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Public Firm Incentives under Asymmetric Information and Prospect of Deregulation and Privatization

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Abstract: Governments dislike poorly performing public firms and often see deregulation and privatisation as a way to improve performance and social welfare. From a theoretical point of view poor performance may be due to information asymmetries between the informed public firm and the relatively uninformed regulator.
The point of view in the paper is that the information asymmetries that makes the regulator unable to achieve first best during regulation, is also the cause of deregulation and privatization failure.
The effect on public firm incentives from introducing deregulation as a consequence from choosing a specific regulation contract is analysed.

JEL classification: D01, D02, D21, D43, D82, H4, L22, L32, L43, L51

Keywords: Regulation, public firms, incentives, optimal deregulation, asymmetric information, deregulation, privatization, contracts, public policy.

1. Introduction

The main problem with regulated public firms is the tendency of such firms to perform poorly compared to private market firms. The difference can be explained as being due to information asymmetries. The better informed firm is able to convince the regulator that providing large incentives is the best thing to do to boost its performance even though such action is not necessary. The result is that the firm receives too large transfers compared to what it would have, if the regulator was fully informed about the firm.

Governments dislike poorly performing public firms, they can become a liability to the government. They can become a financial burden and in times when governments need to restrict government spending governments would consider deregulating markets one of the ways to improve the situation.

Deregulating and privatising a public firm may be a way to solve these problems, but not necessarily a safe way to avoid political problems altogether. Deregulation and privatisation may create new political worries, like whether the deregulation and privatization will provide lower prices and better social welfare.

The pre- and post-deregulation and privatization problems are related in the sense that privatizing a public firm that seems to be inefficient, may turn out not to be so in the deregulated market, if information asymmetries characterises the relationship between the regulator and the firm. Depending on the realised level of competition in the deregulated market, the seemingly inefficient former public firm may turn out to be a market leader or even a monopolist in the deregulated market, resulting in higher prices and in turn prove to be a political problem even in the deregulated market as well. It is thus important for governments to get deregulation right the first time around.

If information about the public firm, the regulated market or the probable deregulation market outcome is ascertain, regulators tend to do what they can to ensure that the deregulation become a success. This can be the use of transitional periods or conditional deregulation, in which the government announces that it

will turn to regulation to reduce any post-deregulation unwanted effects of the deregulation if such are realised.

In this paper the link between regulation and deregulation is explored by proposing a system of regulation contracts that take into account both the public firm incentives during regulation as well as those arising from deregulation.

2. Some empirical studies

There exist a large number of cases of profitable privatised companies, which under state ownership made significant losses.[1] At the same time it is also noticeable that many of these companies became profitable when introduced to the prospect of deregulation and privatisation while they were still in the public sector. When you compare pre- and post-privatisation profitability of public firms there does not seem to be a clear link between post-privatisation profitability and pre-privatisation performance and the deregulation and privatisation goals of the government.

In Leeds (1991) it is found that profitability is higher after privatisation, but that it probably rose three years before the actual privatisation. Moussios (1994) find that privatisation failed to generate a significant and lasting stimulus for lasting improved performance. Parker and Hartley (1991) find a weak relationship between privatisation and improved profitability. Domberger (1993) find that improved profitability appeared to be wholly unrelated to the privatization. And Green and Vogelsang (1991) find that profitability appeared higher after privatisation, but the timing of the improvement was not necessarily related to either the announcement of the sale or the sale itself. In Price (1992) where the deregulation and privatization of the UK gas industry was examined, it is found that British Gas had produced unhelpful and very high estimates of it costs, when introduced to the prospect of being deregulated. The resulting post–deregulated market was characterised by monopolisation and price

[1] See Hodge (2000) for an overview of privatisation and deregulation studies.

discrimination. In Welsby and Nichols (1999) is the privatization of Britain's railways analysed. In 1948 the railways was nationalised, as the government at the time saw it necessary to improve efficiency and modernise the railways and when this goal was reached the railways would be privatised once again. Privatisation was introduced in 1997 because the government wanted to create competition and relieve the government financially. The privatisation was done by franchising lines. It created competition about the franchise of the line, but resulted in monopolisation of consumers.

As the small sample of studies suggest there is no clear link between pre- and post-deregulation performance and profitability, and also suggests that in many cases the deregulation process is characterised by information asymmetries. Whatever may be the case, almost all of the studies suggest that when the government has announced that it will deregulate and privatize, it does not turn back on its commitment to do so, even if the public firm suddenly turns out to have a better performance after the announcement. It is also noticeable that the deregulation target is not always clear, as in some cases it is better performance than what the public firm or firms report to the regulator, e.g. Welsby and Nichols (1999) and in other cases it is deregulate given the present market condition and the low performance of the public firm, e.g. Price (1992).

In Hodge (2000) is a thorough examination of existing studies of privatisation and deregulation around the world. An attempt is also made to make a list of the deregulation and privatisation goals of governments around the world. The list is in short format presented in Table 1.

