Partial Privatization and Incomplete Contracts: The Proper Scope of Government Reconsidered

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Abstract

In this paper it is argued that privatization is not the only alternative to public ownership. Adopting the incomplete contract approach, it is shown that partial privatization may well be the optimal ownership structure. While in the standard incomplete contract model joint ownership is usually dominated, it is shown here that joint ownership in the form of partial privatization can be optimal since it mitigates the disadvantages of public ownership (no incentives to improve quality if the manager invests or too strong incentives if the government invests) and of privatization (too strong incentives for the manager to reduce costs).

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1 Introduction

The costs and benefits of privatization are the issue of a lasting and controversial discussion in public economics.[1] The recent theory of incomplete contracts can help to throw some new light on this important discussion. The incomplete contract approach pioneered by Grossman and Hart (1986) was initially focused on the choice between different ownership structures in the context of privately owned firms. In this context, Hart and Moore (1990) and Hart (1995) have shown that joint ownership is often dominated and can hence be neglected when looking for the optimal ownership arrangement.[2] In the present paper the incomplete contract approach is applied to the privatization issue. It is shown that it may be too rash to view public ownership and privatization as mutually exclusive alternatives. In fact, partial privatization, i.e. joint ownership, may well turn out to be the optimal ownership structure, if the trade-offs that have been emphasized in the privatization context are taken into account.

It is often argued that privatization of public enterprises induces managers to exert more effort in order to decrease costs. However, some economists also think that lower costs may be accompanied by a lower quality of public services that private suppliers deliver.[3] On the other hand, proponents of privatization think that under certain circumstances privatization may not only lead to lower costs, but also to higher quality. In order to clarify this discussion, Hart, Shleifer, and Vishny (1997) have recently developed an incomplete contract model. In their analysis privatization is the only alternative to public ownership. In contrast, in the present paper it is argued that a discussion of the proper scope of governmental ownership should not neglect the possibility of partial privatization.

Specifically, in the spirit of Hart, Shleifer, and Vishny (1997), consider a government represented by a politician or a bureaucrat, who wants a certain

[1] There are by now several books devoted to the issue of privatization; e.g., see Bös (1991) and Vickers and Yarrow (1988). See also Shleifer (1998) for a recent survey article and Schmidt and Schnitzer (1997) for a discussion of different privatization methods.

[2] See Schmitz (2001) for a non-technical survey of the literature on incomplete contracts.

[3] For example, when the railway service is privatized, too many workers may be dismissed, at the cost of safety. When the mail service is privatized, too many post offices may be closed, which reduces the quality of the service in rural areas.

public good or service to be provided. According to the incomplete contract approach, the basic question is who should have the right to control the non-human assets needed for production of the good. Under public ownership the government has the control right, whereas under privatization the manager of the privatized firm has the control right.[4] Independent of the ownership structure, the manager can exert non-contractible effort in order to improve the quality of the good (quality innovation) and to reduce costs (cost innovation). A quality innovation is accompanied by increased production costs, while a cost innovation is accompanied by a reduced quality. However, these negative side effects are sufficiently small so that implementation of both kinds of innovation is ex post efficient. It is assumed that ex ante it is not possible to contractually specify implementation; only incomplete contracts that specify a fixed payment and an ownership structure can be written.

If the government has the authority to implement innovations (public ownership), it will always implement a quality innovation. However, it is only willing to implement a cost innovation if it is compensated for the reduced quality through renegotiation of the payment. Hence, the manager does not invest in quality innovation (since he gets no compensation for the increased costs), and he underinvests in cost innovation (since he receives only part of the renegotiation surplus). If the manager has authority (privatization), he implements the cost innovation, but he only implements the quality innovation if the payment is renegotiated so that he is compensated for the increased costs. Thus, the manager overinvests in cost reduction (since he ignores the quality loss) and underinvests in quality innovation (since he gets only a fraction of the renegotiation surplus).

