Can State Owned Enterprises Restructure?  
Theory and Evidence from China  
(Preliminary, Comments welcome)

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Abstract

State Owned Enterprises (SOEs) are often the recipients of preferential treatment from the state including bailouts in periods of financial stress, access to cheap inputs, etc. These connections between SOEs and the state thus enable unproductive SOEs to avoid restructuring (Kornai, 1990; 1992, Part III). However, Chinese reforms for restructuring SOEs announced during the Fifteenth Party Congress in 1997 have been followed by impressive gains in SOEs’ profitability in the manufacturing sector during 1998-2007. We develop a new method for analyzing firm-level labor share dynamics that enables us to evaluate whether the SOEs successfully restructured. We find that the SOEs were under declining political pressure to hire excess labor, and also had increasingly preferential access to cheap capital for financing investment during 1998-2007. Because the elasticity of substitution between capital and labor is greater than one in Chinese manufacturing sectors, lower political pressure to hire excess labor in combination with subsidies for capital have enabled SOEs to become more profitable by cutting labor and drastically decreasing labor capital ratios; these gains in profitability, however, were not driven by strong improvements in total factor productivity.

Keywords: Labor’s Share, State-Owned Enterprise, Political Pressure, Cost of Capital, Elasticity of Substitution, Markups, Total Factor Productivity

JEL Classification: O19.

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1 Introduction

In 1978 China, under the leadership of Deng Xiaoping, initiated a set of reforms that have gradually moved the Chinese economy to a system that embraces markets. In the 1980s a major component of Chinese gradualism was that managers of State Owned Enterprises (SOEs) had incentives to first fulfill administrative targets and then to make profits. Several influential studies document that during the 1980s the SOEs were productive and profitable (Groves, Hong, McMillan and Naughton, 1994; Groves, Hong, McMillan and Naughton, 1995; Jefferson, Rawski and Zheng, 1996; Li, 1997). However, it also well documented that by the early 1990s the SOEs had become unprofitable and were draining government budgets (see, for example, Putterman and Dong, 2000).

Following Deng Xiaoping’s celebrated Southern Tour in 1992, reforms designed to boost SOEs’ profitability and overall performance have been accelerated. In particular, following the announcement of the slogan, "grasp the big and let go of the small", in the Fifteenth Communist Party Congress in 1997, many large and medium sized SOEs were corporatized; and, many small SOEs owned by local governments were privatized.¹

The Chinese Annual Surveys of Industrial Production (ASIP) provide a rich description of SOEs as well as private, foreign and collective firms in the manufacturing sector during the reform period of 1998-2007.² In 1998 there were 38,206 manufacturing SOEs in operation. Between 1998 and 2007 the number of SOEs had declined by roughly two-thirds and the SOEs’ share of value added dropped from 42 percent to 19 percent. Thus, even though the SOEs in terms of numbers and value-added shares were smaller in 2007 than in 1998, SOEs in 2007 were still major players in manufacturing. The SOEs’ position in the labor market also changed. In 1998 SOEs hired more than half of the workers in the manufacturing sector, and paid wages that were much lower than in foreign firms, but that were marginally higher than in private firms: by 2007 SOEs hired roughly one in seven manufacturing workers and paid the highest wages.

There is evidence that SOE performance dramatically improved during 1998-2007. Figure 1 illustrates that the share of unprofitable SOEs declined from 44 percent in 1998 to 22 percent in 2007; and, while in 1998 the share of unprofitable SOEs was much higher than the shares of

¹These policies were discussed as early as 1993 and some of them were contained in the "Company Law" published in the 1994.
²For ease of exposition, in this section we do not discuss collective firms because they represent a small share of manufacturing. Collective firms are discussed in subsequent sections of this paper.
unprofitable foreign and private firms, by 2007 the shares of unprofitable SOEs and foreign firms were roughly the same, and the differences between the shares of unprofitable SOEs and private firms had become much smaller. Figure 2 illustrates that SOE profit share of value added sharply increased from 2.7 percent in 1998 to 22.3 percent in 2007. While SOEs had much lower profit shares than private and foreign firms in 1998, by 2007 the profitability of SOEs was comparable to the performance of private and foreign firms. Figure 3 shows that labor productivity as measured by value added per employee grew rapidly during 1998-2007. Moreover, labor productivity in SOEs overtook labor productivity in foreign and private firms as of 2004.

How did the Chinese SOEs become more profitable during 1998-2007? And, does their improving profitability indicate that they had restructured? Kornai (1990; 1992, Part III) warns that restructuring unproductive SOEs in formerly planned economies is difficult because SOEs receive preferential treatment from the state including bailouts in periods of financial stress, access to cheap inputs and protections against competitors in product and input markets, etc. These connections between SOEs and the state thus enable unproductive SOEs to avoid restructuring. In order to gain some understanding of how China’s SOEs became more profitable, and if this growing profitability is indicative of restructuring, we draw on recent applied-theoretical work and econometric work and develop a comprehensive method of analyzing labor shares of value added at the firm level. In the Chinese data, value added includes payments to labor, profits (payments to capital and markups) and tax payments to the government. Governments in China, whether local, provincial or national, own the capital in SOEs, collect taxes from SOEs and are residual claimants of the SOEs’ income net of mandatory payments. Thus, one minus labor’s share of an SOE’s value added equals profit share plus net tax payment share, which is the government’s share of an SOE’s value added. Figure 4 illustrates that labor shares of value added in SOEs fell from 30.9 percent in 1998 to 16.3 percent in 2007. Thus, during the period overall government shares of SOE’s value added rose from 69.5 percent to 83.7 percent.

This paper draws on the work of Azmat, Manning and Van Reenen (2012) and Karabarbounis and Neiman (2013) in order to understand how changes in several key characteristics of market environment aspects can influence labor’s share. In China and many developing economies and even in some advanced capitalist economies, SOEs are under political pressure to hire excess labor.

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*Tax payments are net of subsidies received from the government.*
In this vein, Azmat et al (2012) argue that the objective function of an SOE should include profits and a political weight on excess employment. They build a model in which all firms have a value added production function with a unitary elasticity of substitution between capital and labor. The Azmat et al model predicts when SOEs are under less political pressure to hire excess labor, labor’s share of SOE value added will fall. Their model also predicts that if a firm, be it an SOE or a non-state firm, operates in product market that becomes less competitive, then that firm’s payments to labor as a share of its value added will decline.

In China and in many developing economies, SOEs use their political connections as a form of collateral for gaining preferential access to external capital for financing investment (see Allen, Qian and Qian, 2005; Firth, Lin, Liu and Wong, 2009). In this vein, the Karabarbounis and Neiman model implies that for sectors in which the elasticity of substitution between capital and labor exceeds unity (i.e., capital and labor are substitutes), if SOEs gain even more privileged access to capital, then labor’s share of value added will drop. When the elasticity of substitution is unitary (as it is in the Azmat et al model), changes in SOEs’ preferential access to capital has no effect on labor’s share; and in sectors in which the elasticity of substitution is less than unity (i.e., capital and labor are complements), if SOE can get even cheaper capital, then labor’s share of SOE value added will increase.

Using recent micro-econometric methods developed by De Loecker and Warzynski (2012), we find that the elasticity of substitution between capital and labor in China’s manufacturing sectors significantly exceeds unity. We document that during 1998-2007 the user cost of capital versus labor declines, and SOEs can also obtain capital more cheaply than private firms. Thus, SOEs increasingly favorable access to capital is an important reason for declining labor share in SOEs. Moreover, using the methods in De Loecker and Warzynski (2012), we compute markups in product markets for each firm on an annual basis. While SOEs on average enjoy higher markups than private or foreign firms, markups in SOEs do not exhibit much variation during 1998-2007. Thus,

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4 This captures, in a tractable fashion, the idea that SOEs in China government leaders view SOEs "as both holders of state assets and guarantors of worker welfare" (Putterman and Dong, 2000, p.417).


