Municipal capitalism, regulatory federalism and politics

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2011

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Abstract

The phenomenon of municipal capitalism, which characterizes many local governments in Italy and Europe has been subject to many studies, but none have tried to model what this could imply for the choice of the optimal regulatory rule, nor for the vertical allocation of regulatory tasks among the various levels of government.

The Author first considers the case in which a benevolent regulator -at the central or local level- chooses the cost reimbursement rule. Then, the model will be expanded in order to analyze the effects that a partisan planner has on regulation.

1 Introduction

Starting from the UK in the 1980s, countries all over the world (Bortolotti and Milella, 2006) began privatizing many local services in the name of rationalizing and reducing public debt and expenditure (Vickers and Yarrow, 1991; Bortolotti et al., 2003), as well as increasing efficiency. So why do governments, especially at the local level, still own shares in these privatized firms?

Governments still control -through voting rights and/or golden shares- a large portion of these privatized firms, particularly in strategic sectors such as utilities and transportation (Boubakri et al., 2009) which are characterized by bigger and more valuable companies. Privatizing these sectors generally creates public discontent, also because they tend to be

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natural monopolies (raising political and regulatory issues). Bortolotti and Faccio (2004) show that not only have governmental shares not changed over time, but also that this phenomenon -defined as *reluctant privatization*- does not seem to have decreased the firms' market value[1] nor their performance. Note that reluctant privatization involves the transfer of ownership rights, without the contextual transfer of control rights: this divergence can create a higher risk of expropriation for minority shareholders, and sometimes can make managers pay higher dividends in order to signal their commitment (Faccio et al., 2001).

Different levels of government are involved: national governments, governmental agencies, and also local authorities. This is particularly true at the municipal level, with the local authority acting as the main shareholder in the majority of cases (Boubakri et al., 2005).

A spontaneous question arises: why is this form of 'capitalism' mainly a municipal phenomenon. A plausible answer is that the firms operating in some of these sectors (i.e. gas, electricity) are highly profitable; hence, local administrators can use them to counterbalance the negative results of firms operating in other (costly) sectors, or to increase their revenues through dividends, using them for other purposes, and helping the local government to somehow elude budget constraints imposed by the central government[2].

Moreover, given that one of the key objectives of privatization is to make profit maximization the sole objective of the firm while also eliminating the political ones that typically characterize State Owned Enterprises (Shleifer and Vishny, 1994; Boycko et al., 1996), the presence of this residual governmental control can create contrasting objectives.

This gives rise to a twofold issue. The fact that municipal governments still retain high shares in the firms they should have privatized and that they usually still regulate, decreases not only the transparency of their relation with the firm's manager (since they can distribute rents across players and also have better access to the manager's information), but also the transparency to their electorate, since the local government's political orientation can change the effect on outcomes, depending whether the political agenda is aligned or not with its objectives as a shareholder.

The present paper will approach a very common problem in regulation: the choice of the cost reimbursement rule under incomplete information regarding the efficiency of the firm. This is used to compare how the central and local levels of government perform in giving incentives to the manager, in order to understand the effectiveness of the privatization process

[1] The hypothesis is that the goverments' reluctance to privatize should negatively affect the firm's market value. In the empirical analysis, the variable used to compare the firm's market value of the reluctantly privatized firms with respect to their completely private counterparts is the market-to-book ratio, which is defined as the ratio of market value of ordinary and preferred equity to the book value of equity.

[2] As hypothesized by Bianchi et al. (2010) in the case of Italy.

taking into account the fact that the local government has a special link with the manager, since it is also a member of the shareholders board. The element of political inefficiency will also be considered: regulators have a private agenda, and they can use regulatory policy to favour that group of citizens which supports them. In this case, the fact that the local government is a shareholder can either provide support for the political objectives if it is pro-shareholder, or can create conflict when it is pro-consumer.

The next Section gives an overview of the literature on federalism, regulation and political economy, highlighting the points they have in common or which can be linked in order to explain the above mentioned issues. Section 3 presents the institutional details of the problem at hand. In Section 4, the basic model is presented. In Section 5, the model will be extended allowing for a non-benevolent government. Section 6 concludes.

2 Literature review

As already mentioned, privatization has had the multipurpose of reaching gains in efficiency, avoiding wastes, improving performance, and relieving the State budget. In parallel, the academic debate on ownership structure -starting from Sappington and Stiglitz privatization theorem (1987)- has flourished.

Traditionally, ownership issues have been studied using the principal-agent theory (see Shapiro and Willig, 1990; Laffont and Tirole, 1993) or the contract incompleteness approach (Grossman and Hart, 1986; Schmidt,1996)[3].

However, the government often has its own objectives, such as obtaining and maintaining political support which leads to behaviors that are very different from welfare maximization. This means that inefficiencies can also come from the fact that politicians apply policies which are meant to win the support of their voters, while interest groups may try to corrupt them to obtain higher rents[4]. The Chicago and Virginia schools (1970-80s) were the first to give a theoretical treatment of the problem of lobbying, which was later modeled through the principal-agent approach (Laffont and Tirole, 1993) and the contract incompleteness approach (Grossman and Helpman, 1994). Recently, the topic has been integrated with political economy issues such as voting (Faulhaber, 2003; Mu, 2009) and political accountability

[3] In the first case, the problem is that the firm's objective, profit maximization, is different and usually at odds with the government's objective of welfare maximization, and the shareholders are typically more informed than the bureaucrats. In the second case, the problem is the impossibility of a credible commitment.

[4] The importance of the problem of political connections *per se*, their bidirectionality, and the fact that they can entail many forms of preferential treatment, is a central topic for economists (Shleifer and Vishny, 1994; Faccio, 2006).

(Besley and Coate, 2003; Guerriero, 2008).

Thus, it is apparent that a regulatory issue such as the choice of ownership structure cannot be analyzed without also taking into consideration the nature and causes of the ties between politicians and firms: note that it is the presence of asymmetric information that makes these links possible. Laffont (1996) and Martimort (2006) show how the regulatory process is not only characterized by economic inefficiencies (i.e. asymmetric information on the efficiency parameter of the firm), but also by some form of contractual incompleteness (e.g. non-benevolent politician, limited commitment) influencing the way information is distributed and consequently also the trade-off between efficiency and rent extraction.

Traditionally, the main concern in regulation has been the choice of the optimal regulatory rule. However, some general statements in the literature on fiscal federalism can be also applied to regulatory policies (Trillas, 2008): it is important not only to choose the best regulatory rule, but also to study which is the most appropriate (vertical) level of implementation.

From Oates' decentralization theorem (1972), a central question in federalism has been which tasks and responsibilities[5] should be decentralized and to what degree. As privatization, fiscal federalism has been implemented in many countries all over the world in an attempt to restructure the public sector, thereby increasing the autonomy and efficiency of the lower levels of government.

Starting from these considerations, it can be said that the vertical allocation of powers can increase the efficiency of regulation (Laffont, 2000, ch.9); nevertheless, the fact that the local government is also a shareholder will likely modify the effect a federalist approach on regulation.

Moreover, it should be taken into account that the level of (de)centralization can have different implications for the degree of influence that citizens are able to exert on politicians.

This is why more recently, the problems of lobbying (Bardhan and Mookherjee, 2000; Bordignon et al., 2005) and political accountability (Seabright, 1996; Laffont and Pouyet, 2003; Tommasi and Weinschelbaum, 2007) have been dealt with a federalist approach. An important question to ask is which is the better level with which to deal with capture and which provides the best political accountability.

Many elements concur with the decision of the best regulatory level, where centripetal and

[5] It has always been argued that local governments, being closer to the citizens in their districts, have better knowledge of their preferences (but also of local costs and demand), and can provide a combination of services and taxes more coherent with local needs, even if they are limited by the inability to internalize the possible spillover effects and to exploit the economics of scale. For an exhaustive survey on the topic, see Oates (1999, 2005).

centrifugal forces seem to coexist (Alesina and Spolaore, 2003). Local regulators have a better knowledge of local conditions (Trosken, 1996); but more cooperation between vertical levels, and redistribution between horizontal levels are still needed. Moreover, while it is easier for interest groups to organize and capture the local regulator, and they have a greater interest in doing so (Easterbrook, 1983), given that the stakes involved are higher, decentralization may be the only way to limit the power of the Leviathan[6] (i.e. central government).

In conclusion, we need to identify whether a central or a local politician is more suitable for dealing with the regulated firm. This cooperation between the traditional topics of regulation and the federalist approach has given start to what has been defined as 'regulatory federalism' (Trillas, 2008). This approach can be useful not only in finding out which is the best level for dealing with the policy distortions resulting from lobbies, but also in understanding if the subsidiarity principle is effective, and/or if there should be a stronger role of the regulator at the European level.

Although municipal capitalism[7] is likely to be an important issue for policy-makers, as far as the Author knows, there are no theoretical contributions on the topic.

Branco and Mello (1991) and Perotti (1995), focus on political motivations, within the more general topic of partial privatization; they demonstrate that the gradualness and underpricing of sales to private investors are used by politicians as signals of being a committed government. However, they start from the assumption that in the end all shares will be relinquished, yet this is not what happens in reality, and this fact is likely to raise questions on the firm's efficiency and of the role of the regulator.

A second issue to further consider is that capitalism is mainly a local phenomenon; a comparison of local and central regulation, taking this fact into account, seems to be missing in the existing literature. The model in Section 4 is orientated on the regulatory side (or, better, on the side of regulatory federalism): the main objective is to compare the outcomes (in efficiency, citizens' surplus and managerial rent) of local regulation, with shares in the regulated firm, to those coming from the regulation of a central planner with no stakes in the regulated firm.The fact of being a shareholder changes the local government's attitude towards the agents in the economic system: when regulation is implemented by a central or a local politician, the difference is visible not only in terms of welfare maximization, but also of informational advantages.

[6] In Brennan e Buchanan (1980), the public sector is seen as a unique entity (the Leviathan), seeking to maximize its own objectives (i.e. income and prestige); hence its target is to expand, maximizing the income from the economy. From this point of view, decentralization can be a tool to limit its power.

[7] This is how the phenomenon of ownership and control of private firms from local Italian governments has been defined in Bianchi et al. (2010).

A very interesting step towards the link between decentralization, regulation and political accountability has been taken in the paper by Laffont and Pouyet (2003). However, in their model, they study what happens when there is a unique firm in the federation, and either a sole central regulator or two local competing regulators.

The Author will apply a methodology similar to Laffont and Pouyet to study what happens when a firm exists in each of the two regions of the federation connected to one another through a network, and with shares solely owned by the citizens of their own region. In this way the spillover would not be informational or on the rent received by the shareholders (as in the mentioned model), but related to the network. Hence, the focus would be on the trade-off between the internalization of the spillovers provided by the central regulator and the (informational) advantages brought by the special link between the local planner and the firm's manager.

In one sense, in the environment just described, when there is a central regulator is like having complete privatization, and the regulator can only exert external control.When the regulator is at the local level, even if formally the firm has been privatized, the local government also has (some) internal control in the firm. With a local regulator, there is a trade-off between the advantage of having better knowledge of the local conditions and the drawback of an unclear relation between the firm and the regulator. This trade-off can be somewhat exacerbated when the politician is partisan, depending on which category of citizens is favoured by the political party in power. It is also interesting to see how this interacts with the fact that a regulator is local, and consequently how this modifies the above mentioned behaviour. In order to implement political issues in a typical regulatory environment characterized by asymmetric information, the Author will follow the methodology in Laffont (1996) and Martimort (2006).

Note that up to now, the Author has emphasized the importance of the model in order to compare the regulator at the central level with the local one; however, the model can be also applied to the European Union, comparing the regulation provided by the Commission, with the one by the single countries in order to investigate the efficacy and the reasonableness of the subsidiarity principle.

3 Institutional details

As pointed out by Bortolotti and Milella (2006), more than 4,000 privatizations have taken place worldwide between 1997-2004, with 29% of the total deals implemented in Western Europe. Even if in general privatization seems to have been reached, since the average of

Tab. 1: Ownership structure for the sample of privatized firms.

Type of investors	N	Mean			T-statistics
		Total Sample	PC board	NC board	(*** Significance at the 1% level)
Government	213	31.95	45.27	24.86	− 5.29***
Local institutions	172	24.65	23.01	25.46	0.59
Foreign investors	195	15.82	9.05	19.37	3.52***
Employees	156	6.16	5.14	6.60	0.80
Individuals	170	18.35	16.17	19.42	1.12

capital sold attains 60%, looking at the deals through public offers (which involve the largest and more profitable firms), it is striking that the average capital sold decreases to 35%, with the majority of stakes being abandoned only in 21% of the cases.

It is interesting to look at how ownership structure has changed after privatization: Boubakri et al. (2008) provide a summary for their sample of privatized firms from all over the world over the period 1980-2002 (see Table 1). The table presents the average percentage of ownership in the three years after privatization divided by type of shareholder: mean ownership is provided for the total sample, but also for the 2 subsamples of firms with politically connected (PC) and non-connected (NC) boards. The last column provides the T-statistic for the difference in means.

First, it is important to note that, after privatization, significant shares are still owned by local institutions. Second, we see that the mean ownership (for local authorities only) does not change among sub-samples, and the difference is not statistically significant. To explain this it would be best to concentrate more on political competition than on corruption *per se*, since it does not seem to be a determinant in partial privatizations (at the local level). On the one hand, reluctant privatization can be linked to the degree of political competition faced by the ruling party in the jurisdiction (Dinç and Gupta, 2007), while on the other hand, the political orientation can make a government more or less prone to privatization (Perotti, 1995).

In a previous paper, Boubakri et al. (2005) deepen the analysis on the determinants and the composition of shareholders in privatized firms. First, they note that while central government ownership decreases over time, in parallel local authority shares increase so that they seem to appropriate the stakes relinquished by the State.