Now consider partial privatization, i.e. joint ownership. In this case an innovation can only be implemented if the government and the manager agree, i.e. both of them have veto power. In this case both types of innovation will only be implemented through renegotiations, and hence the manager underinvests in quality improvement and in cost reduction. A comparison with public ownership (underinvestment in cost innovation; but no investment in quality innovation) shows that partial privatization is always

[4]For simplicity, the agency problem between the rest of society and the agent representing the government as well as the agency problem between the owners of the private firm and the manager are neglected.

superior.[5]

Hence, in this scenario, in which only the manager faces investment decisions, public ownership can in fact never turn out to be optimal. In order to develop a model that can explain each of the three different ownership arrangements depending on the parameter values within a uniform framework, a second scenario will be considered. In this scenario the manager still chooses investment in cost reduction, but the government chooses investment in quality improvement. Analogous considerations show that under public ownership there is overinvestment in quality improvement and underinvestment in cost reduction, and vice versa in the case of privatization. Partial privatization leads to underinvestment in both kinds of innovation. Each of the three arrangements can be optimal, depending upon the relative importance of the innovations.[6]

Even though the relevance of partial privatization is well-known,[7] to the best of my knowledge this possibility has so far not been considered in the incomplete contracts literature initiated by Grossman and Hart (1986). While this paper is most closely related to Hart, Shleifer, and Vishny (1997), it should be noted that there are some further papers that link the issue of privatization to contractual incompleteness, in particular Shapiro and Willig (1990), Laffont and Tirole (1991), and Schmidt (1996a, 1996b), although the focus of these papers is quite different (they assume informational asymme-

[5] Note that this is in contrast to the standard incomplete contract model outlined by Hart (1995), in which investment incentives under joint ownership can never be larger than under separate ownership. The reason is that in the standard model investments are 'selfish', while here the manager's investment in quality innovation is 'cooperative' in the language of Che and Hausch (1999), i.e. in the absence of renegotiation it is of benefit to the other party only. Even when the government already has veto-power, the manager's incentives can still be improved by giving him veto-power, too, since only then will the manager invest in quality innovation.

[6] The reason that partial privatization (joint ownership) can be optimal in this scenario is that (in contrast to Hart's (1995) standard model) under separate ownership there can be overinvestment, since e.g. the government's investment in quality improvement not only increases the government's benefit, but also the manager's costs. In the second scenario investment incentives under joint ownership can only be smaller than under separate ownership. But unlike in Hart's (1995) standard model, here this can be advantageous, since it prevents overinvestment.

[7] See e.g. Boardman and Vining (1989), Megginson, Nash, and van Randenborgh (1994), Ramamurti (1997), Boubakri and Cosset (1998), and Matsumura (1998).

tries).[8] In the context of private firms, it has recently been pointed out by some authors that joint ownership may be optimal under certain circumstances. Halonen (1995) shows that joint ownership can be optimal in a dynamic framework when the players are honest with a small probability. DeMeza and Lockwood (1998) and Chiu (1998) consider a rule for splitting the renegotiation surplus that is different from Grossman and Hart (1986), which may also make joint ownership optimal. Finally, Rosenkranz and Schmitz (1999) show that joint ownership can be optimal in the context of R&D joint ventures if it is important to induce the parties to disclose their know-how.

The remainder of the paper is organized as follows. In the following section the basic model is introduced. In Section 3, the first scenario is analyzed. It is shown that public ownership is always dominated by partial privatization if only the manager invests. In Section 4, the second scenario is analyzed. When both the manager and the government face investment decisions, each ownership structure can turn out to be optimal. A simple example is briefly discussed in Section 5. Finally, some concluding remarks follow in Section 6.

2 The basic model

A manager M can produce a good or a service for the government G. At some date 1, the parties contractually determine the basic characteristics of the good to be delivered and the payment P_0 to be made from the government to the manager at date 3. The contract also specifies an ownership structure $o \in \{G, M, P\}$. Under public ownership ($o = G$), the government has the right to modify the non-human assets used in the production of the good. Under privatization ($o = M$), the manager controls the assets, and under partial privatization ($o = P$), both parties must agree to any modifications.

