Optimal Partial Privatization in the Presence of Foreign Competition: The Role of Efficiency Differentials and Unemployment

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10 August 2018

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Abstract

This paper studies the privatization policy on a domestic state-owned enterprise (SOE), by incorporating the features of unemployment and efficiency differentials — both exogenous and endogenous — between the SOE and a foreign-owned firm, in a partial-equilibrium mixed oligopoly setting. We characterize and compare the optimal privatization policies under different scenarios, and find that the presence/absence of labor efficiency differentials and unemployment interact in an interesting way. In addition, when there is unemployment, the trade off between labor inefficiency and unemployment in privatization decision depends on the magnitude of damage on the labor efficiency due to an increase in state ownership of the SOE, but not so under full employment.

Keywords: Partial Privatization, Mixed Oligopoly, Efficiency Differentials, Unemployment
JEL Classification: D21, D43, D69, O53

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* This work was supported by the National Natural Science Foundation of China (NSFC, 71603078, 2016); China Postdoctoral Science Foundation Special Support Program (CPSF,2018T110178, 2018); and China Postdoctoral Science Foundation (CPSF, 2017M621006, 2017). We are indebted to Chifeng Dai for his valuable comments. Any remaining mistakes are our own.

1 Introduction

In recent years, the development of the private sector with privatization of State Owned Enterprises (SOE) has played an important role in many developing countries and emerging markets such as Brazil, Malaysia, and Thailand (Cai and Li, 2011; Huang and Yang, 2016; Huang et al., 2017; Fridman, 2018). This also applies to China in a more significant way. As a consequence of the progress made on privatization in China since early 1990s, *inter alia*, the economy of China has experienced a rapid growth, and now has the second highest GDP in the world. However, China is also facing several social issues such as an unemployment rate of 4% and increasing regional disparities.[1] However, although the number of Chinese SOEs has dropped dramatically since 1970s, the public sector in China is still substantial and the central government has been trying to increase the efficiency level of the SOEs through the State-Owned Assets Supervision and Administration Commission of the ruling State Council (SASAC),[2] given that the net profit margin of SOE in China was 4.66% which is about 1.6% lower than that of their private peers (6.28%) in 2015.

The SOEs generally have two broad objectives, viz., social welfare maximization (including a reduction in unemployment) and profit maximization. The latter involves increasing efficiencies in production. Therefore, the two objectives seem to be at odds with each other as increasing labor productivity invariably involves a reduction in the labor force. However, both the Chinese government and the SOEs have been trying to reconcile these two incompatible goals. In particular, the SOEs located in an area are encouraged to mitigate unemployment pressure if there is a large unemployed labor force there. Similarly, except those SOEs operating in strategic industries such as aerospace, banking, energy, etc., which are identified by the Chinese government for domestic leadership, the SOEs in the non-strategic industries attempt, and are expected, to be more market-oriented and to provide

[1] Chinese Statistic Yearbook(2016)

[2] SASAC is a special commission of the People's Republic of China, directly under the State Council. It bears the responsibility of preserving and increasing the economic efficiency of the public firms and the market value of state-owned asset operated and managed by the SOEs.

managerial incentives for cost control and efficiency enhancement. For example, SAIC Motor Corporation Limited (SAIC Motor), the largest state-owned auto company in China and the 41th enterprise on the annual Fortune Global 500 list of 2016, did not reduce its workforce from the level of 17, 000, and kept its net margin and year-over-year (YOY) growth rate at 4.3% and 7.44%, respectively in 2016. In addition, China is redoubling its efforts to improve the efficiency of the SOEs in 2017 by a complete restructuring of the SOEs, according to the 36th meeting of the Central Leading Group for Deepening Overall Reform. Mixed-ownership reform, including both privatization and nationalization, is in fact of the tools the Chinese government is using to improve the efficiency of the SOEs.

Another important aspect that potentially affects the privatization decisions is the presence of foreign firms in the industries where SOEs are being partially or fully privatized. Recent evidence shows that many developing and transition economies including China have been encouraging encourage rapid growth of inward foreign investments, while privatizing government-owned firms.[3] For instance, the FDI average of BRIC nations – Brazil, Russia, India, and China – stood at $ 93.9 billion in 2015, which was higher than the world average of $ 29.3 billion, G7 average of $ 82.8 billion, and the European Union average of $ 19.1 billion.[4,5]

Thus, it is important to analyze the issue of optimal degree of state ownership, balancing the diametrically opposite effects on labor inefficiency and unemployment which usually follow privatization, while allowing for the presence of foreign firms in the domestic industries. We allow for the foreign firm to be either located in the country under consideration (which is the case of foreign direct investment) or located in its home country but exports to the country we focus on.[6] This paper complements the literature of partial privatization

[3]See Dadpay and Heywood(2006), Mukherjee and Suetrong (2009), Wang and Chen (2010), Lin and Matsumura (2012), Caprino (2013), Wang and Lee (2013), and Liu et al. (2016) modeled mixed oligopoly including a foreign private firm.

[4]G7 nations are Canada, France, Germany, Italy, Japan, the UK and the US.

[5]www.uhy.com ; last accessed 2 March 2018.