Table 1: Announced Deregulation and Privatization Objectives by Governments

Objective category	**Objective**
Economic	Efficiency and increased competition.
Political	Funding autonomy, reduce public debt, maximize sales proceeds, and firm autonomy.
Consumer	Better service and lower prices.
Other	Environmental protection, successful transfer to the private sector and preserving the firm as a national firm.

Source: Hodge (2000;18-19) and the author.

3. Previous theoretical work

Modelling the relation between the regulator and public firm, as an asymmetric information game, was first undertaken by Loeb and Magat (1979) and Byron and Myerson (1982). Regulation contracts has since then been extensively examined by various authors such as Laffont and Tirole (1988), Lewis and Sappington (1988) and (1989), Baron and besanko (1984), Dana (1993), Armstrong and Rochet (1999), Armstrong (1999), Laffont and Tirole (1986), and Laffont and Tirole (1990). All of these articles focus on the public firm being under static regulation in sense that the prospect of ever being deregulated or privatised is not a possibility.

Many researchers have tried to explain the behaviour of public firms under regulation and probably just as many have analysed what the outcome of a particular privatization has been, but to the knowledge of this author none have attempted to link the two by explaining privatization outcomes by public firm behaviour during regulation. The primary concern of this paper is therefore to contribute to the understanding of public firm and regulator behaviour when deregulation and privatisation is a possibility.

It is the opinion in this paper that the information asymmetries that causes the principal to choose high powered contracts during regulation, is also what causes deregulation and privatization to fail. In an attempt to explain this and to analyze and determine the optimal regulation contracts associated with deregulation and privatisation, an asymmetric information model is developed. The model allows the regulator to incorporate deregulation rents in the provision of regulation contracts and builds on the contract framework developed for analysing regulation contracts by Laffont and Tirole (1986) among others.

4. **The model and results**

The first period in the deregulation model developed in this paper is similar to that developed in standard regulation contract models. The second period involves deregulation upon the regulator receiving a signal that is consistent with the announced deregulation target. The signal is the public firm's choice of first period contract. Since it is mainly the second period that differs from the standard regulation model, specification of the second period payoff function of the public firm is of particular interest. It assumed that the public firm can be either a low cost type denoted L, and a high cost type denoted H.

Second period payoffs are conditional on two things: first the signal on which the principal chooses to deregulate or continue to regulate and second on the deregulated market entry firms' marginal costs. Looking at the second condition first we assume that in the deregulated market the second period relevant prices are derived from the standard equilibrium conditions arising from Bertrand competition. Assuming Bertrand competition helps to simplify the problem, as Bertrand competition imply that in optimum prices are either equal to entrant's costs, denoted by c_e, i.e. $p_i = c_e$ so far as $c_e > c_i$ for $i \in \{L, H\}$, or be equal to the public firm type's marginal costs, i.e. $p_i = c_i$, so far as $c_e = c_i$, implying that the public firm's costs are either equal to the entrant firms' costs or infinitesimally lower. The payoff function for a type i firm is defined as.

$$\pi_i^2(p_i) = (c_e - c_i)q(c_e) \geq 0$$

eq. 1

It is assumed that the realised deregulation outcome is within the set of feasible outcomes available to the principal in the regulation period. The information available to the principal about entrant costs in the

deregulation period is assumed to be common knowledge. We will later on consider what happens if this is not the case. We can now turn the attention to the incentive constraints of the public firm types.

4.1 Incentive constraints of the firm

When the principal chooses to deregulate on a signal based on the contract chosen by the agent in the first period, the principal is in a sense choosing a specific second period contract for the agent to consider at the same time. It is assumed that the principal does not change deregulation signal, after the agent has chosen a specific contract, to imitate that the regulator is committed to deregulate.

In the same way as when only regulation contracts are possible the principal's choice imply in-optimal contracting, although the degree of in-optimality depends on the deregulation market entrant firms' cost as well.

The principal must decide which deregulation target it is going to be. And then commit on deregulating with the chosen target. It is further assumed that the principal, when not receiving the signal for deregulation, will not use the revealed information to design a signal consistent contract, but repeat the static first period contract, a part from being consistent with the optimal dynamic regulation contract behaviour of the principal of the standard models, see Byron and Myerson (1982), it also helps to simplify the model. The limited reactions available to the regulator implies that we only have to consider four incentive constraints: two for each type depending on whether the first period signal is of type H or L, i.e. denoted as respectively $s = q(c_H)$ and $s = q(c_L)$.

