Privatization of a Renewable Resource Sector in the presence of a Foreign Enterprise*

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Abstract

We analyze the optimal level of privatization of a state-owned enterprise (SOE) in a renewable resource sector. We construct a model where a SOE and a foreign private enterprise compete in quantity in a market of a renewable resource good. In the short-run, a government should privatize the SOE when the foreign private enterprise is present, while it should keep the SOE when the foreign firm is absent. In the long-run, a government should privatize its SOE regardless of the presence or the absence of the foreign private competitor.

JEL Classification: F23, H10, Q2

Key words: privatization, state-owned enterprise, renewable resource, foreign penetration

1. Introduction

In the process of globalization, countries need to be engaged in the world trading system which requires nondiscriminatory treatments to domestic and foreign enterprises. However we have observed that there are many state-owned enterprises (SOEs) with special treatment by their host country. Such a state intervention in markets have been discussed for a long time but have not reached any compromise, especially between emerging economies utilizing SOEs to grow their economy and developed countries seeking for competitive neutrality in new markets. For example, Nguyet (2015) reports that SOEs in Vietnam arouse controversy from Japan and the United States in the recent negotiation of the Trans-Pacific Partnership. How we make markets a level playing field is our challenge.

A reform of Vietnamese State Forestry Enterprises (SFEs) provides a good lesson. A farmland expansion policy from 1960’s resulted in severe deforestation in 1990’s. In response, the Vietnamese government launched a new strategy for forest management. First, it has initiated a reform of the existing SFEs since 1999. Artemiev (2003) reported that originally 403 SFEs in 43 provinces took all responsibilities to manage national forests and produce timbers for any use under direct control of provincial governments. In the reform, SFEs were sorted...

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into three categories by efficiency of their managing forests: efficient SFEs were reorganized into fully autonomous profit-making enterprises; SFEs with larger forests were granted a role for preservation of forests under direct control of Protection Forest Management Boards; SFEs with less than 1,000 ha of forest were converted into shareholding or limited liability companies. Second, the Vietnamese government encouraged these small privatized agencies and foreign capitals to afforest and produce commercial timbers together. As a result, there now exist many joint ventures of foreign enterprises and their Vietnamese partners.*1 Thus the Vietnamese timber market exhibits mixed oligopoly of SFEs and private companies with foreign capital.

The purpose of this paper is to analyze the optimal degree of privatization of a SOE in a renewable resource market accepting a foreign private enterprise. We model the situation where the SOE and the foreign private enterprise compete in quantity in a domestic resource good market. Natural resource is open-access and renewable so that the harvesting behaviors of both enterprises affect the steady-state stock without any effort of conservation in the long-run.*2

Theoretical analysis of privatization of a SOE dates back to De Fraja and Delbono (1989). They show that full privatization of a SOE may be welfare-improving in a mixed oligopoly market with domestic private enterprises. In a model allowing partial privatization where private owners hold some shares of a SOE, Matsumura (1998) finds that neither full privatization nor full nationalization is optimal in a duopoly market. As its extension to an open economy, recent research discusses the optimal level of privatization in the presence of a foreign enterprise. Mukherjee and Suetrong (2009) shows that privatization increases the incentive for accommodating foreign enterprises, which in turn increases the incentive for privatization. On the other hand, Wang and Chen (2011) show that the optimal level of privatization decreases with the degree of foreign penetration. Both papers tell that the presence of a foreign enterprise stimulates the incentive for privatization while it leads to nationalization when the number of foreign enterprises becomes large.

In the literature on renewable resource, few works have done on the optimal level of privatization of a SOE though SOEs are often found in renewable or exhaustible resource sectors. Only one paper sharing our motivation is Brander and Taylor (1997). They construct a model with an open-access resource country and a fully regulated country. The latter is supposed to harvest renewable resource by a full-nationalized SOE with a long-run welfare-maximizing objective. Their research analyzes how this difference in resource management affects trade pattern and the steady-state level of the renewable resource. However they do not consider the optimal strategy for renewable resource management in the situation because it does not allow partial privatization. In this paper, we answer the question with a model incorporating a possibility of partial privatization in a small open economy.