[6]Foreign ownership in private firms plays an important role in mixed oligopolies because it affects the behavior of the public firm directly and affects that of private firms through strategic interaction between

by introducing competing foreign-owned firms and unemployment. It also considers exogenous and endogenous efficiency differentials between domestic and foreign firm and their effects on the optimal degree of privatization of a SOE.[7] We do so in the context of an international mixed oligopoly market. (Partial) privatization of SOE has been extensively discussed in the literature. The literature on privatization policy has typically used mixed oligopoly models in which welfare maximizing public firms compete with profit maximizing private firms.[8] A strand of the literature argues that the optimal degree of welfare- improving privatization policies crucially depends on the cost differentials of firms, and this has been demonstrated and extended in this paper by endogenizing cost differentials.[9] Another strand of the literature concerning the privatization and local unemployment states that the impact of privatization on unemployment is ambiguous. For example, Beladi and Chao (2006) finds that an increase in the private ownership worsens urban unemployment in the short-run by a lowering of production; Boubakri et al. (2004) finds that privatization in some Asian economies lead to significant increases in profitability and efficiency, but its impact on employment is ambiguous. Berkowitz et al. (2014) suggests that the primary consequence of the increased banking via privatization was to reduce unemployment.

In this class of models, some of the firms are jointly owned by the state and the private sector, and the objective of jointly owned firms is not simply maximization of profits, but a combination of profits and social welfare.[10] In spite of the tension between the labor

public and private firms. See the literature starting with Corneo and Jeanne (1994) and Fjell and Pal (1996). See also Barcena-Ruiz and Garzon (2005a, 2005b), Wang et al. (2009), Wang and Chen (2010), Wang and Chen (2011), Lin and Matsumura (2012), Wang and Lee (2013), Wang and Tomaru (2015), Xu et al. (2016), Liu et al. (2018).

[7]We use labor efficiency (labor cost differentials) to represent the overall production efficiency (efficiency differentials). Throughout the paper, we shall use the terms labor cost differentials and efficiency differentials interchangeably.

[8]For a general discussion, see De Fraja and Delbono (1989, 1990), George and La Manna (1996), White (1996), Pal and White (1998), Ishida and Matsumura (2009), Lin and Matsumura (2012), Wang and Lee (2013), Pal and Saha (2014), Colombo (2016), and Chen (2017). For a brief overviews of privatization literature, see Schmidt and Schnitzer (1997), Vickers and Yarrow (1991), and Megginson and Netter (2001).

[9]See also Matsumura (1998), Matsumura and Matsushima (2004), Chang (2007), Tomaru (2007), Mukherjee and Suetrong (2009), Wang et al. (2009), Wang and Chen (2010), and Chen(2017).

[10] For partial privatization approach, see, for example, Matsumura (1998), Chang (2005, 2007), Mukherjee and Suetrong (2009), Wang and Chen (2011), and Mukherjee and Sinha (2014).

inefficiency and unemployment in privatization, the impact of these two factors on optimal privatization policies, to the best of our knowledge, is seldom discussed in the literature. In fact, we find that these two elements interact in an interesting way in the determination of the optimal degree of privatization.

The remainder of this paper is arranged as follows. The model discussed in section 2; the different cases are analyzed in section 3; and concluding remarks are made in the last section.

2 The Model

There are two firms producing a homogeneous good for the domestic market. Firm 1 is a domestic, partially-private firm, i.e., it is owned jointly by government and private investor. Firm 2 is a foreign-owned private firm located in the country we are considering here.

We assume that the demand function and cost functions are linear. The inverse demand function is given by:

$$p = 1 - Q, \tag{1}$$

where p and Q are market price and market demand of the good[11].

Both firms have constant marginal/average cost technologies: ϕ_1 for the local firm 1 and ϕ_2 for the foreign firm 2. To be more specific, the cost functions of the two firms are:

$$c_2 = \phi_2 * q_2, \quad c_1 = \phi_1 * q_1 = \lambda(\alpha)\phi_2 * q_1, \quad \text{where} \quad \phi_1 > 0,\ \phi_2 > 0,\ \lambda(\alpha) \geq 1,\ \lambda' \geq 0, \tag{2}$$

where q_i $(i = 1, 2)$ is firm i's output and α is government's share in firm 1[12]. The condition $\lambda(\alpha) > 1$ would mean that there is an efficiency gap between local firm 1 and private foreign

[11]The hypothesis of linear demand and constant marginal costs for a public firm over private firms prevails in the existing literature on mixed oligopoly. See Pal(1998), Capuano and De Feo(2010), and Matsumura and Ogawa(2010). Wang and Tomaru (2015), Haraguchi and Matsumura (2018), and Liu et al. (2018).

[12]We make the normal assumptions that $(1 - \phi_1) \geq 0$, and $(1 - \phi_2) \geq 0$. These guarantee the non-negativity of the outputs and pricers.

firm 2, namely, the private foreign firm is more cost-efficient than the local firm[13]. Note that we allow λ to be a non-decreasing function of α, implying that the efficiency of the partially privatized local firm is a non-increasing function of the degree of state ownership. The special case $\lambda'(\alpha) > 0$ ($\lambda'(\alpha) = 0$) represents the case of endogenous (exogenous) labor cost differentials.

