Impacts of Privatization on Manufacturing Productive Efficiency: Evidence from China

Song Gao

Department of Economics
Western Michigan University
Song.gao@wmich.edu

Abstract

In this paper, I study the effects of privatization on manufacturing productivity using a panel data of manufacturing firms in China. First, a theoretical model is developed to describe the various features about the different performances between public and privatized firms. In this presentation, I model soft budget constraint (SBC)[1] as a principal-agent problem. The model illustrates that privatized firms are more efficient than public firms in production. Then, multifactor productivity (MFP)[2], unit cost and profitability are used as alternative measurements of the productive efficiency of firms and three different econometric models are employed to estimate the effects of privatization. The result indicates that privatization poses no significant effect on the firms' productivity but significant impact on cost reduction and profitability. Moreover, after dividing the privatized entities into two subgroups: domestic and foreign owned, it is found that foreign ownership generates significantly positive impact on firms' productivity but domestic ownership does not. However, domestic ownership induces larger cost reduction than foreign ownership. Finally, the domestic privatized firms' profitability is improved substantially whereas the effect of foreign ownership on profitability is ambiguous.

Keywords: privatization, soft budget constraint, transition economies, Chinese economy
JEL Classification: L25, P27, P31

[1] Soft Budget Constraint (SBC) refers to the case that the government would bail out failing State-Owned Enterprises (SOEs). Thus, the budget constraint of SOEs is virtually non-binding or "soft" compared to private firms. It can take the form of subsidies or tax reductions offered by the government to SOEs. It is also blamed as a major cause for the poor performance of public firms because managers under SBC are not motivated to control cost.
[2] The multifactor productivity (MFP) refers to the ratio of the real value of output to the combined input of labor and capital. It measures the relative growth of output conditional on the growth of labor and capital.

1. Introduction

Despite the fact that privatization has gained popularity as a remedy for the failing state-owned enterprises (SOEs) in the last two decades, the impacts of privatization on performance of firms remain rather ambiguous. In order to shed light on this issue, this paper uses a more recent Chinese firm-level panel data to study the effects of privatization on firm's productivity in China. A study of the privatization process in China is warranted given that most current literature focuses on the privatization process in Central and Eastern European countries where disappointment with the results of privatization has raised serious questions about the effectiveness and merit of privatization in transition economies. Unlike those countries, China's privatization process has been much more gradual. Therefore, a study of China's privatization may add new evidence and insight to the existing body of literature on the issue of privatization in transition economies.

This paper attempts to contribute to the existing literature on both theoretical and empirical fronts. First, in theoretical modeling, I extend Bös and Peters (1991) approach by including soft budget constraint (SBC) into the model, in which I model SBC as a principal-agent problem. Second, in empirical estimation, following the lead of Brown et al. (2006), I compare and contrast productivity differences across firms with different ownership structure using a relatively new Chinese firm-level dataset, in which MFP, unit cost and profitability constitute alternative measures of manufacturing's productivity.

Bös and Peters (1991)'s principal-agent model treats state as the principal and manager as the agent and provides an insightful analysis on public and privatized firms' efficiencies. In particular, they investigate the effects of external control and manager's income on public firm's productive efficiency. However, Bös and Peters (1991)'s model may not be adequate to capture all dynamics and peculiarities exhibited in the case of Chinese SOEs. In particular, I can not afford to study Chinese public firms without paying attention to the Soft Budget Constraint (SBC) problem in these firms. Lin and Tan (1998) and Zhang (1997) argue that SBC has a prominent presence in Chinese SOEs and is a major cause of Chinese SOEs' inefficiency. Thus, I extend Bös and Peters (1991) to include SBC in my public firm model. The theoretical results indicate that with the

presence of imperfect information, public firms are inferior to private firms in productive efficiency.

The empirical research on Chinese privatization has been limited due to the lack of data. This constraint is mainly caused by the policies adopted by the Chinese government to privatize its SOEs. Even though the economic reform started as early as 1980, the sale of SOEs was merely allowed until 1995. Therefore, previous studies of Chinese privatization have been constrained either by a fairly short time period for time series analysis or by a small number of privatized SOEs for cross sectional analysis. Given these data limitations, it's impractical, if not impossible, for a researcher to even try to address selection bias problem. Utilizing a more recent dataset with longer time span and larger sample size of privatized SOEs, this paper should be able to ascertain the privatization effect more reliably than previous studies.

I attempt to control the selection bias with help of two econometric methods. One is a standard fixed effect (FE) model. The other is the so-called random growth (or trend) model (RG) (Wooldridge (2001)), which, besides controlling for the firm's unobserved time-invariant effect, also enables control of the firm-specific time trend or growth rate. OLS estimation is also conducted and the results are used as the benchmark for comparison purpose. Moreover, in order to evaluate the effectiveness of FE and RG models in eliminating the potential selection bias, the available data in the pre-privatization period is used to facilitate a specification test. This test is designed to see whether different pre-privatization periods generate significantly different effects on dependant variables. If the effects are significantly different due to different pre-privatization periods, the efforts to control the selection bias may not be effective. However, caution still needs to be exercised even when this test is implemented and shows that such concerns are unwarranted. In particular, it would be prudent not to consider the year of privatization due to the possible involvement of the "anticipatory effects".[3]

The focus of this paper is on examining the productive effects of privatization. MFP, unit cost and profitability are used as alternative measurements of firm's

[3] The "anticipatory effect" refers to the case that managers, in anticipation of the upcoming privatization, may either voluntarily increase or reduce production prior to privatization.

productive efficiency. They are defined as, respectively: the ratio of the real value of output to the combined input of labor and capital, the ratio of the material and operational cost to the total output and the ratio of the pre-tax profit to the assets. The results show that privatization has significantly positive impact on firm profitability and unit cost, but not on MFP. In addition to comparing performances between public and private firms in general, I also distinguish between two different types of privatized firms, namely domestic and foreign ones.[4]

Furthermore, this paper also analyzes the firms' performance dynamics before privatization (the pre-privatization period) and afterwards (the post-privatization period). Studying firms' performances in the pre-privatization period would help us to examine not only the existence but also the magnitude of the possible "anticipatory effect". Examining the performances of firms in the post-privatization period would help us to observe and understand the underlying dynamic path of the effects of privatization. For instance, how long does it take for privatization to impose significant effects on firms' performance, and if it does take place, whether this effect would dissipate or strengthen over time.

The reminder of this paper proceeds as follows. The next section reviews the theoretical and empirical literature of privatization and more specifically those related to the reform in China. Section 3 provides a brief historical background of Chinese privatization. Section 4 develops a simple theoretical model to compare the efficiency of private and public firms. The data set used in this paper is reported in Section 5. Section 6 describes the econometric methodologies used and the empirical results are discussed in Section 7. Section 8 summarizes and concludes.

2. Literature Review

Privatization has been widely used by governments in the world today to resolve impending failure or improve the performance of SOEs. Megginson and Netter (2001) and Djankov and Murrell (2002) provide comprehensive surveys on the current

[4] The domestic privatized firm is defined as a firm with more than 50 percent shares owned by domestic investors and correspondingly, the foreign privatized firm is defined as a firm with more than 50 percent shares owned by foreign investors. Consistent with this definition, we call a firm privatized if the private owned share in the firm exceeds 50 percent.

development of theoretical and empirical studies on privatization. Their work focuses more on the privatization that took place in the "transition economies".[5]

2.1 Theoretical Literature on Privatization

The economic theory of privatization could be categorized into two branches: The Public Interest Theory and the Principal-Agent Theory[6]. Public interest theories emphasize the effectiveness of SOEs to solve market failure caused by private firms in an unregulated oligopoly market. In contrast, Principal-Agent theories tend to address productive inefficiency of SOEs arising from asymmetric information.

Public Interest theories state that "Political intervention can help when markets fail, provided that the cure does not cost more than the disease".[7] In other words, a SOE may be superior to a private firm in improving social welfare by allocating resources more efficiently. Public ownership leads a SOE to take account of not only profit but also consumer surplus that a private firm is inclined to ignore. Therefore, in a natural monopoly market, private ownership would be biased toward setting a higher price. As a consequence, the gain of social welfare from cost reduction might be offset by the loss caused by market failure. Willner (2003) proposes a theoretical model which starts with a monopolistic public firm. This public firm maximizes a social welfare function. To compare the change in social welfare under private firm setting, he also considers the case that the public firm is replaced by an n-firm Cournot oligopoly. The comparison of the social welfare under different types of ownership shows that public ownership doesn't necessarily imply inefficiency. Actually, private ownership might lend to social welfare improvement over public ownership, only when the cost reduction it induces exceeds a certain threshold. In addition, Shapiro and Willig (1990) and Vickers and Yarrow (1988) also investigate the advantages of public ownership over private ownership.

The Principal-Agent theories, on the other hand, weight more on the SOE's internal inefficiency which is primarily caused by asymmetric information between the residual claimant and the manager of the firm. It argues that the principal-agent problem can't be sovled without transferring public ownership to private owners, as SOEs are

[5] formerly socialist countries or communist countries undertaking economic reforms
[6] See Vickers and Yarrow (1988)
[7] See Willner (2003), page 61.

unable to eliminate this internal inefficiency by themselves. On the contrary, with the introduction of certain regulations, the merits of private firms may persist and social welfare would be improved after privatization. Principal-Agent theories can be classified into two complementary approaches which differ by modeling who plays the role of the agent, a politician or a manager.

The Principal-Agent theory with a politician being the agent stresses the interference from the politician. SOE may be used to fulfill some personal objectives of that politician, for example, over-employment and election wins rather than social welfare maximization. Shleifer and Vishny (1994) and Boycko et al. (1996) develop a principal-agent model with three players: treasury, politician and manager. In their model, the treasury is concerned with profit and controls cash flow; the politician responds to voters' needs (more jobs available) and is able to help the SOE get subsidies; the manager maximizes profits and bribes politicians in the hope of receiving more subsidies from the state but carrying less burden of the cost of employment. Since the treasury doesn't have full information on the firm's profit, the politician can help the manager to conceal profit and ask for more subsidies in exchange for more employment. Thus, inefficiency of the SOE occurs because of asymmetric information and that the transfer of information is costly. Arin and Okten (2003) adopt similar model to examine the effects of privatization on firm's efficiency and disparities in technology adoption between public and private firms. They show that privatization reduces unit cost and that public firms prefer to maintain labor-intensive technology.

Differing from the politician theory, the Principal-Agent with manager theory considers a typical principal-agent problem which only involves state (principal) and manager (agent). In this type of model, the state is the residual claimant and determines the reward to be given to the manager. However, the state is poorly informed about the firm's performance. The manager, on the other hand, decides how hard he (or she) wants to work and has full knowledge of how well the firm is doing. Vickers and Yarrow (1988) first explore this scheme of the principal-agent problem. Bös and Peters (1991) add uncertainty and external control into the model. They find that the SOE would be competitive in terms of cost reduction only when the state of the economy is good.

With regard to theoretical analysis of Chinese privatization, there are very few studies in the literature. Zhang (1997) models the effects of reform on the performance of a SOE. He finds that shifting decision rights and residual claims from the state to the manager and hardening budget constraints can motive the manager to work hard and thus lead to a better performance. Finally, he concludes that further improvement of efficiency depends on privatization of the state enterprises.

