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Market power of China's State-owned Firms: Evidence from Manufacturing Firm-level Data

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March 2020

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Keywords: Markups, China’s state-owned firms, Manufacturing firm-level data
JEL classification: D22, D24, L11, P21

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1 Introduction

Since China's reform and open-door policies in 1978, various policy measures have been taken to reform the inefficient production systems of the state-owned enterprises (SOEs). In the beginning, the SOEs had been traditionally considered as the foundation of Socialist economy, and drastic reform of the SOEs were not implemented. Despite the reform, SOEs' profit rate had continued to decline in the 1980s. Furthermore, inflation and the Tiananmen Square incident caused a serious blow to Chinese economy. China had been forced to review their strategy for economic growth. After Deng Xiaoping's southern tour of China in 1992, a liberalization policy for economic development was given priority over the preservation of traditional Socialist economy in order to get over the deep recession. The adoption of the liberalization policy led to a massive entry of private sector firms in a wide range of fields and consequently the SOEs sector had contracted their presence in Chinese economy in the 1990s.

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The shrinkage of the state-owned sector and expansion of the private sector in the 1990s is usually described in Chinese as *Guotui Minjin* (i.e., the private advances, the state sector retreats). In a sense, this phenomenon comes as no surprise because China's government has advanced the reform based on market principles. However, in recent years, many scholars have reported a phenomenon running counter to *Guotui Minjin*, that is, *Guojin Mintui* (i.e., the state advances, the private sector retreats).[1)] For example, it is reported that SOEs colluded with government are likely to use public authority to beat private competitors and that SOEs have advantageous access to factor resources such as capital from bank loans, subsidies, and land (Kato, 2012; Watanabe, 2013). Such cases indicate a possibility that there exist unfair competitive conditions between the state and non-state sector firms and that enables SOEs to have larger market power than the private sector.

Has the state-owned sector been expanding in recent years? From a qualitative perspective, the presence of SOEs seems to be increasing after 2003, because after Hu Jintao was elected as the president of China in 2002, the State Asset Supervision and Administration Commission (SASAC) was created in 2003, and SASAC began to increase in the size and importance of the SOEs (Naughton, 2011). As is symbolized by the establishment of SASAC, China's government had revealed a policy to firmly maintain the important presence of the SOEs since then. Furthermore, it is said that many social and economic policies for regional and industrial development, conducted in the 2000s, largely contributed to increasing the presence of SOEs (Naughton, 2011; Kato, 2012). However, the above argument lacks substantial statistical evidence. As Kato (2012) and Marukawa (2015) pointed out, judging from the official macroeconomic data from 1998 to 2008, the share of SOEs tends to decrease in the number of firms, employees, value added, and total assets. By industrial sector, it dramatically decreased in the manufacturing, wholesale and retail industries. For the period from 2009 to 2011, SOEs was slightly increasing in their total number and asset share (Marukawa, 2015). And the share of SOEs was increasing in public and service sectors. In sum, according to previous studies, the expansion of SOEs is observed in the service sector after the 2009 global financial crisis, while that is not observed in the manufacturing sector at least before the crisis. The private sector has an overwhelmingly larger number of firms than the state sector and then, it does not seem to take place *Guojin Mintui* (the state advances, the private sector retreats).

However, as will be mentioned below, the firm size of SOEs is much greater than that of the private sector firms and it tends to increase over time. And there are several studies reporting that the state-owned sector is expanding and undermining private firms. How much influence do SOEs have in China's economy where there exists both small number of large SOEs and large number of small private firms? This study attempt to revisit this issue from the viewpoint of market power. Market power is typically measured by markups (Hall, 1986; De Loecker and Warzynski, 2012). The author uses China's manufacturing firm-level data from 2003 to 2007 to estimate firm-level markups and to compare them between the state-owned, domestic private, and foreign sectors. As a result, it is found that the relative markups of the state sector are smaller than those of the private and foreign sectors, while the markups of the state-owned sector tend to steadily increase and be catching up with the private and foreign firms during 2004–2007; However, the catching up process is not observed in surviving firms, implying that the exit of the state-owned firms with lower markups causes the increase in the average

[1)] See Kato (2012), Watanabe (2013), and Lardy (2019).

markups of the state-owned sector. From the perspective of markups, it seems not to take place the expansion of SOEs in the manufacturing sector in the latter half of the 2000s.

The contribution of this paper is twofold. First, to the best of my knowledge, this study is the first to investigate the presence of SOEs in terms of the firm-level markups. Markups are typically used to represent the magnitude of market power which is the ability to control its product price in the market and is able to capture the presence and influential power of SOEs. As a result, the author finds new evidence that the markups of SOEs are significantly smaller than the private and foreign sectors during the period from 2004 to 2007, and the average markups in the SOEs tends to be increasing because of exiting SOEs with lower markups. Second, the author proposes a new nonparametric estimation strategy for the estimation of markups. While the famous methodology for markup estimation proposed by De Loecker and Warzynski (2012) requires us to estimate a firm-level production function, this paper's nonparametric method enable us to estimate markups without identifying a production function. Because there is a fundamental difficulty in the estimation of production functions (Ackerberg, Caves, and Frazer, 2015; Gandhi, Navarro, and Rivers, 2020), this nonparametric approach is useful and works in the estimation of markups.

The remainder of this paper is organized as follows. Section 2 describes an empirical framework for the estimation of markups. Section 3 describes data used in the estimation, Section 4 reports the estimation results, and Section 5 concludes.

2 An Empirical Model to Estimate markups

This section shows an empirical framework to derive and estimate firm-level markups. Following the seminal paper by De Loecker and Warzynski (2012), the deviation is based on standard cost minimization conditions for a variable input free of adjustment costs. The derived markups are expressed by the cost share of a variable input and the output elasticity with respect to a variable input. After the author clarifies the representation of markups, an empirical strategy for the estimation of markups is discussed.

2.1 Deriving firm-level markups

Let us consider that a firm i at period t operates through discrete time t and produces an output using capital K_{it}, labor L_{it}, and intermediate inputs M_{it}. The relationship between these inputs and output is expressed as

$$Q_{it} = F(K_{it}, L_{it}, M_{it}) \exp\{\omega_{it}\} \tag{1}$$

where ω_{it} is the anticipated productivity level which represents the types of technology, information, knowledge or situations of the firm i that affect its productivity and can be observed by the firm at the beginning of each period, but not be observed by the econometrician. Q_{it} is an output anticipated by firm i at t. The actual and observed output Y_{it} can be described by including the effect of an unanticipated productivity shock ε_{it} which cannot be observed by firm i before making its input decisions for period t:

$$Y_{it} = F(K_{it}, L_{it}, M_{it}) \exp\{\omega_{it} + \varepsilon_{it}\}. \tag{2}$$

Firm i's cost minimization problem can be represented by the following Lagrangian function:

$$L \equiv r_{it}K_{it} + w_{it}L_{it} + \rho_{it}M_{it} + \lambda_{it}[Q_{it} - F(\cdot)\exp\{\omega_{it}\}] \tag{3}$$

where r_{it}, w_{it} and ρ_{it} denote unit prices of capital, labor, and intermediate inputs, respectively. It is assumed that labor and capital are quasi-fixed inputs and predetermined at period t because adjustment costs exist in these inputs (e.g., hiring/firing, job training, or machine installation costs). On the other hand, intermediate input M_{it} is assumed to be flexible and there are no adjustment costs in M_{it}. These assumptions imply that, at the beginning of each period, firm i observes ω_{it} and chooses the level of M_{it} to minimize the firm's cost, under the predetermined levels of labor, capital, and ω_{it}. The first order condition of the cost minimization problem is

$$\rho_{it} - \lambda_{it}\frac{\partial F(\cdot)\exp\{\omega_{it}\}}{\partial M_{it}} = 0. \tag{4}$$