The market-clearing condition is:

$$Q = q_1 + q_2. \tag{3}$$

Profits of the two firms are:

$$\pi_i = pq_i - c_i, \quad i = 1, 2, \tag{4}$$

Firm 2 maximizes profits, but firm 1 which is partially privatized, maximizes an weighted sum of social welfare W and its profit π_1 with the weights reflecting the level of government ownership of the firm. That is, firm 1 maximizes

$$u_1 = \alpha * W + (1 - \alpha)\pi_1, \tag{5}$$

where α is government's share in firm 1 and the social welfare W is defined as

$$W = \mathrm{CS} + \pi_1 + \zeta E, \tag{6}$$

where CS is consumers' surplus and E is the level of employment income created in the industry which is taken to be total labor costs of the two firms. The parameter ζ takes two possible values: $\zeta = 1$ implies the presence of unemployment, and $\zeta = 0$ indicates the presence of full employment.

[13]Many studies have shown that the public firms in developing countries and emerging markets produce less efficiently than private firms (Vickers and Yarrow, 1991; Megginson and Netter, 2001; Tomaru, 2007; Wang et al., 2009; Wang and Chen, 2010). However, this is not universally true. For example, labor productivity in several government-owned monopolistic sectors in China, such as extraction of petroleum and natural gas and railway transport, are exceptions to the rule.

In the literature on oligopoly, there are different ways of treating unemployment. De Fraja (1993), for example, considers a bargain-theoretic approach where a bargaining between a labor union and a firm determines the level of wage and employment. Others, including Brander and Spencer (1987) and Lahiri and Ono (1998), consider an analytically simpler case of classical unemployment where the presence of unemployment does not push the wage rate down to clear the labor market. In this paper we consider the latter approach not just because of its analytical simplicity, but also because it may be more appropriate in countries such as China, where bargaining between labor union and firms is not very common.[14]

When the local economy suffers from unemployment ($\zeta = 1$), the higher are the marginal costs, the greater is employment created. In other word, with the presence of unemployment, the income that workers in the two firms earn are considered, from the stand point of domestic social welfare, as accruing to the originally unemployed labor force (Harris and Todaro, 1970; Katayama et al., 2011), i.e.,

$$E = c_1 + c_2 = \phi_1 q_1 + \gamma \phi_2 q_2, \tag{7}$$

where γ takes two possible values: $\gamma = 1$ when the foreign firm is located in our country of focus and $\gamma = 0$ when foreign firm exports from its home country. Clearly, when the foreign firm is located in its home country, it does not generate any income in the country we analyze here. Consumers' surplus CS is

$$\int_0^{q_1+q_2} p(Q)dQ - pQ = \frac{1}{2}(q_1 + q_2)^2. \tag{8}$$

We consider a two-stage simultaneous-move game as in Matsumura (1998). The government chooses optimal state ownership α to maximize its objective W in the first stage

[14] In terms of welfare, as Lahiri and Ono (2004, p. 83) notes, "... In the presence of unemployment there is a discrepancy between the social and the private production costs. When a firm employs labor, it has to pay wages, which are private costs. However, the opportunity or social cost of labor is zero in the presence of unemployment since the firm can raise production by hiring more labor without reducing the employment and thus the production of any other firm ..."

given the presence/absence of endogenous/exogenous labor cost differentials and/or unemployment. After observing α, both firm 1 and firm 2 choose their output levels simultaneously, in the second stage, by maximizing their respective objectives: u_1 for local firm 1 and π_2 for foreign firm 2. We apply backward induction to solve the model, starting from stage 2, for a Sub-Game Perfect Nash equilibrium.

From stage 2, we solve the output levels as

$$q_1 = \frac{2(1-\phi_1) + 2\alpha\zeta\phi_1 - (1-\alpha)(1-\phi_2)}{(3-\alpha)}, \tag{9}$$

$$q_2 = \frac{-(1-\phi_1) - \alpha\zeta\phi_1 + (2-\alpha)(1-\phi_2)}{(3-\alpha)}. \tag{10}$$

From (9) and (10), we first of all note that the presence of unemployment ($\zeta = 1$) makes q_1 higher and q_2 lower. This is because the domestic firms also wants to increase employment and thus welfare when there is unemployment in the economy. Thus the presence of unemployment increases the domestic firm's market share at the expense of the foreign firm's. Second, from (9) and (10) we obtain the reaction functions as:

$$\frac{\partial q_1}{\partial \alpha} = \frac{2(1-\phi_1) + 6\zeta\phi_1 + 2(1-\phi_2)}{(3-\alpha)^2} - 2 \cdot \frac{\lambda'\phi_2(1-\alpha\zeta)(3-\alpha)}{(3-\alpha)^2}, \tag{11}$$

$$\frac{\partial q_2}{\partial \alpha} = \frac{-(1-\phi_2) - 3\zeta\phi_1 - (1-\phi_1)}{(3-\alpha)^2} + \frac{\lambda'\phi_2(1-\alpha\zeta)(3-\alpha)}{(3-\alpha)^2}. \tag{12}$$

An increase in state ownership of firm 1 increases (decreases) the output of firm 1 (2) when λ' is small enough. This is, because firm 1 takes into account consumers' surplus in its objective function and thus normally produces more as the value of α goes up. When λ' is large, this may not happen as the firm gets significantly inefficient losing market share to the competitor. In other words, the presence/absence of endogenous labor cost differentials can influence the nature of privatization decision. This can happen even in the absence of *initial* labor cost differentials ($\lambda = 1$) when the differential changes because of privatization decision ($\lambda' > 0$). We also note that the presence of unemployment shifts the response function of the domestic (foreign) firm to the right (left).