2.2 Empirical Literature on Privatization

Regarding the effect of privatization in transition economies, Brown et al. (2006) presents a most comprehensive empirical analysis of the effects of privatization on the firms' productivity in four former communist countries, Russia, Ukraine, Romania and Hungary. They take into account the firm specific effect and firm specific time trend effect. They conclude that while the effects of privatization differ in magnitudes across these four nations, the results are robust in that privatization significantly increases productivity in all nations. Moreover, they also find that firms privatized by foreign investors achieve more sustainable growth in productivity than those privatized by domestic investors. This paper applies their methodologies to a Chinese dataset. Comparison of the results from this study and theirs may shed light on how the effects of privatization differ across countries adopting different transition strategies.

Turning to the empirical literature on privatization reform in China, Jefferson and Singh (1999) offer a comprehensive review of industrial SOEs' reform and privatization process in China. Cao (2000) provides a chronology of Chinese privatization since 1978. She also evaluates the consequences of the reform policies that China had adopted during the ownership transition of SOEs. Lin et al. (1998) discuss several issues associated with the managerial and ownership reform of China's SOEs. They conclude that without the easing of policy burdens and the removal of the soft budget constraint, there is little prospect for SOEs to achieve better performance. Dong and Putterman (2003) study the effect of hardening the budget constraint on the redundant labor problem in Chinese SOEs and find that unlike in developed economies[8],

[8]Specifically, Italy, as in their paper, they compare the reform of Italian SOEs' to that of Chinese SOEs.

hardening budget constraint in China only results in an increase in redundant labor if the firms' social burdens are not lessened.

Jefferson and Su (2005), Xu et al. (2005) and Song and Yao (2004) also study the effectiveness of Chinese privatization on firm performance. Using a large panel data of Chinese SOEs, Jefferson and Su (2005) find that a larger non-state share improves the performance of firms. However, the lack of share structure information in their data limits the reliability of their conclusions. Analyzing a national survey of the ownership reform of industrial SOEs in China, Xu et al. (2005) reach several interesting conclusions. In particular, they find that the success of reform positively correlates with reduced political control affording the firms more flexibility in labor deployment. Song and Yao (2004) use the same dataset as being used here to address the effects of privatization on firms' performance. Nonetheless, this study differs from theirs in two ways. First, in addition to controlling the firm specific effect as they did, this study also considers the firm specific time trend. Second, they did not distinguish the effects of privatization associated with different types of ownership whereas this study does.

Finally, Dong et al. (2002) study the impacts of share ownership reform on employee attitudes in China's privatized rural industries. Qi et al. (2000) address how changes in the shareholding structure can affect the performance of stock exchange listed companies by using firm data from the Chinese stock market.

3. Privatization in China

While the reform of SOEs in China began in 1978, considerable amount of privatization of small and medium size SOEs take hold until middle of 1990s. Unlike the massive privatization occurred in Eastern European countries, China initially took a comparatively slow and gradual approach to precede with privatization. The primary goal of the Chinese government to privatize some SOEs was to improve the efficiency of those firms rather than to reduce the influence of the government on firm operations. However, later on the privatization process had picked up speed gradually and apparently, the central government also showed strong support for privatization in certain industrial sectors and for certain size of firms. This reconstruction of SOEs' ownership is not only open to domestic private firms but also to qualified foreign firms allowing them to buy

certain percentage of the shares of SOEs. The trend of this privatization process is more obvious by viewing Table 2. In 1995, only 2.05 percent of firms in the sample had been privatized. However, in 2001, over 16 percent of firms had been privatized.

The Chinese privatization process can be viewed as unfolding in three stages. The first stage began in the early 1980s. When China started to experiment a new economic system in which a non-state sector was created to coexist with the state sector. The new non-state sector, though very small, indeed manifested the benefits of privatization, such as, quick response to the change of the market and more efficient operation. However, the success of the newly created privatized firms did not lead to broader scale of privatization in the economy. The second stage began in the early 1990s. The Chinese government launched a series of measures to reform the SOEs. This industrial reform tried to inject a system of managerial incentives to improve enterprise efficiency without altering the dominant ownership of the state in its enterprises. Li (1997) shows that by injecting incentives and decentralizing the economic decision-making process, the total factor productivity was improved dramatically. The third stage began in mid 1990s. When the Chinese government implemented a massive privatization program guided by a policy called “retain the large, release the small”, which is to retain only 300 or so largest SOEs and privatize the rest. However, even though the scale of this privatization is remarkable, Chinese government did not actually “release the small” but rather retain substantial influence on these privatized firms. Megginson and Netter (2001) and Lin (2000) point out that for most of the so-called “privatized” firms, the government is still the biggest share-holder, and that less than one-third of the shares of those firms are sold to private investors. In addition, the goal of stage three is not only to improve the efficiency of SOEs but also to develop the security market in China. Thus, the effect of this privatization effort is still unclear and is the interest of this study.

4. A Simple Theoretical Model

This section outlines the conceptual framework of the Principal-Agent problem. A theoretical model is developed to compare the efficiency of public and private firms from a principal-agent perspective. This model uses Bös and Peters (1991)’s principal-agent framework as the benchmark model and incorporates the SBC problem. However, unlike

the prior literature of SBC,[9] this model embeds SBC under the principal-agent framework and shows how it may serve as a tool to transfer information from the agent to the principal and how it can reduce the internal efficiency of a public firm. As the starting point, consider a price-setting public firm[10] which attempts to maximize profit and consumer surplus. Productive inefficiency in this public firm arises mainly due to asymmetric information between the owner (state) and the manager. Specifically, asymmetric information lead to government oversight, managerial negligence and soft budget constraint which, in turn, weaken the firm's performance. Next, assume that this price-setting public firm is privatized and becomes a price-setting private firm. With the transfer of ownership from the state to private owners, the principal (private owner) becomes more informed so that the privatized firm suffers less from the principal-agent problem. Consequently, it should be more efficient than the SOE.

There are two periods of time in the model. In the first period (*ex ante*), the principal and the agent sign the contract, the contents of which may differ across different ownerships. The second period (*ex post*) is the time that the agent reports firm's performance to the principal and collects rewards promised in the contract.

4.1 The Public Firm

The public principal observes the marginal cost and the manager's lobby effort for government subsidies *ex post*.[11] However, the public principal has no information on the exact state of the economy (α) but only the distribution of α. The marginal cost function *mc* can be written as

$$mc = k - \alpha(c + s) - e$$

where k is the fixed component of marginal cost; α is the state of economy, which is assumed to be uniformly distributed $\alpha \in [\underline{\alpha}, \overline{\alpha}]$; Marginal cost can be lowered through

[9] Maskin and Xu (2001) survey recent studies on SBC and conclude that SBC can be modeled as either a commitment problem or a moral hazard problem.

[10] Privatization of a price-setting firm is of major interest because "…the competition in the theoretical model leads to fully efficient production regardless of ownership." Bös and Peters (1991). Relaxing this assumption does not alter on our conclusions on firm's productive efficiency.

[11] Bös and Peters (1991) justify these assumptions, especially the observability of total costs. They argue that normally public firms would report their profits in the second period, particularly if the firm is losing money. Thus, with the knowledge of profit, price and quantity produced, the public principal can infer the total cost by subtracting profit from revenue (price times quantity produced).

three channels: external control *c* (i.e. external audit), government subsidies *s* and agent effort *e*. Among them, government subsidies s represents the SBC problem inherent in the public firm. The effectiveness of the first two cost reduction approaches depends on the state of the economy α. They are more effective if the economy is in a good state (i.e. $\alpha > \underline{\alpha}$) and the converse is true, otherwise. Thus, the total cost function can be shown as:

$$C = [k - \alpha(c + s) - e]q + t + h(c) \qquad (1)$$

where *t* is the reward to the manager for his (or her) effort in cost reduction and *h(c)* is the cost of exerting the external control *c*. Upon signing the contract, the manager agrees to transfer information of α to the principal in the second period: $\hat{\alpha}$. This $\hat{\alpha}$ does not necessarily reflect the real value of α because the manager knows that the principal will offer him (or her) the reward conditioning on the marginal cost, and that an identical value of marginal costs can be achieved by reporting either a true or false value of α. First, the agent may cheat on the principal by reporting a bad state of the economy ($\hat{\alpha} < \alpha$) for the first period and correspondingly reduce his (or her) effort in the first period. Second, the agent may also reduce his (or her) effort in the first period by asking for government subsidies in the second period. In order to convince the principal and secure subsidies, he (or she) needs to claim a bad state for the first period ($\hat{\alpha} < \alpha$) and incur some costs on his (or her) own (i.e. bribery, lobbying or bearing a bad reputation) in the second period. The public principal, on the other hand, will try to design a contract *ex ante* which would induce the agent to tell the truth *ex post*. In other words, the reward scheme is chosen in such a way that the manager's utility is maximized by announcing $\hat{\alpha} = \alpha$.

The manager's utility function takes the following form:

$$V(\alpha) = U(t(\alpha), e(\alpha), e^s(\alpha))$$

where $e^s(\alpha)$ is the effort that the manager may put forth to lobby the government (or politicians) for subsidies. It is always favorable for the manager to report the real value of α if the utility function is strictly increasing with respect to the real value of α.

$$V'(\alpha) = -U_2(c + s) > 0$$

where $V' = dV/d\alpha$ and the mathematical details are provided in Appendix (1). This equation[12] shows that if the state of the economy improves, the manager can reduce his (or her) effort on cost reduction and instead lobby for extra government subsidies by c+s units.

Also, the reward to the manager (S) can be expressed as an implicit function of lobbying effort (e^s): $S = K(e^s(\alpha))$. Its corresponding inverse function can be written as $e^s = L(s)$. Additionally, the manager will sign the contract *ex ante* only if he (or she) gets at least his (or her) reservation level of utility. For convenience, the manager's utility function $V = U(t, e, L(s))$ is inverted as: $e = E(t, V, L)$.[13]

Thus, the optimization problem of the principal can be shown as:

$$\max \int_{\underline{\alpha}}^{\overline{\alpha}} \{\lambda M(\alpha) + (1-\lambda)\pi(\alpha)\} d\alpha$$

subject to

$$V'(\alpha) = -U_2(t(\alpha), E(V(\alpha), t(\alpha), L(s(\alpha))) \cdot (c(\alpha) + s(\alpha)),$$

$$V(\underline{\alpha}) = \overline{U}. \qquad (2)$$

where *p*, *c*, *t* and *s* are control variables and *V* is state variable. $M(\alpha)$ is the consumer surplus. λ is the weight that the government would put on the consumer surplus and $0 < \lambda < 1$. $\pi(\alpha)$ is the profit level of the public firm. To solve the corresponding Hamiltonian Equation, the first order conditions become:

$$H_p = 0; H_c = 0; H_t = 0; H_s = 0; H_v = -\mu'.$$

The transversality condition is $\mu(\overline{\alpha}) = 0$ and it can also be proved that $\mu(\alpha) < 0$ for $\alpha < \overline{\alpha}$.[14]

4.1.1 External Control

[12] This equation is also called "incentive compatibility constraint" in the principal-agent problem. See Varian (1992) pp.442.

[13] According to the "Implicit-Function" Theorem (Barro (2004)), we can obtain

$$E_t = -\frac{U_1}{U_2}; E_l = -\frac{U_3}{U_2}; E_V = \frac{1}{U_2}.$$

[14] The detailed proof is given in Appendix 2.