The manager's production costs are denoted by C, whereas the government's benefit from consuming the good is denoted by B. If the parties at date 3 exchange the good and the assets have not been modified, costs and benefit are given by C_0 and B_0, respectively. However, at date 2 non-contractible effort can be invest in two types of innovations that can influence costs and benefits. An innovation is a proposal to modify the assets used

[8] See also De Fraja (1993) for a related line of research.

in the production process, leading to a modified good. The owner(s) of the assets can decide whether such a proposal is implemented. Following the incomplete contract approach, it is assumed that a contract on the modifications can only be written at date 3, but not at date 1, when they are still unknown.[9]

In particular, at date 2 the manager (in scenario I) or the government (in scenario II) can invest $i \in [0, \overline{i}]$ in a quality innovation that (if it is implemented) increases the governments's benefit by $\beta(i)$. The quality improvement is accompanied by an increase in the manager's production costs that is given by $\gamma(i)$. Moreover, the manager can invest $e \in [0, \overline{e}]$ in a cost innovation that decreases production costs by $c(e)$ and goes with a decrease in quality that is given by $b(e)$. Let $x \in \{0, 1\}$ and $y \in \{0, 1\}$ denote the decisions whether the quality innovation and the cost innovation, respectively, are implemented, so that benefit and costs are

$$B(x, y) = B_0 + x\beta(i) - yb(e), \tag{1}$$

$$C(x, y) = C_0 - yc(e) + x\gamma(i). \tag{2}$$

It is assumed that implementation of both kinds of innovation is ex post efficient, i.e. $\beta(i) \geq \gamma(i)$ and $c(e) \geq b(e)$. Moreover, it is supposed that all functions are twice continuously differentiable and satisfy the following standard assumptions:[10] $\beta(0) = 0, \lim_{i \to 0} \beta'(i) = \infty, \beta'(\overline{i}) = 0, \beta''(i) < 0, \gamma(0) = 0, \gamma'(i) > 0, \gamma''(i) \geq 0$, and analogously $c(0) = 0, \lim_{e \to 0} c'(e) = \infty, c'(\overline{e}) = 0, c''(e) < 0, b(0) = 0, b'(e) > 0, b''(e) \geq 0$. The time structure of the model is illustrated in Figure 1.

[9] While this assumption is in accordance with Grossman and Hart (1986), note that the theoretical foundations are still a matter of ongoing discussions (see Maskin and Tirole, 1999, and Hart and Moore, 1999). Recently, Tirole (1999) has advocated a versatile approach and argued that the incomplete contract theory may be a useful shortcut.

[10] Notice that $c(e)$ denotes a cost *reduction* and is hence assumed to be concave, while the benefit *reduction* $b(e)$ is assumed to be convex. While the assumptions are in the spirit of Hart, Shleifer, and Vishny (1997, p. 1134), note that strictly speaking their set of assumptions implies $b(e) \equiv 0$, which is not the case here (see Section 5 for a non-trivial example).

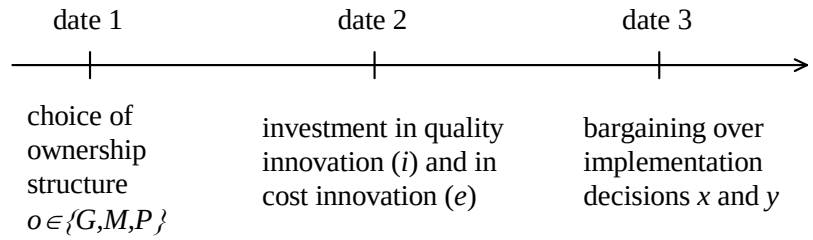

Figure 1: The sequence of events

Total surplus is given by $B(x,y) - C(x,y) - i - e$. If all variables were contractible, the parties would agree on the first-best solution that maximizes total surplus.[11] Under the assumptions made, this benchmark solution is given by the (ex post efficient) implementation decisions $x^{FB} = 1$ and $y^{FB} = 1$ and by the (ex ante efficient) investment levels i^{FB} and e^{FB}, which are implicitly defined by

$$\beta'(i^{FB}) - \gamma'(i^{FB}) = 1, \tag{3}$$

$$c'(e^{FB}) - b'(e^{FB}) = 1. \tag{4}$$

At date 3, the default values of the implementation decisions x and y (i.e., the decisions in the absence of renegotiation) depend upon the allocation of control rights. Under public ownership the government can decide whether or not to implement quality and cost innovations. Since a quality innovation can only increase the government's benefit, it chooses $x^G = 1$. However, if there is no renegotiation of the payment, the government is not willing to implement the cost innovation ($y^G = 0$), since it is accompanied by a decrease in quality and hence in the government's benefit.[12] In the

