. For a review of the labour managed firms performances literature see, for instance, Ireland and Law (1982).

in the model, may affect the ownership distribution equilibrium studied above. By simply assuming a given x-inefficiency cost related to the public form of ownership and variable with the firm's output, $\gamma = \gamma(\theta)Q$, ($\gamma' > 0$, $\gamma(0) = 0$, $\gamma(1) = \gamma$), we can observe which are the most immediate consequences for the analysis.[28]

By including the x-inefficiency cost into the expressions (4) and (6) and computing the first order conditions, the following expression for θ^* ensues:

$$\theta^* = \frac{\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right)}{\left(U_\ell\left(V\left(Q^*\right)\right) - \overline{U}_\ell\right) + \left(U_k\left(\pi\left(Q^*\right)\right) - \gamma Q^* - \overline{U}_k\right)} \tag{22}$$

The effect of the x-inefficiency cost γ is thus mainly which to reduce the firm's surplus when the ownership is public. By considering the value of θ^* as a function $\theta^*\left(Q^*\left(\gamma\right), \gamma\right)$, $\theta^*\left(q_1^*\left(\gamma\right), q_2^*\left(\gamma\right), \gamma\right)$ or $\theta^*\left(q_1^*\left(\gamma\right), q_2^*, \gamma\right)$repectively in the case of monopoly, duopoly with a PMF and duopoly with aVMF (in this case the competitor's quantity is not affected by γ), the expression (16) can be totally differentiated in order to obtain the result of the next proposition.

Proposition 4 *The presence of an inefficiency cost $\gamma = \gamma(\theta)Q$ related to the public share of firm's ownership θ, taking the form of a variable cost with respect to the output produced, makes an employee privatization more suitable than under its absence ($\theta^{\gamma *} < \theta^*$) if the following conditions hold: $\left|\frac{dQ^*}{d\gamma}\gamma\right| > \left|Q^* + \frac{d\pi}{dQ}\frac{dQ^*}{d\gamma}\right|$ for the monopoly case, $\left|\frac{dq_1^*}{d\gamma}\gamma + \frac{\partial\pi}{\partial q_1}\frac{q_1^*}{q^{*2}}\frac{dq_2^*}{d\gamma}\right| > \left|q^* + \frac{\partial\pi}{\partial q_1}\frac{dq_1^*}{d\gamma}\right|$ for the duopoly with a PMF, and $\left|\frac{dq_1^*}{d\gamma}\gamma\right| > \left|q^* + \frac{\partial\pi}{\partial q_1}\frac{dq_1^*}{d\gamma}\right|$ for the duopoly with a VMF.*

Proof. See appendix.

The explanation of the result presented above relies on two opposite effects raised by the presence of an x-inefficiency cost: on the one hand, since this cost is associated only with the public objective function, it reduces the government's surplus of a magnitude $\left(\frac{d\pi}{dQ}\frac{dQ^*}{d\gamma}\right)$, making the government relatively less disposed to the employee privatization as stated by the proposition 1; on the other hand, the presence of the inefficiency cost pushes the players toward the choice of the objective function $U_\ell\left(V\left(Q^*\right)\right)$because the reduction of the equilibrium quantity $\left(\frac{dq_1^*}{d\gamma}\gamma\right)$due to the inefficiency cost requires a lower θ^*(see lemma 1). Under a duopolistic market structure and a PMF type of competitor, as far as an analogous x-inefficiency cost is assumed for this competitor (as due, for instance, to the PMF managers' slackness similar to that assumed for the public

[28]In the appendix we suggest a very simple way to derive a specific functional form for this internal cost.

firm), the possibility that the inefficiency cost induces an employee privatization increases, with the relative advantage represented in the expression by the term $\left(\frac{\partial \pi}{\partial q_1} \frac{q_1^*}{q^{*2}} \frac{dq_2^*}{d\gamma}\right)$. Conversely, when there is a VMF as competitor, since this firm does not bear the internal cost, the problem faced by the contractual firm is quite similar to that observed in the monopolistic market.

