

Optimal Privatization Policy with Unknown Cost of Privatized Firm

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This paper examines the optimal decisions on privatization policy under asymmetric information where the government is not able to observe the post privatization cost function of privatized firm. We propose the incentive compatible lump-sum tax mechanism, which gives the optimal decision on privatization policy, and show that the proposed mechanism of optimal decision on privatization is not affected by asymmetric information on cost parameter. We also provide the optimal privatization policy when the government faces insufficient tax-revenue or regulatory budget problem, which should be used for compensating the value of losers or interest groups from the benefits of privatization, and then show that informationally efficient mechanism with outside fund will generate distortionary decision on privatization policy to increase tax revenue under asymmetric information, which could reduce the informational rent of privatized firm.

keywords: optimal privatization policy; asymmetric information; lump-sum transfer; incentive compatibility; mechanism design;

JEL classifications: D82; L51; H21

1. Introduction

Privatization has been one of the most striking reforms concerning property ownership, which is transference from governments to the private firm. Most of the previous economic researches have focused in identifying circumstances in which privatization policy may be appropriate under the assumption of complete information. (See, for example, De Fraja and Delbono (1989, 1990), De Fraja (1991), Matsumura (1998), Lee and Hwang (2003), and Lee (2006) among others.) Then, it raises an economic inquiry, “will distortionary decision on privatization policy occur if the information matters?” This paper figures out the incentive issues under asymmetric information and gives an answer of Yes or No.

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This paper specifically examines the optimal decisions on privatization policy under asymmetric information where the government is not able to observe the post privatization cost function of privatized firm. We propose the incentive compatible lump-sum tax mechanism, which gives the optimal decision on privatization policy, and show that the proposed optimal post privatization tax mechanism is non-discriminatory on the cost of privatized firm and the optimal decision on privatization is not affected by asymmetric information on cost parameter.

We also provide the optimal privatization policy when the government faces insufficient tax-revenue or regulatory budget problem, which should be used for compensating the value of losers or interest groups from the benefits of privatization. We then show that informationally efficient mechanism with outside fund will generate distortionary decision on privatization policy to increase tax revenue under asymmetric information, which could reduce the informational rent of privatized firm.

Related literature can be found in the context of optimal taxation and incentive regulation. For example, the distortions from subsidy instruments occur if an outside source of funds are available at some constant marginal cost, as provided in Baron and Myerson (1982), Laffont and Tirole (1993), and Laffont and Martimort (2002) under a continuous decision model. Under the different setting with a discontinuous model of optimal trade policy, Mitchell and Moro (2006) also show that asymmetric information can lead to an important tension between efficiency and information rent. The difference of this paper is that it is based on the dichotomous model and considers on the optimal privatization policy with unknown cost information. In particular, we provide the optimal incentive mechanism which might not generate distortionary decision on optimal policy under asymmetric information.

The organization of this paper is as follows: We introduce economic backgrounds on privatization policy in section 2. In section 3, we provide the basic model on privatization policy with complete information, and then extend the analysis into the case of asymmetric information. We also propose the optimal decision mechanism of privatization policy and examine its optimal properties. Conclusion is provided in section 4.

2. Economic Backgrounds on Privatization Policy

Privatization is defined as the deliberate sale by a government of a state-owned enterprise (SOE) or assets to private economic agents. It is one of the most important elements of the current global phenomenon of the increasing use of markets to allocate resources. Privatization now appears as a legitimate tool of statecraft for governments in almost every countries in America, Asia, and Europe.

However, this decision is somewhat difficult because there are economic factors such as

valuing the future profitability with incomplete information and more importantly, privatizations are generally part of an ongoing, highly politicized process. According to U.S. General Accounting Office (1997, 1998), some of the factors that influence the privatization method include: (i) the history of the asset's ownership, (ii) the financial and competitive position of the SOE, (iii) the government's ideological view of markets and regulation, (iv) the past, present, and potential future regulatory structure in the country, (v) the need to pay off important interest groups in the privatization, (vi) the government's ability to credibly commit itself to respect investors' property rights after divestiture, (vii) the capital market conditions and existing institutional framework for corporate governance in the country, (viii) the sophistication of potential investors, and (ix) the government's willingness to let foreigners own divested assets.

Why do then some governments decide to privatize services while others do not, and how do they decide which services to privatize? Several basic arguments are often cited to support a shift from government to private provision of public services. Most reason of privatization is efficiency from reducing the cost of government services, improving the quality of government services, and increasing the labor market flexibility, in addition to political reasons.