7 Li, Liu and Wang (2012) argue that starting in 2001 SOEs continued to dominate upstream industries while downstream industries in the manufacturing sector were liberalized. Li et al. (2012) argue that this has enabled SOEs to enjoy high markups in product markets. In our data set the upstream industries include basic chemicals, steel, iron, and various sectors that use smelting and petroleum according to the upstreamness measure of Antrás,
product market competition is not responsible for the decline of labor’s share in SOEs. Finally, using the approach similar to Goldberg and Maggi (1999), we find that the implied political pressure firms face to hire excess labor becomes weaker during 1998-2007 and, thus caused SOE’s payments to labor as a share of value added to fall.

Our overall message is that labor shares fell in SOEs (and overall government revenues from SOEs increased) because SOEs were under declining political pressure to hire excess labor, and also because SOE’s access to capital versus labor got cheaper over time in a world in which the elasticity of substitution between capital and labor exceeded unity. These factors allowed SOEs to become more profitable by drastically substituting capital for labor. The gains in SOE profitability are not indicative of restructuring. In effect, SOEs gave up their role of being an iron rice bowl, while enjoying the benefits of preferential access to capital and high product markups.

Our study builds on the influential work of Brandt et al (2012) which develops the firm level data set used in our study. Brandt et al (2012) find that the annual average productivity growth of incumbent firms in the manufacturing sector is around 3 percent of gross output, which is one of the highest contributions of TFP growth in the world.\(^8\) We also find that the same growth rate of average TFP growth rate of 3.0 percent for SOEs during 1998-2007, which is slightly higher than those for foreign firms (2.3 percent) and private firms (2.4 percent). The SOEs’ average productivity, however, remained lower than those for private and foreign firms throughout the period. Thus, this substitutability between capital and labor along with cheaper capital and reduced political pressures to hire excess labor allowed SOEs to make profits simply by massively replacing labor with capital and not by boosting their total factor productivity.\(^9\) Our assessment of SOEs is similar to Young’s (2003) more pessimistic assessment of China’s non-agricultural sector during 1978-1998. While Young emphasizes the important role that mobilizing labor played in driving growth during 1978-1998, our study highlights the role that de-mobilizing labor and replacing it with capital plays in the growth performance of manufacturing SOEs during 1998-2007.

Our paper contributes to the debate about the possibility of restructuring SOEs without privatizing them. Shleifer and Vishny (1994) warn that a Chinese style policy or corporatizing SOEs, Chor, Fally and Hillberry (2012).\(^8\) Brandt et al also estimate a value added production function. For technical reasons that are described later in this paper, we can only estimate a gross output production function, and thus we only compare our TFP results with Brandt et al’s findings for the gross output production function.\(^9\) The substitution between capital and labor was much less pronounced within private and foreign firms.
which allows the government to retain day to day control over the SOEs while effectively privatizing cash flows in the form of issuing stock, is problematic for two reasons: first, politicians, who have political objectives that differ from economic efficiency, control the SOEs and, secondly, insiders (managers and controlling politicians) can use the SOEs for their own personal gains. Our findings that SOEs’ productivity was unimpressive during 1998-2007 are consistent with the prediction from Shleifer and Vishny (1994) that corporatization may not promote efficiency. Qian (1996) warns that the corporatization policy in China might encourage SOE insiders to preserve their rents by choosing diffuse outside investors and weak corporate boards. In fact there is evidence that this in fact is the case. Fan, Morck and Yeung’s (2011, p.4-8) survey documents how the Chinese Communist Party has used organizational and financial schemes to keep control major decisions in corporate boards of SOEs. Deng, Morck, Yu and Yeung (2011) argue that Communist Party secretaries can ignore or overrule boards and CEOs. Our findings that SOEs were able to obtain cheap finance for their investments while maintaining high markups and weakening political pressure to hire excess labor suggests that SOEs have used their connections to the state to avoid restructuring.

The rest of this paper is organized as follows. The next section describes our data and provides an overview of labor share trends. Section 3 uses a model to derive predictions about how political pressure to hire excess labor, product market competition, the elasticity of substitution between capital and labor and user cost of capital determine an SOE’s payments to labor as share of value added. Section 4 provides an overview of how we estimate our model, section 5 reports our results and section 6 contains a conclusion.

2 Labor’s Share

2.1 Data Overview

We use the data from the Chinese Annual Surveys of Industrial Production, which covers all SOEs and all non-state enterprises with total sales exceeding 5 million RMB in the industrial sector (including manufacturing, mining, and utilities) during 1998-2007.\textsuperscript{10} We limit our analysis to

\textsuperscript{10}As noted by Cai and Liu (2009), this dataset should be quite reliable because it is designed for computing Chinese GDP. The the National Bureau of Statistics of China (NBSC) oversees this data and has implemented standard data monitoring procedures and has strict double checking procedures for firms above the 5 million RMB reporting threshold. Moreover, firms do not have clear incentives to misreport their information because such information
manufacturing firms. Moreover, in order to have reasonably balanced panel, we analyze firms that have data on gross output, intermediate inputs and capital and employee records available for at least five years during 1998-2007. However, our results are robust even if we use a cutoff of at least three years.

We classify firms by ownership. We follow Brandt et al (2012) and use a firm’s registration type to determine its ownership which can include: state owned enterprises (SOEs), collective and hybrid enterprises (collectives), foreign including firms whose owners are also in Hong Kong, Macao and Taiwan (foreign firms), and domestically owned firms (private firms). When the ownership structure is unavailable, we use a firm’s major contributor to paid-in capital to determine its ownership type.

Table 1 reports several key production, income and factor costs variables for the different forms of ownership. In this table and in several subsequent tables and figures, for ease of exposition, we exclude collectives because they constitute a small share of value added, employment, materials and capital. Table 1.1 shows that the overall number of firms expands from 55,457 in 1998 to 79,644 in 2007. This expansion is driven by a roughly fivefold increase in the number of private firms and a roughly 50 percent decline in the number of SOEs. During this period many SOEs were privatized. For example, out of the 8,031 SOEs in operation in 1998, by 2007 42.5 percent had become private firms and slightly less than half were still registered as SOEs. Another indication of the growing importance of private firms versus SOEs is the share of value added from private firms grew from 9 percent to 38 percent, while the share of value added coming from SOEs fell from 45 percent to 27 percent.

SOEs in China and in many developing economies have been an important source of jobs. It is thus striking that overall employment in SOEs during 1998-2007 fell by 56 percent, while employment in the private and foreign sectors grew by 451 percent and 118 percent, respectively.

We report the growth of employees per firm during 1998-2007. Employment per SOE firm fell by

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11 We follow Brandt et al. (2012) to use firm ID, name, industry, address and other information to track firms over time. One sixth of all firms that are observed for more than one year experience a change in their official ID over the sample period, probably due to restructuring, so it is important to track firms over time.

12 As mentioned above, we limit our analysis to manufacturing firms that have data on gross output, intermediate inputs and capital and employee records available for at least five years during 1998-2007. The actual number of firms increased from 124,218 in 1998 to 277,756 although we cover most of the production activities.

13 We find that there were 8,031 SOEs that kept state ownership in both 1998 and 2007. Among these 8,031 SOEs in 1998, 49 percent were SOEs in 2007 and 42 percent were changed their ownerships to private.
9.4 percent, while employment per private firm and foreign firm grew by 11 percent and 37 percent, respectively. Finally, in all three ownership groups, the employment of capital grew more quickly than labor, and labor capital ratios fell.

Table 1.2 reports distribution of profits and wage as a share of value added and shares of profitable firms. Value added is revenues net of payments to materials, and it is distributed to profits (payments to capital and markups), labor and the government (taxes net of subsidies). During 1998-2007, the share of profits in value added increases overall by 11 percentage points; and, it is striking that this gain is most pronounced in SOEs (a 17 percentage point increase) and then foreign firms (a 9.4 percentage point increase) and negligible within private firms (a 0.4 percentage point increase). Table 1.2 also shows that labor’s share of value added falls by 8 percentage points: and, again, it is striking that this drop is most pronounced in SOEs (-12.8 percentage points) and then private firms (-5.8 percentage points) and is negligible within foreign firms (-1.0 percentage points).