Multiplying both side of Equation (4) by $M_{it}/p_{it}Y_{it}$ yields the observed intermediate cost share equation:

$$\begin{aligned}
S_{it} \equiv \frac{\rho_{it}M_{it}}{p_{it}Y_{it}} &= \frac{\lambda_{it}}{p_{it}}\frac{\partial F(\cdot)\exp\{\omega_{it}\}}{\partial M_{it}}\frac{M_{it}}{Y_{it}} \\
&= \frac{\lambda_{it}}{p_{it}}\frac{\partial F(\cdot)\exp\{\omega_{it}\}}{\partial M_{it}}\frac{M_{it}}{F(\cdot)\exp\{\omega_{it}+\varepsilon_{it}\}} \\
&= \frac{\lambda_{it}}{p_{it}}\frac{\partial F(\cdot)}{\partial M_{it}}\frac{M_{it}}{F(\cdot)}\frac{1}{\exp\{\varepsilon_{it}\}} \\
&= \frac{1}{\mu_{it}}G(K_{it}, L_{it}, M_{it})\frac{1}{\exp\{\varepsilon_{it}\}} \\
G(\cdot) &\equiv \frac{\partial F(\cdot)}{\partial M_{it}}\frac{M_{it}}{F(\cdot)} \\
\mu_{it} &\equiv p_{it}/\lambda_{it}
\end{aligned} \tag{5}$$

where S_{it} is the cost share of the intermediate input M_{it}, p_{it} is output price, and $G(\cdot)$ is the elasticity of output with respect to M_{it}. Because the Lagrange multiplier λ_{it} is equal to the marginal cost (MC_{it}) under the first order condition, μ_{it} can be rewritten as

$$\mu_{it} = p_{it}/MC_{it} = \left(1 - \frac{1}{\nu_{it}}\right)^{-1} \tag{6}$$

where $\nu_{it} \equiv -\frac{p_{it}}{Y_{it}}\frac{dY_{it}}{dp_{it}}$ is the price elasticity of demand, indicating firm i's market power which means the ability to control its product price in the market. If firm i faces a perfectly competitive market (i.e., $\nu_{it} = \infty$), then $\mu_{it} \equiv p_{it}/\lambda_{it} = 1$. In other words, μ_{it} represents firm's profitabilty. Because μ_{it} is the ratio of a selling price and marginal production costs, firms selling a product at a relatively high price compared to their marginal costs can be considered as profitable. If firm i has market power ($\nu_{it} < \infty$), then μ_{it} is greater than 1. In general, the smaller ν_{it} is, the larger the degree of market power (μ_{it}).

This study estimates μ_{it} at firm-level and examines whether the market power of the state-owned firms is greater than the private firms.

2.2 Estimation of Markups

To estimate markups μ_{it}, De Loecker and Warzynski (2012) proposed using an estimate of the output elasticity of a variable input free of adjustment costs, such as

$$\hat{\mu}_{it} = \frac{\hat{G}_{it}}{S_{it} \exp\{\hat{\varepsilon}_{it}\}} \tag{7}$$

where $\hat{G}_{it}$ is an estimated output elasticity of a variable input, and $\hat{\varepsilon}_{it}$ is a residual which can be recovered from the estimated production function. Their approach requires us to estimate the output production function including both quasi fixed inputs with adjustment costs (e.g., labor and capital inputs) and variable inputs free of adjustment costs (e.g., intermediate inputs). However, there is a fundamental difficulty in the estimation of output production functions, referred to as the simultaneity problem (Ackerberg, Caves, and Frazer, 2015; Gandhi, Navarro, and Rivers, 2020).

In this paper, the author proposes an alternative nonparametric approach which does not require us to estimate production function to obtain markups estimates.[2)] Taking the logarithm for both side of Equation (5) yields

$$\begin{aligned} \ln S_{it} &= -\ln \mu_{it} + \ln G(K_{it}, L_{it}, M_{it}) - \varepsilon_{it} \\ &= -\tilde{\mu}_{it} + g(k_{it}, l_{it}, m_{it}) + \eta_{it} \end{aligned} \tag{8}$$

where $\tilde{\mu}_{it} \equiv \ln \mu_{it}$, $g(k_{it}, l_{it}, m_{it}) \equiv \ln G(K_{it}, L_{it}, M_{it})$, and $\eta_{it} \equiv -\varepsilon_{it}$. The lower case letters of inputs denote the logarithm of inputs. A polynomial expression is used to approximate the log elasticity $g(k_{it}, l_{it}, m_{it})$, and the polynomial expression can be divided into a constant and varying components:

$$\begin{aligned} g(k_{it}, l_{it}, m_{it}) &\approx poly(k_{it}, l_{it}, m_{it}) \\ &= c + poly^{v}(k_{it}, l_{it}, m_{it}) \end{aligned} \tag{9}$$

where $poly(k_{it}, l_{it}, m_{it})$ represents a polynomial series of k_{it}, l_{it}, and m_{it}; and c and $poly^{v}(k_{it}, l_{it}, m_{it})$ are the constant and varying components for i and t.[3)] To investigate the differences of the market power $\tilde{\mu}_{it}$ between the ownership sectors, $\tilde{\mu}_{it}$ is replaced as follows:

$$\tilde{\mu}_{it} = \alpha_0 + \alpha_p Private_{it} + \alpha_f Foreign_{it} + \beta_{ex} Expdm_{it} + \mathbf{S}'_{it}\boldsymbol{\gamma} + \mathbf{T}'_{it}\boldsymbol{\theta} + e_{it} \tag{10}$$

where α_0 and e_{it} denote a constant term and an unanticipated price shock which cannot be observed by firm i before making its input decisions for period t. The terms $Private_{it}$ and $Foreign_{it}$ denote the dummy variables of the ownership sectors. Firms are divided by three ownership groups: *State*, *Private+*, and *Foreign*, where *State* denotes the set of SOEs, including state-owned enterprises and solely state-funded corporations; *Private+* denotes the set of domestic and non-state-owned firms, including collective-owned firms (and other hybrids) and privately

[2)]This approach is inspired by Gandhi, Navarro, and Rivers (2020) who propose a nonparametric identification strategy for the estimation of output production functions.

[3)]The application of a polynomial series for the elasticity function follows the nonparametric identification approach of Gandhi, Navarro, and Rivers (2020).

funded enterprises; and *Foreign* denotes the set of firms with funds from Hong Kong, Macao, and Taiwan and those that are purely foreign-funded enterprises. The ownership dummies are defined as $Private_{it} = 1$ if firm $i \in Private+$ and $Foreign_{it} = 1$ if firm $i \in Foreign$. The forth term $ExpDm_i$ denotes a exporting firm dummy which is eqaul to 1 if firm i's exports are observed at any point during the observation periods (2003–2007). The vector of $\mathbf{S}_{it}$ denotes the set of the firm size quintile dummies. Firms are divided by five groups identifying the quintile of firm output at period t. Specifically, the vector $\mathbf{S}_{it}$ is defined as

$$\mathbf{S}_{it} = \left[Sizedm2_{it} \quad Sizedm3_{it} \quad Sizedm4_{it} \quad Sizedm5_{it} \right]',$$

where $Sizedm2_{it}$–$Sizedm5_{it}$ indicate the firm size dummies from second to fifth quintile ranges.[4)] The vector $\mathbf{T}_{it}$ is the set of time dummies. Finally, e_{it} is assumed to be orthogonal to these dummy variables in Equation (10).

Substituting Equations (9) and (10) into (8) and including industrial and regional fixed effects, the following estimation equation is obtained:

$$\begin{aligned} \ln S_{it} = \bar{c} - \alpha_p Private_{it} - \alpha_f Foreign_{it} - \beta_{ex} Expdm_{it} - \mathbf{S}'_{it}\boldsymbol{\gamma} - \mathbf{T}'_{it}\boldsymbol{\theta} \\ + poly^{v}(k_{it}, l_{it}, m_{it}) + IndustryDm + ProvinceDm + \bar{\eta}_{it}, \end{aligned} \tag{11}$$

where $\bar{c} \equiv c - \alpha_0$, $\bar{\eta}_{it} \equiv \eta_{it} - e_{it}$, *IndustryDm* and *ProviceDm* denote the set of 3-digit industrial dummies and the province level regional dummies, respectively. This is the benchmark estimation model in this study. The term $\bar{\eta}_{it}$ is treated as an error term. As mentioned above, $\bar{\eta}_{it}$ is the unanticipated shocks for firm i and not correlated with these dummy variables and $poly^{v}(k_{it}, l_{it}, m_{it})$ in the estimation equation. Although we cannot identify the absolute level of the market power for each ownership sector because α_0 cannot be identified, Equation (11) enables us to estimate the relative market power of the private and foreign sectors compared to the state-owned sector without estimating gross output production functions.

In addition, to investigate changes in the relative market power for each ownership sector, the interaction terms between the ownership and time dummies are introduced:

$$\begin{aligned} \ln S_{it} = \bar{c} - Private_{it} \times \mathbf{T}'_{it}\boldsymbol{\alpha}_p - Foreign_{it} \times \mathbf{T}'_{it}\boldsymbol{\alpha}_f - \beta_{ex} Expdm_{it} - \mathbf{S}'_{it}\boldsymbol{\gamma} - \mathbf{T}'_{it}\boldsymbol{\theta} \\ + poly^{v}(k_{it}, l_{it}, m_{it}) + IndustryDm + ProvinceDm + \bar{\eta}_{it}, \end{aligned} \tag{12}$$

where $\boldsymbol{\alpha}_p$ and $\boldsymbol{\alpha}_f$ represent vectors of parameters indicating changes in the relative market power for the *Private+* and *Foreign* sectors, respectively.

In this study, the author estimates Equations (11) and (12) using China's manufacturing firm-level data, and examines whether the market powers of the *Private+* and *Foreign* sector firms is greater than that of the *State* sector firms, and how the relative market powers change over time.

3 Data Description

Data used for the estimation is China's manufacturing firm-level panel data from 2003 to 2007, drawn from the annual survey of industrial enterprises conducted by the National Bureau of

[4)] The reference firm size distribution is evaluated by two-digit manufacturing sector and year.