First, from the perspective of internal organization efficiency, private sector is often seen as simply better at providing services than the public sector. Private organizations are often believed to be motivated by a strong sense of mission, which may lead them to offer higher quality services, and are generally held to be well-managed. They are often able to offer higher salaries and better benefits and working conditions than government; this contributes to the belief that they attract more productive employees. Private firms, especially large ones, might also have easier access to capital, which can allow them to move into new service areas, expand capacity quickly, or enhance the quality of services. (See Sanger (2001).)

Second, from the perspective of external market efficiency, competitive markets among private firms will result in cheaper and higher quality goods and services as consumers shop around for the best deal and suppliers work to provide the best products at the lowest cost. This suggests that contracting out saves money as the positive pressures of competition force organizations to find ways to work more efficiently. Therefore, the belief that the marketplace and competition will discipline organizations that provide low-quality goods or services by driving them out of business is prevalent and contributes to support for privatization and contracting out.¹

However, there are also some debates on this efficiency issue: First, cost estimates often do not include the transaction costs entailed in the privatization process. Agency officials might not

¹ This perception that government agencies have failed consistently to provide high-quality services and welfare, has motivated some jurisdictions to pursue privatization of social services. For example, government systems and government workers are often seen as too slow, too inflexible, too focused on process, and too indifferent to results.

always include the expense of effective contract design and monitoring in survey estimates. In addition, the cost comparisons between the private and public sector should control for variables, such as the proportion of clients who are difficult to serve or other relevant differences. (See Yates (1997) and Sclar (2000).) Second, the management of private organizations and the quality of their services are not always good since private firms have been cited for mismanagement or for providing lower quality services in order to reduce costs and increase profits. Thus, quality may suffer with privatization because the public sector loses some of its accountability. Finally, it is too soon to know if any single sector will consistently provide the highest quality social services. Therefore, we need to stress the importance of careful program implementation, regardless of whether public or private agencies are the providers.

Third, another related reason that government agencies have been drawn to contracting with the private sector has been their need for labor market flexibility, such as for personnel with specialized skills.² That is, privatization gives common motivation for contracting out public services, which is the potential for greater flexibility in private-sector organizations. Civil service regulations and collective bargaining agreements that often apply to government organizations are seen as inhibiting the ability of these organizations to provide services efficiently or to address necessary system changes with flexibility. For example, government agencies can have difficulty hiring new employees, changing managers or staff, or cutting the workforce when the need for particular services changes suddenly. Therefore, government agencies can "farm out" their work to private organizations through contracts and reap the advantages of the greater flexibility. However, many opponents of privatization view this flexibility negatively, arguing that it circumvents necessary protections for citizens, public employees, and service recipients.

Finally, an ideological preference for employing market-based approaches to address public problems has been on the increase across political party lines, along with skepticism about the value and role of government and a demand for more and better public services. Privatization allows policymakers to maintain their distance from the political liabilities associated with government programs, while satisfying their constituents' demands for a variety of public services.

As has been discussed in the political science literature, the privatization of specific programs has also benefited from the advocacy of key political leaders. Support can come from the office of the governor or mayor, from a top agency official, and/or from members of the legislature, or from other influential political actors. This promotion has been central to the

² This has been particularly acute in the area of information technology, for example. With the recent radical changes in welfare policy, including the institution of work requirements, government time limits on aid, and other provisions that require tracking client data in new ways, government welfare agencies have been attempting to create new management information systems and to modify old ones.

ability of privatization proponents to gather broad political and operational support, to meet the demands of implementation, and to work to reduce or overcome opposition.

The political support for privatization may also lead policymakers to provide more resources for functions, if these services are seen as being provided by competent private-sector organizations rather than public organizations that have come under criticism. Private organizations or companies might also have lobbying capacity that traditional providers lack, helping to increase support and resources.

3. Economic Analysis

3-1. Optimal Privatization Policy with Complete Information

Consider a monopoly with an inverse demand function of $P = P(Q)$ and a constant marginal cost function of $C = cQ$. Then, the profit function for the monopolist and the consumer surplus are given by, respectively,

$$\pi = P(Q)Q - cQ, \quad (1)$$

$$CS = \int_0^Q P(v)dv - P(Q)Q. \quad (2)$$

The social welfare, which is defined as the simple sum of consumers' surplus and firm's profits, is given by³

$$W = \int_0^Q P(v)dv - cQ. \quad (3)$$

There are two types of the monopolist in the following analysis: one type is a public firm, or an agency of government, which is assumed to maximize social welfare, and the other is a private firm, which maximizes its profits.⁴ We denote the cost of public firm as c_0 and that of private

³ This definition follows the descriptions of De Fraja and Delbono (1989) and Lee (2006).