With the assistance of $H_c = 0$, a direct differentiation of the total cost function *C* with respect to *c* can be signed:

$$C_c \begin{cases} < 0 & for \quad \alpha < \overline{\alpha} \\ = 0 & for \quad \alpha = \overline{\alpha} \end{cases} \qquad (3)$$

Equation (3) shows that further external control from the government would reduce costs for all $\alpha < \overline{\alpha}$. Therefore, the government would not exert efficient control unless the economy is in its best state ($\alpha = \overline{\alpha}$). Moreover, Equation (3) implies that higher external control induces higher cost reduction. Hence, the higher the external control, the stronger incentive the manager has to shirk. As a result, higher external control more likely leads to less internal efficiency in the public firm.

4.1.2 Manager's Effort and Reward

A similar conclusion can be reached for the manager as well. $H_t = 0$ implies that the expression of a direct differentiation of the total cost function *C* with respect to effort *e* becomes:

$$C_e \begin{cases} < 0 & for \quad \alpha < \overline{\alpha} \\ = 0 & for \quad \alpha = \overline{\alpha} \end{cases} \qquad (4)$$

Equation (4) shows that an increase in the effort would reduce cost as long as $\alpha < \overline{\alpha}$. This result implies that the reward is not enough to induce the manager to put forth the most efficient effort when $\alpha < \overline{\alpha}$. Only at $\alpha = \overline{\alpha}$, the effort level is chosen efficiently by the manager.

4.1.3 Government Subsidy

To see how the government subsidies influence the manager's effort to reduce cost, examining $H_s = 0$ and a direct differentiation of the total cost function *C* with respect to subsidy *s* yields:

$$C_s \begin{cases} < 0 & for \quad \alpha < \overline{\alpha} \\ = 0 & for \quad \alpha = \overline{\alpha} \end{cases} \qquad (5)$$

Equation (5) indicates that the cost of the public firm decreases if the government's subsidies increase *ex post* as $\alpha < \overline{\alpha}$. In other words, the government's subsidy level is

always below the efficient level unless $\alpha = \overline{\alpha}$. The explanation is that, similar to the case of external control, the government is unwilling to provide adequate subsidies to the public firm for fear of the possibility that the manager may cheat. As a result, the greater the subsidies the manager expects to receive *ex post*, the stronger the incentive that the manager has to cheat *ex ante*.

4.2 The Privatized Firm

Now, assume that the public firm is sold to a private owner. Similar to the public firm case, the owner of the private firm can not observe the manager's effort directly but has *ex ante* knowledge about the current state of the economy α . Thus, the principal can draw a correct conclusion about parameter α from other sources, in spite of the manager's incentive to lie. By observing the marginal cost *ex post*, the principal of the private firm is able to infer the effort level of the manager. This is more so since the private firm has no access to government subsidies and thus *mc* is simply:

$$mc = K - \alpha c - e$$

Therefore, given his (or her) ability to monitor, the private firm's owner can instruct the manager to adopt an optimal effort and price level by offering a contract *ex ante*. Still, the contract has to meet the manager's participation constraint, because otherwise, the manager would just choose to quit. The maximization of a privatized firm can thus be presented as:

$$\max_{p,e,t,c} \quad pq(p) - \left[k - \alpha c - e\right]q(p) - t - h(c)$$

subject to

$$U(t,e) \geq \overline{U}$$

The first order conditions yield

$$-\frac{U_2}{U_1} = \frac{h'}{\alpha} \qquad (6)$$

Equation (6) illustrates that the manager's marginal rate of substitution between the reward and the effort equals to the marginal rate of transformation between control and effort in a privatized firm. Therefore, in a privatized firm, the manager will always

choose the optimal effort level. Recall that in the public firm, the efficient effort level is only chosen when $\alpha = \overline{\alpha}$.

4.3 Comparative Statics

The comparative static analysis here explores how the reward level is determined according to changes in α in the public and privatized firms respectively. In the privatized firm, the differentiation of the manager's utility with respect to the state of the economy α generates

$$t' = -\frac{U_2}{U_1} e' \qquad (7)$$

Thus, the transformation of the manager's effort to remuneration depends on the marginal substitution rate between the effort and the reward of the manager. However, in the public firm, the manager is rewarded for not only the effort he (or she) invests but also how much information he (or she) wants to disclose. Consider a differentiation of the manager's utility with respect to α and the "incentive compatibility constraint":

$$V' = U_1 t' + U_2 e' + U_3 e^{s'} = -U_2 (c + s) \qquad (8)$$

A simple manipulation of Equation (8) yields

$$t' = -\frac{U_2}{U_1}(c + s + e') - \frac{U_3}{U_1} e^{s'} \qquad (9)$$

Examining Equation (7) and (9) closely reveals how the reward schemes differ in different ownerships. In the privatized firm case, Equation (7) shows that the reward increases if the manager chooses a higher effort level. In contrast, the reward of the public firm's manager contains two parts: information and effort. In Equation (9), if α increases, the value of information about α increases by $(c + s)$. The shadow price of this information is represented by $-\frac{U_2}{U_1}$. Moreover, the government can also extract additional information on α from the manager's lobbying effort for subsidies. If $e^{s'} > 0$ which implies the manager increases lobby effort *ex post*, the government may reach a conclusion that the state of the economy is bad by observing the manager's increased lobby effort. As a result, the government may increase the manager's salary by

$-\frac{U_3}{U_1} e^{s'}$ to reward the extra information that the manager is willing to transfer. Thus, no matter which sign e' takes, the manager's reward increases in α as long as $-\frac{U_2}{U_1}(c+s)-\frac{U_3}{U_1}e^{s'} > -\frac{U_2}{U_1}|e'|$. This shows that the manager's reward would be increased if the government values the information of α more than the manager's effort. If $e^{s'} < 0$, the government does not know if the manager's reduced lobby effort is caused by more invested effort on cost reduction or simply a better state of the economy. Thus, the reward to the manager may increase if the government values more information obtained from the external control and the subsidies, $-\frac{U_2}{U_1}(c+s) > -\frac{U_3}{U_1}e^{s'} - \frac{U_2}{U_1}|e'|$. Nonetheless, the comparative analysis implies that due to asymmetric information, the principal of the public firm is willing to reward the manager not only for his (or her) effort to reduce cost but also for his (or her) efforts to transfer information. Therefore, the manager of the public firm always engages in less efficient effort than his (or her) counterpart in the privatized firm.

4.4 Theoretical Implication

Several conclusions can be drawn from the preceding theoretical model:

1. The government's external control over a public firm tends to be lower than the efficient level whereas the control by the private owners is efficient. The higher the external control is, the lower the effort that the manager may choose.
2. The manager of a public firm tends to commit to less effort than the efficient level, whereas the manager in a private firm would choose the efficient effort level.
3. Government's subsidies to a public firm tend to be lower than efficient. The more government's subsidies are, the lower the effort that the manager may choose.

These results form the following general hypothesis to be tested in the empirical sections of this paper:

***Hypothesis*:** Privatized firms perform better than the state-owned enterprises (SOEs) in productive efficiency.

5. Data Description

This paper uses the data from Song and Yao (2004), which is based on a survey conducted by International Finance Corporation and National Bureau of Statistics in 2002. This survey includes 863 firms in 11 cities with information on accounting, employment and the corporation governance.[15] One measure of productive efficiency is MFP which is constructed using information of the annual total value of output, capital and current on-duty employees.[16] Another measure of productive efficiency is the unit cost, which is designed to capture the effort exerted by the managers on cost reduction. It is reflected by the percentage of the managerial and operational cost over the total output. The third measure of productive efficiency is profitability, which is defined as the return to assets, that is, the percentage of the pre-tax profit over the total value of assets. Table 1 displays the descriptive statistics of major variables used in this study over the period of 1995 to 2001. A clear declining trend in labor usage can be observed over years and this may be attributable to the reform efforts. Also notable is a dramatic improvement in output growth and capital investment throughout the sample over the same period. However, changes in unit cost are unclear and profitability stays rather constantly. In addition, the data also contain the industry classification for each firm.[17]

< Insert Table 1 here >

Construction of the ownership variables follows the standard procedure in the literature on privatization in the transition economies (Brown et al (2006) and Song and Yao (2004) etc.), which defines a firm as privately owned if the shares owned by the state are less than 50 percent, otherwise a firm is considered as a SOE. Furthermore, privatized firms are divided into two groups: domestically owned and foreign owned firms. To control for the potential selection bias, the information about the timing of the ownership

[15] These 11 cities are Harbin, Fushun, Tangshan, Xining, Lanzhou, Chengdu, Guiyang, Weifang, Zhenjiang, Huangshi and Henyang.
[16] For detailed of the variable descriptions, see Table 2. The data set is a panel of 219 firms spanning over 7 years (1995-2001).
[17] In this study, we consider 10 industries. The criteria used to categorize these 10 industries resembles that used by Brown et al (2006), such as, mining and quarrying, food processing, textile industry, timber related industry, petroleum industry, chemical industry, metal product industry, machinery manufacture industry, electric equipment industry, production and supply of electric power industry, and others.

change is also needed. While the data allows determination of the year that privatization takes place, it does not provide information about the specific date of the occurrence, assumption is made that a privatization would start at the beginning of the privatization year and be completed at the end of that year. [18] The summary statistics of the ownership changes are given in Table 2. As mentioned before, this table shows that the privatization process merely started in China just before 1995 and began to pick up after 1995. However, up till recently, foreign investors have still been strictly limited to play any significant roles in the process.

< Insert Table 2 here >

6. Empirical Implementation

Following Brown et al (2006), this study tests the hypothesis derived from the theoretical section by employing three econometric models in the wake of possible selection bias problem. First, an OLS model is considered as the benchmark estimation. Second, a fixed effect model is estimated. Third, a RG model is exploited to control for the firm specific time trend or growth rate. Brown et al (2006) contend that using RG model has the merit that "applied to the privatization context, these models control for not only fixed differences among firms but also differing trend productivity growth rates that may affect the probability of privatization." This study also examines the dynamics of privatization effect before and after the occurrence of privatization. Finally, a so-called "pre-program" specification test (Heckman and Hotz (1989)) is applied to evaluate the effectiveness of these models in controlling for selection bias.

The general form of the models can be written as:

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + w_t c_i + \theta_{it}\delta + u_{it} \qquad (10)$$

where i indexes firms from 1 to *N*, t indexes time periods from 1 to *T* (years) and j indexes industry from1 to *J*.[19] y_{it} is a performance measure. It may take the form of

[18] The actual transfer of the share of privatized firms may take months or years to complete. (Megginson and Netter (2001)).

[19] In our regression, N equals to 219 because only firms with more than two-year observations can be used. T equals to 7 because our data cover the period of 1995 to 2001. J equals to 10 because we have suppressed the industry categories from 55 to 10. These 10 industry categories are chosen based on the number of observations in each industry.

ln(output), unit cost and profitability; k_{it} is ln(total asset); l_{it} is ln(on-duty employment); I_j is a $J \times 1$ vector of industry dummies; α_j is a $1 \times J$ vector of coefficients associated with the product of total asset and industry dummies; β_j is a $1 \times J$ vector of coefficients associated with the product of on-duty employment and industry dummies; D_{jt} is a $1 \times JT$ vector of industry-year interaction dummies; γ_{jt} is the $JT \times 1$ vector of coefficients associated with D_{jt}; and u_{it} is an idiosyncratic error term. The variance-covariances of the error term allow within-firm serial correlation and cross-firm heteroskedasticity. Following the clustering method of Arellano (1987), the consistent estimators can be derived. The rest of variables in Equation (10) vary across different specifications: w_t is a vector of firm-specific intercepts and aggregate time variables, c_i is the vector of individual-specific slopes coefficients associated with w_t, θ_{it} is the vector of ownership indicator, and δ, the coefficient associated with θ_{it} is the focus of interests in this study.