The main results we obtain in this paper are follows. In the short-run, a government

*1 For example, Sojitz Corporation of Japan established Vietnam Japan Chip Corporation jointly with its Vietnamese partners. (La and Iida 2006)

*2 In the case of Vietnam Japan Chip Corporation, households contracted with the company are the main producers of timbers for wood chips. Even though they pay a license fee to the government to obtain their forest lands, weak protection of property right results in illegal felling by non-licensed intruders. This implies that production takes place as if in open-access forests. (La and Iida 2006)
should fully nationalize its SOE when a foreign enterprise is absent, but it should partially privatize the SOE when the foreign firm is present. Thus foreign direct investment stimulates privatization of the SOE. In the long-run, a government should privatize the SOE more than at the short-run optimal level in both cases. Privatization conserves more renewable resource by triggering the profitseeking behavior (reducing harvests and increasing market price) of the SOE. This result in improvement of harvesting efficiency and then welfare.

The remaining part of this paper is organized in the following order. The next section explains the model in detail. The third section describes the short-run equilibrium and analyzes the short-run optimal level of privatization in the two cases: a foreign enterprise is absent or present. The fourth section introduces a growth function of renewable resource and studies the long-run impact of privatization on the steady-state level of renewable resources and the optimal level of privatization. The last section concludes this paper.

2. The Model

We assume that a domestic SOE and a foreign private enterprise compete in quantity in a domestic market of a resource good. The inverse demand function is \( p(H) = a - bH \) where \( H = H_D + H_F \). \( H_D(H_F) \) is the output of the domestic (foreign) enterprise.

The SOE is assumed to be owned by a welfare-maximizer government and produce a resource good to maximize its own profit and social welfare at the same time. The objective function of the SOE is given by

\[
U_D = \beta \pi D + (1 - \beta) W_D. \tag{1}
\]

\( \beta \in [0, 1] \) denotes the degree of privatization: as \( \beta \) approaches unity, the domestic firm becomes private, or considers only its own profit. The profit of the SOE is defined as

\[
\pi_D = p(H)H_D - wL_D = p(H)H_D - \frac{\gamma}{S} H_D, \tag{2}
\]

where \( L_D \) is the labor input and \( w \) is the wage rate, which is set to one for simplicity. The SOE harvests according to the Schaefer harvesting production function, \( H_D = \frac{1}{\gamma} SL_D \), which is widely used in studies of open-access renewable resource, e.g., Brander and Taylor (1997, 1998). \( \gamma > 1 \) is the parameter of production efficiency of the SOE. \( S \) is the stock level of the renewable resource. The social welfare consists of consumer surplus and the profit of the SOE such as

\[
W_D = \int_0^H p(x)dx - p(H)H_F - \frac{\gamma}{S} H_D. \tag{3}
\]

Note that profit of the foreign private enterprise is sent to its home country.

Inserting (2) and (3) into (1), we solve the maximization problem of the SOE, given by

\[
\max_{H_D} (1 - \beta) \left[ \int_0^H p(x)dx - p(H)H \right] + p(H)H_D - \frac{\gamma}{S} H_D.
\]

The first order condition gives the reaction function of the SOE such as
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\[ H_D = \frac{\beta}{1+\beta} H_F + \frac{1}{(1+\beta)b} \left( a - \frac{\gamma}{S} \right). \]  

(4)

3. Privatization in the Short-run Equilibrium

We first investigate the optimal level of privatization given the level of the renewable resource is fixed.

3.1 The Equilibrium in the Absence of a Foreign Enterprise

We consider the situation where foreign enterprises are prohibited to enter into a domestic resource market. In this situation, \( H_F = 0 \) and the SOE acts as a monopolist. The monopolist production level is

\[ H_D^M = \frac{1}{(1+\beta)b} \left( a - \frac{\gamma}{S} \right) \]  

from (4). Note that it is positive for \( S \geq \left( \frac{\gamma}{a}, K \right) \) and zero otherwise.

Now we have the following proposition.

**Proposition 1** In the short-run, it is optimal that a government should fully nationalize the SOE when a foreign enterprise is absent.