Table 1.3 summarizes several important trends in costs of labor and capital. In this table, the user cost of capital is calculated from interest payments divided by total liabilities. We need to be cautious in interpreting this variable because there are systematic differences in its availability across ownership groups. For example, 45.1 percent of foreign firms report paying no interest in 2007, whereas only 26.3 percent of private firms report paying no interest in 2007. Moreover, the share of all firms that report no payment of interest increase over 1998-2007. For example, the share of SOEs reporting nonpayment of interest increase from 16.5 percent in 1998 to 34.2 percent in 2007. Thus, we measure the user cost of capital using only firms that paid interest. The user cost of capital declines during 1998-2007 for all firm ownership types. However, while the user cost of capital is marginally cheaper for SOEs versus private firms in 1998 (3.5 percent versus 4.3 percent), capital is substantially cheaper for SOEs as of 2007 (2.0 percent versus 3.1 percent). Moreover, the user cost of capital for SOEs is marginally cheaper than the user cost of capital for foreign firms in 1998 and 2007. Since foreign firms generally depend on foreign banks for loans, the data indicate that SOEs compared to private firms have preferential access to domestic sources of external finance.

In contrast to the declining user cost of capital, the overall real wage increases by more than

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14 If we include firms that report no interest, then these all of these patterns are robust.
115 percent during 1998-2007. It is striking that these gains in real wage are the sharpest with SOEs (175 percent), then within private firms (102 percent) and foreign firms (76 percent). In 1998 SOE workers are paid much less than workers in foreign firms and marginally more than workers in private firms; by 2007 workers in SOEs have the highest real wages.

The data in Table 1 indicates that the SOEs became more profitable during 1998-2007. Table 1 provides some hints as to just how these SOEs became profitable. Compared to private and foreign which hired more labor, SOEs hired less labor. And, over time SOEs could obtain loans from domestic banks more cheaply than private firms could. This suggests that SOEs may have been making profits by substituting capital for labor. SOEs perhaps remained pro-labor because, by 2007, they were paying on average the highest real wages. However, because SOEs were cutting so much labor, their payment to labor as a share of value added fell sharply during 1998-2007. In the next section we discuss overall trends in labor shares during 1998-2007 and the important role that SOEs played in driving this decline in labor’s share.

2.2 Trends in Labor’s Share

According to the Penn World Tables (Version 8; China 2; PPP adjusted), China’s real GDP per capita roughly doubled during 1999-2007. However, as we already shown, during this period profit shares in our manufacturing sector sample increased by 11 percent while labor shares declined by 8 percent, so that the distribution of the benefits from this rapid growth appear to be uneven. Understanding just why these shares changed so dramatically can help us understand how SOEs became profitable. Because profit shares include both payments to capital and markups, it is unclear just who are the recipients of profit shares. Since laborers are the clearly the recipients of wages, in this section and the rest of the paper we focus on labor shares.\footnote{The stability of labor’s share of value added or national income has been one of the stylized facts of growth (e.g., Gollin, 2002). In the current paper, we exploit the variation in labor’s share at the firm level, and show how it can be driven changes in market fundamentals including by a firm’s market power, its elasticity of substitution between labor and capital, and the political pressure it faces to hire excess labor.}

There are two standard approaches to computing labor’s share: one is the production approach, which obtains value added from total sales minus operation costs, and the other is the income approach, which adds up capital depreciation, wage compensation, net production tax, and operation profits to obtain value added. For technical reasons we use the production approach.\footnote{We could have a negative value of value added if a firm incurs a large loss. Consequently, labor compensation could be larger than value added. In our data, the income approach creates more negative values of labor shares} Thus, our
baseline measure of the labor share is

\[ LS_{it} = \frac{w_{it} N_{it}}{VA_{it}} \]  

(1)

where \( w_{it} N_{it} \) is labor compensation of firm \( i \) in year \( t \), which is the product of wage rate \( w_{it} \) and the number of employees \( N_{it} \). Labor compensation includes several additional benefits beyond standard wages including unemployment insurance. Value added from the production approach in firm \( i \) in year \( t \) is denoted \( VA_{it} \).

Figure 5 plots annual labor shares using our firm level data from the manufacturing sector; this figure also plots labor share from China’s corporate sector that uses a flow of funds method as computed by Karabarbounnis and Neiman (2013). By our measure, labor share has declined by 8 percentage point (from 0.257 in 1998 to 0.177 in 2007); the Karabarbounnis and Neiman (2013) measure shows a decline of 6.3 percentage point (from 0.545 in 1998 to 0.482 in 2007). Both measures tend to co-move. The Karabarbounnis-Neiman measure of labor’s share includes the service sector, while our measure excludes this sector. Because the service sector tends to have higher labor shares than manufacturing sectors, the Karabarbounnis-Neiman measure of labor’s share is higher than the measure we compute.\(^{17}\) For the rest of the paper, however, we use our data from manufacturing sector because it enables us to look at detailed firm level data.

In order to get some understanding for the link between the decline in labor shares and ownership, we decompose the change in labor shares into its between and within effects according firms’ ownership. We thus adapt the general decomposition method from Karabarbounis and Neiman (2013) who examine labor share change across industries and within each industries, examine the change in the labor share arising from the composition of ownership types versus the change in the labor share arising within each ownership type. The equation we use for the decomposition exercise is

\[ \Delta LS = \sum_o \Delta S^o ALS^o + \sum_o \Delta LS^o AS^o. \]  

(2)

than the production approach does. Thus, we employ the production approach. In theory, value added from the income approach should equal to that from the production approach. However, these two approaches often differ due to misreporting and different system of financial and production record.

\(^{17}\) As we will discuss in the next section, our value added measure is calculated from revenues minus payments to materials (i.e., the production approach). This approach tends to underestimate labor shares because the compensation items (profits, wages, tax payments, etc.) sum up to 80% of the value added estimated from the production approach. The choice of our approach is another reason our labor share is different from the Karabarbounnis and Neiman (2013) measure.
In equation (2), the change in labor shares in manufacturing during 1998 to 2007 (i.e., -8.0 percentage point) is $\Delta LS = LS_T - LS_0$, where $LS_t$ is the labor share in manufacturing in time $t$, and the subscript $t = T$ ($t = 0$) is year 2007 (1998). We also define the following four variables:

1. the change in labor share of manufacturing firms of ownership type $o$ is $\Delta LS^o = LS_T^o - LS_0^o$, where $LS^o_t$ is the labor share of the type $o$ (aggregated across all firms in type $o$) at time $t$,

2. the change in the firm of ownership type $o$’s share in value added is $\Delta S^o = S_T^o - S_0^o$, where $S_t^o$ is the overall share of the type $o$ firms in value added,

3. the average labor share for the ownership type $o$ during 1998 and 2007 is $ALS^o = 0.5(LS_T^o + LS_0^o)$, and

4. firm type $o$’s average share in value added is $AS^o = 0.5(S_T^o + S_0^o)$. In equation (2), the first term in the right-hand side is the between effect, which captures the change associated with the share of each ownership in value added. The second term is the within effect because it measures the change in the labor shares within each ownership type $o$.\(^\text{18}\)

Table 2 reports the results of this decomposition exercise: it lists between effects, within effects and total changes in labor’s share for SOEs, private firms, foreign firms and collectives/hybrids. The last row sums across ownership types and contains overall between effects, within effects and total changes. Is notable that almost 90 percent of the 8 percentage point decline in labor’s share stems from the within effects (-7.1 percentage points). Moreover, almost two thirds of the overall within effect (-7.1 percentage points) comes from within SOEs effects (-4.6 percentage points). A simple inspection of the breakdown of between effects by ownership categories provides some insight into why overall between effects are negligible. The large and negative between SOEs effect (-4.3 percentage points) is driven largely by their privatization that sets off an expansion of private firms and, thus, a large and positive private between effect (5.2 percentage points). Thus, changes within SOEs and not the privatization of SOEs seems to be driving the declining labor shares during 1998-2007.

3 Labor’s Share and State Ownership: Theory

In this section we build a simple model of how ownership affects the decisions of a Chinese firm. We use the model to make testable predictions about the impact of ownership and other market

\(^{18}\)We can also decompose the total change in the labor share into the between and within effects by replacing the superscript of $o$ in equation (2) to that for industrial sectors, states, or export statuses. See Appendix 2 for the results of these additional decomposition exercises.
fundamentals on labor’s share of value added at the firm-level.

