Partial Privatization and Market-Opening
Policies: A Mixed Oligopoly Approach

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## Abstract

Using a simple mixed oligopoly model with partial privatization, we show that the relaxation of restrictions on foreign investment sets back privatization of public firm. That is, as the share of foreign capital in each corporate joint venture increases in the mixed oligopoly market, the government decreases the degree of privatization. By contrast, given the share of foreign capital in each corporate joint venture, the privatization is promoted by an increase in the number of firms operating in the market. In sum, the two different strategies for market openings result in the opposite impacts on the government's incentive for privatization.

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# 1  Introduction

Over 15 years ago, De Fraja and Delbono (1989) developed a mixed oligopoly model to show that the privatization of welfare-maximizing public firm may improve social welfare[1]. This result received much interest since it paradoxically argues that a welfare-maximizing public firm should not pursue social welfare but it should seek private profits.

One of the important extensions in the literature is to account for the possibility of partial privatization. This type of extension is motivated by the observation that the government usually holds a part of the shares in privatized firms. In De Fraja and Delbono (1989), the government only chooses whether to keep a full share of (public) firm or to fully privatize such (ex ante public) firm. When this setting is extended by allowing partial privatization, interesting results are obtained in the literature. Assuming that a public firm is inefficient compared with a private firm, Fershtman (1990) shows that full nationalization of public firm may reduce social welfare in the Cournot equilibrium. Matsumura (1998) formally shows that neither full privatization nor full nationalization is optimal in a mixed market. Lee and Hwang (2003) elaborate on the framework of Matsumura (1998) to show that partial privatization is a reasonable choice for government in a monopoly market as well as in a mixed duopoly market. Furthermore, although the model is somewhat different from an original mixed oligopoly approach, Beladi and Chao (2006) show that while an increase in partial privatization may lower the welfare in the short term, it can make a positive contribution to social welfare in the long term through capital inflow[2]. These extensions make sense since the

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[1]Excellent surveys on mixed oligopoly theories are provided in De Fraja and Delbono (1990) and Nett (1993).

[2]There are more studies on partial privatization. George and La Manna (1996) extend the Fershtman model to the game of Stackelberg competition, where the public firm is a Stackelberg leader and a private firm the follower, and show that a change in objective function of an ex ante public firm from social welfare to profit results in higher welfare.

governments often keep a part of the shares of public firms from a practical standpoint[3].

The aim of this paper is similar to the studies mentioned above, and we follow it in agreeing that the governments choose the degree of privatization of public firm to maximize the social welfare. The feature of these studies is that all of them are only concerned with the mixed market of domestic firms. This is quite strange since it is often the case that the competitor of a public firm is not only a domestic private firm but also a foreign firm, and a series of mixed market analyses indicate that the existence of foreign private firms considerably changes the equilibrium outcome[4]. The feature that differentiates the present paper from previous studies is that it incorporates foreign investment into the model explicitly. By this extension, we are now able to clarify the effects on the degree of privatization of market openings policies[5].

The market-openings to foreign investors and the privatization of public firms have been among the most important items in reforming the economic structure of most developing countries [Smith and Trebilcock (2001)]. A typical example is the Chinese market, in which there has long been an effective public monopoly or public oligopolies in the market[6]. The Chinese government has started to privatize their public firms, while it applies strict

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Tomaru (2006) proves that the optimal subsidy, output level, firms' profit, and social welfare are identical before and after the partial privatization of a public firm.

[3]Although, in this paper, we use the traditional framework of mixed oligopoly, recent studies on privatization develop a model with two countries each with public and private firms competing in a single market. See Barcena-Ruiz and Garzon (2005), Dadpay and Heywood (2006), and Fujiwara (2006) for related studies.

[4]For a mixed oligopoly model with foreign competitors, see Fjell and Pal (1996), Pal and White (1998), Serizawa (2000), Fjell and Hevwood (2002), Matsumura (2003), Sun, Zhang, and Li (2005), and Chang (2005).

[5]To our knowledge, Chao and Yu (2006) incorporates the partial privatization and foreign competitors into the mixed oligopoly market. As different from our study, their attention is on the effects of a change in the degree of privatization on the tariff rate, so that the degree of privatization is given exogenously.