Thus, what the proposition above shows is that the firm's reaction to the x-inefficiency cost related to the final ownership distribution depends both on the market structures and on the nature of the firm's competitors. When the market is duopolistic and the competitor is a profit-maximizing firm, the presence of an internal cost makes workers' ownership more suitable than under monopoly or duopoly with a VMF. When interpreted as a comparative disadvantage, this relative inefficiency of a public firm makes an employee privatization plan advantageous in terms of the market share gains associated to the reduction of costs.

6 Concluding remarks

About ten years ago the Employee Shares Ownership Schemes (ESOP's) became popular in United States, United Kindom and other Western countries. These schemes arose to save some firms from bankruptcy and their workforces from losing their jobs and the specific skills they had acquired through working within the firm for a long time. At that time this solution probably signified an unusual change of attitude for countries in which employee ownership and labour-managed firms represented an exception to the prevailing capitalistic firms.

Central and Eastern European countries, conversely, have always been more keen in workers' participation - though not in formal ownership - in firm's decision-making. It is thus not so unnatural that, during the transition period, when nationalized firms' privatization is a priority for the Eastern and Central European countries, sometimes public firms' employees spontaneously elect themselves as eligible to be the potential decision-makers and owners of newly privatized firms. This process, of course, does not always appear as a first-best privatization procedure when the main problem of the public firms is that of raising sufficient physical assets and fresh financial funds necessary to the firm's survival and growth, especially when there are other financial investors available. In many intermediate cases, however, for high labour-intensive medium and small firms that are not particularly starving for capital and in absence of available alternatives, employee privatization can be considered a concrete option.

The model presented above, by representing the privatization as a bargaining process between government and workers, underlines limits and advantages of the employee-privatization of a public firm. A first limit exists when firm's physical asset is very high. Two reasons, one concerning the firm's profitability and the other the firm's market strategy, represent possible limits to the employee privatization. The nature of the model presented above matches the often observed empirical evidence that employee-owned firms are more restrictive and smaller than the private firms. When the physical asset investment inherited by the public firm is very high, the employee-privatized firm increases the production in order to cover the fixed costs and repay the firm's shares, thus changing the firm's objective function from a pure value-added to a pure a profit maximizing one. The strategic limit arises conversely when the firm faces the market competition: the model shows that when there is a PMF competing in the product market, the contractual firm has an advantage to behave as a PMF, and this presumibly explains why the public firm may be refrained by adopting a "democratic" ownership structure.

The model offers an opposite prediction when there is a high workers' tradable human capital. Here, the employees have a great incentive to become firm's owner in order to obtain a higher share of its surplus and moreover they have more bargaining power during the negotiation process due to the higher reservation wage (inclusive of the human tradable capital). This is more likely to happen when the market competition is not very intense (ex. a monopoly) so the dimension of the firm does not affect the market share and the firm's profitability. When a high investment in human capital is associated with a relevant x-inefficiency of the public firm, as for instance in the presence of a high cost of monitoring workers' and managers' shirking, and this problem is shared in the market with other firms, the employee privatization offers an advantage, assuming of course, that the members of an employee owned firm do not shirk. A further indication of the model concerns the procedure of an employee privatization: there is an inherent difficulty in obtaining a complete employee-privatization through the bargaining process since the complete privatization in a bargaining model raises as a corner solution and implies zero of workers' net utility. This result can be interpreted by saying that in general, if the public authorities do not enforce or give an incentive for an employee privatization program, it may be difficult for players to obtain it by spontaneous negotiation. A clear indication emerging however from the results of the model is that the set of conditions required for a firm's employee privatization are more likely to arise in Central and Eastern European countries than in theWestern European ones, making more likely negotiated employee ownership privatizations in the former rather than in the latter. It is not implausible, however, that in the presence of a negative business cycle, low wages and low competition, Western countries too may witness a growing rate of employee take-overs of liquidated private and public firms.