Statistics. The survey covers all industrial firms with sales of over 5 million RMB. The data set consists of three industries: mining, manufacturing, and public utilities. This study uses the manufacturing industry data. The data contains information on a series of firms' IDs. However, the IDs are often missing or changes over time. In this study, following Hashiguchi (2020), the author creates a new series of firms' ID for constructing the panel data by using the attributes of firms.[5)]

The variables in the estimation equation (11) are constructed as follwos: S_{it} is the share of the total intermediate inputs in the total gross output, K_{it} is the total fixed assets, L_{it} is the number of employees, and M_{it} is the total intermediate inputs. The deflator for M_{it} are based on the input deflators provided by Brandt, et al. (2012).[6)] The deflator for total fixed assets is constructed using the province-level investment deflator which is obtained the China Statistical Yearbook.

The following firms are removed as outliers from the database: 1) firms with a non-positive value for gross outputs, total fixed assets, employees, or total intermediate input; 2) firms whose gross output per worker or fixed assets per worker in t is more than 1000 times or less than 0.001 the value in $t-1$; or 3) firms in Tobacco and nuclear-related industries. In addition, firms with $S_{it} > 1$ are also removed from the database.

[– Table 1 –]

Table 1 shows the summary statistics. The number of state-owned firms is much lower than those of domestic private and foreign sector firms and a sharp decrease in numbers by 58% from 2003 to 2007, while the numbers of domestic private and foreign firms have increased over five years. The *Private+* sector has the highest number of firms and accounted for 76% of the total in 2007. However, its gross output per firm is nearly five times lower than that of state-owned firms in 2007, indicating that most of the domestic private firms are very small in operating capacity compared to state-owned and foreign firms. The firm size of SOEs, measuring gross output per firm, is much greater than that of the private sector firms and it tends to increase over time. There exists both small number of large state-owned firms and large number of small domestic private firms in China's manufacturing sector.

[– Table 2 –]

[– Table 3 –]

Tables 2 and 3 report the number of firms and the market share by 2-digit industrial sector for 2003 and 2007. China's 2-digit industrial classification is described in Appendix Table 1. Market shares are measured by firm-level gross output values. Average market shares for the *State*, *Private+* and *Foreign* sectors are 10.6%, 55.5%, and 33.9% in 2003, and 5.6%, 59.1%, and 35.3% in 2007, respectively. While the average firm size of the *State* sector firms is much higher than the *Private+* and *Foreign* sector firms, the market shares of the *State* sector are the

[5)] For more details about the construction of the panel data, refer to Hashiguchi (2020).

[6)] See their online appendix: `http://www.econ.kuleuven.be/public/n07057/china/`.

smallest in most of industries and tend to decrease from 2003 to 2007.

Appendix Tables 2 and 3 show the market share of top five largest firms and the Herfindahl-Hirschman Index (HHI), respectively. Market concentration has been slightly decreasing in the manufacturing sector. Higher concentration is found in industries of oil processing, coking, and nuclear manufacturing (#25), chemical fiber manufacturing (#28), rubber product (#29), and removal and processing of obsolete resource and material (#43). Textile industry (#17) has smaller market concentration, while it shows the highest increase in the market concentration during 2003–2007. Overall, the market concentration tends to slightly decrease in many 2-digit industrial sectors, implying that the market competitiveness has been increasing in the manufacturing sector.

4 Estimation Results

[– Table 4 –]

Table 4 shows the estimation result of Equation (11). The polynomial function $poly^{\nu}(k_{it}, l_{it}, m_{it})$ is defined by using first, second, and third order polynomial series. The third order polynomial, which is the most flexible among them, is employed as the benchmark model in this study. It is noted that the estimation results are robust with respect to the order of polynomial expression.

The coefficients of $Private_{it}$ and $Foreign_{it}$ sectors are 0.178 and 0.186, respectively, both of which are statistically significant at 99%. This indicates that the markup μ_{it} of the *State* sector is, on average throughout the period 2003–2007, relatively smaller than those of $Private_{it}$ and $Foreign_{it}$ sectors. The coefficient of the export dummy ($Expdm_{it}$) is slightly positive (0.003) and significant at 90%. China's exporting firms do not necessarily have a large market power compared to non-exporting firms, which is the opposite results of De Loecker and Warzynski (2012). Estimates of the firm size dummies ($Sizedm2_{it}$–$Sizedm5_{it}$) are 0.282, 0.489, 0.708, and 1.003, respectively, and the Wald tests for the equality of estimated parameters show a statistically significant difference between those estimates. This indicates that larger firms tend to have larger markups. The economies of scale may affect the estimate of markups. Estimates of time dummies ($Timedm2_{it}$–$Timedm5_{it}$) tend to increase over time. Although the estimate of $Timedm2_{it}$ is negative indicating that the markup decreases from 2003 to 2004, as the result of the Wald tests shows, the markup significantly increases on average during 2004–2007.

[– Table 5 –]

[– Figure 1 –]

Table 5 shows the estimation result of Equation (12) which includes the interaction terms between the ownership and time dummies. This table reports only the estimates of time dummies and their interaction terms to focus on changes in the relative markups for each ownership sector. The relative markups power of the private and foreign sectors tend to decrease over time, while those of the state-owned sector increases after 2004. As shown in the results of the Wald tests, while changes in the market power from 2003 to 2004 are not statistically significant, the markups tend to significantly increase in the state sector and to decrease in the private and foreign sectors after 2004. Figure 1 demonstrates a time series plots of the estimated relative markups, which are normalized at zero in the *State* sector in 2003.[7)] It is found that, although the relative markups of the state sector are still smaller in 2007 than those of the private and foreign sectors, the market power of the *State* sector has been steadily increasing and catching up with the private and foreign sectors since 2004.

[– Table 6 –]

[– Figure 2 –]

To investigate whether this catching up process is driven by surviving firms during the period for 2003–2007, the author constructs a dummy variable which is equal to one if a firm is observed in both 2003 and 2007, and estimates markups for surviving firms by ownership sector. Table 6 report the estimation results and Figure 2 plots changes in the relative markups of surviving firms. While the markups of surviving SOEs is still smaller than those of the private and foreign sectors, the catching up process shown in Figure 1 almost disappears in Figure 2. This implies that a large increase of markups in the *State* sector is likely to be driven by the exit of SOEs with lower markups.

In the benchmark model, the collectively owned firms are included in the private sector. However, in general, those firms belong to a group of publicly owned firms, and their market power may differ from the privately funded firms. Then, the author divides the private sector firms into the collectively owned and privately funded firms, and examines whether this modification affects the results of the benchmark model. Appendix Tables 5 and 6 report the estimation results. It is found that the relative markup of collectively owned firms is close to the same as those of privately funded firms, suggesting that the benchmark result is robust to this modification.

5 Concluding remarks

Over the past few years, many researchers have shown an interest in the phenomenon: *Guojin Mintui* (i.e., the state advances, the private sector retreats). The official macroeconomic data from 1998 to 2008 shows the share of SOEs tends to decrease in the number of firms, employees, value added, and total assets (Kato, 2012; Marukawa, 2015). By industrial sector, it dramatically decreased in the manufacturing, wholesale and retail industries. It seems that the presence of SOEs was not increasing but rather decreasing in the 2000s. However, no studies have been done to examine the market power of SOEs. This paper revisits the *Guojin Mintui* issue by estimating the market power, measured by markups, for the state-owned, domestic private,

[7)]The relative markups capture a distance from the reference constant term ($\bar{c} = c - \alpha_0$) which includes α_0 indicating the absolute value of markups for the state-owned sector in 2003. Unfortunately, we cannot identify α_0 in the regression, implying that the absolute values of markups cannot be measured. To plot the relative markups, the constant term is conveniently normalized at zero by the author.

and foreign sector firms, using China's manufacturing firm-level data from 2003 to 2007. To estimate the markups, the author proposed a new nonparametric approach in stead of the method of De Loecker and Warzynski (2012). While the author derives markups relying on standard cost minimization conditions for a variable input as is the case of De Loecker and Warzynski (2012), this paper's approach does not need to estimate production functions to obtain markups.

The author found that (1) the markups in the manufacturing sector on average were increasing during the period from 2004 to 2007, (2) the relative markups of SOEs are smaller than those of the private and foreign sector firms through the period, (3) the relative markups of SOEs tended to steadily increase and be catching up with the private and foreign sectors during 2004–2007, and (4) the catching up process is not observed in surviving firms, implying that the exit of the state-owned firms with lower markups causes the increase in the average markups of the state sector. In terms of the relative markups in the manufacturing sector for 2003 to 2007, this study does not support the argument of *Guojin Mintui*.

The persistent lower relative markup in the SOEs suggest possibilities that (1) the SOEs are simply less profitable than the private and foreign firms, (2) the inability of market selection to push less productive SOEs out of the market, and (3) SOEs engage in strategic dumping to obtain scale benefits and market shares (Caselli, Schiavo, and Nesta, 2018). Government subsidies to SOEs and/or a financial system advantageous to SOEs may hinter market selection and cause less profitable SOEs to survive in the market. Behind the lower markup in SOEs, there might be resource misallocation among the ownership sectors.