We consider an economy inhabited by firms that are differentiated by sectors, denoted $s$, and ownership, denoted $o$ and that operate in various time periods, denoted $t$. A firm $i$ in period $t$ uses labor ($N_{it}$), capital ($K_{it}$) and materials ($M_{it}$), and a sector-specific technology to produce a good. The technology for converting these inputs into outputs is the same in each sector and does not change over time. Following Karabarbounis and Neiman (2013), we use a flexible production function that allows for a constant elasticity of substitution between labor and capital and a unitary (Cobb-Douglas) elasticity of substitution between materials and factor inputs:

$$Q_{it} = \omega_{it} \left[ a_s N_{it}^{(\sigma_s-1)/\sigma_s} + (1-a_s) K_{it}^{(\sigma_s-1)/\sigma_s} \right]^{\alpha_s\sigma_s/(\sigma_s-1)} M_{it}^{1-\alpha_s}$$

In this specification, $Q_{it}$ is output for a firm $i$ at time $t$; $\omega_{it}$ is firm-specific Hicks-neutral productivity; $a_s$ is the sector-specific weight on labor versus capital in factor inputs ($0 < a_s < 1$); $\sigma_s$ is the sector-specific elasticity of substitution between capital and labor ($0 \leq \sigma_s < +\infty$); $\alpha_s$ is the Cobb-Douglas weight between the factor inputs (i.e., labor and capital) and materials ($0 < \alpha_s < 1$). We assume constant returns to scale in production.

Firms operate in competitive input markets and can hire all of the labor, capital and materials it wants at input prices that are denoted $w_{it}$, $r_{it}$, and $\tilde{p}_{it}$, respectively. However, product markets are imperfectly competitive and each firm faces an inverse demand function:

$$p_{it} = B_{it} Q_{it}^{-1/\eta_{it}}$$

where $\eta_{it}$ denotes the price elasticity of demand ($\eta_{it} > 1$). In each period, private firms choose inputs in order to maximize profits, which are denoted $\Pi_{it}$:

$$\Pi_{it} = p_{it} Q_{it} - w_{it} N_{it} - r_{it} K_{it} - \tilde{p}_{it} M_{it}.$$  

Because production functions exhibit constant return to scale, in what follows and without loss of generality, we simplify the analysis and set the wage for each firm equal to one.
SOEs that are de facto controlled and owned by the federal, provincial or local governments are also expected to hire excess labor even if this entails foregoing profits. To capture this regulatory environment, SOEs have a political benefit for hiring an additional employee equal to \((1 - 1/\phi_{ot})N_{it}\) where \(\phi_{ot} \geq 1\) for SOEs and \(\phi_{ot} = 1\) for private, collective and foreign firms. Thus, the degree to which the state pressures SOEs to hire excess labor is increasing in \(\phi_{ot}\).

We use the following objective function of a firm:

\[
U_{it} = \Pi_{it} + \left(1 - \frac{1}{\phi_{ot}}\right) N_{it} \quad \text{s.t.} \quad VA_{it} \geq 0
\]  

(5)

where \(VA_{it} \geq 0\) is a financial constraint, i.e, in any period a firm operates when it can cover at least generate value added.\(^\text{19}\) This setup is similar to Azmat et al. (2012). One conceptual difference is that we use an output production function, while Azmat et al (2012) employ a value-added production function.

We solve for the case in which the financial value added is non-binding and subsequently discuss the implication for a binding value-added constraint. The first order condition for maximizing equation (5) with respect to employment is

\[
\phi_{ot} \left(1 - \frac{1}{\eta_{it}}\right) \frac{\partial Q_{it}/Q_{it}}{\partial N_{it}/N_{it}} = \frac{N_{it}}{p_{it}Q_{it}}.
\]  

(6)

We also have the first order condition with respect to capital:

\[
\left(1 - \frac{1}{\eta_{it}}\right) \frac{\partial Q_{it}/Q_{it}}{\partial K_{it}/K_{it}} = \frac{r_{t}K_{it}}{p_{it}Q_{it}}.
\]  

(7)

Then, from equations (3), (6) and (7), we can derive a simple expression for the labor-capital ratio as a function of the elasticity of substitution, the weight on labor versus capital in factor inputs, the cost of capital and the political weight:

\[
\frac{N_{it}}{K_{it}} = \left(r_{it}\phi_{ot}\frac{a_{s}}{1 - a_{s}}\right)^{\sigma_{s}}.
\]  

(8)

Thus, when \(0 < \sigma_{s}\) a higher price of capital, a higher political weight on hiring labor and a higher

\(^{19}\)A zero profits constraint is too strong since there are firms that in each period lose money. A non-negative value added constraint ensures that firms that operate in any period at a minimum can not be destroying value.
weight on labor versus capital in factor inputs corresponds to a higher employment-capital ratio.

Finally, we have the following first order condition for materials:

\[
\left(1 - \frac{1}{\eta_{it}}\right) \frac{\partial Q_{it}/Q_{it}}{\partial M_{it}/M_{it}} = \frac{\tilde{p}_{it}M_{it}}{\tilde{p}_{it}Q_{it}}.
\]  

(9)

Using the first order condition for materials in equation (9) and \((\partial Q_{it}/Q_{it})/(\partial M_{it}/M_{it}) = 1 - \alpha_s\), we can compute a firm’s markup, \(\mu_{it}\):\(^{20}\)

\[
\mu_{it} = 1/\left(1 - \frac{1}{\eta_{it}}\right) = \frac{(p_{it}Q)(1 - \alpha_s)}{(\tilde{p}_{it}M_{it})}.
\]  

(10)

From the markup equation (10) and the definition of value added, we obtain a simple expression for value added:

\[
VA_{it} = p_{it}Q_{it} - \tilde{p}_{it}M_{it} = p_{it}Q_{it} \left(1 - \frac{1 - \alpha_s}{\mu_{it}}\right)
\]  

(11)

Since \(0 < 1 - (1 - \alpha_s)/\mu_{it} < 1\), then a firm always generates positive value added when \(Q_{it} > 0\) and the value-added constraint in equation (5) is non-binding.

Differentiating the production function equation (3) with respect to \(N_{it}\) and multiplying by \(N_{it}/Q_{it}\), we obtain a specific function for output elasticity of labor:\(^{21}\)

\[
\frac{\partial Q_{it}/Q_{it}}{\partial N_{it}/N_{it}} = \frac{\alpha_s a_s N_{it}^{(\sigma_s - 1)/\sigma_s}}{a_s N_{it}^{(\sigma_s - 1)/\sigma_s} + (1 - a_s) K_{it}^{(\sigma_s - 1)/\sigma_s}}.
\]  

(12)

Now, using the expressions for the first order condition for labor, the labor-capital ratio, the markup, value-added and the output elasticity of labor in equations (6), (8), (10), (11) and (12), we derive a simple expression for labor share’s in value added:

\[
LS_{it} = \frac{\phi_{it} a_s}{\mu_{it} - 1 + \alpha_s} \left[1 + \left(1 - \frac{a_s}{\alpha_s}\right) \left(\frac{N_{it}}{K_{it}}\right)^{(1-\sigma_s)/\sigma_s}\right]^{-1}
\]  

(13)

\[
= \phi_{it} a_s \left[\mu_{it} - 1 + \alpha_s\right]^{-1} \left[1 + \left(1 - \frac{a_s}{\alpha_s}\right)^{\sigma_s} \left(r_{it} \phi_{it}\right)^{1-\sigma_s}\right]^{-1}
\]  

(14)

\[
= \phi_{it} a_s F(\mu_{it}, \alpha_s)G(\sigma_s, r_{it}, \phi_{it}, a_s).
\]

\(^{20}\)De Loecker and Warzynski (2012) obtain the markup by assuming that firms employ labor flexibly. In our setting of the model, SOEs do not necessarily choose the profit-maximization level of employment. Thus, we use intermediate inputs as a flexible production input. This approach is taken from Lu et al (2012).