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7 Appendix

7.1 A different specification of the model

Before of presenting the proofs of the different propositions and the changes necessary to introducing into the model the duopolistic market structure, we sketch here some results obtained by using in the game a different specification of the players'utilities. The idea is which to represent both the aim of the government to maximize the consumers' surplus (beside the firm's value) and the workers' interest in the level of employment (a part from their specific concern with the per capita value-added). This can be done by representing the two players' utilities as:

$$\left\{ U_k = \left(\int_{Q=0}^{Q^*} p(Q)\, dQ + \pi(Q) \right),\ U_\ell = V(Q) \cdot L \right\}. \tag{A1}$$

so to obtain:

$$\begin{aligned} &\underset{Q}{Max} \Phi(Q, \theta) = \theta \cdot U_k(Q) + (1-\theta) \cdot U_\ell(Q) \cdot Q = \\ &= \theta \left(\int_{Q=0}^{Q^*} p(Q)\, dQ + \pi(Q) \right) + (1-\theta) \left(wQ + \frac{\pi(Q)}{Q} Q \right) \end{aligned} \tag{A2}$$

whose first order condition is, by using the specification of the section 4:

$$\begin{aligned} 0 &= \frac{\partial \left(\theta \left(aQ - \frac{1}{2}Q^2 + (a-Q)Q - wQ - I_k \right) + (1-\theta)\left((a-Q)Q - I_k \right) \right)}{\partial Q} = \\ &= \theta(2a - 3Q - w) + (1-\theta)(-2Q + a) \end{aligned}$$

with solution:

$$Q^*(\theta) = \frac{\theta a - \theta w + a}{\theta + 2} \tag{A3}$$

It is immediate to check that the first part of the lemma 1 also holds for this specification of the players'utilities (as far as $a > 2w$):

$$\frac{d\left(\frac{\theta a - \theta w + a}{\theta + 2}\right)}{d\theta} = \frac{a - 2w}{(\theta + 2)^2} > 0 \tag{A4}$$

Thus as far as the public firm is more espansive in term of quantity delivered in the market than the employee privatized firm, the bargaining solution associated to the market solution gives rise to results very similar to which presented in the paper.

7.2 Proof of proposition 1

By constructing the Lagrangean function of the problem (4) the following first order condition is obtained:

$$\frac{\partial L(\theta,\lambda)}{\partial\theta} = \frac{\partial\left(U_k(\pi(Q^*))-\overline{U}_k\right)}{\partial Q}\frac{dQ}{d\theta}\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)+\frac{\partial\left(U_\ell(V(Q^*))-\overline{U}_\ell\right)}{\partial Q}\cdot$$

$$\cdot\frac{dQ}{d\theta}\left(U_k\left(\pi\left(Q^*\right)\right)-\overline{U}_k\right)-\lambda\leq 0$$

$$\theta^*\geq 0, \theta^*\cdot\frac{\partial\left(U_k(\pi(Q^*))-\overline{U}_k\right)}{\partial Q}\cdot\frac{dQ}{d\theta}\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)+\frac{\partial\left(U_\ell(V(Q^*))-\overline{U}_\ell\right)}{\partial Q}\cdot \quad (A5)$$

$$\cdot\frac{dQ}{d\theta}\left(U_k\left(\pi\left(Q^*\right)\right)-\overline{U}_k\right)-\lambda=0$$

$$\frac{\partial L(\theta,\lambda)}{\partial\lambda}=(1-\theta^*)\geq 0, \lambda^*\geq 0, \lambda^*\left(1-\theta^*\right)=0$$

while the second order condition holds:

$$\frac{\partial^2 U_k(\pi(Q^*))}{\partial Q^2}\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)+\frac{\partial^2 U_l(V(Q^*))}{\partial Q^2}\left(U_k\left(\pi\left(Q^*\right)\right)-\overline{U}_k\right)+$$