⁴ In the mean time, these assumptions on public firm and private firm should be reexamined from the viewpoint of agency relationship. For example, Levy (1987) suggested that the objective of government should be based on the captured incentive under the political environments, and pointed out that the notion that the government is the principal and the public firm is the agent might be misleading since the government is not a single organization. Cook and Fabella (2002) considered the economic model in which the state-owned enterprise maximizes an unspecified objective function, and examined the theoretical treatment of the welfare and political economy dimensions of the choice between public ownership and privatization.

firm as c_1 .⁵

Let us now focus on the privatization policy, which is transference of property ownership from government to the private firm. Then, the monopolistic firm will maximize social welfare in (3) when it takes the form of public enterprise in pre-privatization, while it will maximize its profit in (1) in post-privatization.

Note that $\frac{\partial Q}{\partial c} < 0$ and $\frac{\partial \pi}{\partial c} < 0$ from the first-order condition of profit-maximization.⁶ This implies that $\frac{\partial CS_1}{\partial c_1} < 0$ and $\frac{\partial W_1}{\partial c_1} < 0$. Finally, we have $\frac{\partial \Delta CS}{\partial c_1} < 0$ and $\frac{\partial \Delta W}{\partial c_1} < 0$, where

$\Delta CS = CS(c_1) - CS(c_0)$ and $\Delta W = W(c_1) - W(c_0)$. Let c^* denote the cost level which

makes $\Delta W = 0$, i.e., $W(c^*) = W(c_0)$, which is assumed to be non-negative. Then we can

show that $c^* < c_0$. This gives the conclusion that if $c_1 > c^*$, the privatization policy is welfare-

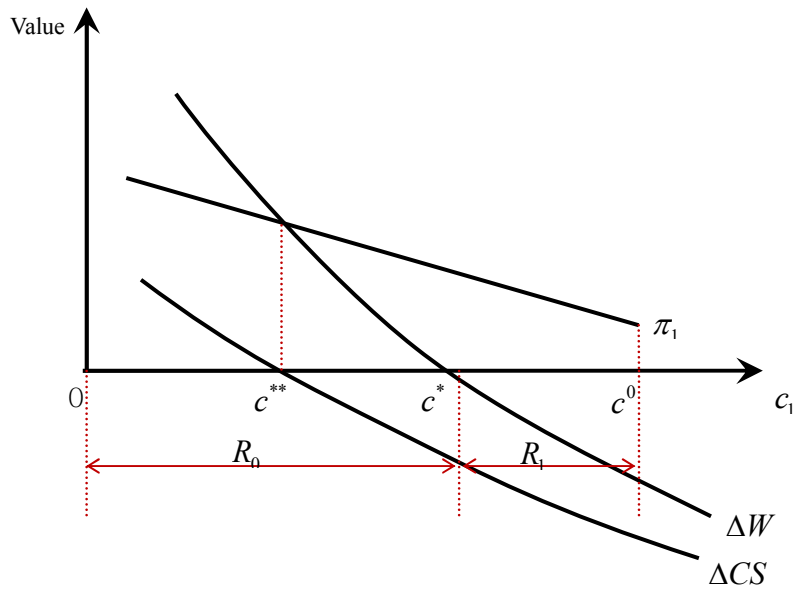
decreasing, while if $c_1 < c^*$, the privatization policy is welfare-increasing. Specifically, if $c_1 < c^*$, the benefit in post-privatization, the increment of profit for the privatized firm, is greater than the loss in post-privatization, the decrement of consumer surplus.⁷ Let us define $P(c^*) = P^*$, $Q(c^*) = Q^*$, and $\pi(c^*) = \pi^*$.

⁵ It is noteworthy that the optimal privatization policy under the same cost function between private and public firms is to keep the status quo since public firm will always maximize the social welfare. Therefore, assuming cost efficiency gap between private and public firms, i.e., $c_0 \geq c_1$, will give interior solutions and reasonable decision on the optimal privatization policy. The efficiency gap implies that in the agency relationships the principal and the agent will incur positive monitoring costs, and in addition there will be some divergence between the agent's decisions and those decisions, which would maximize the welfare of the principal. For example, in the regulatory economics literature, the managerial inefficiency is defined as "waste" and "abuse" in Sappington (1980), Laffont and Tirole (1993), and Laffont and Martimort (2002).