**Proof** Evaluating equation (3) at \( H = H_D^M \) and \( H_F = 0 \) and differentiating it with respect to \( \beta \), we have

\[ \frac{\partial W_D}{\partial \beta} = \left[ p(H_D^M) - \frac{\gamma}{S} \right] \frac{\partial H_D^M}{\partial \beta}. \]  

(5)

Since \( \frac{\partial H_D^M}{\partial \beta} = \frac{-1}{(1+\beta)b} \left( a - \frac{\gamma}{S} \right) < 0 \) and \( p(H_D^M) - \frac{\gamma}{S} = \frac{\beta}{1+\beta} \left( a - \frac{\gamma}{S} \right) \), setting \( \frac{\partial W_D}{\partial \beta} = 0 \) gives \( \beta^M = 0 \). Note that \( p(H_D^M) - \frac{\gamma}{S} = 0 \) so that the SOE gains zero profit. \( \square \)

When a government manages the renewable resource by the single SOE and deters foreign enterprises from the resource good market, the optimal reform action of the government is just to maintain the status quo. This is the reasoning that most of governments still utilize SOEs to control renewable resources. However this result may change when we consider two things: the presence of a foreign enterprise and the long-run perspective taking in growth of the renewable resource.

3.2 The Equilibrium in the Presence of a Foreign Enterprise

Let us consider the situation where a government allows a foreign enterprise to produce a resource good in the country. The foreign private enterprise faces the maximization problem given as

\[ \max_{H_F} p(H) H_F - \frac{1}{S} H_F. \]

Here we assume that the foreign enterprise is more efficient than the SOE \((\gamma > 1)\). The reaction function of the foreign private enterprise is then
We analyze the stable and unique equilibrium. The optimal production levels of each enterprise and the optimal total supply are given by,

\[ H_D^* = \frac{1}{2} H_D + \frac{1}{2b} \left( a - \frac{1}{S} \right), \]

\[ H_F^* = \frac{1}{2} H_F + \frac{1}{2b} \left( a - \frac{1}{S} \right), \]

\[ H^* = \frac{1}{2} H_D + \frac{1}{2b} \left( a - \frac{1}{S} \right). \]

Note that improvement in the harvesting technology of the SOE (a decrease in \( c \)) increases the production level of the SOE and the total production level, while it decreases that of the foreign private enterprise.\(^3\)

Now we scrutinize the impact of \( b \) and \( S \) on production. First, the impact of privatization of the SOE on production is summarized in the following lemma.

**Lemma 1** Privatization of a SOE decreases the production level of the SOE and increases that of a foreign private enterprise. The total supply of the resource good decreases with the degree of privatization.

**Proof** By differentiating of (7), (8), and (9) with respect to \( \beta \), we have

\[ \frac{\partial H_D^*}{\partial \beta} = -\frac{2}{(2+\beta)^2b} \left[ 2a -(1+\gamma) \frac{1}{S} \right] < 0, \]

\[ \frac{\partial H_F^*}{\partial \beta} = \frac{1}{(2+\beta)^2b} \left[ 2a -(1+\gamma) \frac{1}{S} \right] > 0, \]

\[ \frac{\partial H^*}{\partial \beta} = -\frac{1}{(2+\beta)^2b} \left[ 2a -(1+\gamma) \frac{1}{S} \right] < 0. \]

Privatization is modeled as an increase in \( \beta \), which implies more weights on firm’s own profit. To make more profit, the privatized SOE starts producing less to increase the market price through the Cournot competition. On the other hand, the foreign private enterprise increases its production in response to the SOE’s behavior from (6). Total production decreases since the market share of the SOE is larger than that of the foreign private enterprise (\( H_D^* > H_F^* \)).

Second, the impact of an exogenous increase in the stock level of the renewable resource on production is given in the following lemma.

**Lemma 2** An increase in the stock level of the renewable resource always increases the production level of a SOE and the total supply of the resource good. When the SOE is less effi-

\(^3\) See proof in Appendix.
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Scient or less privatized, it decreases the production level of the foreign private enterprise.