A. Type H firm:

Assumption: Assume that the regulator do not use first period signal to design the second period contract for the type L firm and that it will deregulate if the signal $s = q(c_H)$ is observed, i.e. if a high type incentive compatible contract is chosen.

$$T_H - c_H q(c_H) + \delta (c_e - c_H) q(c_e) \geq T_L - c_H q(c_L) + \delta [T_L - c_H q(c_L)]$$
$$\Updownarrow$$
$$T_H - c_H q(c_H) + \delta (c_e - c_H) q(c_e) \geq (1 + \delta)[T_L - c_H q(c_L)]$$

eq. 2

Assumption: Assume that the regulator do not use the first period signal to design the second period contract for the type L firm and that it will deregulate if the signal $s = q(c_L)$ is observed, i.e. if the low type incentive compatible contract is chosen.

$$T_H - c_H q(c_H) + \delta [T_H - c_H q(c_H)] \geq T_L - c_H q(c_L) + \delta (c_e - c_H) q(c_e)$$
$$\Updownarrow$$
$$(1 + \delta)[T_H - c_H q(c_H)] \geq T_L - c_H q(c_L) + \delta (c_e - c_H) q(c_e)$$

eq. 3

B. Type L firm:

Assumption: Assume that the regulator do not use first period signal to design the second period contract for the type L firm and that it will deregulate if the signal $s = q(c_H)$ is observed, i.e. if the high type incentive compatible contract is chosen.

$$T_L - c_L q(c_L) + \delta\left[T_L - c_L q(c_L)\right] \geq T_H - c_L q(c_H) + \delta\,(c_e - c_L) q(c_e)$$
$$\Updownarrow$$
$$(1-\delta)(T_L - c_L q(c_L)) \geq T_H - c_L q(c_H) + \delta\,(c_e - c_L) q(c_e)$$

eq. 4

Assumption: Assume that the regulator do not use first period signal to design the second period contract for the type L firm and that it will deregulate if the signal $s = q(c_L)$ is observed, i.e. if the low type incentive compatible contract is chosen.

$$T_L - c_L q(c_L) + \delta\,(c_e - c_L) q(c_e) \geq T_H - c_L q(c_H) + \delta\left[T_H - c_L q(c_H)\right]$$
$$\Updownarrow$$
$$T_L - c_L q(c_L) + \delta\,(c_e - c_L) q(c_e) \geq (1+\delta)\left[T_H - c_L q(c_H)\right]$$

eq. 5

The next step is to characterise the agent's information rents.

4.1 Characterisation of the agent's information rents

If the public firm type i mimic type j it will receive rents, i,j=L,H. The information rents associated with for example expecting to find that the public firm is a type H firm but it turn out to be a type L is the net difference between the left hand side of firm H's incentive constraint less the right hand side of firm type L's incentive constraint. An agent would get the rents of the mimicked type and any rents due to the difference in information between the principal and the agent, i.e. the information rents.

Since we have two cases of use of information by the principal we have four information rent equations to specify, two for each firm type.

Assumption: Assume that the regulator do not use first period signal to design the second period contract for the type L firm and that it will deregulate if the signal $s = q(c_H)$ is observed, i.e. if the high type incentive compatible contract is chosen.

If H mimics L the rents of H can be written as,

$$(1+\delta)\underbrace{[T_L - c_H q(c_L)]}_{A} = (1+\delta)\underbrace{[T_L - c_L q(c_L)]}_{B} + \Delta AB$$

$$\Downarrow$$

$$\Delta AB = -(1+\delta)\Delta_c q(c_L)\,;\ \Delta_c \equiv c_H - c_L$$

$$\Downarrow$$

$$(1+\delta)[T_L - c_H q(c_L)] = (1+\delta)[T_L - c_L q(c_L)] - (1+\delta)\Delta_c q(c_L) \Leftrightarrow (1+\delta)[T_L - c_H q(c_L)] = R_L - (1+\delta)\Delta_c q(c_L)$$

eq. 6

Rents of firm type L are $R_L = (1+\delta)[T_L - c_L q(c_L)]$. The transfer is,

$$T_L = \frac{R_L}{1+\delta} + c_L q(c_L)$$

eq. 7

In the case when the type L firm mimics H, the rents of type L can be written as,

$$T_H - c_L q(c_H) + \underbrace{\delta (c_e - c_L) q(c_e)}_{A} = T_H - c_H q(c_H) + \underbrace{\delta (c_e - c_H) q(c_e)}_{B} + \Delta AB$$

$$\Downarrow$$

$$\Delta AB = \Delta_c q(c_H) + \delta \Delta_c q(c_e)$$

$$\Downarrow$$

$$T_H - c_L q(c_H) + \delta (c_e - c_L) q(c_e) = T_H - c_H q(c_H) + \delta (c_e - c_H) q(c_e) + \Delta_c q(c_H) + \delta \Delta_c q(c_e)$$

$$\Updownarrow$$

$$T_H - c_L q(c_H) + \delta (c_e - c_L) q(c_e) = R_H + \Delta_c [q(c_H) + \delta q(c_e)]$$

eq. 8

Rents of firm type H are $R_H = T_H - c_H q(c_H) + \delta (c_e - c_H) q(c_e)$. The transfer is,

$$T_H = R_H + c_H q(c_H) + \delta (c_H - c_e) q(c_e)$$

eq. 9

Assumption: Assume that the regulator do not use first period signal to design the second period contract for the type L firm and that it will deregulate if the signal $s = q(c_L)$ is observed, i.e. if the low type incentive compatible contract is chosen.