6.1 Ordinary Least Squares (OLS) model

In the OLS benchmark estimation, the general model Equation (10) takes the following form.

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + \theta_{it}\delta + u_{it} \qquad (11)$$

The focus of interest in this regression lies on the value of δ, the coefficient of the ownership indicator, which would tell how sampled firms' productivity changed following privatization. θ_{it}=1 if firm i has been privatized at time t and zero otherwise (***specification 1***). Moreover, to study the different privatization effects across different types of privatized entities, θ_{it} is replaced with a vector of ($Domestic_{it-1}$, $Foreign_{it-1}$), and accordingly, the associated coefficient δ also changes to a vector of (δ_d , δ_f) (***specification 2***). The regression results of these two specifications are reported in Table 4 and Table 5 respectively.

6.2 Fixed Effect (FE) Model

If firms select themselves into privatization, the OLS estimation generates bias estimators. One way to address the selection bias problem is to estimate the standard fixed effect model (FE). To do so, the Equation (10) is modified as follows.

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + c_i + \theta_{it}\delta + u_{it} \qquad (12)$$

In this FE specification, w_t is assumed to be equal to one. Thus, c_i stands for the unobserved firm specific effect. The FE model is estimated in two steps (Wooldridge (2001)). First, each variable in the regression is demeaned by its within-group sample mean. Next, the within estimator is obtained by estimating the model with the demeaned variables.[20] Similar to the OLS estimation, in addition to considering the case of privatized firms in general (θ_{it} =1 if firm i was privatized at time t and zero otherwise) (***specification 1***), the ownership indicator θ_{it} is also disaggregated into domestically and foreign owned private firms in FE estimation (***specification 2***). The estimation results can be found in Table 4 and Table 5.

6.3 Random Growth (or Trend) (RG) Model

The standard fixed effect estimation imposes a strong assumption: there is only one unobserved fixed effect that has the same impact on productive efficiency in all time periods. The RG model relaxes such an assumption and controls the firm-specific growth rate or time trend in addition to the typical firm-specific time-invariant effect.

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + w_t c_i + \theta_{it}\delta + u_{it} \qquad (13)$$

Hence w_t is assumed to be a vector of (1, t) instead of just one in FE estimation (t takes value from 1 to T). As a result, the firm-specific effect can be disaggregated into a vector of (c_{1i} , c_{2i}), where c_{1i} stands for the unobserved time-invariant firm-specific characteristic whereas c_{2i} is the average firm-specific growth rate or time trend over period 1 to T. This RG model can be estimated in two steps. First, each variable for each firm is detrended by regressing each variable on a constant and time t (t=1, 2, 3…7).[21] Second, the model is estimated with the detrended data. Similar to the fixed effect model, the standard errors also need to be adjusted for the loss of degree of freedom in the

[20] The standard errors in the second step of estimation are adjusted according to the degree of freedom of (NT-N-K).
[21] t takes 1, 2, … 7 because there are seven years in our sample (1995-2001).

second step.[22] The regression results of this RG model are reported in Table 4 (***specification 1***) and in Table 5 when the different ownership structures of the privatized entities are considered (***specification 2***).

6.4 The dynamics of privatization effect

Equation (14) is used to examine the dynamics of privatization effects:

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + w_t c_i + \theta_{it}\delta + u_{it} \qquad (14)$$

Equation (14) differ from Equation (13) in that the ownership indicator θ_{it} is redefined as dummy variables showing the years before and after privatization, i.e. θ_{it} is designated as a vector of ($Privatized_{itp}$) (p=-5, -4, -3, -2, -1, 0, 1, 2) (***specification 1***). p is an index that shows the numbers of years before and after privatization.[23] Correspondingly, the coefficients associated with θ_{it} become δ_{itp}. Due to the limited length of time series in the sample, only 5 years before privatization and 2 years after privatization are considered here. This, however, may be a reasonable constraint because very few Chinese SOEs underwent privatization before 1995 and most privatizations happened after 2000 as revealed in the sample. Additionally, $Privatized_{itp}$ is also divided into two subgroups, $Domestic_{itd}$ and $Foreign_{itf}$, where d=-5, -4, -3, -2, -1, 0, 1, 2 and f=-3, -2, -1, 0, 1, 2 (***specification 2***). The estimation results from using OLS, FE and RG models with ***specification 1*** and ***2*** are shown in Table 7, 8 and 9.

6.5 A simple selection bias specification test

This study conducts a specification test to evaluate the effectiveness and reliability of the OLS, FE and RG models in controlling for selection bias and capturing the privatization effect. This test is essentially a "pre-program" test designed by Brown et al. (2006), which is used by Heckman and Hotz (1989) in program evaluation research. The basic idea of this test is to compare the effect of pre-privatization in the treatment and controlled groups in the same pre-treatment period. The only differences across these two groups should be solely caused by the treatment itself if no selection bias occurs. This test amounts to a typical joint F-test of the statistical significance of each pre-

[22] In this case, the degree of freedom used to adjust the second step standard error is (NT-2N-K).
[23] If p<0, the firm is in the pre-privatization period; p=0 indexes the year in which privatization takes place; p>0 stands for the years after privatization.

privatization effect. The F-test is designed as: $\delta_{it-5} = \delta_{it-4} = \delta_{it-3} = \delta_{it-2} = 0$ for all privatized and domestically owned privatized firms, $\delta_{it-3} = \delta_{it-2} = 0$ for foreign owned privatized firms due to the limitation of data. If these pre-privatization effects are not significantly different from zero, I can claim that the selection bias has been controlled successfully. Therefore, among the OLS, FE and RG models, whichever that passes the F-test is one considered as to be an effective model to control for selection bias. Similar tests are conducted to domestic and foreign investors separately, where the F-tests can be written as $\delta_{it-5d} = \delta_{it-4d} = \delta_{it-3d} = \delta_{it-2d} = 0$ and $\delta_{it-3f} = \delta_{it-2f} = 0$.[24] The results of these F-tests are reported in Table 6. Note that the year before privatization is not taken into account because the possible "anticipatory effect" may contaminate this specification test results.

6.6 Initial diagnostic estimations

To provide more information on the possible selection bias in the sample, initial diagnostic estimations were performed by running OLS on three specifications in Equation (10). Here, variable w_t is assumed to be zero, and θ_{it} is a dummy for the years before privatization.[25] Similar diagnostic estimations were also performed in the cases that θ_{it} is divided into (Pre-Demostic$_{it}$, Pre-Foreign$_{it}$). As a result, Equation (10) is revised to study the output size differences between firms never privatized and those privatized later.

$$y_{it} = D_{jt}\gamma_{jt} + \theta_{it}\delta + u_{it} \qquad (15)$$

The differences in multifactor productivity (MFP) can then be estimated by replacing Equation (10) with

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + \theta_{it}\delta + u_{it} \qquad (16)$$

---

[24] $\delta_{it-5p}, \delta_{it-4p}, \delta_{it-3p}, \delta_{it-2p}$ equal to one for firm i in its pth year before privatization, zero otherwise. $\delta_{it-5d}, \delta_{it-4d}, \delta_{it-3d}, \delta_{it-2d}$ equal to one for firm i which was privatized by domestic investors in its pth year before privatization, zero otherwise. $\delta_{it-3f}, \delta_{it-2f}$ equal to one for firm i which was privatized by foreign investors in its pth year before privatization, zero otherwise.

[25] For instance, if firm i was privatized in year 2001, then $\theta_{i1995} = 1, \theta_{i1996} = 1, ..., \theta_{i2000} = 1, \theta_{i2001} = 0$; if firm i has never been privatized, $\theta_{i1995} = 1, \theta_{i1996} = 1, ..., \theta_{i2001} = 1$.

The study on the differences in the multifactor productivity (MFP) growth during the pre-privatization period can be done by interacting the time trend with the ownership dummy θ_{it}.

$$y_{it} = k_{it}\alpha_j I_j + l_{it}\beta_j I_j + D_{jt}\gamma_{jt} + T\theta_{it}\delta + u_{it} \qquad (17)$$

where T is an $1\times NT$ vector of time trend. It is normalized to be zero on the year that privatization takes place. The regression results are reported in Table 3.

7. Empirical Results

7.1 Initial Diagnostic Estimations

Table 3 reports the estimations from Equation (15) to Equation (17). These results measure the different pre-privatization characteristics between firms ever privatized and never privatized. This comparison reveals, to what extent, the selection bias problem is present in the sample. The results show that firms ever privatized and never privatized do exhibit different characteristics in the pre-privatization periods. In the output specification (Equation (15)), privatized firms are 56 percent larger in output than those never privatized. For those privatized by domestic investors, the size of output is 53 percent larger than never privatized SOEs. Moreover, the foreign privatized firms have output 155 percent significantly larger than never privatized SOEs. Similarly, the MFP specification (Equation (16)) shows that the productivity level of those privatized firms is 37 percent larger than those never privatized. Among them, firms privatized by domestic investors are 36 percent lager than never privatized SOEs in the pre-privatization periods. However, firms privatized by the foreign investors are 56 percent more productive than never privatized firms. In contrast, the MFP growth specification (Equation (17)) indicates that the privatized firms' MFP growth rates are 14 percent lower than those never privatized. Moreover, the domestically and foreign owned privatized firms exhibit 14 percent and 19 percent lower MFP growth rate, respectively. These findings, to some extent, reflect the guideline that the Chinese government had used in selling SOEs to private investors. Firms with higher productivity level and lower productivity growth rate are more likely to be chosen for privatization. In addition, firms privatized by foreign

investors generally show higher productivity level but lower productivity growth rate than those privatized by domestic investors.

< Insert Table 3 here >

7.2 Estimated Effects of Privatization

Tables 4 and 5 are where the main interests of the study lie. Table 4 reports the average effects of privatization on three performance variables, MFP, unit cost and profitability. These results are obtained from Equations (11)-(13)'s ***specification (1)***. It appears that the effects of privatization on MFP are all positive and significant except in the case of FE model where the effect is positive but not significant. Privatization also shows significantly negative impact on cost reduction in all models except the FE model. Similar to MFP, privatization exhibits significantly positive impact on firm's profitability in all models except the FE model. Thus, except the FE model, these results are consistent with and support the hypothesis derived earlier that privatization improves efficiency.

< Insert Table 4 here >

Table 5 shows the estimation results when the privatized firms are divided into domestic and foreign owned ones in Equation (11)-(13)'s ***specification (2)***. The privatization effects of the domestic ownership on MFP are positive and significant in all models, with the exception of the FE model. Compared to the state-owned, the OLS and RG models show that firms' productivities increased by 44 and 41 percent respectively if privatized by domestic owners. However, the FE model gives much smaller positive and insignificant impact of privatization by the domestic ownership. In contrast, the foreign ownership effects are positive and significant in all models with productive-enhancing effects ranging from 75 to 99 percent. Similar results are obtained when the efficiency indicator is changed from MFP to unit cost. Both the domestic and foreign ownerships contribute significantly to cost reduction in all models but the FE model. Firms privatized by the domestic owners have lower unit cost by an average of 137 to 164 percent.