Proof  By differentiating of (7), (8), and (9) with respect to $S$, we have

\[
\frac{\partial H_D}{\partial S} = \frac{2\gamma - \beta}{(2 + \beta)S^2} > 0 \\
\frac{\partial H_F^*}{\partial S} = \frac{1 + \beta - \gamma}{(2 + \beta)S^2} \\
\frac{\partial H_F^*}{\partial S} = \frac{1 + \gamma}{(2 + \beta)S^2} > 0
\]

When $\gamma > 1 + \beta$, $\frac{\partial H_F^*}{\partial S} < 0$. Otherwise $\frac{\partial H_F^*}{\partial S} > 0$. □

An increase in the stock level of resource is considered as improvement of the harvesting efficiency of both enterprises since they can harvest from larger mass of or more condensed resource. However the efficiency of the SOE improves more since it is less efficient a priori than that of the foreign domestic enterprise. This results in the SOE’s stealing the market share of the private foreign enterprise when the difference in efficiency between both enterprises is large or the SOE is less privatized. Lastly an increase in the resource stock on total production always expands total production for the same reason as in comparative statics of the degree of privatization.

Finally this section concludes with the following proposition on the optimal level of privatization.

**Proposition 2**  In the short-run, it is optimal that a government should partially privatize the SOE when a foreign enterprise is present. The optimal level of privatization is given by

\[
\beta^* = \frac{\gamma - 1}{3aS - 1} \geq 0. \tag{10}
\]

Proof  Inserting (7), (8), and (9) into (3) and differentiating it with respect to $\beta$, we have

\[
\frac{\partial W_D}{\partial \beta} = \left[p(H^*) - \frac{\gamma}{S}\right] \frac{\partial H_D}{\partial \beta} - p'(H^*)H_F^* \frac{\partial H_F^*}{\partial \beta}. \tag{11}
\]

By $\frac{\partial W_D}{\partial \beta} = 0$ and assuming that $3aS > 1$, we have $\beta^*.$\(^*4\) □

The impact of $\gamma$ and $S$ on $\beta^*$ is as follows. First, a government should privatize its SOE more as the SOE is less efficient. This is because the government wants the less efficient SOE to produce less from welfare perspective. Note that full nationalization is optimal when there is no difference in efficiency ($\gamma = 1$). Second, a government should do so for the same reason as the resource stock is small.

Propositions 1 and 2 produce the first main message of this paper; a government should privatize the SOE when a foreign enterprise is present. Note that this happens when the SOE

\(^*4\) Indeed we have negative profit at $\beta = \beta^*$ in the short-run. This phenomenon is widely observed in a mixed duopoly literature. Discussion is found in Mukherjee and Suetrong (2009).
is less efficient than its competitor. The reasoning behind this is that the SOE can reduce production and gain higher profit since reduction in supply is partially compensated by the foreign private enterprise. Decrease in consumer surplus due to smaller supply is offset by an increase in profit so that there will be an inner level of privatization in the case of foreign penetration.

4. Privatization in the Long-run Equilibrium

In this section, we allow the stock level of the renewable resource to vary across time so that harvesting behaviors affect the steady-state stock level. Following Brander and Taylor (1997, 1998), the growth function of the resource is given by

\[ G = gS \left( 1 - \frac{S}{K} \right), \]

where \( g \) is the intrinsic growth rate and \( K \) is the maximum level of the renewable resource stock.

4.1 The Long-run Equilibrium in the Absence of a Foreign Enterprise

We consider the situation where a foreign private enterprise is absent. Let us define the transition equation for the stock of the renewable resource in this situation such as

\[ h^M(S; \beta) \equiv G - H^M_\beta = gS \left( 1 - \frac{S}{K} \right) - \frac{1}{(1+\beta)b} \left( a - \frac{\gamma}{S} \right). \]

We focus on the stable steady-state equilibrium. The steady-state stock level of the renewable resource \( S^M \) is determined by setting \( h^M(S; \beta) = 0 \). The impact of privatization of a SOE on the steady-state stock level of the renewable resource is summarized in the following lemma.