It is noted that the SOEs' market power may have been more increasing since the global financial crisis in 2008. Chinese central government announced a 4 trillion RMB (US $586 billion) public investment in November 2008 to get out of the economic crisis. And the local government also expanded public works spending by taking advantage of the active economic stimulus policies of the central government. The series of the public investment policies can significantly increase the presence of Chinese government through the state-owned firms. While this study shows a trend of the SOE's markups during the period from 2003 to 2007, this is quite likely to change after 2008. We need further research for the market structure and the operating environment of firms in China.

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Table 1: Summary statistics[1)]

		Average				
	Num	Gross output	Fixed assets	Wokers	Intermediate	S
All (2003)	170,108	71,473	23,138	275	54,815	0.7494
All (2004)	242,433	65,227	19,058	226	49,734	0.7499
All (2005)	239,669	78,754	21,845	240	59,338	0.7449
All (2006)	267,961	87,188	22,787	229	65,363	0.7413
All (2007)	302,540	96,793	23,302	220	72,357	0.7383
State (2003)	14,136	116,392	69,822	599	89,342	0.7190
State (2004)	13,079	110,699	59,996	465	84,480	0.7029
State (2005)	9,475	177,003	88,121	608	134,759	0.7061
State (2006)	8,076	221,057	108,724	636	168,487	0.6998
State (2007)	6,017	347,201	151,685	802	270,346	0.7044
Private+ (2003)	119,465	53,242	15,380	219	40,741	0.7537
Private+ (2004)	175,836	48,170	13,384	180	36,744	0.7566
Private+ (2005)	176,010	58,273	15,286	188	44,013	0.7490
Private+ (2006)	201,554	64,297	15,604	177	48,282	0.7449
Private+ (2007)	231,539	71,170	15,922	169	52,986	0.7413
Foreign (2003)	36,507	113,741	30,450	332	87,501	0.7467
Foreign (2004)	53,518	110,157	27,695	317	83,919	0.7393
Foreign (2005)	54,184	128,102	31,560	343	95,929	0.7386
Foreign (2006)	58,331	147,753	35,710	350	110,105	0.7347
Foreign (2007)	64,984	164,903	37,708	350	123,044	0.7307
Number of province-level regions: 31						
Number of 3-digit industrial sectors: 159						

[1)] Outliers are excluded. S denote the share of total intermediate input in the total gross output. Num is the number of firms. *State* denotes the set of state-owned firms, including state-owned enterprises and solely state-funded corporations. *Private+* denotes the set of domestic and non-state-owned firms, including collective-owned firms (and other hybrids) and privately funded enterprises. *Foreign* denotes the set of firms with funds from Hong Kong, Macao, and Taiwan and those that are purely foreign-funded enterprises.

Table 2: Number of firms and output share by industry in 2003

	Number of firms				Output share		
Industry[1)]	All	State	Private+	Foreign	State	Private+	Foreign
13	10,317	1,452	7,347	1,518	0.095	0.627	0.278
14	4,183	559	2,638	986	0.084	0.531	0.385
15	2,956	448	2,035	473	0.132	0.553	0.316
17	14,829	648	10,864	3,317	0.074	0.676	0.250
18	8,594	173	4,849	3,572	0.016	0.540	0.444
19	4,453	56	2,519	1,878	0.008	0.460	0.533
20	3,323	192	2,468	663	0.074	0.669	0.257
21	2,032	83	1,308	641	0.009	0.430	0.561
22	5,304	283	4,197	824	0.072	0.606	0.322
23	3,673	1,097	2,047	529	0.202	0.485	0.313
24	2,422	61	1,194	1,167	0.016	0.384	0.600
25	1,188	114	985	89	0.212	0.684	0.104
26	12,929	1,205	9,753	1,971	0.176	0.588	0.236
27	3,753	466	2,651	636	0.174	0.613	0.212
28	877	42	661	174	0.098	0.717	0.185
29	2,092	108	1,501	483	0.119	0.497	0.385
30	7,856	248	5,350	2,258	0.024	0.547	0.429
31	15,342	1,492	12,066	1,784	0.097	0.725	0.177
32	3,984	235	3,438	311	0.359	0.551	0.090
33	3,381	250	2,760	371	0.212	0.652	0.136
34	8,747	376	6,596	1,775	0.045	0.597	0.359
35	12,041	1,163	9,194	1,684	0.141	0.612	0.248
36	6,428	961	4,445	1,022	0.197	0.566	0.237
37	7,695	1,170	5,251	1,274	0.234	0.366	0.400
39	10,024	499	7,241	2,284	0.053	0.591	0.356
40	5,322	336	2,325	2,661	0.062	0.173	0.765
41	2,455	283	1,377	795	0.057	0.323	0.620
42	3,748	133	2,282	1,333	0.060	0.544	0.396
43	160	3	123	34	0.013	0.756	0.231
Mean	5,866	487	4,119	1,259	0.107	0.554	0.339

[1)] China's 2-digit industrial codes.

Table 3: Number of firms and output share by industry in 2007

	Number of firms				Output share		
Industry[1)]	All	State	Private+	Foreign	State	Private+	Foreign
13	17,509	475	14,597	2,437	0.021	0.695	0.284
14	6,360	146	4,808	1,406	0.030	0.580	0.390
15	4,254	159	3,408	687	0.064	0.570	0.366
17	27,279	221	21,536	5,522	0.019	0.741	0.241
18	14,421	91	8,385	5,945	0.010	0.536	0.454
19	7,331	17	4,614	2,700	0.003	0.493	0.504
20	7,676	78	6,561	1,037	0.012	0.793	0.194
21	4,010	15	2,759	1,236	0.001	0.528	0.471
22	8,049	74	6,626	1,349	0.032	0.606	0.362
23	4,924	376	3,834	714	0.099	0.593	0.307
24	4,011	19	2,221	1,771	0.007	0.379	0.614
25	2,015	59	1,765	191	0.113	0.756	0.132
26	22,125	532	18,020	3,573	0.080	0.621	0.299
27	5,467	157	4,325	985	0.065	0.679	0.256
28	1,517	16	1,206	295	0.078	0.623	0.299
29	3,569	54	2,693	822	0.081	0.565	0.354
30	14,924	97	11,020	3,807	0.014	0.589	0.397
31	23,400	600	19,963	2,837	0.028	0.782	0.190
32	6,799	136	6,103	560	0.222	0.632	0.146
33	6,381	168	5,450	763	0.155	0.684	0.162
34	17,443	195	13,739	3,509	0.028	0.621	0.351
35	26,003	561	21,668	3,774	0.072	0.654	0.274
36	12,890	444	9,771	2,675	0.125	0.603	0.272
37	13,563	659	10,161	2,743	0.131	0.413	0.457
39	18,730	261	13,971	4,498	0.031	0.594	0.375
40	10,673	184	4,946	5,543	0.022	0.136	0.842
41	4,328	146	2,765	1,417	0.039	0.329	0.632
42	6,269	72	4,125	2,072	0.032	0.580	0.388
43	620	5	499	116	0.045	0.743	0.213
Mean	10,432	207	7,984	2,241	0.057	0.590	0.353

[1)] China's 2-digit industrial codes.

Table 4: Estimation results

$poy^v(k_{it}, l_{it}, m_{it})$		(1) 3rd polynomial[1)]		(2) 2nd polynomial[2)]		(3) 1st polynomial[3)]	
Private$_{it}$	α_p	0.1785***	(0.0103)	0.2085***	(0.0115)	0.1212***	(0.0111)
Foreign$_{it}$	α_f	0.1861***	(0.0102)	0.2123***	(0.0115)	0.1310***	(0.0124)
Expdm$_{it}$	β_{ex}	0.0030*	(0.0017)	0.0018	(0.0019)	0.0073**	(0.0027)
Sizedm2$_{it}$ (2nd Quintile)	γ_2	0.2815***	(0.0093)	0.2635***	(0.0103)	0.2357***	(0.0083)
Sizedm3$_{it}$ (3rd Quintile)	γ_3	0.4887***	(0.0155)	0.4390***	(0.0176)	0.4208***	(0.0138)
Sizedm4$_{it}$ (4th Quintile)	γ_4	0.7083***	(0.0218)	0.6142***	(0.0238)	0.6305***	(0.0203)
Sizedm5$_{it}$ (5th Quintile)	γ_5	1.0027***	(0.0294)	0.8472***	(0.0286)	1.0174***	(0.0326)
Timedm2$_{it}$ (2004)	θ_2	−0.0173***	(0.0049)	−0.0100**	(0.0047)	−0.0153***	(0.0052)
Timedm3$_{it}$ (2005)	θ_3	0.0309***	(0.0063)	0.0321***	(0.0057)	0.0317***	(0.0063)
Timedm4$_{it}$ (2006)	θ_4	0.0634***	(0.0083)	0.0620***	(0.0075)	0.0705***	(0.0085)
Timedm5$_{it}$ (2007)	θ_5	0.0998***	(0.0102)	0.0947***	(0.0089)	0.1099***	(0.0102)
3-digit industrial dummies		Yes		Yes		Yes	
Province dummies		Yes		Yes		Yes	
Sample size		1,222,711		1,222,711		1,222,711	
Wald tests							
$\alpha_p = \alpha_f$		20.65***		4.53**		13.39***	
$\gamma_2 = \gamma_3$		146.79***		139.08***		139.11***	
$\gamma_3 = \gamma_4$		131.71***		143.02***		172.75***	
$\gamma_4 = \gamma_5$		158.54***		166.91***		175.84***	
$\theta_2 = \theta_3$		1006.54***		523.33***		944.49***	
$\theta_3 = \theta_4$		954.15***		698.93***		864.70***	
$\theta_4 = \theta_5$		946.74***		1452.9***		820.72***	

Equation (11) is used for the estimation. The asterisks *, **, and *** denote 10%, 5%, and 1% significance levels. Figures in parentheses are standard errors, clustered at the 2-digit industrial classification.