In stage 1, the government maximizes W with respect to α, taking the reaction functions (11) and (12) into account. The first-order condition of this problem is given by:

$$\frac{dW}{d\alpha} = \frac{\partial W}{\partial q_1}\frac{\partial q_1}{\partial \alpha} + \frac{\partial W}{\partial q_2}\frac{\partial q_2}{\partial \alpha} + \frac{\partial W}{\partial \phi_1}\frac{\partial \phi_1}{\partial \lambda}\frac{\partial \lambda}{\partial \alpha} = 0, \tag{13}$$

where the expressions for $\partial W/\partial q_1$, $\partial W/\partial q_2$, and $\partial W/\partial \phi_1$ can be found in the Appendix A (see (A.1)) and $\partial q_1/\partial \alpha$ and $\partial q_2/\partial \alpha$ are given above in (11) and (12) respectively. Also, the expression for $\partial W/\partial \alpha$ is given in Appendix A (see (A.2)).

3 The analysis of the special cases

Having set up the general model and derived the basic welfare equation (see (A.2) in Appendix A), we shall now consider a number of special cases.

3.1 Case 1: $\zeta = \lambda' = 0$

We start with the case when there is full employment characterized by $\zeta = 0$ and when cost differentials, if any, is purely exogenous, that is $\lambda' = 0$. This case was considered by Matsumura (1998). Substituting $\zeta = \lambda' = 0$ in (A.2) and setting $\partial W/\partial \alpha = 0$, we derive the optimal value of α as:

$$\alpha^* = \frac{3(1-\phi_1)}{2(1-\phi_1)+(1-\phi_2)} > 0. \tag{14}$$

It is straightforward from (14) that when $\lambda > 1$, i.e., is when $\phi_1 > \phi_2$, the optimal value of α is strictly less than 1 and greater than 0, $0 < \alpha^* < 1$. That is, when there is an exogenous labor cost differential between the two oligopolistic competitors, the optimal policy is to partially privatize the domestic firm. (Matsumura and Matsushima, 2004; Chang, 2007; Mukherjee and Suetrong, 2009).

When $\lambda = 1$ ($\phi_1 = \phi_2 = \phi$), we get:

$$\alpha^* = 1. \tag{15}$$

That is, it is optimal to fully nationalize the local firm, when there is full employment and there is no exogenous labor cost differential between the two firms. Since the two firms are equally efficient in production, there is no efficiency cost of nationalization, and with fully nationalization, this firm maximizes social welfare in deciding its output level.

It is also to be note is that at the optimal level of $\alpha^* = 1$, foreign firm will be driven out ($q_2 = 0$) and the local firm will become a monopolistic producer in the domestic market. This because since there is no cost differentials ($\lambda = 1$), and the profit of firm 2 is not part of the objective function of the government, the loss of consumers' surplus because of the move from a duopoly to monopoly is not significant and it is compensated by an increase in profits by the domestic firm.

Proposition 1. *Suppose that there is full employment and cost differential is not dependent on the degree of privatization of the domestic firm.Then we have:*
(i) when there is no exogenous cost differentials between the domestic and the foreign firm, the optimal policy is to fully nationalize the domestic firm, and the foreign firm is driven out of the domestic market, and
(ii) where there is an exogenous cost difference between the two firms, the optimal policy is to partially privatize the domestic firm.

3.2 Case 2: $\zeta = \lambda = 1,\ \lambda' = 0$

We now assume that there is unemployment in the economy, i.e. $\zeta = 1$, but assume away any exogenous cost differential, i.e., $\lambda = 1$.[15] Substituting $\zeta = 1,\ \lambda' = 0,\ \lambda = 1$ in (A.2) and setting $\partial W/\partial\alpha = 0$, the optimal α is calculated as

$$\alpha^* = \frac{3(1-\phi) + 3(2-\gamma)\phi}{3(1-\phi) + (5-\gamma)\phi}.$$

[15]The assumption $\lambda' = 0$ means that there is no endogenous cost differential either.

However, at this level of α, the output level of the foreign firm does not satisfy the non-negativity condition.[16] This is true irrespective of whether $\gamma = 0$ or $\gamma = 1$.[17] Therefore, the solution for the optimal level of α is a corner one in this case. To obtain the corner optimal value of α, we first write the solution for q_2 from (10) as

$$q_2 = \frac{(1-\alpha)(1-\phi) - \alpha\phi}{3-\alpha}. \tag{16}$$

Setting $q_2 = 0$ in (16), the corner solution of optimal α is derived as:[18]

$$\alpha^{\S} = 1 - \phi. \tag{17}$$

It is clear from (17) that $\alpha^{\S}$ satisfies $0 < \alpha^{\S} < 1$. That is, in this case partial privatization is optimal unlike the case of full employment and no exogenous cost differentials. However, the two cases have one property in common: the foreign firm is driven out of the domestic market in both cases and the domestic firm becomes a monopolist. This is true irrespective of whether $\gamma = 0$ or $\gamma = 1$.