Table 2 presents the change in public ownership and in the concentration between the three largest private shareholders, in a sample of 209 firms from 25 emerging markets and 14 industrialized countries privatized between 1980 and 2001.

Tab. 2: The ownership structure before and after privatization.

	Ownership share one year before privatization	Ownership share after privatization (year relative to privatization)			
		0	+1	+2	+3
Type of institution					
Government (Mean)	77.01	35.78	31.13	26.06	21.85
Government (N)	198	201	192	181	161
Local institutions (Mean)	6.13	20.94	24.87	26.65	30.24
Local institutions (N)	127	126	144	145	111
Private ownership concentration					
Cumulative share of the three largest investors (Mean)	10.29	33.15	37.30	39.86	40.94
Cumulative share of the three largest investors (N)	159	160	170	165	132
Herfindahl index (Mean)	3.11	16.28	17.84	19.11	19.42

They show that the local authorities are the investors which have mostly benefited from privatization, with the main concentration in those countries with poorer investor protection (civil law countries): thus, among others, European countries (except for the UK) are likely to be affected by this phenomenon.

In particular, while prior to privatization the average government stake was 78.7% in common law countries and 76.1% in civil law countries, the difference is not statistically significant; after privatization, the average stake is statistically lower in civil law countries with respect to common law countries. Thus, central governments in civil law countries seem to sell high portions of their shares faster. Yet, after privatization, the higher stakes are in the hands of local authorities in civil law countries, somehow substituting the central government. Three years after privatization the average stakes in firms in civil law countries is 37.2%, while in common law countries it is 18.6%.

A recent study by the European Centre of Employers and Enterprises providing Public services (CEEP) shows that in Europe, in which most countries are civil law, services characterized by infrastructure networks provide on average 9.4% of jobs in the EU27 (in particular, electricity, gas and water 2%, while transport 4%), with a higher than average employment from firms in central/eastern EU countries. They also contribute to 4.8% of EU GDP.

In the majority of European countries, municipalities organize utilities in communal enterprises, serving the local jurisdiction; they can be the sole property of a municipality, in

Tab. 3: Local Public Enterprises in Europe.

	Austria	Belgium	Germany	Estonia	France	Greece	Italy	Poland	Sweden
N	1,450	243	3,500	224	1,198	1,116	963	2,415	1,750
Personnel	44,000	27,250	53,000	10,900	66,426	27,500	152,662	160,402	55,000

comanagement with various municipalities, or in co-participation with private agents. In the latter case, the municipality has a minority stake in a growing portion of cases. Examples of States with this kind of organizations are Germany, France, Austria, Poland, Estonia, Italy, but also Northern countries (See Table 3). Thanks to the evolution of the decentralization and privatization processes, mixed local companies seem to be developing in most of the European countries.

Due to the important role of the local authorities in partial privatization, especially in strategic sectors and in civil law countries such as the European ones, more empirical and theoretical work[8] should be devoted to the topic given the regulatory, political and institutional issues they can raise.

4 The basic model

To present the regulatory issue, the Author will use the regulatory structure in Laffont and Tirole (1993), which has been adopted by both Laffont (1996) and Laffont and Pouyet (2003). The basic framework that deals with the choice of the cost reimbursement rule under asymmetric information is by Laffont and Tirole, to which Laffont adds the element of malevolent regulator and, later, together with Pouyet, the elements of regional competition and regulatory federalism.

As in the model by Laffont and Pouyet, the Author will consider a federation (or a country) composed of two regions, denoted by $i = 1, 2$, with the same number of citizens, with a mass unity, and whose preferences are homogeneous. However, while in the mentioned model, there is a single firm implementing a project for each of the two regions (creating competition between local regulators), in the present model, there is a (monopolistic) firm implementing an indivisible project in each of the two regions.

The regulator fully reimburses the observable production costs $C_i = (\beta_i - e_i)q_i$ to the firm: total production costs are equal to the marginal costs $(\beta_i - e_i)$ of production multiplied by the

[8] A thorough discussion of the problem and of stylized facts for 2005 is provided by Bianchi et al. (2010), for Italy. However, even in this case, an empirical analysis is missing.

quantities produced q_i, while fixed costs are normalized to zero, since they are assumed to be known. Thus, the (marginal) cost of the project depends on the efficiency in production β_i and the level of effort of the firm's manager e_i. When asymmetric information is introduced, the efficiency parameter β_i is the manager's private information. For simplicity, let us assume that β_i can have two values (high or low): $\overline{\beta}$ and $\underline{\beta}$, with probability ν and $1-\nu$ respectively. Naturally $\overline{\beta} > \underline{\beta}$, and we can define $\Delta\beta = \overline{\beta} - \underline{\beta}$.

The manager can exert a (positive) effort e_i in order to reduce the marginal cost of the project, but this effort generates a disutility $\psi(e_i)$ for him. This disutility of effort is increasing and convex in effort (i.e. it increases at an increasing rate), so that $\psi' > 0$ and $\psi'' > 0$.

The firm is run by a manager, who responds to the shareholders, hence his utility is given by $U_i = t_i - \psi(e_i) - z_i$. The transfer t_i is given to the firm by the regulator and is financed through a tax on citizens which implies a distortionary effect for each monetary unit levied, represented by λ, the so-called shadow cost of public funds. The dividends to the shareholders are denoted by z_i. The reservation utility of the manager is normalized to zero.

The regulator and the shareholders simultaneously and non cooperatively offer a contract to the firm's manager so that he accepts to work: the regulator offers the manager the transfer t_i, while the shareholders design the dividend scheme z_i.

The consumers' net surplus generated by the project is equal to $V_i^C = \delta S(q_i) - (1+\lambda)[t_i + C_i]$ in the case of regulation by the central government, while it is $V_i^D = S(q_i) - (1+\lambda)[t_i + C_i]$ under decentralization of the regulatory function. The difference is that the central government can fully internalize the effects of the project entailing spillover δ (which can be less or greater than 1 depending on whether is is negative or positive) on the gross surplus $S(q_i)$, while the local government cannot. The Author decided to add the spillover element in the model, since this kind of services (i.e. utilities) are usually provided through a network, implying some sort of externality between the jurisdictions.

Note that, as in Laffont (1996), portion $\alpha \in [0,1]$ of these citizens-consumers-taxpayers also owns some shares of the firm in their district; therefore, they are also shareholders. As we will see later in this paper, with this assumption we are dividing the population between rich and poor, and partisanship not only has an opportunistic connotation, but also an ideological one: the politician who favours consumers-only is left-wing, viceversa if he favours citizens-shareholders.

However, in the model presented in the next Sections, in order to represent the phe-

Tab. 4: The social welfare components under central and local regulation.

	Central government	**Local government**
Citizens' surplus	$V_i^C = \delta S(q_i) - (1+\lambda)\left[t_i + C_i\right]$	$V_i^D = S(q_i) - (1+\lambda)\left[t_i + C_i\right]$
Manager's utility	$U_i = t_i - \psi(e_i) - z_i$	
Citizens' dividends	αz_i	
Government's dividends	0	$(1-\alpha)z_i$

nomenon under consideration, local government also has some dividends $(1-\alpha)z_i$ from the $(1-\alpha)$ shares owned in the local firm; they are used to increase the budget. For example, the money in excess can be used to finance a local public good, or to increase the quality of the network used by the firm. Thus, this portion of dividends appears as an additional component in the social welfare function when the regulatory function is in the hands of the local government.

Note that the (im)possibility of internalizing spillovers and the additional component in the maximization process are not the only differences in the regulatory levels. If the government is not one of the owners (i.e. as in the case of central regulation), it will weigh the shareholders' utility z_i using the parameter α, while if it is the owner of the residual shares (i.e. as in the case of local regulation), shareholders profits will be fully weighed (since it will weigh the part owned by the citizens plus its own shares, which sum to one). In the latter case, it will also choose the retention rate (defined as the percentage of present earnings held back by the firm) $r \in [0,1]$ on the dividends to be distributed. Table 4 illustrates the different components of the welfare function taken into consideration by the central/local regulator.

Assuming, as in Laffont and Tirole (1993) and Martimort (2006), that the ownership structure either allows or does not allow the regulator to control communication channels between the manager and outsiders (i.e. the shareholders), this has a slightly different implication for our model.

Given that the central government has no shares in the firms, it can only exert the external control, then privatization is 'full': thereby, the regulator weighs the shareholders' net dividends only on the basis of their 'voting' portion in the population. Moreover, the manager faces two principals: the shareholders (internal control) and the regulator (external control).

Under decentralization, the local government can exert both types of control, but only

proportionally to its shares (we can think that internal control is exerted through representatives in a board).

Note that in the present model, central and local governments do not communicate, hence the local government does not provide the central authority with access to its privileged information.

4.1 Complete information

In this section, symmetric information is assumed: the value β_i of the efficiency parameter for each of the two firms is known, so the manager's effort level e_i is observable. The Author will compare the outcomes obtained under central and local regulation in the full information benchmark.

4.1.1 Central government

When regulation is implemented by the central government, spillover effects on consumers surplus are taken into account, but the utility of the shareholders is only considered for that portion of the firm's shares that are owned by citizens, while the utility related to the shares still owned by the local government is not taken into consideration.

$$\max_{(q_i,e_i)} \quad \sum_{i=1}^{2} \left\{ \delta S(q_i) - (1+\lambda)(t_i + C_i) + \alpha z_i + U_i \right\} \tag{1}$$

s.t. $V_i^C = \delta S(q_i) - (1+\lambda)\left[t_i + C_i\right]_i \geqslant 0$, $U_i \geqslant 0$, $z_i \geqslant 0$, with $i = 1, 2$.

The central politician maximizes a utilitarian social welfare function, consisting of the weighted sum of the utilities of citizens, manager, and shareholders, under the participation constraints of these three groups. The participation constraints for the citizens are needed so they do not move to another area (i.e. voting with their feet[9]).

$$W = \sum_{i=1}^{2} \Big\{ \delta S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) + (1-\alpha)z_i\right] - \lambda\alpha z_i - \lambda U_i \Big\} \tag{2}$$

Maximization leads to the following results:

1. No rent to the firms' managers, since it is costly: $U_1 = U_2 = 0$. Thus, $t_i = \psi(e_i) + z_i$, for $i = 1, 2$.

[9] Tiebout (1956) envisaged the possibility that citizens, through interjurisdictional mobility, could choose the community with the preferred combination of tax and local good, imposing in this way additional restraints on the central government's powers.

2. Marginal disutility equal to marginal cost savings of effort: $\psi'(e_i) = q_i$. As a result, $e_1 = e_2 = e^*$: effort is equal in the two areas and reaches the socially optimal level.

3. $\frac{S'(q_i)}{1+\lambda} = \frac{\beta_i - e_i}{\delta}$: in both regions the marginal utility of the public good equates its marginal cost, and spillovers are internalized.

4. The project is undertaken and the citizens' participation constraints in both areas are satisfied if and only if: $\delta S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) + (1-\alpha)z_i\right] \geqslant 0$.

4.1.2 Local government

The local regulator only takes into account the welfare of the players in his area, not internalizing the spillovers on the citizens' gross surplus. However, given that he still retains some shares in the local firm, not only does he fully weigh the shareholders' utility, but he also adds an additional element to his social welfare function that represents the monetary value he receives from the shares owned. This last element depends on the level of the retention rate r: that is, the portion of present earnings of the firm that the board of shareholders decides not to distribute as dividends. Since the local government is also a shareholder, it has an optimal retention rate which is obtained from the maximization problem.

$$\max_{(q_i, e_i)} \quad S(q_i) - (1+\lambda)(t_i + C_i) + z_i + U_i + (1-\alpha)(1-r)z_i \tag{3}$$

s.t. $V_i^D = S(q_i) - (1+\lambda)\left[t_i + C_i\right] \geqslant 0$, $U_i \geqslant 0$, $z_i \geqslant 0$, with $i = 1, 2$.

$$W_i = S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i)\right] - \lambda U_i - \lambda z_i + (1-\alpha)(1-r)z_i \tag{4}$$

The managers' zero rent and optimal effort results are the same as described above except for the fact that now $\frac{S'(q_i)}{1+\lambda} = \beta_i - e_i$: spillovers cannot be internalized by local government.

Furthermore, now the government (also a shareholder), has control of the additional variable of dividends and chooses the retention rate r, so that $r = 1 - \frac{\lambda}{1-\alpha}$ [10]. The selected retention rate decreases with the second component on the right hand side of the equation which can be seen as savings in terms of the social cost of public fund that can be achieved if government dividends instead of (socially costly) taxes are used to finance local public goods. In other words, the higher the social cost of public funds λ, the more costly is the use of taxes. Hence it becomes more convenient for the benevolent local government to use its

[10] Under the assumption that $\lambda \leq 1-\alpha$, financing the project with taxes is less/equally costly than financing it through dividends.

portion of dividends in order to finance the transfer to the firm: consequently, the retention rate decreases.

The results, under complete information for the rent of the manager (1) and for the effort levels (2), are standard.

The (im)possibility of internalizing spillover effects (3) and the necessity of fulfilling the citizens' participation constraints (4) arise from the fact that the federalist approach has been implemented in the model.

Finally, shareholders' dividends are introduced in the model in a way that is different with respect to the orthodox model: one portion (the one obtained by 'rich' citizens) is considered by both regulators, while the other portion is taken into account only when regulation is implemented by the government which also owns the residual shares (i.e. the local government).