Decreased unit costs also occur in the foreign privatized firms but with smaller magnitudes. Considering profitability, a similar pattern as the MFP results can be observed. The domestic ownership generates significantly positive impacts in all three models but not significant in the FE model. The foreign ownership exhibits positive and significant effects in all models with magnitudes ranging from 3 to 6 percent. Finally, an F-test is conducted to determine whether or not the effects of the domestic and foreign privatizations on firms' efficiency differ from each other. The F-test shows that they are indeed significantly different with the only exception being the FE model when unit cost is the efficiency indicator.

< Insert Table 5 here >

In sum, the estimation results support the hypothesis from the theoretical model. Privatization considerably improves firms' productive efficiency. In particular, the efforts devoted to cost reduction are found to be most prominent. This may be attributed to the fact that privatization transfers SOEs from multiple-target endeavor to simple task of cost reduction and profit maximization. Moreover, compared to the foreign ownership, the domestic privatization achieves smaller increase in the firms' MFP and profitability but seems to be more effective on cost reduction.

7.3 Dynamics of privatization effects

The dynamics of privatization of this study show how the performance of firms privatized to different investors evolve during years before privatization and years thereafter. Tables 7-9 report the dynamics of privatization effects on three performance variables. Table 7 corresponds to Equation (14) ***specification (1)*** and displays the estimated privatization coefficients of θ_{itp} where p=-5, -4, -3, -2, -1, 0, 1, 2. It compares the effects of privatization in the pre and post-privatization periods. Tables 8 and 9 correspond to Equation (14) ***specification (2)*** and display the estimated effects of privatization for firms owned by the domestic and foreign investors respectively, where θ_{it} =(Domestic$_{itp,}$ Foreign$_{itp}$), and for Domestic p= -5, -4, -3, -2, -1, 0, 1, 2; for Foreign p=-3, -2, -1, 0, 1, 2.

< Insert Tables 7, 8 and 9 here >

For ease of comparison, the estimated coefficients from the OLS, FE and RG models are also plotted and shown in Figures 1, 2 and 3.[26] The horizontal axis of these figures displays the lapse of time before and after the privatization with zero indicating the year that privatization took place. The vertical axis indicates the estimated coefficients of privatization overall θ_{itp} , domestic θ_{itpd} and foreign θ_{itpf} dummies, respectively. Regarding the privatization effect on MFP, there are no discernable changes in MFP for all privatized and domestic privatized firms in the pre and post-privatization periods. However, the time profile of the privatization effects for the firms privatized by foreign investors tells a different story. A dramatic increase in MFP can be observed for the foreign privatized firms in the pre-privatization periods. In the years after privatization, a slight decline appears in the OLS and RG models whereas a continuing growth is shown in the FE model.

Turning to the privatization effect on unit cost, the results are mixed. In the OLS and FE models, the unit cost shows steady decline in the pre-privatization periods for all privatized entities (including overall, domestic and foreign privatized firms). Like been shown above in the MFP case, the foreign ownership dominates domestic ownership in cost reduction. However, in the post-privatization periods, while cost continues to decline in the domestic privatized firms, it takes a U-turn and unit cost starts to rise in the foreign owned firms. In the RG model, the privatization does not exhibit significant movement throughout the entire observation period as whole.

The results of the privatization effect on profitability from estimating all three models are consistent with those in the above MFP case. Privatization does not appear to stimulate a significant increase in profitability in the pre and post-privatization periods for privatized firms in general and for the domestically owned privatized firms. In contrast, firms privatized by the foreign investors already show a modest increase in profitability in the pre-privatization period and enjoy a significant increase in the first

[26] Figures 1, 2 and 3 plot the estimated ownership effects based on the estimated coefficients reported in Tables 7, 8 and 9.

year of privatization. This suggests that the "anticipatory effect" does exist among firms privatized by foreign investors.

< Insert Figure 1, 2 and 3 here >

7.4 Pre-program specification test

Before drawing definitive conclusions on the effect of privatization, I need to evaluate the three econometric models, namely OLS, FE and RG models, in terms of the extent to which each model can control for the selection bias problem in the sample. As mentioned earlier, a "pre-program" specification test developed by Heckman and Hotz (1989) [27]is used to evaluate the effectiveness and reliability of these three models. This is a joint F-test of whether or not firms' pre-privatization performance is significant different from zero in the wake of privatization (F-statistics and the P-values are shown in Table 6). The null hypotheses are: $\hat{\delta}_{-5p} = \hat{\delta}_{-4p} = \hat{\delta}_{-3p} = \hat{\delta}_{-2p} = 0$, $\hat{\delta}_{-5p} = \hat{\delta}_{-4d} = \hat{\delta}_{-3d} = \hat{\delta}_{-2d} = 0$ and $\hat{\delta}_{-3f} = \hat{\delta}_{-2f} = 0$ [28](Coefficients retained from Equation (14)). The F-test shows mixed results. The fixed effect model appears to be best at controlling for the selection bias problem for MFP estimations. For unit cost, the OLS and random trend models perform equally well. With respect to profitability, no selection bias is found in the private and domestic cases. However, none of the three econometric models can effectively treat the potential selection bias problem in the foreign privatized case.

< Insert Table 6 here >

7.5 Interpretation

Based on the results from the above pre-program specification test, I will draw from the estimation results of the FE model to discuss the effects of privatization on MFP and the those of RG model to examine the privatization effects on firms' unit cost and profitability changes.

[27] Brown et al. (2006) first applied this test in the privatization study.
[28] We drop the coefficient of the year immediately before privatization in order to avoid disturbances from the "anticipatory effect".

The FE model suggests that privatization does not have significant effect on firms' productivity although the positive sign reckons our theoretical speculations. This finding is consistent with Song and Yao (2004) and Dong et al. (2006) since they also find that privatization shows no significant impact on firms' productivity in China. One plausible explanation for this finding is that the private owners may be more focused on cost reduction and profitability than on productivity. This finding could also be caused by the ongoing Chinese SOE reform, which promotes a more efficient management system resulting in productivity improvements in the public firms. Along the same time, the quantity of more autonomy and the enlarging of incentives to the manager, as well as the hardening of the budget constraint, may all help improve SOEs' productivity. On the other hand, firms privatized by the foreign investors indeed show, on average, 76 percent increase in productivity. Brown et al. (2006) document the same result in their study of four Eastern European countries' privatization experience.

Unlike the case of productivity, the RG model confirms the significant and positive impact of privatization on cost reduction. This finding corroborates our theoretical predictions. Overall, unit cost declines by 132 percent in the privatized firms. Furthermore, firms privatized by domestic investors seem to devote more effort on cost reduction than those privatized by foreign investors. The average cost was reduced by 137 percent in the domestically controlled firms, whereas only 80 percent decrease in cost is observed from the foreign controlled firms.

The results from the RG model show that privatization has significantly positive impacts on firms' profitability. The 3 percent increase in profitability on average among the privatized firms implies that privatization induces concentrations more on profit maximization instead of social welfare. The relatively modest increase in profitability is also consistent with China's privatization policy. As Chen et al. (2006) argue that since the government tends to retain considerable interference and control over the previous SOEs following privatization, these privatized firms may not achieve significant improvements in profitability. (e.g. the government may impose on the privatized firm to retain excessive employment). By the same reasoning, it is understandable that the domestic privatized firms' profitability increase by a mere 2 percent. However, since none of the three models (OLS, FE and RG) can address the potential selection bias

problem with satisfaction in the foreign privatized case, I can not determine definitively the effects of the foreign ownership on firms' profitability. The only concrete finding is that the presence of the "anticipatory effect" in this case is prominent. This implies that, expecting the firm to be privatized by foreign investors, the managerial team has incentive to increase profitability as the date of privatization approaches.

8. Summary and Conclusions

This paper studies the effects of privatization on firms' productive efficiency in China. First, a principal-agent model is developed to describe the various aspects of the Chinese economy that could lead to different performances between the SOEs and privatized firms. The theoretical modeling incorporates the Soft Budget Constraint (SBC) problem into a principal-agent framework. The model demonstrates that the lack of an effective monitoring system in a public firm leads to poor performance compared to a privatized firm.

The subsequent empirical study uses a panel dataset of the manufacturing firms in China. The multifactor productivity (MFP), unit cost and profitability are adopted to measure the productive efficiency of firms. Three econometric specifications are used to estimate the privatization effects on firms' productive efficiency, namely, the OLS, standard fixed effect (FE) and random growth (or trend) (RG) models. Among the three models, the standard FE model turns out to control for the selection bias problem in the case of MFP. On the other hand, the OLS and RG models can better eliminate selection bias in the unit cost case. All three models perform equally well in dealing with selection bias when profitability is the efficiency indicator.

Several conclusions can be drawn from the empirical findings. First, privatization has no significant effect on manufacturing productivity in China. Second, a significant cost reduction can be observed after privatization took place. Further study of the dynamics of privatization effects reveals that this cost reduction trend is persistent over two years after privatization. Third, privatization indeed boosts firms' profitability. However, rising profitability is not significant in the post-privatization periods.

Furthermore, after dividing privatized firms into domestically and foreign owned, I find that the effects of privatization vary across different ownership structures. Foreign

ownership generates significantly positive impact on firms' productivity but not the domestic ownership. On the other hand, the domestic ownership induces larger cost reduction than the case of foreign ownership. Finally, the domestic privatized firms' profitability is improved significantly following privatization, whereas the effect of foreign ownership on profitability is ambiguous.

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Appendix 1. Incentive-Compatibility Constraint

In order to induce the manager to report the real value of the state of economy (α), the principal needs to design the optimal incentive scheme by minimizing the following equation.

$$D(\hat{\alpha}) = V(\alpha) - U(t(\hat{\alpha}), \tilde{e}(\alpha, \hat{\alpha}), e^s(\alpha, \hat{\alpha})) \qquad \text{A (1.1)}$$

Since $\tilde{e}(\alpha, \hat{\alpha}) = e(\hat{\alpha}) + (\hat{\alpha} - \alpha)(c(\hat{\alpha}) + s(\hat{\alpha}))$ and $e^s(\alpha, \hat{\alpha}) = L(s(\hat{\alpha}))$, Equation A (1.1) becomes

$$D(\hat{\alpha}) = V(\alpha) - U(t(\hat{\alpha}), e(\hat{\alpha}) + (\hat{\alpha} - \alpha)(c(\hat{\alpha}) + s(\hat{\alpha})), L(s(\hat{\alpha}))) \qquad \text{A (1.2)}$$

Minimizing Equation A (1.2) with respect to $\hat{\alpha}$ yields the first order condition:

$$D'(\hat{\alpha}) = -U_1 t' - U_2(e' + c + s + (\hat{\alpha} - \alpha)(c' + s')) - U_3 L' s' = 0 \qquad \text{A (1.3)}$$

Let $\hat{\alpha} = \alpha$, then Equation A (1.3) becomes

$$D'(\hat{\alpha}) = -U_1 t' - U_2(e' + c + s) - U_3 L' s' = 0 \qquad \text{A (1.4)}$$

Recall the direct differentiation of the manager's utility function with respect to α

$$V'(\alpha) = U_1 t' + U_2 e' + U_3 L' s' \qquad \text{A (1.5)}$$

Substitute Equation A (1.5) into Equation A (1.4), I have the Incentive-Compatibility Constraint.

$$V'(\alpha) = -U_2(c + s)$$

Appendix 2. Sufficient Conditions for Minimization

The first order condition is (from Appendix 1):

$$D'(\hat{\alpha}) = -U_1 t' - U_2(e' + c + s + (\hat{\alpha} - \alpha)(c' + s')) - U_3 L' s' \quad \text{A (2.1)}$$