\(^{21}\)If the production function is Cobb-Douglas (\(\varepsilon_s = 0\)), we have \(\frac{\partial Q_{it}/Q_{it}}{\partial N_{it}/N_{it}} = a_s \alpha_s\).
where $F(\mu_{it}, \alpha_s) = [\mu_{it} - 1 + \alpha_s]^{-1}$ is denote the markup composite and $G(\sigma_s, r_{it}, \phi_{ot}, a_s) = \left[1 + \left(\frac{1-a_s}{a_s}\right)^{\sigma_s} (r_{it}\phi_{ot})\right]^{-1}$ is denoted the substitution effect.

Here, for ease in the empirical implementation of the theory, we redefine $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ so that the relative cost of capital (in terms of labor) is replaced by the labor-capital ratio:

\[
\tilde{G}(\sigma_s, N_{it}/K_{it}, a_s) = \left[1 + \left(\frac{1-a_s}{a_s}\right) \left(\frac{N_{it}}{K_{it}}\right)^{(1-\sigma_s)/\sigma_s}\right]^{-1}
\]

The right hand side of equation (14) shows how labor’s share is a function of three parameters that are of fundamental to this study: the political weight on labor ($\phi_{ot}$), the markup ($\mu_{it}$) and the real user cost of capital ($r_{it}$). As we will argue below, whether the elasticity of substitution between labor and capital ($\sigma_s$), is greater than one, one or less will be important for our prediction about the impact $\phi_{ot}$, $\mu_{it}$ and $r_{it}$ on labor’s shares.

Markups only appear in the term $F(\mu_{it}, \alpha_s)$ the right hand side of equation (14). When product market competition gets weaker, a firm can enjoy higher markups, $\mu_{it}$. In this situation, a firm equi-proportionally extracts payments from labor, capital and materials. An increase in markups lower the $F(\mu_{it}, \alpha_s)$. Thus, our model predicts that labor’s share falls when production market competition gets weaker. This is consistent with the predictions in Azmat et al. (2012).

The political weight ($\phi_{ot}$) in equation (14) however, appears in the direct linear term $\phi_{ot}$ and is also within the term $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ in equation (14). Labor’s share of value is clearly increasing in the linear term $\phi_{ot}$: this is because a small increase in political pressure to hire more labor increases the cost of not distributing income to labor more expensive for a firm’s residual claimants. However, just how this increase in the political weight affects labor’s share through the term $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ depends on the elasticity of substitution between capital and labor. In the case in which labor and capital are substitutes and $\sigma_s > 1$, and $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ is increasing in $\phi_{ot}$. In the knife edged Cobb-Douglas case where $\sigma_s = 1$, $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ does not change with $\phi_{ot}$. And, when labor and capital are complements: $\sigma_s < 1$, $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ is decreasing in $\phi_{ot}$. Thus, when $\sigma_s \geq 1$ and labor and capital are not complements, our model predict that labor’s share is increasing in $\phi_{ot}$. In principle if the absolute impact of an increase in the political weight, $\phi_{ot}$, is stronger for $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$ than for $\phi_{ot}$ in equation (14), then it is possible that labor share’s can be decreasing.

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\[\text{22In the analysis of Table 1.3 in Section 2.1, we noted that direct measures of the cost of capital are noisy because a substantial share of firms do not report paying interest on loans. Using these direct measures would force us to drop a large share of our sample. Because we employ a tractable CES production function, then we can then simply express the relative cost of capital in terms of the labor-capital ratio and relevant parameters from the production function and thus be able to analyze the full data set.}\]

\[\text{23Since we the wage for each firm equal to one, } r_{it} \text{ in fact should be relative to wage } (r_{it} = r_{it}/w_{it} \text{ where } w_{it} = 1).\]
in $\phi_{ot}$ when $\sigma_s < 1$. However, in Appendix 3 we show that for our functional form, labor’s share is always increasing in $\phi_{ot}$ even when $\sigma_s < 1$.

The user cost of capital ($r_{it}$) does not directly influence the costs of distributing income to labor. However, an increase in capital cost ($r_{it}$) makes labor relatively cheaper than capital, and it enters the term, $G(\sigma_s, r_{it}, \phi_{ot}, a_s)$. When labor and capital are substitutes ($\sigma_s > 1$), labor’s share of value added is increasing in the cost of capital. In the Cobb-Douglas case ($\sigma_s = 1$), a change in $r_{it}$ has no impact of labor’s share. Finally, in the case in which labor and capital are complements, a higher cost of capital lowers labor’s share.

4 Estimating the Sectoral Production Function

Our objective is to estimate equation (14). However, this equation is non-linear in the political weight ($\phi_{ot}$) which is one of main variables of interest. To reduce the computational difficulty, we estimate equation (13) which uses the labor capital ratio as a proxy for the cost of capital interacted with the political weight. We conduct our empirical strategy in two stages. First, we estimate equation (3) using the general method of moments (GMM) proposed by De Loecker and Warzynski (2012), and obtain the key variables for production, $\hat{s}_s$, $\hat{\alpha}_s$, $\hat{a}_s$ and $\hat{\mu}_{it}$. Once we have the estimates of these structure variables, in the second stage we estimate the political weight ($\phi_{ot}$), in equation (13).

4.1 Estimating Strategy

The traditional methods of estimating a constant elasticity of substitution (CES) production function include Kmenta (1967), León-Ledesma et al. (2010) and Chirinko et al (2011). While the approach of Kmenta (1967) uses the polynomial approximation of Taylor’s theorem, Chirinko et al. (2011) use the first order condition of the CES production function and estimates the long-run elasticity of substitution between labor and capital. However, these influential and traditional methods are not suitable for our purposes. For example, the Kmenta (1967) approach is to approximate the elasticity of substitution around unity; however, this approach becomes increasingly inaccurate as the actual elasticity of substitution between capital and labor diverges from one. And, the method of Chirinko et al (2011) requires that we have a long time series and stable times of the production data and user cost of capital.
In this paper, we follow the recent approach proposed by De Loecker and Warzynski (2012) and obtain all the parameters (i.e., $\sigma_s$, $\alpha_s$, $\bar{s}$, and $\hat{\mu}_{it}$) using a GMM estimation procedure. De Loecker and Warzynski (2012) follow the tradition of estimating firm level production function (i.e., Olley and Pakes, 1996; Levinsohn and Petrin, 2003; Ackerberg et al., 2006). These papers concentrate on overcoming the simultaneity bias that can occur when the productivity shocks ($\omega_{it}$) are observed by the firm but not by the econometrician. These productivity shocks are thus problematic because they can shape how a firm optimally chooses its flexible inputs.

Equation (3) is estimated in two stages. In the first stage, the second-order polynomial function of the three inputs and the dummy variable of export status ($E_{it}$), plus region-year dummy variables, is estimated:

$$\ln(Q_{it}) = \Phi_{it}(\ln(N_{it}), \ln(K_{it}), \ln(M_{it}), E_{it}, D_{it}) + \epsilon_{it}. \quad (15)$$

In equation (3) we deflate $Q_{it}$ and $M_{it}$ with industry-level output and input deflators from Brandt et al. (2012), respectively.26

After the first stage equation (15) is estimated, we can compute the corresponding value of productivity (TFP) for any combination of parameters $\Omega = (\alpha_s, \sigma_s, \bar{s})$. This enables us to express the log of productivity $\ln(\omega_{it}(\Omega))$ as

$$\ln(\omega_{it}(\Omega)) = \hat{\Phi}_{it} - \frac{\alpha_s \sigma_s}{\sigma_s - 1} \ln \left[ a_s N_{it}^{(\sigma_s - 1)/\sigma_s} + (1 - a_s) K_{it}^{(\sigma_s - 1)/\sigma_s} \right] - (1 - \alpha_s) \ln(M_{it}). \quad (16)$$

By assuming a non-parametric first-order Markov process, we can approximate the productivity process with the third-order polynomial:

$$\ln(\omega_{it}(\Omega)) = \gamma_0 + \gamma_1 \ln(\omega_{i,t-1}(\Omega)) + \gamma_2 \ln(\omega_{i,t-1}(\Omega))^2 + \gamma_3 \ln(\omega_{i,t-1}(\Omega))^3 + \zeta_{it}(\Omega).$$