[11] For concreteness, one can assume that at date 1 the government has all bargaining power. It would then set the payment P_0 such that the manager receives his reservation utility (which is assumed to be zero). Hence, it is in the government's interest to maximize total surplus.

[12] It will be shown that in scenario I the manager does not invest in quality improvement under public ownership. However, this does not change the fact that at date 3 the government would implement the quality innovation if the manager had invested (both parties know the innovations; cf. Aghion and Tirole, 1994). This is to be contrasted with Hart, Shleifer, and Vishny's (1997) model. Moreover, it is assumed here that once the parties are locked-in, the government cannot hire another manager from a competitive market to implement the cost innovation.

case of privatization, the manager has the authority to decide about x and y. He chooses $x^M = 0$ and $y^M = 1$, because the quality innovation leads to higher production costs which the manager is not willing to incur without compensation, while the cost innovation reduces his production costs. Finally, consider the case of partial privatization, so that the consent of both parties is required in order to implement the innovations.[13] Then the default decisions are $x^P = 0$ and $y^P = 0$, since the government puts a veto on cost innovations and the manager puts a veto on quality innovations. Note that in the present context this is equivalent to saying that the cost innovation can only be implemented if the government agrees (i.e., reductions in quality, e.g. safety of the service to be provided, need the government's approval), while the manager is free to implement the quality innovation.

It is assumed that the parties are symmetrically informed, so they will according to the Coase - Theorem always enter renegotiations at date 3 and implement the ex post efficient decisions x^{FB} and y^{FB}. Following the incomplete contracts approach introduced by Grossman and Hart (1986), it is assumed that the parties split the renegotiation surplus according to the Nash bargaining solution. Let the default decisions under ownership structure $o \in \{G, M, P\}$ be denoted by x^o and y^o. Suppose that the manager's bargaining power $\pi \in (0, 1)$ does not depend on the control structure.[14] Then the parties' anticipated payoffs at date 3 (i.e., not including the investment costs) are given by

$$\begin{aligned} U_M^o &= P_0 - C(x^o, y^o) \\ &\quad +\pi \left([B(1,1) - C(1,1)] - [B(x^o, y^o) - C(x^o, y^o)] \right), \end{aligned} \tag{5}$$

$$\begin{aligned} U_G^o &= B(x^o, y^o) - P_0 \\ &\quad +(1-\pi) \left([B(1,1) - C(1,1)] - [B(x^o, y^o) - C(x^o, y^o)] \right). \end{aligned} \tag{6}$$

In order to characterize the investment decisions under the different ownership structures, the two scenarios under consideration have now to be

[13] Instead of joint control over one asset (or a set of assets), one can alternatively imagine that two complementary assets are needed for production of the public good. Joint ownership or partial privatization then means that one asset is controlled by the government and the other asset by the manager. In any case, both parties' approval is needed in order to implement an innovation.

[14] This assumption is usually made in the incomplete contract literature. As has been pointed out by Hart (1995, p. 39), it would be *too* easy to obtain a theory of the optimal allocation of property rights if it were supposed that the bargaining process changes under different ownership structures.

distinguished.

