

# Grasp the Large, Let Go of the Small:

## The Transformation of the State Sector in China\*

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### Abstract

Starting in the late 1990s, China undertook a dramatic transformation of the large number of firms under state control. Small state-owned firms were privatized or closed. Large state-owned firms were corporatized and merged into large industrial groups under the control of the Chinese state. The state also created many new and large firms. We use detailed firm-level data to show that from 1998 to 2007, (i) state-owned firms that were closed were smaller and had low labor and capital productivity; (ii) the labor productivity of state-owned firms converged to that of private firms; (iii) the capital productivity of state-owned firms remained significantly lower than that of private firms; and (iv) total factor productivity (TFP) growth of state-owned firms was faster than that of private firms. We find the reforms of the state sector were responsible for 20 percent of aggregate TFP growth from 1998 to 2007.

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# 1 Introduction

A central feature of the industrial revolution in China over the last two decades is the decline of the state-owned sector. Figure 1 illustrates that the share of state owned firms in industrial output declined from 50 percent in 1998 to 30 percent by 2005, and has continued to fall since then, albeit at a slower rate. This fact naturally suggests that China’s growth was driven by the growth of the private sector and the reallocation of resources away from state-owned firms. According to this view, the growth of the private sector was only possible when, starting in the late 1990s, state-owned firms were shut down or privatized. The shutdown of loss-making state-owned firms released resources that were more profitably employed by private firms. In turn, the privatization of state-owned firms may have raised their productivity because such firms may have a closer alignment of control and cash-flow rights. The industrial revolution in China is, thus, nothing more than the triumph of “Markets Over Mao ”, to quote the title of a recent book (Lardy 2014).

There is another view that China’s growth was driven by “State Capitalism”. Advocates of the role of “State Capitalism” point out that although many state owned firms were closed or privatized, firms that remained under state control are among the largest firms in China today. For example, 67 of the 69 Chinese companies in Fortune Magazine’s 2014 list of the 500 largest companies in the world are state owned. One can also point to the experience of specific state owned companies. Consider, for example, the experience of the Baoshan Steel Company. Baoshan, a large steel manufacturer in Shanghai, became a publicly traded company in 2000.<sup>1</sup> The controlling share (75 percent) was held by a holding company (the BaoSteel Group) wholly owned by the Chinese central government.<sup>2</sup> Baoshan has done very well since the late 1990s. Total sales increased from USD 2.8 billion in 1998 to USD 17 billion by 2007. Profits increased by even more, from USD 122 million in 1998 to USD 2.5 billion by 2007. Baoshan is currently the largest steel producer in China and the second-largest steel producer in the world.

The experience of Baoshan is an example of how many state owned firms have changed. Such firms have been “corporatized ” and merged into large state-owned conglomerates. Many are now publicly listed and are among the largest companies in China today. While the concern

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<sup>1</sup>Technically, Baoshan was closed in 2000, and a new company called Baoshan Company Limited was established with the assets of the old state company and publicly listed on the Shanghai Stock Exchange.

<sup>2</sup>Baoshan is legally controlled by the Central Government’s State Assets Supervisory Committee (SASAC), and Baoshan’s senior executives are appointed by the Organization Department of the Chinese Communist Party.

in the late 1990s was over the threat posed by the non-performing loans of state-owned firms, the concern now is that the state-owned firms are too successful. A new popular phrase in China is “guo jin min tui” which translates roughly as “state advances, private sector retreats”. Implicit in this slogan is the recognition that state-owned firms have been successful, but their success has had negative aggregate effects.

What is missing in this debate is evidence, and this is what we provide in this paper. We use detailed firm-level data from China’s Industrial Survey to measure the quantitative importance of the transformation of the state sector on aggregate productivity growth. We report the following findings. First, small state-owned firms were closed or privatized after 1998, and these firms generally had lower labor and capital productivity. Second, many new state-owned firms were established after 1998. These new firms are typically large, with labor productivity similar to that of the average private firm but capital productivity that is significantly lower. Third, the labor productivity of surviving state-owned firms and privatized firms converged to that of private firms, but there is little change in the gap in capital productivity.

We then interpret these facts through the lens of a standard model of monopolistic competition with heterogeneous firms. Under the assumption that the aggregate supply of capital is elastic, we find that closing and privatizing state-owned firms accounted for slightly more than 3.2 percent of the aggregate growth in the industrial sector from 1998 to 2007. This is driven by reallocation of resources from the closed and privatized state-owned firms and by the increase in productivity among the privatized firms. In addition, productivity growth and the release of surplus labor by surviving state-owned firms (such as Baoshan) were responsible for more than 13 percent of aggregate growth over the same period. Finally, the creation of new state-owned firms drives more than 7 percent of aggregate growth over this period.

The rest of the paper is organized as follows. In Section 2, we lay out a model to guide our empirical analysis. Section 3 presents the facts regarding the characteristics of exiting firms, survivors, and entrants in the state sector relative to that of their private counterparts. We then use the model to back out firm-level productivity and distortions in Section 4. We also explore the institutional forces behind the dramatic changes in the state sector. Section 5 quantifies the effect of the reallocation towards private firms and the productivity improvements among state-owned firms on aggregate GDP. Section 6 concludes.

## **2 A Model-Based Accounting Framework**

This section presents a standard model of heterogeneous models with monopolistic competition. We will use this framework to quantify the effect of the different forces behind China’s growth.

Aggregate output is a CES aggregate of output of individual firms,

$$Q = \left( \sum_i^N Q_i^{1-\eta} \right)^{\frac{1}{1-\eta}}. \quad (1)$$

Here,  $i$  indexes the firm;  $N$  is the number of firms;  $Q_i$  is firm output; and  $1/\eta > 1$  is the elasticity of substitution between varieties. Firm output is given by

$$Q_i = A_i K_i^\alpha L_i^{1-\alpha},$$

where  $A_i$  denotes firm-specific productivity (TFP).

Each firm chooses factor inputs (and output and revenue) to maximize current profits

$$\pi_i = P_i Q_i - (1 + \tau_i^L) w L_i - (1 + \tau_i^K) r K_i, \quad (2)$$

where  $P_i$  is the firm-specific output price;  $L_i$  and  $K_i$  denote labor and capital inputs;  $w$  and  $r$  denote the common undistorted cost of labor and capital; and  $\tau_i^L$  and  $\tau_i^K$  denote firm-specific distortions to the cost of labor and capital. These distortions can arise because of differences in the access to capital across firms, firm-specific subsidies or taxes, or political pressures to maintain employment within state-owned firms.

Profit maximization yields the standard first-order conditions:

$$MRPL_i \equiv (1 - \alpha) (1 - \eta) \frac{P_i Q_i}{L_i} = (1 + \tau_i^L) w, \quad (3)$$

$$MRPK_i \equiv \alpha (1 - \eta) \frac{P_i Q_i}{K_i} = (1 + \tau_i^K) r. \quad (4)$$

This says that the marginal revenue product of labor ( $MRPL_i$ ) and of capital ( $MRPK_i$ ) are proportional to average labor and capital productivity. Crucial to this result is the assumption of common markups and capital elasticities. Furthermore, marginal and average products of labor and capital are higher in firms with higher  $\tau_i^L$  and  $\tau_i^K$ , respectively.

The equilibrium allocation is characterized by

$$P_i Q_i \propto \left( \frac{A_i}{(1 + \tau_i^K)^\alpha (1 + \tau_i^L)^{1-\alpha}} \right)^{\frac{1-\eta}{\eta}}, \quad (5)$$

$$L_i \propto \frac{1}{1 + \tau_i^L} \left( \frac{A_i}{(1 + \tau_i^K)^\alpha (1 + \tau_i^L)^{1-\alpha}} \right)^{\frac{1-\eta}{\eta}}, \quad (6)$$

$$K_i \propto \frac{1}{1 + \tau_i^K} \left( \frac{A_i}{(1 + \tau_i^K)^\alpha (1 + \tau_i^L)^{1-\alpha}} \right)^{\frac{1-\eta}{\eta}}. \quad (7)$$

It is useful to combine equations (3), (4) and (5) to express firm revenue in terms of variables that we can measure in the data:

$$P_i Q_i \propto \left( \frac{A_i}{\left( \frac{P_i Q_i}{L_i} \right)^\alpha \left( \frac{P_i Q_i}{K_i} \right)^{1-\alpha}} \right)^{\frac{1-\eta}{\eta}}. \quad (8)$$

This says that firm revenues are increasing in  $A_i$  and decreasing in labor and capital productivity. Intuitively, firms with high labor and capital productivity are the ones in which the marginal products of labor and capital are high, which reduce input demand and firm size (holding  $A_i$  fixed).

Finally, we assume labor supply is fixed (and normalized to one). In addition, we assume  $r$  is exogenous and equal to the world interest rate. The elastic supply of capital assumption seems realistic for China, as savings have exceeded investment for more than a decade since the late 1990s. We later consider an alternative where the supply of capital in China is fixed.

After we impose profit maximization and the market clearing conditions, aggregate output is:

$$Y = \left[ N^{\frac{\eta}{1-\eta}} A^* \left( \sum \omega_i^{\frac{1-\eta}{\eta}} Y_i^* \right)^{\frac{\eta}{1-\eta}} \right]^{\frac{1}{1-\alpha}}. \quad (9)$$

where

$$\begin{aligned} A^* &\equiv \left( \frac{1}{N} \sum_i A_i^{\frac{1-\eta}{\eta}} \right)^{\frac{\eta}{1-\eta}}, \\ Y_i^* &\equiv \frac{1}{N} \left( \frac{A_i}{A^*} \right)^{\frac{1-\eta}{\eta}}, \\ \omega_i &\equiv \left( \frac{r}{MRPK_i} \right)^\alpha \left( \frac{\overline{MRPL}}{MRPL_i} \right)^{1-\alpha}, \end{aligned} \quad (10)$$

and  $\overline{MRPL}$  denotes the average MRPL.

The first term in (9) is the standard variety effect. More entry and less exit, *ceteris paribus*, increase aggregate output. The second term  $A^*$  is a harmonic mean of firm TFP and reflects the direct effect of firm TFP. The third term,  $\left( \sum \omega_i^{\frac{1-\eta}{\eta}} Y_i^* \right)^{\frac{\eta}{1-\eta}}$ , measures the effect of resource misallocation: more dispersed marginal products across firms, *ceteris paribus*, lower the aggregate output. This term is one when the marginal product of labor and capital is the same across firms. Finally,  $1/(1-\alpha)$  measures the effect of endogenous capital accumulation. If we drop the assumption that the cost of capital is exogenous and, instead, assume a fixed supply of capital, this effect would not be there and the coefficient would be one.

We can now map the channels via which the transformation of the state sector affects aggregate output.

First, exit of state-owned firms has two effects. Holding the weighted average of firm TFP fixed, exit reduces the number of varieties  $N$  and aggregate output. Exit may also affect the weighted average of firm TFP, depending on the marginal product of labor of exiting firms relative to the average marginal product. If the marginal product of resources used by the exiting firm is equal to the average marginal product, then the envelope theorem applies and there is no net welfare gain from the reallocation of resources. In this case, the effect of exit on aggregate output is unambiguously negative. However, if the marginal product of exiting firms is significantly lower than the average marginal product, then the reallocation of resources from exiting firms increases aggregate output. Thus, the net effect on aggregate output depends on whether the gain from reallocation exceeds the loss in the number of varieties.

The mechanisms via which entry affects aggregate output are similar to those of exit. First, entry increases the number of varieties. Second, the gain from reallocation to entrants depends on whether the marginal product of entrants is higher or lower than that of existing firms. In the next section, we will measure the number of state-owned firms that exited, the number of new state-owned firms, and the marginal product of these firms.

Second, privatization of state-owned firms has the following effects. First, privatization has no effect on the number of varieties  $N$ . Second, privatization may improve firm TFP, and the effect on aggregate productivity is given by

$$\begin{aligned} \frac{\partial Y}{\partial A_i} &= \frac{1}{1-\alpha} \left( \frac{Y}{A^*} \frac{\partial A^*}{\partial A_i} + \frac{Y}{\Omega} \frac{\partial \Omega}{\partial A_i} \right) \\ &= \frac{1}{1-\alpha} \left( \underbrace{\frac{Y_i}{A_i}}_{\text{the direct effect}} + \underbrace{\frac{1}{\eta} \frac{L_i}{A_i} (MRPL_i - \overline{MRPL})}_{\text{the reallocation effect}} \right). \end{aligned} \quad (11)$$

The first term of (11) captures the effect of  $A_i$  on  $A^*$ , holding the efficiency of resource allocation fixed. We think of this as the direct effect of TFP. The second term reflects how  $A_i$  affects aggregate productivity through its effect on the allocation of resources. The reallocation effect is negative if the firm's MRPL is below the average MRPL and positive otherwise. Intuitively, when labor is reallocated towards firm  $i$  with  $MRPL_i < \overline{MRPL}$  in response to higher TFP, aggregate allocative efficiency declines since the reallocation widens the gap between  $MRPL_i$  and  $\overline{MRPL}$ . When the MRPL gap is sufficiently large, the negative reallocation effect can dominate the technological effect. Specifically, (11) can be expressed as:

$$\frac{\partial Y}{\partial A_i} = \frac{1}{1-\alpha} \frac{1}{\chi \eta} \frac{L_i}{A_i} (MRPL_i - \chi \overline{MRPL}), \quad (12)$$

where  $\chi \equiv \frac{(1-\eta)(1-\alpha)}{1-\alpha(1-\eta)} < 1$ . If  $MRPL_i < \chi \overline{MRPL}$ , an increase in the firm's TFP will lower aggregate output. Whether higher TFP increases or lowers aggregate output depends on the gap between the firm's MRPL and the average marginal product (and the value of  $\chi$ ).

Privatization can also increase MRPL and MRPK of the privatized firms (relative to the other firms). For example, if state-owned firms were forced to employ more workers than necessary,  $\tau_i^L$  of state-owned firms could decline after they are privatized and no longer face political constraints to keep unproductive workers on the payroll. Similarly, privatized state-owned firms may no longer have preferential access to capital, which is modeled here as a decline in  $\tau_i^K$ . The effect of a change in the gap in MRPL relative to the average on aggregate output is given by:

$$\frac{\partial Y}{\partial \tau_i^L} = -\frac{1-\alpha}{\chi\eta} \frac{L_i}{1+\tau_i^L} (MRPL_i - \overline{MRPL}). \quad (13)$$

This says that a decline in the gap between a firm's MRPL and the average MRPL always increases aggregate output. Similarly, the effect on aggregate output of a change in MRPK of a given firm follows:

$$\frac{\partial Y}{\partial \tau_i^K} = -\frac{\alpha}{\chi\eta} \frac{L_i}{1+\tau_i^K} (MRPL_i - \chi \overline{MRPL}). \quad (14)$$

The reason that this looks different from the effect of changes in MRPL is the assumption that capital is available elastically at world interest rates. A decline in MRPK of a firm is like a positive TFP shock, and the "TFP shock" can have a negative effect on aggregate output if it significantly worsens the allocation of labor.