[6]Some other case examples on the foreign investment regulation are given in Chakrabarti and Heywood (2004).

rules on foreign capital to place a restraint on a remarkable increase in foreign investment[7]. By the regulations on foreign investment, most of foreign firms entering to the Chinese market have been forced to take the form of joint-stock companies. However, after China joins the WTO, the Chinese government has to relax the limitation on foreign investment in stages. With the background of this relaxation of foreign capital regulation, the present concern is how the Chinese government changes its domestic industrial policy. Specifically, the practician cares about whether the privatization advances or is set back with the opening of the domestic market to foreign investors. Moreover, the relationship between market openings and privatization is not only concerned in the developing countries but also in the developed countries, particularly in the EU. Concerns over the changes in domestic industrial policies have arisen as new major players become outward investors, prompting a number of countries to review their privatization policies[8].

We explore the features of a mixed oligopoly model involving foreign investment and privatization decision. Analysis shows that the degree of privatization of a public firm critically depends on the level of restrictions on the market entry of foreign companies. As the restriction on the share of foreign ownership of domestic firms is relaxed so that the share of foreign capital in each joint venture increases, the government inhibits the privatization of public firm. In this sense, the open market policy may lead governments to pull back from their privatization programs. However, the open market policy, measured by the increase in the number of firms operating in the

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[7]In an automobile market, for instance, the controlling share of foreign capital is restricted to less than 50 percent, and the foreign enterprises can establish only one or two joint-stock companies (China Automobile Industry Development Policy, State Council of the People's Republic of China, May 21, 2004).

[8]With the background of increase in the degree of free-trade within the EU, Barcena-Ruiz and Garzon (2005, p.502) state that "The competitive environment created with the implementation of the Single Market has led Member States to take stock of the benefits they obtain by holding on to state ownership in some companies".

market, accelerates the privatization. The two different strategies for opening market result in the opposite impacts on the government's incentive for privatization.

This examination is important for several reasons. First, the present paper serves to extend the domestic mixed duopoly model with the partial privatization to an international mixed duopoly. Researchers who examine the effects on the degree of privatization of other issues such as non-benevolent government, political process, and uncertainty need a basic model. Second, empirical researchers may wish to test how the market-opening policies affect the progress of privatization. This paper offers a simple but fundamental model to classify the effects of different market-opening policies on the privatization levels.

The remainder of the paper is organized as follows: Section 2 introduces the model. Section 3 studies the market equilibrium and Section 4 concludes the paper covering some possible extensions.

## 2  Model

We consider a mixed oligopoly market, where there is a single public firm and $n$ identical private firms. These firms operate in a homogeneous good market with inverse demand given by $p = a - Q$, where $p$ is market price and $Q \equiv q_0 + q_1 + ..., q_n$ is the total quantity of the output in the market. $q_j$ $(j = 0, 1, .., n)$ is the output of firm $j$. Firm 0 is a (public) firm which maximizes a certain objective function given later. Firm $i = 1, ..., n$ is a profit maximizing private firm, which is partially owned by foreign investors. The cost function is identical for all firms and is given by $C_j = f + 0.5q_j^2$. We do not consider the entry problem, so $f = 0$ is assumed in the following analysis.

The profit of firm $j$ $(j = 0, 1, .., n)$ is given by

$$\pi_j = (a - Q)q_j - 0.5q_j^2. \tag{1}$$

Public firm 0 is owned by the government, so that its profit, $\pi_0$, will be involved in the social welfare. Similarly, if private firm $i$ $(i = 1, .., n)$ is the domestic firm, its profit, $\pi_i$, should be involved in the social welfare. However, $\pi_i$ will be eliminated from social welfare if firm $i$ is owned by foreign investors. In this paper, we define social welfare as