3 Scenario I: One-sided investment

In the first scenario, the manager chooses both investment levels. Hence, the investment levels under ownership structure o are given by

$$(i^o, e^o) = \arg\max_{(i,e)} U_M^o - i - e. \tag{7}$$

Consider first public ownership. In this case the default decisions are $x^G = 1$ and $y^G = 0$, so that

$$\left(i^G, e^G\right) = \arg\max_{(i,e)} P_0 - C_0 - \gamma(i) + \pi\left[c(e) - b(e)\right] - i - e. \tag{8}$$

Therefore, $i^G = 0$, and e^G is implicitly defined by the first-order condition

$$\pi\left[c'(e^G) - b'(e^G)\right] = 1. \tag{9}$$

Under public ownership the government would implement a quality innovation, but the manager anticipates that he will have to incur the increased production costs without being compensated, and thus the manager does not exert any effort in order to work out a proposal aimed at increasing quality. However, knowing that the government is not willing to implement a cost innovation that is accompanied by a reduction in its benefit without compensation, the manager anticipates that at date 3 renegotiation in order to implement the cost innovation will occur. Since he receives only a fraction π of the renegotiation surplus, the manager underinvests in cost innovation relative to the first-best benchmark ($e^G < e^{FB}$).[15]

Consider next the case of privatization. The manager then chooses

$$\left(i^M, e^M\right) = \arg\max_{(i,e)} P_0 - C_0 + c(e) + \pi\left[\beta(i) - \gamma(i)\right] - i - e. \tag{10}$$

The investment levels are thus given by the first-order conditions

$$\pi\left[\beta'(i^M) - \gamma'(i^M)\right] = 1, \tag{11}$$

$$c'(e^M) = 1. \tag{12}$$

A comparison of (12) with the first-best solution (4) shows that the manager overinvests in cost innovation ($e^M > e^{FB}$).[16] The reason is that the

[15] This follows immediately from the fact that $c(e) - b(e)$ is strictly concave and $\pi < 1$.

[16] This follows from concavity of $c(e)$ and $c(e) - b(e)$ and from the fact that $b'(e)$ is positive.

manager always implements the cost innovation but disregards the fact that it is accompanied by a quality reduction. The manager underinvests in quality innovation ($i^M < i^{FB}$), since it will only be implemented through renegotiation and the manager merely gets a fraction π of the renegotiation surplus.

Finally, consider partial privatization. The manager chooses

$$\left(i^P, e^P\right) = \arg\max_{(i,e)} P_0 - C_0 + \pi\left[\beta(i) - \gamma(i) + c(e) - b(e)\right] - i - e. \quad (13)$$

The first-order conditions are

$$\pi\left[\beta'(i^P) - \gamma'(i^P)\right] = 1, \quad (14)$$

$$\pi\left[c'(e^P) - b'(e^P)\right] = 1. \quad (15)$$

The manager underinvests in both dimensions, since both innovations are only implemented through renegotiation and the manager does not receive the full renegotiation surplus.

As an immediate consequence of the preceding discussion, the following lemma can now be stated.

Lemma 1 *In scenario I, the investment levels under the different ownership structures can be ranked as follows:*

$$i^G = 0 < i^M = i^P < i^{FB}, \quad (16)$$

$$e^G = e^P < e^{FB} < e^M. \quad (17)$$

At date 1 the parties agree on the ownership structure that maximizes total surplus $S^o = B_0 + \beta(i^o) - b(e^o) - [C_0 - c(e^o) + \gamma(i^o)] - i^o - e^o$. The first result says that in scenario I either privatization or partial privatization is optimal.

Proposition 1 *If only the manager invests, public ownership can never be optimal.*

Proof. Note that investment in cost innovation is identical under $o = G$ and $o = P$. Moreover, while investment in quality innovation is always smaller than in the first-best solution, it is larger under $o = P$ than under $o = G$. Since S^o is concave in i^o, this implies that public ownership is always inferior to partial privatization. ■

Whether privatization or partial privatization is optimal depends upon the parameter constellation.[17] In particular, the following characterization can be provided.