Third, the corporatization of state-owned firms potentially has two effects on aggregate output. Firm TFP can increase, and the effect of an improvement in firm TFP is ambiguous, depending on whether the direct effect of higher TFP exceeds the effect of changes in resource allocation. State-owned firms may also be able to increase their MRPL by shedding its surplus labor, which has an unambiguous positive effect on aggregate output.

Finally, while we have focused on the effect of the state sector on aggregate output, the channels via which the private sector affects aggregate output are exactly the same. If the marginal product of resources used by private firms is the same as that of the state sector, then entry of private firms increases output via the first term in equation (9) and productivity growth raises aggregate output through its effect on the second term of the same equation. If the marginal product of private firms is higher compared to state firms, then private entry and productivity growth have the additional effect of improving the allocation of resources (the third term in (9) increases). This paper only analyzes the transformation of the state sector, but it is important to keep in mind that private sector growth has surely played an important role as well.

### 3 Facts

This section describes the institutional background behind the state sector reforms that began in the late 1990s. We then present a comprehensive set of empirical facts found in China's industrial firm data. We give special attention to the identification of state ownership, which is often disguised by the firms' legal registration.

#### 3.1 Institutional Background

The policy changes we describe below were formally announced in 1999 in the Fourth Plenum of the Communist Party's Central Committee.<sup>3</sup> The slogan adopted by the Communist Party to describe the proposed reforms was "Grasp the Large, Let Go of the Small." "Let Go of the Small" refers to the fact that small state-owned firms were to be closed or sold.

As for the large state-owned firms, the plan was that large firms were to be "grasped" by the state. By "grasp", the central committee meant that large state-owned firms were to be merged into large industrial conglomerates and the control over these conglomerates was to be consolidated by the central government or by local governments. In the steel sector, for example, five large industrial groups were created in the late 1990s and early 2000s, and ownership of the state-owned steel manufacturers was transferred to these groups. Three of these groups are owned by the Chinese central government (the BaoSteel Group, the WuSteel Group, and the AnSteel Group) and two by provincial governments (the Hebei Steel Group and the Shandong Steel Group). The BaoSteel Group, for example, controls six large steel manufacturers – three wholly owned by the Group and three publicly traded (such as Baoshan) with the Group as the controlling shareholder. The automobile industry provides another example. In this sector, state-owned automobile companies were consolidated into six state-owned conglomerates, the largest of which is the Shanghai Automobile Industrial Group (SAIC) owned by the municipal government of Shanghai. The SAIC Group owns a controlling share of the equity (73 percent) of the original state-owned firm (SAIC Motor Co., Ltd.), which is now a publicly traded company. SAIC Motor Co., Ltd., in turn, holds 50 percent of the equity of two new companies jointly established with General Motors (Shanghai-GM) and Volkswagen (Shanghai-Volkswagen).<sup>4</sup>

A more fundamental goal of "Grasp the Large" was to transform the large state-owned

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<sup>3</sup>See CCP (1999) for the formal announcement. As is typical with all the major reforms implemented in China, the official decision in 1999 was preceded by several years of small-scale experimentation. See Aivazian et al. (2005) for an assessment of the initial experiments with reforms in corporate governance.

<sup>4</sup>The SAIC Group also owns other companies, but the biggest company under its control is SAIC Motor Co., Ltd.



firms into profit-maximizing firms under the control of the Chinese State. Two aspects of the reorganization of the large state-owned firms were meant to accomplish this goal. First, state-owned firms were often incorporated as limited liability corporations, and the managers were to be held accountable for the firm’s bottom line. The terminology used in China was that state-owned firms were to be “corporatized.” The parent company, as the controlling shareholder, was to monitor the firm and be responsible for appointing and deciding the compensation of the firm’s senior managers. In turn, the senior executives of the parent company (the industrial group) were to be directly appointed by the local government (in the case of groups owned by local governments, such as the SAIC Group) or by the Central Organization Department of the Communist Party (in the case of groups owned by the central government, such as the BaoSteel Group).

In addition, although the plans laid out in the late 1990s did not mention the establishment of new state-owned firms, we will show that this has been an important part of what happened. Because the new state-owned firms are predominantly large firms, we will also call this part of what was meant by “Grasp the Large.”

The question is how the Chinese state chose to exercise its control right over the industrial groups and, in particular, what criteria it used to reward and punish the groups’ senior executives. In 2003, the State-Owned Assets Supervision and Administration Commission (SASAC) was set up as the legal owner of the state-owned groups.<sup>5</sup> These bodies were set up simultaneously at the central- and local-government levels. However, it is still the case that the ultimate hiring and firing authority was kept in the hands of the Communist Party’s Organization Department, and we have little information on how the Party chose to exercise its authority. What we can do is to measure the performance of these firms, which we do in the rest of Section 3.

### **3.2 State Ownership**

The main data we use are the micro-data from the Annual Survey of Industries conducted by China’s National Bureau of Statistics from 1998 to 2007. This survey is a census of all state-owned firms and the non-state-owned firms (referred to as private firms, henceforth) with more than five million RMB in revenues in the industrial sector. The unit of observation in the data is a registered firm. For the firms owned by the state-owned industrial groups, each firm owned

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<sup>5</sup>With the exception of state-owned tobacco companies and state-owned financial institutions, ownership of all state-owned groups was transferred to the SASACs in 2003. Tobacco companies are controlled by the State Tobacco Monopoly Administration and financial institutions by a holding company (Huijin) controlled by China’s Banking Regulatory Commission.

by the group is a separate observation in our data.

Identifying state-owned firms is key to our analysis. A common way to identify state ownership in China is through the firm’s legal registration. Specifically, firms in China are legally registered as state-owned, collectively owned, privately owned, limited-liability corporations, share-holding firms (including publicly traded), or foreign firms. With this classification, state ownership is typically defined as firms that are legally registered as state-owned.

There are two problems with using the firm’s legal registration to identify ownership, particularly for state-owned firm. First, many firms that are ultimately state-owned are legally registered as foreign firms. This can happen because firms in which at least a third of the ownership is foreign-held can be registered as foreign firms. For example, the joint ventures of the Shanghai local government with GM and Volkswagen (Shanghai-GM and Shanghai-VW) are registered as foreign firms. This can also happen when the firm is owned by a holding company registered outside of China. For example, Lenovo and CNOOC (a state-owned oil company) are owned by holding companies registered in Hong Kong and, thus, legally registered as foreign firms in China. Second, many state-owned firms, particularly after 1998, are registered as limited-liability or publicly traded companies, albeit with the controlling stake held by a state-controlled holding company. The Baoshan steel company and Shanghai’s SAIC Group’s stand-alone car company (SAIC) discussed earlier are examples of publicly listed companies (and, thus, registered as share-holding companies) but with a controlling stake held by a holding company owned by the Chinese state (the Central government in the case of Baoshan and the local Shanghai government in the case of SAIC).

Instead of using the firm’s legal registration, we use another approach to identify state ownership. First, our data provide the share of the firm’s registered capital owned by the state, collective, private persons, foreigners, and legal person. Here, a legal person can be another firm or a holding company. For example, publicly traded state-owned firms such as Baoshan and SAIC typically have a minority share of their registered capital held by “private persons” (the publicly traded share) and a majority share held by a “legal person” (the state-owned parent holding company). Our data do not provide additional information on the identity of the “legal person,” but the share of the registered capital owned by a “legal person” in the Chinese industrial sector has increased since 1998, particularly among large firms.<sup>6</sup> Second, our data provide information on the firm’s controlling shareholder. In particular, it classifies the “controlling shareholder” of the firm as the state, a collective, a foreigner, or a private

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<sup>6</sup> Among the firms that survived from 1998 through 2007, 22 percent had the legal person registered capital share above ten percent in 1998. The share increased to 30 percent in 2007. Among the large firms with the initial value added in the top decile, the shares were 27 and 43 percent in 1998 and 2007, respectively.

person.

We use these two variables to define state-owned firms. Specifically, we define a firm as state-owned when the share of registered capital held directly by the state exceeds or equals 50 percent or when the state is reported as the controlling shareholder. The former definition captures traditional state-owned firms when the state owns all or the majority of the firm's registered capital. The latter definition captures publicly traded firms when the state holds a controlling stake through a holding company, but excludes firms when the state may hold a minority share through a holding company.

We supplemented this definition of state ownership by manually checking the websites of all the industrial firms in the top one percentile of the firm value added distribution in 2007. We find that virtually all the firms that we identified as state owned via this laborious procedure are also coded as state owned using our definition. Interestingly, our forensic analysis indicates that more than two-thirds of the firms of the top one percentile firms are directly or indirectly controlled by SASAC, but almost half of these firms are legally registered as private firms. Our procedure might understate the state share if some companies do not publicly reveal the state's ownership stake on their websites. On the other hand, we could overstate the state share if some SASAC firms are ultimately privately owned but use SASAC to mask their ownership stake. For example, the Sydney Morning Herald reported in 2011 that a large shadow bank in Chongqing (Chongqing International Trust) was legally owned by the local government of Chongqing, but was in fact privately owned by a crony of the Party Secretary of Chongqing at the time.<sup>7</sup>

The top panel of Figure 1 shows that the revenue share of state-owned firms, by our definition, is similar to that reported by the China Statistical Yearbook through the sample period, indicating that our definition is closer to the official one. In contrast, the dashed line shows that using the firm's registration status to define state ownership would understate the size of the state sector. Figure 2 plots the number of the state-owned firms that are registered as private firms as a share of the number of firms we define as state owned. In 1998, 15 percent of state-owned firms were registered as private firms. By 2007, almost one half of the state-owned were registered as some form of privately owned firm. Among the state-owned firms registered as private firms in 2007, 60 percent were registered as limited-liability corporations; 16 percent were publicly traded companies; and 18 percent were registered as foreign firms.<sup>8</sup>

Table 1 presents the number and total employment of the firms in our sample in 1998 and

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<sup>7</sup> John Garnaut, Sydney Morning Herald, August 7, 2011.

<sup>8</sup> See the online appendix for details.

2007.

### 3.3 Size, Labor and Capital Productivity

We use firms' registration ID provided in the data to match firms over time. The registration ID may change when a firm is restructured or acquired by another firm. For the sample of firms that we cannot match over time with the registration ID, we also use the firm's name, address, and phone number to identify surviving firms that changed their registration ID.<sup>9</sup> About 95 percent of the panel from 1998 to 2007 is identified by the registration ID, while the remainder are matched by the firm's name, address, and phone number.

The other variables from the data we use are value added, employment, and the book value of the firm's capital stock. We define the real capital stock at time  $t$  as

$$K_t = (1 - \delta)K_{t-1} + \frac{BK_t - BK_{t-1}}{P_t^K},$$

where  $BK$  is the book value of capital and  $P^K$  is the price of capital.<sup>10</sup> Labor input is measured by employment, as our data do not have the composition of the firm's labor force. However, as a robustness check, we use the firm-level records of the 2004 Economic Census (which has information on the educational composition of firm's labor force) to measure differences in labor quality across firms.

To control for industry effects, all the firm-level variables we present are, unless otherwise stated, scaled by their median values of surviving private firms in the same two-digit industry.

#### 3.3.1 Exiters

Table 2 presents the average annual exit rate for state-owned and privately owned firms for the 1991-1995 and 1998-2007 time periods.<sup>11</sup> The average exit rate for state-owned firms was under one percent a year from 1991 to 1995 and increased to 13 percent per year after 1998. Among private firms, the exit rate was roughly similar in the two time periods, at 12-13 percent a year. Figure 3 presents the average annual exit rate from 1998-2007 of state-owned and private firms

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<sup>9</sup>We follow the procedure used by Brandt et al. (2012).

<sup>10</sup>We use Perkins and Rawski's (2008) estimates of the price of capital. The initial book value of capital stock is initial book value reported by the firm for firms established after 1998. For firms founded before 1998, we assume that the book value in 1998 is given by  $BK_{t_0} = BK_{t_1} / (1 + g)^{t_1 - t_0}$ , where  $BK_{t_0}$  is the projected initial book value of the capital stock in year  $t_0$ ;  $BK_{t_1}$  is the book value of capital stock when the firm first appears in the dataset in year  $t_1$ ; and  $g$  is the average growth rate of the capital stock in the period we observe in the data after year  $t_1$ .

<sup>11</sup>The exit rate from 1998 to 2007 is computed from the Annual Industrial Survey. The exit rate from 1991-1995 is computed from the 1996 China Statistical Yearbook and the micro-data of the 1995 Industrial Census. State-owned firms that were privatized by 2007 are not considered exiting firms. See the online appendix for additional details.

for each size bin defined by the firm’s value added in 1998. Exit rates of smaller state-owned are higher than those of comparably sized private firms. The annual exit rate exceeds 30 percent among state-owned firms in the bottom ten percentiles of the size distribution, about ten percentage points higher than comparably sized private firms.

Table 3 quantifies the characteristics of state-owned firms in 1998 (the omitted group is private firms that survived until 2007). Comparing the first row (exiting state-owned firms) with the third row (surviving state-owned firms), it can be seen that value added, labor productivity, and capital productivity are generally lower among exiting state-owned firms than among surviving state-owned firms. These patterns are roughly consistent with the goal implicit in the slogan “Let go of the small”, although the implementation seems far from perfect. Many small state-owned firms were not closed and some large state-owned firms were closed.

### 3.3.2 Survivors

We now turn to the balanced panel of firms between 1998 and 2007. We focus on three groups of surviving firms in the balanced panel: state-owned, privatized state-owned and private firms. Figure 4 plots the percent of privatized state-owned firms in bins defined by the firm’s value added in 1998. There is an inverse U shape relationship between the probability of privatization and the initial size of the state-owned firms in 1998. Although the goal was that small state-owned firms were to be closed or privatized (“let go”), many of the smallest state-owned firms were kept under state control. For example, only 30 to 35 percent of the state-owned firms in the bottom decile of the size distribution were privatized. The privatization rate is highest among mid-sized state-owned firms, and is lowest among the largest state-owned firms. These last two facts are consistent with the officially stated goal that large firms were to be kept under state control, or “grasped” by the Chinese state. But again, implementation of was highly imperfect, as many small state-owned firms were not privatized (or closed).