Proposition 1. *Under full information, centralization is equivalent to decentralization, except for the fact that spillovers cannot be internalized. The level of efforts are symmetric and equal to the socially optimal effort, and in both cases its marginal disutility is equalized to its marginal cost savings. Moreover, the firms' managers never get any rent.*

4.2 Incomplete information

In this Section asymmetric information on the efficiency parameter β_i is introduced, hence the regulator only observes the realized cost C_i, and bases the net transfer on it. The rent for the efficient type -necessary to avoid mimicking the inefficient one- is denoted by $\Phi(\overline{e}_i) = \psi(\overline{e}_i) - \psi(\overline{e}_i - \Delta\beta_i)$, and depends on the level of effort required by the manager in the inefficient firm. For notational simplicity, $\overline{t}_i \equiv t_i(\overline{\beta}_i)$, $\overline{C}_i \equiv C_i(\overline{\beta}_i)$, etc.

4.2.1 Central government

Now the planner (for details of the solution see Appendix B) should maximize the expected social welfare under the aggregate veto constraints:

$$\max_{(\underline{q}_i,\overline{q}_i,\underline{e}_i,\overline{e}_i)} \sum_{i=1}^{2} \Bigg\{ \delta \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \right] + \\ - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - \lambda\nu\Phi(\overline{e_i}) \Bigg\} \quad (5)$$

s.t.[11]

$$\delta S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \delta S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{6}$$

$$\delta S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu\left[2\lambda + (1-\alpha)\right]}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{7}$$

Maximizing expected social welfare we obtain:

1. $\frac{\partial L}{\partial \overline{q}_i} = 0 : \ \frac{S'(\overline{q}_i)}{1+\lambda} = \frac{\overline{\beta}_i - \overline{e}_i}{\delta} \ \Leftrightarrow \ \overline{q}_i = q^*(\overline{\beta}_i - \overline{e}_i)$.
2. $\frac{\partial L}{\partial \underline{q}_i} = 0 : \ \frac{S'(\underline{q}_i)}{1+\lambda} = \frac{\underline{\beta}_i - \underline{e}_i}{\delta} \ \Leftrightarrow \ \underline{q}_i = q^*(\underline{\beta}_i - \underline{e}_i)$.
3. $\frac{\partial L}{\partial \underline{e}_i} = 0 : \underline{q}_i = \psi'(\underline{e}_i) \ \Leftrightarrow \ \underline{e}_i = e^*$.
4. $\frac{\partial L}{\partial \overline{e}_i} = 0 : \ \psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{(1-\alpha)\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) \ \Leftrightarrow \ \overline{e}_i^C < e^*$.
5. $\underline{U}_i = \Phi(\overline{e}_i) \ > \ 0, \quad \underline{t}_i = \psi(e_i^*) + \underline{z}_i + \Phi(\overline{e}_i)$.
6. $\overline{U}_i = 0, \quad \overline{t} = \psi(\overline{e}_i) + \overline{z}_i$.

Since the expected cost of the informational rent given to the efficient firm, $\nu\lambda\Phi(\overline{e}_i)$, depends only on $\overline{e}_i$, the levels of $\underline{q}_i$ and $\underline{e}_i$ are equal to those obtained under full information, while $\overline{q}_i = q^*(\overline{\beta}_i - \overline{e}_i)$. Thus, quantities are not distorted in order to give the right incentives to the efficient firm's manager. The levels of effort and output for the efficient firm are the same as under symmetric information, but now the manager enjoys the informational rent; in order to limit the amount of this rent, the incentive scheme given to the inefficient firm is low-powered so that the level of effort is distorted downwards.

The level of distortion is greater than in the classical case of cost-reimbursement (see Laffont and Tirole (1993)): part of the additional distortion is visible in the second element on the right hand side of the equation and is due to the presence of the multiprincipal problem[12] (following the results obtained by Martimort (2006)), given that the internal and

[11] The aggregate veto constraint (7) is binding with $\mu(1-\nu)$ as multiplier.

[12] In this case, an Agent reports to several Principals (each offering a direct truthful mechanism) with conflicting interests; hence the Revelation Principle must be revised. Now that communication with other Principals is important, direct mechanisms which satisfy individual incentive compatibility and participation constraints are not useful to describe this game of non-cooperating multiprincipals: aggregate constraints are necessary so that coalitions do not form in order to manipulate informational reports.

This model is called a Common Agency Model, or a Multiprincipals Model. Martimort and Stole (1998) suggested the use of the Taxation Principle to characterize the set of equilibria: direct mechanisms are equivalent to a nonlinear transfer based on the observable cost, C, of the firm.

external control of the firm are split between the shareholders and regulator. In order not to have any of the two principals that veto the inefficient firm's production, an increased distortion is needed. This also means that when the firm is inefficient its budget constraints is harder, since it has to respond to the requirements of two principals. Thus, while on the one hand there are additional distortions, on the other hand, the budget constraint for the inefficient firm is enforced.

However, the distortion is even greater than in Martimort's model, since the central government does not weigh the residual shares in its social welfare function, and this distortion is represented by the last element on the right hand side of the equation. Note that the residual shares are those owned by the local government, so not taking them into account further distorts the results. In practice, the central government discards the possibility of cooperation with the lower level of government which could somehow help to solve the multiprincipal problem. Instead, not only is the local government treated by the central planner as a normal shareholder, but its utility is not taken into account, thereby creating an additional element of distortion.

Proposition 2. *Under asymmetric information and central regulation, spillovers are internalized and outputs are chosen so that the marginal disutility of effort is equalized to its marginal cost savings either with an efficient or an inefficient firm. The level of effort is socially optimal in the case of the efficient firm, while it is lower than optimal if the firm is inefficient. In the first case, the firm gets an informational rent.*

4.2.2 Local government

As already pointed out, in the complete information case, the local planner -in contrast to the central regulator- fully weighs the shareholders' utility and has an additional element in the social welfare function representing the monetary value of its shares of distributed dividends.

Thus, the problem (for details see Appendix B) he must solve is:

$$\max_{(\underline{q}_i,\overline{q}_i,\underline{e}_i,\overline{e}_i)} \nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i) - (1+\lambda)\nu[((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + \\ + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - \lambda\nu\Phi(\overline{e}_i) \tag{8}$$

The Agent chooses his announcement to maximize his utility, while the Principals play a Nash equilibrium choosing the best contract given the choices of the others. Naturally, if the activities required by the Principals are complements or substitutes in the Agent's utility function, his rent is reduced/increased. The Agent's response to a contract from Principal 1 depends on the contract offered by Principal 2.

s.t.[13]

$$S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{9}$$

$$S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu 2\lambda}{1-\nu}\Phi(\overline{e}_i) + (1-\alpha)(1-r)\frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{10}$$

The results of the maximization process are the following:

1. $\frac{\partial L}{\partial \overline{q}_i} = 0 : \ \frac{S'(\overline{q}_i)}{1+\lambda} = \overline{\beta}_i - \overline{e}_i \ \Leftrightarrow \ \overline{q}_i = \overline{q}^*(\overline{\beta}_i - \overline{e}_i)$.
2. $\frac{\partial L}{\partial \underline{q}_i} = 0 : \ \frac{S'(\underline{q}_i)}{1+\lambda} = \underline{\beta}_i - \underline{e}_i \ \Leftrightarrow \ \underline{q}_i = \underline{q}^*(\underline{\beta}_i - \underline{e}_i)$.
3. $\frac{\partial L}{\partial \underline{e}_i} = 0 : \underline{q}_i = \psi'(\underline{e}_i) \ \Leftrightarrow \ \underline{e}_i = e^*$.
4. $\frac{\partial L}{\partial \overline{e}_i} = 0 : \ \psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) + \frac{(1-\alpha)(1-r)\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) \Leftrightarrow \ \overline{e}_i^C < \overline{e}_i^L < e^*$.
5. $\underline{U}_i = \Phi(\overline{e}_i) \ > \ 0, \quad \underline{t}_i = \psi(e_i^*) + \underline{z}_i + \Phi(\overline{e}_i)$.
6. $\overline{U}_i = 0, \quad \overline{t} = \psi(\overline{e}_i) + \overline{z}_i$.

As for the rent given to the efficient firm, the levels of output, and the level of effort for the efficient firm, the results are the same obtained by the central planner.

Regarding for the inefficient firm's effort, a higher distortion still exists due to the multiprincipal problem, but the second distortion of the centralized case is eliminated since the dividends are now fully weighed in the social welfare function. Finally, if the inefficient firm's production is not vetoed, some dividends could be distributed to the local government and therefore it is more 'balanced' towards the shareholders, mitigating the multiprincipal problem. This is visible in the third element on the right hand side of the equation at point 4. The optimal retention rate does not change.

Proposition 3. *Under asymmetric information and local regulation, outputs are chosen so that the marginal disutility of effort is equalized to its marginal cost savings either with an efficient or an inefficient firm. The level of effort is socially optimal in the case of an efficient firm (and the firm receives an informational rent), while it is lower than optimal*

[13] (10) is binding with $\mu(1-\nu)$ as multiplier.

(but higher than in the centralized case) if the firm is inefficient: the fact that the politician takes into consideration the values of his dividends in the social welfare function mitigates the distortion created by the multiprincipal problem under asymmetric information. As usual, spillovers cannot be internalized.

Under asymmetric information and a benevolent government, the central regulator can internalize the spillover effects while the local regulator can obtain a higher level of effort from the inefficient firm thanks to its privileged access to information (given that the local government is on the shareholders board).

In Boubakri et al. (2005) the empirical analysis results show that ownership by a local authority has a positive (even if insignificant) impact on the firm's performance, also with respect to central government ownership. This could mean that spillover effects are less important than the better knowledge of local conditions available to local institutions, and this beneficial effect can only be magnified if the local shareholder is a regulator as well.

These results should be put together with the fact that the presence of residual stakes in public hands increases the probability of political connections on the firm's management board (Boubakri et al., 2008), even if results on how this affects the firm's performance are mixed (Bortolotti and Faccio, 2004; Boubakri et al., 2008). Indeed, the interaction of the government level and the political factor could completely change the results. This is something still missing in the empirical literature on partial privatization.

4.3 Decentralization and the shadow costs of public funds

In this Section, let's assume that λ is higher at the local level. There can be many ways to justify this assumption. It can be due, for example, to the fact that even if the tax is decided by the local regulator it is then collected by the central government which imposes some constraint or retains a portion of the collected tax, thus increasing the distortion needed to achieve the same results than under central regulation. In the Italian case, the increase in λ could represent the tightness imposed by the so-called *Patto di Stabilità e Crescita*.

In this case, the fact that the local government owns shares in the firm and is willing to use the resulting revenues is further justified: the more the shadow costs of public funds are high at the local level, the less the retention rate chosen by the local government.

Another way to see the problem can be taken from the literature on fiscal federalism (Keen and Kotsogiannis, 2004; Wigger and Wharta, 2004). It has been shown that introducing an additional level of government can generate the so-called 'vertical tax externality': when the tax power is divided between different levels of government, each level does not fully

take into account the erosion of the tax base at the next level when imposing taxes and the related welfare effects. In other words, we can imagine that, giving the local government the power to regulate and tax (while some powers[14] would still remain at the central government level), the vertical tax externality would reduce the tax revenue collected by each level of government, given the presence of the tax base erosion effect on the other tax levels. This is why the local government, to collect the same amount of taxes as the central government, imposes a greater distortion on the citizens. This does not happen when all the regulation and taxation instruments are in the hands of the central government.

Note that the horizontal tax externality, which moves in the opposite direction, has not been considered, since it is assumed (see Section 3.1) that citizens cannot vote with their feet[15].

Consider first our environment under complete information. In this case, the increase in λ with a local regulator has effect only on $\frac{S'(q_i)}{1+\lambda} = \frac{\beta_i - e_i}{\delta}$: i.e. producing the local public good has an increased cost. On the basis of this result, asking if it is better to have a central or a local regulator (under symmetric information), centralization is justified not only by the possibility of internalizing the spillovers mentioned in Proposition 1, but also by the fact that the use of taxation causes less distortions than under local regulation. This effect remains unchanged also when asymmetric information is introduced.

However, adding asymmetric information to the model, a different level of λ, at this point has an effect also on the levels of effort and on the distortion of the less efficient firm. To calculate the change imposed by an increase in λ to the marginal disutility of effort at local level, total differentiation is used to obtain:

$\frac{\partial L/\partial \overline{e}_i}{\partial \lambda} = -\frac{1}{(1+\lambda)^2}\frac{1+2\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{1}{(1+\lambda)^2}\frac{(1-\alpha)(1-r)\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$.

Thus, the fact that the shadow costs of public funds are higher at the local level decreases the beneficial effect of having a local regulator who is also on the shareholders board, and the distance between the effort levels of the inefficient firm's manager with a central and local regulator is diminished (i.e. $\overline{e}_i^L$ decreases).

[14] For example, a public goods as national defense should still be in the hands of the central planner, and consequently the central government should also impose some kind of taxes to finance it.

[15] With horizontal externalities, the various jurisdictions decrease their tax rates to attract the mobile tax base. This often leads to a race to the bottom, as each area neglects the harm it does to the others.

5 Partisan politicians

Politicians can be biased toward a special group of the population for their political support. This Section will not consider the hypothesis of a well-intentioned planner, assuming instead that he is interested in the outcome of the electoral process: he can be pro-shareholder or pro-consumer, favouring the group that supports him.

In the present model, consumers in each area are randomly split in two groups: those who are only consumers, and those who also own some shares in the regional firm, in portion $1-\alpha$ and α, respectively. Given the fact that part of the population is classified as 'consumers only', while another part has shares in the firm (they can also benefit from the shareholders' utility, z_i), this can be seen as a way to divide the population between poor and rich; thus, the fact that the government is pro-consumer or pro-shareholder can be seen as an ideological stance (i.e. left or right wing).

Before the government is elected, the level of regulatory (de)centralization is chosen. Depending on whether $\alpha_i > 1/2$ or not, the government will commit to govern favouring consumer-shareholders or consumers only, and it will care only about the well-being of the citizens which represent the majority.