⁶ The first-order condition is $\frac{\partial \pi}{\partial Q} = P(Q) + P'(Q) - c = 0$. Then, from the assumption that profit-

maximization problem is concave, we have $\frac{\partial Q}{\partial c} = -\frac{\partial^2 \pi}{\partial Q \partial c} / \frac{\partial^2 \pi}{\partial Q^2} < 0$ since the second-order condition is satisfied.

⁷ On the other hand, let c^{**} denote the cost level which makes $\Delta CS = 0$ (or $\Delta Q = \Delta P = 0$). Then, we find that $c^* > c^{**}$. Then, if $c_1 < c^{**}$, privatization policy increases consumer surplus, or Pareto-improving to both consumers and privatized firm, i.e., $\Delta W = \Delta CS + \pi_1 > 0$ since $\Delta CS > 0$ and $\pi_1 > 0$. However, if $c^{**} \leq 0$, privatization policy always reduces consumer surplus.



[Figure 1] Optimal Privatization Policy with complete Information

The optimal privatization policy under complete information is shown in Figure 1, where $R_0 = \{0 \leq c_1 \leq c^*\}$ is for privatization and $R_1 = \{c^* \leq c_1 \leq c_0\}$ is for status quo. Therefore, the welfare in post-privatization increases only if the cost efficiency of privatized firm is sufficiently high.⁸

3-2. Optimal Privatization Policy with Incomplete Information

We now consider the case where the cost level of the privatized firm is private information and thus, is not exactly observed by the government. The government knows only that c_1 is nonnegative and can calculate c^* , which is the threshold level of privatization.⁹ Then, we will provide privatization policy that is socially optimal when there is a private information on the cost level.

⁸ As a literature in the optimal decision on privatization, De Fraja and Delbono (1989) considered an increasing cost function and shown that there is a trade-off in privatization and nationalization. Furthermore, De Fraja (1991) considered the X-inefficiency in the less-production case and also shown that there is a trade-off in the process of privatization. Matsumura (1998) considered optimal partial privatization under oligopoly market while Lee and Hwang (2003) extended into monopoly market, which balances the trade-off on privatization.

⁹ If the private information is public, then government can decide its optimal policy, depending on the values of c_1 and c^* .

We model the set of policies as follows: The government chooses $m = 0$, which implies privatization policy, or $m = 1$, which implies maintaining the public firm as a status quo. When the government implements privatization policy, it can impose a lump-sum tax to the privatized firm with zero social cost. The optimal policy has a decentralized form: the government offers the privatized firm the choice between implementing or dropping privatization policy; if privatization policy is implemented, the privatized firm transfers a lump-sum tax to the government. It represents that we consider the optimal privatization policies by formulating the problem as a mechanism design, in which we can use the revelation principle of the truth-telling mechanism. That is, the privatized firm reports its private information of c_1, \hat{c}_1 , and as a function of the report, the government imposes a tax $t(\hat{c}_1)$ and policy $m(\hat{c}_1)$, which is 0 or 1. Specifically, we will provide the optimal mechanism, in which the government chooses the following combinations of a lump-sum tax and privatization policy:

For any $\hat{c}_1 \leq c^*$, $t = t^* = \pi^* = \pi(c^*) = (P^* - c^*)Q^*$ and $m = 0$,

and for any $\hat{c}_1 > c^*$, $t = 0$ and $m = 1$.

Proposition 1. The proposed optimal policy with incomplete information achieves the efficient decision under complete information.

[Proof] First, for a given report of \hat{c}_1 , the net profit of the privatized firm is

$$\pi(\hat{c}_1, c_1) = \pi(c_1) - \pi(c^*) = (P_1 - c_1)Q_1 - \pi^* \text{ if } \hat{c}_1 \leq c^*,$$

$$\pi(\hat{c}_1, c_1) = 0 \text{ if } \hat{c}_1 > c^*$$

First, when $c_1 \leq c^*$, the firm has no incentive to report $\hat{c}_1 > c^*$. If so, the government chooses $m = 1$ and the privatization policy will be dropped, which yields zero profit. But, the firm can earn more profits from reporting $\hat{c}_1 \leq c^*$.

Second, when $c_1 > c^*$, the firm has no incentive to report $\hat{c}_1 \leq c^*$. If so, the government chooses $m = 0$ and the privatization policy will be fulfilled, which yields negative net profit to the privatized firm. That is, $\pi(\hat{c}_1; c_1) = \pi(c_1) - \pi(c^*) < 0$ since $\frac{\partial \pi_1}{\partial c_1} < 0$. But, the firm can

earn zero profit from reporting $\hat{c}_1 > c^*$. q.e.d.