If the type H firm mimics L, the rents of H can be written as,

$$\underset{A}{T_L - c_H q(c_L) + \delta (c_e - c_H) q(c_e)} = \underset{B}{T_L - c_L q(c_L) + \delta (c_e - c_L) q(c_e)} + \Delta AB$$

$$\Downarrow$$

$$\Delta AB = T_L - c_H q(c_L) + \delta (c_e - c_H) q(c_e) - T_L - c_L q(c_L) + \delta (c_e - c_L) q(c_e)$$

$$= -\Delta_c q(c_L) - \delta \Delta_c q(c_e)$$

$$\Downarrow$$

$$T_L - c_H q(c_L) + \delta (c_e - c_H) q(c_e) = R_L - \Delta_c [q(c_L) + \delta q(c_e)]$$

eq. 10

The transfer is,

$$T_L = R_L + c_L q(c_L) + \delta (c_L - c_e) q(c_e)$$

eq. 11

If the type L firm mimics H, the rents of L can be written as,

$$\underset{A}{(1+\delta)[T_H - c_L q(c_H)]} = \underset{B}{(1+\delta)[T_H - c_H q(c_H)]} + \Delta AB$$

$$\Downarrow$$

$$\Delta AB = (1+\delta)[T_H - c_L q(c_H)] - (1+\delta)[T_H - c_H q(c_H)] = (1+\delta)\Delta_c q(c_H)$$

$$\Downarrow$$

$$(1+\delta)[T_H - c_L q(c_H)] = R_H + (1+\delta)\Delta_c q(c_H)$$

eq. 12

The transfer is,

$$T_H = \frac{R_H}{1+\delta} + c_H q(c_H)$$

eq. 13

A further restraint on the public firm behaviour has to be set, this relates to whether it at a given offered contract will choose to accept the contract or not.

4.3 Social welfare and the optimization problem of the principal

The social welfare of the principal is in the first period is defined as the consumers' surplus subtracted the transfers spend to subsidise the production of the agent. In the second period regulation outcome this is also the case. The deregulation outcome imply that market competition determine social welfare. Market competition also implies that the principal has a choice between being concerned about rents or choose to ignore them. In this paper it is assumed that the principal does not care about firm rents in the deregulated market. This is in line with how some schools within antitrust economics treat the existence of rents, as a natural result from firms being more competitive and as a payoff for being more efficient than competitors. If the principal disliked deregulation rents it could always regulate the level of deregulation rents through a corporate tax policy and use the extracted rents on social welfare improving projects.

The expected social welfare of the principal is signal dependent, thus the principal will have two different expected social welfare functions to optimize. Further the principal will have two states to consider, one for which the agent is efficient, i.e. L, with probability φ and one for which the agent is inefficient, i.e. H, with probability of 1-φ and $0 \leq \varphi \leq 1$.

Expected social welfare when the signal $s = q(c_H)$ is,

$$EW = \varphi\left[S(q_L) - T_L\right] + (1-\varphi)\left[S(q_H) - T_H\right] \Rightarrow \quad EW = \varphi\left[S(q_L) - T_L\right] + (1-\varphi)\left[S(q_H) - T_H\right]$$

eq. 14

Insert T_L and T_H from eq. 7 and eq. 9 in eq. 14 to get,

$$EW = \varphi\left[S(q_L) - c_L q(c_L)\right] + (1-\varphi)\left[S(q_H) - c_H q(c_H) - \delta\,(c_H - c_e) q(c_e)\right] - \left[\varphi\,\frac{R_L}{1+\delta} + (1-\varphi)R_H\right]$$

eq. 15

Expected social welfare when the signal $s = q(c_L)$ is,

$$EW = \varphi\left[S(q_L) - T_L\right] + (1-\varphi)\left[S(q_H) - T_H\right]$$
$$\Downarrow$$
$$EW = \varphi\left[S(q_L) - T_L\right] + (1-\varphi)\left[S(q_H) - T_H\right]$$

eq. 16

Insert T_L and T_H from eq. 11 and eq. 13 respectively in eq. 16 to get,

$$EW = \varphi\left[S(q_L) - c_L q(c_L) - \delta\,(c_L - c_e) q(c_e)\right] + (1-\varphi)\left[S(q_H) - c_H q(c_H)\right] - \left[\varphi R_L + (1-\varphi)\frac{R_H}{1+\delta}\right]$$

eq. 17

Eq. 15 and eq. 17 is the principal's objective function and is the sum of expected social welfare and information rents.

4.4 The optimization problem of the principal

Proposition 1. The introduction of deregulation imply the possibility of deregulation rents and compared to standard regulation contracts less high powered contracts.

Proof

It is impossible for the principal satisfy every participation and incentive constraint of the two types at the same type. This is implied by the assumption that $c_L < c_H$.

The consequence for the principal is that a choice has to be made between allowing a type H or L firm to earn rents. It is counterintuitive to allow L to earn zero rents and at the same time ensure that type firms can earn rents, also implied by the assumption above. Thus, we can ignore this case.