$$W = CS + \pi_0 + \alpha \sum_i \pi_i, \tag{2}$$

where $CS \equiv 0.5Q^2$ is the consumer surplus. In (2), $\alpha$ $(0 \leq \alpha \leq 1)$ represents the extent of domestic ownership of a private firm. In this paper, the restrictions on foreign investment are represented by $\alpha$. When $\alpha = 1$, foreign investments are not allowed so that private firms are owned by domestic residents/consumers. $\alpha = 0$ corresponds to the case in which firm $i$ is a foreign enterprise which is completely owned by foreign investors. If $\alpha$ is positive (but not equal to one), private firms are considered as a joint ownership enterprise. In this case, it is natural to consider that $100\alpha$ percent of firm $i$'s profit should be attributed to domestic residents. In this paper, $\alpha$ is set to be exogenous, and it is allowed to take a value less than 1. This assumption follows Huizinga and Nielsen (1997), and is well-justified, when the interest is the effects on the equilibrium values of an exogenous change in $\alpha$. In consideration of a foreign investment, we can examine how the abolition of control on the foreign investment targeted by WTO changes the privatization policy.

The government owns a share of $(1 - \theta) \in [0, 1]$ of the public firm. The manager of this firm will maximize the weighted average of social welfare and the profit. Following Matsumura (1998), we define the objective function of firm 0 as

$$V = \theta\pi_0 + (1 - \theta)W. \tag{3}$$

Note that the manager of fully privatized firm ($\theta = 1$) seeks the firm's profit, while the manager of a fully nationalized firm ($\theta = 0$) maximizes social welfare.

# 3  Equilibrium

The game is constructed by two-stage decision-making. The government chooses the level of privatization, $\theta$, to maximize (2) in the first-stage. Observing $\theta$, the firms choose the quantity supplied in the second stage. The private firm $i$ maximizes (1) and the semi-public firm 0 maximizes (3). We follow the concept of backward induction and solve the equilibrium from the second stage.

## 3.1  Second Stage

For given $\theta$, the standard Cournot-Nash equilibrium in the second stage can be derived as

$$q_0 = a[n(1 - \alpha)(1 - \theta) + 2]/\Delta \tag{4}$$

$$q_i = a(\theta + 1)/\Delta, \tag{5}$$

$$p = 2a(\theta + 1)/\Delta, \tag{6}$$

where $\Delta \equiv n\alpha\theta + 2\theta + 4 + n(2 - \alpha) > 0$. Comparative statics results yield

$$\partial q_0/\partial \theta = a[2n^2(\alpha - 1) + 2n(2\alpha - 3) - 4]/\Delta^2 < 0 \tag{7}$$

$$\partial q_i/\partial \theta = 2a(n + 2 - n\alpha)/\Delta^2 > 0 \tag{8}$$

$$\partial p/\partial \theta = 4a(n + 2 - n\alpha)/\Delta^2 > 0 \tag{9}$$

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Hence, the privatization decreases firm 0's output, and increases firm $i$'s output and the market price. Using (4) and (5), the profits and consumer surplus in the second stage can be obtained as

$$\pi_0 = \frac{a^2[n(1-\alpha)(1-\theta)+2][4\theta+2-n(1-\alpha)(1-\theta)]}{2\Delta^2}, \qquad (10)$$

$$\pi_i = \frac{3a^2(\theta+1)^2}{2\Delta^2} \qquad (11)$$

$$CS = \frac{a^2[n\alpha\theta+2+n(2-\alpha)]^2}{2\Delta^2}. \qquad (12)$$

Notice that while firm $i$'s profit is always positive, the profit of firm 0 is negative (positive) if $4\theta+2-n(1-\alpha)(1-\theta) < (>)0$[9]. Furthermore, from (10)-(12), we have

$$\partial\pi_i/\partial\theta = 6a^2(\theta+1)(n+1-n\alpha)/\Delta^3 > 0 \qquad (13)$$

$$\partial\pi_0/\partial\theta = 2a^2H/\Delta^3, \qquad (14)$$

where $H \equiv n^2(n+4)\alpha^2 + n(2n^2+11n+8)\alpha\theta + (n^3+5n^2+8n+4) - n^2(n+4)\alpha^2\theta - n(2n^2+9n+8)\alpha - (n^3+7n^2+10n+4)\theta$. (13) and (14) show that while privatization serves to increase firm $i$'s profit, its effect on the firm 0's profit is ambiguous. Furthermore, the following comparative statics result shows that the privatization results in a negative effect on the consumer surplus:

$$\partial CS/\partial\theta = 4a^2[n\alpha\theta+2+n(2-\alpha)](n\alpha-n-1)/\Delta^3 < 0. \qquad (15)$$

