

Chapter 3

The Threat of Private Acquisition as an Effort Stimulating Instrument

I. Introduction

This paper treats a publicly owned firm as an agent of the government. It investigates how the firm (its management) responds to the threat of privatization where "privatization" means that the government removes the public firm's "soft budget constraint" by making it responsible for its own losses which then goes bankrupt and has zero payoff. By implementing this policy, is it possible to encourage effort inside public enterprises ? This question is of interest from both the theorists' and policy makers' perspectives. The strategic situation is modeled as a game in extensive form with a potential "privatization threat" carried out at a later stage. The power of the "privatization threat" depends on whether or not the government can commit to it. This gives rise to three possible scenarios : (1) Absence of threat; (2) Threat without commitment; (3) Threat with commitment.

Ability to commit is always a concern in policy implementations. In transition economies, this concern appears in the form of a question regarding the government's capability to resist the temptation to re-nationalize a firm (after it has been privatized) to serve certain social goals, e.g. to capture the profit of a firm and then redistribute it to the public. This phenomenon is well recognized and some theoretical work has already been done how to resolve the problem; see for example, Perotti (1995). But the nature of the commitment problem my paper addresses is more "fundamental" in the sense that the government's ability to commit to privatization is questioned. Namely ubiquitous "noise" in markets of transition economies prevents the government from correctly evaluating the performance of a firm. Therefore, as J. E. Stiglitz (1994) said "... (that) there is such "noise" makes it less likely that the government commitment not to subsidize in the event of a default is credible." If so, can privatization still be a useful instrument to harden the soft budget constraint ? And how can the government overcome the commitment problem ? Answers to these questions may challenge the viewpoint that privatization threats

always constitute a commitment device to harden soft budget constraints, such as in Schmidt (1996a, 1996b).

In section III, I treat case (1) Absence of threats, as a benchmark case. In section IV, it turns out that the government will play a mixed strategy, if the privatization threat is available but the government cannot commit to it. This result shares some similarity with the optimal auditing contract literature (see for example Khalil 1997). Thus, there will be some, albeit reduced impact of the "privatization threat" on the firm's behavior. In particular, the effectiveness of the privatization strategy in the no-commitment case is related to the role of the government as the final guarantor of the public firm's losses. In section V, I study the outcome when the government has full commitment power. I will also address the question which instrument can serve as governmental commitment devices. Two elements in the contract are considered to be such devices : the government's investment subsidy to the public firm and the amount of fixed wage⁶ paid by the government to the public firm's manager, a prominent feature of public firms. In section VI, I will contrast the commitment and no-commitment cases and see what roles the commitment devices play.

I find that, in the case when commitment to privatize is impossible, the government will set a strictly positive wage rate and a strictly positive investment subsidy to signal the government's determination to implement the privatization policy. Section VII concludes and discusses some possible extensions of the paper.

I assume that if the government implements the privatization scheme, it will subsidize the public firm's losses so as to serve two different but related purposes. One is to attract buyers for the public firm in the auction market. The other one is to help the firm to recoup its productivity, as long as the government believes that its losses can be attributed to factors beyond its control. Note that this financial subsidy is made subsequent to the output being observed whereas the investment subsidy is granted to the firm prior to a productive action being taken.

⁶ The wage is fixed in the sense that it is not contingent either on the output or the effort level exerted by the firm. Such a fixed wage can be used to show that the firm we are studying is of public nature.

The true type of the public firm is known to itself only. But the government can deploy an imperfect monitoring technology to collect information regarding the firm's true type. The imperfection of such a technology is used to model the noisy signal observed by the government. I find that a higher ex post financial subsidy will induce the firm to exert a higher effort level in the no-commitment case. However, an increase of the fixed wage rate has an incentive-degrading effect. This result is consistent with the empirical observation that, in many public firms, an increase of a fixed wage rate does not have a significant incentive effect.

Exposure to risk can also stimulate one's work effort. Specifically, Holmström (1979) has shown that the optimal way to motivate a risk-averse agent is to link this agent's payoff to the level of a stochastic output. But to what extent should the payoff depend on the output is a question. In addition, some aspects of output, e.g. quality, are not always contractible. That may explain why fixed wage schemes still abound. The threat of layoff is another instrument to motivate hard work. When low output is observed, the manager of the firm may be fired. But this strategy is credible only if a crucial assumption is satisfied : the expected value of production of the firm is always lower than the manager's payoff. Once that is not the case, the manager will not believe that he will be fired. "If you fire me, the loss you incur will be more serious than mine." This paper is based on these observations and discusses the effectiveness of privatization strategy when the layoff threat per se proves ineffective in a public firm. Under the threat of altering the ownership nature, the public firm should have a higher work incentive since it might be responsible for the losses.