Figure 5 presents the distribution of employment by value added among state-owned (top panel) and privatized firms (bottom panel) in 1998 and 2007. The size distribution of state-owned and privatized firms shifted slightly to the left from 1998 to 2007, relative to the value added of private firms in each year. Furthermore, the change in size distribution is similar for state-owned and privatized firms.

Figure 6 plots the corresponding distribution of employment by labor productivity (value added/employment). The figure shows that the labor productivity of the two groups of state-owned firms was significantly lower than that of private firms in 1998. The difference in 1998 was about 40 percent (Table 3). By 2007, the gap in labor productivity had narrowed

significantly, and about equally for the firms that remained under state control and for the firms that were privatized by 2007. On average, the labor productivity for the two groups of firms had narrowed from about 60 percent of the labor productivity of private firms in 1998 to 75 percent of the labor productivity of private firms in 2007 (Table 4).

Figure 7 plots the corresponding distribution of capital productivity (value added/capital). The capital productivity of state-owned firms is also significantly lower than that of private firms in 1998. Table 3 indicates that the average capital productivity of state-owned firms was 34 percent of that of private firms in 1998. By 2007, the gap in capital productivity had narrowed slightly: capital productivity of state-owned firms was then 46 percent of that of private firms. And, perhaps surprisingly, there was still a significant gap in capital productivity between privatized and private firms in 2007.

There are also distinctive patterns between small and large state-owned firms. While state-owned firms grew, on average, at the same rate as private firms (Figure 5), state-owned firms that were small (large) in 1998 grew at a slower (faster) rate compared to private firms with the same initial size. The heterogeneity across the size distribution is similar for the relative labor productivity growth but less pronounced for the relative capital productivity growth. In contrast, there is no evidence that the relative output growth and the narrowing of the labor and capital productivity gaps differ between small vs. large privatized state-owned firms.

### 3.3.3 Entrants

We now turn to the 2007 entrants, defined as firms created after 1998. Table 1 indicates that one third of the state-owned firms in 2007 were established after 1998. Figure 8 plots the distribution of value added (top panel), labor productivity (middle panel), and capital productivity (bottom panel) of state-owned entrants and private entrants. As before, we normalize by the corresponding statistic for surviving private firms. The top panel shows that new state-owned firms are significantly larger than new private firms. The middle panel shows that the labor productivity of new state-owned firms and new private firms is about the same as that of surviving private firms. Finally, the bottom panel shows that the capital productivity of new state-owned firms is lower than that of surviving private firms, while the capital productivity of new private firms is about the same.

To summarize, the main facts are:

1. Exit: Exit rates increased after 1998 among state-owned firms, particularly for small state-owned firms.

2. Privatization: Large state-owned firms were kept mostly under state control, but the smallest state-owned firms that survived were also kept under state ownership. Mid-sized state-owned firms were the most likely to be privatized.
3. State-Owned vs. Privatized Firms: The performance of the average state-owned firm is similar to that of the average privatized firm. For both groups of firms, from 1998 to 2007, the labor productivity gap with surviving private firms narrowed significantly and the capital productivity gap by much less. Capital productivity was still less than 50 percent that of private firms.
4. Small vs. Large State-Owned Firms: The labor productivity gap with surviving private firms narrowed significantly between 1998 and 2007 for large state-owned firms and widened for small state-owned firms. The capital productivity gap widened for small state-owned firms.
5. New State-Owned Firms: New state-owned firms are larger, have the same labor productivity, and have lower capital productivity compared to new private firms.

We end this section by presenting evidence on the patterns after 2007. We do not have access to comparable firm-level data. So, the only information we have is from the published aggregates provided by the China Statistical Yearbook.<sup>12</sup> Figure 9 plots the weighted average of aggregate labor productivity and capital productivity across two digit industries for state-owned firms relative to private firms. For comparability, Figure 9 also plots the weighted average of aggregate labor productivity and capital productivity calculated from our micro-data. Aggregate data are less than ideal because they do not allow us to separately measure entrants vs. exiters vs. incumbents. As can be seen, the narrowing of the gap in aggregate labor productivity is much larger than that seen among incumbent firms (in Figures 6 and 7). Similarly, while there is little convergence in capital productivity between incumbent state-owned firms and private firms, the aggregate data suggest a rapid convergence in capital productivity. Clearly, an important factor driving this difference is the high exit rate of state-owned firms from 1998 to 2007 with low labor and capital productivity.

Nonetheless, with these caveats firmly in mind, it seems clear that the convergence in labor productivity from 1998 to 2007 ended after 2007. In fact, there is some evidence of a decline in relative labor and capital productivity in 2009, perhaps driven by efforts undertaken by the government to combat the world recession by forcing state-owned firms to increase

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<sup>12</sup>The China Statistical Yearbook stopped publishing the series on industry employment and capital after 2011.

employment and to overinvest. And it is also not the case that the convergence in labor and capital productivity ended simply because the state sector caught up with the private firms by 2007. Figures 6 and 7 indicate that labor and capital productivity were still below that of private firms in 2007. Instead, it appears that the political forces behind the transformation of the state-owned firms ran out of steam after 2007.

## 4 Productivity and Distortions of State-Owned and Privatized Firms

We now interpret the facts presented above through the lens of the model in Section 2. We apply the model to each industry and then aggregate industry output into aggregate output. To capture the industry effects, we allow  $\delta$ ,  $w$  and  $\alpha$  to be industry-specific. We also assume the labor force to be fixed in an industry.<sup>13</sup>

We begin with the differences in labor productivity between state and private firms. According to equation (3), differences in the average product of labor reflect differences in  $\tau_i^L$  and the marginal revenue product of labor. The convergence in labor productivity from 1998 to 2007 between state-owned and private firms shown in Figure 6 indicates that MRPL in state-owned firms increased relative to that of private firms over this time period.<sup>14</sup> Similarly, equation (4) indicates that the gap in capital productivity between state-owned and privatized firms relative to private firms reflects differences in MRPK. Therefore, the evidence in Figure 7 indicates that MRPK in state-owned firms was lower than that of private firms, and that much of this gap was still present in 2007. Furthermore, there is little difference in MRPL and MRPK between state-owned firms that remained under state control and those that were privatized. In particular, MRPK of the privatized state-owned firms in 2007 was almost the same as that of the state-owned firms, as if the privatized firms continued to have access to capital on the same terms as the state-owned firms. And among the state-owned firms established after 1998, Figure 8 indicates these firms' MRPL is similar to that of private firms, but MRPK is substantially lower.

The fact that MRPK is lower among state-owned firms, and has remained low, is not surprising if the low marginal product is due to such firms having preferential access to capital. Preferential access to capital increases the profits of firms with access. Under this interpretation, it appears that formerly state-owned firms, even after they are privatized, continue to benefit from preferential access to capital.

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<sup>13</sup>We can generate a fixed labor supply in an industry by assuming that aggregate output is a Cobb-Douglas aggregate of aggregate industry output.

<sup>14</sup>See also Kamal and Lovely (2013) for the convergence of MRPL between state and private firms.



In contrast to the patterns in capital productivity, there is significant convergence of labor productivity between state-owned and private firms. We see this among the surviving state-owned firms, among the newly established state-owned firms, and even among the privatized state-owned firms. This finding is hard to interpret if lower labor productivity reflects a lower marginal cost of labor. Firms' profits increase when capital costs are low and when labor costs are low. However, suppose that the lower average product of labor does not reflect lower marginal products. Specifically, consider a production function that incorporates overhead labor,  $f_i$ :

$$Q_i = A_i K_i^\alpha (L_i - f_i)^{1-\alpha}. \quad (15)$$

Here,  $f_i$  has a straightforward interpretation for state-owned firms: It represents the redundant workers who have zero MRPL but cannot be fired. When  $f_i \neq 0$ , the marginal product of labor is no longer proportional to the average product of labor. We denote  $\hat{\tau}_i^L$  as the distortions that affect MRPL, while  $\tau_i^L$  still stands for the distortions that affect labor productivity. To see the relationship between the two distortions, we rewrite the first-order condition as

$$\frac{P_i Q_i}{L_i} \propto 1 + \tau_i^L = \left(1 - \frac{f_i}{L_i}\right) (1 + \hat{\tau}_i^L). \quad (16)$$

The gap in the average product of labor, as represented by  $\tau_i^L$ , can be decomposed into two components:  $f_i$  and  $\hat{\tau}_i^L$ . A reduction in  $f_i$  will not affect the marginal product of labor but will increase the average product.

The fact that the average product of labor is lower among state-owned firms in 1998 could be due to overstaffing in these firms.<sup>15</sup> The political pressure to employ redundant workers declined after 1998, as state-owned firms became corporatized and presumably were incentivized to maximize profits. In our data, employment in the surviving state-owned firms declined by 3.6 million workers from 1998 to 2007, about 40 percent of their initial employment. We do not know how many of these workers were redundant workers, but note that a decline in the number of redundant workers will show up as a decline in the average product of labor and in the labor share. Specifically, we can rewrite (16) as:

$$\underbrace{\frac{(1 + \hat{\tau}_i^L) w L_i}{Y_i}}_{\text{Labor Share}} \propto \frac{1}{1 - f_i/L_i}. \quad (17)$$

Equation (17) shows that the labor share falls when  $f_i/L_i$  falls. Figure 10 plots the average

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<sup>15</sup>According to a survey conducted by the Chinese Academy of Social Science in 1995, the narrowly-defined redundant workers – i.e., those who are idle and have no definite position – accounted for more than ten percent of total employment in about half of the state-owned firms (Dai, 1996).

labor shares of state-owned, privatized, and private firms in the 1998-2007 balanced panel.<sup>16</sup> The initial labor shares of state-owned and privatized firms were considerably higher than those of private firms. Moreover, the labor shares of state-owned and privatized firms fell substantially after 1998.

Finally, from equation (8), firm productivity  $A$  can be measured as the residual of firm value added after controlling for the effect of the average product of capital and labor. We use the labor share of private firms in each two-digit industry to measure industry-specific  $\alpha$ , where we adjust the labor share in each sector such that we match the labor share in China's industrial sector.<sup>17</sup> We use a baseline value of  $1/\eta = 7$ , corresponding to a markup of 1.17.<sup>18</sup>

Figure 11 plots the resulting distribution of  $A$  of state-owned firms (top panel) and privatized firms (bottom panel) in the balanced panel. The top panel indicates that  $A$  of state-owned firms was lower than that of private firms in 1998. By 2007, the gap in  $A$  between state-owned firms and private firms had narrowed. Similarly,  $A$  of privatized firms was lower compared to private firms, but the gap had also declined by 2007. Specifically, the weighted average TFP of surviving state-owned firms relative to that of surviving private firms increased from 55 to 75 percent. The relative TFP of surviving privatized firms increased from 60 to 77 percent.

We next examine the heterogeneity in the change in  $A$  across the size distribution. The top panel of Figure 11 plots the ratio of  $A$  of state-owned relative to private firms in bins defined by the value added in 1998 (top panel). This figure indicates that  $A$  of state-owned firms in the top decile in firm size in 1998 was 30 to 40 percent of that of the privately owned firms of comparable size in 1998. By 2007,  $A$  among the top decile of state-owned firms had increased to 60 percent of that of the same group of private firms. For small state-owned firms, the pattern is exactly the opposite. In 1998,  $A$  of the smallest state-owned firms was 80 to 90 percent of that of private firms of comparable size. By 2007,  $A$  among state-owned firms had dropped to 40 percent of that of the same group of private firms. The bottom panel plots the relative  $A$  of the privatized firms. Here, there is less heterogeneity across the size distribution. On average,  $A$  of privatized firms grows at faster rates than that of private firms does, and this is the case throughout the size distribution. These findings are the mirror images of the facts documented in Section 3.3.

In summary, we find high growth rates of TFP and reduction in labor distortions among

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<sup>16</sup>We use value added shares of an industry (averaged over 1998-2007) as the weight to aggregate labor shares across industries.

<sup>17</sup>See the online appendix. We use the labor share of private firms because distortions may bias the labor share of state-owned firms.

<sup>18</sup>We later show the results with different values of  $1/\eta$ , as well as allowing markups to differ across state-owned and private firms.

state-owned and privatized firms since the late 1990s. However, the return to capital among state-owned and privatized firms continues to be significantly lower than those in private firms. Large state-owned firms have particularly high growth rates in TFP relative to their private counterparts, but the opposite is true for small state-owned firms.

We end this section with three sets of robustness checks. First, we measure labor input by employment, which implicitly assumes that labor quality is the same across firms. However, the gap in labor productivity between state and private firms shown in Figure 9 may be due to differences in worker quality. To check this, we use the data from the 2004 Economic Census to measure the differences in worker quality between state and private firms.<sup>19</sup> The 2004 Census indicates that workers in state-owned firms have, on average, 1.3 more years of schooling than workers in private firms. When we adjust for the implied gap in worker quality (using estimates of the Mincerian return to schooling), this reduces labor productivity among surviving privatized state-owned firms by about ten percent. The convergence of labor productivity between state and private firms is not affected, though.

Second, the convergence of TFP is robust to alternative assumptions on markups. Lowering  $1/\eta$  to three gives essentially the same relative TFP growth of surviving state-owned firms. Our calculations assume that markups are the same for all firms. We now consider the possibility that state-owned firms have higher markups than private firms. This has two effects on the empirical results.<sup>20</sup> First, although higher markups among state-owned firms change the implied levels of TFP,  $\tau_i^L$ , and  $\tau_i^K$  for these firms, it does not change their implied growth rates. Second, if we assume that markups among privatized state-owned firms decline after becoming privatized, then the implied growth rate of TFP among privatized firms would be higher than shown in Figure 10. In addition, the implied reduction in labor and capital distortions among the privatized firms would be larger than shown in Figures 6 and 7.

Finally, the evidence presented above suggests that the convergence of labor productivity between state-owned and private firms can be explained by the reduction in the number of surplus workers in the state sector (instead of an increase in the marginal product of labor in state-owned firms). Notice that with the presence of surplus labor,  $A_i$  has to be adjusted by  $f_i$ . We consider the following scenario in which (i) redundant workers exist only in the firms that are initially state-owned and have labor productivity below the average of surviving private firms in the same industry; and (ii) the labor productivity gap entirely reflects the number of redundant workers. These assumptions are rather extreme, implying massive labor redundancy

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<sup>19</sup>The 2004 Economic Census provides data on the educational composition of employment in each firm. See the online appendix.