In Laffont (1996) the same democratic process is assumed, but it is not used -as in the present model- to compare the different behaviours and outcomes from the various levels of government. Laffont introduces the election stage to check the effects or the lack of the choice of ownership structure. The influence of partisanship on the decentralization of regulatory functions is instead studied -using the same democratic framework- in Laffont and Pouyet (2003).

5.1 Complete information

Consider first the complete information benchmark under the partisan planner, for both the central and local government. Under symmetric information, pricing discrimination is possible (i.e. the tax payed by the poor citizens is different from that payed by the rich ones). This will be impossible under asymmetric information because of ex-post incentive compatibility.

In Laffont (1996) it is shown that, under complete information and a partisan planner, the solution is the same as under normative analysis (i.e. benevolent planner), except that the citizens in the majority appropriate all the surplus. Moreover, in this context, ownership structure is neutral. In this Section it will demonstrated that similar results are obtained in

the model presented here: the citizens represented by the politician in power capture all the welfare, and the federalist structure (decentralized versus centralized) does not matter.

5.1.1 Central government

Partisanship under a central informed regulator is considered first (for the procedure used to solve the model, see Appendix C).

Pro-shareholder

A pro-shareholder central planner will maximize the weighted sum of the net surplus (internalizing the spillovers) for the portion of 'rich' (R) consumers, together with the utility these citizens get from being shareholders of the firm, as well as the manager's utility. As for the 'poor' (P) citizens, only their participation constraint is considered.

Note that in this case the weight that the central planner gives to the shareholders' utility, z_i, is the same as if he were benevolent. This is due to different motivations: in the present case, he uses the weight, α, because it represents that portion of the electorate he wants to favour (i.e. citizen-shareholders), while in the case of the benevolent planner, this behavior is due to the fact that he does not want to fully weigh the shareholders' utility, but at the same time he recognizes the importance of this element for part of the population.

$$\max_{(q_i,e_i)} \quad \sum_{i=1}^{2} \left\{ \delta\alpha S(q_i) - (1+\lambda)\alpha(t_i^R + C_i) + \alpha z_i + U_i \right\} \tag{11}$$

s.t. $(1-\alpha)V_i = (1-\alpha)\left[\delta S(q_i) - (1+\lambda)(t_i^P + C_i)\right] \geqslant 0,$
$U_i = \alpha t_i^R + (1-\alpha)t_i^P - \psi(e_i) - z_i \geqslant 0,$
$z_i \geq 0$, for *i=1,2*.

When maximizing the social welfare function under the participation constraints of the poor citizens, the manager and all the shareholders, the expected welfare is obtained as:

$$W = \sum_{i=1}^{2} \left\{ \delta\alpha S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) - (1-\alpha)z_i - \frac{1-\alpha}{1+\lambda}\delta S(q_i) \right] - \lambda\alpha z_i - \lambda U_i \right\} \tag{12}$$

As a result, the conclusions are very similar to those obtained under normative analysis:

1. No rent to the firms' mangers: $U_1 = U_2 = 0$. Thus, $(1-\alpha)t_i^P + \alpha t_i^R = \psi(e_i) + z_i$, for $i = 1, 2$.

2. Marginal utility of effort is equal to its marginal cost savings: $\psi'(e_i) = q_i \Longleftrightarrow e_1 = e_2 = e^*$, implying that the effort is equal in the two regions, and attains its optimal level.

3. Marginal utility and marginal costs of the public good are equalized, and spillovers are internalized: $\frac{S'(q_i)}{1+\lambda} = \frac{\beta_i - e_i}{\delta}$.

4. Note that the condition for 'poor' consumers is satisfied with the binding constraint, while before it was slack, as is still the case for 'rich' consumers (who appropriate all the benefits); this is due to the presence of price discrimination. Thus, $\delta(1-\alpha)S(q_i) - (1+\lambda)(1-\alpha)\left[(\beta_i - e_i)q_i + \psi(e_i) + (1-\alpha)z_i\right] = 0$.

Pro-consumer

Since the population is composed of citizens who are all consumers (even though different categories: rich and poor), the net consumer surplus is fully weighed, as well as the manager's utility. Instead, the politician being pro-consumer, he does not weigh the shareholders' utility in the social welfare function; only their participation constraint will be satisfied. Here price discrimination is not implemented, given that all citizens are consumers.

$$\max_{(q_i, e_i)} \quad \sum_{i=1}^{2} \Big\{ \delta S(q_i) - (1+\lambda)(t_i + C_i) + U_i \Big\} \tag{13}$$

s.t. $V_i = \delta S(q_i) - (1+\lambda)(t_i + C_i) \geqslant 0$,
$U_i = \alpha t_i^R + (1-\alpha)t_i^P - \psi(e_i) - z_i \geqslant 0$,
$z_i \geq 0$, for *i=1,2*.

The expected welfare in this case becomes:

$$W = \sum_{i=1}^{2} \Big\{ \delta S(q_i) - (1+\lambda)\left[C_i + z_i + \psi(e_i)\right] - \lambda U_i \Big\} \tag{14}$$

yielding results which are the same for points 1, 2 and 3, as under a pro-shareholder central government. They are also the results achieved under a benevolent central planner with complete information. Thus, no rent is left to the firm, the levels of effort are optimal and the spillovers are internalized.

The difference with respect to the solution with a pro-shareholder politician is the fact that price discrimination is not implemented and the citizens' participation constraints (for both rich and poor citizens) are slack: $\delta S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) + (1-\alpha)z_i\right] \geq 0$. This exact result is also obtained under a benevolent central planner with complete information.

Proposition 4. *With a central government, under positive analysis and complete information, nothing changes with respect to the normative analysis except for the fact that with a pro-shareholder planner the rich citizens capture all the welfare.*

5.1.2 Local government

In the case of local government, the regulator will only take into account the well-being of the agents in his region. However, things change slightly with the maximization process, since the regulator is also a shareholder. Thus, not only is z_i weighed differently with respect to the central government, but also an additional element representing the local government's revenue from the dividends is present in the social welfare function.

Pro-shareholder

With a pro-shareholder local government, as in case of central government, the net surplus is taken into account only proportionally to the rich part of the population; the manager's utility is fully taken into account. However, shareholders' utility is fully considered, since the shares not owned by the citizens are property of the local government. Moreover, the value of dividends distributed that is accrued by the government is an additional element in the social welfare function.

$$\max_{(q_i,e_i)} \quad \alpha S(q_i) - (1+\lambda)\alpha(t_i^R + C_i) + z_i + U_i + (1-\alpha)(1-r)z_i \tag{15}$$

s.t. $(1-\alpha)V_i = (1-\alpha)\left[\delta S(q_i) - (1+\lambda)(t_i^P + C_i)\right] \geqslant 0,$
$U_i = \alpha t_i^R + (1-\alpha)t_i^P - \psi(e_i) - z_i \geqslant 0,$
$z_i \geq 0$, for *i=1,2.*

This yields:

$$W = \alpha S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) - \frac{1-\alpha}{1+\lambda}S(q_i)\right] - \lambda U_i - \lambda z_i + (1-\alpha)(1-r)z_i \tag{16}$$

with its maximization leading to the same results as those obtained with a central planner under symmetric information. Thus, no rent is left to the firm and the transfer is designed so that in each region $\alpha t_i^R + (1-\alpha)t_i^P = \psi(e_i) + z_i$. Moreover, the level of effort is optimal and equates the marginal disutility to the marginal cost savings. The poor citizens' participation constraint is binding, so that $\delta(1-\alpha)S(q_i) - (1+\lambda)(1-\alpha)\left[(\beta_i - e_i)q_i + \psi(e_i) + (1-\alpha)z_i\right] = 0$, given that price discrimination is impossible. The only difference with respect to the pro-shareholder central regulator is that equalizing the marginal utility and the marginal cost of the public good, spillovers are not internalized.

Nothing changes with respect to the solution obtained under decentralization with a benevolent planner; even the retention rate is the same, since the government is also a shareholder. This is due to the fact that the commitment of the local government to the shareholders is visible only in the weight it assigns to the consumers' net surplus, while the weight given to the shareholders' utility is the same as if the planner were benevolent, given the fact that he owns the residual shares not owned by the citizens.

Pro-consumer

When the local government is pro-consumer, it fully accounts for the consumers' net surplus (i.e. for both rich and poor citizens) and for the manager's utility, while it completely ignores the shareholders' utility; this is also true for the central pro-consumer government. Nevertheless, being a shareholder as well, the government's portion of distributed dividends is considered in the social welfare function. The fact that the local government does not include the shareholders' utility in the social welfare function, even if it takes into account its income from the distributed dividends, is due to the attempt to balance between its commitment toward its voters (i.e. poor citizens) and its position as shareholder in the firm.

$$\max_{(q_i,e_i)} \quad S(q_i) - (1+\lambda)(t_i + C_i) + U_i + (1-\alpha)(1-r)z_i \tag{17}$$

s.t. $V_i = \delta S(q_i) - (1+\lambda)(t_i + C_i) \geqslant 0$,
$U_i = \alpha t_i^R + (1-\alpha)t_i^P - \psi(e_i) - z_i \geqslant 0$,
$z_i \geq 0$, for *i=1,2.*

$$W = S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) + z_i\right] - \lambda U_i + (1-\alpha)(1-r)z_i \tag{18}$$

The results obtained are the same under the benevolent local regulator since there is no price discrimination (so the participation constraints for both kinds of citizens are slack).

However, now $r = 1 - \frac{1+\lambda}{1-\alpha}$[16]. Since the government is pro-consumer, the rate at which dividends are distributed decreases with the shares owned by the local government, also a shareholder. This is again due to the mentioned need for the regulator to balance its commitment to voters and to the shareholders board. As a result: $r^{PC} > r^{PS} = r^{B}$ (the retention rate under a pro-consumer planner is greater than under a pro-shareholder planner, which is the same as under a benevolent planner).

Proposition 5. *Under local government, maximization under symmetric information and a partisan planner leads to the same results as with the benevolent planner scenario, so that no inefficiencies are introduced. As in the case of a pro-shareholder central planner, poor citizens are taxed all their surplus. Moreover, the optimal retention rate under a pro-consumer local planner changes, since he has to balance being a shareholder and also being a left-wing politician.*

To summarize, as in the case of a benevolent planner with complete information, the resulting rent of the manager (1) and effort levels (2) are standard. Once again, the problem of internalizing spillover effects (3) originates from choosing a federalist environment.

Citizens' participation constraints (4) are binding (slack) under a pro-shareholder (pro-consumer) planner, since under complete information price discrimination is possible. Thus, with a right-wing government, the rich citizens appropriate all the surplus, as shown by the results obtained by Laffont (1996).

The introduction of partisan planners in this background in which the local government is also a shareholder in the firm, implies that no matter which political party is in power, the local government always puts more weight on the shareholders' utility. In other words, central and local governments follow their political ideology in weighting the citizens' net surplus and the shareholders' dividends. However, the local government -when pro-shareholder- also takes into account its portion of shares; moreover, it always takes into account the monetary value of distributed dividends. Naturally, in the complete information setting, this has an effect only on the retention rate; while under incomplete information, this will also distort the level of effort.

5.2 Incomplete information

Assuming that politicians in power are elected by citizens who vote for the candidate representing their own category, different results arise depending on whether the politician is

[16] Under the assumption that $(1 + \lambda)(1 - \alpha) < 1$.

pro-shareholder or pro-consumer. This is due to the fact that political inefficiencies (partisan planner) interact with economic inefficiencies (asymmetric information on the efficiency parameter of the firm), affecting the distribution of information and consequently the trade-off between efficiency and rent extraction.

In this Section, as already mentioned, discriminatory taxes are not feasible, otherwise social welfare maximization would be achieved by extracting the entire surplus from the minority of citizens, and the orientation of the political party in power would not entail any effect on the regulatory policy.

The regulator chooses the level of transfers $t_i\left(\beta_i(e_i)\right)$, while the shareholders simultaneously and non cooperatively choose the level of dividends $z_i\left(\beta_i(e_i)\right)$: these are their contractual offers to the firm's manager. For the procedure used in the maximization process see Appendices D (asymmetric information, central government) and E (asymmetric information, local government).

5.2.1 Central government

Pro-shareholder

A politician who favors shareholders maximizes the net surplus of that part of the population; moreover, the shareholders' and the manager's utility are fully weighed.

Now, the planner must solve:

$$\max_{(\underline{q}_i,\overline{q}_i,\underline{e}_i,\overline{e}_i)} \sum_{i=1}^{2} \left\{ \delta\alpha \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i)\right] - (1+\lambda)\alpha[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + \right.$$
$$\left. + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - [\alpha\lambda - (1-\alpha)]\,\nu\Phi(\overline{e_i}) \right\} \tag{19}$$

s.t.[17]

$$\delta\alpha S(\underline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{20}$$

$$\delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu\left[2\lambda\alpha - (1-\alpha)\right]}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{21}$$

[17] (19) is binding with $\mu(1-\nu)$ as multiplier.