In general, in the presence of unemployment, the government prefers to increase the market share of the domestic firm which takes into account the presence of unemployment in its output decision. This is what drives the foreign firm out. However, the findings here suggest that, provided domestic firm 1 is as efficient as foreign firm 2, the government reduces its control on local firm 1 as privatization of firm 1 induces it to place more emphasis on profit maximization, which contributes to social welfare maximization and mitigates the domestic unemployment pressure. These results are formally stated in the following proposition.

[16] We assume the absence of negative profit conditions in this study. However, there are literatures do not take the non-negative profit condition into account, such as Wang and Chen(2011), and Wang and Tomaru (2015).

[17] It can be shown that

$$q_2|_{\zeta=1,\ \lambda'=0,\ \lambda=1,\ \alpha=\alpha^*} = \frac{-\phi(2-\gamma)(2+\phi)}{3(2+\phi)} < 0.$$

[18] It can be verified from (16) that $dq_2/d\alpha < 0$, and that $(\partial W/\partial\alpha)|_{\zeta=1,\ \lambda'=0,\ \lambda=1,\ \alpha^{\S}=1-\phi} > 0$, confirming that it is indeed a corner solution. See also (A.3) and (A.4) in Appendix A.

Proposition 2. *Suppose that there is unemployment and there is no exogenous cost differential between the two firms. The foreign firm is located either in its home country or in the local country. Then we have:*
(i) The foreign firm is driven out of the domestic market, and the optimal policy is to partially privatize the domestic firm, and
(ii) The presence of unemployment induces the government not to fully nationalize the domestic firm.

3.3 Case 3: $\zeta = 0,\ \lambda = 1,\ \lambda' > 0$

In this case we shall compare the effect of endogenizing cost differentials ($\lambda' > 0$) on the optimal privatization decision in the absence of unemployment ($\zeta = 0$) and the absence of initial labor cost differentials ($\lambda = 1$),. In particular, we shall compare the current case with case 1 with $\lambda = 1$. Note from proposition 1 that in the case $\zeta = 0,\ \lambda = 1,\ \lambda' = 0$, we found that it was optimal for the government to fully nationalize the domestic firm ($\alpha^* = 1$).

In order to focus on the effect of the endogeniety of cost differential ($\lambda' > 0$), we shall assume that at $\alpha = 1$ the value of λ is equal to unity (no initial cost differential), i.e., $\lambda(1) = 1$. Then, from (A.2), we get:

$$8b \cdot \frac{dW}{d\alpha}\bigg|_{\zeta=0,\ \lambda'>0,\ \lambda=1,\ \alpha^*=1} = -8\lambda'\phi(1-\phi) < 0, \tag{18}$$

Therefore, the optimal level of α is strictly less than 1. That is, starting from no exogenous labor cost differentials ($\lambda = 1$) and full employment ($\zeta = 0$), the fact that an increased stake of the government in local firm 1 decreases its efficiency level ($\lambda' > 0$) has negative impact on the level of optimal degree of nationalization (α). In other word, the endogeneity of labor cost differentials affect the privatization decision, even though there is no initial difference in cost differentials between the local firm and the foreign firm.

To understand the result, we note from (A.1) that when $\zeta = 0,\ \lambda = 1,\ \alpha = 1$, we have $\partial W/\partial q_1 = \partial W/\partial q_2 = 0$. That is, the initial levels of outputs of both firm 1 and firm 2 are at the socially optimal level, and therefore the only channel via which the degree of privatization affects welfare is the third term in (13), i.e., through its effect of efficiency reduction of the domestic firm, and this effect is negative.

The above results are stated formally in the following proposition.

Proposition 3. *Suppose there is no unemployment and there is no initial labor cost differentials between the domestic and the foreign firms. Then, the optimal degree of privatization of the local firm $(1 - \alpha)$ is higher when privatization increases the efficiency level of the domestic firm, i.e., $\lambda' > 0$, compared to the situation where it has no effect efficiency, i.e., $\lambda' = 0$.*

3.4 Case 4: $\zeta = 1,\ \lambda = 1,\ \lambda' > 0$

We now deviate from case 2 by assuming that labor cost differentials between the two firms depend on the degree of privatization. That is , we examine the effect endogenizing labor cost differentials ($\lambda' > 0$) in the presence of unemployment ($\zeta = 1$) and the absence of initial labor cost differentials ($\lambda = 1$).[19] In case 3, we did the same in the absence of unemployment.

As in case 2, if we find the optimal value of α by setting $\partial W/\partial\alpha = 0$, we find that the equilibrium level of the output of the foreign firm q_2, evaluated at that value of α is negative. Therefore, it cannot be the optimal value of α and it has to be obtained by setting $q_2 = 0$. By letting $q_2 = 0$ in (10), we find

$$\alpha^{\dagger} = 1 - \phi \tag{19}$$

Proof See the Appendix B.

[19]The parameter λ is this case is endogenous and depends the value of α. But, in order to focus on the endogeniety of cost differential ($\lambda' > 0$), we assume that the initial value of λ evaluated at the optimal level of α is unity.