From this third order polynomial, we can recover the innovation to productivity, $\zeta_{it}(\Omega)$, for a given set of the parameters. Since the productivity term, $\omega_{it}$, can be correlated with the current

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24 See their online appendix for the application of their general method to a CES production function.
25 The regional-year-fixed effects would capture the other potential factors that determine productivity, for example, the accumulation of human capital, which would be region- and year-specific (e.g., Cheng, Morrow and Tacharoen, 2013).
26 See Appendix 1 for the development of consistent real capital stock data.
choices of flexible inputs, \( \ln(N_{it}) \) and \( \ln(M_{it}) \), but it not correlated with the predetermined variable, \( \ln(K_{it}) \), the innovation to productivity, \( \zeta_{it}(\Omega) \), will not be correlated with \( \ln(K_{it}) \), \( \ln(N_{i,t-1}) \), and \( \ln(M_{i,t-1}) \). Thus, we use the moment condition similar to De Loecker and Warzynski (2012).\(^{27}\)

\[
E \begin{bmatrix}
\zeta_{it}(\Omega)
\end{bmatrix}
\begin{bmatrix}
\ln(K_{it}) \\
\ln(N_{i,t-1}) \\
\ln(K_{it}) \ln(N_{i,t-1}) \\
\ln(K_{it})^2 \\
\ln(N_{i,t-1})^2 \\
\ln(M_{i,t-1})
\end{bmatrix}
\tag{17}
\]

and search for the optimal combination of \( \hat{\alpha}_s \), \( \hat{\sigma}_s \), and \( \hat{\alpha}_s \) by minimizing the sum of the moments for all plausible values of \( \Omega \).

Once we have these optimal parameters for each industry, we can obtain the value of markup by using equation (10):

\[
\hat{\mu}_{it} = \frac{(p_{it}Q)(1 - \hat{\alpha}_s)}{(\hat{\rho}_s M_{it})}
\]

where we use the actual values of nominal gross output \( (p_{it}Q) \) and intermediate input spending \( (p_{it}Q) \).

Table 3 report three parameters of equation (3) for each of 28 2-digit CIC industries\(^{28}\) estimated from the moment condition in equation (17). On average the weight on factor inputs \( (\hat{\alpha}_s) \) is 0.163, the weight on labor relative to capital \( (\hat{\sigma}_s) \) is 0.798, and the elasticity of substitution between labor and capital \( (\hat{\alpha}_s) \) is 1.509. Our results indicate that there is a high degree of the substitutability between labor and capital in the Chinese manufacturing sector. Our findings differ significantly

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\(^{27}\)The choice of instrumental variables in the current moment condition is influenced by the choice of instruments in Ackerberg et al. (2006), De Loecker and Warzynski (2012), and Kmenta (1967). Since our CES production function could be approximated by the Translog production function using the Kmenta (1967) approach, we use the six instrumental variables to exactly identify the six parameters in the Translog with capital and labor. The moment condition is thus over-identified because when we nest the Translog to be a CES production function, we are left with three parameters to estimate. To check if our results are robust to exact identification, we use just three instrumental variables, i.e., log of lagged labor, log of capital and log of lagged real material input. We find that our results are robust.

\(^{28}\)The 28 manufacturing sectors (CIC 2-digit code numbers are in the parenthesis) are Food Processing (13), Food Production (14), Beverages (15), Tobacco (16), Textile (17), Garments (18), Leather and Fur (19), Timber (20), Furniture (21), Papermaking (22), Printing (23), Cultural, Educational and Sports products (24), Petroleum Processing (25), Raw Chemical (26), Medical Products (27), Chemical Fibers (28), Rubber (29), Plastics (30), Non-metallic Mineral Products (31), Pressing of Ferrous Metals (32), Pressing of Nonferrous Metals (33), Metal Products (34), General Machinery (35), Special Equipment (36), Transport Equipment (37), Electrical Machinery and Equipment (39), Electronic and Telecom Equipment (40), and Instruments (41).
from the estimates of the United States which tends to find that labor and capital are complements. This suggests that while many employees in the Chinese manufacturing sector can substituted once firms use more capital-intensive production technologies, this kind of drastic automation would not occur in the United States.\footnote{The results in the paper are related to work on skill-biased technological change (Krusell et al, 2000; Caselli and Coleman II, 2006) which shows that the rapid growth of physical capital interacts differently with different types of labor. The major finding is that wages for skilled workers and for unskilled workers evolve differently according to the accumulation of worker skills and physical capital.}

4.2 Productivity and Markups

Productivity (TFP), markups and labor-capital ratio are critical measures of a firm’s market conditions. Thus, before presenting our results on the determinants of firm-level labor shares, in this section we provide an overview of how productivity, markups and the labor-capital ratio vary across the various ownership categories and how these differences evolve over time. We thus estimate the equation:

$$\ln(X_{it}) = \theta^o D^o_{it} + \theta^r D^r_{it} + \theta^s D^s_{it} + \theta^t D^t_{it} + e_{it}. \quad (18)$$

where the dependent variable $X_{it}$ could be the log of TPF, $\ln(\omega_{it})$\footnote{In particular, we use the actual value of real output to calculate TFP: $\ln(\omega_{it}) = \ln(Q_{it}) - (1 - \hat{a}_s) \ln(M_{it}) - \hat{a}_s \frac{\sigma_s}{\sigma_s - 1} \ln \left[ \hat{a}_s N_{it}^{(\beta_s - 1)/\beta_s} + (1 - \hat{a}_s) K_{it}^{(\beta_s - 1)/\beta_s} \right].$}, the log of markups, $\ln(\mu_{it})$, or the log of the labor-capital ratio; and, $\ln(N_{it}/K_{it})$, $D^o_{it}$, $D^r_{it}$, $D^s_{it}$ and $D^t_{it}$ are ownership-, region-, sector-, and year dummy variables, respectively. In this equation private firms are the baseline. Thus, this equation enables to estimate SOEs, foreign and collective firms compare to private firms in terms of TFP, markups and labor capital ratios; and, how these differences evolve during 1998-2007.

Our results are contained in Table 4. In the first set of columns the dependent variable is the log of total factor productivity. The coefficient on the SOE dummy, for example, shows the average percentage difference in productivity between SOEs and private firms in the same year, region, and industry. The SOEs are less productive, and this difference is statistically significant for all three time periods reported. The results indicate that SOEs were catching up, because this difference between SOEs and private firms reduced in absolute terms from -10.5 percent in 1998 to -4.3 percent in 2007. Figures 6.1 and 6.2, also illustrate that average productivity is much smaller for the SOEs, whereas productivity distribution of SOEs is also located to the left of that of foreign
The next set of columns in Table reports differences in log of markups. The SOEs have the higher average markup, and this difference is statistically significant in three time periods in which the data is reported. In percentage term, the differences in markups between SOEs and private firms is reduced from 4.2 percent in 1998 to 2.5 percent in 2007. Figure 7.1 show that while SOEs maintain high markups throughout 1998-2007, private and foreign firms had increased their markups and we speculate that this was because the forces of globalization gave private and foreign firms better access to cheaper foreign inputs. It is notable that SOEs with high markups remain in the market throughout the period we examine. Our results about markups are similar to those in Lu et al (2012).

The last set of the columns in Table 4 reports the difference in the labor-capital ratio for SOEs, collectives and private firms compared to foreign firms. Here, foreign firms are convenient to use as the baseline because they exhibit and almost constant average labor-capital ratio throughout 1998-2007. SOEs, collective and private firms have a much higher labor-capital ratio than foreign firms in 1998. In 2007 this difference between collective (private) firms and foreign is smaller but still significant. However, in 2007 SOEs have roughly the same labor-capital ratios as foreign firms.

4.3 Changes in SOE Status

If SOEs had successfully restructured during 1998-2007, then we would observe that the performance of continuing SOEs would be no worse than SOEs that had become private as of 2007. Table 5 thus reports the status change of SOEs and the transition of the key production variables. We select firms whose ownership in 1998 were SOEs and remained operation in 2007 regardless of the ownership types. Among 8,031 SOEs in 1998, 49 percent were SOEs in 2007, while 42 percent of these firms were privatized. We use equation similar to equation (18) but we change the ownership dummy variable according to the ownership changes over the period.

