Is State Capitalism Sustainable? Insights from an Examination of the Twin Costs of State Ownership in China

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Abstract

State capitalism has been acclaimed by some as a sustainable model in emerging economies. We examine the twin costs of state ownership (low production efficiency and administrative monopoly power) in China. Employing the difference-in-differences approach, we investigate the changes in firm-level markup and total factor productivity (TFP) following the privatization and restructuring of state-owned enterprises (SOEs) in the period 1998-2005. Privatized SOEs experienced a significant decline in markup and rise in TFP following privatization and restructurings. These results demonstrate that state ownership is associated with administrative monopoly power and low production efficiency, which suggests that state capitalism is unsustainable in emerging economies.

1 Introduction

In the past decade, the world economy has witnessed two prominent parallel developments. On the one hand, the advanced economies in Europe and North America have been striken hard by the global financial crisis and the Eurozone crisis. On the other hand, the emerging market economies represented by the BRICS have espoused state capitalism that melds the power of the state with the powers of capitalism. In Russia, the disaster of the radical privatization in the 1990s created a frustration with liberal capitalism and a craving for order and state control. Consequently, the Russian leadership has reasserted direct state control over "strategic" industries and brought the remaining private-sector oligarchs to heel. In China, the state sector has been strengthened as described by the Chinese saying "the state advances and the private sector retreats". In the wake of global financial

crisis, China's fiscal stimulus package working primarily through state companies has stabilized output growth and employment, helped the country to weather the crisis, and even led the world out of recession. In the Middle East, state companies such as the Dubai World have become the spearhead of state-sponsored modernization campaign. In Brazil, the government reverted the privatization drive pursued in the 1990s and cultivated a handful state champions (Economist, 2012).

Clearly, the most striking aspect of state capitalism is the widespread state ownership or control of businesses. In those economies, the state holds a substantial proportion of shares in large companies, promotes state-controlled national champions through favorable industrial policies and generous financial support, and steers state-controlled companies to help the state to fulfill political and social objectives. For instance, state companies make up 80% of the stock market capitalization value in China, 62% in Russia and 38% in Brazil. They also account for one-third of the emerging economies's foreign direct investment between 2003 and 2010 (Economist, 2012).

The dynamic economic growth of the emerging market economies adopting state capitalism apparently presents a sharp contrast to the long stagnation and volatility of the developed world following the global financial crisis. This has allegedly exposed the weakness and instability of liberal capitalism, and cast serious doubts on the effectiveness of the invisible hand. At the same time, it boosts the public and the leadership's confidence in state capitalism as a sustainable model rather than a transient one on the road to liberal capitalism.

The wide adoption and practice of state capitalism have posed a serious threat to the established view of an ideal model of market economy and aroused a heated debate among academics and practioners. Advocates of state capitalism claim that it is extremely effective in building world-class infrastructure, nurturing infant industries, and producing globally competitive national champaigns. Nonetheless, the opponents to state capitalism point to its downsides that include cronynism, corruption, low capability of technological innovation, low effficiency in production, heavy reliance on state subsidy and state protection to gain access to capital and market, etc. (Economist, 2012). It is claimed that the apparent profitability of state companies largely stems from the administrative monopoly power maintained by the government (World Bank, 2012).

Hence, the debate about the merits and demerits of state capitalism is largely centered around the production efficiency and the administrative monopoly power of state-owned companies. A study of these two issues will help us understand the nature of state ownership in emerging economies, and help us assess whether state capitalism will be a viable model of market

economy in the long term.

In this study, we investigate the market power and production efficiency of state-owned enterprises (SOEs) in China. China is important not only because of the sheer size of its economy and of its state sector but also because the country is often cited as a model of state capitalism. Thus, an anatomy of market power and productivity of Chinese SOEs could shed light on whether the state capitalism model is sustainable.

It is no news that SOEs typically have low productivity because they need to fulfill many political and social objectives and the employees do not have sufficient incentives to raise production efficiency. Consequently, SOEs often make low profits or even make losses. But SOEs are still prevalent around the world, even in developed economies, for various reasons. First, SOEs can help overcome market failures to engage in public utilities industries and natural monopoly industries which private enterprises typically shun. Second, SOEs can help bureaucrats to win popular support and election victories by creating employment and maintaining social stability. Third, in general, SOEs can be a powerful instrument for bureaucrats to utilize social resources to achieve their political goals and seek rents. To keep SOEs alive, bureaucrats often provide subsidies to them, which is practised in many developed and developing countries. The state subsidy also played a significant part in helping out SOEs in China. Alternatively, bureaucrats and SOE managers can collude to establish administrative monopoly so as to subsidize SOEs by overcharging, i.e., bureaucrats help maintain market monopoly power for SOEs by means of administrative restrictions on industry entry, etc. The administrative monopoly rents relieve bureaucrats of the fiscal burden in sustaining inefficient SOEs and provide abundant funds for bureaucrats to pursue their political agenda. This is a way to keep SOEs alive by undermining consumer interests and creating market distortion.

Since administrative monopoly is fairly covert and hard to measure, the earlier literature on SOEs mainly focuses on SOE productivity. In this study, we employ the difference-in-differences (DID) approach to examine both market power and production efficiency of SOEs in China. Using the experience of SOE restructuring and privatization around 1998-2005 as a quasi-natural experiment, we investigate the changes in firm-level markup and total factor productivity (TFP) following SOE privatization. In order to recover the firm-level markup estimates, we apply the method of De Loecker and Warzynski (2012) to a comprehensive data set of Chinese enterprises, Chinese Industrial Enterprises Survey, compiled by the National Bureau of Statistics in China. In estimating firms' output elasticity of the production function and TFP, we follow the control function approach developed by Ackerberg et al. (2006). In order to identify the administrative monopoly power and low production

efficiency (i.e., the twin costs) of state ownership, we use the Rubin DID causal model. Specifically, we investigate the changes in markup and TFP for privatized SOEs before and after restructuring, and compare them with the changes in markup and TFP for the control group firms that remained as SOEs throughout the sample period. Implicitly, we assume that the privatized SOEs would have followed the same trend in markup and TFP changes if they had not been restructured. The differences in the changes of markup and TFP between privatized SOEs and the control group firms reflect the effects of state ownership on markup.

It is found that privatized SOEs experienced a statistically significant decline in markup and a significant rise in TFP in the post-restructuring years. These changes occurred primarily in the year of privatization and the immediate following year. Given that TFP has increased following privatization, the decline in markup is unlikely to be driven by an increase in marginal costs. On the contrary, a reduction in market prices and hence monopoly power is the primary reason for the drop in markup for privatized SOEs. These results demonstrate that state ownership is associated with administrative monopoly power and low production efficiency, and privatization can substantially reduce monopoly power and improve production efficiency.

These findings are robust to a series of validity checks on DID estimation such as checking the pre-restructuring years and adding control variables. We have also carried out some other robustness tests such as excluding some potential outliers and using alternative markup estimation method. Our main findings remain robust in these tests.

To understand better that SOEs' high markup comes from administrative monopoly power, we further explore heterogeneous responses by considering the differences in the markup among SOEs of different types. It is found that the administrative monopoly costs of state ownership is more significant and serious for SOEs under purview of the central and provincial governments than for those under city or county governments. Presumably the SOEs of the former type enjoy monopoly power in a larger market protected by the government. In addition, we find that the SOEs engaged in high capital intensity industries also incur a higher markup. This suggests that SOEs more favored by government industrial policies and development strategies receive more administrative protection.

This study makes several contributions to the literature. Firstly, we make the first attempt to employ the DID method to analyze the changes in markup and TFP associated with the privatization of SOEs so as to identify the twin costs of administrative monopoly and low production efficiency associated with state ownership. Our findings generally suggest that China's state capitalism model is nonviable and unsustainable in the long run. Our findings

also contain important implications for understanding and assessing the sustainability of the state capitalism model pursued in other emerging market economies.

Secondly, our study demonstrates forcefully that the improvement in privatized firm performance in China does not come from the surge in monopoly power after privatization. As Megginson and Netter (2001) point out, the studies of post-privatization firm performance rarely examine the welfare effects on consumers. Few studies consider the possibility that improvements of privatized firms could be due to greater exploitation of monopoly power. This study demonstrates that the improvement in privatized firm performance does not stem from the exploitation of monopoly power.

Finally, our study sheds light on one long overlooked shortcoming of China's incremental economic reform. We argue that China's gradual reform postponed the resolution of some core issues in economic reforms. The SOE sector has become an instrument of rent seeking by bureaucrats and SOE managers.

There is a small line of literature on the impacts of privatization on firm markup. Konings, Cayseele and Warzynski (2005) find that privatization is associated with higher price-cost margins for Bulgarian and Romanian manufacturing firms. This effect is stronger in highly competitie sectors, which suggests that the cost reduction is the main reason for the increase in markup. Thus, in these two transition economies, the creation of competitive market and privatization go together.

The rest of the paper is organized as follows. Section 2 lays out the conceptual framework. Section 3 discusses the estimation framework. Empirical results are presented and discussed in Section 4. Section 5 concludes the paper.

2 Conceptual Framework

2.1 Twin Costs of State Ownership

China's economic reforms, particularly SOE reforms, in the past thirty plus years can largely be divided into two phases. In the first phase from 1978 to the early 2000s, the government gradually relaxed its monopolistic grip over industry by allowing non-state enterprises such as township and village enterprises, private enterprises, foreign-invested firms, etc. to emerge and proliferate in many manufacturing industries, especially the labor-intensive consumer-goods industries. Over years, the non-state sector has become the most vibrant growth engine, contributing a lion's share to China's GDP. At

the same time, the Chinese government has been reforming SOEs. In the 1980s and early 1990s, SOEs were granted with more autonomy in production and management through schemes such as "managerial contract responsibility system"; from the late 1990s, under the principle of "grasp the big and let go the small ones", a large number of small and medium-sized SOEs were restructured and privatized. As a consequence, the number of SOEs declined drastically, accounting for approximately 15% of the total number of industrial enterprises.

In the second phase from the early 2000s to the present, the privatization and restructuring of the state sector have slowed down, and the state sector regained some losing ground. It is increasingly clear that China has been pursuing a model of state capitalism that relies heavily on state-owned or state-controlled companies. In 2007, the total number of SOEs in China still stands at approximately 112,000, the vast majority of which are administered by provincial or local governments. The government has cultivated a host of national champions such as Petro China, China Petrochemical Corporation, State Grid Corporation of China, etc. At present, SOEs account for 63.2% of China's top 500 enterprises in terms of number, 82.82% in terms of operational income, and 90.40% in terms of total assets. China's largest SOE, China Petrochemical, has an operational income ten times as large as does Huawei, the largest private enterprise in China (Statistical data of China Enterprise Confederation, 2011).

In general, the state sector still makes up a big chunk of the national economy and permeates into most industries. SOEs are dominating in strategically important industries, in industries producing public goods and services and in natural monopoly industries (e.g. natural resources, telecommunications, finance, real estate). In most of the competitive manufacturing industries, the share of SOEs in total output still lies slightly below 40% (Report on SOE Competitiveness, 2006; World Bank, 2012). At the same time, the average performance of the state sector in the 2000s turns out much better than that in the 1990s, registering fairly high profitability. Among China's top 500 firms, profits produced by SOEs account for 81.88% of the total profits. The ten most profitable firms in China are all SOEs.

The state sector development in China has aroused many criticisms. SOEs are widely criticized for enjoying administrative monopoly power, reaping administrative monopoly rents, and typically having low efficiency in production. These twin costs are the direct consequences of the state capitalism model pursued by China.

Firstly, the political and social objectives of SOEs lead to low production efficiency. The market-oriented reforms in China have been carried out in the absence of an adequate and extensive social safety net. To minimize the

shocks of reforms to social stability, SOEs have borne many political and social obligations and inherited many policy burdens from the pre-transition period that encompass retirement pensions, medical and housing provision, redundant workers, etc. (Justin Lin and Guofu Tan, 1999). Under the political constraints to maintain employment and provide social safety net, SOEs play a major part in absorbing surplus labor and helping to maintain social stability (Bai, Li, Tao, and Wang, 2000).