In the presence of unemployment, the optimal value of α in this case is the same compared to $\alpha^{\S}$ (case 2) in which $\lambda' = 0$. This result suggests that a threat of being cost inefficient due to increasing in state ownership, i.e. the endogeneity of the cost differentials ($\lambda' > 0$), does not affect the optimal degree of privatization, given the presence of unemployment. This is true irrespective of whether $\gamma = 0$ or $\gamma = 1$. In all four cases in this study, we find that the optimal degree of privatization is free of the choice in FDI ($\gamma = 1$) and exportation ($\gamma = 0$). However, Mukerjee and Suetrong (2009), considering an international mixed oligopoly wherein a foreign private firm chooses exports to a domestic country with one public firm or FDI, show that the optimal degree of privatization relies crucially on the entry mode of foreign firm. The reason for this contradiction could be that the decision on FDI or exportation in our study always comes along with the presence of unemployment, which essentially determines the privatization decision.

Comparing the differences between cases 1 and 3 with the differences between cases 2 and 4, we note that the presence/absence of unemployment interacts with endogeneity of labor cost differentials between the domestic and foreign firms, i.e. the threat of being inefficient, in an interesting way. In the absence of unemployment, the endogeniety of the cost differentials does not affect the degree of privatization, but in the presence of unemployment it does. In the absence of unemployment (case 1 and case 3), the existence of the endogeneity of the cost differentials, i.e. $\lambda' > 0$, leads to a decreasing in state ownership of a public firm in order to keep the cost inefficiency at a lower level. However, in the presence of unemployment (case 2 and case 4), the existence of the endogeneity of the cost differentials keep the degree of privatization at same level to alleviate the pressure of unemployment.

The above results are formally stated in proposition 4

Proposition 4. *Suppose that there is unemployment in the economy but no initial cost differentials between the domestic and foreign firms. The foreign firm is located either in its home country or in the local country. Then, the optimal degree of privatization of the local*

firm $(1-\alpha)$ is the same when privatization increases the efficiency level of the domestic firm, i.e., $\lambda' > 0$, compared to the situation where it has no effect on efficiency.

4 Numerical Analysis

In the preceding sections, we have investigated if we can have interior solutions for the optimal degree of privatization. When they are at the corner – as in case 2 and case 4, we have derived exact values of the optimal degree of privatization. But in case 3, we have not derived the exact analytical solution for the optimal value. In this section, we shall compute the values of the optimal level of privatization by setting different values of the parameters.

According to parameter specification, the numerical result of case 1 is in column (3), (4), and (5) of table 1; result of case 2 is in column (7) and (9) of table 2; result of case 3 is in column (1) and (2) of table 1; result of case 4 is in column (6) and (8) of table 2.[20]. The numerical results are straightforward in interpretation. In case 1 of column (3), since the two firms are equally efficient in production($\lambda = 1$), there is no efficiency cost of nationalization, and pure public monopoly maximizes social welfare in deciding its output level. In case 1 of column (4) and (5), it implies that the optimal policy is to partially privatize the domestic firm where there is an exogenous cost difference between the public firm 1 and foreign firm 2($\lambda > 1$). In case 2 of both column (7) and (9), we find that the foreign firm is located either in its home country ($\gamma = 0$) or in the local country ($\gamma = 1$), the presence of unemployment induces the government not to fully nationalize the domestic firm, while driving the foreign firm out of the domestic market. In case 3 of column (1) and (2), the optimal policy is partial privatization. In addition, the optimal degree of privatization of the local firm $(1 - \alpha)$ is higher when privatization increases the efficiency level of the domestic firm, i.e., $\lambda' > 0$, compared to the situation where it has no effect efficiency, i.e., $\lambda' = 0$ (optimal degree of

[20]Note that, in order to investigate the observable variations of the optimal degree of privatization in different cases, we considered different values of the marginal (average) costs ϕ_1 and ϕ_2 in both table 1 and table 2.

privatization, 0.036 in column (1) is larger than 0.021 in column (2) and 0 in column (3) when $\phi_1 = \phi_2 = 0.01$).

Table 1: **Numerical Analysis on Optimal α when $\zeta = 0$**

ζ & γ	$\zeta = 0$, irrespective of $\gamma = 0$ or $\gamma = 1$				
λ & λ'	$\lambda = 1$ & $\lambda' \geq 0$			$\lambda > 1$ & $\lambda' = 0$	
	$\lambda' = 5$	$\lambda' = 3$	$\lambda' = 0$	$\lambda = 5$	$\lambda = 8$
	Optimal α			**Optimal α**	
	(1)	(2)	(3)	(4)	(5)
$\phi_2 = 0.01$	0.964	0.979	1.000	0.986	0.975
$\phi_2 = 0.02$	0.923	0.956	1.000	0.971	0.947
$\phi_2 = 0.03$	0.874	0.930	1.000	0.955	0.916
$\phi_2 = 0.04$	0.816	0.900	1.000	0.938	0.879
$\phi_2 = 0.05$	0.747	0.868	1.000	0.918	0.837
$\phi_2 = 0.06$	0.663	0.830	1.000	0.897	0.788
$\phi_2 = 0.07$	0.561	0.788	1.000	0.874	0.729
$\phi_2 = 0.08$	0.437	0.740	1.000	0.849	0.659
$\phi_2 = 0.09$	0.288	0.684	1.000	0.821	0.571
$\phi_2 = 0.10$	0.118	0.619	1.000	0.790	0.462

Note: The linear demand function is $p = 1 - q_1 - q_2$, thus all ϕ's (including both ϕ_1 and ϕ_2) are less than 1. Efficiency differential λ is defined as a monotonic-increasing function of α, where $\lambda \geq 1$. Therefore, when $\lambda > 1$ ($\lambda = 1$), it implies $\phi_1 > \phi_2$ ($\phi_1 = \phi_2$). In addition, optimal α is the optimal degree of nationalization, while $(1 - \alpha)$ is the degree of privatization.