It is of interest to point out that the way to introduce informational asymmetry about the public firm's efficiency in my model is slightly different from previous studies. The idiosyncrasy of a firm is not determined by the state of nature but by an action taken by the firm. Similar to an initial investment decision, this action has a long term influence on the performance of the firm. Therefore, the firm can choose its own type by exerting an effort level, a moral hazard situation.

II. The Model

There are two players in a two-stage game - the government and the public firm. At the beginning, the government offers the public firm a mandatory contract which specifies (i) the amount of a fixed wage, (ii) the amount of investment subsidy, and (iii) the privatization probability (in the commitment case). After receiving the contract, the public firm makes an effort -investment decision which will produce an output, $x \in \{1,0\}$ for the government in the current period. The government can receive a long run gain α by owning the firm and putting it to alternative uses. For simplicity, α is assumed to be a constant. The public firm can borrow an amount of investment subsidy $I \geq \bar{I}$ from the government to produce. \bar{I} is the minimum amount of investment subsidy the government will lend, which is normalized as zero. But I does not enter the production process directly⁷. In section III, I will show that I indeed contributes to the production in an indirect way in the no-commitment case.

The output is a function of the firm's effort level only. e is an effort level exerted by the firm with $e \in \{e_1, e_2\}$ and $e_1 > e_2 = 0$. If $e = e_1$, the probability for $x = 1$ is equal to q ; the probability for $x = 0$ equals $1 - q$. If $e = e_2 = 0$, $x = 0$ with probability 1. The effort level chosen by the firm is a hidden choice after the contract is signed. A cost $C(e) = e$ is incurred by the firm. The output level is observable to all parties. If $x = 1$ is observed, the government knows that the firm has chosen high effort level e_1 . So it will not privatize the firm. However, if output is equal to 0, the government relies on a monitoring technology to detect the type of the firm. This monitoring technology is costless and imperfect. If the firm exerts high effort, the monitoring technology will report that the firm is working hard. If the effort level is low, with probability k the monitoring technology will successfully detect the firm's cheating behavior. Once such behavior is found the government will privatize the public firm. I assume that the government has no motivation to privatize if the firm is performing well. To the contrary, it will privatize the

⁷ I can also be considered as a loan from the government to the firm. Brander and Lewis (1986) and Damania (1997) are examples in which a firm's debt level has no productive function but only strategic commitment value.

firm with probability one if the public firm is found lazy. We do not consider the problem of looking for a buyer for the public firm.

Note that the effort level e exerted by the firm in my model can be considered as a kind of firm-specific investment. I assume that this investment has an enduring effect in such a way that the firm's effort choice will affect its output in the future. Therefore, the public firm is actually choosing its own type at the beginning of the game by exerting high or low effort, causing a moral hazard problem.

A fixed wage, τ , is paid by the government to the firm if the firm is publicly owned. If the public firm is privatized, it needs to reimburse the investment subsidy I which is borrowed at the beginning of the game (interest rate is 0). Otherwise, I is charged to the government's account. An amount of subsidy F (financial subsidy) will be granted to the firm if zero output is observed and the monitoring technology reports that the firm is working hard. If the firm is working hard, its payoff is $F - e_1 - I$. It will be reasonable to assume that $F - e_1 - I \geq 0$. (Otherwise, it is better for the government to set $F = 0$.) If the firm is lazy (but the monitoring technology does not detect that), it will still receive F after being privatized. But this low effort (bad) type firm cannot survive the market competition in the future even with this financial subsidy - as a consequence of being lazy. Thus its payoff equals 0. The government will thus be responsible for the investment subsidy. If the monitoring technology detects that the firm is lazy, the government will "privatize" the firm without financial forgiveness. In this case, the public firm will go bankrupt after privatization and the government will incur the loss of investment subsidy.

The contract signed by the government and the firm is of the form $\{\tau_n, I_n\}$ in the no-commitment case and $\{P_c, \tau_c, I_c\}$ in the commitment case where P_c is the probability of privatization. Note that F is not part of the contract. This type of contract captures some feature of the institutional arrangement in transition economies : the sharing of surplus between the central government and agents (public firms or local governments) can be contracted but contracts are incomplete leaving open the amount of financial subsidy.

Usually, the more serious is the financial distress, the higher the financial subsidy. Thus it is conceivable that, for each state-owned enterprise, there is an ex ante expected value of F . See Zou & Sun (1996) for a discussion about this kind of soft-budget constraint phenomenon in mainland China. Also note that the definition of bankruptcy for the firm does not have a parallel interpretation at the government end. I assume that a current period deficit ($U^G < 0$) does not prevent the government from regular operations.

The government knows the distribution of the public firm's effort level. It knows that the public firm will exert high effort level with probability Π but low effort level with probability $1 - \Pi$. After observing low output, the government will privatize the firm with probability P . Correspondingly, $1 - P$ is the probability for nationalization. Besides the effort level chosen by the firm, all other information is public knowledge.