This function determines that SOE reform is hard to achieve the desired outcome. In the 1980s, the SOE reform was carried out along the lines of expanding enterprise autonomy and stimulating managerial profit motives through schemes such as the "managerial contract responsibility system". This has generated some positive effects (see, e.g., Groves, Hong, McMillan, and Naughton, 1995). In the 1990s, the focus of the SOE reform has shifted to the restructuring of SOE ownership structure, the corporatization of SOEs, and improvement in corporate governance. Overall, however, the managerial autonomy and profit motives had very limited effects on enterprise productivity. SOEs are eventually controlled by the central and local governments. In the course of socioeconomic reforms, the constraints of policy burdens and social responsibility that SOEs face determine that productivity improvement is overwhelmed by political and social obligations. This results in an average low productivity level for SOEs.

Secondly, SOEs and bureaucrats have also colluded to seek rents through administrative monopoly. The early stage SOE reforms centered on autonomy expansion have generated some managerial motives for profit making. Nonetheless, under the constraint of policy burdens and political tasks of maintaining redundant employment, profit making is easily transformed into rent seeking through administrative monopoly. SOE managers try to improve firm performance by lobbying bureaucrats for government protection to maintain the SOE monopoly power.

It is also in the interests of government officials to help maintain the monopoly power for SOEs. First, bureaucrats like to see the presence of a sizeable SOE sector, which facilitates them to steer production to realize their political objectives including maintaining employment and achieving social stability. One widely recognized reason for SOE reform to fail to be effective is the political control of managerial appointment (Qian, 2002). Under this circumstance, SOEs are ensured to be instruments of bureaucrats to fulfill their political objectives. Second, bureaucrats like to grant SOEs monopoly rents in order to relieve the burden of subsidizing SOEs so that fiscal budget could be released for bureaucrats to pursue other political objectives. Third, bureaucrats also have strong motivations to improve SOE performance as a showcase of their administrative performance. SOEs have been regarded

as the leading force of a "socialist market economy", and numerous efforts were made to improve SOE performance. A natural way for bureaucrats to support SOEs is to help maintain SOE monopoly through means such as reducing the competition pressures from non-SOE entrants and offering government procurement contracts to SOEs.

Hence, administrative monopoly is an effective means of seeking rents for government officials and SOE managers. It is widely agreed that administrative monopoly has contributed tremendously to the apparent profitability of a large number of SOEs, particularly those large SOEs. Among the ten most profitable firms in China that are all state companies, the five state-owned commercial banks and the three state-owned oil companies earn profits twice as many as those of the 184 private companies in China's top 500 firms list. As pointed out by the World Bank (2012), a large share of state enterprises' profits comes from limits on entry and competition and favorable treatment of SOEs in public procurement.

Ironically, high profitability does not lead to sizeable profit contributions of SOEs to the state. In 2011, only 7.4% of SOE profits were contributed to the state. At the same time, SOEs lag far behind private enterprises in technological innovation. SOEs account for only 35%, 25%, and 20% of the total number of patent applications, the total number of technological innovations, and the total number of new products developed, respectively, in China (FORTUNE(China), 2011). It is widely believed that a large proportion of profits were used to raise employee salaries, fringe benefits, etc.

The twin costs of state ownership produce profound impacts on social welfare. On the one hand, the maintenance of excessive employment and the fulfillment of other social obligations by the SOEs might have enhanced the welfare of some disadvantaged groups of people such as those SOE employees with low chances of securing decent jobs in the non-state sector. The contribution of SOEs to maintaining social stability has helped establish a stable business environment which also benefited the whole society to some degree. On the other hand, the employment protection has created production efficiency losses, and the administrative monopoly power enjoyed by SOEs have undermined the interests of non-state businesses who are potential competitors for SOEs, and more importantly, have harmed the interests of consumers in general. Even more worrisome is that the administrative monopoly could easily generate some vested interests that might well resist a full-fledged market-oriented economic reform. At present, there is a consensus that the vested interest groups surrounding SOEs and their monopoly status constitute a primary barrier to the further economic reforms in China (World Bank, 2012). The Development Research Centre (DRC), the core government think-tank in China, has recommended that the government push

forward the economic reform, especially weakening the grip of state-owned firms over the economy. They warned that "without such reforms, China could get caught in a 'middle-income trap', with inflation and instability leading to possible stagnation." (The Economist, March 3rd, 2012).

Although our study is focused on the case of China, we expect that administrative monopoly could be a quite general symptom of state capitalism in the emerging world. In advanced economies, SOEs are established primarily in order to overcome market failures and to complement and support private firms. Many SOEs are engaged in public utilities and natural monopolies, or in infant industries to promote their development, which are the industries that are typically shunned by private firms. In those countries, state ownership is typically associated with oversized employment and low production efficiency. But administrative monopoly is not a big concern. SOEs are typically associated with low or subsidized prices of goods and services, and serve as a way to prevent market monopoly power of private enterprises from infringing upon the public interets (Shleifer, 1998). The strong institutions of public governance in developed countries minimizes the likelihood of the rise of rent-seeking administrative monopoly.

Nonetheless, the emerging market economies that espouse and implement state capitalism typically have weak governments. Countries such as China, Russia and Brazil are plagued with corruption, nepotism and cronyism. If we look at the World Bank Governance Indicators in 2008 where a higher index value corresponds to better institutions, Brazil, China and Russia have a value of -0.0152, -0.4448, -1.035 for the control of corruption index, respectively, and a value of -0.365, -0.339, and -0.963 for the rule of law index, respectively, whereas the U.S. has values of 1.453 and 1.658 for the control of corruption index and the rule of law index respectively. Obviously, the gap in institutional quality between BRICS and developed countries is quite striking. Under weak government institutions, state capitalism provides a fertile ground for rent seeking by both bureaucrats and state company managers and employees. Since emerging markets typically have weak institutions as does China, administrative monopoly may well be a widespread phenomenon in emerging economies pursuing state capitalism.

2.2 SOE Privatization and the Identification of Administrative Monopoly Cost

Numerous studies in the literature have discussed the cost of low production efficiency associated with SOEs in advanced market economies, in transition

economies, in developing economies, and in China [1] However, as far as we know, there is no serious study of China's SOE productivity based on TFP estimation, and of course there is no study of SOEs' TFP using the DID approach. In contrast to the large literature on SOE productivity, the cost of administrative monopoly has not received due attention in the literature. In this study, we use the privatization and restructuring experiences of SOEs in China in the late 1990s and 2000s as a quasi-natural experiment to help identify the existence of administrative monopoly costs.

From the late 1990s, the restructuring of the SOE sector has been carried out on a large scale. Under the principle of "grasp the big and let go the small ones", a large number of small and medium-sized SOEs were restructured and privatized. The number of SOEs declined drastically, and is now accounting for approximately 15% of the total number of industrial enterprises. The restructuring and privatization efforts were made in response to SOEs' growing financial difficulties and heavy financial losses. The central leadership conducted SOE restructurings in the hopes of bringing them out of their financial plight. In the process of restructuring, some small SOEs were completely privatized through management buyout, etc. But this type of restructuring remains a small proportion (no more than 10%). The majority of SOEs were restructured into limited liability companies, where private stake holding was substantial (Lin and Zhu, 2001). It is reported that in the period 1995-2001, the average proportion of private shares increased from a mere 3.5% in 1995 to 33% in 2001 (Garnaut, Song and Yao, 2006). High debt level and redundant employment are thorny issues in SOE restructuring. Under the arrangement of the central government, a large amount of SOE non-performing loans was transferred from state banks to the four newly established state asset management companies under the central government. The government also issued treasury bonds to raise funds to replenish the equity capital of state banks. Hence, the mounting debts of SOEs were channelled to the fiscal system through these arrangements. In the restructuring process, a large number of surplus personnel in SOEs were laid off, which was mainly absorbed by the private sector (Lin and Zhu, 2001). [2]

[1] Examples include MacAvoy (1989) for developed countries, [[Paul W. MacAvoy (1989):Privatization and state-owned enterprises: lessons from the United States, Great Britain, and Canada;]], Lin and Li (2009) for developing economies, Musacchio and Flores-Macias (2009) for transition economies [[Aldo Musacchio, Francisco Flores-Macias (2009, Harvard international review);]] Sun and Tong (2003), Dollar and Wei (2007), and Cao and Liu (2011) for China.

[2] Privatization in China often does not mean the complete retreat of the state from the firms. On the contrary, the state ownership still remains significant in quite a few restructured SOEs, especially those relatively large in size and engaged in some key economic sectors (Lin and Zhu, 2001). The persistence of state ownership after restructuring reflects

Under the guiding principle of establishing the "modern enterprise system", restructuring truly brought about some positive changes in corporate governance and business management. Restructured enterprises have widely adopted modern organizational arrangements such as shareholder meetings, boards of directors, etc. Management in restructured enterprises claimed to have much more autonomy in decision making and a heightened sense of entirely bearing financial losses and business risks, etc. (Lin and Zhu, 2001). Hence, restructuring has truly reduced to a substantial extent the close link between government and enterprises. World Bank (2012) indicates that SOE restructuring through ownership diversification, corporatization and privatization have stimulated entry and competition in most manufacturing industries. Therefore, SOE restructurings and privatization have fundamentally changed the way through which these firms are operated, and hence provided a good setting for us to estimate the twin costs by analyzing the changes in firm markup and TFP before and after the change in ownership nature.

3 Empirical Methodologies

In this section, we discuss the estimation methods of firm-level markup, and the empirical strategy for identifying the effects of state ownership on firm-level markup.

3.1 Estimation of Firm-level Markup

To recover firm-level markup, we follow the recent work of De Loecker and Warzynski (2012). Specifically, we assume that the production function of firm i at time t is[3]

$$Q_{it} = F_{it}\left(L_{it}, K_{it}, M_{it}, \omega_{it}\right) \tag{1}$$

where L_{it}, K_{it}, and M_{it} are the inputs of labor, capital, and intermediate materials, respectively; ω_{it} denotes firm-specific productivity. The production function $F\left(.\right)$ is assumed to be continuous and twice-differentiable with respect to all of its arguments.

the central leadership's intention to uphold the dominance of public ownership in the national economy. It is also a result of the vested bureaucratic interests, that is, bureaucrats try to maintain the resources under their control by keeping a substantial share of state ownership. Nevertheless, restructurings did cause many changes in the way the firms were managed and the link between the government and the firm also became weaker in the post-restructuring period (Lin and Zhu, 2001; ****).

[3]Note that the framework is robust to any arbitrary number of inputs. As we mainly only observe three inputs (i.e., labor, capital, and intermediate materials) in our data, we here focus on a production function with only these three inputs.

Consider the following cost minimization problem faced by firm i at time t

$$\min_{\{L_{it},K_{it},M_{it}\}} w_{it}L_{it} + r_{it}K_{it} + p_{it}^{m}M_{it} \tag{2}$$

$$\begin{aligned} s.t.\ F_{it}\left(L_{it},K_{it},M_{it},\omega_{it}\right) &\geq \bar{Q}_{it} & (3)\\ G\left(L_{it}\right) &\geq I\left[D_{it}=1\right]\bar{S}_{it} & (4)\end{aligned}$$

where w_{it}, r_{it}, and p_{it}^{m} denote the wage rate, rental price and the price of intermediate inputs, respectively; D_{it} is an indicator of state-owned enterprise, i.e.,

$$D_{it} = \begin{cases} 1 & \text{if firm } i \text{ at time } t \text{ is an SOE} \\ 0 & \text{otherwise} \end{cases}; \tag{5}$$

and $I\left[.\right]$ is an indicator function that takes a value of 1 if the statement in the bracket is true and 0 if otherwise.