In both case 2 and case 4 presented in table 2, foreign firm 2 is driven out of the domestic market, i.e. $q_2^* = 0$. The optimal degrees of privatization $(1 - \alpha)$ in case 2 and case 4 are exactly the same compared to each other, equal to $1 - \phi$, irrespective of $\lambda' = 0$ or $\lambda' > 0$. The numerical result indicates that, given the presence of unemployment in domestic market, the threat of being cost inefficiency, by keeping the state ownership of public firm ($\lambda = 1$ and $\lambda' > 0$) on a high level, does not affect the optimal degree of privatization in this public firm. At this point in time, alleviation of unemployment pressure maintains the state ownership of public firm as it was initially, even if there is the threat of being cost inefficiency by keeping the state ownership on a high level. Be noted that this result is contrary in case 1 and case 3, given the absence of unemployment.

Table 2: **Numerical Analysis on Optimal α when $\zeta = 1$**

ζ & γ	$\zeta = 1$ & $\gamma = 0$		$\zeta = 1$ & $\gamma = 1$	
	$\lambda' > 0$	$\lambda' = 0$	$\lambda' > 0$	$\lambda' = 0$
	Optimal α		**Optimal α**	
	(6)	(7)	(8)	(9)
$\phi_2 = 0.1$	0.90	0.90	0.90	0.90
$\phi_2 = 0.2$	0.80	0.80	0.80	0.80
$\phi_2 = 0.3$	0.70	0.70	0.70	0.70
$\phi_2 = 0.4$	0.60	0.60	0.60	0.60
$\phi_2 = 0.5$	0.50	0.50	0.50	0.50
$\phi_2 = 0.6$	0.40	0.40	0.40	0.40
$\phi_2 = 0.7$	0.30	0.30	0.30	0.30
$\phi_2 = 0.8$	0.20	0.20	0.20	0.20
$\phi_2 = 0.9$	0.10	0.10	0.10	0.10
$\phi_2 = 1.0$	0.00	0.00	0.00	0.00

Note: The linear demand function is $p = 1 - q_1 - q_2$, thus all ϕ's (including both ϕ_1 and ϕ_2) are less than 1. Efficiency differential λ is defined as a monotonic-increasing function of α, where $\lambda \geq 1$. Therefore, when $\lambda > 1$ ($\lambda = 1$), it implies $\phi_1 > \phi_2$ ($\phi_1 = \phi_2$). In addition, optimal α is the optimal degree of nationalization, while $(1-\alpha)$ is the degree of privatization.

5 Concluding Remarks

In this study, we examine the research question: do the presence of unemployment efficiency differentials (namely, labor cost differentials) between a state-owned enterprise (SOE) and a foreign-owned firm play a role in determining the optimal level of state ownership of the domestic firm in a mixed oligopoly market? We find that they do. In particular, we find that when there is exogenous labor efficiency differentials (unemployment), but no unemployment (exogenous labor efficiency differentials), it is optimal to partially privatize the domestic firm.

We also find that the exogeneity or endogeneity of labor efficiency differentials does matter for privatization decision, due to the presence/absence of unemployment. More interestingly, we find that the two interact in an interesting way. To be specific, in the absence of unemployment, the optimal privatization decision depends crucially on the degree of possible deterioration of the labor efficiency differentials due to increasing state ownership

of the domestic firm; in the presence of unemployment, it does not.

This paper provides an insight into the mixed ownership reform with respect to the SOEs in non-strategic industries in China, given that many regions of China are facing serious unemployment problems and nationalization can cause labor inefficiencies to increase.

However, our model and related results are subject to a number of shortcomings. Constant return to scare, linear preferences, and consideration only of classical unemployment are some of the important limitations. However, we think that our results are just suggestive, and similar results would hold under more broader situations, but at the cost of substantial increase in the complexities of analysis.

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Appendix A

$$
\begin{aligned}
(3-\alpha)\cdot\frac{\partial W}{\partial q_1} &= (1-\alpha)(1-\phi_1)+(1-\alpha)(1-\phi_2)+3(1-\alpha)\zeta\phi_1,\\
(3-\alpha)\cdot\frac{\partial W}{\partial q_2} &= -(1-\phi_1)+(2-\alpha)(1-\phi_2)+(3-\alpha)\gamma\zeta\phi_2-\alpha\zeta\phi_1. \qquad \text{(A.1)}\\
\frac{\partial W}{\partial \phi_1} &= -(1-\zeta)q_1
\end{aligned}
$$