In order to make the threat of layoff not credible, I assume the following condition to be satisfied in what follows : $q > \tau > 0$. Since the expected production is higher than the wage, the government has no interest to privatize the firm. This assumption also rules out that the government sets a very large (infinite reward for high effort) or very small (negative infinite punishment for low effort) τ to approximate the first best result. At last, I also assume $\alpha \geq \max\{I_c, I_n\}$ so that the government has the motivation to lend.

III. A Benchmark Case

We will study a benchmark model in this section for reference purposes. In this case, no privatization/nationalization decision is made. We will show that the effort level exerted by the public firm must be inefficient.

Lemma 1. If there is no privatization/nationalization decision, the public firm will exert inefficient effort level. That is $\Pi = 0$.

Proof : In this situation, the government is solving the following problem (NP) :

$$\begin{aligned} & \underset{\{\tau, I\}}{\text{Max}} \Pi[q(1 + \alpha - \tau - I) + (1 - q)(\alpha - \tau - I)] + (1 - \Pi)(\alpha - \tau - I) \\ & \text{s.t. } \tau \geq 0, I \geq 0 \end{aligned}$$

The objective function is the government's expected payoff when no privatization policy is implemented. The public firm's payoff is $\tau - e_1$ if working hard but τ if lazy. Since $\tau - e_1 < \tau$, clearly, the public firm will choose $1 - \Pi = 1$ or equivalently, $\Pi = 0$. NP can thus be simplified into :

$$\underset{\{\tau, I\}}{\text{Max}} \alpha - \tau - I$$

$$\text{s.t. } \tau \geq 0, I \geq 0$$

The constraint must be binding. So, $\tau = 0$ and $I = 0$. Obviously, the government's revenue is equal to α . **Q.E.D.**

As can be seen, if the government does not consider the possibility of privatization, the public firm will not work hard and as a result of that, the government can only receive α . Note that we do not take the public firm's participation constraint into account because the public firm has no choice but to accept the contract and produce. This constraint is in the form $\Pi[q(\tau - e_1) + (1 - q)(\tau - e_1)] + (1 - \Pi)\tau \geq 0$. I will follow this practice throughout the paper.

In the following, we will show that if privatization/nationalization is possible, the public firm will choose a high effort level with strictly positive probability.

IV. Privatization/Nationalization without Commitment

In this section, the privatization issue will be discussed without the government's capability to commit to such policy. However, when the government announces that it will impose the privatization/nationalization decision and the firm believes that the government has the intention to do so, the public firm's choice of effort will be affected.

In order to facilitate the following discussion, we will first compute the probability of working hard and being lazy of the firm. When the monitoring technology reports that the effort level exerted by the public firm is high ($e = e_1$), $\frac{(1 - q)\Pi}{(1 - q)\Pi + (1 - k)(1 - \Pi)}$ will be

the probability that the firm is really working hard. Accordingly,

$\frac{(1-k)(1-\Pi)}{(1-q)\Pi + (1-k)(1-\Pi)}$ is the probability that the firm is lazy when the report shows $e = e_1$. The following lemmas establish how the public firm's and the government's behavior will be altered.

Lemma 2. The government will choose a privatization probability $P < 1$.

Proof : Suppose that $P = 1$. Then from the public firm's viewpoint, its revenue from working hard is : $(1-q)(F - I - e_1) > 0$. If it is lazy, its revenue is zero. Certainly, the public firm will choose to work hard. But if that is the case, the government will choose not to privatize the public firm. Since, if $\Pi = 1$, the government can collect $-F(1-q)$ from privatizing the firm but $q[1 + \alpha - \tau - I] + (1-q)(\alpha - \tau - I) = q + \alpha - \tau - I$ from not privatizing the firm. Note that $q + \alpha - \tau - I > 0$ since $q > \tau$ and $\alpha \geq I$.

Therefore, the government will choose nationalization if $\Pi = 1$, which implies P to be 0. That is contradicting the assumption. Thus, $P < 1$. **Q.E.D.**

It is noteworthy that the government will not set P equal to 1. Full scale privatization is not a wise strategy since the government has to afford a financial subsidy F . The larger this financial burden, the less attractive the privatization decision is.

If $1 > P > 0$, we can compute the equilibrium probability for the firm's effort choice, Π :

Lemma 3. If $1 > P > 0$, $\Pi < 1$.