The constraint equation (4) captures a prominent feature of SOEs that they are often required to hoard redundant labor to meet an employment target ($\bar{S}_{it}$) so as to help bureaucrats to maintain social stability.[4]

The estimation of firm-level markup hinges upon the optimal choice of inputs free of any adjustment costs and the estimation of the output elasticity of inputs. As labor is not freely chosen due to the constraint (4) and capital is often considered as a dynamic input, we focus on the optimal choice of intermediate materials. Specifically, the Lagrangian function associated with the optimization problem (2) can be written as

$$\begin{aligned} \mathcal{L}\left(L_{it},K_{it},M_{it},\lambda_{it},\eta_{it}\right) &= w_{it}L_{it} + r_{it}K_{it} + p_{it}^{m}M_{it} \\ &\quad +\lambda_{it}\left[\bar{Q}_{it} - F_{it}\left(L_{it},K_{it},M_{it},\omega_{it}\right)\right] \\ &\quad +\eta_{it}\left[I\left[D_{it}=1\right]\bar{S}_{it} - G\left(L_{it}\right)\right]. \end{aligned} \tag{6}$$

Hence, the first-order-condition for intermediate materials is

$$\frac{\partial \mathcal{L}}{\partial M_{it}} = p_{it}^{m} - \lambda_{it}\frac{\partial F_{it}}{\partial M_{it}} = 0. \tag{7}$$

Re-arranging equation (7) and multiplying both sides by $\frac{M_{it}}{Q_{it}}$ leads to

$$\begin{aligned} \frac{\partial F_{it}}{\partial M_{it}}\frac{M_{it}}{Q_{it}} &= \frac{1}{\lambda_{it}}\frac{p_{it}^{m}M_{it}}{Q_{it}} \\ &= \frac{P_{it}}{\lambda_{it}}\frac{p_{it}^{m}M_{it}}{P_{it}Q_{it}}, \end{aligned} \tag{8}$$

[4]For example, during the financial crisis in 2008-2009, the Chinese President Hu Jintao annouced publicly that SOEs could not lay off their employees and should try to expand labor employment.

where P_{it} is the price of the final good.

Of course, we admit that the cost minimization with respect to material inputs is at best an approximation to characterize SOE behavior. It is likely that SOEs would use more materials than necessary in production because of their lack of incentives to minimize costs. Nonetheless, compared with the problem of overemployment of labor, the overuse of material inputs is less of a concern in the literature. An analysis of our sample firms also testifies to this view. In unreported results, we use the DID method to examine the changes in labor employment and material inputs after restructuring, and find that labor employment exhibits a statistically significant decline after privatization but materials show no significant changes. This finding suggests that our sample SOEs truly suffered from redundant employment problem before privatization, a prominent symptom of SOEs around the world. Nonetheless, SOEs did not have a serious problem with the overuse of material inputs. Hence, material inputs had been adjusted relatively freely even in SOEs. Since material inputs incur much smaller adjustment costs than does labor, we employ materials to recover firm-level markup.

Note that $\lambda_{it} = \frac{\partial \mathcal{L}}{\partial Q_{it}} = c_{it}$ represents the marginal cost of production at a given level of output. We define the markep μ_{it} as the ratio of price over marginal cost, i.e., $\mu_{it} \equiv \frac{P_{it}}{\lambda_{it}}$. Hence, equation (8) leads to our estimation expression of firm-level markup[5]

$$\mu_{it} = \theta_{it}^{m} \left(\alpha_{it}^{m}\right)^{-1}, \tag{9}$$

where $\theta_{it}^{m} \equiv \frac{\partial F_{it}}{\partial M_{it}} \frac{M_{it}}{Q_{it}}$ is the output elasticity of intermediate materials and $\alpha_{it}^{m} \equiv \frac{p_{it}^{m} M_{it}}{P_{it} Q_{it}}$ is the share of expenditure on intermediate materials in total revenue.

As the information on the expenditure on intermediate materials and total sales is available in the data, α_{it}^{m} can be readily calculated. However, the output elasticity of intermediate materials θ_{it}^{m} is obtained through the estimation of the production function. There is a large literature on the estimation of the production function focusing on how to control for the unobserved productivity shocks (see Ackerberg, Benkard, Berry, and Pakes, 2007, for a review). The solution ranges from the instrumental variable estimation, to the GMM estimation, and to the control function approach proposed by Olley and Pakes (1996). We adopt the control function approach

[5]Note that this expression holds under any form of competition and demand function. Meanwhile, De Locker and Frederic (2012) discuss some alternative settings of market competition, which leads to a similar estimation expression for firm-level markup. These alternative settings include Cournot competition, Bertrand competition, and monopolistic competition.

developed by Ackerberg, Caves, and Frazier (2006), which consists of a two-step estimation.[6]

The production function to be estimated is expressed as

$$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it}, \tag{10}$$

where the lower case letters represent the logarithm of the upper case letters; $\boldsymbol{\beta} = (\beta_l, \beta_k, \beta_m)$ is the vector of the production function coefficients; ω_{it} is productivity (TFP); and ε_{it} is an i.i.d. error term. In Appendix 1, we lay out the details of the procedure in estimating the production function.

Several caveates are worth noting. First, the above framework implicitly assumes a single-product firm. In reality, however, firms may produce a range of products. Without detailed information on the amounts of inputs used for each product, the markup calculated in equation (23) should be interpreted as the average markup across all product segments for a firm. Since we are only interested in the impacts of state ownership on markup, the markup at the firm level is most relevant, and thus the average markup across products is totally legitimate. Moreover, the existence of multi-product firms would not affect our identification strategy because it utilizes the variations in markups over time for the same firm.

Second, the estimation of the production function requires an observation of firm-level output in quantity. Unfortunately, such information is unavailable in most of the firm-level data including ours. As a compromise, the quantity-based output is recovered by deflating the observed revenue with the industry-level price index, which is subject to the omitted price bias as pointed out by Klette and Griliches (1996). However, this may not be a concern in our setting. The omitted price bias affects the level of the estimated markup, while our identification relies on the differences in the estimated markup across time and across firms (see De Loecker and Warzynski, 2012, for more discussion on this point). Nonetheless, in robustness check, we follow De Loecker (2011) to control for this potential omitted price bias in the estimation of the production function.

Third, in estimating the production function (1), we use the full sample and run regressions separately for each 2-digit industry. However, one may be concerned that SOEs might have employed different production technologies than did non-SOEs (i.e., different sets of $\boldsymbol{\beta}$ for SOEs and non-SOEs in the same 2-digit industry). As a robustness check, we estimate production function (1) separately for SOEs and non-SOEs (and for each 2-digit industry).

[6] Our results with the Olley and Pakes (2006)'s method are qualitatively the same.

Fourth, to measure k_{it}, we mainly use the net value of capital reported in the data, taking into account the depreciation over time. However, one may have concern that SOEs might have manipulated the depreciation of captial stock, especially those having undergone restructuring. For example, in the process of privatization through means such as management buyouts, the SOE managers might have exaggerated capital depreciation in order to undervalue corporate assets and purchase them at a lower price. As a robustness check, we re-estimate production function by using the book value of capital reported in the data.

3.2 Identification of the Effect of State Ownership on Markup

To illustrate our identification strategy for the effect of state ownership on firm markup, we adopt the Rubin causal model. Assume that for firm i at time t, we can observe two potential outcomes, $Y_{it}(1)$ and $Y_{it}(0)$, where Y_{it} represents the outcome variables such as price, marginal cost, and markup; $Y_{it}(1)$ denotes the value that would be realized if firm i at time t is an SOE; and $Y_{it}(0)$ denotes the value that would be realized if firm i at time t is a non-SOE.

As the logarithm of markup is defined as $\ln \mu_{it} = \ln P_{it} - \ln c_{it}$, the effect of state ownership on markup can be identified as

$$\begin{aligned} \gamma &\equiv E\left[\ln \mu_{it}(1) - \ln \mu_{it}(0)\right] \\ &= E\left[\ln P_{it}(1) - \ln P_{it}(0)\right] - E\left[\ln c_{it}(1) - \ln c_{it}(0)\right]. \end{aligned} \tag{11}$$

Denote the excess of price charged by SOEs over that by non-SOEs by $\gamma_{it}^P \equiv \frac{P_{it}(1)-P_{it}(0)}{P_{it}(0)}$ and the excess of marginal costs incurred by SOEs over that by non-SOEs by $\gamma_{it}^c \equiv \frac{c_{it}(1)-c_{it}(0)}{c_{it}(0)}$. Hence, Equation (11) can be simplified as

$$\begin{aligned} \gamma &= E\left[\ln\left(1+\gamma_{it}^P\right)\right] - E\left[\ln\left(1+\gamma_{it}^c\right)\right] \\ &\simeq E\left[\gamma_{it}^P\right] - E\left[\gamma_{it}^c\right] = E\left[\gamma_{it}^P - \gamma_{it}^c\right] = E\left[\gamma_{it}\right], \end{aligned} \tag{12}$$

where $\gamma_{it} \equiv \gamma_{it}^P - \gamma_{it}^c$.

It is expected that $\gamma_{it}^c > 0$, implying that state ownership is associated with higher marginal costs and thus lower production efficiency (referred to as *cost distortion*). Meanwhile, it is expected that $\gamma_{it}^P > 0$, implying that state ownership is accompanied by higher market price (referred to as *price distortion*). Clearly, the price distortion raises markup for SOEs, whereas the cost distortion reduces markup for SOEs. The difference between the two types of distortion, γ_{it}, provides a good gauge on the net effect of these two

distortions on markup by comparing their relative magnitude. Specifically, if $\gamma_{it} > 0$, we have $\gamma_{it}^{P} > \gamma_{it}^{c}$, which implies that the price distortion is larger than the cost distortion so that markup goes up. And if $\gamma_{it} < 0$, we have the opposite finding, that is, the cost distortion is larger than the price distortion so that markup goes down.

However, in the observational data like ours, we are only able to observe one of the two potential outcome values, that is, either $Y_{it}(1)$ or $Y_{it}(0)$. This makes the identification of the effect of state owership through equation (12) infeasible. To retrieve the effect of state ownership, we exploit a quasi-natural experiment setting, that is, some SOEs underwent restructurings to become non-SOEs during our sample period, to conduct a DID analysis.

We examine the change in markup for privatized or restructured SOEs before and after restructuring, and compare it with the change in markup for the control group firms that remained as SOEs throughout the sample period. The difference in the changes in markup between privatized SOEs and the control group firms reflects the effects of privatization on markup changes and, as the other side of the same coin, the effects of state ownership on markup. This DID analysis is built upon the assumption that restructured SOEs would have followed the trend of the control group firms in markup changes if they had not undergone restructuring and privatization.

Appendix 2 provides a detailed description of the rationale for the DID analysis.

In regression form, the DID estimation has the following specification

$$\ln \mu_{it} = \lambda_i + \lambda_t + \gamma \cdot S_i \cdot Post_{it} + \lambda_i \cdot t + \varepsilon_{it}, \tag{13}$$

where λ_t is the time dummy, capturing those factors common to all firms at time t; λ_i is the firm dummy, capturing firm i's all time-invariant characteristics; S_i is a dummy variable that takes value one if an SOE underwent restructuring and privatization and zero otherwise. $Post_{it}$ indicates the post-restructuring periods for firm i and is defined as follows

$$Post_{it} = \begin{cases} 1 & \forall t \geq t_0 \\ 0 & \text{otherwise} \end{cases} ; \tag{14}$$

where t_0 is the year in which restructuring takes place and ε_{it} is the error term. The coefficient γ represents the net effect of state ownership on markup, i.e., the net effect of price distortion and cost distortion. To cope with the potential heteroskedasticity, we cluster the standard errors at the firm level (see Duflo, 2004).

4 Data and Variables

4.1 Data and Sample

Our dataset comes from the Annual Industrial Enterprises Survey conducted by the National Bureau of Statistics of China (NBS). This dataset covers all the SOEs and "above-scale" (annual sales larger than RMB 5 million, or US$620,000) non-SOEs in industrial sectors. The number of firms covered by this dataset varies from one year to another. In general, there is an increasing trend in the number of firms covered over years. For example, the data set includes over 140,000 firms in the late 1990s and over 243,000 in 2005.[7] The data set provides detailed information on the identity and business nature of each firm; it also furnishes comprehensive operational and financial data for each firm. This dataset is noted for its representativeness because the sample firms contributed to the majority of China's industrial value-added. The dataset is used to calculate metrics in the national income account (e.g., GDP) and major statistics published in China Statistical Yearbooks. This dataset has also proved to be reasonably accurate and reliable due to the strict double checking procedures in data collection (Cai and Liu, 2009). Thus, it has been widely used by economic researchers in recent years (Cai and Liu, 2009; Bai et al, 2009; Lu et al., 2010, Brandt, Van Biesebroeck and Zhang, 2012).