$$+2\left(\frac{dU_k(\pi(Q^*))}{dQ}\cdot\frac{dU_\ell(V(Q^*))}{dQ}\right)<0$$

Now, we first prove **part (a)** of proposition 1. When $\theta^*=0$, it follows from the third expression of FOC (A5) that $\lambda=0$, that is, the constraint is not binding. Then, for θ^* to be the maximum of the problem (4) it is necessary that, at an equilibrium point:

$$\frac{\partial\left(U_k(\pi(Q^*))-\overline{U}_k\right)}{\partial Q}\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)+\frac{\partial\left(U_\ell(V(Q^*))-\overline{U}_\ell\right)}{\partial Q}\left(U_k\left(\pi\left(Q^*\right)\right)-\overline{U}_k\right)\leq 0 \quad \text{(A6)}$$

From the lemma 1 we know that when $\theta^*=0$, $\frac{\partial U_\ell(V(Q^*))}{\partial Q}=0$ and $\frac{\partial U_k(\pi(Q^*))}{\partial Q}>0$. Since $\frac{\partial\left(U_k(\pi(Q^*))-\overline{U}_k\right)}{\partial Q}=\frac{\partial U_k(\pi(Q^*))}{\partial Q}>0$ and $\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)\geq 0$ by assumption, the first term of (A6) can be just greater or equal to zero. Now, looking at the second term of (A6), we know that $\frac{\partial\left(U_\ell(V(Q^*))-\overline{U}_\ell\right)}{\partial Q}=\frac{\partial U_\ell(V(Q^*))}{\partial Q}=0$ and then this term is equal to zero. As a consequence, the expression (A6) can be respected only with the sign of equality. This can happens only when $\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)=0$.

Part (b) When $\theta^*=1$, we obtain from the third expression of FOC (A5) that $\lambda>0$ and then the constraint is binding. Then, for θ^* to be the maximum of the problem (4) it is necessary that an equilibrium point:

$$\frac{\partial\left(U_k(\pi(Q^*))-\overline{U}_k\right)}{\partial Q}\left(U_\ell\left(V\left(Q^*\right)\right)-\overline{U}_\ell\right)+\frac{\partial\left(U_\ell(V(Q^*))-\overline{U}_\ell\right)}{\partial Q}\left(U_k\left(\pi\left(Q^*\right)\right)-\overline{U}_k\right)\geq 0 \quad \text{(A7)}$$

From the lemma 1 we know that when $\theta^* = 1$, $\frac{\partial U_k(\pi(Q^*))}{\partial Q} = 0$ and $\frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$. Since $\frac{\partial\left(U_k(\pi(Q^*))-\overline{U}_k\right)}{\partial Q} = \frac{\partial U_k(\pi(Q^*))}{\partial Q} = 0$ the first term of (A7) is equal to zero and the second term is lesser than zero since $\frac{\partial\left(U_l(V(Q^*))-\overline{U}_l\right)}{\partial Q} = \frac{\partial U_\ell(V(Q^*))}{\partial Q} < 0$. As a consequence, the expression (A7) can be respected only when $\left(U_k\left(\pi\left(Q^*\right)\right) - \overline{U}_k\right) = 0$. **(Q.E.D.)**

7.3 The duopolistic framework

Now, we introduce in more detail the duopolistic framework adopted in the section 4 to yields some comparative statics results.