Proof : If $1 > P > 0$, the expected payoff for the government from privatizing and not privatizing the public firm will be equal, i.e.

$$\frac{(1-q)\Pi}{(1-q)\Pi + (1-k)(1-\Pi)}(-F) + \frac{(1-k)(1-\Pi)}{(1-q)\Pi + (1-k)(1-\Pi)}(-I - F) = \alpha - \tau - I$$

$$\text{Therefore, } \Pi = \frac{(1-k)(\alpha - \tau + F)}{(1-k)(\alpha - \tau + F) + (1-q)(\tau + I - F - \alpha)} \quad (1)$$

from which $\Pi < 1$ follows. **Q.E.D.**

The non-negativity of Π is guaranteed if $(1-k)(\alpha - \tau + F) + (1-q)(\tau + I - F - \alpha) > 0$. This can be reduced to $(1-q)I + (\alpha - \tau + F)(q - k) > 0$. We will assume that this is true.

It is obvious that $\frac{\partial \Pi}{\partial F} = \frac{(1-k)(1-q)}{[(1-k)(\alpha - \tau + F) + (1-q)(\tau + I - F - \alpha)]^2} > 0$. When the financial subsidy is large, the public firm will be prone to higher effort level. Thus, the public firm's investment behavior is affected by the government's willingness to subsidize.

Since $1 > \Pi > 0$, the expected payoff of the public firm from exerting high effort and low effort must be equal. Then, we can explicitly pin down the privatization probability P . Indifference means

$$q(\tau - e_1) + (1-q)[P(F - I - e_1) + (1-P)(\tau - e_1)] = (1-P)(1-k)\tau$$

We can rewrite this equation as :

$$P(1-q)(F - I - e_1) + [1 - P(1-q)](\tau - e_1) = (1-P)(1-k)\tau$$

This equation can also be interpreted in the following way : when zero output is produced, the public firm's expected payoff is the same regardless of work effort.

By solving this equation, we find $P = \frac{e_1 - k\tau}{(1-q)(F - I - \tau) + (1-k)\tau}$.

In order to secure $P > 0$, we first need to assume that the cost of effort e_1 is large enough. That is, the benefit from privatization should be attractive enough for the government to launch the decision. In addition, we also need the following assumption :

$$(1-q)(F - I - \tau) + (1-k)\tau > 0. \text{ From the expression for } P, \text{ it is easy to see that } \frac{\partial P}{\partial F} < 0.$$

The higher the financial subsidy, the less likely is privatization. In other words, the credibility of a high privatization probability diminishes as the public firm believes ex ante that a high F will be paid.

After characterizing the probabilities P and Π , we will show that the optimal τ and I in the no-commitment contract are greater than zero. The government is going to solve the following problem (NC) to find τ and I :

$$\underset{\{\tau, I\}}{\text{Max}} \Pi q [1 + \alpha - \tau - I] + [1 - \Pi q - (1 - \Pi)k] \left\{ \begin{array}{l} \frac{\Pi(1-q)}{\Pi(1-q) + (1-\Pi)(1-k)} [P(-F) + (1-P)(\alpha - \tau - I)] + \\ \frac{(1-\Pi)(1-k)}{\Pi(1-q) + (1-\Pi)(1-k)} [P(-I - F) + (1-P)(\alpha - \tau - I)] \end{array} \right\} - (1 - \Pi)kI$$

s.t. $\tau \geq 0$, $I \geq 0$, with Π as in (1).

The objective function of program NC can be simplified to program nc (see appendix for detailed derivation):

$$\underset{\{\tau, I\}}{\text{Max}} \Pi(q + \alpha - \tau - I) + (1 - \Pi)[(1 - k)(\alpha - \tau) - I]$$

s.t. $\tau \geq 0$, $I \geq 0$

with Π as in (1).

$$\text{Let } L_1 = \Pi(q + \alpha - \tau - I) + (1 - \Pi)[(1 - k)(\alpha - \tau) - I]$$

We will ignore the non-negativity constraints at the moment. After finding the optimal solutions, we will check whether they satisfy the non-negativity requirements. The FOCs of the program nc are the following :

$$\frac{\partial L_1}{\partial \tau} = 0 \Rightarrow \frac{\partial \Pi}{\partial \tau} [q + \alpha - \tau - (1 - k)(\alpha - \tau)] = \Pi + (1 - \Pi)(1 - k) \dots \dots \dots (*)$$

$$\frac{\partial L_1}{\partial I} = 0 \Rightarrow \frac{\partial \Pi}{\partial I} [q + \alpha - \tau - (1 - k)(\alpha - \tau)] = 1 \dots \dots \dots (**)$$

$$\text{where } \frac{\partial \Pi}{\partial \tau} = - \frac{(1 - k)(1 - q)I}{[(1 - k)(\alpha - \tau + F) + (1 - q)(\tau + I - F - \alpha)]^2}$$

$$\frac{\partial \Pi}{\partial I} = - \frac{(1 - k)(1 - q)(\alpha - \tau + F)}{[(1 - k)(\alpha - \tau + F) + (1 - q)(\tau + I - F - \alpha)]^2}$$

It is obvious that $\frac{\partial \Pi}{\partial \tau} < 0$ and $\frac{\partial \Pi}{\partial I} < 0$. In the following, I will prove that the optimal τ (call it τ_n) and optimal I (call it I_n) which satisfy the first order conditions must be greater than zero.