Our sample includes all SOEs and those non-SOEs that transformed from SOEs, i.e., restructured SOEs, in manufacturing industries during 1998-2005. Firms that were not SOEs for the whole sample period are excluded from our sample. We further refine our sample by deleting: 1) firms that are not continuously observed during the sample period (i.e. there exists gaps between any two observed data points, or only appears in 1998); 2) SOEs that changed their ownership status for more than once during the whole sample period.

Our treatment group consists of firms that changed their ownership type from SOEs to non-SOEs. And our control group consists of firms that remained as SOEs throughout the whole sample period.

The total number of observations of our sample is 157,377, including 32,664 observations from 5,522 treatment firms (privatized SOEs) and 124,713 observations from 27,347 control firms (continuous SOEs).

[7] Though the data set has been updated to 2009, it is not widely available yet. More importantly, the late 1990s and early 2000s are the period when SOE privatization and restructurings were most active. Hence, focusing on 1998-2005 should provide us with a good picture of SOE restructurings.

4.2 Variables

1. SOE vs. non-SOE. We define SOEs according to their registration types which can be directly observed from the dataset. Three types of firms are defined as SOEs, i.e. state-owned enterprises, state-owned associated enterprises (joint ventures of SOEs), and soly-state-owned corporations (Co. Ltd). The rest of the firms are regarded as non-SOEs that encompasss collectively owned enterprises (COE), private firms, foreign-invested firms and all sorts of joint ventures between firms of these non-SOE ownership types.

Firms have the legal obligation to report the major changes in their ownership structure to local administration authorities (e.g. industry & commerce administration bureau, taxation bureau, etc.) and apply for changing the corresponding registration types following the change in ownership nature and comply with different taxation and administrative policies applicable to different types of firms. Usually, for restructured or privatized SOEs, the total assets were initially owned by the state before restructuring, but they became partially or even completely owned by non-state entities after registration type changes. It may take several years for this process to be completed (Bai, Lu and Tao, 2009). It is noteworthy that restructuring or privatization of SOEs in China often does not mean the complete withdrawal of state ownership from the firm. To reduce the concern with the vestiges of state ownership in restructured SOEs, we also adopt an alternative definition of SOEs and non-SOEs wherein SOEs are defined as firms whose shares of state-owned capital equals 100% and Non-SOEs are defined as firms who have no state-owned capital at all.

2. Privatization. It is a dummy variable taking value one if an SOE has changed its registration type to a non-SOE type. It indicates that a firm has incurred a major reduction in the proportion of state shares so that it is no longer registered as an SOE.

3. Control variables. Additional control variables in our DID analytical framework include firm size measured by log total output, firm age, and export status of firms indicating whether they are exporters or not.

5 Empirical Results

5.1 Baseline Results

Figure 1 provides a visual impression of the average markup of SOEs and non-SOEs in the period 1998-2005. It is quite striking that SOEs enjoyed a higher average level of markup than did non-SOEs in each year. This illustrates the persistence of SOE markup premium over years. Morevoer, there is also a

general trend of decreasing average markups for both categories of firms. This suggests that the gradual liberalization of the market following China's accession into the WTO has substantially enhanced market competition. Table 1 presents the detailed summary statistics (mean and its standard error) of firm-level markup for SOEs and non-SOEs in each year in the period 1998-2005. It is quite clear that the mean markup of SOEs is consistently higher than that of non-SOEs over sample years, and the difference remains statistically significant.

After obtaining a general impression of firm-level markup, we take a look at productivity (TFP) differences between SOEs and non-SOEs. Figure 2 presents the average TFP of SOEs and non-SOEs in the period 1998-2005. Strikingly, non-SOEs always had a higher average level of TFP than did SOEs, although both groups show an increasing trend in TFP over the sample years. Appendix Table 1 presents the mean and standard deviation of TFP for SOEs and non-SOEs in each year in the period 1998-2005. Clearly, non-SOEs had consistently higher mean TFP than did SOEs in each sample year, and the difference is statistically significant. Figure 3 depicts the average markup differences between the treated firms and control firms over the five periods before and after privatiztion. The upper and lower bounds of 95% confidence interval show that their differences are not significantly different from zero before privatization but the markups of privatized SOEs become significantly lower than SOEs in the control group since the first year of privatization, and the gaps between them keep widening till the last observational periods.

These figures and summary statistics suggest that SOEs had higher markup and lower TFP than did non-SOEs in the sample period. To confirm that this observation truly holds, we conduct DID regression analysis to identify the impacts of state ownership on firm-level markup and TFP. In Table 2, we present the baseline regression results for the impacts of privatization and restructurings on firm-level markup following regression model (**??**) The difference between Column 1 (3) and Column 2 (4) lies in that Column 2 (4) controls for firm-time trend while Column 1 (3) does not. The results demonstrate quite clearly that restructured SOEs enjoyed a statistically significant reduction in markup and significant increment in TFP after privatization, and this change is significant after taking into account the corresponding changes in the markup and TFP of those continuous SOEs. Our findings of TFP increases after SOE restructurings reinforce the conclusion reached in the earlier studies such as Brown, Earle, and Telegdy (2006, JPE), Brown, Earle, and Telegdy (2004, working paper), Li and Xu (2004, J of Law and Econ), Jefferson and Su (2006, JCE), and Bai, Lu and Tao (2009, JCE) (See Estrin, Hanousek, Kočenda, and Svejnar (2009, JEL) for a review of litera-

ture.) [8] Our results of a decline in markup upon privatization provide new insights on the relationship between monopoly power and privatization.

Theoretically speaking, a decline in markup after restructuring may be induced by a decrease in product prices and/or an increase in production costs. The fact that TFP has increased substantially after restructuring implies that an increase in production costs is unlikely to occur, or at least is unlikely to be the dominant driving force for the decline in markup. Hence, a reduction in product prices must be the primary factor that pushes down markup in the post-restructuring period. This in turn demonstrates that SOEs had enjoyed substantial administrative monopoly power and thus could overcharge for their products before restructuring and privatization.

Based on the results in Columns (2) and (4), we can see that, after an SOE was restructured, its markup would decline by 0.3% and its TFP would rise by 0.9%, after deducting the corresponding changes in markup and TFP for those firms remaining as SOEs. Since the change in markup observed in regressions represents the net effect after taking into account the changes in product price and marginal cost, the surge in TFP and thus the expected drop in costs would imply that the product price has decreased much more than have the TFP and the markup. This in turn suggests that SOEs had enjoyed sustantial monopoly power before they were restructured and privatized.

The existence of administrative monopoly power enjoyed by SOEs can be corroberated by some other conventional measures of industrial monopoly power. In Figure 4-1 and 4-2, we present the scatterplots of the relationship between industry Herfindahl index (i.e. degree of industrial concentration) and the concentration of SOEs in the industry reflected in the share of SOEs' employment in total employment of the industry and in the share of SOEs' output in the total output of the industry, respectively. Clearly, there is a positive relationship between industry Herfindahl index and the two indicators of SOE concentration in the industry, which implies that industries have a higher degree of concentration when SOEs account for a larger proportion of output and employment.

Another indicator that could measure the government protection and hence the administrative power enjoyed by SOEs is the industrial spatial Gini coefficient which gauges the inequality in spatial distribution of industry across regions (Krugman, 1991). We caculate spatial Gini coefficient for each 2-digit industry at both province-level and city-level. Spatial Gini coefficient is calculated as $G_i = \sum_r (x_r - s_{ir})^2$, where x_r is the average share of region r in the national total labor employment of all industries, and s_{ir} is the

[8] Since the effects of privatization and restructurings on TFP in China are well studied in the literature, we will mainly present our results on markup in the following discussion.

share of region r's labor employment of industry i in the national total labor employment in industry i. Obviously, this spatial Gini cofficient measures the deviation of a region's labor employment concentration in a certain industry from its average labor employment concentration across all industries.

In Figure 5-1 and 5-2, we plot the relationship between inequality of industry spatial distribution (measured by spatial Gini coefficients) and the share of SOEs emploment in total employment of the industry. Clearly, there is a negative relationship, which means industries with a higher share of SOEs tend to be more evenly distributed across China's regions. As we know, both provinces and cities in China exhibit substantial differences in natural resource and human capital endowments. If there were no local government protection, the spatial distribution of industries would be fairly uneven because different regions would be specialized in the industries in which they had comparative advantage. On the contrary, if there is local government protection of local enterprises, different regions may display a high degree of similarity in industrial structure and a low degree of inequality in spatial distribution across regions. Since we find that industries with a higher level of SOE participation exhibit a lower degree of spatial distribution inequality, we can infer that industries with high SOE involvement must have received tremendous local government protection and support to maintain administrative monopoly by repressing competition from non-SOEs in the region and enterprises from other regions.

5.2 Validity Checks on the DID Estimation

1. Pre-treatment period. To see whether privatization or restructurings led to changes in markup, we examine the markup changes in the three years prior to privatization. If statistically significant changes had already taken place before privatization, it would cast doubt on whether the markup changes were caused by restructurings. If no significant changes were detected, we are more confident with the claim that privatization/restructuring led to changes in markup. As shown in Column 1 of Table 3, no statistically significant changes in markup were detected in the three years before privatization. This confirms that markup changes were induced by privatization.

2. Adding control variables. If the restructured SOEs (the treatment group) and the SOE control group are balanced, the inclusion of additional firm-level controls should not change the statistical significance and magnitude of the estimator. To see whether our results are robust, we add some firm-level characteristics including firm size (log output), firm age, export status, and industry-time fixed effects. Firm size may affect markup, although the direction of its impacts is ambiguous. For instance, larger firms could

have lower marginal production costs due to economy of scale and hence increase markup when they charge the same prices for their products as do their smaller counterparts. Alternatively, larger firms may be more capable of developing differentiated products and thus enjoy higher monopoly power so as to display higher markup. We use logarithm of output as a proxy of firm size. Our results remain qualitatively equivalent if we use total employment or total assets to gauge firm size. Firm age is likely to indicate the degree of maturity of the firm, which could affect the monopoly power enjoyed by the firm. Presumably the longer a firm is able to survive in the market, the more profitable the firm is likely to be, which in turn leads to higher markup. We use the the logarithm of the number of years since the firm's establishment to measure firm age. Exporting status is arguably related to firm-level markup. Exporting firms are likely to enjoy higher markup. De Loecker and Warzynski (2012) examine the impacts of export status on firm markup. To control for the effects of exporting on markup, we add a dummy variable Export Status that takes value 1 if the firm exports its products and 0 otherwise. In addition, we also control for industry-time fixed effects in addition to industry fixed effects to capture the changes in industry-level factors over time that may affect firm-level markup. For instance, in doing so, we can effectively control for the changes in the degree of market competition in any industry over time in the process of market economy development, and are thus able to disentangle the impacts of state ownership and those of industry competition degree on firm-level markup. Column 2 of Table 3 shows that our main results remain intact after adding these control variables.

3. Focusing on the sub-sample of restructured SOEs. One may be concerned that the SOE restructuring process is not exogerous so that restructured SOEs could be systematically different from the continuous SOEs. For instance, under the principle of "grasp the big and let go the small ones", the remaining SOEs might be strategically more important to the national economy and thus enjoyed higher monopoly power from government support and protection than those SOEs that were restructured and privatized. Hence, it is possible that using continuous SOEs in the sample period as the control group may not produce a good comparison benchmark for the counterfactual scenario that the restructured SOEs had not been privatized, i.e. we might exaggerate the markup premium that restructured SOEs might be able to obtain if they had not been restructured. We admit we cannot completely rule out this concern. Nevertheless, we can minimize the potential impacts of this endogenous restructuring decision issue on our control group construction by focusing on the sub-sample of restructured SOEs in our data set. As different firms were privatized in different years, SOEs that were restructured in a later year can be ideal control group firms for those

that changed their ownership identity in an earlier year. This approach could maximize the similarity and comparability between the treatment group and the control group, and minimize the impacts of some potential systematic factors on SOE restructuring decisions and the changes in markup. Column 3 in Table 3 reports the regression results for markup changes by focusing on the restructured SOE sample. The main results are equivalent to what we have in Table 2.