The second order condition for minimization can be derived as

$$\begin{aligned} D''(\hat{\alpha}) &= -(U_1 t'' + (U_{11} t' + U_{12}(e' + (c + s) + (\hat{\alpha} - \alpha)(c' + s')) + U_{13} L' s') t') \\ &- (U_2(e'' + 2(c' + s') + (\hat{\alpha} - \alpha)(c'' + s'')) + (U_{21} t' + U_{22}(e' + c + s + (\hat{\alpha} - \alpha)(c' + s')) + U_{23} L' s')(e' + c + s + (\hat{\alpha} - \alpha)(c' + s'))) \\ &- ((U_{31} t' + U_{32}(e' + c + s + (\hat{\alpha} - \alpha)(c' + s')) + U_{33} L' s') L' s' + U_3 L'' s'^2 + U_3 L' s'') \geq 0 \end{aligned}$$

A (2.2)

When $\hat{\alpha} = \alpha$, Equation A (2.2) can be written as

$$\begin{aligned} D''(\hat{\alpha}) &= -(U_1 t'' + (U_{11} t' + U_{12}(e' + c + s) + U_{13} L' s') t') \\ &- (U_2(e'' + 2(c' + s')) + (U_{21} t' + U_{22}(e' + c + s) + U_{23} L' s')(e' + c + s)) \\ &- ((U_{31} t' + U_{32}(e' + c + s) + U_{33} L' s') L' s' + U_3 L'' s'^2 + U_3 L' s'') \geq 0 \end{aligned}$$

A (2.3)

Recall from Appendix 1 that when $\hat{\alpha} = \alpha$,

$$D'(\hat{\alpha}) = -U_1 t' - U_2(e' + c + s) - U_3 L' s' = 0 \quad \text{A (2.4)}$$

Therefore

$$\begin{aligned} dD'(\hat{\alpha}) &= -(U_1 t'' + (U_{11} t' + U_{12} e' + U_{13} L' s') t') \\ &- (U_2(e'' + c' + s') + (U_{21} t' + U_{22} e' + U_{23} L' s')(e' + c + s)) \\ &- ((U_{31} t' + U_{32} e' + U_{33} L' s') L' s' + U_3 L'' s'^2 + U_3 L' s'') = 0 \end{aligned} \quad \text{A (2.5)}$$

Plugging Equation A (2.5) into Equation A (2.3) yields

$$D''(\hat{\alpha}) = -U_{12}(c + s)t' - U_2(c' + s') - U_{22}(c + s)(e' + c + s) - U_{32}(c + s) L' s' \geq 0 \quad \text{A (2.6)}$$

From Equation A (2.4), I can obtain an expression of $(e' + c + s)$

$$(e' + c + s) = \frac{-U_1 t' - U_3 L' s'}{U_2} \quad \text{A (2.7)}$$

Plug Equation A (2.7) into Equation A (2.6)

$$-(U_{12} - U_{22} U_1 / U_2) t'(c + s) - (U_{32} - U_{22} U_3 / U_2) L' s'(c + s) - U_2(c' + s') \geq 0 \quad \text{A (2.8)}$$

Thus, the sufficient conditions for a local minimization of Equation A (1.1) can be summarized as

1. $U_{12} - U_{22} U_1 / U_2 < 0$
2. $U_{32} - U_{22} U_3 / U_2 < 0$
3. $t' \geq 0$
4. $L' = \partial L / \partial s \geq 0$
5. $c' \geq 0$
6. $s' \geq 0$

Appendix 3. Sign of the Multiplier μ in the Hamiltonian Equation

The first order condition of the Hamiltonian Equation yields

$$H_v: \quad \mu'(\alpha) = \mu(\alpha)A(\alpha) + B(\alpha) > 0 \qquad \text{A (3.1)}$$

Where

$$A(\alpha) = U_{22}E_v(c+s) > 0 \quad \forall \alpha$$

$$B(\alpha) = -(1-\lambda)E_v q > 0 \quad \forall \alpha$$

Equation A (3.1) is a typical first-order non-homogeneous linear differential equation. It can be solved and yields

$$\mu(\alpha) = e^{\int_{\underline{\alpha}}^{\alpha} A(\alpha)d\alpha} \int_{\underline{\alpha}}^{\alpha} B(\alpha)e^{\int_{\underline{\alpha}}^{\alpha} A(\alpha)d\alpha} d\alpha + \mu(\underline{\alpha})e^{\int_{\underline{\alpha}}^{\alpha} A(\alpha)d\alpha}$$

where e is the basis of the natural logarithm. Because I know that the transversality condition is $\mu(\overline{\alpha}) = 0$, the above equation can be converted into:

$$\mu(\underline{\alpha}) = \frac{e^{\int_{\underline{\alpha}}^{\overline{\alpha}} A(\alpha)d\alpha} \int_{\underline{\alpha}}^{\overline{\alpha}} B(\alpha)e^{\int_{\underline{\alpha}}^{\overline{\alpha}} A(\alpha)d\alpha} d\alpha}{e^{\int_{\underline{\alpha}}^{\overline{\alpha}} A(\alpha)d\alpha}} < 0$$

Therefore, I are able to prove that $\mu(\alpha) < 0, \quad \forall \alpha < \overline{\alpha}$. The proof procedure is borrowed from Bös and Peters (1991):

Lemma: $\mu(\alpha) < 0, \quad \forall \alpha < \overline{\alpha}$

Proof:

This lemma can be proved by contradiction. Assume $\mu(\alpha') \geq 0$ for $\alpha' < \overline{\alpha}$. Note that $\mu(\alpha)$ is a monotonically increasing function of α (Recall $\mu' = \mu A + B > 0$). Hence $\mu(\alpha) > 0$ for all $\alpha > \alpha'$. Thus, this implies $\mu(\overline{\alpha}) > 0$, which violates the transversality condition.■

Table 1: Descriptive Statistics (mean and standard deviation)of Major Variables in the Sample

Year	Output	Unit Cost	Profitability	Labor	Capital
1995	29.08	1.43	-0.05	680.78	45.01
	(43.78)	(2.85)	(0.12)	(1057.79)	(59.17)
1996	31.44	1.35	-0.06	658.64	55.17
	(46.25)	(0.87)	(0.08)	(1026.17)	(68.91)
1997	32.03	1.99	-0.06	632.75	59.71
	(51.50)	(6.32)	(0.08)	(1030.09)	(73.93)
1998	31.38	2.02	-0.07	588.78	63.90
	(49.33)	(4.08)	(0.09)	(1120.07)	(78.59)
1999	33.22	4.31	-0.06	544.63	62.68
	(56.11)	(40.37)	(0.08)	(1076.15)	(76.39)
2000	32.32	2.18	-0.06	492.10	58.48
	(52.39)	(6.03)	(0.11)	(985.02)	(71.58)
2001	37.84	3.25	-0.06	463.73	59.61
	(37.84)	(18.06)	(0.10)	(1023.18)	(74.92)
Average Sample Size	426	390	396	573	517

Note: Sample size is expressed in terms of the number of firms. Average sample size is the average number of firms from 1995 to 2001. Output equals the value of gross output and is measured by Chinese currency (unit: million Yuan in current price) and adjusted by the ex-factory price indices of industrial products (year 1995 is chosen as the base year). Unit cost is the ratio of managerial and operation cost (total sales minus pretax profit) over total sales. Profitability is measured by the ratio of pretax profit over total asset. Labor equals the number of working employees. Capital equals the value of total asset and is measured by Chinese currency (unit: 10,000 Yuan in current price) and adjusted by the ex-factory price indices of industrial products (year 1995 is chosen as base year). Stand Deviations are shown in the brackets.

Table 2: Percentage of Firms Privatized in the sample: Total, Domestic, and Foreign

	1995	1996	1997	1998	1999	2000	2001
Private Total	2.05	2.49	2.93	4.98	7.62	12.89	16.84
Domestic	1.46	1.90	2.49	4.54	7.03	12.30	16.25
Foreign	0.59	0.59	0.44	0.44	0.59	0.59	0.59
Foreign share >0	1.17	1.17	1.17	1.17	1.32	1.46	1.61

Note: “Private” refers to firms with more than 50% of shares held privately. “Foreign” refers to privatized firms with more than 50% foreign-owned shares. The remaining privatized firms that are not majority foreign owned are classified as “Domestic”. “Foreign share>0” refers to firms with some outstanding shares held by foreign investors. The sample size=683.

Table 3: Pre-Privatization Relative Output, MFP Productivity, and MFP Productivity Trend
(Estimated Value of δ in Equation (15), (16) and (17))

	Output	MFP	MFP Trend
Pre-Private	0.561***	0.372***	-0.141***
	(0.188)	(0.123)	(0.041)
Pre-Domestic	0.527***	0.357***	-0.141***
	(0.192)	(0.127)	(0.042)
Pre-Foreign	1.545***	0.800***	-0.192***
	(0.441)	(0.182)	(0.036)

Note: * =significant at 10%, ** =significant at 5%, *** =significant at 1%. These estimated pre-privatization characteristics of privatized firms relative to never privatized are obtained from the sample of never privatized and pre-privatized firms. The Pre-Private specification is a single Pre-Private dummy designed to measure pre-privatization differences between all firms subsequently privatized and those firms always state-owned. The second specification permits the differences to vary over Pre-Domestic and Pre-Foreign firms, in both cases relative to those always state-owned. All equations have log (output) as the dependent variable and include a full set of industry-year interactions. The MFP (multi-factor productivity) and MFP trend estimation also include labor and capital interacted with industry dummies. The MFP trend equation also includes Pre-Private (Pre-Domestic and Pre-Foreign) interacted with a linear time trend normalized to zero in the year of privatization. Standard errors are also adjusted for clustering of firms. Totally, 2746 observations are available for the regression.

Table 4: Estimated Effects of Privatization on Manufacturing Productive Efficiency
(Estimated Value of δ in Equations (11), (12) and (13) with ***specification (1)***, respectively)

Ownership Variable	MFP			Unit Cost			Profitability		
	OLS	FE	RG	OLS	FE	RG	OLS	FE	RG
$\hat{\delta}_p$	0.480***	0.098	0.457***	-1.704***	-1.641	-1.315**	0.031***	0.011	0.025**
	(0.141)	(0.075)	(0.181)	(0.669)	(1.457)	(0.659)	(0.010)	(0.010)	(0.011)
Adj. R^2	0.603	0.211	0.363	0.023	0.066	0.048	0.116	0.058	0.183
Sample Size	2569	2569	2569	2119	2119	2119	2644	2644	2644

Note: * =significant at 10%, ** =significant at 5%, *** =significant at 1%.Estimated coefficients $\hat{\delta}$ and their corresponding standard errors are shown for Private (=1 if the firm is majority privately-owned at the end of year t-1). The dependent variables are MFP, Unit Cost and Profitability. The independent variables include log(Capital) and log(Employment), with coefficients permitted to vary across industries, as well as full set of unrestricted industry-year interaction dummies. FE= fixed effect model. GR=random growth (trend) model. R-squares in all regressions are adjusted R-square.