<sup>20</sup>See the online appendix for details on the model with variable markups, as well as the empirical results.

that accounts for 54 and 35 percent of state employment in 1998 and 2007, respectively. The TFP growth of state-owned firms has to be adjusted downwards by falling surplus labor. The weighted average TFP of surviving state-owned firms relative to that of surviving private firms grew by 36 percent from 1998 through 2007 in the benchmark case, while the growth would decrease to 26 percent if we were to adopt the above assumptions on  $f_i$ . Yet the TFP convergence between state and private firms remains qualitatively unchanged.

#### 4.1 Why Have State-Owned Firms Changed?

We now turn to institutional forces that may be behind the patterns presented in the last section.

First, governance may have improved among large state-owned firms. Figure 2 shows that almost half of the state-owned firms in 2007 were legally registered as private firms. For a subset of these firms for which we can put together detailed ownership information, the typical form this takes is that state-owned firms are “corporatized” with a minority share traded in the stock market and merged into a large state-owned conglomerate. We do not have information on the precise ownership structure of all the firms in the data, but we do know the share of registered capital held by “legal person.” For the sample of state-owned firms for which we have ownership information, the legal person is essentially the equity share of the state-owned conglomerate. Figure 12 shows that the average share of registered capital held by legal persons increased dramatically among all state-owned firms from 1998 to 2007.

Second, there is clear evidence that state-owned firms face greater competition from private firms. Although the goal of the Chinese government was to restrict entry by private firms in the “strategic” or “pillar” industries, private firms have entered in many of the industries in which the state has sought to maintain the dominance of state-owned firms.<sup>21</sup> Table 5 presents the value added share of state-owned firms in nine such industries (these industries account for about half of China’s industrial output). Although state-owned firms have a dominant share in most of these industries, the state’s share has shrunk in all sectors (except for Electric and Heat Power). The decline in the other (non-strategic) sectors is even more dramatic: The overall value added share of state-owned firms in the industrial sector fell from 55 to 34 percent in the same period.

Table 6 examines the correlation of private-sector entry with productivity growth in the state sector across two-digit sectors. We define the private entry rate as the number of new private firms created in a year relative to the number of all private firms in that year. The

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<sup>21</sup>See the online appendix for details on “strategic” and “pillar” industries.

private entry rate averaged 7.6 percent in the 1998-2007 period, with a standard deviation of eight percentage points across industries. Column 1 shows that the private-sector entry rate is positively correlated with productivity growth. The effect is independent of ownership.

Third, many of the state-owned firms in 2007 were newly established. Figure 9 shows that these firms were large and also enjoyed preferential access to capital. Such firms may also have provided competition to the surviving state-owned firms. The entry rate of state-owned firms is 2.1 percent per year, with a standard deviation of 0.8 percentage points across two-digit sectors (the correlation between the private entry rate and state firm entry rate is 0.6). Column 2 (Table 6) shows that the entry rate of state-owned firms is also positively correlated with TFP growth of state-owned firms. Comparing the  $R^2$  in Columns 1 and 2, it appears that the entry of new state-owned firms explains more of the variation in TFP growth among surviving state-owned firms. The entry rate of state-owned firms is also positively correlated with TFP growth in the privatized state-owned firms, but not in the surviving private firms.

More generally, an explicit goal of the organizational design was to generate competition among the state-owned firms. In the case of the automobile industry, Dunne (2011) argues that the main competition faced by Shanghai-GM (GM's joint venture with the state-owned SAIC Group) is between the two large automobile companies owned by its joint-venture partner (the SAIC Group). For example, Dunne (2011) describes how SAIC's joint venture with Volkswagen introduced the Volkswagen Passat to undercut the Shanghai-GM's profits from the Buick. To capture this force, we measure the market power of state-owned firms using the Herfindahl index. Column 3 shows that TFP growth among surviving state-owned firms is lower in sectors in which the Herfindahl index of surviving state-owned firms increases. This fact also suggests that the high TFP growth rate among surviving state-owned firms is not simply mismeasured monopoly power. If it were, then we should find a positive correlation between market concentration of state-owned firms and TFP growth of the same firms. However, the facts suggest that the exact opposite is true.

Finally, there is some evidence that unsuccessful state-owned conglomerates are forced to sell their firms to other state-owned conglomerates. For example, the Baoshan Steel Company, discussed earlier, is perhaps the most successful steel manufacturer in China. Since 2007, its parent company (the BaoSteel Group) has acquired three large steel manufacturers owned by other state-owned industrial groups.<sup>22</sup> One of these companies is ShaoSteel, a publicly traded steel manufacturer that was owned by local governments in Guangdong Province. After ShaoSteel suffered losses totaling almost USD 400 million from 2008 to 2012, the BaoSteel

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<sup>22</sup>Specifically, BaoSteel acquired the Bayi Steel in 2007, Ningbo Steel in 2007, and ShaoSteel in 2012.

Group acquired the firm in 2012.<sup>23</sup> The case of the Nanjing Auto Group (owned by the local government of Nanjing) is another example. This company also ran perpetual deficits before the SAIC Group acquired the entire group in 2007.

There are no systematic data on the extent of this reallocation, but some basic facts about the groups and firms owned by the Central SASAC suggest this may have been important. When Central SASAC was first established in 2003, it was in charge of 189 industrial groups that controlled a total of 15,546 firms. By 2010, the number of industrial groups it owned had been whittled down to 124. At the same time, these 124 groups controlled a total of 23,738 firms. Put differently, due to this reallocation process, the number of firms controlled by the average Central SASAC Group increased from 82 in 2003 to 191 in 2010.

## 5 Welfare Implications

We now turn to the assessment of the aggregate implications of the changes observed in the state sector. Although it might seem that high TFP growth and a reduction in labor distortions in the state sector would have positive effects on aggregate welfare, there will be offsetting effects in general equilibrium. And, under some assumptions, these offsetting effects may be large enough that aggregate welfare is lower when state-owned firms increase TFP and reduce labor distortions.

### 5.1 Counterfactual Experiments

We conduct counterfactual experiments to quantify the welfare implications of “Grasp the Large, Let Go of the Small.” We start with the 2007 data and then calculate aggregate output under two counterfactuals: “Let go of the Small” and “Grasp the Large,” defined as follows:

1. “Grasp the Large” assumes that (i) TFP and distortions of surviving state-owned firms would be the same as their initial values; and (ii) no new state-owned firms would be established.
2. “Let Go of the Small” assumes that (i) TFP and distortions of privatized firms would be the same as their initial values; and (ii) exiting state-owned firms would survive, with TFP and distortions equal to their initial values.

In each counterfactual, we start with the 2007 data and calculate the hypothetical level of aggregate output under each scenario. We keep the aggregate labor supply fixed and assume

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<sup>23</sup>News reports indicate that ShaoSteel’s senior management was replaced after it was acquired by the Baosteel Group.

that the aggregate supply of capital is available elastically at an exogenously determined world interest rate in the benchmark calculation (we relax this assumption later).

Table 8 presents the percentage decline in aggregate output in 2007 in each scenario. The first column, “no surplus labor,” assumes that  $\tau_i^L$  represents gaps in the marginal product of labor, so, here, increases in TFP among firms with a sufficiently low average product of labor may lower aggregate output. The first three rows present the effect of the closure and privatization of state-owned firms. The first row shows that 2007 aggregate output in the “Let-Go-of-the-Small” counterfactual is 1.6 percent lower. The next two rows present the effects of exit vs. those of privatization. Exit has a positive effect, increasing aggregate output by 0.3 percent. Privatization alone raises aggregate output by 1.4 percent. Both results deserve comment. The reason that the effect of privatization is relatively small, despite the TFP gains among these firms, is that output per worker among privatized firms is still lower than the average. Since we assume that lower average product reflects lower marginal product, higher TFP among these firms worsens the allocation of labor, which offsets the effect of higher TFP on aggregate output.<sup>24</sup> The positive effect of exit on aggregate output is also driven by the same force. In the model we use, exit always lowers aggregate output when resources are allocated efficiently. However, when the marginal product of labor in exiting firms is low, which is the case in China, exit improves the allocation of labor. In the Chinese context, the marginal product of labor is low enough that the effect of improved allocation due to exit more than offsets the direct effect of exit on aggregate output.

The next three rows present the effect of “Grasp the Large,” which accounts for ten percent of 2007 aggregate output. The reforms among surviving state-owned firms raises the 2007 aggregate output by 6.1 percent, and the creation of new state-owned firms accounts for five percent of the aggregate output in 2007. The fact that newly formed state-owned firms contribute almost as much to aggregate output as surviving state-owned firms may be surprising, given that total value added of surviving state-owned firms in 2007 was about four times larger than that of the new state-owned firms. The difference in the contribution of these groups of large state-owned firms stems from the fact that average labor productivity among new state-owned firms is about the same as that of the average private firm, so entry of these firms does not worsen the allocation of labor. In contrast, the average product of labor among state-owned firms in 2007 was still lower than that of the average private firm. So, here, as is

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<sup>24</sup>Our benchmark parameterization implies a mean of 0.78 for  $\chi$  across industries (see equation (12)). We have shown that labor productivity of state-owned and privatized firms was about half and three quarters of that of private firms in 1998 and 2007, respectively. Therefore, many state-owned and privatized firms would easily satisfy the condition.

the case with privatized state-owned firms, higher TFP among state-owned firms worsens the allocation of labor, which offsets the effect of higher firm TFP on aggregate output.

The estimates in column 1 assume that gaps in the average product of labor reflect differences in the marginal product. However, the evidence presented in Section 4 suggests that the convergence of labor productivity between state-owned and private firms can be explained by the reduction in the number of surplus workers in the state sector (instead of an increase in the marginal product of labor in state-owned firms). In column 2, we assume that (i) gaps in the average product of labor between state and non-state-owned firms entirely reflects the number of redundant workers in the state sector, but that the marginal product of labor is the same in the two sectors;<sup>25</sup> and (ii) redundant workers in the state sector have zero productivity and, hence, reducing  $f_i$  does not affect labor supply. Then, TFP growth in firms with low labor productivity does not worsen the allocation of labor. As can be seen, the effects on aggregate output are now almost twice as large (compared to the estimates in column 1). “Let Go of the Small” accounts for three percent of aggregate output in 2007, and “Grasp the Large” for 18 percent. The two reforms together, shown in the last row, account for 21 percent of aggregate output in 2007.

We have so far assumed that the aggregate supply of capital in China is perfectly elastic. This can be the case because of capital mobility or because a consumption Euler equation generates a constant interest rate. Song et al. (2011) documents that savings has exceeded investments in China, suggested that an open economy with an elastic supply of capital is a reasonable assumption for China. In addition, Bai et al. (2006) find that the return to capital to non-state firms was roughly constant over this time period, which is consistent with a fixed cost of capital.

Nonetheless, it is useful to examine the welfare effects when we assume a fixed capital stock at the aggregate level. The results are reported in the last two columns. Since the marginal product of capital is lower among surviving state-owned firms, privatized state-owned firms, and newly established state-owned firms, the implication of a fixed capital stock is that higher productivity growth among these firms raises the equilibrium interest rate and worsens the allocation of capital. Column 3 further assumes that low labor productivity reflects low marginal product, so the effect of TFP growth among low-labor-productivity firms also worsens the allocation of labor. This is the worse-case scenario because higher TFP growth among state-owned firms potentially worsens the allocation of both labor and capital. As can be seen, the effect of this alternative assumption is dramatic. For example, the effect of higher TFP

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<sup>25</sup>  $f_i/L_i$  is assumed to be the same among state-owned firms.



growth among surviving state-owned firms worsens aggregate output by almost five percent. Intuitively, the marginal products of capital and labor are low enough in these firms in 2007 such that the effect of higher TFP on resource misallocation overwhelms the direct effect of higher TFP on aggregate output. This effect is less strong among the newly established state-owned firms. This is because the creation of these firms worsens the allocation of capital (the average productivity of capital is lower in these firms) but not the allocation of labor (the average productivity of labor in these firms is about the same as the average).

The last column assumes that gaps in labor productivity reflect redundant workers (as in column 2), so, here, higher TFP growth in low-labor-productivity firms has no effect on the efficiency of labor allocation. Thus, comparing columns 2 with 4 isolates the effect of TFP on capital allocation. The effect of worse capital allocation due to TFP growth in low-capital-return firms is very large. The effect of worse capital allocation due to TFP growth among surviving state-owned firms lowers aggregate output by more than 14 percent ( $13.2 + 0.9$ ). The effect of worse capital allocation due to the entry of high-TFP but low-capital-return state-owned firms lowers aggregate output by 5.6 percent ( $7.2 - 1.6$ ).

In summary, the magnitude of the welfare gain depends on the extent to which capital supply is elastic. If the reality is that the cost of capital to private firms does not change due to the reform of state-owned firms, then the effect of the reform is likely to have increased aggregate output significantly. Similarly, the effect of TFP growth also depends on the extent to which it worsens the allocation of labor. Although we present evidence that the convergence in labor productivity between state and private firms is due to the reduction in redundant workers, we do not know whether the remaining gap in 2007 reflects differences in the marginal product of labor or in the number of redundant workers.

## 6 Conclusion

We document the dramatic transformation of Chinese state-owned firms from 1998 to 2007. Smaller state-owned firms were closed or privatized; large state-owned firms were corporatized and merged into large state-owned holding companies; and new state-owned firms were created. We show that labor productivity and TFP increased in the privatized and surviving state-owned firms. In contrast, there was little convergence in the capital productivity of these two types of firms from 1998 to 2007. Among the newly established state-owned firms, we show that TFP of the state-owned firms is significantly higher than that of their private counterparts, while labor productivity is about the same and capital productivity significantly lower.

Although these changes unambiguously increase state-sector profits, the effects on welfare

are more ambiguous. If higher TFP in state-owned firms does not worsen resource allocation, then the reform of the state sector is potentially responsible for 20 percent of aggregate output in 2007. However, if the aggregate supply of capital is fixed, the effect of higher TFP and the creation of new high-TFP state-owned firms can worsen the allocation of capital by enough that the net effect on aggregate output may be negative. Likewise, if the marginal product of labor among state-owned firms is low, higher TFP can also lower aggregate output by reallocating workers away from private firms, where the marginal product of labor is presumably higher.