We check the optimality of the mechanism on privatization policy. First, for any c_1 , $\pi(\hat{c}_1, c_1) \geq 0$, which guarantees that the privatized firm is no worse off than the status quo, $m = 1$. That is, it satisfies the IR (Individual Rationality) constraint.

Second, it also satisfies the IC (Incentive Compatibility) constraint since the privatized firm has

no incentive to report false cost level, which belongs to other decision region; truth-telling property.¹⁰

Finally, the proposed mechanism gives government optimal decision on privatization policy, which increases social welfare. In addition, since lump-sum tax is neutral transfer between the privatized firm and consumers, the mechanism achieves the same welfare level with complete information.

Proposition 2. The proposed optimal policy is a unique incentive mechanism, which maximizes tax revenue under incomplete information.

[Proof] First, we can show that the optimal tax is constant in each policy range. If not, the firm has an incentive to misreport the cost level which can lower tax level under same m . Hence, the amount to be taxed must be equal in each policy range. Second, tax level under $m=1$ should be equal zero, as far as the privatized firm earns an economic normal profit in the market. Otherwise, it can not satisfy the IR constraint. Finally, tax level under $m=0$ should be equal to $\pi(c^*) = \pi^*$, which is the maximized tax level when $c_1 = c^*$. For example, if tax level is greater than π^* , it will violate IR constraint. Furthermore, if tax level is lower than π^* , government can increase tax level without the violation of IR constraint. q.e.d.

We now review the properties of optimal mechanism under asymmetric information. First, for the discrete choice on m , there is a threshold where the optimal policy choice divides the range of c_1 with the privatization range R_0 and status quo range R_1 . In particular, $m=0$ when $c_1 \leq c^*$, and $m=1$ when $c_1 > c^*$. That is, the privatization range is for the low values of c_1 and status quo range is for the high values of c_1 . Therefore, the optimal policy choice of privatization $m(c_1)$ is non-decreasing in c_1 .

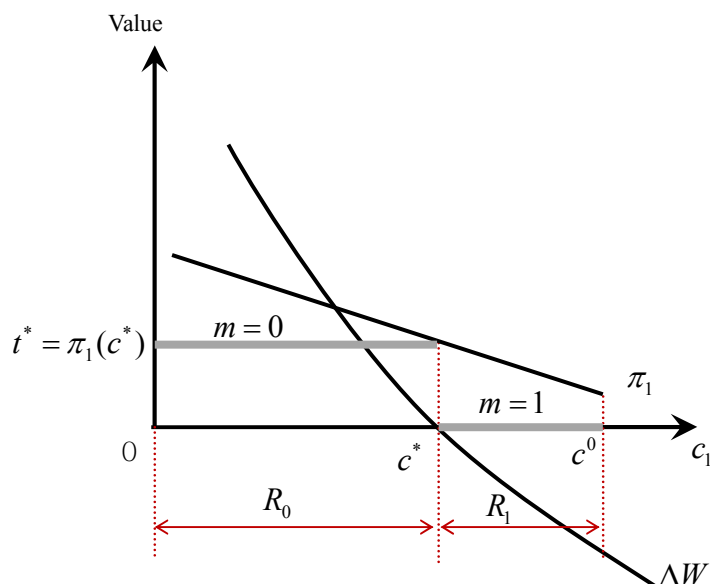
Second, the optimal tax is lump-sum and thus, is non-discriminatory whenever the policy choice is constant. In particular, the amount of lump-sum tax in the privatization range is exactly equal to the profit level when $c_1 = c^*$. (Note: if the tax rate is discriminatory, however, the firm has an incentive to over-report on c_1 to earn higher profit under the same policy range of privatization, $m=0$.) Therefore, since $\frac{\partial \pi}{\partial c_1} < 0, \pi(c_1, c_1) > 0$ when $c_1 < c^*$. That is, truth-telling gives positive profits when $c_1 < c^*$; there is informational rent for the efficient cost level

¹⁰ Actually, the firm has no incentive to report $\hat{c}_1 \neq c_1$ since the false report wouldn't increase its profit level of zero.

under asymmetric information. And this informational rent is discriminatory on the efficiency level of cost.

Finally, there is a dichotomy between decision on privatization policy and decision on production level of the privatized firm. That is, the optimal mechanism on privatization policy does not control the output level of the privatized firm. It recalls another option for output regulation in post privatization.¹¹

Figure 2 illustrates the optimal policy where privatization range ($m = 0$) is for $c_1 \leq c^*$ and status quo range ($m = 1$) is for $c_1 > c^*$. It shows that that the proposed optimal mechanism under asymmetric information is not distortionary policy.