This gives us four cases to consider, two for each signal.

Cases $= q(c_H)$*:*

$$R_H = 0, R_L \geq 0$$
$$\Downarrow$$
$$\max_{q_H, q_L} \quad EW = \varphi\left[S(q_L) - c_L q(c_L)\right] + (1-\varphi)\left[S(q_H) - c_H q(c_H) - \delta\,(c_H - c_e) q_H(c_e)\right] - \varphi\left[\frac{\Delta_c q(c_H) + \delta \Delta_c q_H(c_e)}{1+\delta}\right]$$
$$\Downarrow$$
$$\frac{\partial EW}{\partial L} = \varphi\left[S'(q_L) - c_L\right] = 0 \Leftrightarrow \quad S'(q_L) = c_L \Rightarrow \quad p_L = c_L$$
$$\frac{\partial EW}{\partial H} = (1-\varphi)\left[S'(q_H) - c_H - \delta\,(c_H - c_e)\right] - \varphi \Delta_c = 0 \Leftrightarrow \quad p_H = S'(q_H) = (1+\delta)c_H - \delta c_e + \frac{\varphi}{1-\varphi}\Delta_c$$

eq. 18

In the same fashion we proceed by deriving the socially optimal prices if the deregulation target is $s = (c_L)$.

Case $s = q(c_L)$*:*

For the case of providing zero rents to the inefficient type and positive rents to the inefficient, the socially optimal prices is,

$$R_H = 0, R_L \geq 0$$
$$\Downarrow$$
$$EW = \varphi\left[S(q_L) - c_L q_L(c_L) - \delta\,(c_L - c_e)q(c_e)\right] + (1-\varphi)\left[S(q_H) - c_H q(c_H)\right] - \left[\varphi\,(1+\delta)\Delta_c q(c_H)\right]$$
$$\Downarrow$$
$$\frac{\partial EW}{\partial H} = (1-\varphi)\left[S'(q_H) - c_H\right] - \varphi\,(1+\delta)\Delta_c = 0 \Rightarrow \quad p_H = S'(q_H) = c_H + \frac{\varphi}{1-\varphi}(1+\delta)\Delta_c$$
$$\frac{\partial EW}{\partial L} = \varphi\left[S'(q_L) - c_L - \delta\,(c_L - c_e)\right] = 0 \Rightarrow \quad p_L = S'(q_L) = (1+\delta)c_L - \delta c_e$$

eq. 19

In summary the results of the optimization are:

Signal/focus	$s = q(c_H)$	$s = q(c_L)$
$R_H = 0, R_L \geq 0$	$p_H = c_H + \delta\,(c_H - c_e) + \frac{\varphi}{1-\varphi}\Delta_c$ $p_L = c_L$	$p_H = c_H + \frac{\varphi}{1-\varphi}(1+\delta)\Delta_c$ $p_L = c_L + \delta\,(c_L - c_e)$

The deregulation contracts offered to the public firm reflects how the incorporation of deregulation in offered contracts affect public firm incentives. If the regulator suddenly and unexpectedly from the point of view of the public firm decided to deregulate without in advance announcing a deregulation target and on the basis of pure regulation contracts, the result would be that past contracts would be too high powered. This would also be the case if deregulation was known in advance and the standard regulation contracts was not adjusted for incentives from the announced deregulation of the public firm. Thus, the introduction of deregulation as part of a specified contract enables the regulator to lower the incentives provided in the offered contract compared to the standard regulation model.

Adjusting for deregulation incentives can be done in a number of ways. One way would be to use a combination of regulation type contracts and rent extraction through corporate taxation policies in the deregulation period.

5 Separating and pooling equilibrium

Proposition 2. A separating equilibrium and pooling equilibrium at the deregulation target is consistent with deregulation.

Proof

To determine when we have a separating or pooling equilibrium we start by determining for which values of c_e type H contracts are equivalent to type L contracts given that the signal is $s = q(c_H)$,

$$p_H = p_L \Rightarrow c_H + \delta (c_H - c_e) + \frac{\varphi}{1-\varphi}\Delta_c = c_L \Leftrightarrow c_e = c_H + \frac{1}{1-\varphi}\frac{\Delta_c}{\delta} \equiv \underline{c_e}$$

eq. 20

Eq. 20 implies that firm types are indifferent between choosing a type H and a type L contract. This means that we have a separating equilibrium. It also implies that the regulator is indifferent between deregulating a type L or type H firm and that deregulation occur.

For values of c_e different from those of eq. 20 we have

$$\begin{array}{ccc} > & < & \textit{pooling at } L \Rightarrow \textit{ no deregulation} \\ c_e = c_H + \dfrac{1}{1-\varphi}\dfrac{\Delta_c}{\delta} \Rightarrow & p_H = p_L \Rightarrow & \textit{separating} \Rightarrow \textit{ deregulation} \\ < & > & \textit{pooling at } H \Rightarrow \textit{ deregulation} \end{array}$$

eq. 21

If we perform the same exercise for the deregulation signal $s = q(c_L)$ we have,

$$\begin{array}{ccc} > & > & \textit{pooling at } H \Rightarrow \textit{ no deregulation} \\ c_e = c_L - \dfrac{(1-\varphi)+\varphi(1+\delta)}{(1-\varphi)\delta}\Delta_c \Rightarrow & p_H = p_L \Rightarrow & \textit{separating} \Rightarrow \textit{ deregulation} \\ < & < & \textit{pooling at } L \Rightarrow \textit{ deregulation} \end{array}$$

eq. 22

This analysis has the following implications for the determination of the socially optimal deregulation signal.