Table 5: Estimated Effects of Domestic and Foreign Privatization on Manufacturing Productive Efficiency
(Estimated Value of δ_d and δ_f in Equations (11), (12) and (13) with ***specification (2)***, respectively)

Ownership Variable	MFP			Unit Cost			Profitability		
	OLS	FE	RG	OLS	FE	RG	OLS	FE	RG
$\hat{\delta}_d$	0.439***	0.081	0.411**	-1.636**	-1.675	-1.366**	0.030***	0.012	0.022*
	(0.150)	(0.099)	(0.192)	(0.744)	(1.483)	(0.706)	(0.011)	(0.014)	(0.012)
$\hat{\delta}_f$	0.961***	0.759***	0.988***	-1.005*	-0.407	-0.804*	0.054***	0.033**	0.055***
	(0.188)	(0.095)	(0.242)	(0.594)	(0.944)	(0.497)	(0.013)	(0.015)	(0.015)
Adj. R^2	0.603	0.213	0.363	0.043	0.065	0.048	0.090	0.084	0.183
P($\hat{\delta}_d = \hat{\delta}_f$)	0.000	0.000	0.000	0.005	0.513	0.091	0.000	0.064	0.000
Sample Size	2569	2569	2569	2119	2119	2119	2644	2644	2644

Note: * =significant at 10%, ** =significant at 5%, *** =significant at 1%.Estimated coefficients $\hat{\delta}_d$ and $\hat{\delta}_f$ (and their corresponding standard errors) are shown for Domestic (=1 if the firm is majority private but not majority foreign-owned at the end of year t-1) and Foreign (=1 if the firm is majority foreign-owned at the end of year t-1), respectively. The dependent variable is log(Output), and independent variables include log(Capital) and log(Employment), with coefficients permitted to vary across industries, as well as full sets of unrestricted industry-year interaction dummies. FE=fixed effect model. FE&FT=random growth model. Regressions are not weighted. P is the P-value from an F test for the equality of the coefficients associated with the domestic and foreign ownership dummies.

Table 6: The Pre-Program Specification Test Results

	MFP			Unit Cost			Profitability		
	OLS	FE	RG	OLS	FE	RG	OLS	FE	RG
Privatized	3.08	0.79	2.57	0.72	1.22	0.60	1.37	0.29	1.06
	(0.016)	(0.534)	(0.037)	(0.581)	(0.303)	(0.664)	(0.242)	(0.885)	(0.376)
Domestic Privatized	2.92	0.36	2.44	0.68	1.21	0.59	1.58	0.32	1.26
	(0.021)	(0.836)	(0.046)	(0.606)	(0.306)	(0.671)	(0.180)	(0.864)	(0.283)
Foreign Privatized	19.21	3.31	16.42	1.47	3.20	1.56	37.79	37.37	33.68
	(0.000)	(0.037)	(0.000)	(0.230)	(0.042)	(0.212)	(0.000)	(0.000)	(0.000)

Note: F-statistics and P-values in parenthesis are shown for three hypotheses concerning to the estimated pre-privatization impact of privatization for all privatized, and domestic and foreign privatized firms separately: $\hat{\delta}_{-5d} = \hat{\delta}_{-4d} = \hat{\delta}_{-3d} = \hat{\delta}_{-2d} = 0$, and $\hat{\delta}_{-3f} = \hat{\delta}_{-2f} = 0$. The corresponding coefficients are graphed in Figures 1 and 2. FE=fixed effect model and RG=random growth model. Numbers of observations for MFP, Unit Cost and Profitability are respectively, 2569, 2119 and 2644.

Table 7: Dynamics of the Privatization Effects
(Estimates of δ_{itp} from Equation (14) ***specification (1)***)

	MFP			Unit Cost			Profitability		
	OLS	FE	RG	OLS	FE	RG	OLS	FE	RG
All Privatized$_{-3}$	0.551***	-0.190	0.543***	-0.364	2.933	-1.009	0.018**	0.006	0.018*
	(0.172)	(0.156)	(0.186)	(0.504)	(1.823)	(0.867)	(0.009)	(0.016)	(0.010)
All Privatized$_{-2}$	0.462***	-0.197	0.449***	-0.401	2.470	-0.566	0.016	0.003	0.014
	(0.137)	(0.120)	(0.148)	(0.286)	(1.613)	(0.379)	(0.011)	(0.013)	(0.012)
All Privatized$_{-1}$	0.463***	-0.079	0.459***	-0.558	2.168	-0.762*	0.015	-0.002	0.017*
	(0.144)	(0.095)	(0.156)	(0.394)	(1.563)	(0.409)	(0.010)	(0.012)	(0.010)
All Privatized$_{0}$	0.433***	-0.137	0.451***	-1.177	1.689	-1.141	0.021**	0.003	0.011
	(0.144)	(0.090)	(0.141)	(0.801)	(1.747)	(0.815)	(0.011)	(0.013)	(0.012)
All Privatized$_{1}$	0.395***	-0.179**	0.262*	-1.225*	1.221	-0.880	0.019**	0.000	0.008
	(0.126)	(0.082)	(0.142)	(0.686)	(0.959)	(0.753)	(0.009)	(0.010)	(0.010)
All Privatized$_{2}$	0.419***	-0.048	0.361***	-1.872*	0.426	-1.443	0.031***	0.013	0.018**
	(0.110)	(0.075)	(0.120)	(0.991)	(0.608)	(0.994)	(0.008)	(0.009)	(0.008)

Note: * =significant at 10%, ** =significant at 5%, *** =significant at 1%. .Estimated coefficients $\hat{\delta}_{itp}$ and their corresponding standard errors are shown for Private (=1 if the firm is majority privately-owned at the end of year t-1). The dependent variables are MFP, Unit Cost and Profitability. The independent variables include log(Capital) and log(Employment), with coefficients permitted to vary across industries, as well as full set of unrestricted industry-year interaction dummies. FE= fixed effect model. GR=random growth (trend) model.

Table 8: Dynamics of the Privatization Effects for firms owned by domestic investors
(Estimates of δ_{itd} from Equation (14) ***specification (2)***)

	MFP			Unit Cost			Profitability		
	OLS	FE	RG	OLS	FE	RG	OLS	FE	RG
Domestic Privatized$_{-3}$	0.563***	-0.124	0.555***	-0.372	3.016	-1.053	0.021**	0.007	0.020**
	(0.177)	(0.158)	(0.192)	(0.524)	(1.896)	(0.901)	(0.009)	(0.015)	(0.010)
Domestic Privatized$_{-2}$	0.456***	-0.152	0.443***	-0.402	2.542	-0.574	0.016	0.001	0.014
	(0.140)	(0.136)	(0.152)	(0.294)	(1.674)	(0.390)	(0.011)	(0.012)	(0.012)
Domestic Privatized$_{-1}$	0.457***	-0.037	0.452***	-0.558	2.244	-0.776*	0.015	-0.004	0.016
	(0.147)	(0.127)	(0.159)	(0.406)	(1.624)	(0.424)	(0.010)	(0.011)	(0.010)
Domestic Privatized$_{0}$	0.422***	-0.110	0.435***	-1.174	1.771	-1.136	0.021**	0.000	0.011
	(0.145)	(0.107)	(0.143)	(0.813)	(1.800)	(0.829)	(0.011)	(0.012)	(0.012)
Domestic Privatized$_{1}$	0.380***	-0.154*	0.243*	-1.234*	1.271	-0.884	0.016*	-0.003	0.005
	(0.130)	(0.093)	(0.146)	(0.715)	(1.009)	(0.785)	(0.009)	(0.009)	(0.010)
Domestic Privatized$_{2}$	0.398***	-0.024	0.336***	-1.935*	0.425	-1.491	0.027***	0.009	0.015*
	(0.114)	(0.093)	(0.123)	(1.038)	(0.639)	(1.039)	(0.007)	(0.008)	(0.008)

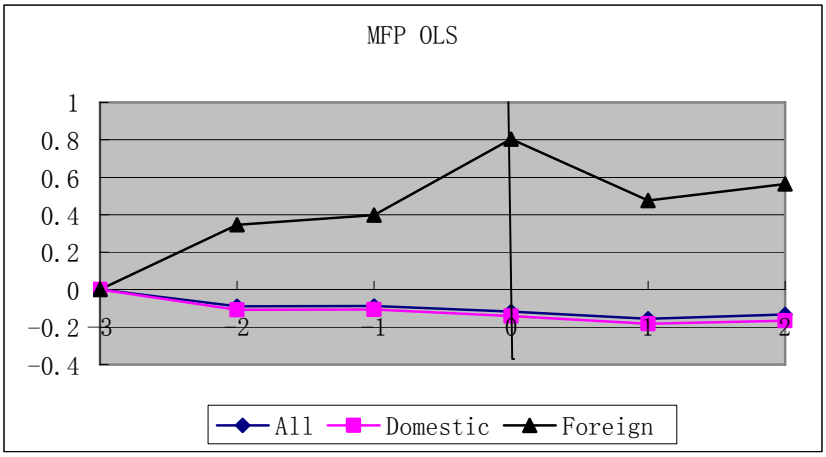
Note: * =significant at 10%, ** =significant at 5%, *** =significant at 1%. .Estimated coefficients $\hat{\delta}_{itd}$ and their corresponding standard errors are shown for Private (=1 if the firm is majority privately-owned by domestic investors at the end of year t-1). The dependent variables are MFP, Unit Cost and Profitability. The independent variables include log(Capital) and log(Employment), with coefficients permitted to vary across industries, as well as full set of unrestricted industry-year interaction dummies. FE= fixed effect model. GR=random growth (trend) model.

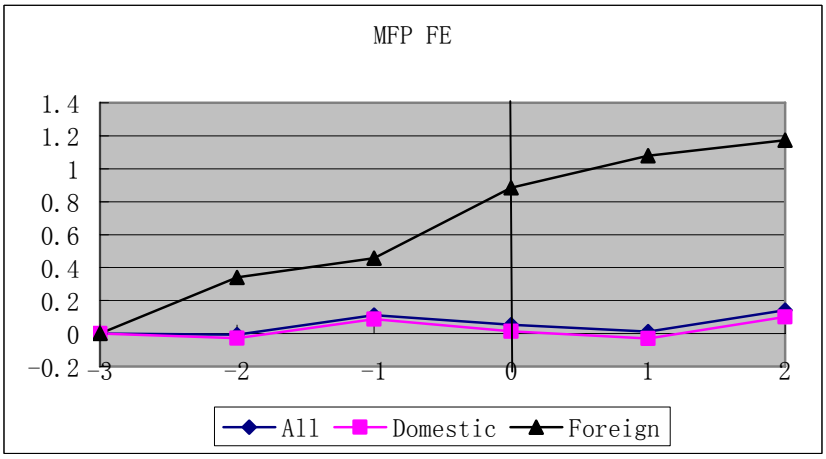
Table 9: Dynamics of the Privatization Effects for firms owned by foreign investors
(Estimates of δ_{itf} from Equation (14) ***specification (2)***)