Proposition 1. *The optimal τ_n and I_n for program nc must be greater than zero.*

Proof : First, we compare the left and right hand sides of equations (*) and (**). It is easy to see that, for these two equations to hold, their left hand sides must be greater than zero.

Then, I cannot be equal to zero. Otherwise, $\frac{\partial \Pi}{\partial \tau} = 0$ and we will get a contradiction

from equation (*). If $I < 0$, $\frac{\partial \Pi}{\partial \tau} > 0$. From equations (*) and (**), we would reach the conclusion that $[q + \alpha - \tau - (1 - k)(\alpha - \tau)]$ must be positive and negative at the same

time. Therefore, I cannot be negative either. Since $\frac{\partial \Pi}{\partial \tau} < 0$ and $\frac{\partial \Pi}{\partial I} < 0$, we know that

$q + \alpha - \tau - (1 - k)(\alpha - \tau) < 0$. Or, $q + k(\alpha - \tau) < 0$. So, the optimal τ must satisfy

$$\tau_n > \frac{q}{k} + \alpha > 0. \text{ Q. E. D.}$$

Note that the sum of $\frac{q}{k}$ and α has to be smaller than one. For that to be true, k must be

greater than q and α must be smaller than 1. Otherwise, this result will contradict the assumption that $1 > q > \tau$. From Proposition 1, we know that τ_n must be greater than α .

This has the following intuitive meaning. In order to convince the public firm to believe in the privatization policy, the government needs to give up all its future profit from owning the firm.

The above result means that τ_n and I_n must assume a value greater than that in the benchmark case to induce higher effort from the public firm. At the same time, the non-negativity constraints can be satisfied automatically (are not binding in this case). The following proposition summarizes the main results of this section.

Proposition 2. *In the no-commitment case, the government will privatize the public firm*

with probability $P_n = \frac{e_1 - k\tau_n}{(1-q)(F - I_n - \tau_n) + (1-k)\tau_n}, 0 < P_n < 1$. The public firm will

exert high effort level with probability

$\Pi_n = \frac{(1-k)(\alpha - \tau_n + F)}{(1-k)(\alpha - \tau_n + F) + (1-q)(\tau_n + I_n - F - \alpha)}, 0 < \Pi_n < 1$. *The contract is $\{\tau_n, I_n\}$*

with $\tau_n > 0, I_n > 0$ in contrast to $\tau = 0, I = 0$ in the benchmark case.

Now, I will briefly sketch the reason why I_n is productive in an indirect way. A simple comparative statics study shows that a change of the effort contingent output from $x \in \{0,1\}$ to $\tilde{x} \in \{0,2\}$ will increase both I_n and τ_n . Therefore, I_n and τ_n are related to output x positively. If that is the case, we can imagine in the no-commitment case that the government can choose an $I \in \{I_1, I_2, I_3, \dots, I_z\}$ where $I_z > I_{z-1} > \dots > I_1 > 0$ at the beginning of the game to induce the public firm to produce an output which is contingent upon the level of investment subsidy and effort. The higher I , the more output will be produced. In this sense, I_n can be considered to be productive.

V. Privatization/Nationalization with Commitment

The privatization probability P is part of the optimal contract with commitment which is the major difference to the no-commitment case where it is not. With commitment, the government needs to solve the following (CM) problem :

$$\begin{aligned} \underset{\{\tau, P, I\}}{\text{Max}} \quad & \Pi q(1 + \alpha - \tau - I) + [1 - \Pi q - (1 - \Pi)k] \left\{ \begin{aligned} & \frac{\Pi(1-q)}{\Pi(1-q) + (1-\Pi)(1-k)} [P(-F) + (1-P)(\alpha - \tau - I) + \\ & \frac{(1-\Pi)(1-k)}{\Pi(1-q) + (1-\Pi)(1-k)} [P(-I - F) + (1-P)(\alpha - \tau - I)] \end{aligned} \right\} \\ & - (1 - \Pi)kI \end{aligned}$$

$$\text{s.t. } q(\tau - e_1) + (1-q)[P(F - I - e_1) + (1-P)(\tau - e_1)] \geq (1-k)(1-P)\tau \text{ and } \tau \geq 0, I \geq 0$$