Proposition 2 *(i) If the manager's bargaining power is sufficiently large, partial privatization is the optimal ownership structure. (ii) Suppose that* $b(e) = \theta\tilde{b}(e)$, *where* $\theta > 0$. *Then for* θ *sufficiently small (i.e., the benefit reduction due to a cost innovation is sufficiently small), privatization is optimal.*

Proof. Note that investment in quality innovation is identical under $o = M$ and $o = P$. (i) If the manager's bargaining power π converges to 1, the investment e^P in cost innovation under partial privatization converges to the first-best level e^{FB} (compare (15) and (4)), while the overinvestment e^M in cost innovation under privatization remains unchanged (see (12)). (ii) If $\theta \to 0$, then the first-best investment level e^{FB} converges to e^M (compare (4) and (12)), while under partial privatization there is still underinvestment (see (15)). ■

To summarize, if only the manager faces investment decisions, public ownership is never optimal. Under public ownership the government would always implement a quality innovation without compensating the manager for the increased production costs, and hence the manager would not exert any effort aimed at quality improvements. Moreover, while under privatization the costs are lower than under partial privatization, the quality is also lower, since under privatization the manager has too strong incentives to reduce production costs. It may hence well be optimal to choose a partially privatized ownership structure such that the government can block cost innovations that reduce quality. In this case the manager's incentives to reduce costs are smaller and the incentives to improve quality are identical compared with the case of privatization.

While public ownership cannot be optimal in scenario I once the possibility of partial privatization is considered, in the next section a variant of

[17] Notice that privatization is not always the optimal ownership structure, even though only the manager invests. While in Hart's (1995) standard incomplete contract model a non-investing party should never have veto-power, there are other papers which also show that this may in fact be optimal under certain circumstances, cf. Rajan and Zingales (1998) and Schmitz and Sliwka (2000).

the model will be introduced that can offer a rationale for any of the three ownership structures.

4 Scenario II: Two-sided investment

In the second scenario, the manager still chooses the investment in cost innovation, but now the government chooses the investment in quality improvement. This seems to be a plausible setting. Since the manager is in charge of the production process, he is probably in the best position to search for ways to reduce production costs. On the other hand, the quality innovation aims at increasing the government's benefit. There may well be situations in which the government itself is in the best position to work out proposals that may increase its benefit.[18]

The investment levels in scenario II are thus determined by[19]

$$i^o = \arg\max_i U_G^o - i, \tag{18}$$

$$e^o = \arg\max_e U_M^o - e. \tag{19}$$

It is straightforward to see that the manager's investment levels e^G, e^M, and e^P are still characterized by the same first-order conditions (9), (12), and (15) as in scenario I.

In order to analyze the government's investment in quality innovation, consider first public ownership, so that

$$i^G = \arg\max_i B_0 - P_0 + \beta(i) + (1-\pi)\left[c(e) - b(e)\right] - i. \tag{20}$$

Hence, i^G is now determined by

$$\beta'(i^G) = 1. \tag{21}$$

[18] In fact, most papers on the hold-up problem assume that the seller can invest in order to reduce his costs, while the buyer can invest in order to increase her benefits (e.g., see Hart and Moore, 1988, Hermalin and Katz, 1993, Nöldeke and Schmidt, 1995, Edlin and Reichelstein, 1996, or Schmitz, 2000). See also the basic incomplete contract model in Hart (1995).

[19] Notice that the default decisions x^o and y^o do not depend on who invests, i.e. they remain unchanged. For example, the government would still implement the quality innovation under public ownership. Recall that implementation means that the assets are modified by the owner. In the example this means that the manager cannot avoid incurring higher production costs if the government implements the quality innovation under $o = G$.

Under public ownership the government implements the quality innovation without renegotiation, but disregards the fact that it is accompanied by higher production costs for the manager. Therefore, the government overinvests relative to the first-best benchmark ($i^G > i^{FB}$).

Consider next privatization, so that the government chooses

$$i^M = \arg\max_i B_0 - P_0 - b(e) + (1-\pi)\left[\beta(i) - \gamma(i)\right] - i. \tag{22}$$

The government's investment level is thus given by

$$(1-\pi)\left[\beta'(i^M) - \gamma'(i^M)\right] = 1. \tag{23}$$

The government underinvests in quality innovation ($i^M < i^{FB}$), since it will only be implemented through renegotiation and the government merely gets a fraction $1-\pi$ of the renegotiation surplus.

Finally, consider partial privatization. The government chooses

$$i^P = \arg\max_i B_0 - P_0 + (1-\pi)\left[\beta(i) - \gamma(i) + c(e) - b(e)\right] - i, \tag{24}$$

so that the first-order condition is again

$$(1-\pi)\left[\beta'(i^P) - \gamma'(i^P)\right] = 1. \tag{25}$$

The preceding discussion immediately implies the following lemma.