$$
\begin{aligned}
&2\cdot(3-\alpha)^3 b\cdot\frac{\partial W}{\partial \alpha} = \qquad . \qquad \text{(A.2)}\\
&\{2[(3-2\alpha)(1-\phi_1)-\alpha(1-\phi_1)][(1-\phi_1)+(1-\phi_2)]-2(3-\alpha)(9-4\alpha)\lambda'\phi_2(1-\phi_1)\\
&+2(3-\alpha)(\alpha^2-3\alpha+3)\lambda'\phi_2(1-\phi_2)\}\\
&+[2(15-11\alpha)\phi_1(1-\phi_1)+4(3-4\alpha)\phi_1(1-\phi_2)+2(3-\alpha)(3+2\alpha)(2-\alpha)\lambda'\phi_2(1-\phi_1)\\
&-2(3-\alpha)(2\alpha^2-4\alpha+3)\lambda'\phi_2(1-\phi_2)-2(3-\alpha)(3+2\alpha)(2-\alpha)\lambda'\phi_1\phi_2]*\zeta\\
&+[6(6-5\alpha)\phi_1^2+2(3-\alpha)(12-7\alpha)\alpha\lambda'\phi_1\phi_2]*\zeta^2\\
&-2(3-\alpha)[\phi_2(1-\phi_1)+\phi_2(1-\phi_2)-(3-\alpha)\lambda'\phi_2^2]*\zeta\gamma\\
&-2(3-\alpha)[3\phi_1\phi_2+(3-\alpha)\alpha\lambda'\phi_2^2]*\zeta^2\gamma
\end{aligned}
$$

$$
\left.\frac{dq_2}{d\alpha}\right|_{\zeta=1,\ \lambda'=0,\ \lambda=1} = \frac{-2(1-\phi)-3\phi}{[(3-\alpha)]^2 b} < 0. \qquad \text{(A.3)}
$$

$$
\left(\frac{2a+\phi}{a}\right)^3 b\cdot\left.\frac{\partial W}{\partial \alpha}\right|_{\zeta=1,\ \lambda'=0,\ \lambda=1,\ \alpha=(1-\phi)} = \frac{(2-\gamma)(2+\phi)^2\phi}{a} > 0, \qquad \text{(A.4)}
$$

Appendix B

Given (A.2), we plugging $\zeta = 1, \quad \lambda = 1$, we find three solutions of optimal α in case 4. They are listed as follows.

$$\alpha_1^* = \frac{3\phi - 3\gamma\phi + 3}{2\phi - \gamma\phi + 3},$$

$$\alpha_2^* = \frac{2\lambda'\phi + \sqrt{\lambda'\phi(\phi + \lambda'\phi + 2)}}{\lambda'\phi},$$

$$\alpha_3^* = \frac{2\lambda'\phi - \sqrt{\lambda'\phi(\phi + \lambda'\phi + 2)}}{\lambda'\phi}. \tag{B.1}$$

Now we are going to verify q_2 in case 4 w.r.t each α listed above, in order to check the non-negativity of q_2, where the general q_2 and specified q_2 in case 4 are,

$$q_2|_{\zeta=1,\ \lambda=1} = \frac{1 - \alpha - \phi}{3 - \alpha}, \tag{B.2}$$

Thus, we find that both α_1^* and α_2^* cannot keep the non-negativity of q_2 in case 4. We only left α_3^* valid. Now we check whether α_3^* satisfies the s.o.c as an interior solution of the optimal degree of privatization under case 4 by inserting α_3^* into the s.o.c in case 4.

$$(\alpha - 3)^4 \cdot \frac{dW^2}{d^2\alpha}\bigg|_{\zeta=\lambda=1,\ \lambda'>0,\ \alpha_3^*=\frac{2\lambda'\phi - \sqrt{\lambda'\phi(\phi+\lambda'\phi+2)}}{\lambda'\phi}} =$$

$$-\frac{(\lambda'\phi)^3(2\phi + 2\lambda'\phi + 2\sqrt{\lambda'\phi(\phi + \lambda'\phi + 2)} + 4)}{[\lambda'\phi + \sqrt{\lambda'\phi(\phi + \lambda'\phi + 2)}]^4} \cdot \Omega, \tag{B.3}$$

where

$$\Omega = (3 + \phi + \gamma\phi)\lambda'\phi - (2\phi + 3 - \gamma\phi)\sqrt{\lambda'\phi(\phi + \lambda'\phi + 2)}$$

As we observe in (B.3), its denominator is always positive, given $0 \leq \alpha \leq 1$. Thus, we focus on the negativity of its numerator after inserting α_3^*. The first polynomial in (B.3) is negative due to the positivity of λ' and ϕ. If $\gamma = 0$, indicating exportation of output from home country of firm 2 to domestic market, a corner solution of the optimal degree of privatization is demanded, where $\alpha^\dagger = 1 - \phi$. In addition, if $\gamma = 1$, indicating FDI from the

home country where firm 2 originates to domestic market, α_3^* could possibly be an interior solution of the optimal degree of privatization if $\lambda' > (3+\phi)^2/3\phi^2$.

To summarize, in order to ensure α_3^* in (B.1) is the qulified optimal α in case 4, it has to satisfy the following conditions. First, α_3^* shall be able to keep the non-negativity of q_2 in case 4, which requires $\lambda' \leq 1/\phi^2$; Second, the interiority of α_3^* requests that $\lambda' > (2+\phi)/(3\phi)$; Third, the satisfaction of SOC requests that $\lambda' > (3+\phi)^2/3\phi^2$. However, we find that there is no such a λ' which satisfies the above all three conditions, meaning that α_3^* could not be the optimal α.