[1)–3)] $poy^v(k_{it}, l_{it}, m_{it})$ is approximated by using third, second, and first order polynomial series, respectively.

Table 5: Changes in the relative market power

$poly^v(k_{it}, l_{it}, m_{it})$		(1) 3rd polynomial[1)]		(2) 2nd polynomial[2)]		(3) 1st polynomial[3)]	
$Private_{it} \times Timedm1_{it}$	$\alpha_{p,2003}$	0.2268***	(0.0156)	0.2530***	(0.0164)	0.1708***	(0.0140)
$Private_{it} \times Timedm2_{it}$	$\alpha_{p,2004}$	0.2214***	(0.0138)	0.2668***	(0.0148)	0.1532***	(0.0129)
$Private_{it} \times Timedm3_{it}$	$\alpha_{p,2005}$	0.1699***	(0.0083)	0.1984***	(0.0104)	0.1160***	(0.0116)
$Private_{it} \times Timedm4_{it}$	$\alpha_{p,2006}$	0.1507***	(0.0080)	0.1768***	(0.0100)	0.0954***	(0.0119)
$Private_{it} \times Timedm5_{it}$	$\alpha_{p,2007}$	0.0381***	(0.0078)	0.0473***	(0.0094)	−0.0120	(0.0107)
$Foreign_{it} \times Timedm1_{it}$	$\alpha_{f,2003}$	0.2453***	(0.0162)	0.2690***	(0.0168)	0.1862***	(0.0152)
$Foreign_{it} \times Timedm2_{it}$	$\alpha_{f,2004}$	0.2334***	(0.0141)	0.2772***	(0.0150)	0.1677***	(0.0138)
$Foreign_{it} \times Timedm3_{it}$	$\alpha_{f,2005}$	0.1768***	(0.0083)	0.2014***	(0.0102)	0.1241***	(0.0128)
$Foreign_{it} \times Timedm4_{it}$	$\alpha_{f,2006}$	0.1556***	(0.0079)	0.1765***	(0.0098)	0.1017***	(0.0134)
$Foreign_{it} \times Timedm5_{it}$	$\alpha_{f,2007}$	0.0404***	(0.0078)	0.0453***	(0.0096)	−0.0031	(0.0127)
$Timedm2_{it}$ (2004)	θ_2	−0.0123	(0.0103)	−0.0233**	(0.0094)	0.00002	(0.0079)
$Timedm3_{it}$ (2005)	θ_3	0.0861***	(0.0118)	0.0855***	(0.0110)	0.0838***	(0.0101)
$Timedm4_{it}$ (2006)	θ_4	0.1377***	(0.0123)	0.1372***	(0.0121)	0.1430***	(0.0118)
$Timedm5_{it}$ (2007)	θ_5	0.2854***	(0.0163)	0.2976***	(0.0159)	0.2875***	(0.0167)
Wald test							
$\alpha_{p,2003} = \alpha_{p,2004}$		0.40		3.23*		6.47**	
$\alpha_{p,2004} = \alpha_{p,2005}$		33.33***		62.75***		33.91***	
$\alpha_{p,2005} = \alpha_{p,2006}$		16.59***		20.12***		16.44***	
$\alpha_{p,2006} = \alpha_{p,2007}$		234.78***		164.14***		134.15***	
$\alpha_{f,2003} = \alpha_{f,2004}$		2.01		1.20***		8.02**	
$\alpha_{f,2004} = \alpha_{f,2005}$		33.95***		66.04***		37.40***	
$\alpha_{f,2005} = \alpha_{f,2006}$		22.98***		26.42***		19.03***	
$\alpha_{f,2006} = \alpha_{f,2007}$		233.52***		167.51***		136.04***	
$\theta_{2004} = \theta_{2005}$		95.48***		119.13***		127.30***	
$\theta_{2005} = \theta_{2006}$		197.86***		153.73***		142.34***	
$\theta_{2006} = \theta_{2007}$		391.46***		256.67***		229.93***	

Equation (12) is used for the estimation. The asterisks *, **, and *** denote 10%, 5%, and 1% significance levels. Figures in parentheses are standard errors, clustered at the 2-digit industrial classification.

1)–3) $poy^v(k_{it}, l_{it}, m_{it})$ is approximated by using third, second, and first order polynomial series, respectively.

Table 6: Changes in the relative market power of surviving firms

$poy^y(k_{it}, l_{it}, m_{it})$		3rd polynomial	
$Private_{it} \times Timedm1_{it}$	$\alpha_{p,2003}$	0.2109***	(0.0153)
$Private_{it} \times Timedm2_{it}$	$\alpha_{p,2004}$	0.3223***	(0.0186)
$Private_{it} \times Timedm3_{it}$	$\alpha_{p,2005}$	0.2771***	(0.0130)
$Private_{it} \times Timedm4_{it}$	$\alpha_{p,2006}$	0.2616***	(0.0130)
$Private_{it} \times Timedm5_{it}$	$\alpha_{p,2007}$	0.0072***	(0.0095)
$Foreign_{it} \times Timedm1_{it}$	$\alpha_{f,2003}$	0.2340***	(0.0164)
$Foreign_{it} \times Timedm2_{it}$	$\alpha_{f,2004}$	0.3254***	(0.0186)
$Foreign_{it} \times Timedm3_{it}$	$\alpha_{f,2005}$	0.2766***	(0.0131)
$Foreign_{it} \times Timedm4_{it}$	$\alpha_{f,2006}$	0.2619***	(0.0130)
$Foreign_{it} \times Timedm5_{it}$	$\alpha_{f,2007}$	0.0074	(0.0101)
$Timedm2_{it}$ (2004)	θ_2	−0.1020***	(0.0142)
$Timedm3_{it}$ (2005)	θ_3	−0.0143	(0.0136)
$Timedm4_{it}$ (2006)	θ_4	0.0337**	(0.0137)
$Timedm5_{it}$ (2007)	θ_5	0.3235***	(0.0199)
$Private_{it} \times Timedm1_{it} \times DmSuv_i$	$\alpha^{suv}_{p,2003}$	0.0333***	(0.0026)
$Private_{it} \times Timedm2_{it} \times DmSuv_i$	$\alpha^{suv}_{p,2004}$	−0.2839***	(0.0165)
$Private_{it} \times Timedm3_{it} \times DmSuv_i$	$\alpha^{suv}_{p,2005}$	−0.2366***	(0.0138)
$Private_{it} \times Timedm4_{it} \times DmSuv_i$	$\alpha^{suv}_{p,2006}$	−0.2256***	(0.0130)
$Private_{it} \times Timedm5_{it} \times DmSuv_i$	$\alpha^{suv}_{p,2007}$	0.0396***	(0.0087)
$Foreign_{it} \times Timedm1_{it} \times DmSuv_i$	$\alpha^{suv}_{f,2003}$	0.0222***	(0.0033)
$Foreign_{it} \times Timedm2_{it} \times DmSuv_i$	$\alpha^{suv}_{f,2004}$	−0.2607***	(0.0160)
$Foreign_{it} \times Timedm3_{it} \times DmSuv_i$	$\alpha^{suv}_{f,2005}$	−0.2187***	(0.0138)
$Foreign_{it} \times Timedm4_{it} \times DmSuv_i$	$\alpha^{suv}_{f,2006}$	−0.2120***	(0.0127)
$Foreign_{it} \times Timedm5_{it} \times DmSuv_i$	$\alpha^{suv}_{f,2007}$	0.0484***	(0.0097)
$Timedm2_{it} \times DmSuv_i$ (2004)	θ^{suv}_2	0.2637***	(0.0157)
$Timedm3_{it} \times DmSuv_i$ (2005)	θ^{suv}_3	0.2285***	(0.0135)
$Timedm4_{it} \times DmSuv_i$ (2006)	θ^{suv}_4	0.2164***	(0.0127)
$Timedm5_{it} \times DmSuv_i$ (2007)	θ^{suv}_5	−0.0505***	(0.0091)

Equation (12) is used for the estimation. The asterisks *, **, and *** denote 10%, 5%, and 1% significance levels. Figures in parentheses are standard errors, clustered at the 2-digit industrial classification. $poy^y(k_{it}, l_{it}, m_{it})$ is approximated by using third order polynomial series.