Lemma 2 *In scenario II, the investment levels under the different ownership structures can be ranked as follows:*

$$i^M = i^P < i^{FB} < i^G, \tag{26}$$

$$e^G = e^P < e^{FB} < e^M. \tag{27}$$

At date 1, the parties again choose the ownership structure that maximizes total surplus S^o. In scenario II any ownership structure can turn out to be optimal, depending upon the parameter constellation. Specifically, the following characterization can be provided.

Proposition 3 *(i) Suppose that $b(e) = \theta\tilde{b}(e)$, where $\theta > 0$. Then for θ sufficiently small, privatization is optimal, if the manager's bargaining power is sufficiently small or if the quality innovation is unimportant (suppose that $\beta(i) - \gamma(i) = \tau[\tilde{\beta}(i) - \tilde{\gamma}(i)]$, with $\tau > 0$ sufficiently small). (ii) Suppose that $\gamma(i) = \psi\tilde{\gamma}(i)$, where $\psi > 0$. Then for ψ sufficiently small, public ownership*

is optimal, if the manager's bargaining power is sufficiently large or if the cost innovation is unimportant (suppose that $c(e)-b(e)=\phi[\tilde{c}(e)-\tilde{b}(e)]$ *with* $\phi>0$ *sufficiently small). (iii) If the adverse side effects of the innovations are substantial, partial privatization can be optimal.*

Proof. (i) If θ converges to 0, then $e^{FB}\rightarrow e^{M}$ (see (4) and (12)) while there is still underinvestment in cost reduction under public ownership and under partial privatization. Moreover, if $\pi\rightarrow 0$, then $i^{M}\rightarrow i^{FB}$ (see (23) and (3)), so that $o=M$ is optimal. Alternatively, if τ converges to 0, then $i^{FB}\rightarrow 0$, so that again $o=M$ is optimal. (ii) If $\psi\rightarrow 0$, then $i^{FB}\rightarrow i^{G}$ (see (3) and (21)), while there is still underinvestment in quality improvement under privatization and under partial privatization. Moreover, if $\pi\rightarrow 0$, then $e^{G}\rightarrow e^{FB}$ (see (9) and (4)), so that $o=G$ is optimal. Alternatively, if ϕ converges to 0, then $e^{FB}\rightarrow 0$, and hence $o=G$ is again optimal. (iii) In order to prove the remaining part, it is sufficient to give an example. Such an example will be discussed in the following section. ■

Note in particular that in scenario II public ownership can be optimal, while it was always inferior to partial privatization in scenario I. The reason is as follows. The manager's incentives to invest in cost reduction are always the same under $o=G$ and $o=P$. Moreover, under partial privatization there is always underinvestment in the quality innovation. However, in scenario I the manager has no incentives to invest in quality improvement under public ownership, while in scenario II the government's incentives to invest in quality improvement are too strong under $o=G$. In scenario II it may well happen that the overinvestment in quality innovation under $o=G$ is less harmful than the underinvestment under $o=P$, so that public ownership is no longer dominated by partial privatization.[20]

In the next section it will be demonstrated that the assumptions made in this paper are consistent with non-trivial examples and that in scenario II any of the three ownership structures (including partial privatization) can be optimal for a wide range of parameter values, depending on the relative importance of quality and cost innovations.

[20] Note that only in scenario I (in which public ownership is never optimal if partial privatization is taken into account) can quality under public ownership be lower than under private ownership (since $i^{M}>0$). In scenario II there is always a clear trade-off between costs and quality.

5 A simple example

Some of the main insights of this paper can now be briefly illustrated using a simple example. Let the quality improvement be given by $\beta(i) = 2i^{1/2} - i$, and the accompanying cost increase by $\gamma(i) = \psi i$. Let the cost reduction $c(e) = 2e^{1/2} - e$ be accompanied by a benefit reduction $b(e) = \theta e$. Moreover, $\overline{i} = 1, \overline{e} = 1, B_0 = 2, C_0 = 1$, and $\pi = \frac{1}{2}$. It is easily verified that all assumptions are satisfied if $\psi \in (0,1)$ and $\theta \in (0,1)$.