In addition, although we provide suggestive evidence that changes in corporate governance, competition from private firms and other state-owned groups, and reallocation of assets between state-owned groups may have been important drivers of the changes observed in state-owned firms, the evidence is far from conclusive. Furthermore, our analysis of the welfare effect of “Grasp the Large, Let Go of the Small” relies on a specific model, but the effect may be different with a different model. Finally, our firm-level data end in 2007, and based on the industry-level data in the post-2007 period, it seems possible that some patterns could have changed since then. We find some evidence that this might have been the case, but definitive answers will only come once similar micro-data for the post 2007 period is available.

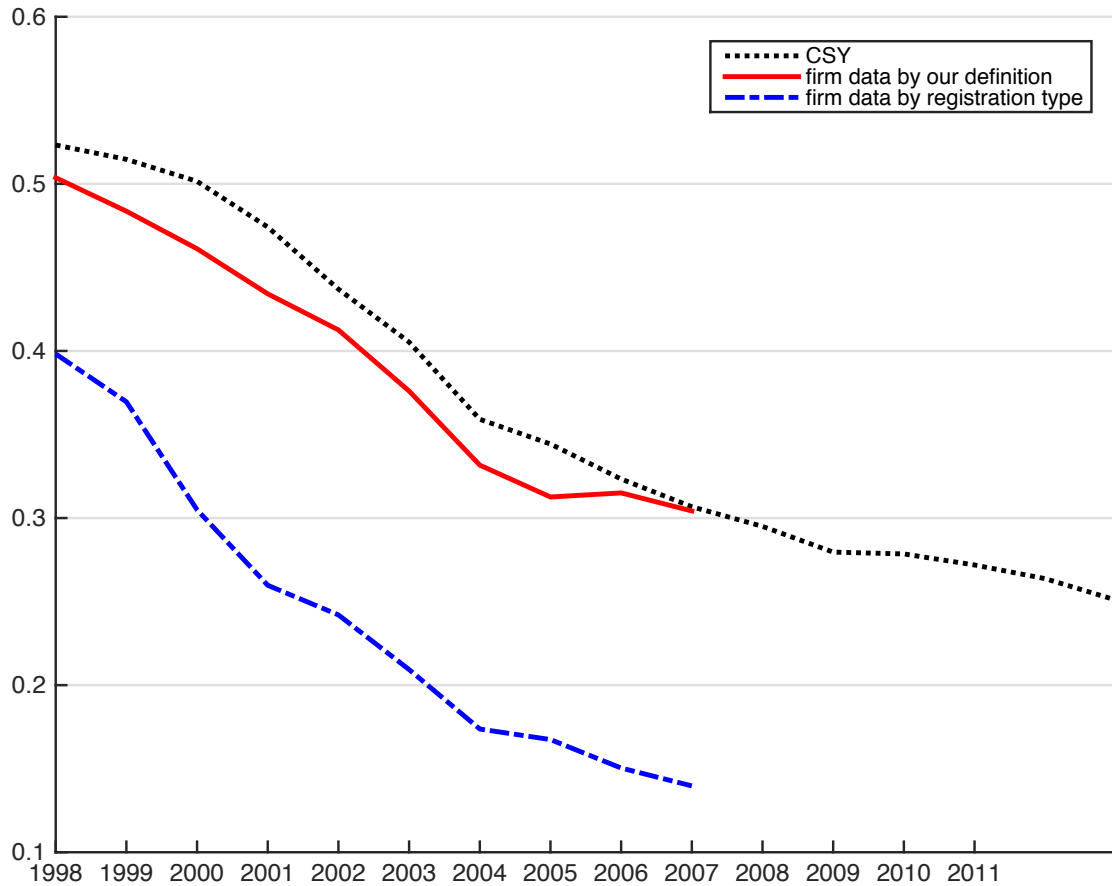
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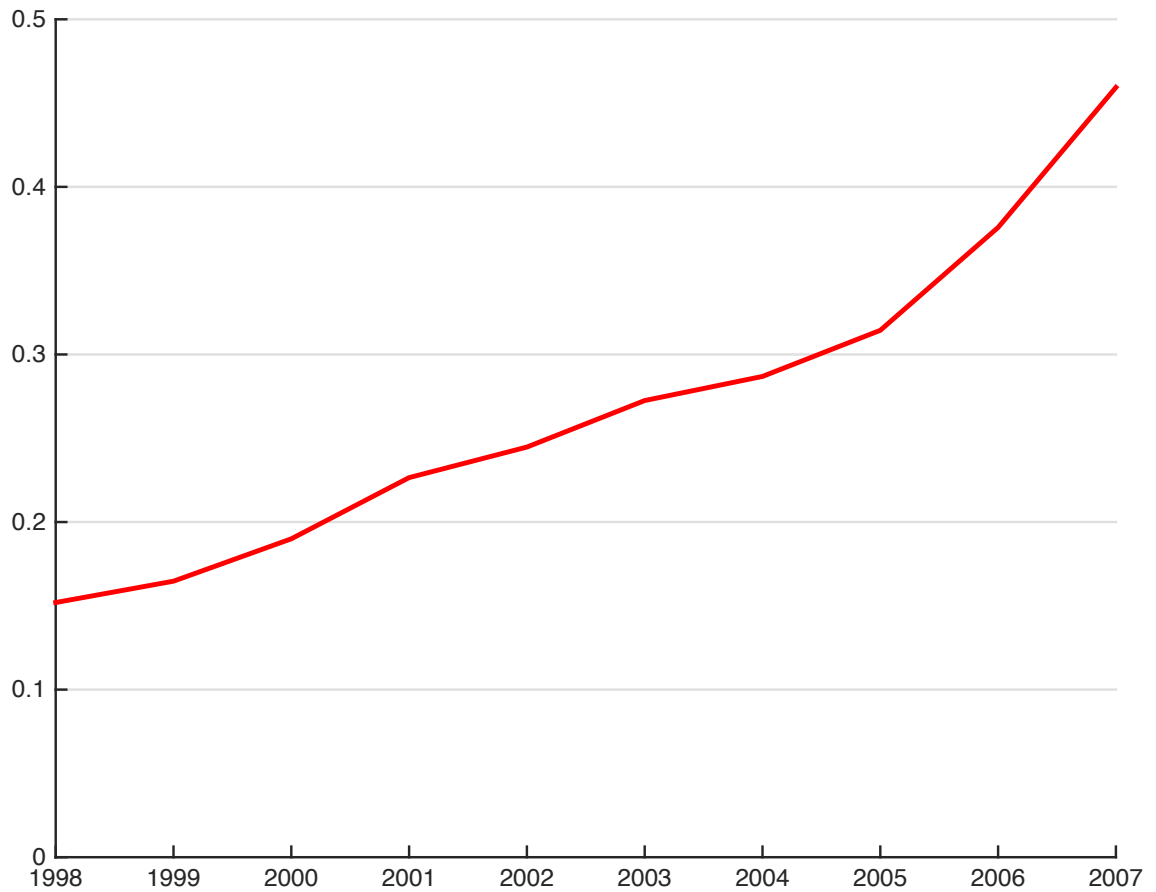
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**Figure 1: Revenue Shares of State-Owned Firms**



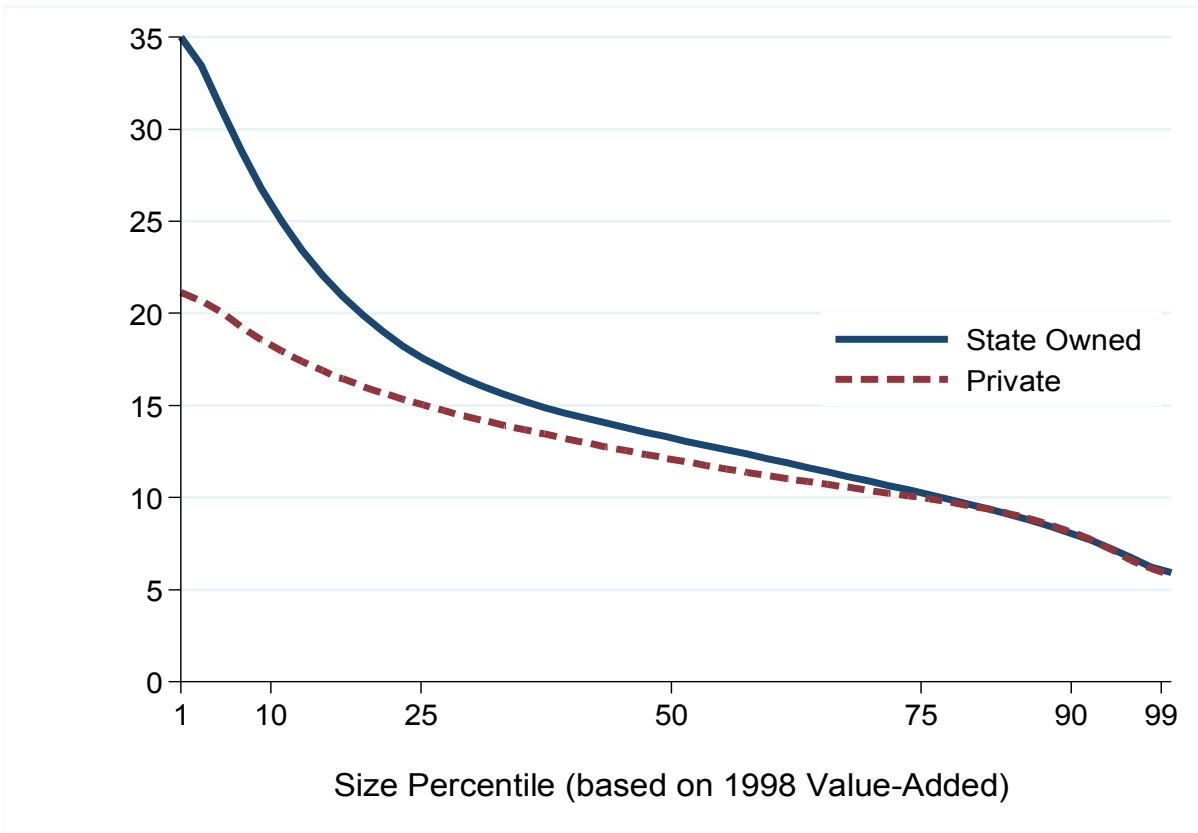
Note: This figure plots the revenue share of state-owned firms in China's industrial sector. CSY refers to the share computed from aggregate data published in the China Statistical Yearbooks (CSY). Using firm-level data described in Section 3.2, the solid and dashed lines plot the share of state-owned firms identified by our definition (see Section 3.2 for details) and by their registration types, respectively.

**Figure 2: Share of State-Owned Firms Registered as Private Firms**



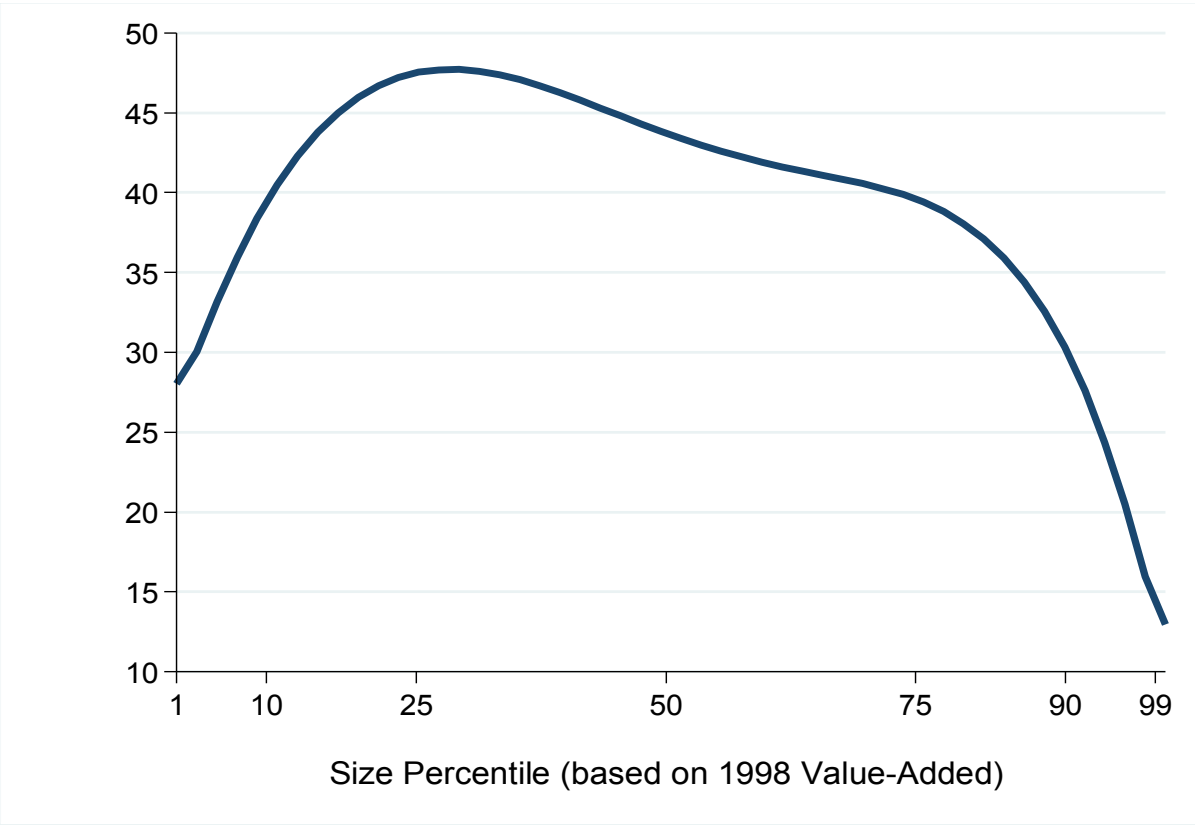
Note: This figure plots the number of the state-owned firms (by our definition) that are registered as private firms as a share of the number of all state-owned firms.

**Figure 3: Exit Rate 1998-2007**



Note: The solid and dotted lines plot the annual exit rate for state-owned and private firms, defined as state and privately owned in 1998, respectively. See the online appendix for the definition of the annual exit rate.