6 Social optimal deregulation signal

If we compare the c_e needed for the regulator to deregulate as found in the previous section and if we call the two c_e's found for $\overline{c_e}$ and $\underline{c_e}$ for respectively the c_e establishing equivalence for signal $s = q(c_H)$ and $s = q(c_L)$, we see that

$$\overline{c_e} - \underline{c_e} > 0 \Rightarrow \overline{c_e} > \underline{c_e}$$

eq. 23

If we start be defining $S_i(p_j)$ as the social welfare from the public firm choosing a contract providing a price of p_j when the deregulation target is i,j=H,L. If we compare the offered contracts under the different signals we see that

$$c_e > c_H + \frac{1}{1-\varphi}\frac{\Delta_c}{\delta} \Rightarrow S(regulation) > S(deregulation)$$

$$c_H + \frac{1}{1-\varphi}\frac{\Delta_c}{\delta} \geq c_e > c_L - \frac{(1-\varphi)+\varphi(1+\delta)}{(1-\varphi)\delta}\Delta_c \Rightarrow S_H(p_H) \geq S_L(p_L) \Rightarrow s^* = q(c_H)$$

$$0 \leq c_e \leq c_L - \frac{(1-\varphi)+\varphi(1+\delta)}{(1-\varphi)\delta}\Delta_c \Rightarrow S_H(p_H) < S_L(p_L) \Rightarrow s^* = q(c_L)$$

eq. 24

Proposition 3. If only information about the public firm is used to determine when to deregulate, the best thing to do is to announce deregulation if inefficient contracts are chosen.

Proof

If the regulator is uninformed about entrant cost, it would be reasonable to expect that the regulator uses the information it has about the public firm to make predictions about entrant firm costs, or make expectations about entrant cost based on his beliefs about the public firm. That is the information that the regulated firm can be two types and the signal the public firm send about its true type by choosing one of the contracts offered by the regulator. The regulator's beliefs are the probabilities assigned to the public firm being either inefficient or efficient.

In this case the expected entrant cost is $Ec_e = \varphi c_L + (1-\varphi)c_H$, the implication of this is that $c_L \leq Ec_e \leq c_H$.

By comparing this with eq. 24 it can be seen that it implies that the optimal signal is $s^* = q(c_H)$.

7 Game Participation

So far game participation has been ignored, but in this section we consider the effects different participation goals may have on the results.

If we assume that firms can choose whether to participate or not given the offered set of contracts and that participation imply

$$R_i \geq 0$$

eq. 25

; $i \in \{H, L, e\}$ indicating that the firms that will consider participation is the firm types H and L and entrants. Intuitively participation depends on the size of the first period and second period deregulation payoff and as long as the participation condition of the high type is greater than or equal to zero first period participation of both types is ensured, as long as $p_H \geq p_L \geq c_H$.

We will consider three cases of participation: 1) the case where firms do not care about period profit being greater than zero, as long as the sum of the period profits are greater than or equal to zero, i.e. $TR_i = \sum R_i^t$. Thus, firms accept a period loss as long as it is covered by the profit from the proceeding or preceding period; 2) the other case is where the regulator has an obligation to supply policy or public service requirement. This policy implies under the model settings, that the regulated firm must earn zero or positive rents. And 3) the regulator may employ a no shutdown policy on the former public firm.

7.1 Total period rents

Proposition 4. A deregulation target consistent with the public firm being inefficient, imply that only high type contracts will ensure participation. A deregulation consistent with the public firm being efficient, imply that participation is ensured for high type contracts and only for certain levels of entrant costs also for low type contracts.

Proof

If the firm only care about the total period rents being greater than or equal to zero this imply $TR_i = p_i - c_i + c_e - c_i \geq 0$, where $i = H, L$. The range of entrant costs compatible with this condition depends on the chosen contract and the deregulation signal.

If the deregulation target is $s = q(c_H)$ and type L contracts are chosen it is immediately evident that type L contract cannot ensure participation of type H firms. Thus, we can concentrate on participation in relation to type H contracts. If a type H contract is chosen it is seen that $p_H \to -c_e$ for $c_e \to \infty$ implying that $TR_H \to 0$ and that at the limit $p_H < c_e$ and further that $TR_H > 0 \forall c_e \in R_+$. Thus, participation is ensured for both firm types.