## 3.2 First Stage

In the first stage, the government chooses the level of privatization of public firm 0. Substituting (10)-(12) into (2), the objective function of the govern-

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[9]Lump-sum transfer from consumer to firm 0 may be conducted when $\pi_0$ takes a negative value.

ment in the first stage is obtained as

$$W = \frac{a^2 \Gamma}{2\Delta^2},\tag{16}$$

where

$$\Gamma \equiv n(2n+7)\alpha\theta^2 + 6n\alpha\theta + 2(n^2+2n+4)\theta + (3n^2+8n+8) - n(2n+1)\alpha - n(n+4)\theta^2.$$

The maximization of (16) with respect to $\theta$ yields

$$\partial W/\partial \theta = 2a^2 \Omega/\Delta^3,\tag{17}$$

where $\Omega \equiv n^2(n-1)\alpha^2 + n(2n^2+12n+9)\alpha\theta + n^2(n+1) - n^2(n+5)\alpha^2\theta - n(2n^2-1)\alpha - (n^3+7n^2+10n+4)\theta$. Setting $\partial W/\partial \theta = 0$, we obtain the optimal degree of privatization as[10]

$$\theta = \frac{n(2n^2-1)\alpha - n^2(n-1)\alpha^2 - n^2(n+1)}{n(2n^2+12n+9)\alpha - n^2(n+5)\alpha^2 - (n^3+7n^2+10n+4)}.\tag{18}$$

From (18), we have the main results of this paper.

**Proposition 1.** Privatization is set back with the relaxing the regulation on foreign investment; $\partial\theta/\partial\alpha > 0$.

**Proof.** From (18), we have

$$\frac{\partial\theta}{\partial\alpha} = \frac{2n(n+2)(n\alpha-n-1)^2}{[n(2n^2+12n+9)\alpha - n^2(n+5)\alpha^2 - (n^3+7n^2+10n+4)]^2}.$$

For any $n > 1$ and $0 \le \alpha \le 1$, $\partial\theta/\partial\alpha > 0$.

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[10]We can easily confirm that $\theta$ is in [0,1] for $n > 1$ and $0 \le \alpha \le 1$, and the second-order condition is satisfied, $\partial^2 W/\partial\theta^2 < 0$.

**Proposition 2**. Privatization is promoted by an increase in the number of firms operating in the market; $\partial\theta/\partial n > 0$.

**Proof**. From (18), we have

$$\frac{\partial\theta}{\partial n} = \frac{\Phi}{[(2\alpha - \alpha^2 - 1)n^3 + (12\alpha - 5\alpha^2 - 7)n^2 + (9\alpha - 10)n - 4]^2},$$

where $\Phi \equiv 6(1-\alpha)^4 n^4 + 20(1-\alpha)^3 n^3 + 2(2\alpha^3 + 7\alpha^2 - 20\alpha + 11)n^2 + 8(1-\alpha^2)n + 4\alpha$. For any $n > 1$ and $0 \le \alpha \le 1$, $\partial\theta/\partial n > 0$.

The above propositions show that the market-opening policy measured by the increases in the share of foreign investment in private firm gives the government less incentive to privatize its own public firms. This is simply because if a private firm is domestically owned, its profit remains in the country. This provides the government with an incentive to privatize public firm. By contrast, if foreign capitalists own private firms, private firm profits flow out to foreign countries, so that public firm decreases the degree of privatization so as not to yield profits to private firms and to keep their profits in the country. The market-opening policy measured by the increase in the number of private firms gives us an opposite result. It gives the government more incentive to privatize its own public firms. The two different strategies for opening market result in the opposite impacts on the government's incentive for privatization.

# 4   Concluding Remarks

In this paper, we investigated the effects of market-openings policies on the degree of privatization in the mixed oligopoly market. A series of mixed oligopoly analyses indicate that the existence of foreign investment considerably changes the equilibrium outcome. Nevertheless, market-openings strategies in the mixed market model with partial privatization have been nearly

neglected. By introducing a change in the levels of regulation on foreign investment, we have shown alternative features of the degree of privatization in mixed market.