[Figure 2] Optimal Privatization Policy with Incomplete Information

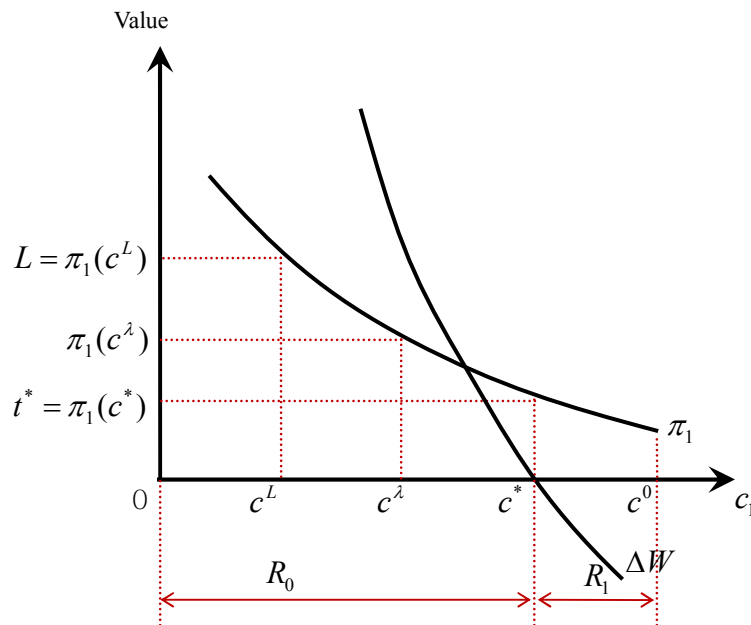
3-3. Distortionary Privatization Policy with Incomplete Information

We will consider the case of budget problem of privatization policy and show that the optimal privatization policy is distortionary when there is outside budget problem in privatization. This happens when the optimal policy trades off the cost of increasing tax revenue for compensation versus the deadweight loss generated by the distortionary policy. In particular, when government considers not only the welfare improvement but also the welfare loss from privatization, the optimal policy should balance the interest of them. For example, government

¹¹ See, for example, Sappington and Sibley (1988), and Kim and Lee (1995) for optimal regulation on the output of private firm with asymmetric information.

might consider the political resistance from the interest groups such as labor unions, who care about their job security after privatization, or consumers, who care about the price and quality of service after privatization. In addition, there is a transaction cost of privatization policy for management agency.

For the concrete analysis, let the valuation of losses L , which is fixed and constant. Then, the budget constraint of privatization policy with the proposed mechanism design will be $L - t^*$, which is assumed to be positive.¹²



[Figure 3] Distortionary Privatization Policy with Incomplete Information

We will consider the two cases of budget resources. The first is self-budgeted case, in which government should compensate the losses of privatization from the tax revenue of privatization. Then, it's easy to find the threshold cost level, c^L , from $\pi(c^L) = (P_1 - c^L)Q_1 - L = 0$. Since $\frac{\partial \pi}{\partial c_1} < 0$, we have $c^L < c^*$, which increases tax amount greater than t^* . Figure 3 illustrates the

distortionary decision on privatization policy with self-budget problem when $L > t^*$, where the threshold can be found by moving the welfare curve to the left, which satisfies $\pi(c^L) = L$.

The second case is outside fund case, in which the government might use the outside fund with the shadow price of λ . Then, government should take the trades-off between the welfare loss from distorting optimal policy and the cost of outside fund into consideration on its objectives.

¹² We know that if $L \leq t^*$, we can achieve the optimal decision on privatization policy without budget problem.

In balancing the marginal cost of welfare loss, the government takes the probability in c_1 into its consideration, where c_1 is assumed to be drawn from the cumulative distribution $F(c_1)$, where $c_1 \in [0, \bar{c}]$, which is differentiable and has a density function $f(c_1)$.

Finally, we can define the welfare loss as the sum of expected welfare loss of distortion from the optimal decision on privatization and the cost of outside fund.

$$WL = F(c^* - c^\lambda)[W(c^\lambda) - W(c^*)] + \lambda(L - t(c^\lambda)) \quad (4)$$

where c^λ is the choice of threshold. The first part in (4) represents the expected welfare loss from changing threshold for decision on privatization policy, i.e., moving the threshold from c^* to c^λ , and the second part represents the social cost of the insufficient tax revenue, which should come from outside transfer. Note that if $\lambda = 0, c^\lambda = c^*$, which gives no welfare loss.