The first inequality is the incentive compatibility constraint. The second and the third inequalities are regular non-negativity constraints. The objective function of CM equals the expected payoff of the government. Since high effort level must be induced in equilibrium, Π must equal 1. Then, the program CM can be simplified to :

$$\begin{aligned} & \underset{\{\tau, P, I\}}{\text{Max}} q(1 + \alpha - \tau - I) + (1 - q)[P(-F) + (1 - P)(\alpha - \tau - I)] \\ \text{s.t. } & q(\tau - e_1) + (1 - q)[P(F - I - e_1) + (1 - P)(\tau - e_1)] \geq (1 - k)(1 - P)\tau \\ & \tau \geq 0, I \geq 0 \end{aligned}$$

Obviously, it is optimal for the government to set $I = 0$ and the program simplifies to :

$$\begin{aligned} & \underset{\{P\}}{\text{Max}} q(1 + \alpha - \tau) + (1 - q)[P(-F) + (1 - P)(\alpha - \tau)] \\ \text{s.t. } & q(\tau - e_1) + (1 - q)[P(F - e_1) + (1 - P)(\tau - e_1)] \geq (1 - k)(1 - P)\tau \text{ and } \tau \geq 0 \end{aligned}$$

Let us call this program cm. Let

$$L_2 = q(1 + \alpha - \tau) + (1 - q)[P(-F) + (1 - P)(\alpha - \tau)] + \lambda\{q(\tau - e_1) + (1 - q)[P(F - e_1) + (1 - P)(\tau - e_1)] - (1 - k)(1 - P)\tau\}$$

where λ is the Lagrange multiplier. First, we will ignore the second constraint of program cm. In the following proposition, I will prove that the optimal privatization probability is strictly between zero and one.

Proposition 3. *The optimal privatization probability in the case with commitment, P_c is strictly between zero and one.*

Proof : First, let us examine the first order conditions of the program cm.

$$\begin{aligned} \frac{\partial L_2}{\partial \tau} &= -q - (1 - P)(1 - q) + \lambda\{q + (1 - P)(k - q)\} \dots\dots\dots(*)' \\ \frac{\partial L_2}{\partial P} &= -(1 - q)(F + \alpha - \tau) + \lambda\{(1 - q)(F - \tau) + (1 - k)(\tau - e_2)\} \dots\dots\dots(**)' \end{aligned}$$

If $\lambda = 0$, $\tau = 0$ and $P = 0$ from equations (*)' and (**)' . The incentive compatibility constraint will thus become $-qe_1 - (1 - q)e_1 \geq 0$. Hence, $-e_1 \geq 0$. Or, $e_1 \leq 0$. That is a contradiction to $e_1 > 0$. Therefore, λ must be greater than zero. Then the incentive

compatibility constraint must be binding. From this binding constraint, we can find the equilibrium privatization probability which must be between zero and one by

assumptions : $P_c = \frac{e_1 - k\tau}{(1-q)(F - \tau) + (1-k)\tau}$. **Q.E.D.**

From equation (*)', we cannot determine whether the optimal τ in this case, τ_c is greater than zero. The sign of τ_c is most easy to see by simplifying the incentive compatibility constraint to

$$[k(1 - P) + Pq]\tau \geq e_1 - P(1 - q)F.$$

Given that the optimal P is strictly between zero and one, the government will set τ_c to be greater than zero to satisfy the incentive compatibility constraint if e_1 is large enough. Otherwise, τ_c is equal to zero.

Proposition 4 will summarize the main results of this section.

Proposition 4. *In the commitment case, the government will privatize the firm with*

probability $P_c = \frac{e_1 - k\tau_c}{(1-q)(F - \tau_c) + (1-k)\tau_c}$, $0 < P_c < 1$. The public firm will work hard

with probability $\Pi = 1$. The optimal contract is in the form $\{P_c, \tau_c, I_c\}$ with $I_c = 0$.

$\tau_c > 0$ if e_1 is large enough. Otherwise, $\tau_c = 0$.

VI. Comparison

The difference between the pairs $\{\tau_c, \tau_n\}$ and $\{I_c, I_n\}$ is obvious by comparing Propositions 2 and 4. This difference can be explained in the following intuitive way. When the government can commit to implementing the privatization policy, the public firm will work hard to avoid bankruptcy in the future. Even though the financial subsidy from the government is secured regardless of work effort, the lazy firm cannot survive the market competition in the future. Therefore, the best strategy is to choose working hard. In that case, the government need not use I_c to show its determination to execute

the policy. But τ_c must be greater than zero to induce high work effort from the public firm when e_1 is high.

However, if the government cannot commit to implementing the privatization policy, it will be optimal for the government to set a positive investment subsidy, because then it will be in its interest to privatize the firm when the output turns out to be zero. By privatizing the firm, the government can redeem the investment subsidy from the public firm. Moreover, equilibrium requires that the public firm shirks with positive probability.

This is achieved by setting $\tau_n > 0$, since $\frac{\partial \Pi}{\partial \tau} < 0$.