4. Matched control group estimation. So far we have been using the average value of markup in all firms in the control group as a proxy for the outcome of a counterfactual scenario that a restructured SOE in the treatment group were not privatized. A more refined approach to selecting control group is to adopt the propensity score matching method to construct a matched counterfactual for each restructured SOE. Specifically, we use the 1-1 nearest neighbor matching based on the pre-treatment firm characteristics. By following Bai, Lu and Tao (2009), we consider some important firm and region characteristics in carrying out propensity score matching, i.e., sales, sales per capita, debt-to-assets ratio, employment share of non-SOEs in 3-digit industry, employment share of non-SOEs in city, changes of non-SOEs in 3-digit industry, changes of non-SOEs in city in previous year, year fixed effects, industry fixed effects, and firm-year trend, etc. Clearly, we consider factors such as firm size, firm debt burden, and the progress of private sector development in the industry and region as potential determinants of SOE restructuring. By controlling for industry fixed effects and industry-year trend, we also take into account the impacts of industry characteristics (such as the strategic importance of different industries, the degree of market competition of different industries, etc.) and their time variation on firm markup. Employing this propensity score matching method, we form a matched control group, i.e. a group of firms that had similar tendency to be privatized and restructured but in reality still remained as SOEs. This matched control group is expected to produce a sharper comparison with the treatment group (i.e. privatized SOEs). Column 4 of Table 3 shows that the statistical significance and the magnitude of the estimated coefficient remain unchanged, that is, our main findings remain both quantitatively and qualitatively equivalent.

5. Post-treatment period. One concern with our DID estimator in equation (13) is that it is an average effect for the post-privatization years so that it might well capture the effects of some other events taking place after restructuring/privatization. To see how the effects vary over the post-privatization years, we decompose our DID estimator in equation (25) into effects of year 0 (the year of restructuring), year 1 (the year immediately after restructuring), and years 2-6 (two to six years following restructuring). Column 5 of Table 3 shows that the decline in firm markup of restructured

SOEs primarily occurred in years 0 and 1, i.e., the year of restructuring and the first year after restructuring. The same conclusion holds even if we separate the effects of years 2-6 into those of five different years. This pattern helps mitigate the concern that some other corporate events could possibly drive our results.

6. Placebo tests. If restructuring/privatization and some other corporate events happened at the same time, our DID estimators of markup changes may capture the effects of ownership identity changes and other factors. To minimize this concern, we conduct a placebo test. Specifically, assume that there exists a variable z that is not supposed to be affected by the change in ownership nature. Then, a DID estimation of ownership status changes on z should produce no statistically significant estimated coeffcients. For the choice of z, we use corporate diversification, i.e., the proportion of non-core-business in total business calculated as the ratio of non-core-business revenue over total revenue. Arguably, firms may not adjust their product mixes after restructuring/privatization, at least in a short period. Column 6 of Table 3 confirms that SOE restructuring did not produce statistically significant effects on the changes in the proportion of non-core-business revenue in total revenue.

We admit that it is impossible for us to exhaust all kinds of other corporate events and distinguish their impacts from that of restructuring. An alternative way to test if the effect of restructuring on markup comes from some extraneous events is to counterfactually change the event year. That is, we move backward and forward the restructuring year, and see whether the effects of restructuring still remain intact. If yes, it is highly suspicious that the impacts of some other corporate events are intermingled with those of privatization. In Columns 7 and 8, we use the pre-treatment year t-2 and the post-treatment year t+2 as the event year, respectively. Clearly, the significant effects of restructuring on markup have disappeared in these two placebo tests. This provides support to our claim that restructuring rather than some other events is the main driving force for the observed impacts on markup.

5.3 Some Other Robustness Checks

1. Excluding potential outliers. To ensure that our results are not driven by outliers, we exclude some potential extreme observations, i.e., observations (firm-years) whose markups are in the top or bottom 0.5%, from our sample. In Column 1 of Table 4, we obtain qualitatively equivalent results, i.e., the magnitude of the estimated coefficient of SOE restructuring remains the same as that in Column 2 of Table 2, although the statistical significance drops

slightly.

2. Alternative classifications of SOEs and non-SOEs. As mentioned above, after restructuring, state ownership still keeps a fairly sizeable presence in quite a few restructured enterprises, especially those that are relatively large in size and engaged in some key economic sectors (Lin and Zhu, 2001). Since SOE restructuring/privatization did not drive out state ownership in many restructured/privatized firms, and the state instead often still holds some stake or even controlling stake in the restructured SOEs, it is natural for one to be concerned with the vestiges of state ownership in the restructured/privatized SOEs that could affect our findings. To deal with this concern, we re-classify SOEs and non-SOEs in our sample. SOEs are defined as those firms where the state has 100% ownership share, whereas non-SOEs are defined as firms without any state capital share. Obviously, this is the most extreme but clearcut classification of SOEs and non-SOEs. We focus on the subsample where SOEs were restructured into pure non-SOEs without any state ownership, and use all constant SOEs to form a control group. In Column 2 of Table 4, we present the DID estimation results with this alternative classification. Clearly, our main findings remain unchanged. This relieves us of the concern about the efficacy of restructurings in diminishing the link between the government and the firm for those restructured SOEs where the state retains some stake.

3. Alternative markup estimation. So far SOEs and non-SOEs share the same production function in our estimation of markup. Nonetheless, it is likely that SOEs and non-SOEs are systematically different from each other in utilizing production factors. To tackle this possible problem, we estimate production function coefficients for SOEs using the SOE sample, and those for non-SOEs using the non-SOE sample. Afterwards we combine the two groups of estimates together in regression analysis. The DID estimation results are shown in Column 3 of Table 4. The results remain equivalent.

4. Alternative capital measure. We have used the book value of capital reported in the data set to measure k_{it} after taking into account the depreciation of capital stock over time. Nevertheless, as mentioned earlier, SOEs might have manipulated the depreciation of captial stock, especially those restructured SOEs. It is possible that depreciation was exaggerated in the restructuring process to reduce the value of capital stock so that management or outside acquirers might benefit from undervalued capital in the privatization process. As a robustness check, we re-estimate the production function by using the original value of capital reported in the data set that is much less affected by depreciation. In Column 4 of Table 4, we present the DID estimation results using this alternative measure of capital stock. The estimated coefficient remains unchanged, although its statistical significance

diminishes slightly.

5. Dealing with omitted price bias. As mentioned above, we follow the method of De Loecker (2011, Econometrica) to deal with the omitted price bias in estimating production function. Specifically, sector aggregate demand shifters (3-digit industry total output) are introduced as an additional regressor into the production function estimation. The regression results are shown in Column 5 of Table 4, which are essentially unchanged.

5.4 Heterogeneous Responses and the Nature of Administrative Monopoly Power

By examining the changes in markup of privatized SOEs before and after restructuring, we can detect the monopoly power enjoyed by SOEs. We have argued that SOE monopoly power is erected and maintained by the administrative power of governments. It is a way for bureaucrats to protect and support SOEs so as to steer SOE resources to achieve the political and social objectives set by bureaucrats. To further understand the nature of SOE markup premium as a result of administrative monopoly power, we examine how SOE markup is shaped by government power and its economic policies. In particular, we investigate whether SOE markup and thus the degree of administrative monopoly power is affected by the level of the governments that "own" and supervise those SOEs and by the priority given to different types of SOEs in government's industrial policy. For this purpose, we conduct some analysis of heterogeneous responses of different sub-samples.

Firstly, we investigate how SOE markup varies with the level of governments that administer them. In China, in both the central planning period and the reform era, SOEs are administered by different levels of governments. A relatively small proportion of SOEs have been administered by the central government ministries or the provincial governments. The majority of SOEs have been administered by city or county governments. In our sample, a proportion of 31% of SOEs are administered by the central or provincial governments, whereas a proportion of 69% by city or prefectural governments.

If the SOE monopoly power is granted and maintained by the administrative power of governments, we expect that SOEs affiliated with higher level governments, e.g., the central government ministries or provincial governments, would have wielded larger market monopoly power before restructuring than did SOEs affiliated with lower level governments, e.g., city or county governments. This is mainly because SOEs administered by the higher level governments enjoyed access to a larger market under the jurisdiction of higher

level governments and could collude with their supervising governments to seek more monopoly rents. Hence, the former is anticipated to witness a sharper decline in markup than did the latter after restructuring.

We classify the SOE sample into two sub-samples. One consists of the SOEs under the administration of the higher-level governments including both the central government and the provincial governments, whereas the other is made up of SOEs under the purview of city or county governments. Then we carry out the DID regression analysis for the two sub-samples separately. Columns 1 and 2 of Table 5 present the estimation results for the higher-level SOEs and lower-level SOEs respectively. Both groups of SOEs exhibit the positive effects of state ownership on markup. Nonetheless, the effect is statistically significant in the sub-sample of higher-level SOEs but insignificant in the lower-level SOE sub-sample. Moreover, the magnitude of the impact is much higher for the higher-level SOEs than for the lower-level SOEs. These striking results confirm our prediction that the SOEs affiliated with the higher-level governments had enjoyed a higher degree of monopoly power before privatization. The variation in SOEs' markup with the level of supervising governments testifies to that the SOE monopoly power comes from government protection and support.

Secondly, we investigate how the differences in SOE markup are shaped by the variations in the priority given to different types of SOEs in government's development strategy and industrial policy. It is well documented in the literature that the Chinese government has placed primary emphasis on the development of capital and technology-intensive industries in the transition period**.** These industries can generate more value added taxes and push up GDP growth more effectively than do labor-intensive industries **(Lin, 2009),** which is consistent with the government's policy objectives. Hence, the industrial development in China exhibits salient characteristics of deviating from endowment-based comparative advantage and overemphasizing heavy industries. As we know, China's spectacular economic growth in the past decades was mainly achieved under two institutional building blocks, i.e. the tax sharing system and the promotion tournament for bureaucrats (Xu, 2011). Under the incentive structure created by this institutional framework, provincial and local governments are striving to raise GDP growth and tax revenue. As a primary policy instrument, bureaucrats give priority to the development of capital and technology-intensive industries in order to promote tax revenue growth and GDP growth, which in turn would showcase their administrative achievement and enhance their promotion prospects in the ladder of administration hierarchy (Lin and Tan, 1999). Since SOEs are the dominant players in the industrialization process, bureaucrats will promote capital and technology-intensive industries by providing protection

for and support to the SOEs engaged in these types of industries (Lin and Tan, 1999; Lin, 2009). Consequently, those SOEs engaged in more capital and technology-intensive industries are expected to exhibit a more striking decline in markup upon restructuring and privatization.

To examine the potential differential responses, we first examine industries with different levels of capital intensity. We measure industry capital intensity by the average ratio of capital to labor in the industry, and partition all industries in our sample into three categories: high capital intensity (the top 25%), medium capital intensity (the middle 25-75%), and low capital intensity (the bottom 25%). Then all the sample firms are divided into three sub-samples, and we conduct DID regression analysis for each sub-sample separately. Columns 3-5 of Table 5 report the DID estimates for the high, medium, and low capital intensity sub-samples, respectively. It is found that the effects of state ownership on raising markup are statistically significant only in the sub-sample of high capital intensity industries. At the same time, the magnitude of the estimated coefficient is also the largest in the regression analysis for the sub-sample of the high capital intensity industries.