Then, the first-order condition for c^λ is¹³

$$\frac{\partial WL}{\partial c^\lambda} = -f(c^* - c^\lambda)[W(c^\lambda) - W(c^*)] + F(c^* - c^\lambda)W'(c^\lambda) - \lambda t'(c^\lambda) = 0 \quad (5)$$

The left hand side in (5) represents marginal cost of distorting choice or welfare-reducing effect from optimal decision on privatization, i.e., moving the threshold from c^* to c^λ . And the right hand side in (5) represents marginal benefit of distorting choice or welfare-increasing effect from saving informational rent, i.e., reducing outside fund. Therefore, there is a tension that compensating through fund transfer generates an informational rent, and that rent distorts the optimal policy away from such transfers. There will be again a threshold compensation level c^λ : if the cost of privatized firm is low enough, the privatization is fulfilled, and a transfer for losses is made. However, insufficient cost efficiency of privatized firm might result in bringing about the distortionary policy. In Figure 3, any cost level between c^* and c^λ indicates the region of distortionary privatization policy with outside funds.

Proposition 3. There exists distortionary policy when the optimal policy with incomplete information is to maintain the public firm even though it could not happen with complete information.

¹³ For this calculation, we assume that this minimization problem is convex and thus the second-order condition is satisfied, i.e.,

$$-f''[W(c^\lambda) - W(c^*)] - 2f(c^* - c^\lambda)W'(c^\lambda) + F(c^* - c^\lambda)W''(c^\lambda) - \lambda t''(c^\lambda) > 0.$$

It is noteworthy that the threshold cost level, c^λ , is decreasing in λ .¹⁴ For example, if $\lambda = 0$, $\frac{\partial WL}{\partial c^\lambda} < 0$ and thus $c^\lambda = c^*$, and if λ goes to infinity, $\frac{\partial WL}{\partial c^\lambda} > 0$ and thus $c^\lambda = c^L$, which satisfies the budget constraint, L .

Proposition 4. $c^L \leq c^\lambda \leq c^*$

3-4. Summary of Optimal Privatization Policy with an Example

Now, we will summarize optimal privatization policy with the budget constraint of L .

(i) If $L \leq \pi^*$,
for any $\hat{c}_1 \leq c^*$, $t = \pi^*$ and $m = 0$,
for any $\hat{c}_1 > c^*$, $t = 0$ and $m = 1$, where c^* is chosen at $\Delta W(c^*) = 0$.

(ii) If $L > \pi^*$ and self-budgeted case,
for any $\hat{c}_1 \leq c^L$, $t = \pi(c^L)$ and $m = 0$,
for any $\hat{c}_1 > c^L$, $t = 0$ and $m = 1$, where c^L is chosen at $L = \pi(c^L)$.

(iii) If $L > \pi^*$ and outside fund with social cost λ ,
for any $\hat{c}_1 \leq c^\lambda$, $t = \pi(c^\lambda)$ and $m = 0$,
for any $\hat{c}_1 > c^\lambda$, $t = 0$ and $m = 1$, where c^λ is chosen at
 $-f(c^* - c^\lambda)[W(c^\lambda) - W(c^*)] + F(c^* - c^\lambda)W'(c^\lambda) - \lambda t'(c^\lambda) = 0$.

Example: linear demand and uniform distribution on c_1 .

Consider a monopoly facing a linear inverse demand function of $P(Q) = a - bQ$. With some simple calculations, the welfare-maximizing output of the public firm is determined at

$P(Q) = c_0$ or $Q_0 = \frac{a - c_0}{b}$, which gives the social welfare $W_0 = CS_0 = \frac{(a - c_0)^2}{2b}$ since

$\pi_0 = 0$. Again, profit-maximizing output of the privatized firm is determined at

$P(Q) - bQ = c_1$ or $Q_1 = \frac{a - c_1}{2b}$, and thus, $P_1 = \frac{(a + c_1)}{2}$. Then,

¹⁴ From the implicit function theorem, we can show that $\frac{\partial c^\lambda}{\partial \lambda} < 0$ if the second-order condition for minimization is satisfied.