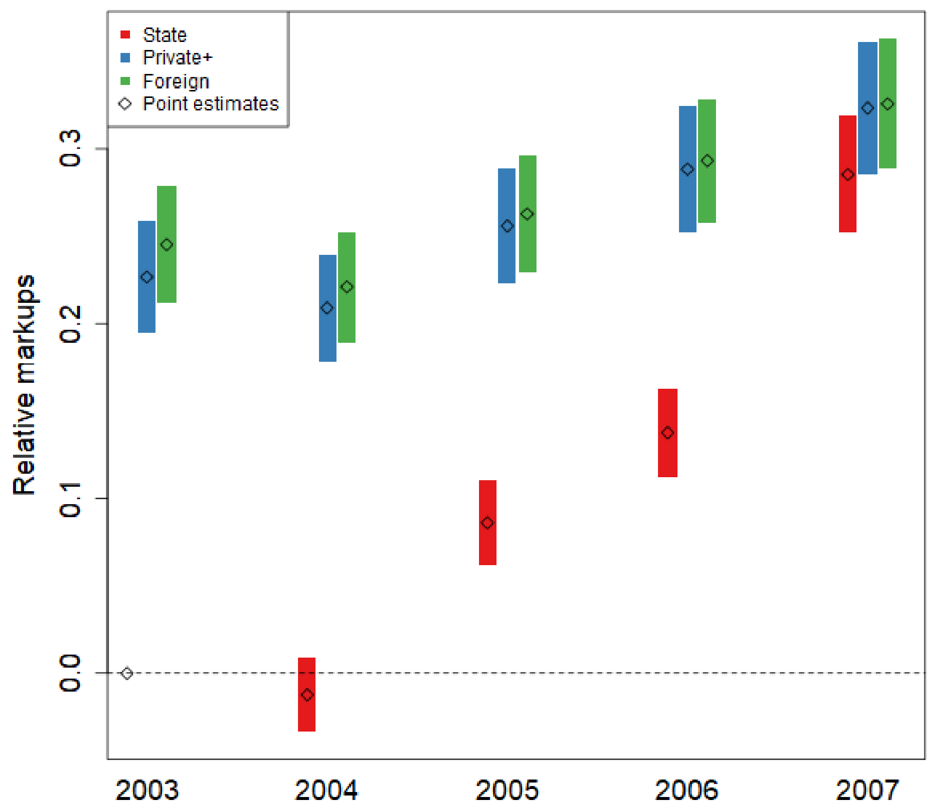

Figure 1: Changes in the relative markups

Notes: The vertical axis depicts the estimated relative markups for the *State*, *Private+*, and *Foreign* sectors. The diamond plots and bars indicate the point estimates and the 95% confidence intervals. The relative markups capture a distance from the reference constant term ($\bar{c} = c - \alpha_0$). The term $\bar{c}$ includes α_0 indicating the absolute value of markups for the *State* sector in 2003. But we cannot identify it in the regression, implying that the absolute values of markups cannot be measured. To plot the relative markups, the constant term is conveniently normalized at zero by the author.

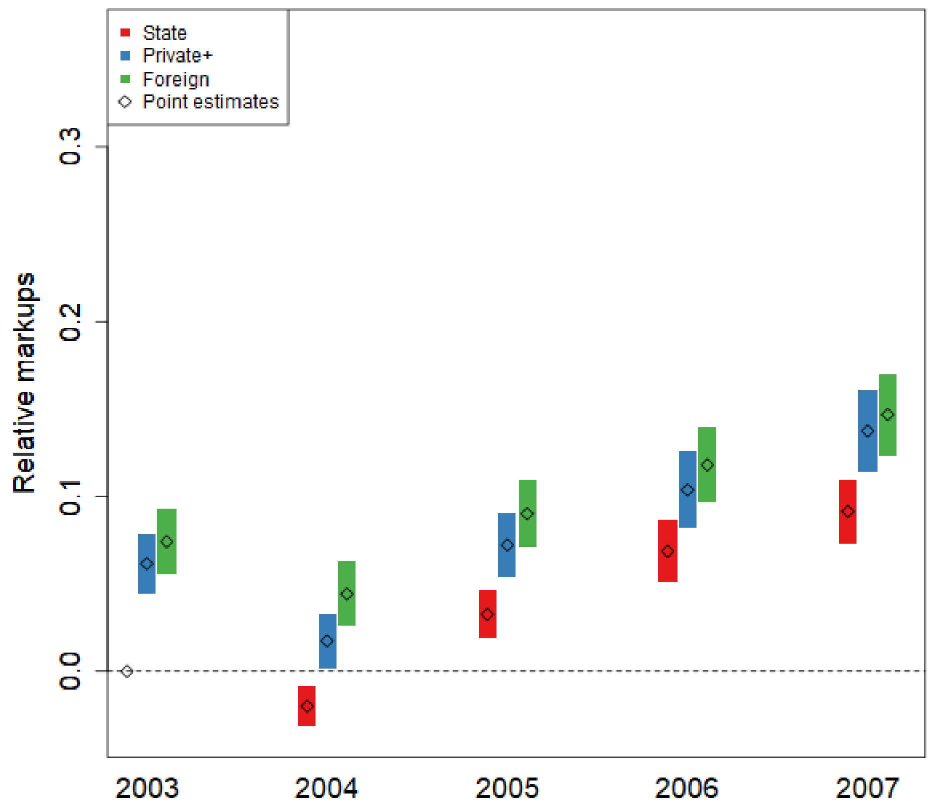

Figure 2: Changes in the relative markups of surviving firms during the period 2003–2007

Notes: The vertical axis depicts the estimated relative markups of surviving firms in the *State*, *Private*+, and *Foreign* sectors. The diamond plots and bars indicate the point estimates and the 95% confidence intervals. The relative markups capture a distance from the reference constant term ($\bar{c} = c - \alpha_0$). The term $\bar{c}$ includes α_0 indicating the absolute value of markups for the *State* sector in 2003. But we cannot identify it in the regression, implying that the absolute values of markups cannot be measured. To plot the relative markups, the constant term is conveniently normalized at zero by the author.

Appendix Table 1: China's 2-digit Industrial Classification

#	Description
13	Agriculture and food processing industry
14	Foodstuff manufacturing industry
15	Soft drink manufacturing industry
17	Textile industry
18	Weaving costume, shoes and cap manufacturing industry
19	Leather, fur and feather manufacturing industry
20	Wood working and wood,bamboo,bush rope,palm,straw manufacturing industry
21	Furniture manufacturing industry
22	Paper making and paper products industry
23	Print and copy of record vehicle industry
24	Stationary and sporting goods manufacturing industry
25	Oil processing, coking and nuclear manufacturing industry
26	Chemical material and chemical product manufacturing industry
27	Medicine manufacturing industry
28	Chemical fiber manufacturing industry
29	Rubber product industry
30	Plastics product industry
31	Nonmetallic mineral product industry
32	Ferrous metal refining and calendaring processing industry
33	Non-ferrous metal refining and calendaring processing industry
34	Metal product industry
35	Universal equipment manufacturing industry
36	Task equipment manufacturing industry
37	Transport and communication facilities manufacturing industry
39	Electric machine and fittings manufacturing industry
40	Communication apparatus, computer and other electric installation manufacturing industry
41	Instrument and meter, stationery machine manufacturing industry
42	Handicraft and other manufacturing industry
43	Removal and processing of obsolete resource and material industry