Maximizing expected social welfare we obtain:

1. $\frac{\partial L}{\partial \overline{q}_i} = 0 : \ \frac{S'(\overline{q}_i)}{1+\lambda} = \frac{\overline{\beta}_i - \overline{e}_i}{\delta} \ \Leftrightarrow \ \overline{q}_i = q^*(\overline{\beta}_i - \overline{e}_i)$.
2. $\frac{\partial L}{\partial \underline{q}_i} = 0 : \ \frac{S'(\underline{q}_i)}{1+\lambda} = \frac{\underline{\beta}_i - \underline{e}_i}{\delta} \ \Leftrightarrow \ \underline{q}_i = q^*(\underline{\beta}_i - \underline{e}_i)$.
3. $\frac{\partial L}{\partial \underline{e}_i} = 0 : \underline{q}_i = \psi'(\underline{e}_i) \ \Leftrightarrow \ \underline{e}_i = e^*$.
4. $\frac{\partial L}{\partial \overline{e}_i} = 0 : \ \psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)} \frac{\nu}{1-\nu} \Phi'(\overline{e}_i) + \frac{1-\alpha}{\alpha(1+\lambda)} \frac{\nu}{1-\nu} \Phi'(\overline{e}_i) \Leftrightarrow e^* > e^C_{PS} > e^C_B$.
5. $\underline{U}_i = \Phi(\overline{e}_i) \ > \ 0, \quad \underline{t}_i = \psi(e^*_i) + \underline{z}_i + \Phi(\overline{e}_i)$.
6. $\overline{U}_i = 0, \quad \overline{t} = \psi(\overline{e}_i) + \overline{z}_i$.

As in the case of asymmetric information with a benevolent central politician (see Subsection 4.2.1), the multiprincipal problem induces the first of the two distortions visible in point 4.

Moreover, when the central government is pro-shareholder, only a part of the population appropriates the rent of the firm; and given that price discrimination is not possible, this creates a second, positive, type of distortion, since a part of the firm is still owned by the local government. This positive distortion decreases with the strength of the majority (i.e. the higher α is) and with the shadow costs of public funds. Thus, with a pro-shareholder central government, the fact that the local government still owns some shares has a positive effect on the distortionary effect of asymmetric information, somehow protecting the poor citizens from the government's partisan behavior. Point 4 can also be written as: $\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda}{\alpha(1+\lambda)} \frac{\nu}{1-\nu} \left[\alpha - \frac{1-\alpha}{\lambda}\right] \Phi'(\overline{e}_i) - \frac{\lambda}{1+\lambda} \frac{\mu}{1+\mu} \frac{\nu}{1-\nu} \Phi'(\overline{e}_i)$. It is now is more apparent that the distortion is a combination of the multiprincipal problem and the impossibility of implementing price discrimination, as in Laffont (1996).

Note that the distortion of effort for the inefficient firm is less than under a benevolent planner given that the government is pro-shareholder: this fact mitigates the multiprincipal problem, since the government (partly) works in the same direction of the shareholders.

Pro-consumer

The planner in this case favors all the citizens, but completely avoids to account for the shareholders' utility. So he must solve:

$$\max_{(\underline{q}_i,\overline{q}_i,\underline{e}_i,\overline{e}_i)} \sum_{i=1}^{2} \Bigg\{ \delta \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i)\right] - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + \\ + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - \lambda\nu\Phi(\overline{e}_i) \Bigg\} \tag{22}$$

s.t.[18].

$$\delta S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \delta S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{23}$$

$$\delta S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu(1+2\lambda)}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{24}$$

Yielding:

1. $\frac{\partial L}{\partial \overline{q}_i} = 0 : \ \frac{S'(\overline{q}_i)}{1+\lambda} = \overline{\beta}_i - \overline{e}_i \ \Leftrightarrow \ \overline{q}_i = \overline{q}^*(\overline{\beta}_i - \overline{e}_i)$.
2. $\frac{\partial L}{\partial \underline{q}_i} = 0 : \ \frac{S'(\underline{q}_i)}{1+\lambda} = \underline{\beta}_i - \underline{e}_i \ \Leftrightarrow \ q_i = \underline{q}^*(\underline{\beta}_i - \underline{e}_i)$.
3. $\frac{\partial L}{\partial \underline{e}_i} = 0 : \underline{q}_i = \psi'(\underline{e}_i) \ \Leftrightarrow \ \underline{e}_i = e^*$.
4. $\frac{\partial L}{\partial \overline{e}_i} = 0 : \ \psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) \Leftrightarrow e^* > e^C_{PS} > e^C_B > e^C_{PC}$.
5. $\underline{U}_i = \Phi(\overline{e}_i) \ > \ 0, \quad \underline{t}_i = \psi(e_i^*) + \underline{z}_i + \Phi(\overline{e}_i)$.
6. $\overline{U}_i = 0, \quad \overline{t} = \psi(\overline{e}_i) + \overline{z}_i$.

In this case, the second element of distortion in point 4 is due to the fact that the effort of the manager is reduced if the government does not take into account the effect that the shareholders' no shut down condition has on the manager's utility; note that this element is also present in the basic model for the central government, but is weighed by $(1-\alpha)$, since the government in that case gives a (reduced) weight to the shareholder's utility (equal to α) in its social welfare function, while now its weight in the social welfare function is equal to zero (so the distortion's weight equals one).

As a result, the level of effort for the inefficient firm's manager is even lower than under a benevolent planner. Given that the government completely ignores the shareholders' utility,

[18] (22) is binding with $\mu(1-\nu)$ as multiplier.

this exacerbates the multiprincipal problem: the central regulator and the shareholders board move in opposite directions when giving incentives increasing the measure of distortion.

Thus, even if the government tries to favour its citizens by ignoring the shareholders' utility, the fact that it does not consider the system as a whole, results in lower incentives for the manager and lower level of effort than under a benevolent planner.

Proposition 6. *Under a central partisan planner and asymmetric information, the level of effort is distorted further downwards if the politician is pro-consumer, while the distortion is mitigated when he is pro-shareholder. This is due to the fact that, while under a benevolent planner the no shut-down condition imposed by the shareholders is weighed only for their voting portion in the population (α), now the partisan planner oscillates between no weight (when pro-consumer) and full weight (when pro-shareholder) toward their utility.*

5.2.2 Local government

Pro-shareholder

Recalling that local government cannot internalize the spillovers, and that it is a shareholder as well, the planner must now solve:

$$\max_{(\underline{q}_i,\overline{q}_i,\underline{e}_i,\overline{e}_i)} \alpha\left[\nu S(\underline{q}_i)+(1-\nu)S(\overline{q}_i)\right]-(1+\lambda)\alpha[\nu((\underline{\beta}_i-\underline{e}_i)\underline{q}_i+\psi(\underline{e}_i))+ \\ +(1-\nu)((\overline{\beta_i}-\overline{e_i})\overline{q}_i+\psi(\overline{e_i}))]-[\alpha\lambda-(1-\alpha)]\,\nu\Phi(\overline{e}_i) \tag{25}$$

s.t.[19].

$$\alpha S(\underline{q}_i)-(1+\lambda)\alpha\left[(\underline{\beta}_i-\underline{e}_i)\underline{q}_i+\psi(\underline{e}_i)\right]\geqslant \alpha S(\overline{q}_i)-(1+\lambda)\alpha\left[(\underline{\beta}_i-\overline{e}_i)\overline{q}_i+\psi(\overline{e}_i)\right] \tag{26}$$

$$\alpha S(\overline{q}_i)-(1+\lambda)\alpha\left[(\overline{\beta}_i-\overline{e}_i)\overline{q}_i+\psi(\overline{e}_i)\right]+\frac{\nu(1-\alpha)(1-r)}{1-\nu}\Phi(\overline{e}_i)\geqslant 0 \tag{27}$$

The solution of the maximization problem leads to the following results:

1. $\frac{\partial L}{\partial \overline{q}_i}=0:\ \frac{S'(\overline{q}_i)}{1+\lambda}=\overline{\beta}_i-\overline{e}_i\ \Leftrightarrow\ \overline{q}_i=\overline{q}^*(\overline{\beta}_i-\overline{e}_i)$.
2. $\frac{\partial L}{\partial \underline{q}_i}=0:\ \frac{S'(\underline{q}_i)}{1+\lambda}=\underline{\beta}_i-\underline{e}_i\ \Leftrightarrow\ \underline{q}_i=\underline{q}^*(\underline{\beta}_i-\underline{e}_i)$.

[19] (25) is binding with $\mu(1-\nu)$ as multiplier.

3. $\frac{\partial L}{\partial \underline{e}_i} = 0 : \underline{q}_i = \psi'(\underline{e}_i) \Leftrightarrow \underline{e}_i = e^*$.

4. $\frac{\partial L}{\partial \overline{e}_i} = 0 : \psi_i'(\overline{e}_i) = \overline{q}_i - \frac{\lambda}{(1+\lambda)\alpha}\frac{\nu}{1-\nu(1+\mu)}\left[\alpha - \frac{1-\alpha}{\lambda}\right]\Phi'(\overline{e}_i) + \frac{(1-\alpha)(1-r)\mu}{(1+\lambda)(1+\mu)\alpha}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) \Leftrightarrow e^* > e_L^{PS} > e_L^B$.

5. $\underline{U}_i = \Phi(\overline{e}_i) > 0, \quad \underline{t}_i = \psi(e_i^*) + \underline{z}_i + \Phi(\overline{e}_i)$.

6. $\overline{U}_i = 0, \quad \overline{t} = \psi(\overline{e}_i) + \overline{z}_i$.

Looking at result 4, the second element on the right hand side of the equation is the distortion described in Laffont (1996): it is generated by the government's inability to use price discrimination. In this case, there is also an additional weight $\left(\frac{1}{\alpha(1+\mu)}\right)$ which represents the importance of the satisfaction of the aggregate veto constraint for the shareholders.

However, in this case, the distortion also depends on the presence of the aggregate veto constraint, given the presence of a multiprincipal problem which is absent in Laffont's model. The third element on the right hand side of equation 4, mitigates the distortion, and measures the effect on the aggregate veto constraint of the local government also being a shareholder. Recall that the local government is not only a regulator, but also a member of the shareholders board of the firm, and its power depends on the shares owned.

Thus, when the regulator maximizes, his objectives are not so much at odds with those of the shareholders (in the present case he is also pro-shareholder by election), and this partially helps to solve the multiprincipal problem.

However, given that the government is pro-shareholder, $\alpha \in [1/2; 1]$, meaning that the shareholders board is dominated by citizen-shareholders (who also voted for the current local government), the government has a minority portion of the shares, and, hence, the beneficial effect is not so high.

Now, the level of effort is greater with respect to the benevolent framework, since price discrimination is not possible. But the fact that the regulator is pro-shareholder dampens the problem since he and the shareholders push in the same direction. So, the fact that there are two principals is not a big issue, as long as the two have similar objectives. Note that the mitigation of the multiprincipal problem, due to the presence of the local government on the shareholders board, is not so high and is maximized when the portion of shares owned by the government converges with the portion of those owned by the citizens (i.e. the other shareholders are not so powerful with respect to the local shareholders in managing the firm).

The retention rate is now $r = 2 - \frac{\alpha}{1-\alpha}\lambda$[20]: notice that this is reasonable, since the

[20] Under the condition that $\lambda \leq \frac{2(1-\alpha)}{\alpha}$.

government is pro-shareholder (thus, $\alpha > 1/2$) and the second element on the right hand side of the equation is always greater than one.

Pro-consumer

The pro-consumer local planner must solve:

$$\max_{(\underline{q}_i,\overline{q}_i,\underline{e}_i,\overline{e}_i)} \nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i) - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + \\ + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - \lambda\nu\Phi(\overline{e}_i) \tag{28}$$

s.t.[21].

$$S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{29}$$

$$S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu(1+2\lambda)}{1-\nu}\Phi(\overline{e}_i) + (1-\alpha)(1-r)\frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{30}$$

yielding:

1. $\frac{\partial L}{\partial \overline{q}_i} = 0 : \ \frac{S'(\overline{q}_i)}{1+\lambda} = \overline{\beta}_i - \overline{e}_i \ \Leftrightarrow \ \overline{q}_i = \overline{q}^*(\overline{\beta}_i - \overline{e}_i)$.
2. $\frac{\partial L}{\partial \underline{q}_i} = 0 : \ \frac{S'(\underline{q}_i)}{1+\lambda} = \underline{\beta}_i - \underline{e}_i \ \Leftrightarrow \ q_i = \underline{q}^*(\underline{\beta}_i - \underline{e}_i)$.
3. $\frac{\partial L}{\partial \underline{e}_i} = 0 : \underline{q}_i = \psi'(\underline{e}_i) \ \Leftrightarrow \ \underline{e}_i = e^*$.
4. $\frac{\partial L}{\partial \overline{e}_i} = 0 : \ \psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{[1-(1-\alpha)(1-r)]\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) \Leftrightarrow e^* > e_L^{PS} > e_L^B > e_L^{PC}$.
5. $\underline{U}_i = \Phi(\overline{e}_i) \ > \ 0, \quad \underline{t}_i = \psi(e_i^*) + \underline{z}_i + \Phi(\overline{e}_i)$.
6. $\overline{U}_i = 0, \quad \overline{t} = \psi(\overline{e}_i) + \overline{z}_i$.

[21] (28) is binding with $\mu(1-\nu)$ as multiplier.

The level of effort obtained is even lower than under a benevolent planner: given that the local government has the majority of shares, it can decide without taking into account the incentives of the rest of the board. So, if on one hand this allows access to information and less contrast with the shareholders' objectives, on the other hand the government is left-wing, and has objectives (e.g. redistribution) which are different from those of the shareholders, creating greater conflict than with the benevolent planner.

Hence, the retention rate that the local government would choose is $r = 1$, since as a left-wing politician, the local planner ignores the shareholders' utility, and as a shareholder he decides that is better not to distribute dividends. Even though this scenario seems quite strong, it could be explained by the fact that the local government, when trying to balance its commitment to its voters and to the shareholders board, favours the first, since the distribution of dividends can be perceived as a signal of disloyalty to the electoral mandate by the poor citizens.

In other words, since the citizen-shareholders are the majority on the shareholder board, they will vote for a level of r which is lower than one. However, it can be predicted that the value of the expected distributed dividends, when the government is left-wing, is less than under a right-wing government, since it would be the result of an attempt to balance the retention rate desired by the local government and the private shareholders.