Next, we analyze industries with different levels of technology. We gauge the industry technology level according to the OECD 2007 technology classification of manufacturing industries at 2-digit industry level. We assign all the sample firms into four categories, i.e. high technology level, medium-high technology level, medium-low technology level, and low technology level, and carry out DID regression analysis for each sub-sample separately. Columns 6-9 of Table 5 present the DID regression results for the high, medium-high, medium-low and low technology sub-samples, respectively. It is found that restructuring reduces markup for all the four sub-samples. The magnitude of the effect of state ownership on markup is much higher in the sub-samples of high and medium-high technology industries than in the other two. Nevertheless, the effect is statistically significant only in the group of SOEs with medium-high level technology. One possible explanation of this pattern of findings is that SOEs engaged in lower-technology industries received small government support and protection both before and after restructuring so that they exhibit no striking changes in markup. SOEs in high-technology industries could have enjoyed monopoly power partly from the government protection and partly from their differentiated products based on their technology strength before restructuring. After privatization and restructuring, the government is likely to still provide some support to these privatized SOEs because they are major players for local industrial development. They could also continue to enjoy some market power with the help of their technology advantage. Thus, this group of high-technology firms exhibits no salient changes in markup. The SOEs with medium-high level technology are most

sensitive to ownership change. It is likely that the market power they enjoyed in the pre-restructuring period was primarily derived from government protection. After restructuring, the government placed primary emphasis on supporting high-tech firms so that this group of firms lost most of government support and protection after restructurings. At the same time, they do not have enough technology advantage to enjoy market power. Hence, they display the most salient changes in markup following privatization.

The findings in this sub-section not only shed light on the nature of SOE markup premium as administrative monopoly rents, but also suggest that those remaining SOEs in the Chinese economy are still enjoying substantial monopoly rents. First, our control group of continuous SOEs has been shown to continue to enjoy tremendous monopoly rents. Second, under the principle of "grasp the big and let go the small ones", those SOEs having survived the restructuring wave are probably the privileged SOEs that are regarded as of strategic importance to the national and regional governments. It is expected that they have and continue to receive tremendous government protection and support, and hence they probably have and continue to enjoy even higher monopoly rents than did those restructured SOEs.

6 Concluding Remarks

[[**To be expanded...**]]

A growing number of emerging economies have espoused state capitalism and regarded it as a sustainable model for economic development. As the most important instrument of state capitalism, SOEs have played an increasingly important role in those economies. In this study, we employ the DID approach to investigating the changes in firm-level markup and TFP before and after SOE restructurings and privatization in China. We obtain strong evidence for the existence of twin costs of state ownership in China, that is, low production efficiency and high monopoly power. Our findings demonstrate forcefully that the apparent prosperity of SOEs stems from administrative monopoly power at the expense of market competition and consumer welfare.

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References

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Press.

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7 Appendix 1: Production Function Estimation

We re-write the production function (1) in the translog form

$$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it}, \tag{15}$$

where the lower case letters represent the logarithm of the upper case letters; $\boldsymbol{\beta} = (\beta_l, \beta_k, \beta_m)$ is the vector of the production function coefficients; and ε_{it} is an i.i.d. error term. To proxy ω_{it}, Levinsohn and Petrin (2003) assume that

$$m_{it} = m_t (l_{it}, k_{it}, \omega_{it}). \tag{16}$$

Given the monotonicity of $m_t(.)$, we can have

$$\omega_{it} = h_t (l_{it}, k_{it}, m_{it}). \tag{17}$$

In the first stage, we estimate the following equation

$$q_{it} = \phi_t (l_{it}, k_{it}, \omega_{it}) + \varepsilon_{it}, \tag{18}$$

where

$$\phi_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + h_t (l_{it}, k_{it}, m_{it}), \tag{19}$$

and obtain the estimates of the expected output ($\hat{\phi}_{it}$) and the error term ($\hat{\varepsilon}_{it}$).

Meanwhile, to recover all the production function coefficients $\boldsymbol{\beta}$ in the second stage, we model that firm productivity follows a first-order Markov movement, i.e.,

$$\omega_{it} = g_t (\omega_{it-1}) + \xi_{it}, \tag{20}$$

where ξ_{it} is an idiosyncratic shock.

From the first stage, the productivity for any given value of $\boldsymbol{\beta}$ can be computed as

$$\omega_{it} (\boldsymbol{\beta}) = \hat{\phi}_{it} - \beta_l l_{it} - \beta_k k_{it} - \beta_m m_{it}. \tag{21}$$

Then the idiosyncratic shock to productivity given $\boldsymbol{\beta}$, $\xi_{it} (\boldsymbol{\beta})$, can be obtained through a non-parametrical regression of $\omega_{it} (\boldsymbol{\beta})$ on $\omega_{it-1} (\boldsymbol{\beta})$.

To identify the coefficients of the production function, Ackerberg, Caves, and Frazier (2006) assume that capital is determined one period beforehand and hence is not correlacted with $\xi_{it}(\boldsymbol{\beta})$. Meanwhile, wage rates and prices of intermediate materials are assumed to vary across firms and be serially correlated. Therefore, the moment conditions used to estimate the coefficients of the production function are

$$E\left(\xi_{it}(\boldsymbol{\beta})\begin{pmatrix} l_{it-1} \\ k_{it} \\ m_{it-1} \end{pmatrix}\right) = 0. \tag{22}$$

After we recover the coefficient of intermediate materials in the production function $\hat{\beta}_m$, which is the estimated output elasticity of intermediate material inputs, the firm-level markup can be calculated based on equation (9), i.e.,

$$\hat{\mu}_{it} = \hat{\beta}_m \left(\hat{\alpha}_{it}^m\right)^{-1}, \tag{23}$$

where $\hat{\alpha}_{it}^m = p_{it}^m M_{it} / \left(S_{it}/exp\left(\hat{\varepsilon}_{it}\right)\right)$ and S_{it} is the total revenue.

8 Appendix 2: Rationale for the DID Analysis

Consider the situation that there are two groups of SOEs, in which one group changed the status from SOE to non-SOE at time t_0 and the other group remained as SOEs through the time. Denote the indictor of the group identity S_i as

$$S_i = \begin{cases} 1 & \text{if SOE } i \text{ in the treatment group} \\ 0 & \text{otherwise} \end{cases}. \tag{24}$$

Hence, the DID estimator is

$$\begin{aligned} -\gamma_{\mathbf{DID}} &= E\left[\ln \mu_{it_0} - \ln \mu_{it_0-1} | S_i = 1\right] - E\left[\ln \mu_{it_0} - \ln \mu_{it_0-1} | S_i = 0\right] \\ &= E\left[\ln \mu_{it_0}(0) - \ln \mu_{it_0-1}(1) | S_i = 1\right] - E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1) | S_i = 0\right] \\ &= -\gamma \\ &\quad + \begin{pmatrix} E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1) | S_i = 1\right] \\ -E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1) | S_i = 0\right] \end{pmatrix}. \end{aligned} \tag{25}$$

The term in the parenthesis constitutes our identification assumption, that is,

$$E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1) | S_i = 1\right] = E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1) | S_i = 0\right]. \tag{26}$$

Literally, the identification assumption requires that if the treatment group had not undergone status change, it should follow the same trend over time as the control group.[9] We further include firm-specific time trend to allow each firm to follow a different trend over time. Hence, our identification assumption becomes

$$E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1)|\lambda_i, S_i = 1\right] = E\left[\ln \mu_{it_0}(1) - \ln \mu_{it_0-1}(1)|\lambda_i, S_i = 0\right], \tag{27}$$

where λ_i denotes firm dummy.

We discuss a few necessary conditions and robustness checks on the identification assumption (27) of our DID estimation.

First, the identification assumption (27) implies that the change in markup for firms in the treatment group before they changed the status should be the same as that for firms in the control group. Specifically, denote

$$\delta(-s) = E\left[\ln \mu_{it_0-s} - \ln \mu_{it_0-s-1}|S_i = 1\right] - E\left[\ln \mu_{it_0-s} - \ln \mu_{it_0-s-1}|S_i = 0\right], \tag{28}$$

where $s \geq 1$. Hence, a necessary condition for our identification assumption is that

$$\delta(-s) = 0 \forall s. \tag{29}$$

Second, if the treatment and control groups are balanced, the inclusion of additional firm-level controls should not change the statistical significance and magnitude of the estimator. Specifically, denote

$$-\gamma_{\mathbf{X}} = E\left[\ln \mu_{it_0} - \ln \mu_{it_0-1}|\lambda_i, \Delta\mathbf{X}_i, S_i = 1\right] - E\left[\ln \mu_{it_0} - \ln \mu_{it_0-1}|\lambda_i, \Delta\mathbf{X}_i, S_i = 0\right], \tag{30}$$

where $\mathbf{X}_i$ is a vector of firm-level controls. Hence, a necessary condition for our identification assumption is that

$$\gamma_{\mathbf{X}} = \gamma_{\mathbf{DID}}. \tag{31}$$

Third, one may be concerned that SOEs with changes in their ownership status could be systematically different from those without; hence, the control group may not be a good counterfactual for the treatment group. As a robustness check, we focus on the sub-sample of SOEs who changed their ownership status during our sample period. As the change of ownership status happened in different years, SOEs who changed their status later become the control group for those who changed earlier. Specifically, denote

[9] Note that our identification assumption allows the treatment and control groups to be different.

the DID estimator from this sub-sample as $\gamma_{\mathbf{Subsample}}$. Hence, a necessary condition for our identification assumption is that

$$\gamma_{\mathbf{Subsample}} = \gamma_{\mathbf{DID}}. \tag{32}$$

Fourth, instead of using the average of all firms in the control group to proxy the counterfactual outcome for a firm in the treatment group, we adopt the propensity score matching method to construct a matched counterfactual for each firm in the treatment group. Specifically, we use the 1-1 nearest neighbor matching based on the pre-treatment firm characteristics (for the choice of these firm characteristics, see Bai, Lu, and Tao, 2008). Denote the DID estimator from this matched sub-sample as $\gamma_{\mathbf{Matched}}$. Hence, a necessary condition for our identification assumption is that

$$\gamma_{\mathbf{Matched}} = \gamma_{\mathbf{DID}}. \tag{33}$$

Fifth, one may be concerned that our DID estimator in equation (13) may capture the effects of some other events happened after the change of the ownership status. As a robustness check, we decompose our DID estimator in equation (25) into effects of each year in the post-treatment period. Specifically, denote

$$\delta(s) = E\left[\ln \mu_{it_0+s} - \ln \mu_{it_0+s-1} | S_i = 1\right] - E\left[\ln \mu_{it_0+s} - \ln \mu_{it_0+s-1} | S_i = 0\right], \tag{34}$$

where $s \geq 0$. And a necessary condition for our identification assumption is that

$$\delta(0) = \gamma_{\mathbf{DID}}. \tag{35}$$

Sixth, if there are some other events that happened at the time of treatment, our DID estimator may not just capture the effect of state ownership. To rule out this concern, we conduct a placebo test. Specifically, assume there exists a variable z that is not supposed to be affected by the change in the ownership. Then, a DID estimator of z should produce not any statistical significance, i.e.,

$$-\gamma_z = E\left[\ln z_{it_0} - \ln z_{it_0-1} | S_i = 1\right] - E\left[\ln z_{it_0} - \ln z_{it_0-1} | S_i = 0\right] = 0. \tag{36}$$

For the choice of z, we use the ratio of non-core-business revenue over total revenue. Arguably, firms may not adjust their product mixes after the change in their ownership status, at least in a short period.