First, consider scenario I, i.e. the manager chooses both investment levels. Figure 2 shows the total surplus under the three different ownership arrangements as functions of θ, holding $\psi = \frac{1}{2}$ fixed. As a benchmark, the dotted line represents the first-best surplus. Public ownership can obviously never be optimal. Moreover, if θ is smaller than a certain cut-off value κ (which in this example is equal to $\frac{1}{2}\sqrt{17} - \frac{3}{2} \approx 0.56$), privatization is better than partial privatization.

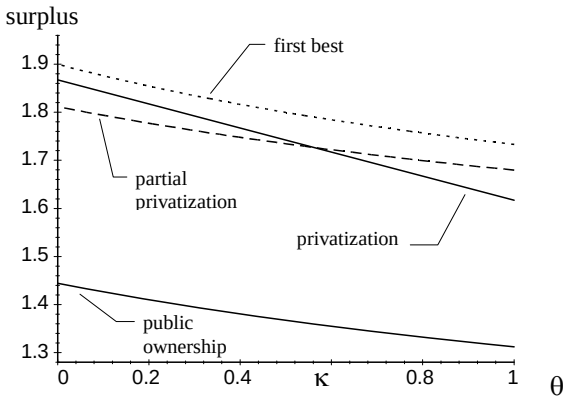

Figure 2: Surplus in scenario I

Second, consider scenario II, so that the manager chooses the investment in cost reduction, while the government chooses the investment in quality improvement. The example demonstrates that in this case each of the three ownership structures can be optimal under certain circumstances. Figure 3 displays the optimal ownership arrangement depending on θ and ψ.

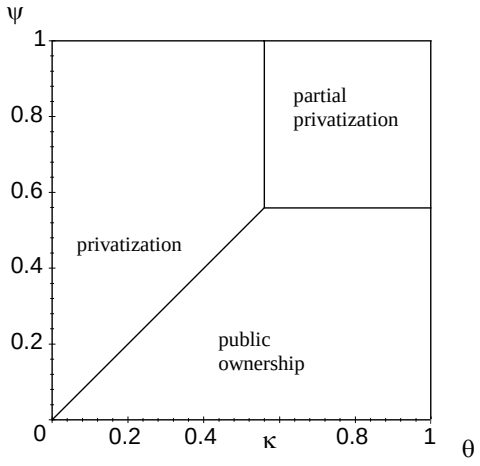

Figure 3: Optimal ownership structure in scenario II

Since the manager's incentives to invest in cost reduction are the same as in scenario I, and since the government's incentives to invest in quality improvement are identical under privatization and partial privatization, it is still true that partial privatization is better than privatization whenever $\theta \geq \kappa$. However, partial privatization is only the optimal ownership structure if ψ is large. If ψ is sufficiently small (due to the symmetry of the example, this means if ψ is smaller than κ), public ownership is better than partial privatization (while the manager's investment in cost reduction is identical under both arrangements, the government's investment in quality improvement is near the first best for small ψ under public ownership). Finally, if both θ and ψ are small, partial privatization is never optimal. Whether public ownership or privatization is superior depends on the relative importance of investments in quality and cost innovations (in the symmetric example, if θ is smaller than ψ, so that cost reduction is more important, then privatization is optimal).

6 Conclusion

A discussion of the proper scope of governmental ownership should take the possibility of partial privatization into account. If only the manager faces investment decisions, public ownership is always dominated by partial privatization, since under public ownership the manager has no incentives to

invest in quality improvements. But if the manager as well as the government have investment opportunities, each of the three ownership structures $o \in \{G, M, P\}$ may turn out to be optimal. If cost-reducing innovations are likely to be accompanied by serious reductions in quality, public ownership may be desirable. On the other hand, if quality-enhancing innovations lead to significant cost increases, privatization may be superior. Finally, if the adverse side effects of both kinds of innovation are substantial, partial privatization may be optimal, since it prevents overinvestments.

7 References

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