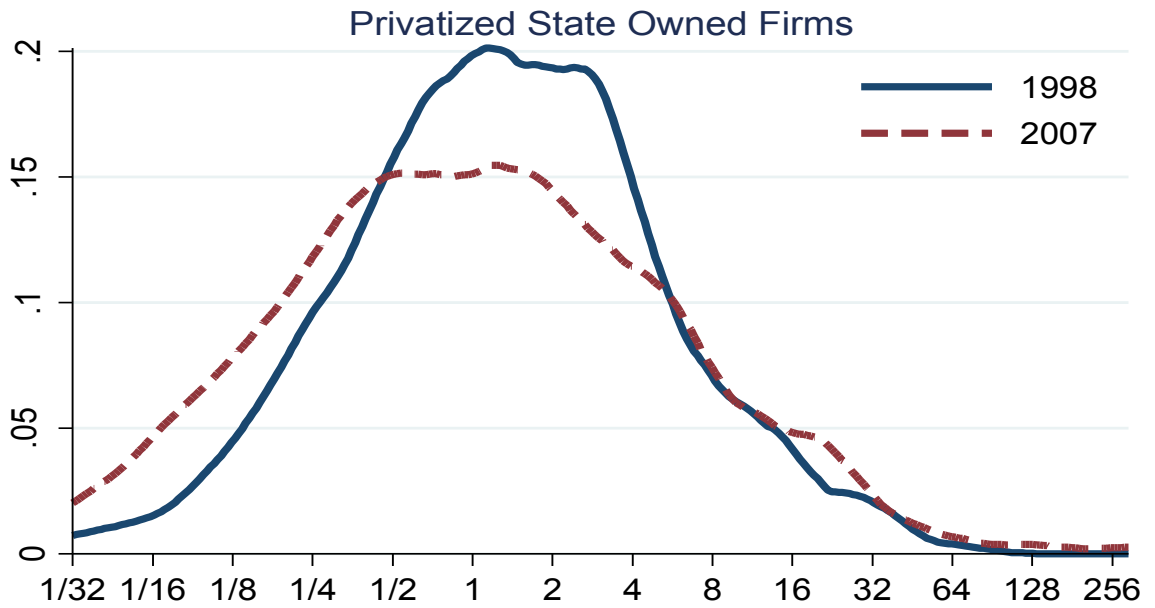
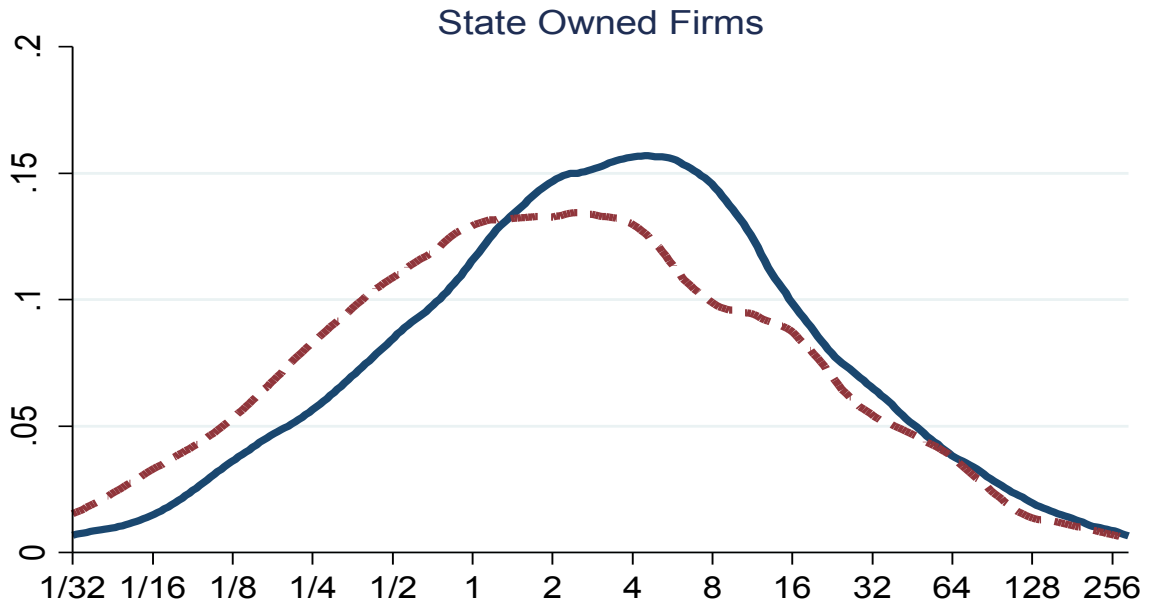
**Figure 4: Privatized State-Owned Firms/All Surviving State-Owned Firms**



Note: This figure plots the ratio of the number of private firms in 2007 that were state-owned in 1998 divided by the number of state-owned firms in 1998 that survived until 2007 (including state-owned firms in 1998 that were privatized by 2007).



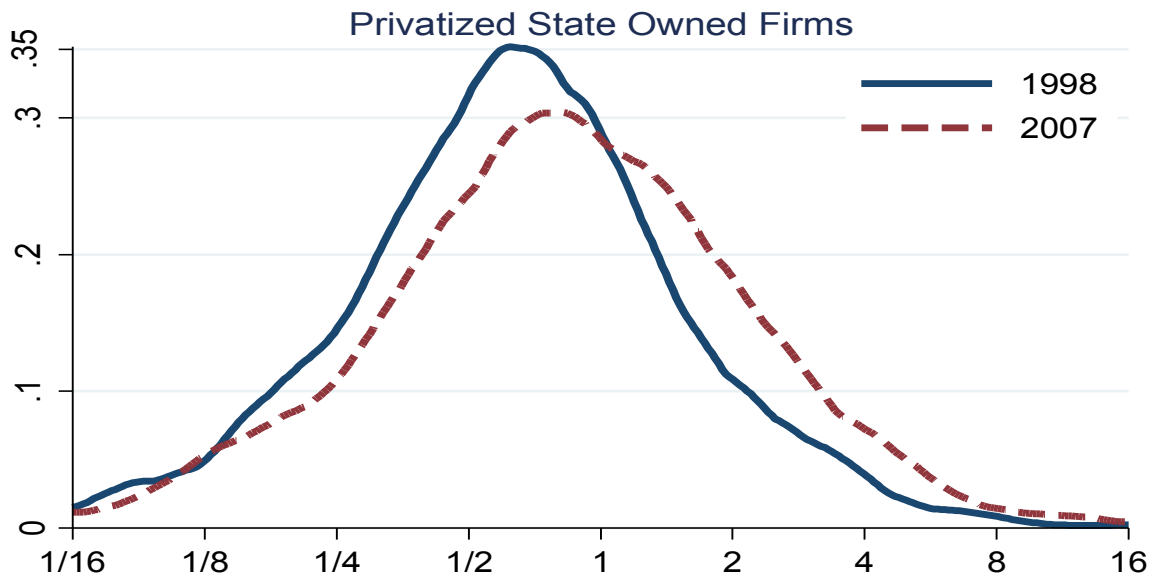
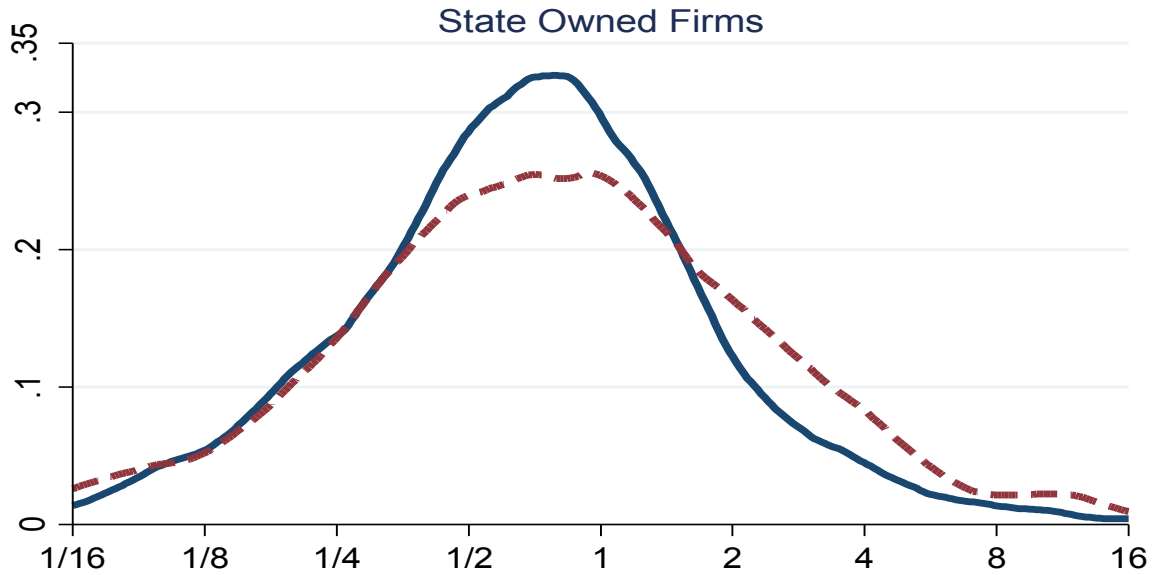
**Figure 5: Distribution of Firm Value added**



Value-Added (Mean Private Firms = 1)

Notes: The sample is the balanced panel from 1998 to 2007. Size is measured by firm value added normalized by weighted mean of value added of private firms in each year. Observation for each firm is weighted by employment. State-owned firms are defined as state-owned in 1998 and 2007. Privatized firms are defined as state-owned in 1998 and privately owned in 2007.

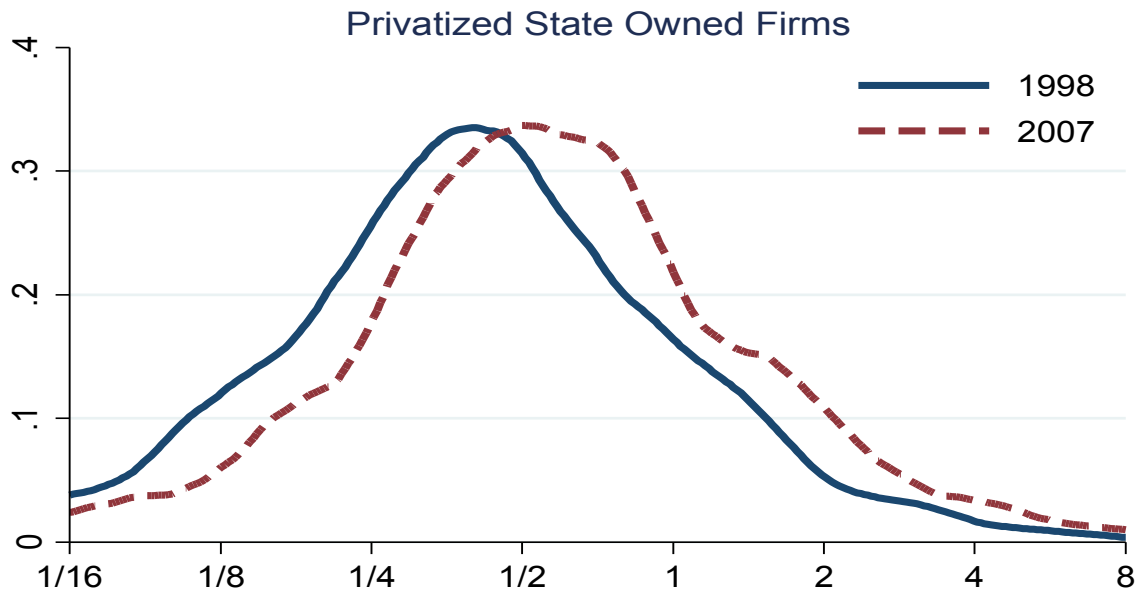
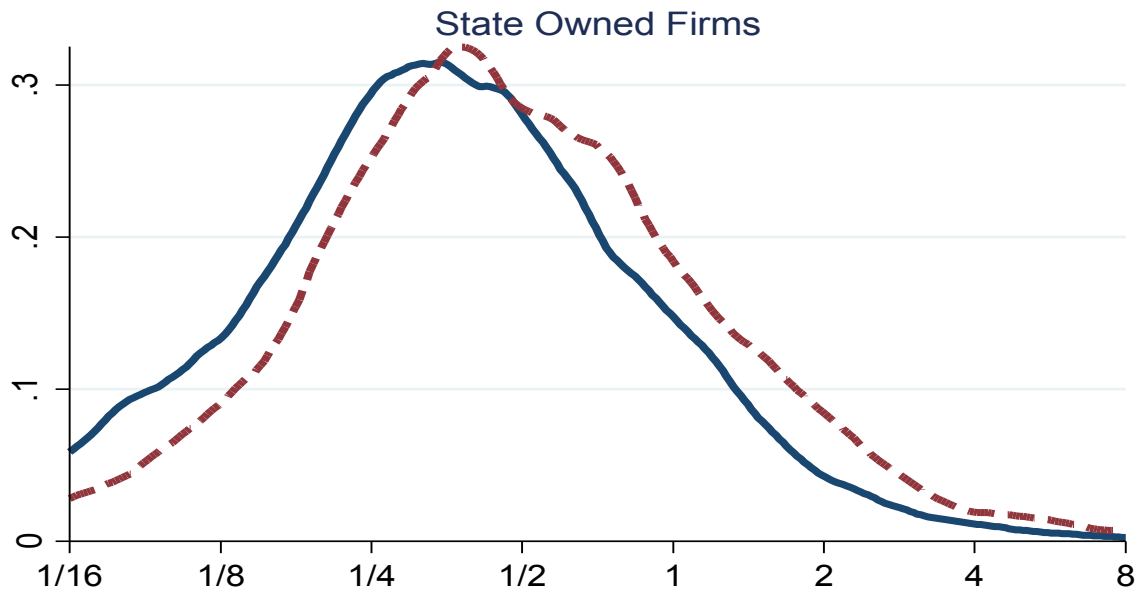
**Figure 6: Distribution of Labor Productivity**



VA/Worker (Mean Private Firms = 1)

Notes: Sample is the balanced panel from 1998 to 2007. Labor productivity is normalized by output weighted mean of labor productivity of surviving private firms in each year. Observation for each firm is weighted by firm employment. State-owned firms are state-owned in 1998 and 2007. Privatized firms are state-owned in 1998 and privately owned in 2007.