$CS_1 = \frac{(a-c_1)^2}{8b}$, $\pi_1 = \frac{(a-c_1)^2}{4b}$, and $W_1 = \frac{3(a-c_1)^2}{8b}$. Therefore, from

$\Delta W = W_1 - W_0 = \frac{\{3(a-c_1)^2 - 4(a-c_0)^2\}}{8b}$, we can find that $c^* = 2\sqrt{3}\frac{c_0}{3} - \{2\sqrt{3} - 3\}\frac{a}{3}$,

which is assumed to be non-negative. Then, we have the following results:

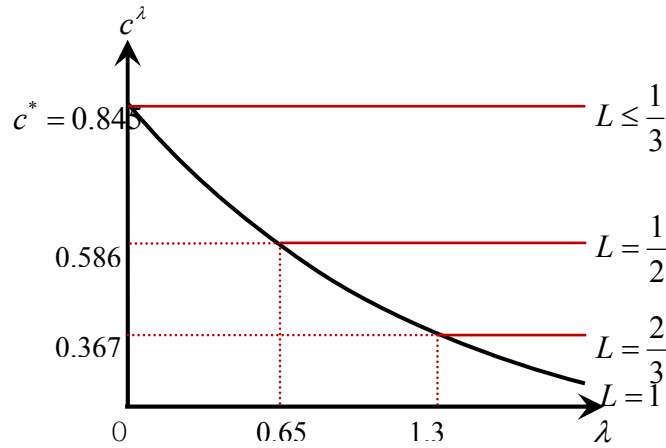
$$Q^* = Q_1(c^*) = \frac{(a-c^*)}{2b} \text{ and } P^* = P(Q^*) = \frac{(a+c^*)}{2}.$$

Next, more specifically, we consider $a = 2$, $b = c_0 = 1$, and uniform distribution on c_1 , i.e.,

$f(c_1) \sim U[0, c_0]$. Then, $f(c_1) = \frac{1}{c_0}$ and $F(c_1) = \frac{c_1}{c_0}$. Then, $W_0 = \frac{1}{2}$, $W_1 = \frac{3(2-c_1)^2}{8}$, and

$\Delta W = \frac{\{3(2-c_1)^2 - 4\}}{8}$. Therefore, $c^* = 0.845$ and $t = \pi(c^*) = \frac{1}{3}$. Finally, we can find the

relations between λ and c^λ from the optimal decision in (5), which can be rewritten as, specifically, $(2-c^\lambda)(9c^\lambda - 11.07 + 4\lambda) + 4 = 0$.



[Figure 4] The relations between λ and c^λ

Figure 4 illustrates some simulation results on the relation between λ and c^λ , depending upon the size of losses L , for the optimal privatization policy under incomplete information.

When the loss is sufficiently small, for example, if $L \leq \frac{1}{3}$, the optimal threshold is constant at

c^* since lump-sum tax t^* can cover this losses, and thus there is no distortion. However, in general, when the optimal tax is not sufficient, there is distortionary decision on privatization

policy. For example, if we let $L = \frac{2}{3}$, $\pi_1(c^L) = \frac{2}{3}$, and $c^L = 0.367$. And if the outside fund is

available, c^λ is in between c^* and c^L . That is, if $\lambda = 0$, $c^\lambda = 0.845 = c^*$ while if

$\lambda = 1.33, c^\lambda = 0.367 = c^L$. Again, if $\lambda = 0.1, c^\lambda = 0.812, t = \pi_1(c^\lambda) = 0.353, L - t = 0.314$. Figure 4 also shows the other combinations of c^λ and λ , depending upon the size of L , where $0 \leq L \leq 1$.

4. Conclusion

This paper provides the optimal decisions on privatization policy under asymmetric information where the government is not able to observe the post privatization cost function of privatized firm. We propose the incentive compatible lump-sum tax mechanism, which gives the optimal decision on privatization policy. First, we show that the optimal tax mechanism is non-discriminatory on the cost of privatized firm ex post and the optimal decision on privatization is independent of asymmetric information. Next, we provide the optimal privatization policy when the government faces insufficient tax-revenue or regulatory budget problem, which should be used for compensating the value of losers or interest groups from the benefits of privatization. We then show that informationally efficient mechanism will generate distortionary decision on privatization policy to increase tax revenue under asymmetric information which can reduce the informational rent of private firm.

The mechanism design problem analyzed in this paper is static Bayesian game in that the government has the ability to commit to a policy as a function of the cost of privatized firm. The problem in dynamic Bayesian game is that once the cost is revealed, the government prefers to use this information to increase welfare ex post privatization since there might be monopoly power in the market. (For the incentive regulation in a dynamic setting, see Sappington and Sibley (1988) for monopoly, and Kim and Lee (1995) for oligopoly.) Another challenging issue is to consider a private information about the welfare loss especially when the incomplete information on welfare loss is associated with the distortionary policy. Finally, the issue of partial privatization in a mixed market is also highly important in an open competition environment.

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