VII. Conclusion

In this paper, we have shown that the optimal privatization probability is strictly between zero and one. In other words, in order to stimulate the public firm manager's labor effort, a mixed privatization strategy will be optimal. But given such a mixed privatization strategy, the manager will also choose a mixed strategy as his optimal response. Therefore, privatization can fortify the soft budget constraint to some extent but cannot overcome the problem completely.

When the government cannot commit to implement the privatization policy, it may use two instruments in the contract to remedy this credibility problem. One is through the design of investment subsidy. A positive investment subsidy will ensure that the government has an incentive to implement the privatization threat. A positive wage rate can be used to induce some shirking behavior in equilibrium. In contrast, the government does not need to use positive τ or I to induce itself to implement the policy in the case with commitment.

There are several ways to extend the above analysis. One is to introduce another player into the game - a potential buyer of the privatized firm. After the firm being privatized, the buyer will decide whether to purchase it. In order to make a wise decision, this buyer will collect information concerning the performance of the firm. It will be interesting to

see how the second best contract will be re-characterized by the presence of this third player. Another extension is to introduce a government's balanced budget constraint into the model. So far, we always assume that the government can incur a financial deficit without causing any problem. But in reality, the financial subsidy to those state-owned enterprises is always a burden of the government in many countries.

Appendix

When the government cannot commit to the privatization policy, its objective function is :

$$\begin{aligned}
& \Pi q(1 + \alpha - \tau - I) + [1 - \Pi q - (1 - \Pi)k] \left[\frac{\Pi(1 - q)}{\Pi(1 - q) + (1 - \Pi)(1 - k)} (P(-F) + (1 - P)(\alpha - \tau - I)) + \right. \\
& \left. \frac{(1 - \Pi)(1 - k)}{\Pi(1 - q) + (1 - \Pi)(1 - k)} (P(-I - F) + (1 - P)(\alpha - \tau - I)) \right] + (1 - \Pi)k(-I) \\
& = \Pi q(1 + \alpha - \tau - I) + [\Pi(1 - q) + (1 - \Pi)(1 - k)] \left[\frac{\Pi(1 - q)}{\Pi(1 - q) + (1 - \Pi)(1 - k)} P(-F) + \right. \\
& \left. \frac{(1 - \Pi)(1 - k)}{\Pi(1 - q) + (1 - \Pi)(1 - k)} P(-I - F) + (1 - P)(\alpha - \tau - I) \right] + (1 - \Pi)k(-I) \\
& = \Pi q(1 + \alpha - \tau - I) + [\Pi(1 - q) + (1 - \Pi)(1 - k)](1 - P)(\alpha - \tau - I) + \\
& [\Pi(1 - q) + (1 - \Pi)(1 - k)]P \left[\frac{\Pi(1 - q)}{\Pi(1 - q) + (1 - \Pi)(1 - k)} (-F) - \frac{(1 - \Pi)(1 - k)}{\Pi(1 - q) + (1 - \Pi)(1 - k)} (-I - F) \right] \\
& + (1 - \Pi)k(-I)
\end{aligned}$$

According to Lemma 3, the above equation can be simplified to :

$$\begin{aligned}
& \Pi q(1 + \alpha - \tau - I) + [\Pi(1 - q) + (1 - \Pi)(1 - k)](1 - P)(\alpha - \tau - I) + \\
& P[\Pi(1 - q) + (1 - \Pi)(1 - k)](\alpha - \tau - I) + (1 - \Pi)k(-I) \\
& = \Pi q(1 + \alpha - \tau - I) + [\Pi(1 - q) + (1 - \Pi)(1 - k)](\alpha - \tau - I) + (1 - \Pi)k(-I) \\
& = \Pi q(1 + \alpha - \tau - I) + \Pi(1 - q)(\alpha - \tau - I) + (1 - \Pi)(1 - k)(\alpha - \tau - I) + (1 - \Pi)k(-I) \\
& = \Pi(q + \alpha - \tau - I) + (1 - \Pi)(1 - k)(\alpha - \tau - I) + (1 - \Pi)k(-I) \\
& = \Pi(q + \alpha - \tau - I) + (1 - \Pi)[(1 - k)(\alpha - \tau) - I] \blacksquare
\end{aligned}$$