Appendix Table 2: Market shares of five largest firms

	Market shares of five largest firms					Normalized in 2003				
	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
13	0.05	0.05	0.05	0.05	0.04	1.00	0.97	0.97	0.89	0.81
14	0.09	0.08	0.08	0.08	0.07	1.00	0.93	0.97	0.90	0.80
15	0.14	0.10	0.11	0.11	0.10	1.00	0.67	0.78	0.74	0.69
17	0.04	0.04	0.05	0.06	0.06	1.00	1.06	1.28	1.37	1.37
18	0.05	0.04	0.05	0.05	0.05	1.00	0.89	0.97	1.08	0.98
19	0.07	0.04	0.05	0.05	0.04	1.00	0.57	0.80	0.68	0.66
20	0.07	0.07	0.07	0.07	0.06	1.00	0.99	0.92	0.90	0.82
21	0.10	0.08	0.07	0.07	0.05	1.00	0.82	0.74	0.68	0.54
22	0.09	0.08	0.09	0.09	0.09	1.00	0.96	1.04	0.99	0.98
23	0.06	0.04	0.04	0.04	0.04	1.00	0.78	0.74	0.77	0.75
24	0.06	0.05	0.06	0.06	0.06	1.00	0.82	0.87	0.90	0.97
25	0.21	0.21	0.20	0.20	0.18	1.00	0.99	0.96	0.96	0.86
26	0.08	0.09	0.08	0.07	0.06	1.00	1.07	0.93	0.87	0.76
27	0.09	0.08	0.07	0.07	0.06	1.00	0.88	0.85	0.79	0.75
28	0.21	0.18	0.20	0.18	0.16	1.00	0.86	0.94	0.84	0.76
29	0.15	0.15	0.14	0.13	0.14	1.00	1.02	0.99	0.90	0.94
30	0.04	0.04	0.04	0.03	0.03	1.00	0.88	0.92	0.79	0.80
31	0.02	0.02	0.02	0.02	0.02	1.00	1.08	1.17	0.87	0.79
32	0.15	0.13	0.13	0.12	0.12	1.00	0.85	0.86	0.80	0.77
33	0.08	0.08	0.09	0.10	0.09	1.00	0.99	1.18	1.19	1.16
34	0.04	0.04	0.04	0.04	0.04	1.00	1.04	0.98	0.92	0.94
35	0.06	0.05	0.05	0.05	0.04	1.00	0.80	0.88	0.90	0.77
36	0.06	0.06	0.06	0.05	0.06	1.00	0.87	0.92	0.85	0.92
37	0.19	0.14	0.13	0.12	0.11	1.00	0.74	0.66	0.63	0.58
39	0.10	0.09	0.09	0.08	0.07	1.00	0.90	0.87	0.80	0.74
40	0.13	0.12	0.12	0.13	0.13	1.00	0.92	0.96	1.04	1.01
41	0.14	0.12	0.12	0.11	0.10	1.00	0.85	0.88	0.79	0.72
42	0.07	0.06	0.05	0.05	0.05	1.00	0.82	0.69	0.68	0.67
43	0.33	0.23	0.18	0.16	0.17	1.00	0.69	0.55	0.48	0.50
Mean	0.10	0.09	0.09	0.08	0.08		0.89	0.91	0.86	0.82

Scale
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.8
0.7
0.6
0.5

Notes: Outliers are excluded. The market shares are measured by the fraction of total output by five largest firms by two-digit industrial sector.

Appendix Table 3: Herfindahl-Hirschman Index

	Herfindahl-Hirschman Index (HHI)					Normalized in 2003				
	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
13	0.0013	0.0012	0.0011	0.0010	0.0009	1.00	0.95	0.87	0.76	0.67
14	0.0032	0.0028	0.0028	0.0025	0.0022	1.00	0.90	0.90	0.79	0.69
15	0.0072	0.0041	0.0056	0.0050	0.0043	1.00	0.58	0.78	0.69	0.60
17	0.0008	0.0009	0.0012	0.0015	0.0016	1.00	1.14	1.63	1.94	2.11
18	0.0011	0.0008	0.0010	0.0012	0.0010	1.00	0.74	0.91	1.04	0.86
19	0.0020	0.0011	0.0015	0.0012	0.0011	1.00	0.56	0.72	0.59	0.54
20	0.0023	0.0023	0.0020	0.0017	0.0015	1.00	1.02	0.87	0.77	0.66
21	0.0047	0.0030	0.0024	0.0022	0.0016	1.00	0.63	0.51	0.47	0.35
22	0.0031	0.0027	0.0030	0.0028	0.0028	1.00	0.86	0.97	0.91	0.91
23	0.0020	0.0014	0.0014	0.0014	0.0013	1.00	0.72	0.72	0.71	0.65
24	0.0024	0.0019	0.0019	0.0019	0.0018	1.00	0.80	0.79	0.79	0.77
25	0.0202	0.0183	0.0180	0.0183	0.0157	1.00	0.90	0.89	0.90	0.78
26	0.0024	0.0025	0.0021	0.0019	0.0015	1.00	1.02	0.85	0.80	0.64
27	0.0030	0.0025	0.0024	0.0022	0.0020	1.00	0.83	0.82	0.75	0.68
28	0.0152	0.0115	0.0137	0.0119	0.0108	1.00	0.76	0.90	0.79	0.71
29	0.0082	0.0084	0.0081	0.0070	0.0067	1.00	1.02	0.98	0.85	0.82
30	0.0010	0.0008	0.0008	0.0007	0.0006	1.00	0.79	0.79	0.68	0.62
31	0.0004	0.0004	0.0004	0.0003	0.0003	1.00	0.93	0.96	0.77	0.68
32	0.0090	0.0070	0.0072	0.0065	0.0060	1.00	0.78	0.80	0.73	0.67
33	0.0036	0.0031	0.0037	0.0038	0.0035	1.00	0.87	1.04	1.05	0.97
34	0.0010	0.0009	0.0009	0.0008	0.0007	1.00	0.95	0.88	0.78	0.73
35	0.0015	0.0010	0.0012	0.0012	0.0009	1.00	0.69	0.83	0.80	0.63
36	0.0022	0.0017	0.0018	0.0017	0.0016	1.00	0.74	0.80	0.75	0.73
37	0.0103	0.0064	0.0061	0.0056	0.0052	1.00	0.62	0.59	0.54	0.50
39	0.0034	0.0028	0.0026	0.0022	0.0019	1.00	0.82	0.76	0.65	0.56
40	0.0065	0.0055	0.0065	0.0066	0.0063	1.00	0.85	1.01	1.02	0.97
41	0.0073	0.0059	0.0062	0.0054	0.0049	1.00	0.81	0.86	0.74	0.67
42	0.0023	0.0017	0.0015	0.0014	0.0015	1.00	0.75	0.67	0.62	0.64
43	0.0383	0.0167	0.0137	0.0100	0.0105	1.00	0.44	0.36	0.26	0.27
Mean	0.0057	0.0041	0.0042	0.0038	0.0035		0.81	0.84	0.79	0.73

Scale: 2.1, 1.9, 1.7, 1.6, 1.4, 1.2, 1.0, 0.8, 0.6, 0.4, 0.3

Notes: Outliers are excluded. The HHI is measured as the sum of the squares of the firms' market shares within the two-digit industrial sector.

Appendix Table 4: Number of firms

		Code	Business Registration Type	2003	2004	2005	2006	2007
State-owned sector		110	国有企业	13,021	11,995	8,535	7,173	5,090
		141	国有联营企业	210	193	142	112	113
		151	国有独资公司	905	891	798	791	814
Private+	Collective	120	集体企业	18,999	14,467	12,327	10,690	9,827
		130	股份合作企业	8,610	7,590	6,861	5,784	5,356
		142	集体联营企业	397	313	252	229	217
		143	国有与集体联营企业	485	377	303	243	214
	Private	149	其他联营企业	315	284	258	231	228
		159	其他有限责任公司	22,047	34,962	35,455	39,852	45,315
		160	股份有限公司	5,476	6,188	6,192	6,169	6,680
		171	私营独资企业	19,925	24,489	25,443	30,722	35,823
		172	私营合伙企业	4,077	5,156	5,213	5,913	6,505
		173	私营有限责任公司	36,392	77,729	78,998	96,097	114,957
		174	私营股份有限公司	2,742	4,281	4,708	5,624	6,417
Forieign		210	合资经营企业（港或澳台资）	8,449	9,974	9,313	9,610	10,305
		220	合作经营企业（港或澳台资）	1,863	1,695	1,569	1,533	1,558
		230	港澳台独资企业	9,411	14,504	15,104	16,480	18,416
		240	港澳台商投资股份有限公司	223	275	280	268	314
		310	中外合资经营企业	8,197	12,110	11,859	12,390	13,634
		320	中外合作经营企业	972	1,531	1,481	1,349	1,375
		330	外资（独资）企业	6,801	12,783	13,337	15,551	17,948
		340	外商投资股份有限公司	189	313	309	340	468
		190	其他企业	402	333	932	810	966

Notes: Outliers are excluded. *State* denotes the set of state-owned firms, including state-owned enterprises and solely state-funded corporations. *Private+* denotes the set of domestic and non-state-owned firms, including collective-owned firms (and other hybrids) and privately funded enterprises. *Foreign* denotes the set of firms with funds from Hong Kong, Macao, and Taiwan and those that are purely foreign-funded enterprises.