If the deregulation target is $s = q(c_L)$ and type H contracts are chosen it is immediately evident that this is sufficient to ensure participation of both firm types. If a type L contract is chosen it is seen that $p_H \to -c_e$ for $c_e \to \infty$ implying that $TR_L \to 0$ and that at the limit $p_L < c_e$ and further that $TR_L > 0 \forall c_e \in R_+$. Thus, participation of a type L firm is ensured for any value of entrant costs. With regard to the inefficient firm type participation is ensured for values of entrant costs satisfying

$$c_e \geq c_L - \frac{\Delta_c}{\delta}.$$

Thus, the participation condition of total rents being greater than or equal to zero limits the possible social optimal outcome space for both deregulation targets.

7.2 Obligation to supply

Proposition 4. An obligation to supply is inconsistent with a deregulation target of $s = q(c_L)$, but consistent with a deregulation target of $s = q(c_H)$ and further optimal for values of entrant cost within the range

$$c_H + \frac{1}{1-\varphi}\frac{\Delta_c}{\delta} \geq c_e > c_L - \frac{(1-\varphi)+\varphi(1+\delta)}{(1-\varphi)\delta}\Delta_c.$$

Proof

If the regulator employs an obligation to supply policy, it implies that the participation constraint is binding whenever the firm is regulated. This reflects the difference between public service requirements and the goals of deregulation, the principal is assumed to only be concerned about first period participation. Participation in the deregulated market is in a sense always ensured in the model, it is either

ensured by the former public firm or by an entrant firm. In light of this you can say that we have partial participation of the public firm if it only participates in the first period.

A supply obligation means that irrespective of firm type the regulator must ensure that the firm produces. Thus, the regulator must provide contracts that respect the participation condition irrespective of the deregulation signal. Given that the firm can be of either a high or a low cost type any contract that ensures participation of the high cost type will also ensure participation of the H type.

It is immediately seen that the range of entrant costs compatible with an obligation to supply given a deregulation signal of $s = q(c_H)$ and given a type L contract is chosen cannot ensure participation of type H firms. Thus, we can concentrate on participation in relation to type H contracts.

$$p_H \geq c_H \Rightarrow \; 0 \leq c_e^p \leq c_H + \frac{\varphi}{1-\varphi}\frac{\Delta_c}{\delta} \Rightarrow \; \overline{c_e} - c_e^p \geq \frac{\Delta_c}{\delta} > 0 \Rightarrow \; \overline{c_e} > c_e^p$$

Eq. 26

; c_e^p is the entrant cost level compatible with participation.

It is seen from eq. 26 that it is consistent with deregulation, though if it is further required to be within the range given in eq. 24 it will also be optimal.

If we turn to the range of entrant costs compatible with an obligation to supply given a deregulation signal of $s = q(c_L)$ it is seen that whenever a type H contract is chosen participation of both types is ensured. If a type L contract is chosen the range of entrant costs is

$$p_L \geq c_H \Rightarrow \ 0 \leq c_e^p \leq c_L - \frac{\Delta_c}{\delta} \Rightarrow \ \underline{c_e} - c_e^p \geq -\frac{\varphi(1+\delta)}{(1-\varphi)\delta^2}\Delta_c < 0 \Rightarrow \ \underline{c_e} < c_e^p$$

Comparing this with eq. 22 it is seen that participation will make pooling at H the only possible solution. This implies that the deregulation target is inconsistent with first period participation and deregulation in the second period.

7.3 No shutdown policy

Proposition 5. A no shutdown policy for the contracting firm in both periods is inconsistent with a deregulation target of $s = q(c_L)$, but consistent with a target of $s = q(c_H)$ for values of entrant costs of $c_e \geq c_H$.

Proof

A no shutdown policy in both periods implies $R_{H,t}, R_{L,t} \geq 0 \forall\, t \in \{1,2\}$. The minimum value of c_e fulfilling this requirement is $c_e = c_H$. Comparing this with the results of eq. 24 the optimal signal is $s = q(c_H)$. A no shutdown policy is consistent with values of entrant costs of $c_e \geq c_H$. The policy limits the socially optimal outcome space, available contracts and strategies of the regulator. If the realised entrant costs are $c_e < c_H$ the participation requirement is unobtainable and the no shutdown policy is impossible to uphold, unless the regulator continues to fund the public firm even after deregulation.

8 Conclusion

Incorporating deregulation as a variable in contract set up to regulated firms changes the incentives that the public firm has. It should also induce regulators to rethink regulation contracts and incorporate probable deregulation rents available to the firm types. If the regulator do so it implies regulation contracts that provide less incentive to the public firm compared to standard regulation contracts.

When regulators use public firm types as a projection of deregulation outcome it limits the possible social optimal outcome space and require that the regulator uses the inefficient firm type contracts as deregulation target. Deregulation increases the ways that the regulator can perceive and use participation policy. The different views have pronounced effects on the possible optimal social outcome space. The most limiting effect on outcome space is when the regulator has an obligation to supply policy and the least limiting effects has a laissez faire participation policy, where the firm considers the sum of period rents as the participation condition. As assumed in the model the regulator can choose between two deregulation targets reflecting different points of view on when deregulation should be performed from a political point of view. In the context of the model and given the different participation targets, the deregulation target that is most likely to be consistent with socially optimal deregulation, is to deregulate if the public firm chooses an inefficient firm type contract.