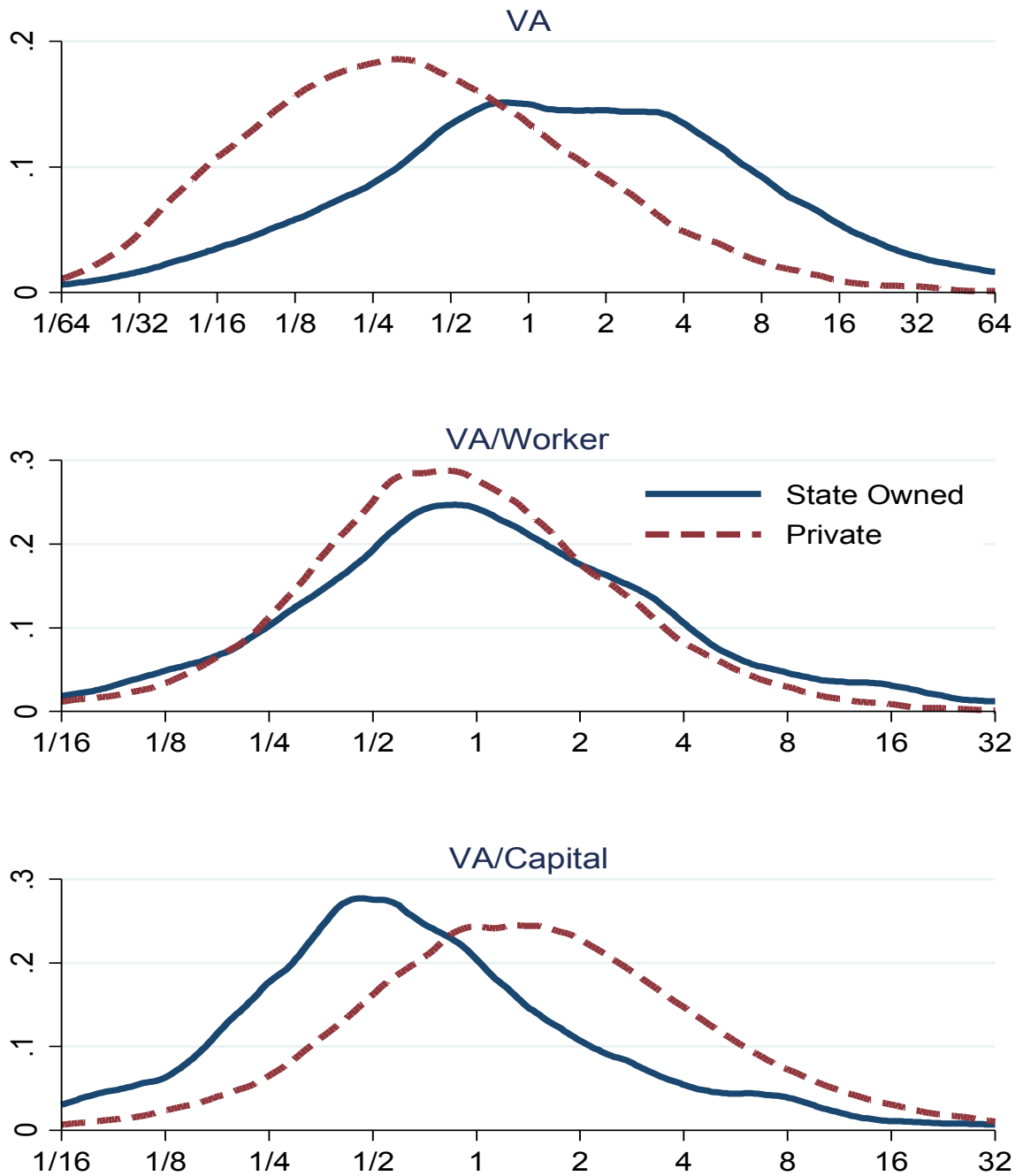
**Figure 7: Distribution of Capital Productivity**



VA/Capital (Mean Private Firms = 1)

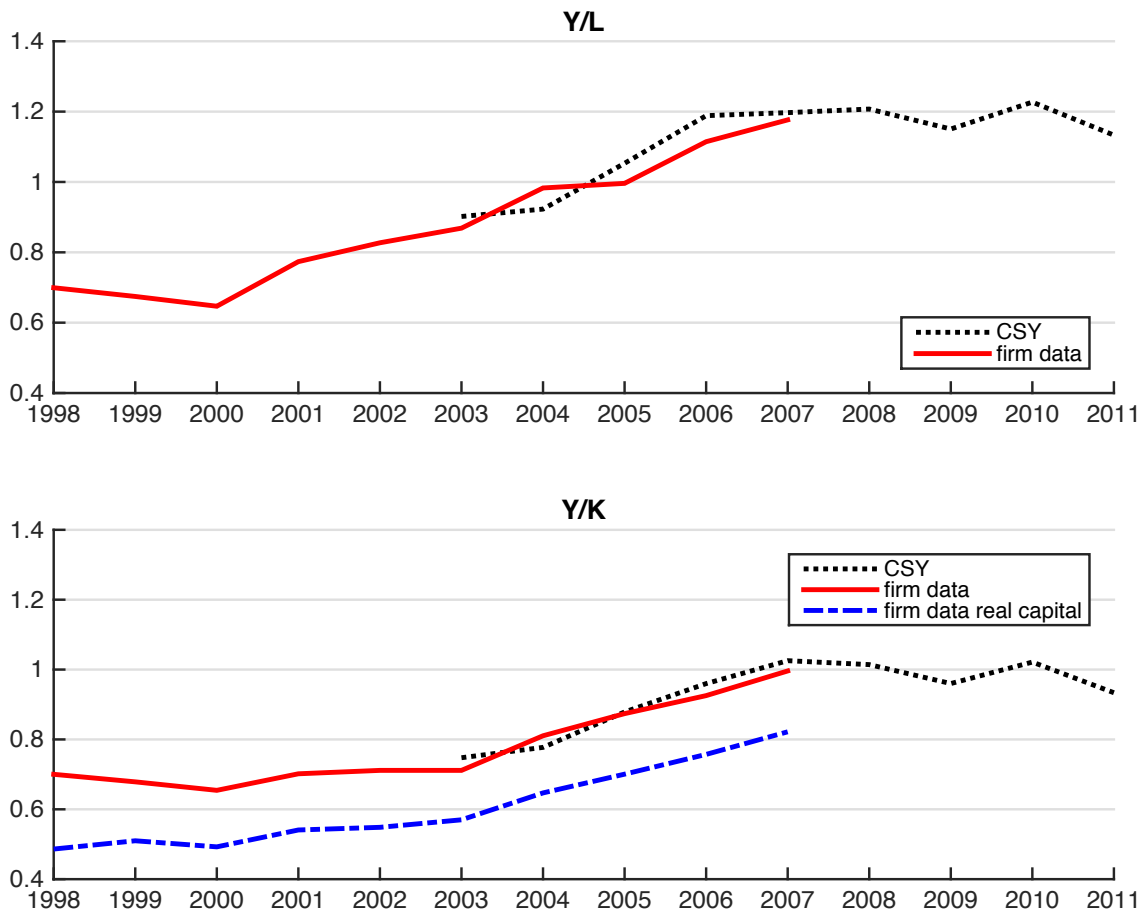
Notes: Sample is the balanced panel from 1998 to 2007. Capital productivity is normalized by output weighted mean of capital productivity of surviving private firms in each year. Observation for each firm is weighted by employment. State-owned firms are state-owned in 1998 and 2007. Privatized firms are state-owned in 1998 and privately owned in 2007.

**Figure 8: Distribution of Size, Labor Productivity, and Capital Productivity among Entrants  
(Mean Surviving private Firms = 1)**



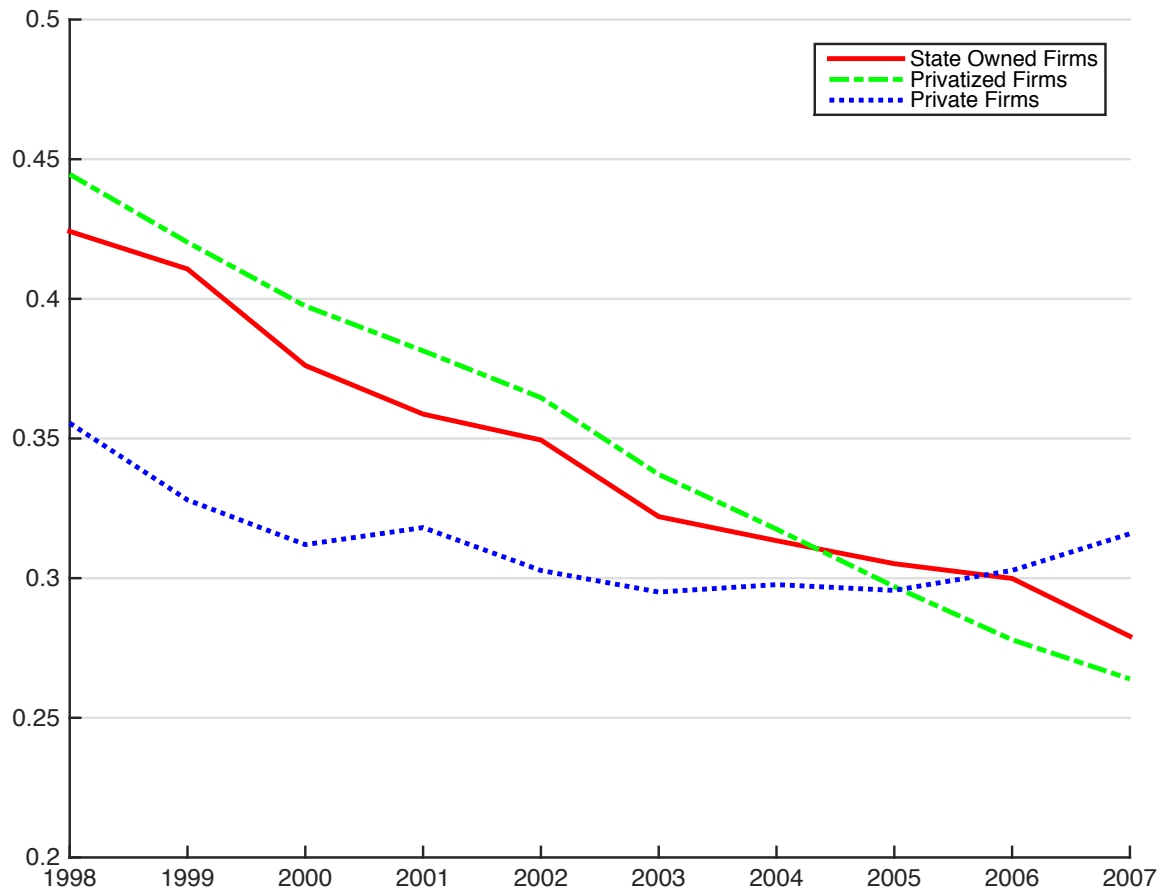
Notes: Sample is firms in 2007 established after 1998. Size is Value added (VA), Labor Productivity is VA/Worker, and Capital Productivity is VA/Capital. Observations are weighted by employment and normalized by weighted mean of surviving private firms in 2007.

**Figure 9: Relative Labor and Capital Productivity**



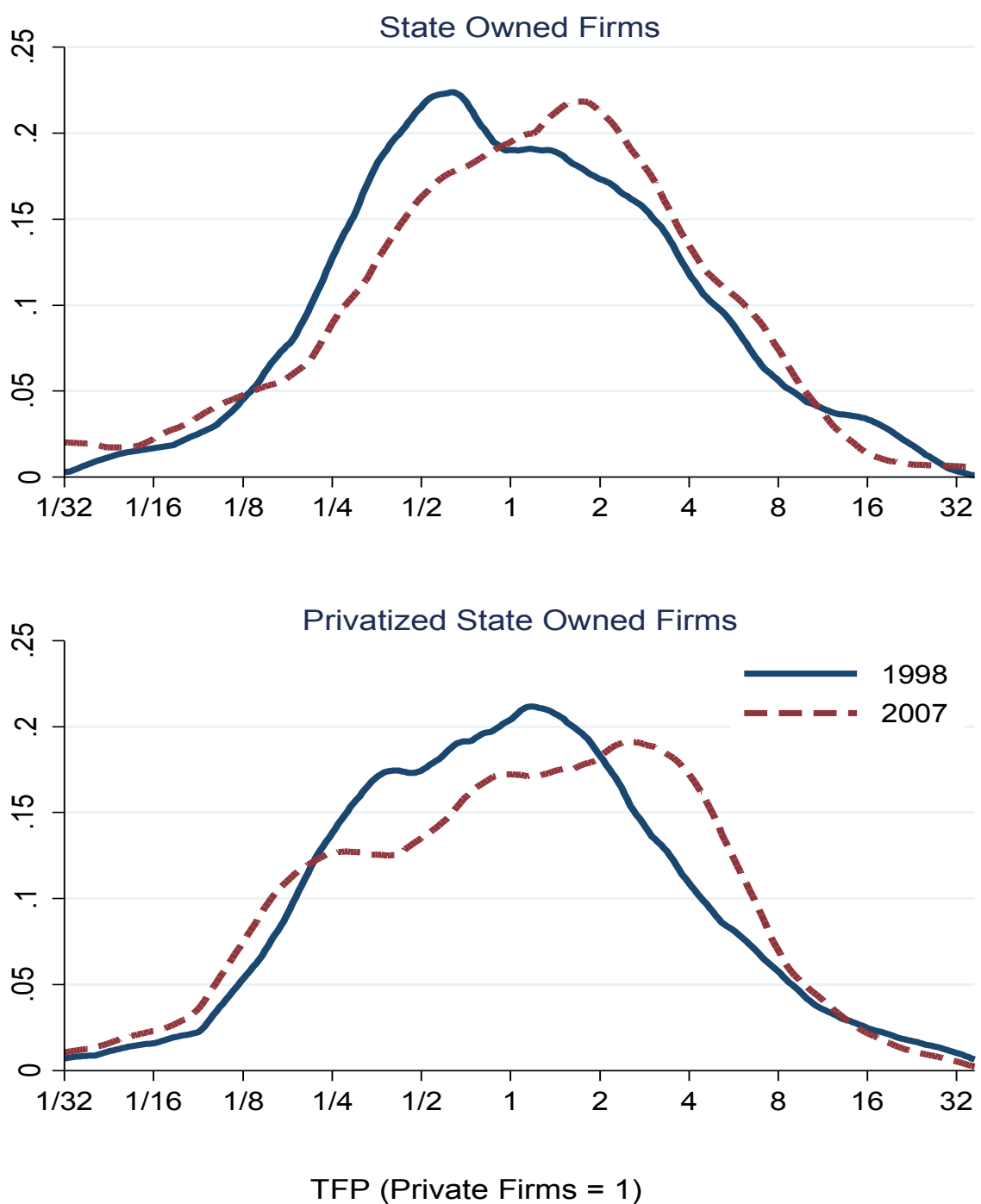
Note: The top panel plots the weighted average of the revenue per worker of state-owned firms relative to that of private firms in each two-digit industry. The dotted line uses two-digit industry-level data from China Statistical Yearbooks, while the solid line uses the firm-level data. The dotted and solid lines in the bottom panel plot the weighted average of the revenue per unit of book value of fixed assets net of depreciation of state-owned firms relative to that of private firms in each two-digit industry. The dotted line uses two-digit industry-level data from the China Statistical Yearbooks, while the solid line uses firm-level data. The dashed line plots the weighted average of the revenue per unit of real capital of state-owned firms relative to that of private firms in each two-digit industry, where real capital is defined in Section 3.3.