Table 1: Markup and TFP of SOEs and Non-SOEs in China

	1998	1999	2000	2001	2002	2003	2004	2005
	Panel A: comparison of markup of SOEs and Non-SOEs							
Markup of SOEs	1.58	1.56	1.47	1.44	1.42	1.35	1.26	1.18
St. Err.	.001	.002	.002	.002	.002	.002	.002	.002
# of Obs.	34642	32035	26025	20838	17448	13756	9041	9404
Markup of Non-SOEs	1.41	1.41	1.33	1.31	1.29	1.24	1.15	1.10
St. Err.	.001	.001	.001	.001	.000	.000	.000	.000
# of Obs.	85124	92842	99885	112504	127007	146785	135684	217783
Markup difference between SOEs and Non-SOEs	0.16***	0.16***	0.14***	0.13***	0.13***	0.12***	0.11***	0.08***
	Panel B: comparison of TFP of SOEs and Non-SOEs							
TFP of SOEs	0.84	0.87	0.93	0.96	0.97	1.03	1.17	1.22
Std. Err.	0.003	0.003	0.003	0.003	0.004	0.004	0.007	0.005
# of Obs.	41,432	36,120	29,446	23,876	19,946	15,537	10,049	10,465
TFP of Non-SOEs	0.95	0.96	1.02	1.04	1.05	1.11	1.21	1.25
Std. Err.	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
# of Obs.	100,221	102,387	110,505	126,198	140,278	160,613	145,091	231,870
TFP difference between SOEs and Non-SOEs	-0.11***	-0.09***	-0.09***	-0.08***	-0.08***	-0.08***	-0.04***	-0.03***

Note: Simple means are reported. Markup and TFP are estimated following De Loecker and Warzynski (2012) ; *** denotes two-group mean comparison t-test 1% significance level.

Table 2: Baseline results

	1	2	3	4
	DV: log Markup		DV: log TFP	
γ	0.004***	0.003**	0.014***	0.009*
	(0.001)	(0.002)	(0.005)	(0.006)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Firm time trend	No	Yes	No	Yes
N of Obs. of treated firms	22,785	22,785	22,785	22,785
N of Obs. of control firms	69,628	69,628	69,628	69,628

Note: Standard errors, clustered at firm level, are in parenthesis. *, **, *** denote significance at 10%, 5%, and 1% level, respectively.

Table 3: Validity checks on the DID estimation

DV: log Markup	1 Pre- treat	2 Controls	3 Sub- sample	4 Matched	5 Post- treat	6 Placebo test1	7 Placebo test2	8 Placebo test3
γ	0.003**	0.003**	0.003*	0.003**		-0.269	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.001)		(3.257)	(0.002)	(0.002)
δ (-1)	-0.002							
	(0.002)							
δ (-2)	-0.001							
	(0.002)							
δ (-3)	-0.001							
	(0.002)							
δ (0)					0.004**			
					(0.002)			
δ (+1)					0.004**			
					(0.002)			
δ (+2 ~ +6)					-0.001			
					(0.002)			
Log output		-0.000***						
		(0.000)						
export status		-0.007***						
		(0.002)						
firm age		0.000						
		(0.000)						
Industry*time dummies		Yes						
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs. of treated firms	22,785	22,785	22,785	21,547	32,664	22,785	22,785	22,785
# of Obs. of control firms	69,628	69,628	-	14,610	124,713	69,628	69,628	69,628

Note: (1) Sub-sample only include those privatized firms, i.e. excluding constant SOEs.
(2) Matched sample: 1-1 nearest neighbor matching based the pre-privatization firm characteristics, including sales, sales per capita, debt asset ratio, share of Non-SOEs in 3-digit industry, share of Non-SOEs in city, changes of Non-SOEs in 3-digit industry, changes of Non-SOEs in city in previous year, etc. (Bai, Lu, and Tao, 2008). Pair dummies are included.
(3) Placebo test1: use diversification of business (ratio of non-core-business revenue/total revenue) as dependent variable.
(4) Placebo test2: use pre-treatment (t-2) as event time instead of t.
(5) Placebo test3: use pre-treatment (t+2) as event time instead of t.
(6) Standard errors, clustered at firm level, are in parenthesis. *, **, *** denote significance at 10%, 5%, and 1% level, respectively.

Table 4: Robustness checks

DV: log Markup	1 Excl. outliers	2 Alternative definition of SOEs and Non-SOEs	3 Alternative markup estimation	4 Alternative capital measure	5 Allowing for omitted price bias
γ	0.003**	0.003**	0.003**	0.003*	0.003**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Firm time trend	Yes	Yes	Yes	Yes	Yes
# of Obs. of treated firms	22,745	21,899	22,785	22,785	22,785
# of Obs. for control firms	69,287	59,172	69,628	69,628	69,628

Note:(1) Outliers: observations whose markups are in the top or bottom 0.5%.

(2) Alternative definition of SOEs and Non-SOEs: SOEs are defined as firms whose state capital share equals 100%; Non-SOEs are defined as firms without state capital at all.

(3) Alternative markup estimation: estimating production function coefficients using pure SOEs sample.

(4) Alternative capital measure: use original value of capital stock to estimate production function instead of using book value.

(5) Allowing for omitted price bias: we follow De Loecker (2011)'s method to solve omitted price bias in estimating production function.

(6) Standard errors, clustered at firm level, are in parenthesis. *, **, *** denote significance at 10%, 5%, and 1% level, respectively.

Table 5: Heterogeneous responses

DV: log Markup	1	2	3	4	5	6	7	8	9
	SOEs affiliation ranking		Industry capital intensity			Industry technology level			
	High	Low	High	Medium	low	High	Med-high	Med-low	Low
γ	0.009**	0.002	0.005*	0.002	0.002	0.007	0.006***	0.003	0.002
	(0.004)	(0.002)	(0.002)	(0.002)	(0.004)	(0.007)	(0.002)	(0.003)	(0.002)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs. of treated firms	3,170	19,615	7,182	10,906	4,697	2,106	8,409	4,577	7,693
# of Obs. of control firms	21,831	47,797	17,424	36,790	15,414	3,681	25,986	13,364	26,597

Note: (1) SOEs affiliation: central or provincial governments and governments at lower levels are defined as high-level and low-level affiliations, respectively

(2) Industry capital intensity: industries with capital/labor ratio in top 25%, 25-75%, and lower 25% among all industries are defined as high-, medium, and low- capital intensity industries, respectively.

(3) Technology levels are classified according to OECD 2007 technology classification of manufacturing industries at 2-digit industry level.

(4) Standard errors, clustered at firm level, are in parenthesis. *, **, *** denote significance at 10%, 5%, and 1% level, respectively.

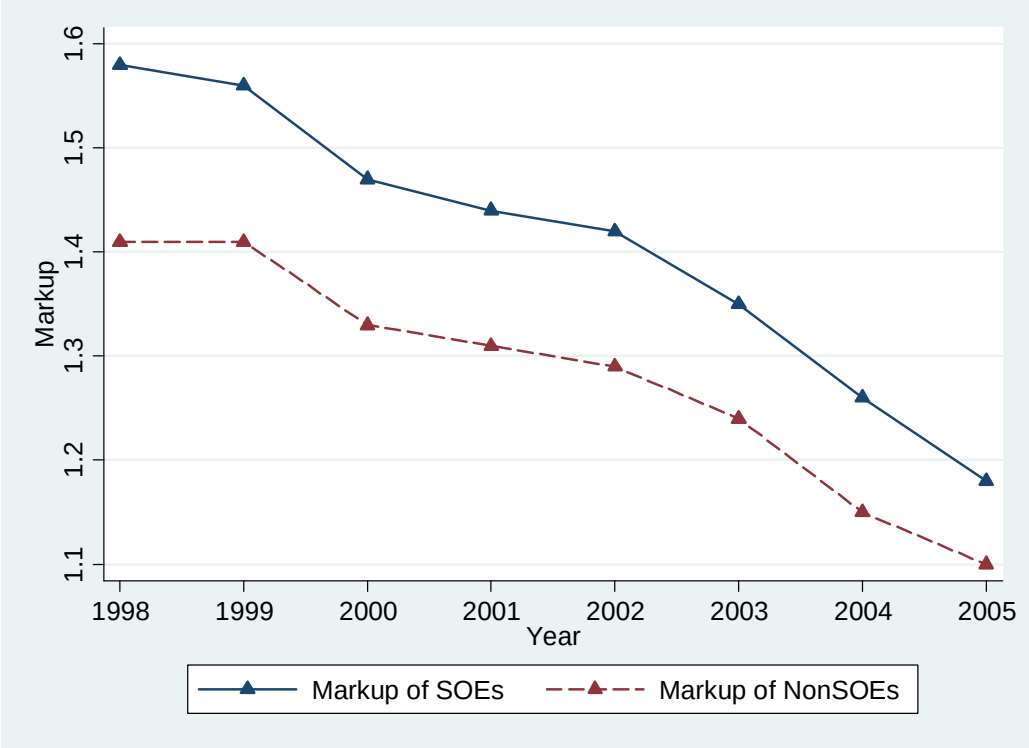

Figure 1: Average markups of SOEs and Non-SOEs in China (1998-2005)

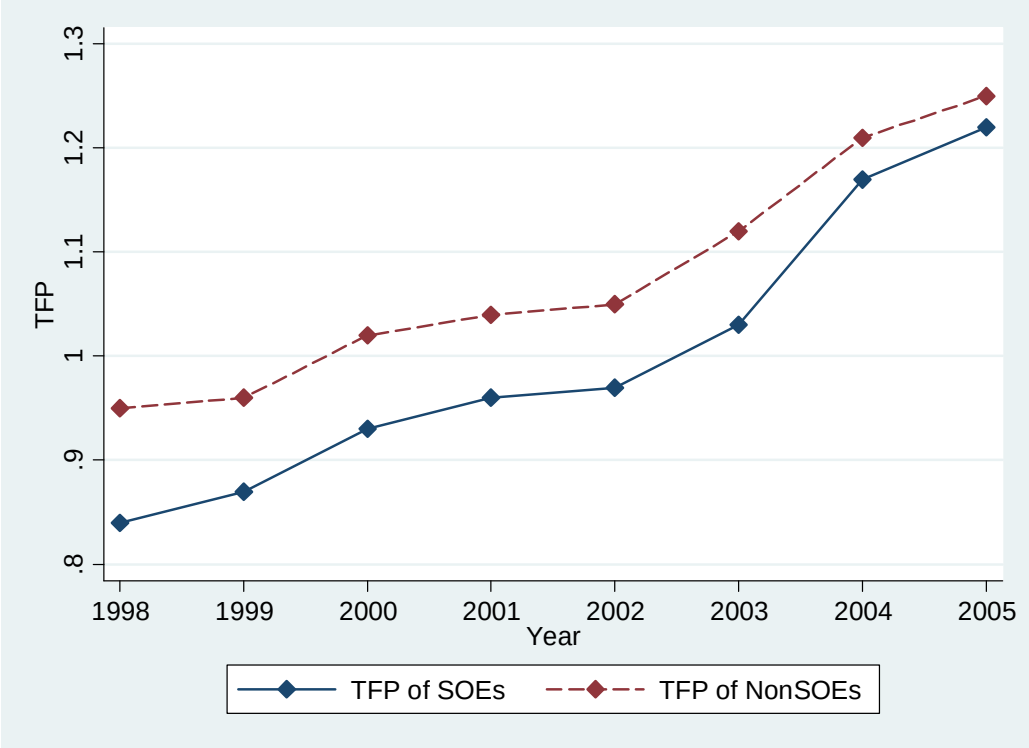

Figure 2: Average TFPs of SOEs and Non-SOEs in China (1998-2005)