The main assumption used in the text is that during the bargaining game the firm 1 (the firm that has to decide about its new ownership status) takes into account the fact that the output of the competing firm (the firm 2) also depends on θ through the firm's one quantity, that is, $q_2 = q_2\left(q_1\left(\theta\right)\right)$. In this case, the bargaining game becomes:

$$\underset{\theta}{Max}\ N(q_1(\theta),q_2(q_1(\theta)))=\left(U_k(\pi(q_1(\theta),q_2(q_1(\theta))))-\overline{U}_k\right)\left(U_\ell(V(q_1(\theta),q_2(q_1(\theta))))-\overline{U}_\ell\right)$$
$$s.t.\ \theta\in[0,1],\ U_i\geq\overline{U}_i,\ (i=\ell,k)$$

and the first order condition is:

$$\left(\frac{\partial\left(U_k(\pi(q_1(\theta),q_2(q_1(\theta))))-\overline{U}_k\right)}{\partial q_1}\frac{dq_1}{d\theta} + \frac{\partial\left(U_k(\pi(q_1(\theta),q_2(q_1(\theta))))-\overline{U}_k\right)}{\partial q_2}\frac{\partial q_2}{\partial q_1}\frac{dq_1}{d\theta}\right)\cdot$$

$$\cdot\left(U_\ell\left(V\left(q_1\left(\theta\right), q_2\left(q_1\left(\theta\right)\right)\right)\right) - \overline{U}_\ell\right) =$$

$$-\left(\frac{\partial\left(U_\ell(V(q_1(\theta),q_2(q_1(\theta))))-\overline{U}_\ell\right)}{\partial q_1}\frac{dq_1}{d\theta} + \frac{\partial\left(U_\ell(V(q_1(\theta),q_2(q_1(\theta))))-\overline{U}_\ell\right)}{\partial q_2}\frac{\partial q_2}{\partial q_1}\frac{dq_1}{d\theta}\right)\cdot$$

$$\cdot\left(U_k\left(\pi\left(q_1\left(\theta\right), q_2\left(q_1\left(\theta\right)\right)\right)\right) - \overline{U}_k\right)$$

The results in section 4 are obtained by solving simultaneously the following equations:

$$\begin{cases} \theta\left(-2Q + a - w\right) + \left(1-\theta\right)\frac{-2Q+a}{Q} - \left(1-\theta\right)\frac{(a-Q)Q-\sum I_i}{Q^2} = 0 \\ (a-2Q-w)\left(\frac{(a-Q)Q-\sum I_i}{Q} - w - \frac{I_i(1-\sigma)}{Q}\right) + \left(-1+\frac{I_i(2-\sigma)}{Q}\right)\left((a-Q-w)Q-\sum I_i - I_i(1-\sigma)\right) = 0 \end{cases}$$

for the monopoly,

$$\left\{\begin{array}{l} -3\theta q_1^3 + q_1^2\left(3a\theta - \theta w - 2a\right) + 2\left(a-\theta\right)\sum I_i = 0 \\ \\ \left(\frac{a-2q_1-w}{2}\right)\left(\frac{\left(\frac{a-q_1+w}{2}\right)q_1 - \sum I_i - I_i(1-\sigma)}{q_1} - w\right) + \\ +\left(-1+\frac{I_i(2-\sigma)}{q_1}\right)\left(\left(\frac{a-q_1+w}{2}\right)q_1 - wq_1 - \sum I_i - I_i(1-\sigma)\right) = 0 \end{array}\right.$$

for the duopoly with a PMF, and

$$\left\{\begin{array}{l} -2\theta q_1^3 + q_1^2\left(2a\theta - \theta w - a - \theta\sqrt{\sum I_i}\right) + \left(a-\theta\right)\sum I_i = 0 \\ \\ \left(a-2q_1-w-\sqrt{\sum I_i}\right)\left(\frac{\left(a-q_1-w-\sqrt{\sum I_i}\right)q_1 - \sum I_i - I_i(1-\sigma)}{q_1} - w\right) + \\ +\left(-1+\frac{I_i(2-\sigma)}{q_1^2}\right)\left(\left(a-q_1-w-\sqrt{\sum I_i}\right)q_1 - wq_1 - \sum I_i - I_i(1-\sigma)\right) = 0 \end{array}\right.$$

for the duopoly with a VMF.