The first set of columns in Table 5 reports productivity differences and SOEs that had privatized are the baseline. The coefficient on the SOE -SOE dummy, for example, shows the average percentage difference in productivity between firms that kept SOEs ownership and SOEs that pri-

31The results for the average productivity are sensitive to outliers. Thus, we develop $v_i = [\max(w_{it}) - \min(w_{it})]/\min(w_{it})$ for each firm $i$ and eliminate the top one percentile of the largest cross-year change in this number. By doing this procedure, we can eliminate the unrealistic growth rates of productivity such as $v_i = 20,000$. We use a similar method of eliminating outliers for markups.
vatized over the period in the same year, region, and industry. There is no statistically significant
difference in productivity in 1998 between SOEs that continued as SOEs and those that were priva-
tized, became foreign owned or became collectives. However, in 2007 in contrast to the findings of
Brandt et al (2012, p.350) as of 2007, continuing SOEs are 2.2 percent less productive than SOEs
that had privatized and this difference is significant at the 5 percent level.

The next set of the columns in Table 5 report the differences in markups and, again, SOEs
that had privatized are the baseline. The SOEs that continued to be SOEs have the higher average
markup in 1998, which is statistically significant in 1998 and 2007 although the difference is reduced
from 2 percent in 1998 to 1.3 percent in 2007. Finally, the last set of the columns in Table 5 reports
the differences the labor-capital ratio by ownership groups. Here, the SOEs that became privately
owned remain as the baseline because SOEs that had become foreign companies is simply too small
of a group. In contrast to the SOEs that had privatized, continuing SOEs, in particular, employ
much less labor and more capital. In 1998, SOEs have 17.6 percent lower value of the labor-capital
ratio; by 2007 this difference was less profound (7.8 percent).

5 Estimating Labor’s Share

5.1 Pooled Estimation

Using our estimates for the production parameters $\hat{\sigma}_s$, $\hat{\alpha}_s$, $\hat{\bar{a}}_s$, and $\hat{\mu}_s$, we can estimate the log of
firm-level labor share as a function of political weight on excess employment (i.e., $\phi_{ot}$), the markup
composite (i.e., $F(\cdot) = F(\hat{\mu}_s, \hat{\alpha}_s)$) and the substitution effect (i.e., $\tilde{G}(\cdot) = \tilde{G}(\hat{\sigma}_s, \hat{\bar{a}}_s, N_{it}/K_{it})$):

$$\ln(\ln(LS_{it})) = \delta^D D_{it}^{SOE} + \delta^a \ln[F(\cdot)] + \delta^s \tilde{G}(\cdot) + \delta^r D_{it}^r + \delta^K D_{it}^K + \delta^t D_{it}^t + e_{it}.$$  \hspace{1cm} (19)

In order to obtain the implied sectoral political pressure to hire excess labor, $\phi_{ot}$, we replace $\ln(\phi_{ot})$
with $D_{it}^{SOE}$, which is a dummy variable that equals one for an SOE and is zero otherwise.\footnote{This strategy was first used by Goldberg and Maggi (1999) to estimate another model in which a firm has non-economic objective function.}

Our benchmark estimating equation include regional-, sector- and year-specific fixed effects.
The sector-fixed effects are important for two reasons. First, sector-specific fixed effects capture
$\alpha_s$ (the output elasticity of materials) in the theoretical prediction in equation (13). Second, they...
also capture measurement errors associated with the parameters ($\hat{\sigma}_s$, $\hat{\alpha}_s$ and $\hat{\omega}_s$) estimated from equation (17). Finally, depending on the upstream or downstream position in production chain (e.g., Li et al, 2012), industries would have difference markups by nature.

Table 6 reports the results of the estimating equation (19) for all firms in manufacturing sector. Models 1 through 6 estimate the variant of equation (19) with Ordinary Least Squares (OLS) and report the estimated parameters and robust standard errors in parentheses. Consistent with the predictions of our theory (see equation (14)), the results indicate that labor’s share is positively associated with political weight on employment and negatively associated with the markup and that labor-capital substitution terms. These association are precisely estimated and statistically significant at the 1 percent confidence level. Consider the benchmark equation (Model 3). We estimate that $\delta^\phi = \ln(\hat{\rho}_{ol})$ is 0.472. As we specify in equation (5), this coefficient implies that SOEs employ more workers and put 37.6% weight ($1 - 1/\hat{\rho}_{ol} = 1 - 1/(\exp(0.480)) = 0.381$) on employment relative to profits. Regarding the other terms, the markup composite (-0.393) and the labor-capital substitution effect (-0.785), also have the expected signs.

Estimating the three parameters consistently requires that we deal with several standard econometric issues. The first issue is simultaneity and endogeneity. In particular, the labor-capital ratio in the substitution effect term is a function of the political weight on excess employment and the real user cost of capital ($r_{it}$) as in equation (14). The reason why we use the labor-capital ratio directly rather than using real user cost of capital which would be exogenous is, as we have already discussed above in section 2, the user cost of capital is not fully available for whole sample. Because many firms report no payment of interest, and there are systematic differences in non-reporting of interest payment across ownership categories and over time, we can only compute this variable for the set of firms that report making interest payment. Thus, we are forced to drop many observations. An alternate candidate variable would be $r_{it} = (VA_{it} - w_{it}N_{it})/K_{it}$ divided by $w_{it} = w_{it}N_{it}/N_{it}$; but, this yet is another endogenous variable.

Another issue is the markup could also be endogenous because it could be obtained from the marginal product of labor divided by the labor share if labor is a flexible input (i.e., De Loecker and Warzynski, 2012). Thus, to avoid this endogeneity issue, we compute the markup by taking the marginal product of intermediate inputs and dividing it by the revenue share of intermediate inputs as in equation (10). To deal with the issue of endogeneity, we use standard methods with
instrumental variables. Model 7 estimates the baseline model by introducing the lagged values of the markup composite and the substitution effect term as their instruments, whereas Model 8 uses the political weight on employment, the real user cost of capital, and lagged variables as instruments for the markup and substitution terms. As in Table 6, the results from the Two Stage Least Squares (2SLS) for Models 7 and 8 are similar to those from Model 3.

Serial correlation could be an issue in our data set since our panel data spans ten continuous years. We use the traditional robustness test and check the time differenced series of our variables. In Model 9 in Table 6, we report the results when we use the time differenced series of the data. Since the time-differences eliminate any constant terms, we are forced to drop political weight on employment. Nevertheless, we obtain the same signs and similar magnitudes of the effects for both the markup and substitution effect terms even if we use the time-differenced series.

Finally, to deal with the endogeneity and serial correlation simultaneously, we use Arellano and Bond’s (1991) GMM procedure to estimate our baseline method. Again, we are forced to drop the political weight on employment due to time differencing. However, we obtain the results similar to Model 3. Overall, our results in Table 6 confirm that our predictions of how markups, political pressure to hire excess labor and the substitution effects drive labor’s share.

5.2 Transition of Political Pressure to Hire Excess Labor

In order to examine how political pressure to hire excess employees has evolved during 1998-2007, we modify equation (19). If in fact the reforms announced in 1997 in the Fifteenth Party Congress and subsequently went forward, then SOEs would be allowed to focus more on profits and less on hiring more workers for social stability. This would imply that the political pressure on SOEs to hire excess workers was declining and would be a reason for the decline in labor’s share of value added in SOEs as shown in Figure 4. In particular, we allow the political weight on employment as time-varying variable as follows:

\[
\ln(LS_{it}) = \delta^\phi D_{it}^{SOE} + \delta^\mu \ln[F(\cdot)] + \delta^\sigma [G(\cdot)] + \delta^r D_{it}^r + \delta^s D_{it}^s. \tag{20}
\]

Table 7 reports the results for the panel from all observations (all regions) as well as four regions (North, East, South and West) of China.\textsuperscript{33} The first column reports the results from all

\textsuperscript{33}Each region includes the following provinces or province-equivalent municipal cities. North: Beijing, Tianjin,
observations. Although we estimate the coefficients on all years, we only report the coefficients on year 1998 and those on year 2007 where we report the differences from 1998 so that we can examine how the political pressure had changed over the period. The political weight on excess employment is 0.541 in year 1998, which is reduced by 0.212 to 0.329. The difference between the value of 1998 and that of 2007 is negative and statistically significant at the 1% confidence level. Our results indicate that Chinese SOEs had faced less pressure to employ excess workers and thus, could pay more attention to making profits. In particular, the political weight \(1 - 1/\hat{\phi}_{ot}\) had declined from 41.8% in 1998 to 28.0% in 2007 relative to profits. The magnitudes of the transition are quite different across the regions. The declines of the political pressures are most drastic for reformist regions such as the East and South, and less less drastic for the North and West regions (Table 7 and Figure 8).