The findings of this paper suggest that regulators should be aware of the effects of probable deregulation on public firm incentives when designing regulation contracts. The findings also suggest that the deregulation target and participation policy should be chosen with great care and by carefully assessing the most probable deregulation outcome.

References

Armstrong, M. (1999). Optimal Regulation with Unknown Demand and Cost Functions. *Journal of Economic Theory*, 84(2), 196-215.

Baron, D.P., & Myerson, R.B. (1982). Regulating a Monopolist with Unknown Costs. *Econometrica*, 50(4), 911-930.

Baron, D.P., & Besanko, D. (1984). Regulation, Asymmetric Information, and Auditing. *RAND Journal of Economics*, 15(4), 447-470.

Boubakri, N., & Cosset, J.-C. (1998). The Financial and Operating Performance of Newly Privatised Firms: Evidence from Developing Countries. *The Journal of Finance*, 53(3), 1081-1110.

Dana, J., (1993). The Organization and Scope of Agents: Regulating Multiproduct Industries. *Journal of Economic Theory*, 59(2), 288-310.

Domberger, S., (1993). Privatisation: What does the British Experience Reveal? *Economic Papers*, 12(2), 58-68.

D'Souza, J., & Megginson, W.L. (1999). The Financial and Operating Performance of Privatized Firms during the 1990s. *The Journal of Finance*, 54(4), 1397-1438.

Eckel, C., Eckel, D., & Singal, V. (1996). Privatization and Efficiency: Industry Effects of the Sale of British Airways. *Journal of Financial Economics*, 43, 275-298.

Green, R., & Vogelsang, I. (1991). British Airways: A Turn - Around Anticipating Privatization. In Bös, D. (1991). Privatization; A theoretical Treatment. Clarendon Press, Oxford.

Hodge, G. A. (2000). Privatization: An International Review of Performance. Westview Press, A member of the Perseus Books Group, 2000.

Hunt, L.C., & Lynk, E.L. (1995). Privatization and Efficiency in the UK Water Industry: An Empirical Analysis. *Oxford Bulletin of Economics and Statistics*, 57(3), 371-88.

Parker, D., & Hartley, K. (1991). Do Changes in Organizational Status Affect Financial Performance? *Strategic Management Journal*, 12(8), 631-641.

Laffont, J.J., & Martimort, D. (2002). The Theory of Incentives: The Principal – Agent Model. Princeton University Press.

Laffont, J.J., & Tirole, J. (1990). Adverse Selection and Renegotiation in Procurement. *Review of Economic Studies*, 57, 597-625.

Laffont, J.J., & Tirole, J. (1988). The Dynamics of Incentive Contracts. *Econometrica*, 56(5), 1153-1175.

Laffont, J.J., & Tirole, J. (1986). Using Cost Observation to Regulate Firms. *Journal of Political Economy*, 94(3), 614-641.

Leeds, R.S. (1991). Privatization through Public Offerings: Lessons from Two Jaimaican Cases. In Ramamurti, R. & Vernon, R. (Eds.), Privatization and Control of State-owned Enterprises, World Bank, 86-125.

Lewis, T., & Sappington, D. (1989). Countervailing Incentives in Agency problems. *Journal of Economic Theory*, 49(2), 294-313.

Lewis, T., & Sappington, D. (1988). Regulating a Monopolist with Unknown Demand. *American Economic Review*, 78(5), 986-998.

Loeb, M., & Magat, W. (1979). A Decentralised Method for Utility Regulation. *Journal of Law and Economics*, 22, 399-401.

Moussios, A. (1994). ”Hybrid” Status, Regulation and Performance: An Empirical Analysis of the Decentralisation of British Telecom. DPA Thesis, University of Georgia.

Perotti, E.C. (1995). Credible Privatization. *The American Economic Review*, 85(4), 847-859.

Perotti, E.C., & Guney, S.E. (1993). The Structure of Privatization Plans. *Financial Management*, 22(1), 84-98.

Price, C. (1992). Regulation of the UK Gas Industry. *Annals of Public and Cooperative Economics*, 63(2), 189-206.

Sappington, D., & Stiglitz, J. (1987). Privatization, Information and Incentives. *Journal of Policy Analysis and Management*, 6, 567-582.

Schmitz, P.W. (2000). Partial Privatization and Incomplete Contracts: The Proper Scope of Government Reconsidered. *FinanzArchiv*, 57, 394-411.

Vickers, J.S., & Yarrow, G. (1988). Privatization: An Economic Analysis. Cambridge, MIT Press.

Welsby, J., & Nichols, A. (1999). The Privatization of Britain's Railways: An inside View. *Journal of Transport Economics and Policy*, 33(1), 55-76.

Yarrow, G. (1986). Privatization in Theory and Practice. *Economic Policy*, April 1986, 323-364.