Proposition 7. *Under asymmetric information and a local partisan planner, the effort is further distorted downward for both the pro-consumer and the pro-shareholder planner. In the latter case, the direction of the distortion is opposite with respect to the central pro-shareholder regulator and is due to the fact that the local government is also a shareholder, but cannot use price discrimination.*

The result that the incentive scheme is less powerful under a pro-consumer planner is also reached by Laffont (1996). He emphasizes that moving from a left-wing to a right-wing party, strengthens incentives and increases the level of effort.

Note: the result that effort under a centralized regulator is distorted upward/downward with respect to its utilitarian level when the regulator is pro-shareholder/consumer is in line with the findings in Laffont and Pouyet (2003). However, in Laffont and Pouyet model, competition between politicians when regulation is decentralized (due to the fact that there is a single firm producing for both regions) avoids fluctuations so the level of effort under the local regulators is the same, whichever party is in power. In contrast, in the Author's model, there is no regulatory competition given that each region has its own firm operating in its territory. The direction of the distortion in the levels of effort, due to the introduction of

Tab. 6: Effort distortion for the inefficient firm

Benevolent	
Central	$\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{(1-\alpha)\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$
Local	$\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) + \frac{(1-\alpha)(1-r)\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$
Pro-shareholder	
Central	$\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) + \frac{1-\alpha}{\alpha(1+\lambda)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$
Local	$\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda}{(1+\lambda)(1+\mu)\alpha}\frac{\nu}{1-\nu}\left[\alpha - \frac{1-\alpha}{\lambda}\right]\Phi'(\overline{e}_i) + \frac{(1-\alpha)(1-r)\mu}{(1+\lambda)(1+\mu)\alpha}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$
Pro-consumer	
Central	$\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$
Local	$\psi_i'(\overline{e_i}) = \overline{q}_i - \frac{\lambda(1+2\mu)}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{[1-(1-\alpha)(1-r)]\mu}{(1+\lambda)(1+\mu)}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$

an electoral stage, is the same as under centralization, but it is somehow magnified/reduced (depending on the case) with respect to the central level since the local regulator is also a shareholder, and has a kind of 'double personal agenda' (one as a politician committed to his voters and one as a member of the shareholders board). Indeed, it is easy to show that $e^* > \bar{e}_L^{PS} > \overline{e}_C^{PS} > \bar{e}_L^{B} > \overline{e}_C^{B} > \overline{e}_C^{PC} > \overline{e}_L^{PC}$. The main results of all the scenarios of the model under asymmetric information are represented in Table 6.

One would think that a pro-consumer government, which has redistribution as its main target would be the one to obtain the level of effort nearest to the optimum. However, following Perotti (1995), the Author considers that the left-wing government -even if it is a shareholder in the firm- is seen by the manager as not committed to not redistributing the firm's profits (even those to the other shareholders), and this affects the firm performance, as empirically demonstrated by Boubakri et al. (2009). Moreover, right-wing governments are traditionally seen as more likely to implement market-oriented reforms, another motivation to believe they are more committed.

5.3 Political alignment between central and local level

Up to now the Author has assumed that the center and the regions do not communicate nor share any information, and the possibility that they do not belong to the same political party in power has not been considered (or has been assumed to have no consequence).

Here, on the contrary, a sort of political competition between the local and the central government is introduced. We can expect that the fact that the political party in power at

the local level is the same as (or the opposition) at the central level has a positive (negative) effect on the shadow costs of public funds.

Suppose that the level of λ, taken in consideration in the previous Section, is attained when it is assumed that the political alignment/disalignment between the center and the periphery is of no consequence. Then, let us assume that an increase/decrease in the level of the shadow costs of public funds λ is due to the mentioned political disalignment /alignment. This can be justified in terms of compatibility between levels of government, due to common ideology, agenda and political programme, and also in terms of a greater ease, for example, for the two levels of government to come to an agreement, or for the local government to obtain additional funds.

To see which would be the final direction of the distortion due to an increase/decrease of the shadow costs of public funds, let us differentiate with respect to λ the results obtained on partisan planners.

For any level of decentralization and any political party in power, points 1 and 2 of the solution (i.e. related to the marginal utility of the public good's production for both the efficient and inefficient firm) are always negatively/positively distorted by an increase/decrease of λ: $\frac{\partial L/\partial q_i}{\partial \lambda} = \beta_i - e_i$.

As for point 4, the components of the distortion of the marginal disutility of effort for the inefficient firm with respect to its optimal level are different and go in different directions, requiring a case by case analysis.

With a central pro-shareholder planner we have:
$\frac{\partial L/\partial \overline{e}_i}{\partial \lambda} = -\frac{1}{(1+\lambda)^2}\frac{1+2\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{1}{(1+\lambda)^2}\frac{1-\alpha}{\alpha}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$,
while with a central pro-consumer planner we have:
$\frac{\partial L/\partial \overline{e}_i}{\partial \lambda} = -\frac{1}{(1+\lambda)^2}\frac{1+2\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) + \frac{1}{(1+\lambda)^2}\frac{\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$.

Thus, an increase in the shadow costs of public funds has an effect which can be decomposed in two parts. The first part is common among political parties and has the same (negative) intensity: an increase in λ increments the distortion imposed by the presence of the multiprincipal problem. The second component reinforces (mitigates) the negative effect of an increase in λ, depending on whether the politician is pro-shareholder or pro-consumer. The negative effect under a pro-shareholder planner is due to the fact that the protection of poor citizens provided by the residual shares not owned by the voters comes at an increasing cost (since price discrimination is not possible), while the positive effect, under a pro-consumer planner, is due to the fact that, as λ increases, the regulator perceives that ignoring the shareholders' no shut-down condition can have bad consequences on the multiprincipal problem. Naturally, the directions of the distortions due to a decrease in the shadow

costs of public funds would be of opposite sign and equal intensity.

With local pro-shareholder and pro-consumer politicians, the variations due to an increase in λ are respectively:
$\frac{\partial L/\partial \overline{e}_i}{\partial \lambda} = -\frac{1}{(1+\lambda)^2}\frac{1}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{1}{(1+\lambda)^2}\frac{1}{1+\mu}\frac{1-\alpha}{\alpha}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{1}{(1+\lambda)^2}\frac{(1-\alpha)(1-r)}{\alpha}\frac{\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$
and $\frac{\partial L/\partial \overline{e}_i}{\partial \lambda} = -\frac{1}{(1+\lambda)^2}\frac{1+2\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{1}{(1+\lambda)^2}\frac{\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i) - \frac{(1-\alpha)(1-r)}{(1+\lambda)^2}\frac{\mu}{1+\mu}\frac{\nu}{1-\nu}\Phi'(\overline{e}_i)$.

In the pro-shareholder regulator case, the second component represents the fact that the impossibility of making price discrimination comes at an increasing cost when the shadow costs of public funds increment, while the first and the second components should be put together to represent the growing cost of the multiprincipal problem, worsened by the fact that the more it is costly to make transfers to the firm, the higher should be the shares of the local government. In the pro-consumer regulator case, the first part is the one related to the multiprincipal problem, while the last two represent the fact that a positive effect can be obtained when not all the shares are owned by the local government -which has objectives opposed to those of the shareholders- so that the multiprincipal conflict is mitigated; this comes at a higher cost when λ is high.

6 Conclusion

This study is motivated by the -worldwide- phenomenon of reluctant privatization, which in many cases is mainly at the local level. Local governments, retaining some stakes in the firm, can influence the operative, economic and financial choices of the firm (i.e. imposing the distribution of dividends when needed), but they also regulate the firm. Hence, the local government still retains control of the firm which provides the service in its jurisdiction. This can raise some doubts on the efficacy of the privatization process and consequently on externalizing the local services provision. The objectives of cost reduction and simplification, given the present situation, are unlikely to be reached. So, the fact that local politicians are eager to acquire and retain stakes in the firms lessens the transparency in the relationship between the private and the public sector in the implementation of the regulatory rules, and finally in the democratic representation of the citizens' interests.

Even if this anomaly, that characterizes many local governments in Italy and Europe, has been subject to various (mainly empirical) studies, none of them as of yet have tried to model what this would imply for the choice of the optimal regulatory rule, nor for the vertical allocation of regulatory tasks among the various levels of government.

In the present model, the Author has attempted to fill this missing point in the literature, using a methodology which demonstrates how asymmetric information interacts not only with

political inefficiencies, but also with the degree of decentralization, providing some insights on a problem which is still at the center of the academic debate. What emerges is that a local regulator is -in the majority of cases- better than a central one, even if he is a shareholder in the regulated firm. Thus, the application of the subsidiarity principle has a beneficial effect on regulation, even in case of municipal capitalism. As noted before, this is true for both the benevolent and the pro-shareholder planner. However, with a pro-consumer government, the higher the level of regulation, the better it is. This is due to what can be called the curse of the myopic attitude of left-wing governments that, acting in the interest of citizens, end up in a situation which worsens instead of improves their constituents' situation, since they do not take the shareholders' interests enough into consideration. The shareholders fate is (especially in Italy) closely and obscurely entwined with that of politicians. Moreover, it should be pointed out that, in the majority of cases, in Italy it has been the left-wing government which has implemented privatizations. This is the result of pressure from entrepreneurs, who were eager to acquire the firms once the State withdrawed, and the government's need to get money in order to alleviate the problem of public finances in a period when the application of the Maastricht rules was particularly rigid. This may be related to the fact that the retention rate is lower when the local government is pro-consumer.

The research agenda in this line of research is still rich: other formalizations on regulatory problems can be added, as well as the problem of cross-subsidization between firms (and consequently, between jurisdictions). Other levels of government could be introduced, and the ownership of some shares by the central government could be hypothesized. More than just two groups of citizens can be taken into consideration, in order to generalize the results, and the introduction of re-election constraints and the reputational effects can show how the problem would change in a dynamic environment.

7 Appendix

Appendix A- Complete information, central government

$$W = \sum_{i=1}^{2} \Big\{ \delta S(q_i) - (1+\lambda)\left(t_i + (\beta_i - e_i)q_i\right) + \alpha z_i + (t_i - \psi(e_i) - z_i) \Big\} =$$

$$= \sum_{i=1}^{2} \Big\{ \delta S(q_i) - \lambda t_i - (1+\lambda)C_i - (1-\alpha)z_i - \psi(e_i) \Big\}$$

Adding and subtracting $\lambda(\psi(e_i) + z_i)$, we obtain:

$$W = \sum_{i=1}^{2} \left\{ \delta S(q_i) - (1+\lambda)\left(C_i + \psi(e_i)\right) - (1-\alpha)z_i - \lambda\left(\alpha z_i + (1-\alpha)z_i\right) - \lambda\left(t_i - \psi(e_i) - z_i\right) \right\} =$$
$$= \sum_{i=1}^{2} \left\{ \delta S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) + (1-\alpha)z_i\right] - \lambda\alpha z_i - \lambda U_i \right\}$$

Appendix B - incomplete information, basic model

In the incomplete information environment the important equations and constraints for the manager are:

Utility: $U_i(\beta_i) = t_i(\beta_i) - \psi(e_i(\beta_i)) - z_i(\beta_i)$.

Participation **Constraints:** $\underline{U}_i \geqslant \overline{U}_i + \Phi(\overline{e}_i)$, $\overline{U}_i \geqslant 0$.

Incentive **Compatibility constraints:** $\underline{t}_i = \psi(\underline{e}_i) + \underline{z}_i + \underline{U}_i$, $\bar{t}_i = \psi(\overline{e}_i) + \overline{z}_i + \overline{U}_i$.

The rent for the manager of the efficient firm is $\Phi(\overline{e}_i) = \psi(\overline{e}_i) - \psi(\overline{e}_i - \Delta\beta_i)$.
Citizens also have the participation constraint (so they cannot vote with their feet), that is: $V(q_i) \geq 0$.

Central government

Regulator's best response to the shareholder's dividend scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \sum_{i=1}^{2} \left\{ \delta\left[\nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i)\right] - (1+\lambda)\left[\nu(\underline{C}_i + \underline{t}_i) + (1-\nu)(\overline{C}_i + \bar{t}_i)\right] + \right.$$
$$\left. + \alpha\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] + \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] \right\} \tag{31}$$

subject to the managers' ICs and PCs and the citizens' PCs.

The expected welfare with a centralized solution under a benevolent planner is:

$$E(W_C^B) = \sum_{i=1}^{2} \Bigg\{ \delta \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \right] - (1+\lambda)[\nu(\underline{C}_i + \psi(\underline{e}_i) + (1-\alpha)\underline{z}_i) + \\ + (1-\nu)(\overline{C}_i + \psi(\overline{e}_i) + (1-\alpha)\overline{z}_i)] - \lambda\alpha \left[\nu \underline{z}_i + (1-\nu)\overline{z}_i \right] - \lambda\nu\Phi(\overline{e}_i) \Bigg\} \tag{32}$$

Shareholder's best response to the regulatory scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \nu(\underline{t}_i - \psi(\underline{e}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{e}_i)) - \left[\nu \underline{U}_i + (1-\nu)\overline{U}_i \right] \tag{33}$$

subject to the managers' ICs and PCs.
Recall: $U_i = t_i - \psi(e_i) - z_i \Rightarrow z_i = (t_i - \psi(e_i) - U_i)$.