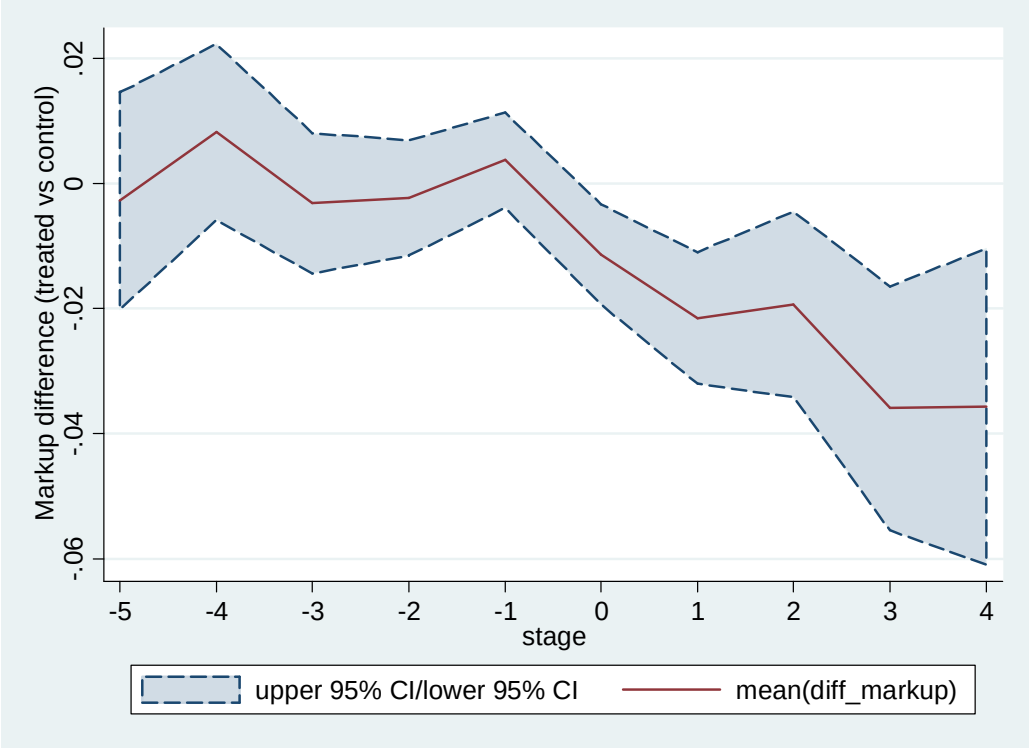

Figure 3: Markup differences between treated firms (SOEs being privatized) and control firms (SOEs not being privatized)

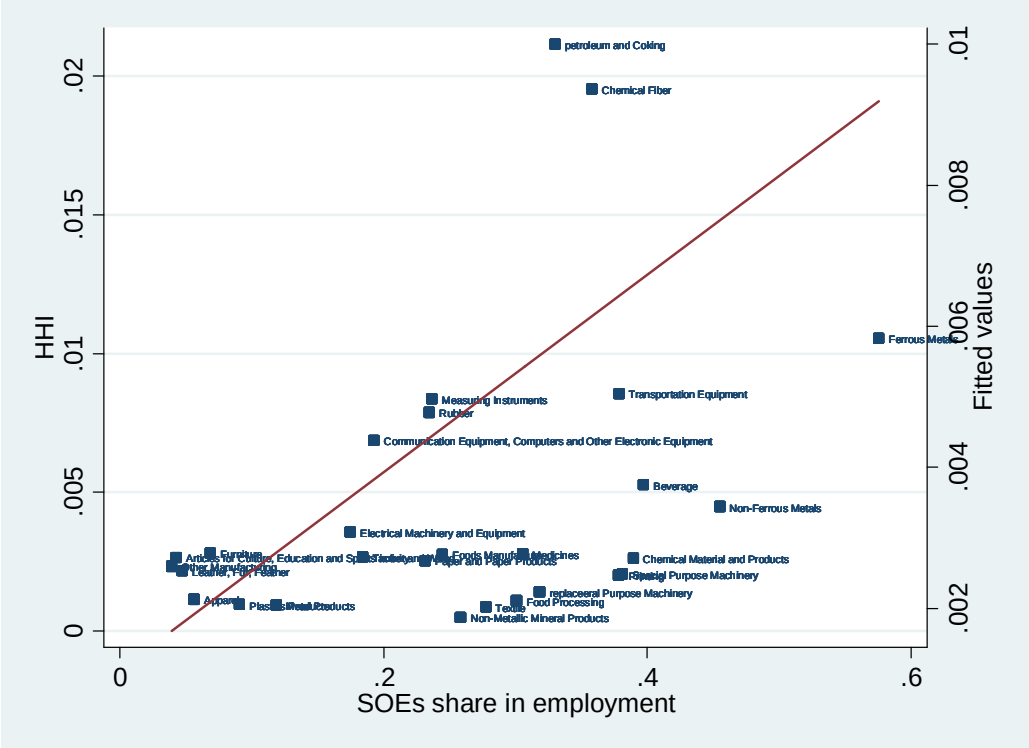

Figure 4-1: industry SOEs shares (in employment) and industry Herfindahl index

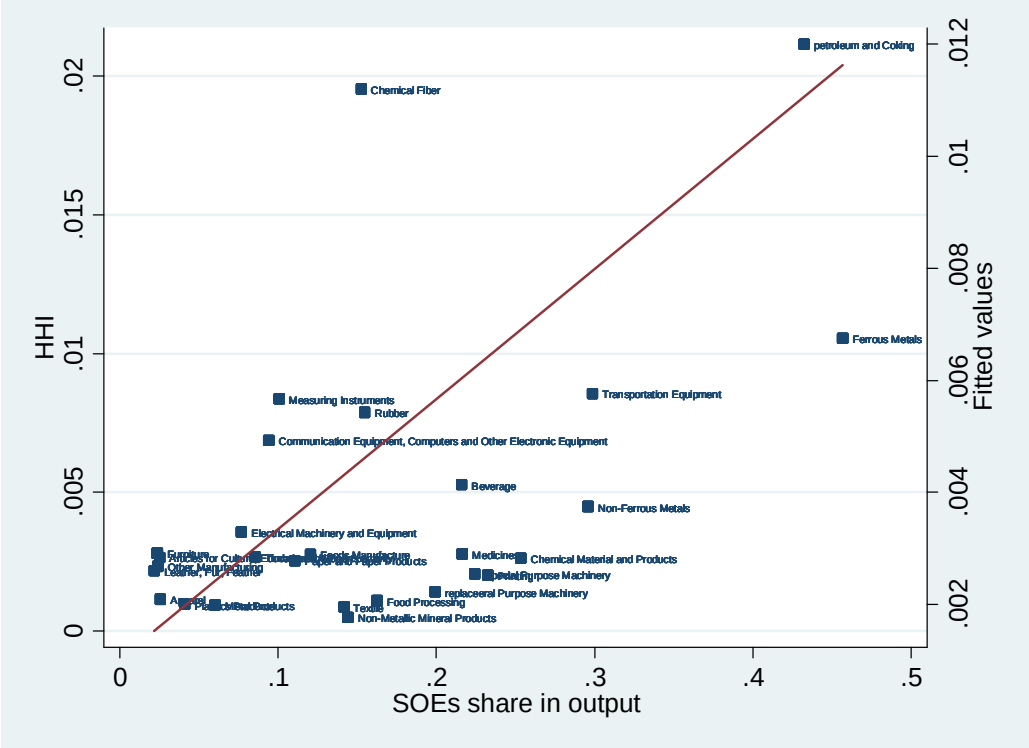

Figure 4-2: industry SOEs shares (in output) and industry Herfindahl index

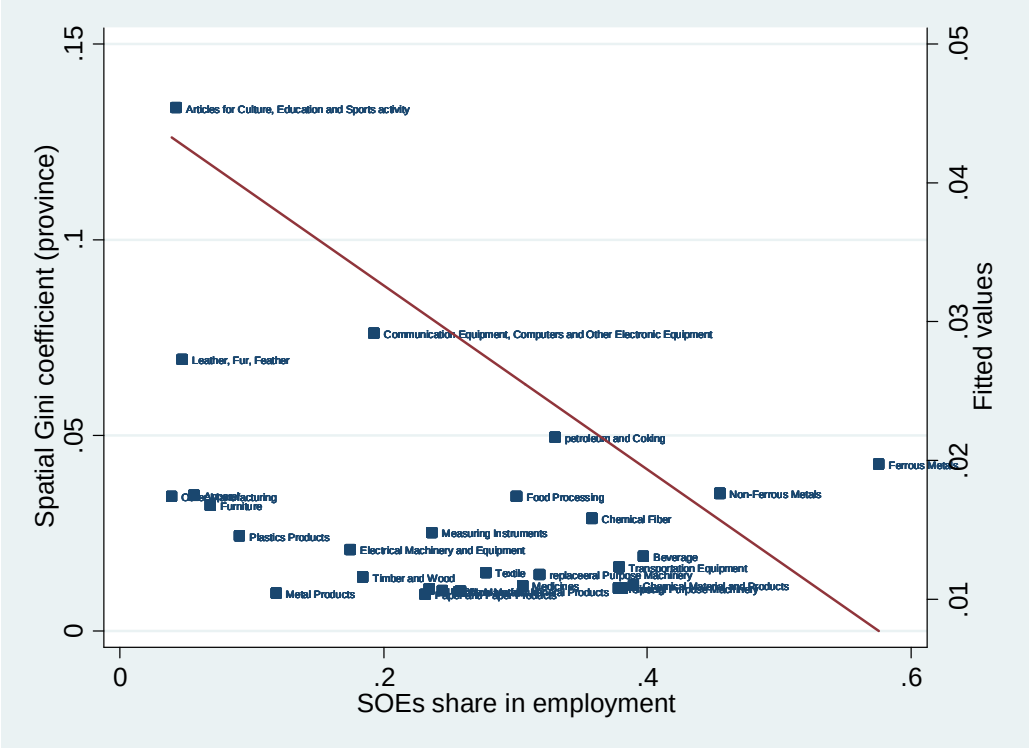

Figure 5-1: industry SOEs shares (in employment) and industry spatial concentrations (measured at province level)

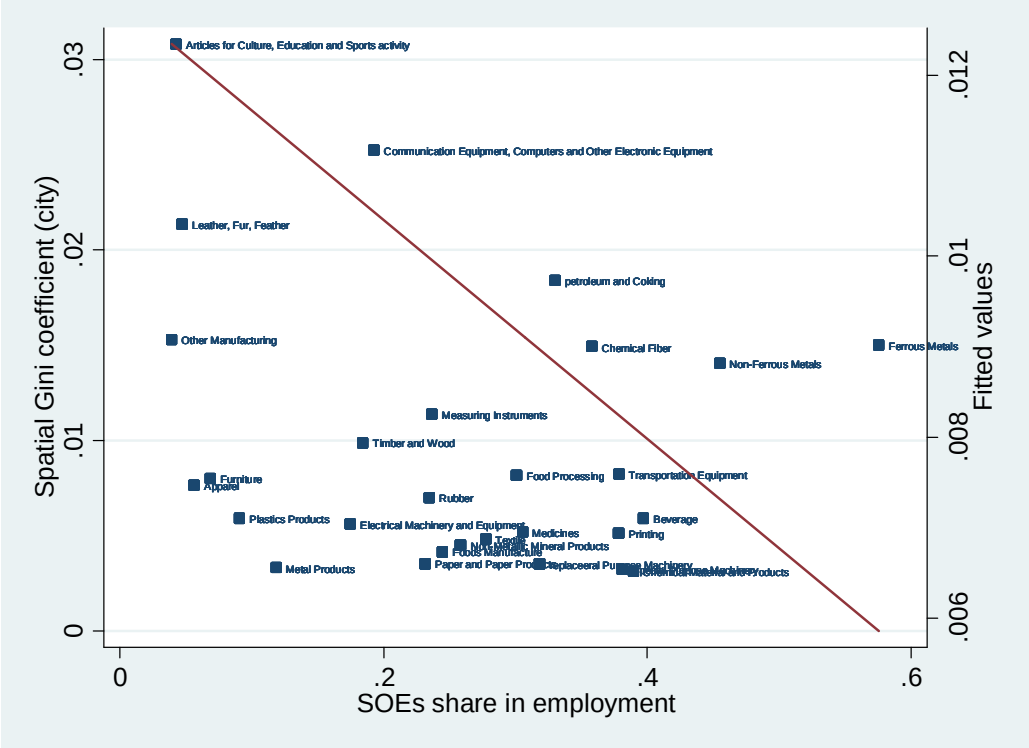

Figure5-2: industry SOEs shares (in employment) and industry spatial concentrations (measured at city level)

Appendix C:

DV:	Log material	Log labor	log material/labor
Privatization (s>=0)	-0.0036	-0.0503***	0.0410***
	(0.0123)	(0.0084)	(0.0129)
Time fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Firm time trend	Yes	Yes	Yes
N of Obs.	116669	124508	116669

Note: negative effect of privatization on labor implies that there are surplus labors in SOEs which are laid off after privatization. In contrast, the materials used by SOEs did not change significantly after privatization. This is because materials input incur much smaller adjustment costs than do labor input, therefore, we use material input to recover markups.