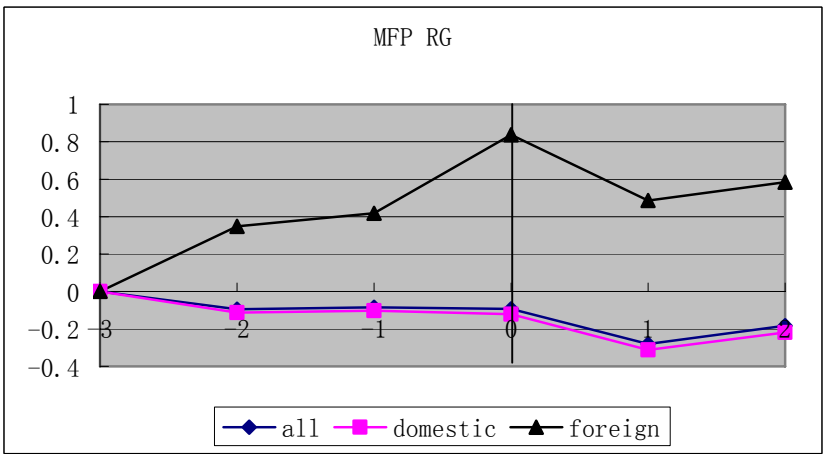
	MFP			Unit Cost			Profitability		
	OLS	FE	RG	OLS	FE	RG	OLS	FE	RG
Foreign Privatized$_{-3}$	0.331***	-1.571**	0.319***	-0.048	1.343	0.136	-0.030***	-0.067	-0.031***
	(0.110)	(0.678)	(0.117)	(0.274)	(0.946)	(0.344)	(0.008)	(0.047)	(0.008)
Foreign Privatized$_{-2}$	0.677***	-1.230*	0.668***	-0.325	0.878	-0.253	0.020**	-0.019	0.018**
	(0.122)	(0.677)	(0.132)	(0.293)	(0.911)	(0.316)	(0.009)	(0.047)	(0.009)
Foreign Privatized$_{-1}$	0.729***	-1.114*	0.737***	-0.530*	0.368	-0.528	0.021***	-0.010	0.021**
	(0.118)	(0.676)	(0.127)	(0.310)	(0.846)	(0.339)	(0.009)	(0.047)	(0.009)
Foreign Privatized$_{0}$	1.135***	-0.686	1.156***	-1.281	-0.650	-1.450	0.014	0.009	0.015
	(0.134)	(0.676)	(0.146)	(1.522)	(1.368)	(1.439)	(0.014)	(0.049)	(0.015)
Foreign Privatized$_{1}$	0.808***	-0.493	0.806***	-0.984*	0.648	-0.745	0.108***	0.065	0.107***
	(0.185)	(0.377)	(0.208)	(0.569)	(0.793)	(0.480)	(0.039)	(0.071)	(0.043)
Foreign Privatized$_{2}$	0.895***	-0.398	0.903***	-0.589	0.696	-0.420	0.105***	0.065	0.105***
	(0.253)	(0.376)	(0.285)	(0.386)	(0.694)	(0.356)	(0.038)	(0.066)	(0.042)

Note: * =significant at 10%, ** =significant at 5%, *** =significant at 1%. .Estimated coefficients $\hat{\delta}_{itf}$ and their corresponding standard errors are shown for Private (=1 if the firm is majority privately-owned by foreign investors at the end of year t-1). The dependent variables are MFP, Unit Cost and Profitability. The independent variables include log(Capital) and log(Employment), with coefficients permitted to vary across industries, as well as full set of unrestricted industry-year interaction dummies. FE= fixed effect model. GR=random growth (trend) model.

Figure 1: Dynamics of Privatization Effects on Manufacturing MFP

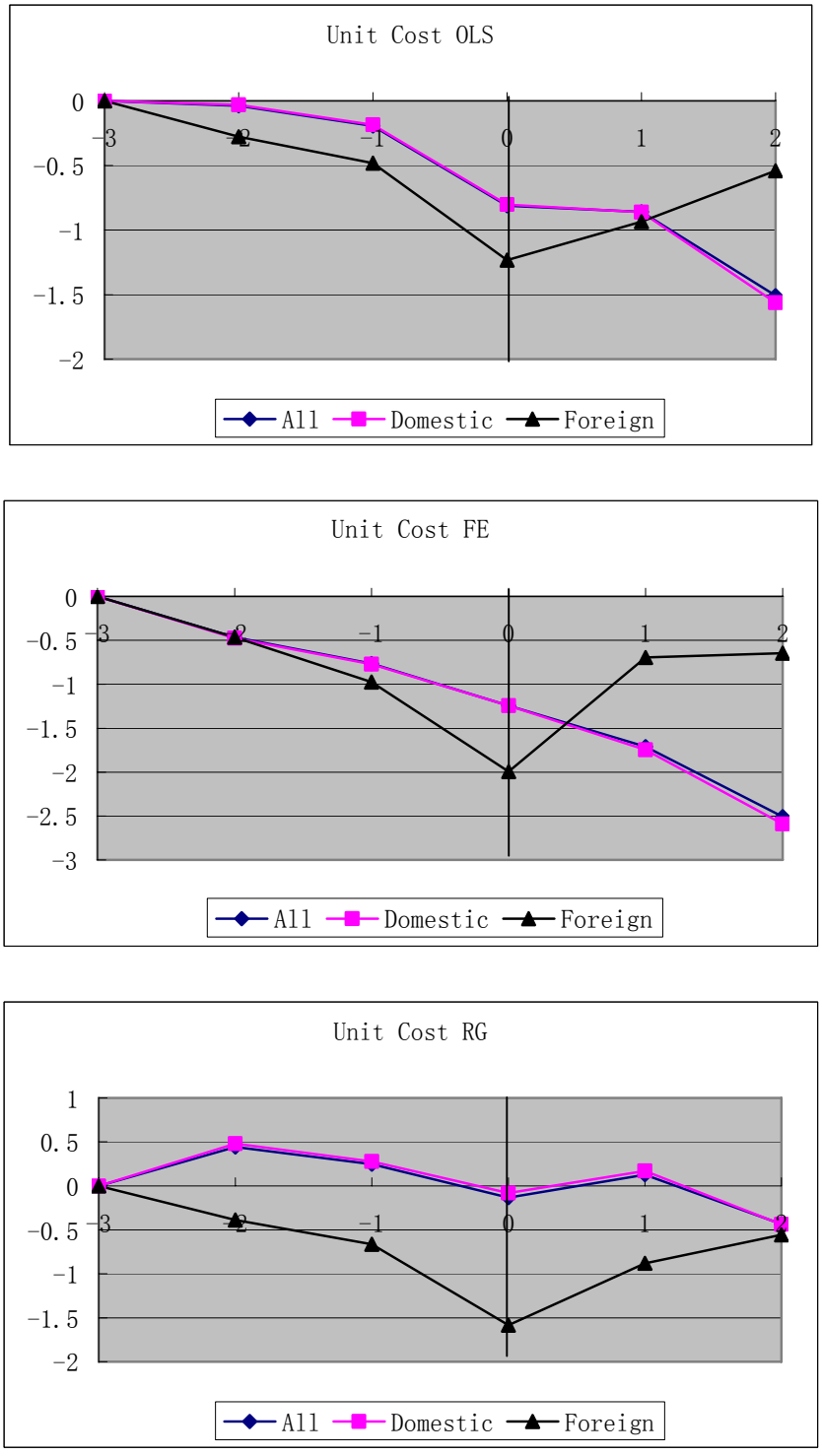






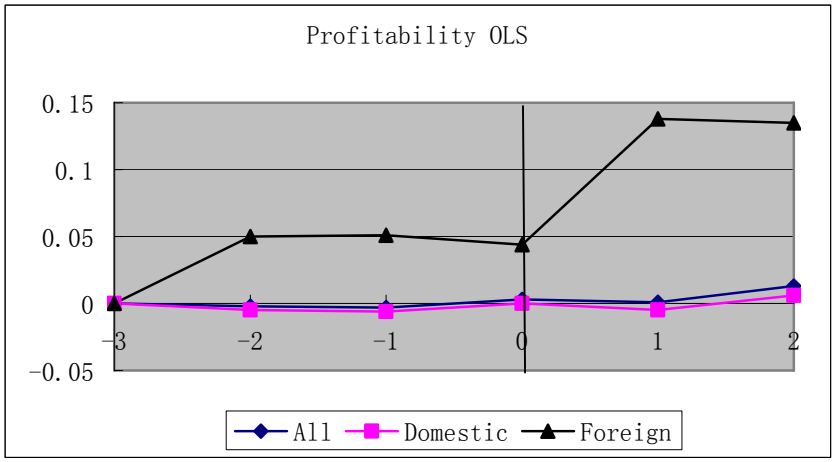
Note: The three panels show values of $\hat{\delta}_{itp}$, $\hat{\delta}_{itd}$ and $\hat{\delta}_{itf}$ from estimating Equation (14) with the OLS, FE and RG specifications respectively.

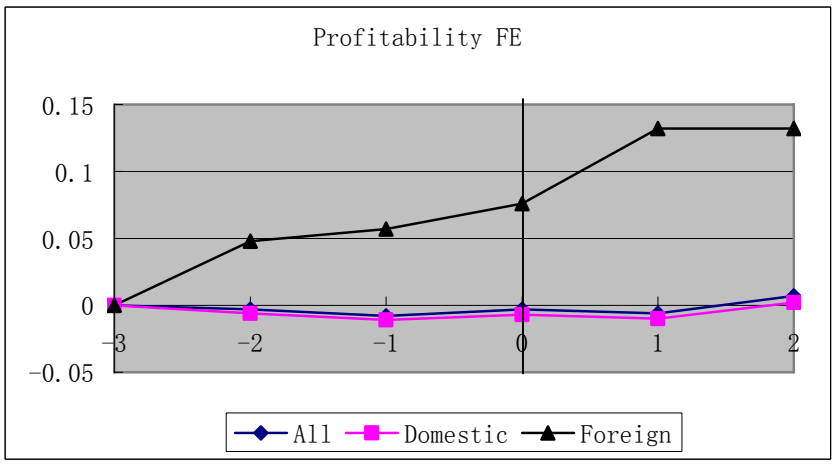
Figure 2: Dynamics of Privatization Effects on Manufacturing Unit Cost

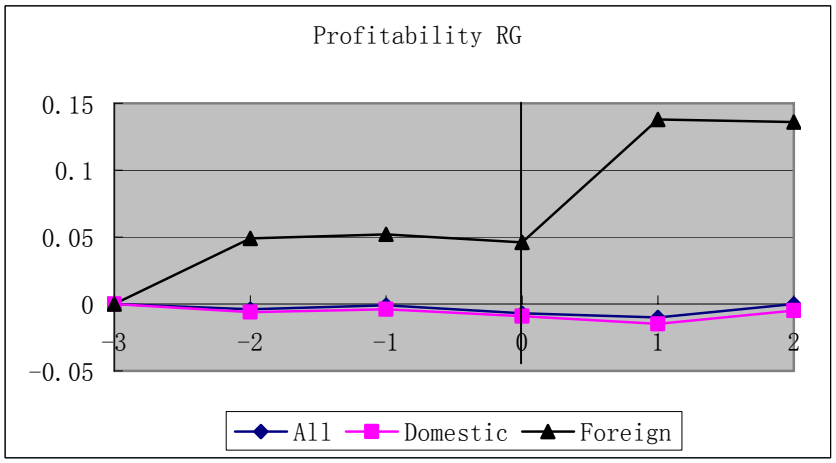


Note: The three panels show values of $\hat{\delta}_{itp}$, $\hat{\delta}_{itd}$ and $\hat{\delta}_{itf}$ from estimating Equation (14) with the OLS, FE and RG specifications respectively.

Figure 3: Dynamics of Privatization Effects on Manufacturing Profitability







Note: This three panels show the values of $\hat{\delta}_{itp}$, $\hat{\delta}_{itd}$ and $\hat{\delta}_{itf}$ from estimating Equation (14) with the OLS, FE and RG specifications respectively.