Given the two schemes $t_i(\beta_i)$ and $z_i(\beta_i)$, the manager must also make the equilibrium choices of quantities q_i:

$$\begin{aligned} \overline{q}_i &\in \underset{q_i}{argmax} \quad t_i(q_i(\overline{\beta}_i)) - z_i(q_i(\overline{\beta_i})) - \psi(e_i) \\ \underline{q}_i &\in \underset{q_i}{argmax} \quad t_i(q_i(\underline{\beta}_i)) - z_i(q_i(\underline{\beta}_i)) - \psi(e_i) \end{aligned}$$

***

By maximizing the regulator's objective, for the manager to choose $q_i = q_i^*$, it should be that:

$$\delta S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i) \right] - \left[(1+\lambda)(1-\alpha) + \alpha\lambda \right] \underline{z}_i \geqslant \delta S(\overline{q}_i) + \\ - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i) \right] - \left[(1+\lambda)(1-\alpha) + \alpha\lambda \right] \overline{z}_i \tag{34}$$

and, not to have too high dividends given to the shareholders nor to shut down the inefficient firm, we should have:

$$\delta \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \right] - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i) + (1-\alpha)\underline{z}_i) + \\ + (1-\nu)((\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i) + (1-\alpha)\overline{z}_i)] - \lambda\alpha \left[\nu \underline{z}_i + (1-\nu)\overline{z}_i \right] - \lambda\nu\Phi(\overline{e}_i) \geqslant \\ \delta\nu S(\underline{q}_i) - (1+\lambda)\nu[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i) + (1-\alpha)\underline{z}_i] - \lambda\alpha\nu\underline{z}_i$$

$$\Longrightarrow \delta S(\overline{q}_i) - (1+\lambda)[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)] - [(1+\lambda)(1-\alpha) + \alpha\lambda]\,\overline{z}_i - \frac{\nu}{1-\nu}\lambda\Phi(\overline{e}_i) \geqslant 0 \quad (35)$$

The conditions to characterize the shareholder's best response:

$$\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) \geqslant \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) \quad (36)$$

$$\nu(\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i)) - \nu\Phi(\overline{e}_i) \geqslant \nu(\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i))$$

$$\Rightarrow \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \quad (37)$$

The last condition is needed, so that shareholders (if the transfer is high enough) do not veto the production to the inefficient firm.
Plus:

$$\underline{U}_i = \underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) - \underline{z}_i = \overline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) - \overline{z}_i = \overline{U}_i + \Phi(\overline{e}_i) \quad (38)$$

$$\overline{U}_i = \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \overline{z}_i = 0 \quad (39)$$

Using constraints (34), (36) and (38), we obtain:

$$\delta S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \delta S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \quad (40)$$

i.e. there is an output pair, $(\overline{q}_i, \underline{q}_i)$, which is implementable as a Nash equilibrium of the common agency game.
Then, using conditions (35), (37) and (39), we obtain:

$$\delta S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu\,[2\lambda + (1-\alpha)]}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \quad (41)$$

This is the aggregate veto constraint, characterizing the quantity that could be implemented in the inefficient firm: it is binding, with $\mu(1-\nu)$ as multiplier.
So the Lagrangian of the problem is:

$$L = \sum_{i=1}^{2} \Bigg\{ \delta \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \right] - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + \\ + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - \lambda\nu\Phi(\overline{e_i}) + \\ + \mu(1-\nu) \left[\delta S(\overline{q}_i) - (1+\lambda)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i})) - \frac{\nu\left[2\lambda + (1-\alpha)\right]}{1-\nu}\Phi(\overline{e_i}) \right] \Bigg\} \tag{42}$$

Local government

Regulator's best response to the shareholder's dividend scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) - (1+\lambda)[\nu(\underline{C}_i + \underline{t}_i) + (1-\nu)(\overline{C}_i + \overline{t}_i)] + \\ + [\nu\underline{z}_i + (1-\nu)\overline{z}_i] + \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] + (1-\alpha)(1-r)\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] \tag{43}$$

subject to the manager's ICs and PCs and the citizens' PCs.

The expected welfare with a decentralized solution under a benevolent planner is:

$$E(W_L^B) = \nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) - (1+\lambda)[\nu(\underline{C}_i + \psi(\underline{e}_i)) + (1-\nu)(\overline{C}_i + \psi(\overline{e}_i))] + \\ - \lambda\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] - \lambda\nu\Phi(\overline{e}_i) + (1-\alpha)(1-r)\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] \tag{44}$$

Shareholder's best response to the regulatory scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \nu(\underline{t}_i - \psi(\underline{e}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{e}_i)) - \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] \tag{45}$$

subject to the manager's ICs and PCs.

Recall: $U_i = t_i - \psi(e_i) - z_i \Rightarrow z_i = (t_i - \psi(e_i) - U_i)$.

Given the two schemes $t_i(\beta_i)$ and $z_i(\beta_i)$, the manager must also make the equilibrium choices of quantities q_i:

$$\overline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\overline{\beta}_i)) - z_i(q_i(\overline{\beta_i})) - \psi(e_i)$$
$$\underline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\underline{\beta}_i)) - z_i(q_i(\underline{\beta}_i)) - \psi(e_i)$$

***

By maximizing the regulator's objective, for the manager to choose $q_i = q_i^*$, it should be that:

$$S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] - [\lambda - (1-\alpha)(1-r)]\,\underline{z}_i \geqslant S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - [\lambda - (1-\alpha)(1-r)]\,\overline{z}_i \quad (46)$$

and, not to have too high dividends given to the shareholders nor to shut down the inefficient firm, we should have:

$$S(\overline{q}_i) - (1+\lambda)[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)] - [\lambda - (1-\alpha)(1-r)]\,\overline{z}_i - \frac{\nu}{1-\nu}\lambda\Phi(\overline{e}_i) \geqslant 0 \quad (47)$$

The conditions to characterize the shareholder's best response:

$$\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) \geqslant \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) \quad (48)$$

$$\overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \quad (49)$$

The last condition is needed, so that shareholders (if the transfer is high enough) do not veto the production to the inefficient firm.

Plus:

$$\underline{U}_i = \underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) - \underline{z}_i = \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) - \overline{z}_i = \overline{U}_i + \Phi(\overline{e}_i) \quad (50)$$

$$\overline{U}_i = \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \overline{z}_i = 0 \quad (51)$$

Using conditions (46) and (48), together with
condition (50), we obtain:

$$S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \quad (52)$$

i.e. there is an output pair, $(\overline{q}_i, \underline{q}_i)$, which is implementable as a Nash equilibrium of the common agency game. Using constraints (47), (49) and (51), we get:

$$S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu 2\lambda}{1-\nu}\Phi(\overline{e}_i) + (1-\alpha)(1-r)\frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \quad (53)$$

This is the aggregate veto constraint, characterizing the quantity that could be implemented in the inefficient firm.

The Lagrangian is:

$$L = \nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i) - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] +$$
$$- \lambda\nu\Phi(\overline{e_i}) + \mu(1-\nu)\left[S(\overline{q}_i) - (1+\lambda)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i})) - \frac{\nu\left[2\lambda - (1-\alpha)(1-r)\right]}{1-\nu}\Phi(\overline{e_i})\right]$$

Appendix C - partisan planner, complete information

Central government

$$W = \sum_{i=1}^{2}\left\{\delta\alpha S(q_i) - (1+\lambda)\alpha\left(t_i^R + (\beta_i - e_i)q_i\right) + \alpha z_i + \left(\alpha t_i^R + (1-\alpha)t_i^P - \psi(e_i) - z_i\right)\right\} =$$
$$= \sum_{i=1}^{2}\left\{\delta\alpha S(q_i) - \lambda\alpha t_i^R - (1+\lambda)\alpha C_i + (1-\alpha)t_i^P - z_i + \alpha z_i - \psi(e_i)\right\}$$

Adding and subtracting $\lambda(\psi(e_i) + z_i)$, and $\lambda(1-\alpha)t_i^P$ we obtain:

$$W = \sum_{i=1}^{2}\left\{\delta\alpha S(q_i) - (1+\lambda)\left(\alpha C_i + \psi(e_i) - (1-\alpha)z_i - (1-\alpha)t_i^P\right) - \lambda\alpha z_i - \lambda\left(t_i - \psi(e_i) - z_i\right)\right\} =$$
$$= \sum_{i=1}^{2}\left\{\delta\alpha S(q_i) - (1+\lambda)\left[(\beta_i - e_i)q_i + \psi(e_i) - (1-\alpha)z_i - \frac{1-\alpha}{1+\lambda}\delta S(q_i)\right] - \lambda\alpha z_i - \lambda U_i\right\}$$

Appendix D - partisan planner, incomplete information, central government

Pro-shareholder

Regulator's best response to the shareholder's dividend scheme is:

$$\max_{\{(\underline{q}_i,\underline{U}_i);(\overline{q}_i,\overline{U}_i)\}} \sum_{i=1}^{2} \Bigg\{ \delta\alpha \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i)\right] - (1+\lambda)\alpha[\nu(\underline{C}_i + \underline{t}_i) + \\ +(1-\nu)(\overline{C}_i + \overline{t}_i)] + \alpha\left[\nu \underline{z}_i + (1-\nu)\overline{z}_i\right] + \left[\nu \underline{U}_i + (1-\nu)\overline{U}_i\right] \Bigg\} \tag{54}$$

$\overline{U}_i \geqslant 0, \quad (a), \underline{U}_i \geqslant \overline{U}_i + \Phi(\overline{e}_i) \quad (b), \quad V_i \geqslant 0 \quad (c),$
$\underline{t}_i = \underline{z}_i + \psi(\underline{e}_i) + \underline{U}_i \quad (d), \quad \overline{t}_i = \overline{z}_i + \psi(\overline{e}_i) + \overline{U}_i \quad (e).$

The expected welfare with a centralized solution under a pro-shareholder planner is:

$$E(W_C^{PS}) = \sum_{i=1}^{2} \Bigg\{ \delta\alpha \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i)\right] - (1+\lambda)\alpha[\nu(\underline{C}_i + \psi(\underline{e}_i)) + \\ + (1-\nu)(\overline{C}_i + \psi(\overline{e}_i))] - [\alpha\lambda - (1-\alpha)]\,\nu\Phi(\overline{e}_i) - \alpha\lambda\left[\nu \underline{z}_i + (1-\nu)\overline{z}_i\right] \Bigg\} \tag{55}$$

Shareholder's best response to the regulatory scheme is:

$$\max_{\{(\underline{q}_i,\underline{U}_i);(\overline{q}_i,\overline{U}_i)\}} \nu(\underline{t}_i - \psi(\underline{e}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{e}_i)) - \left[\nu \underline{U}_i + (1-\nu)\overline{U}_i\right] \tag{56}$$

s.t. *(a), (b), (d), (e).*
Recall: $U_i = t_i - \psi(e_i) - z_i \Rightarrow z_i = (t_i - \psi(e_i) - U_i)$.

Given the two schemes $t_i(\beta_i)$ and $z_i(\beta_i)$, the manager must also make the equilibrium choices of quantities q_i:

$$\overline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\overline{\beta}_i)) - z_i(q_i(\overline{\beta_i})) - \psi(e_i)$$
$$\underline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\underline{\beta}_i)) - z_i(q_i(\underline{\beta}_i)) - \psi(e_i)$$

***

By maximizing the regulator's objective, for the manager to choose $q_i = q_i^*$, it should be that:

$$\delta\alpha S(\underline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] - \lambda\alpha\underline{z}_i \geqslant \delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \lambda\alpha\overline{z}_i \tag{57}$$

and, not to have too high dividends given to the shareholders nor to shut down the inefficient firm, we should have:

$$\delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)] - \lambda\alpha\overline{z}_i - \frac{\nu}{1-\nu}\left[\alpha\lambda - (1-\alpha)\right]\Phi(\overline{e}_i) \geqslant 0 \tag{58}$$

The conditions to characterize the shareholder's best response:

$$\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) \geqslant \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) \tag{59}$$

$$\overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{60}$$

The last condition is needed, so that shareholders (if the transfer is high enough) do not veto the production to the inefficient firm.

Plus:

$$\underline{U}_i = \underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) - \underline{z}_i = \overline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) - \overline{z}_i = \overline{U}_i + \Phi(\overline{e}_i) \tag{61}$$

$$\overline{U}_i = \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \overline{z}_i = 0 \tag{62}$$

Using constraints (57), (59) and (61), we obtain:

$$\delta\alpha S(\underline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{63}$$

i.e. there is an output pair, $(\overline{q}_i, \underline{q}_i)$, which is implementable as a Nash equilibrium of the common agency game.

Then, using conditions (58), (60) and (62), we obtain:

$$\delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu\left[2\lambda\alpha - (1-\alpha)\right]}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{64}$$

This is the aggregate veto constraint, characterizing the quantity that could be implemented in the inefficient firm.

$$L = \sum_{i=1}^{2} \Bigg\{ \delta\alpha \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \right] - (1+\lambda)\alpha [\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + \\ + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] - [\alpha\lambda - (1-\alpha)]\, \nu\Phi(\overline{e_i}) + \\ + \mu(1-\nu) \left[\delta\alpha S(\overline{q}_i) - (1+\lambda)\alpha((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i})) - \frac{\nu\,[2\lambda\alpha - (1-\alpha)]}{1-\nu} \Phi(\overline{e_i}) \right] \Bigg\} \quad (65)$$

Pro-consumers

Regulator's best response to the shareholder's dividend scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \sum_{i=1}^{2} \Bigg\{ \delta \left[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \right] - (1+\lambda)[\nu(\underline{C}_i + \underline{t}_i) + (1-\nu)(\overline{C}_i + \overline{t}_i)] + \\ + \left[\nu \underline{U}_i + (1-\nu)\overline{U}_i \right] \Bigg\} \quad (66)$$

$\overline{U}_i \geqslant 0, \quad (a), \underline{U}_i \geqslant \overline{U}_i + \Phi(\overline{e}_i) \quad (b), \quad V_i \geqslant 0 \quad (c),$
$\underline{t}_i = \underline{z}_i + \psi(\underline{e}_i) + \underline{U}_i \quad (d), \quad \overline{t}_i = \overline{z}_i + \psi(\overline{e}_i) + \overline{U}_i \quad (e).$

The expected welfare with a centralized solution under a pro-consumer planner is:

$$E(W_C^{PC}) = \sum_{i=1}^{2} \Bigg\{ \delta \Big[\nu S(\underline{q}_i) + (1-\nu) S(\overline{q}_i) \Big] - (1+\lambda)[\nu(\underline{C}_i + \psi(\underline{e}_i) + \underline{z}_i) + \\ + (1-\nu)(\overline{C}_i + \psi(\overline{e}_i) + \overline{z}_i)] - \lambda\nu\Phi(\overline{e}_i) \Bigg\} \quad (67)$$

Shareholder's best response to the regulatory scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \left[\nu(\underline{t}_i - \psi(\underline{e}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{e}_i)) \right] - \left[\nu \underline{U}_i + (1-\nu)\overline{U}_i \right] \quad (68)$$

s.t. *(a), (b), (d), (e).*
Recall: $U_i = t_i - \psi(e_i) - z_i \Rightarrow z_i = (t_i - \psi(e_i) - U_i)$.