Appendix Table 5: Estimation results with the collectively owned firms dummy variables

$poy^v(k_{it}, l_{it}, m_{it})$		(1) 3rd polynomial[1)]		(2) 2nd polynomial[2)]		(3) 1st polynomial[3)]	
$Collective_{it}$	α_c	0.1739***	(0.0101)	0.2030***	(0.0115)	0.1184***	(0.0115)
$Private*_{it}$	α_p	0.1793***	(0.0103)	0.2095***	(0.0116)	0.1217***	(0.0110)
$Foreign_{it}$	α_f	0.1864***	(0.0102)	0.2127***	(0.0115)	0.1312***	(0.0124)
$Expdm_{it}$	β_{ex}	0.0029*	(0.0017)	0.0016	(0.0019)	0.0073**	(0.0027)
$Sizedm2_{it}$ (2nd Quintile)	γ_2	0.2815***	(0.0093)	0.2635***	(0.0102)	0.2357***	(0.0083)
$Sizedm3_{it}$ (3rd Quintile)	γ_3	0.4886***	(0.0155)	0.4389***	(0.0175)	0.4208***	(0.0138)
$Sizedm4_{it}$ (4th Quintile)	γ_4	0.7082***	(0.0218)	0.6141***	(0.0238)	0.6305***	(0.0203)
$Sizedm5_{it}$ (5th Quintile)	γ_5	1.0027***	(0.0294)	0.8471***	(0.0286)	1.0174***	(0.0326)
$Timedm2_{it}$ (2004)	θ_2	−0.0177***	(0.0049)	−0.0105**	(0.0047)	−0.0156***	(0.0051)
$Timedm3_{it}$ (2005)	θ_3	0.0305***	(0.0063)	0.0315***	(0.0057)	0.0314***	(0.0063)
$Timedm4_{it}$ (2006)	θ_4	0.0628***	(0.0083)	0.0613***	(0.0075)	0.0701***	(0.0084)
$Timedm5_{it}$ (2007)	θ_5	0.0991***	(0.0102)	0.0939***	(0.0088)	0.1095***	(0.0102)
3-digit industrial dummies		Yes		Yes		Yes	
Province dummies		Yes		Yes		Yes	
Sample size		1,222,711		1,222,711		1,222,711	
Wald tests							
$\alpha_p = \alpha_f$		15.64***		2.77		11.96***	
$\alpha_p = \alpha_c$		11.17***		15.42***		3.13*	
$\alpha_f = \alpha_c$		93.52***		51.20***		22.35***	
$\gamma_2 = \gamma_3$		146.44***		138.53***		138.85***	
$\gamma_3 = \gamma_4$		130.94***		142.26***		172.40***	
$\gamma_4 = \gamma_5$		157.95***		166.44***		175.93***	
$\theta_2 = \theta_3$		1007.68***		523.55***		944.84***	
$\theta_3 = \theta_4$		955.33***		699.62***		865.15***	
$\theta_4 = \theta_5$		947.92***		1454.48***		820.80***	

The asterisks *, **, and *** denote 10%, 5%, and 1% significance levels. Figures in parentheses are standard errors, clustered at the 2-digit industrial classification.

[1)–3)] $poy^v(k_{it}, l_{it}, m_{it})$ is approximated by using third, second, and first order polynomial series, respectively. $Collective_{it}$ denotes the set of collective-owned firms (and other hybrids). $Private*$ denotes the set of domestic and non-state-owned firms without collective-owned firms (and other hybrids).

Appendix Table 6: Changes in the relative market power with the collectively owned firm dummy variables

$poly^v(k_{it}, l_{it}, m_{it})$		(1) 3rd polynomial[1)]		(2) 2nd polynomial[2)]		(3) 1st polynomial[3)]	
$Collective_{it} \times Timedm1_{it}$	$\alpha_{c,2003}$	0.2126^{***}	(0.0153)	0.2375^{***}	(0.0162)	0.1627^{***}	(0.0144)
$Collective_{it} \times Timedm2_{it}$	$\alpha_{c,2004}$	0.2173^{***}	(0.0131)	0.2625^{***}	(0.0142)	0.1483^{***}	(0.0134)
$Collective_{it} \times Timedm3_{it}$	$\alpha_{c,2005}$	0.1703^{***}	(0.0084)	0.1985^{***}	(0.0104)	0.1168^{***}	(0.0121)
$Collective_{it} \times Timedm4_{it}$	$\alpha_{c,2006}$	0.1477^{***}	(0.0088)	0.1730^{***}	(0.0108)	0.0940^{***}	(0.0125)
$Collective_{it} \times Timedm5_{it}$	$\alpha_{c,2007}$	0.0387^{***}	(0.0077)	0.0470^{***}	(0.0094)	−0.0127	(0.0110)
$Private*_{it} \times Timedm1_{it}$	$\alpha_{p,2003}$	0.2313^{***}	(0.0157)	0.2581^{***}	(0.0164)	0.1735^{***}	(0.0139)
$Private*_{it} \times Timedm2_{it}$	$\alpha_{p,2004}$	0.2222^{***}	(0.0139)	0.2676^{***}	(0.0149)	0.1541^{***}	(0.0129)
$Private*_{it} \times Timedm3_{it}$	$\alpha_{p,2005}$	0.1700^{***}	(0.0083)	0.1985^{***}	(0.0104)	0.1160^{***}	(0.0115)
$Private*_{it} \times Timedm4_{it}$	$\alpha_{p,2006}$	0.1511^{***}	(0.0080)	0.1773^{***}	(0.0099)	0.0956^{***}	(0.0119)
$Private*_{it} \times Timedm5_{it}$	$\alpha_{p,2007}$	0.0381^{***}	(0.0078)	0.0475^{***}	(0.0095)	−0.0119	(0.0107)
$Foreign_{it} \times Timedm1_{it}$	$\alpha_{f,2003}$	0.2455^{***}	(0.0162)	0.2693^{***}	(0.0168)	0.1864^{***}	(0.0152)
$Foreign_{it} \times Timedm2_{it}$	$\alpha_{f,2004}$	0.2337^{***}	(0.0141)	0.2774^{***}	(0.0151)	0.1679^{***}	(0.0138)
$Foreign_{it} \times Timedm3_{it}$	$\alpha_{f,2005}$	0.1770^{***}	(0.0083)	0.2017^{***}	(0.0102)	0.1243^{***}	(0.0128)
$Foreign_{it} \times Timedm4_{it}$	$\alpha_{f,2006}$	0.1558^{***}	(0.0079)	0.1768^{***}	(0.0098)	0.1019^{***}	(0.0134)
$Foreign_{it} \times Timedm5_{it}$	$\alpha_{f,2007}$	0.0405^{***}	(0.0078)	0.0455^{***}	(0.0096)	−0.0030	(0.0127)
$Timedm2_{it}$ (2004)	θ_2	−0.0124	(0.0103)	-0.0234^{**}	(0.0094)	−0.00002	(0.0079)
$Timedm3_{it}$ (2005)	θ_3	0.0861^{***}	(0.0118)	0.0855^{***}	(0.0110)	0.0838^{***}	(0.0101)
$Timedm4_{it}$ (2006)	θ_4	0.1377^{***}	(0.0123)	0.1372^{***}	(0.0121)	0.1431^{***}	(0.0118)
$Timedm5_{it}$ (2007)	θ_5	0.2854^{***}	(0.0163)	0.2976^{***}	(0.0159)	0.2876^{***}	(0.0167)
Wald test							
$\alpha_{c,2003} = \alpha_{c,2004}$		0.28		8.83^{***}		3.04^{*}	
$\alpha_{c,2004} = \alpha_{c,2005}$		27.31^{***}		52.48^{***}		22.42^{***}	
$\alpha_{c,2005} = \alpha_{c,2006}$		19.1^{***}		23.37^{***}		17.34^{***}	
$\alpha_{c,2006} = \alpha_{c,2007}$		228.65^{***}		165.03^{***}		118.67^{***}	
$\alpha_{p,2003} = \alpha_{p,2004}$		1.19		1.61		8.00^{***}	
$\alpha_{p,2004} = \alpha_{p,2005}$		34.02^{***}		64.04^{***}		35.27^{***}	
$\alpha_{p,2005} = \alpha_{p,2006}$		15.92^{***}		19.24^{***}		15.68^{***}	
$\alpha_{p,2006} = \alpha_{p,2007}$		233.04^{***}		163.16^{***}		134.25^{***}	
$\alpha_{f,2003} = \alpha_{f,2004}$		2.00		1.21		8.00^{***}	
$\alpha_{f,2004} = \alpha_{f,2005}$		34.00^{***}		66.13^{***}		37.47^{***}	
$\alpha_{f,2005} = \alpha_{f,2006}$		22.98^{***}		26.41^{***}		19.02^{***}	
$\alpha_{f,2006} = \alpha_{f,2007}$		233.41^{***}		167.44^{***}		136.07^{***}	
$\theta_{2004} = \theta_{2005}$		95.56^{***}		119.24^{***}		127.50^{***}	
$\theta_{2005} = \theta_{2006}$		197.90^{***}		153.77^{***}		142.37^{***}	
$\theta_{2006} = \theta_{2007}$		391.23^{***}		256.53^{***}		229.97^{***}	

The asterisks *, **, and *** denote 10%, 5%, and 1% significance levels. Figures in parentheses are standard errors, clustered at the 2-digit industrial classification.

[1)–3)] $poy^v(k_{it}, l_{it}, m_{it})$ is approximated by using third, second, and first order polynomial series, respectively. $Collective_{it}$ denotes the set of collective-owned firms (and other hybrids). $Private*$ denotes the set of domestic and non-state-owned firms without collective-owned firms (and other hybrids).