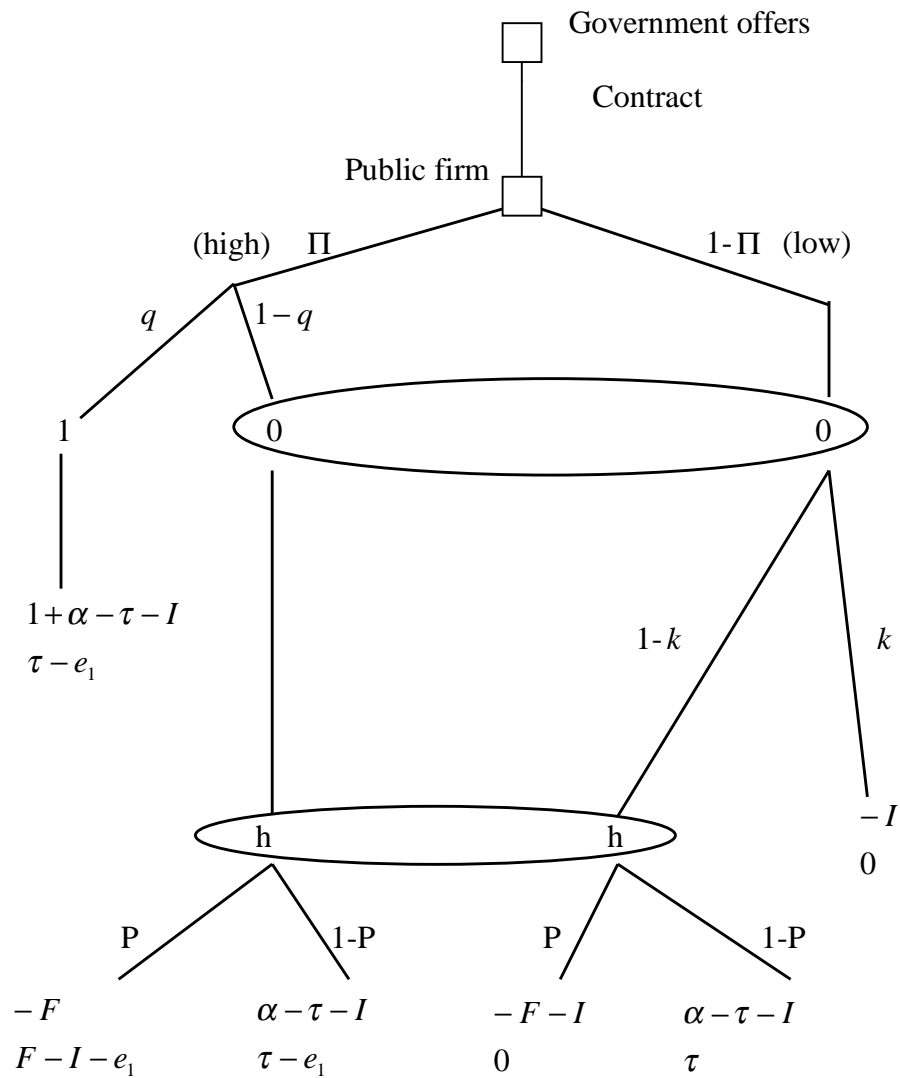


Figure 1. The game tree between the government and the public firm
 (Payoff : Government / Public Firm)

References

Baker, George, Gibbs, Michael, and Holmstrom, Bengt. 1994a. "The Internal Economics of the Firm : Evidence from the Personnel Data." *The Quarterly Journal of Economics* CIX, 881-919.

Baker, George, Gibbs, Michael, and Holmstrom, Bengt. 1994b. "The wage Policy of a Firm." *The Quarterly Journal of Economics* CIX, 921-955.

Brander, James, A. and Lewis, Tracy, R. 1986. "Oligopoly and Financial Structure : the Limited Liability Effect." *American Economic Review* 76, 956-70.

Chong-en, Bai. 1997. "Earnings Profile and Monitoring under Asymmetric Information." *Economics Letters* 57, 219-25.

Crémer, Jacques. 1995. "Arm's Length Relationships." *Quarterly Journal of Economics* 110, 275-295.

Damania, Dick. 1997. "Debt as a Collusive Device in an Oligopoly Supergame." *Journal of Economics* 66, 249-69.

Hart, Oliver and Holmstrom, Bengt. 1987. "The Theory of Contracts." in *Advances in Economic Theory* (ed. Bewley, T.) Cambridge University Press.

Holmstrom, Bengt. 1979. "Moral Hazard and Observability." *The Bell Journal of Economics* 10, 74-91.

Khalil, Fahad. 1997. "Auditing without Commitment." *Rand Journal of Economics* 10, 74-91.

Khalil, Fahad, and Parigi, Bruno. 1998. "The Loan Size as a Commitment Device." *International Economic Review* 39, 135-150.

Perotti, Enrico C. 1995. "Credible Privatization." *American Economic Review* 85, 847-859.

Stiglitz, Joseph E. 1996. *Whither Socialism ?* MIT Press, Cambridge.

Zou, Liang, and Sun, Laixiang. 1996. "Interest Rate Policy and Incentives of State-Owned Enterprises in the Transitional China." *Journal of Comparative Economics* 23, 292-318.