**Lemma 3** In the long-run, privatization of a SOE increases the steady-state stock level of the renewable resource.

**Proof** For stability, we assume that \( h^M_S \equiv \frac{\partial h^M(S; \beta)}{\partial S} < 0 \). By total differentiation of \( h^M(S; \beta) = 0 \), we have

\[ \frac{\partial S^M}{\partial \beta} = - \frac{h^M_S}{h^M_{SS}} > 0, \]

where \( h^M_{SS} = \frac{1}{(1+\beta)^2b} \left( a - \frac{\gamma}{S^M} \right) > 0. \)

*5 In this setting, we implicitly assume that a SOE chooses the level of harvest to maximize the weighted average of its current profits and current social welfare without taking into account the effects of harvest on the resource stock in the long run.

*6 Since the equation is cubic, there are two possible sets of solutions: (1) three real solutions and (2) one real solution and two imaginary solutions. In the first case there will be two stable solutions and one unstable solution while in the second case there will be only a stable solution. When we focus on the stable solutions, comparative statics of \( \beta \) tells the same story.
Contrary to one’s intuition, a privatized SOE conserves more renewable resource than a fully-nationalized SOE. It is because privatization increases the weights on profit. This results in reducing harvesting and raising the market price to gain more profit. This profit-maximizing behavior turns into conservation of the renewable resource at the steady state.

We readily derive the following result from the lemma above.

**Proposition 3** *In the long-run, it is optimal that a government should privatize the SOE when a foreign enterprise is absent.*

**Proof** Evaluating (3) at $H = \hat{M}_D, H_F = 0$, and $S = \hat{S}$, differentiating it with respect to $\beta$ gives

$$
\frac{\partial \bar{W}}{\partial \beta} = \left[ p(H^*_D) - \frac{\gamma}{S} \right] \frac{\partial H^*_D}{\partial \beta} + \left[ p(H^*_D) - \frac{\gamma}{S} \right] \frac{\partial H^*_S}{\partial S} + \frac{\gamma}{(S^*)^2} H^*_S \frac{\partial S^*}{\partial \beta}. \tag{15}
$$

Evaluating equation (15) at $\beta = \beta^M = 0$ gives $\frac{\partial \bar{W}}{\partial \beta} = \frac{\gamma}{(S^*)^2} H^*_D \frac{\partial S^*}{\partial \beta} > 0$ from $p(H^*_D) - \frac{\gamma}{S} = 0$ at $\beta = \beta^M$ and Lemma 3. Thus the long-run optimal level of privatization is higher than $\beta^M = 0$.

Propositions 1 and 3 produce the second main message of this paper; a government should privatize the SOE of a renewable resource sector in the long run. Knowing that the profit-seeking behavior of the SOE helps to conserve more renewable resource at the steady state, a government with a long-run perspective privatizes the SOE.

### 4.2 The Long-run Equilibrium in the Presence of a Foreign Enterprise

Now we consider the situation where a foreign private enterprise is present. The transition equation for the renewable resource is given by

$$
h(S; \beta) = G - H^* = gS \left( 1 - \frac{S}{K} \right) - \frac{1}{(2 + \beta)} b \left[ 2a - (1 + \gamma) \frac{1}{S} \right]. \tag{16}
$$

The steady-state stock level of the renewable resource $S^*$ is determined by $h(S, \beta, \gamma) = 0$.

The long-run effect of privatization on the steady-state stock level is

$$
\frac{\partial S^*}{\partial \beta} = - \frac{h_\beta}{h_S} > 0, \tag{17}
$$

where $h_\beta \equiv - \frac{\partial H^*}{\partial \beta} > 0$ from Lemma 1 and $h_S \equiv \frac{\partial h(S; \beta)}{\partial S} < 0$ for stability. Thus Lemma 4 still holds in this case.

We conclude this section with the following proposition.

**Proposition 4** *In the long-run, it is optimal that a government should privatize the SOE more than at the short-run optimal level when a foreign enterprise is present.*

**Proof** The long-run impact of privatization on welfare is given by
By differentiation on (7), (8) and (9) with respect to $\gamma$, we have

\[
\frac{\partial H_D^\ast}{\partial \gamma} = -\frac{2}{(2+\beta)bS} < 0.
\]
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\[
\frac{\partial H^c}{\partial \gamma} = \frac{1}{(2+\beta)bS} > 0, \\
\frac{\partial H^*}{\partial \gamma} = -\frac{1}{(2+\beta)bS} < 0.
\]

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