### Figure 10: Labor Share



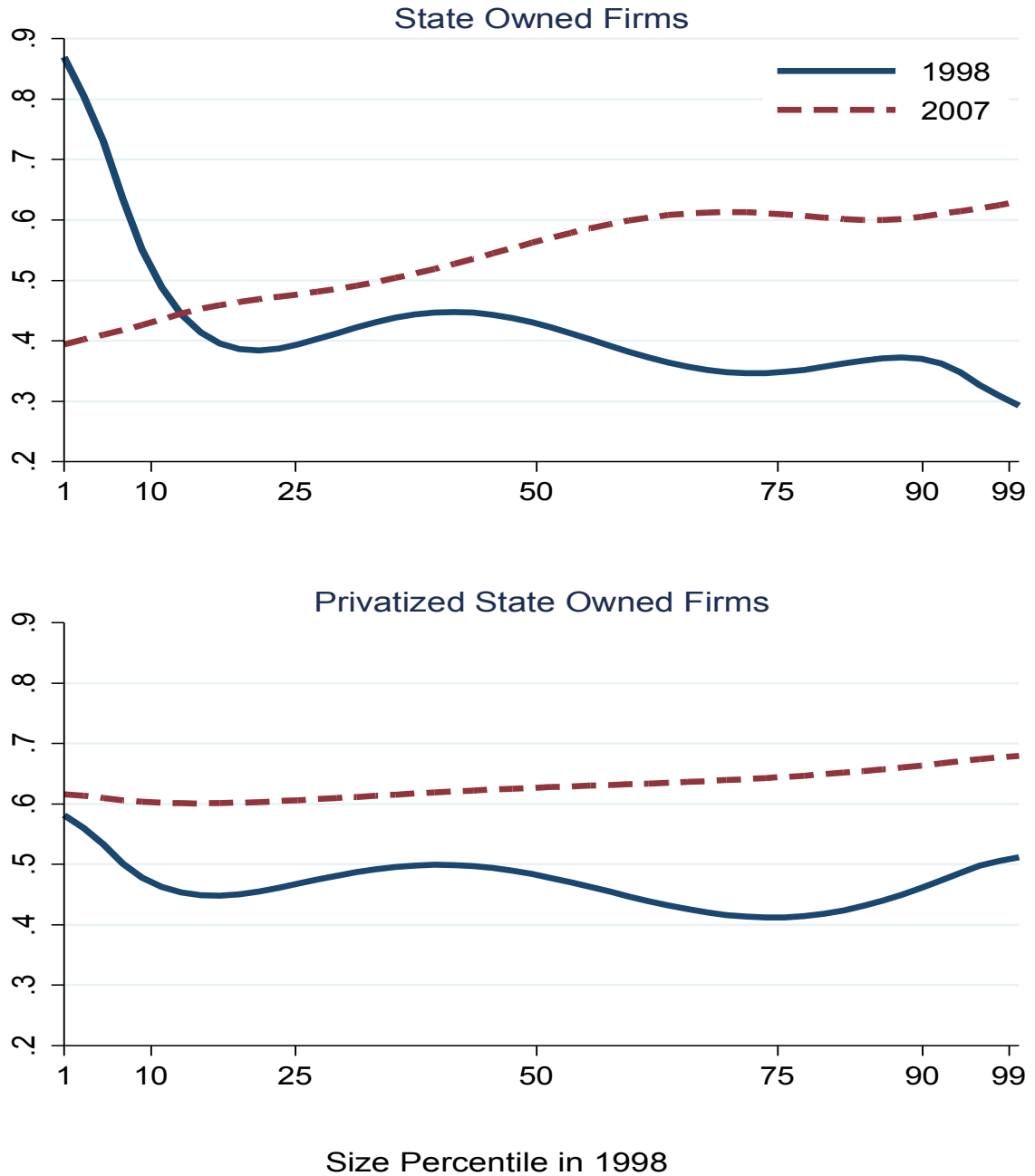
Notes: Sample is the balanced panel of industrial firms from 1998 to 2007. The solid, dashed and dotted lines plot the labor share of state-owned firms, privatized firms and private firms, respectively, in the balanced panel.

**Figure 11: Distribution of Firms by TFP**



Notes: Sample is the balanced panel from 1998 to 2007. TFP is normalized by mean of surviving private firms in each year. State-owned firms are state-owned in 1998 and 2007. Privatized firms are state-owned in 1998 and privately owned in 2007.

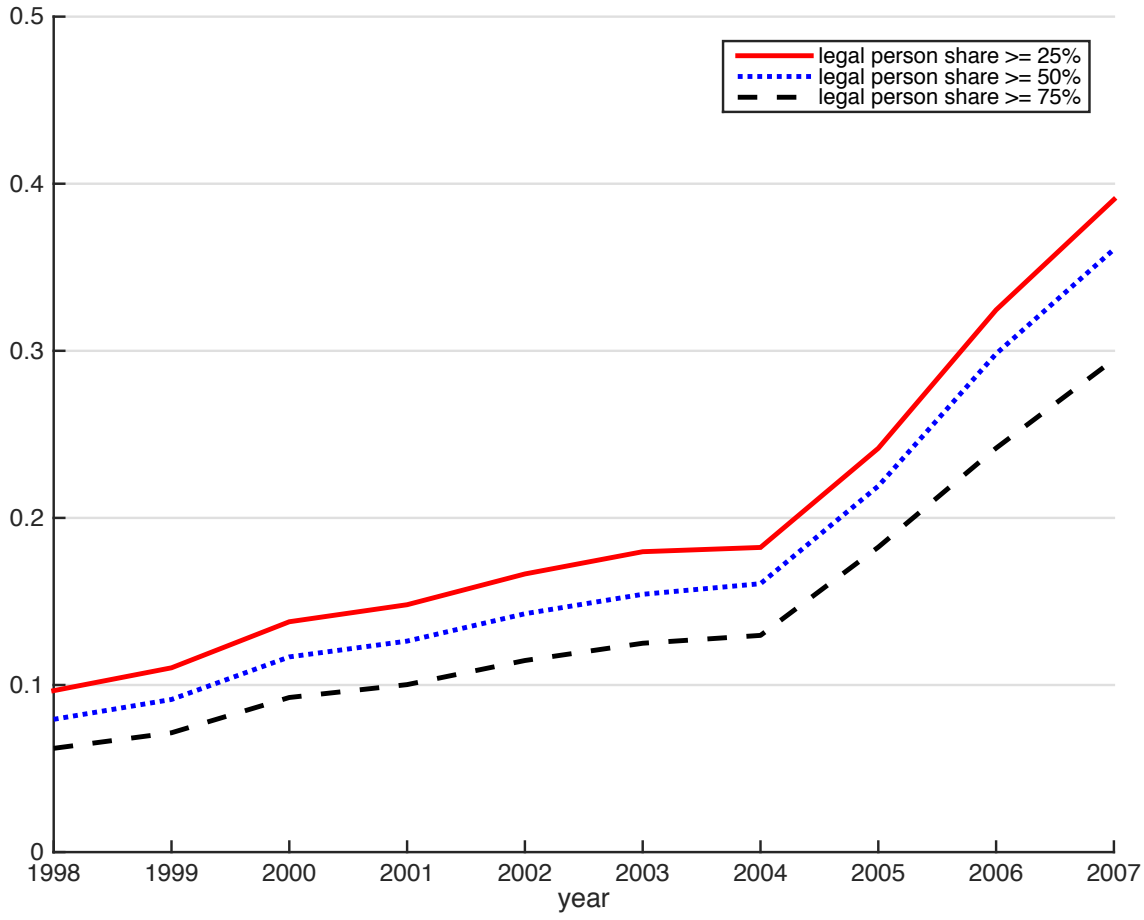
**Figure 12: TFP by Size in 1998**



Notes: Sample is the balanced panel in 1998 and 2007. TFP in each percentile is normalized by median TFP of surviving private firms in the percentile in each year. State-owned firms are state-owned in 1998 and 2007. Privatized firms are state-owned in 1998 and privately owned in 2007. Size in 1998 is defined as value added.



**Figure 13: Fraction of State-Owned Firms by "Legal Person" Ownership Share**



Notes: The solid, dotted and dashed lines plot the number of state-owned firms with legal person share above or equal to 25%, 50% and 75% as a share of the number of all state-owned firms, respectively.

**Table 1: Firms and Employment by Ownership**

	<b># Firms</b>	<b>Employment</b>
<b>State-Owned in <u>1998</u></b>		
Exit by 2007	38.1	15,077
State-Owned in 2007	7.6	12,679
Private in 2007	5.0	3,196
<b>Private in <u>1998</u></b>		
Exit by 2007	58.2	11,871
Private in 2007	28.1	8,422
<b>State-Owned in <u>2007</u></b>		
Entrant	4.2	2,475
State-Owned in 1998	7.6	9,308
<b>Private in <u>2007</u></b>		
Entrant	199.4	30,767
State-Owned in 1998	5.0	2,512
Private in 1998	28.1	11,549

Note: Number of firms and employment is in thousands. Entrants in 2007 are the firms established between 1999 and 2007 (inclusive).

**Table 2: Average Annual Exit Rate**

	1991-1995	1998-2007
State-Owned	0.9 %	13.2 %
Private	13.2 %	12.0 %

### **Table 3: Firm Characteristics by Ownership, 1998**

**(Weighted Mean Relative to Surviving Private Firms)**

	<b>VA</b>	<b>VA/Worker</b>	<b>VA/Capital</b>
<b>State-Owned in 1998</b>			
Exit by 2007	-0.556 (0.132)	-1.072 (-0.058)	-1.350 (0.076)
Privatized by 2007	0.223 (0.095)	-0.504 (0.046)	-0.929 (0.076)
State-Owned in 2007	0.935 (0.167)	-0.447 (0.063)	-1.081 (0.119)
<b>Private in 1998</b>			
Exit by 2007	-0.651 (0.043)	-0.275 (0.026)	0.038 (0.026)

Note: VA is log value added, VA/Worker is log value added per worker, and VA/Capital is log value added per capital. Omitted category in each column is private firms in 1998 that survived until 2007. All observations are weighted by employment. Exit by 2007 are firms that exit between 1999 and 2007 (inclusive). Privatized by 2007 are firms that are state-owned in 1998 and privatized between 1999 and 2007 (inclusive). State-owned in 2007 are firms that are state-owned in 1998 and 2007. Standard errors are in parentheses.

## Table 4: Firm Characteristics by Ownership, 2007

(Weighted Mean Relative to Surviving Private Firms)

	VA	VA/Worker	VA/Capital
<b>State-Owned in 2007</b>			
Entrant	0.484 (0.184)	0.058 (0.117)	-0.402 (0.091)
State-Owned in 1998	0.438 (0.175)	-0.344 (0.129)	-0.775 (0.137)
<b>Private in 2007</b>			
Entrant	-1.004 (0.042)	-0.128 (0.028)	0.384 (0.028)
State-Owned in 1998	-0.038 (0.087)	-0.256 (0.039)	-0.580 (0.054)

Note: VA is log value added, VA/Worker is log value added per worker, and VA/Capital is log value added per capita. Omitted category is surviving private firms in 2007 (that also existed in 1998). All observations are weighted by employment. Entrants are firms established after 1998. Standard errors are in parentheses.

**Table 5: Value added Share of State-Owned Firms in Strategic Sectors**

	<b>1998</b>	<b>2007</b>
Mining of Coal	82	66
Extraction of Petroleum	100	97
Processing of Petroleum	88	63
Chemical	51	24
Ferrous Metals	79	46
Non-Ferrous Metals	54	34
Transport Equipment	65	49
Communication Equipment	42	8
Electric and Heat Power	86	88

**Table 6: TFP Growth and Market Entry**

Dependent Variable: TFP Growth State-Owned Firms			
	(1)	(2)	(3)
Private Entry Rate	0.737 (0.251)		
State Entry Rate		3.613 (1.019)	
$\Delta$ State Herfindahl			-0.160 (0.0711)
R-squared	0.213	0.282	0.137

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Dependent Variable = TFP Growth Privatized Firms			
	(1)	(2)	(3)
Private Entry Rate	0.874 (0.236)		
State Entry Rate		3.419 (0.947)	
$\Delta$ State Herfindahl			-0.183 (0.0671)
R-squared	0.307	0.296	0.189

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Dependent Variable = TFP Growth Private Firms			
	(1)	(2)	(3)
Private Entry Rate	1.284 (0.337)		
State Entry Rate		1.587 (1.707)	
$\Delta$ State Herfindahl			-0.0266 (0.110)
R-squared	0.312	0.026	0.002

Note: Each observation is a two-digit industry (N=34). Dependent variables is average annual TFP growth rate of median firm of each type in the balanced panel from 1998 to 2007. State-owned Firms are state-owned in 1998 and 2007. Privatized Firms are stated owned in 1998 and privately owned in 2007. Private firms are privately owned in 1998 and 2007. Private Entry Rate is number of new private firms/total private firms in each year; State Entry Rate is number of new state-owned firms/total state-owned firms; and  $\Delta$  State Herfindahl is the average change in Herfindahl index for state-owned firms in the balanced panel. Standard errors clustered by industry in parentheses.

**Table 7: Productivity Gains from "Grasp the Large, Let Go of the Small"**

	<b>Open Economy</b>		<b>Closed Economy</b>	
	<b>No Surplus Labor</b>	<b>Surplus Labor</b>	<b>No Surplus Labor</b>	<b>Surplus Labor</b>
<b>Let Go of the Small</b>	1.6	3.2	0.0	0.9
Exit	0.3	-0.5	0.4	0.0
Privatization	1.4	3.7	-0.4	0.9
<b>Grasp the Large</b>	10.0	18.4	-3.5	0.9
Surviving State Firms	6.1	13.2	-4.6	-0.9
New Firms	5.3	7.2	0.5	1.6
<b>Grasp the Large + Let Go of the Small</b>	11.4	21.0	-3.0	1.9

Note: This table reports the percentage increase of 2007 aggregate output in each counterfactual relative to that in the benchmark case. Columns 1 to 2 and 3 to 4 report the results in the open and closed economy, respectively.