We first show that the relaxation of restriction on foreign investment sets back privatization of public firm. Second, with the increase in the number of private firms that are jointly owned by domestic and foreign investors, the government increases the degree of privatization. In this sense, while the market-opening policies called for by international agreement, such as WTO, tend to set back the privatization of public firm, the increase in the number of firms operating in the market accelerates the privatization. The two different strategies for market-openings result in the opposite impacts on the government's incentive for privatization.

Finally, it should be noted that some of our assumptions could be relaxed without changing the main results of this paper. Specifically, although our assumption of a quadratic cost function allows us to derive clear-cut results, the assumption of constant marginal cost would only change the results in a quantitative sense unless public firm has less efficient technology than private firms. Furthermore, since our interest is the exogenous change in the regulation of foreign direct investment, we simply assume that the government only controls the degree of privatization. However, the government may use the level of foreign investment regulation as policy variables. The extension of the present model, which is left for a future investigation, to the one that considers the endogenous determination of FDI regulation and privatization could well provide insightful implications on the optimal policies taken in the mixed oligopoly market.

# References

Barcena-Ruiz, J.C. and M.B. Garzon 2005, International Trade and Strategic Privatization, Review of Development Economics, vol.9(4), 502-513.

Beladi, H. and C.C. Chao 2006, Mixed Ownership, Unemployment, and Welfare for a Developing Economy, Review of Development Economics, vol.10(4), 604-611.

Chang, W.W. 2005, Optimal Trade and Privatization Policies in an International Duopoly with Cost Asymmetry, Journal of International Trade and Economic Development, vol.14(1), 19-42.

Chakrabarti, A. and J.S. Heywood 2004, Foreign Investment, Vertical Integration and Local Equity Requirements, Economica, vol.71, 559-574.

Chao, C.C. and E.S.H. Yu 2006, Partial Privatization, Foreign Competition, and Optimum Tariff, Review of International Economics, vol.14(1), 87-92.

Dadpay, A. and J.S. Heywood 2006, Mixed Oligopoly in a Single International Market, Australian Economic Papers, vol.45(4), 269-280.

De Fraja, G. and F. Delbono 1989, Alternative Strategies of a Public Enterprise in Oligopoly, Oxford Economic Papers, vol.41, 302-311.

Fjell, K. and D. Pal 1996, A Mixed Oligopoly in the presence of Foreign Private Firms, Canadian Journal of Economics, vol.29, 737-743.

Fjell, K. and J.S. Heywood 2002, Public Stackelberg Leadership in a Mixed Oligopoly with Foreign Firms, Australian Economic Papers, vol.41, 267-281.

Fujiwara, K. 2006, Trade Pattern in an International Mixed Oligopoly, Economics Bulletin, vol.6(9), 1-7.

Huizinga, H. and S.B. Nielsen 1997, Capital Income and Profit Taxation with Foreign Ownership of Firms, Journal of International Economics, vol.42, 149-165.

Lee, S-H. and H.S. Hwang 2003, Partial Ownership for the Public Firm and Competition, Japanese Economic Review, vol.54(3), 324-335.

Matsumura, T. 1998, Partial Privatization in Mixed Duopoly, Journal of Public Economics, vol.70, 473-483.

Matsumura, T. 2003, Stackelberg Mixed Duopoly with a Foreign Competitor, Bulletin of Economic Research, vol.55, 275-287.

Pal, D. and M.D. White 1998, Mixed Oligopoly, Privatization, and Strategic Trade Policy, Southern Economic Journal, vol.65, 264-281.

Serizawa, N. 2000, Optimal Trade Policy in an International Mixed Oligopoly, Seoul Journal of Economics, vol.13, 107-122.

Smith D.A.C. and J.M. Trebilcock 2001, State-Owned Enterprises in Less Developed Countries: Privatization and Alternative Reform Strategies, European Journal of Law and Economics, vol.12, 217-252.

Sun, Q., A. Zhang, and J. Li 2005, A Study of Optimal State Share in Mixed Oligopoly: Implications for SOE Reform and Foreign Competition, China Economic Review, vol.16, 1-27.

Tomaru, Y. 2006, Mixed Oligopoly, Partial Privatization and Subsidization, Economics Bulletin, vol.12(5), 1-6.