Given the two schemes $t_i(\beta_i)$ and $z_i(\beta_i)$, the manager must also make the equilibrium choices of quantities q_i:

$$\overline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\overline{\beta}_i)) - z_i(q_i(\overline{\beta_i})) - \psi(e_i)$$
$$\underline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\underline{\beta}_i)) - z_i(q_i(\underline{\beta}_i)) - \psi(e_i)$$

***

By maximizing the regulator's objective, for the manager to choose $q_i = q_i^*$, it should be that:

$$\delta S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] - (1+\lambda)\underline{z}_i \geqslant \delta S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - (1+\lambda)\overline{z}_i \tag{69}$$

and, not to have too high dividends given to the shareholders nor to shut down the inefficient firm, we should have:

$$\delta S(\overline{q}_i) - (1+\lambda)[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)] - (1+\lambda)\overline{z}_i - \frac{\nu}{1-\nu}\lambda\Phi(\overline{e}_i) \geqslant 0 \tag{70}$$

The conditions to characterize the shareholder's best response:

$$\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) \geqslant \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) \tag{71}$$

$$\overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{72}$$

The last condition is needed, so that shareholders (if the transfer is high enough) do not veto the production to the inefficient firm.

Plus:

$$\underline{U}_i = \underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) - \underline{z}_i = \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) - \overline{z}_i = \overline{U}_i + \Phi(\overline{e}_i) \tag{73}$$

$$\overline{U}_i = \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \overline{z}_i = 0 \tag{74}$$

Using conditions (69) and (71), together with condition (73), we obtain:

$$\delta S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \delta S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{75}$$

i.e. there is an output pair, $(\overline{q}_i, \underline{q}_i)$, which is implementable as a Nash equilibrium of the common agency game. Using constraints (70), (72) and (74), we get:

$$\delta S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu(1+2\lambda)}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{76}$$

This is the aggregate veto constraint, characterizing the quantity that could be implemented in the inefficient firm.

$$L = \sum_{i=1}^{2} \Bigg\{ \delta\left[\nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i)\right] - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + (1-\nu)((\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i))] +$$
$$- \lambda\nu\Phi(\overline{e}_i) + \mu(1-\nu)\left[\delta S(\overline{q}_i) - (1+\lambda)((\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)) - \frac{\nu(1+2\lambda)}{1-\nu}\Phi(\overline{e}_i)\right] \Bigg\} \tag{77}$$

Appendix E - partisan planner, incomplete information, local government

Pro-shareholder

Regulator's best response to the shareholder's dividend scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \alpha\left[\nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i)\right] - (1+\lambda)\alpha[\nu(\underline{C}_i + \underline{t}_i) + (1-\nu)(\overline{C}_i + \overline{t}_i)] +$$
$$+ [\nu\underline{z}_i + (1-\nu)\overline{z}_i] + \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] + (1-\alpha)(1-r)\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] \tag{78}$$

$\overline{U}_i \geqslant 0, \quad (a), \underline{U}_i \geqslant \overline{U}_i + \Phi(\overline{e}_i) \quad (b), \quad V_i \geqslant 0 \quad (c),$
$\underline{t}_i = \underline{z}_i + \psi(\underline{e}_i) + \underline{U}_i \quad (d), \quad \overline{t}_i = \overline{z}_i + \psi(\overline{e}_i) + \overline{U}_i \quad (e).$

The expected welfare with a decentralized solution under a pro-shareholder planner is:

$$E(W_L^{PS}) = \alpha\left[\nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i)\right] - (1+\lambda)\alpha[\nu(\underline{C}_i + \psi(\underline{e}_i)) + (1-\nu)(\overline{C}_i + \psi(\overline{e}_i))] +$$
$$+ \left[(1-\alpha) - \alpha\lambda\right]\nu\Phi(\overline{e}_i) - \left[\alpha\lambda + (1-\alpha)r\right]\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] \tag{79}$$

Shareholder's best response to the regulatory scheme is:

$$\max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} \left[\nu(\underline{t}_i - \psi(\underline{e}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{e}_i))\right] - \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] \tag{80}$$

s.t. *(a), (b), (d), (e).*

Recall: $U_i = t_i - \psi(e_i) - z_i \Rightarrow z_i = (t_i - \psi(e_i) - U_i)$.

Given the two schemes $t_i(\beta_i)$ and $z_i(\beta_i)$, the manager must also make the equilibrium choices of quantities q_i:

$$\overline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\overline{\beta}_i)) - z_i(q_i(\overline{\beta}_i)) - \psi(e_i)$$
$$\underline{q}_i \in \underset{q_i}{argmax} \quad t_i(q_i(\underline{\beta}_i)) - z_i(q_i(\underline{\beta}_i)) - \psi(e_i)$$

***

By maximizing the regulator's objective, for the manager to choose $q_i = q_i^*$, it should be that:

$$\alpha S(\underline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] - [\alpha\lambda + (1-\alpha)r]\,\underline{z}_i \geqslant \alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - [\alpha\lambda + (1-\alpha)r]\,\overline{z}_i \quad (81)$$

and, not to have too high dividends given to the shareholders nor to shut down the inefficient firm, we should have:

$$\alpha S(\overline{q}_i) - (1+\lambda)\alpha[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)] - [\alpha\lambda + (1-\alpha)r]\,\overline{z}_i - \frac{\nu}{1-\nu}\left[(1-\alpha) - \alpha\lambda\right]\Phi(\overline{e}_i) \geqslant 0 \quad (82)$$

The conditions to characterize the shareholder's best response:

$$\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) \geqslant \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) \quad (83)$$

$$\overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \quad (84)$$

The last condition is needed, so that shareholders (if the transfer is high enough) do not veto the production to the inefficient firm.

Plus:

$$\underline{U}_i = \underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) - \underline{z}_i = \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) - \overline{z}_i = \overline{U}_i + \Phi(\overline{e}_i) \quad (85)$$

$$\overline{U}_i = \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \overline{z}_i = 0 \quad (86)$$

Using conditions (81) and (83), together with condition (85), we obtain:

$$\alpha S(\underline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant \alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{87}$$

i.e. there is an output pair, $(\overline{q}_i, \underline{q}_i)$, which is implementable as a Nash equilibrium of the common agency game. Using constraints (82), (84) and (86), we get:

$$\alpha S(\overline{q}_i) - (1+\lambda)\alpha\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] + \frac{\nu(1-\alpha)(1-r)}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{88}$$

This is the aggregate veto constraint, characterizing the quantity that could be implemented in the inefficient firm.

$$\begin{aligned} L = {} & \alpha\left[\nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i)\right] - (1+\lambda)\alpha[\nu((\underline{\beta_i} - \underline{e_i})\underline{q}_i + \psi(\underline{e_i})) + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] + \\ & -[\alpha\lambda - (1-\alpha)]\,\nu\Phi(\overline{e_i}) + \mu(1-\nu)\left[\alpha S(\overline{q}_i) - (1+\lambda)\alpha((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i})) + \frac{\nu(1-\alpha)(1-r)}{1-\nu}\Phi(\overline{e_i})\right] \end{aligned} \tag{89}$$

Pro-consumers

Regulator's best response to the shareholder's dividend scheme is:

$$\begin{aligned} \max_{\{(\underline{q}_i, \underline{U}_i);(\overline{q}_i, \overline{U}_i)\}} & \nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i) - (1+\lambda)[\nu(\underline{C}_i + \underline{t}_i) + (1-\nu)(\overline{C}_i + \overline{t}_i)] + \\ & + \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] + (1-\alpha)(1-r)\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] \end{aligned} \tag{90}$$

$\overline{U}_i \geqslant 0, \quad (a), \underline{U}_i \geqslant \overline{U}_i + \Phi(\overline{e}_i) \quad (b), \quad V_i \geqslant 0 \quad (c),$
$\underline{t}_i = \underline{z}_i + \psi(\underline{e}_i) + \underline{U}_i \quad (d), \quad \overline{t}_i = \overline{z}_i + \psi(\overline{e}_i) + \overline{U}_i \quad (e).$

The expected welfare with a decentralized solution under a pro-consumer planner is:

$$\begin{aligned} E(W_L^{PC}) = {} & \nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i) - (1+\lambda)[\nu(\underline{C}_i + \psi(\underline{e}_i)) + (1-\nu)(\overline{C}_i + \psi(\overline{e}_i))] + \\ & - \lambda\nu\Phi(\overline{e}_i) - [1 + \lambda - (1-\alpha)(1-r)]\left[\nu\underline{z}_i + (1-\nu)\overline{z}_i\right] \end{aligned} \tag{91}$$

Shareholder's best response to the regulatory scheme is:

$$\max_{\{(\underline{q}_i,\underline{U}_i);(\overline{q}_i,\overline{U}_i)\}} \left[\nu(\underline{t}_i - \psi(\underline{e}_i)) + (1-\nu)(\overline{t}_i - \psi(\overline{e}_i))\right] - \left[\nu\underline{U}_i + (1-\nu)\overline{U}_i\right] \tag{92}$$

s.t. *(a), (b), (d), (e).*

Recall: $U_i = t_i - \psi(e_i) - z_i \Rightarrow z_i = (t_i - \psi(e_i) - U_i)$.

Given the two schemes $t_i(\beta_i)$ and $z_i(\beta_i)$, the manager must also make the equilibrium choices of quantities q_i:

$$\begin{aligned}
\overline{q}_i &\in \underset{q_i}{argmax} \quad t_i(q_i(\overline{\beta}_i)) - z_i(q_i(\overline{\beta_i})) - \psi(e_i) \\
\underline{q}_i &\in \underset{q_i}{argmax} \quad t_i(q_i(\underline{\beta}_i)) - z_i(q_i(\underline{\beta}_i)) - \psi(e_i)
\end{aligned}$$

***

By maximizing the regulator's objective, for the manager to choose $q_i = q_i^*$, it should be that:

$$\begin{aligned}
S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] - [1+\lambda-(1-\alpha)(1-r)]\,\underline{z}_i \geqslant \\
S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - [1+\lambda-(1-\alpha)(1-r)]\,\overline{z}_i
\end{aligned} \tag{93}$$

and, not to have too high dividends given to the shareholders nor to shut down the inefficient firm, we should have:

$$S(\overline{q}_i) - (1+\lambda)[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)] - [1+\lambda-(1-\alpha)(1-r)]\,\overline{z}_i - \frac{\nu}{1-\nu}\lambda\Phi(\overline{e}_i) \geqslant 0 \tag{94}$$

The conditions to characterize the shareholder's best response:

$$\underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) \geqslant \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) \tag{95}$$

$$\overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{96}$$

The last condition is needed, so that shareholders (if the transfer is high enough) do not veto the production to the inefficient firm.

Plus:

$$\underline{U}_i = \underline{t}_i - \psi(\underline{\beta}_i - \underline{C}_i) - \underline{z}_i = \underline{t}_i - \psi(\underline{\beta}_i - \overline{C}_i) - \overline{z}_i = \overline{U}_i + \Phi(\overline{e}_i) \tag{97}$$

$$\overline{U}_i = \overline{t}_i - \psi(\overline{\beta}_i - \overline{C}_i) - \overline{z}_i = 0 \tag{98}$$

Using conditions (93) and (95), together with condition (97), we obtain:

$$S(\underline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)\right] \geqslant S(\overline{q}_i) - (1+\lambda)\left[(\underline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] \tag{99}$$

i.e. there is an output pair, $(\overline{q}_i, \underline{q}_i)$, which is implementable as a Nash equilibrium of the common agency game. Using constraints (94), (96) and (98), we get:

$$S(\overline{q}_i) - (1+\lambda)\left[(\overline{\beta}_i - \overline{e}_i)\overline{q}_i + \psi(\overline{e}_i)\right] - \frac{\nu(1+2\lambda)}{1-\nu}\Phi(\overline{e}_i) + (1-\alpha)(1-r)\frac{\nu}{1-\nu}\Phi(\overline{e}_i) \geqslant 0 \tag{100}$$

This is the aggregate veto constraint, characterizing the quantity that could be implemented in the inefficient firm.

$$\begin{aligned} L = {} & \nu S(\underline{q}_i) + (1-\nu)S(\overline{q}_i) - (1+\lambda)[\nu((\underline{\beta}_i - \underline{e}_i)\underline{q}_i + \psi(\underline{e}_i)) + (1-\nu)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i}))] + \\ & - \lambda\nu\Phi(\overline{e_i}) + \mu(1-\nu)\left[S(\overline{q}_i) - (1+\lambda)((\overline{\beta_i} - \overline{e_i})\overline{q}_i + \psi(\overline{e_i})) - \frac{\nu\left[1+2\lambda+(1-\alpha)(1-r)\right]}{1-\nu}\Phi(\overline{e_i})\right] \end{aligned} \tag{101}$$

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