6 Conclusions

Kornai (1990; 1992, Part III) warns that the strong political connections between SOEs and the state enable SOEs to avoid restructuring. Nevertheless, if we were simply to examine profits, it appears that SOEs in China successfully restructured during 1998-2007. In this paper we have developed a comprehensive method for evaluating the effectiveness of restructuring: this method that enables us to evaluate the impact of product market competition, political pressures to hire excess labor and the substitutability between labor and capital (which is related to the user cost of capital). The method also enables us to simultaneously estimate TFP. We find that SOEs enjoyed all of the benefits of their political connections including preferential access to external finance for investment and relatively high markups in product markets. At the same, SOE were under less political pressure to hiring excess labor and could easily generate profits by firing labor.

Our findings provide an important counter-example to the Chong et al (2011) study of privatization of SOEs around the world. Using privatization prices, Chong et al argue that releasing excess labor in SOEs that are privatizing is more important for restructuring than labor retrenchment policies. However, in the case of China, we document that while SOEs massively released labor, they did not restructure. This suggests that simply firing labor without weakening political

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Hebei, Shanxi, Neimenggu, Liaoning, Jilin, and Heilongjiang, East: Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong, South: Henan, Hubei, Hunan, Guangdong, Guangxi, and Hainan, and West: Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shanxi, Gansu, Qinghai, Ningxia, and Xinjiang.
connections between SOEs and the state is problematic. Our results are an update to Young’s (2003) findings that the Chinese non-agricultural sector during 1978-1998 grew to a large extent by mobilizing labor and without strong growth in total factor productivity. During Young’s period of study SOEs accounted for a large share of the non-agricultural sector. Our period of analysis post-dates Young and is also a time when there is much more private activity. Nevertheless, we also show that SOEs’ productivity growth was not as impressive as their profitability growth.

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Appendix

Appendix 1: Real Capital Stock

Real capital stock is constructed using the perpetual inventory method described in Brandt et al. (2012). We have the book value of firms’ fixed capital stock at original purchase prices. Since these book values are the sum of nominal values for different years, they should not be used directly. Instead, we construct real capital stock series using the following formula:

\[ K_{it} = (1 - \delta) K_{i,t-1} + \frac{(BK_{it} - BK_{i,t-1})}{P_t} \]  

(A-1)

where \( BK_{it} \) is the book value of capital stock for firm \( i \) in year \( t \); \( P_t \) is the investment deflator constructed by Brandt and Rawski (2008). To construct it, we need to know the initial nominal capital stock, which is projected as

\[ BK_{i,t_0} = BK_{i,t_1}/(1 + g_{ps})^{t_1-t_0} \]
$BK_{i,t_1}$ is the book value of capital stock when firm $i$ first appears in the data set in year $t_1$; $g_{ps}$ is the average growth rate of capital, calculated using province-sector level capital growth rate between the earliest available survey (1995) and the first year that the firm enters the data.\textsuperscript{34} For firms founded later than 1998, the initial book value of capital stock is taken directly from the data set.

Using information on the age of firm $i$, we could get the projected book value of capital stock in the beginning year $t_0$ ($BK_{i,t_0}$), which can be thought of as the initial nominal value of capital. So the real capital stock $K_{i,t_0} = BK_{i,t_0} / P_{t_0}$. By the perpetual inventory method as in (A-1), we could get real capital stock in each year, assuming the annual depreciation rate as 0.09.\textsuperscript{35} Our estimated real capital is highly correlated with the original value of nominal capital as well as the net value of nominal capital.

**Appendix 2: The Between and Within Effects**

We decomposed the national-level decline in labor’s share into the between and within effects by ownership types of firms. In the literature of the industry-level analyses, however, labor share should differ across industries since the underlying production technologies are industry-specific. For example, apparel production process requires more labor than capital, suggesting high labor shares in labor-intensive industries. In Chinese data, labor-intensive industries include garments, leather, fur, feather, and textiles, whereas capital-intensive industries include petroleum processing and steel industries. Somewhat surprisingly, several food industries such as food processing and beverages are capital-intensive in China.

By replacing the superscript $o$ in equation (2) to other types of categories such as sectors ($s$), we can study five additional decomposition exercises to confirm the importance of the within effect for labor share declines. In Table A-1, we report the between and within effects. First, we divide the firms into exporters versus non-exporters (e.g., Bernard and Jensen, 1997 and 1999). As in the standard firm-heterogeneity model of trade by Melitz (2003), exporters would be more productive, or they would have higher markups in the product markets (De Loecker and Warzynski, 2012). In this case, it is plausible that the rapid pace of China’s integration into a global market would be critical to explain the decline in labor share in China. However, the data suggests that there is no

\textsuperscript{34}To be more concrete, we use 1995 industrial census and calculate the province-sector level growth rate for book value of capital. Note that Brandt et al. (2012) use the province-sector level aggregate capital stock growth, which overlooks entry and exit. We instead use the province-sector level average capital stock growth.

\textsuperscript{35}We also try alternative depreciation rate at 0.05, the results are qualitatively similar.
significant change between the exporter and non-exporter statuses. Specifically, the between effect explains 0.08 percentage point of total decline (a 8 percentage point decline) in labor share. This tendency is consistent even we examine the between effects across regions, provinces, and sectors (2- and 3-digit CIC industries). Our results suggest that the composition changes of value added across exporters, industries and provinces do not explain the significant part of the labor share decline in China.

Appendix 3: The Overall Theoretical Impact of the Political Weight on Labor’s Share

It is possible that labor’s share can be decreasing in the political weight when the elasticity of substitution is less than one. However, differentiating equation (14). with respect to $\phi_{ot}$, it is straightforward to show:

$$\frac{\partial LS_{it}}{\partial \phi_{ot}} = LS_{it} \left[ \left( \frac{1}{\phi_{ot}} \right) - \left( \frac{\partial G/\partial \phi_{ot}}{G} \right) \right] > 0 \quad \forall \sigma_s \geq 0$$  \hspace{1cm} (21)

since $\forall \sigma_s \geq 0, \forall \phi_{ot} \geq 1, \left( \frac{1}{\phi_{ot}} \right) \geq 1$ and $\partial G/\partial \phi_{ot}/G = 
\left[ (1 - \sigma_s) \left( \frac{1-\alpha_s}{\alpha_s} \right)^{\sigma_s-r_t^1-\sigma_s} \right]^{-1} < 1.$

References


[35] X. Li, X Liu and Y. Wang, "A Model of China’s State Capitalism." mimeo, the Hong Kong University of Science and Technology, October 2012.


Tables and Figures

Fig 1. Share of Unprofitable Firms

Fig 2. Profit Shares
# Table 1. Key Variables by Ownership Types

## 1. Production Variables

<table>
<thead>
<tr>
<th></th>
<th>SOE</th>
<th>Private</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of firms</td>
<td>14,515</td>
<td>7,026</td>
<td>-51.6%</td>
<td>9,282</td>
</tr>
<tr>
<td>Value added (billion RMB, 2000 price)</td>
<td>446</td>
<td>949</td>
<td>112.7%</td>
<td>87</td>
</tr>
<tr>
<td>Employee (1,000)</td>
<td>14,429</td>
<td>6,330</td>
<td>-56.1%</td>
<td>2,360</td>
</tr>
<tr>
<td>Real capital (billion RMB, 2000 price)</td>
<td>1,475</td>
<td>1,612</td>
<td>9.2%</td>
<td>124</td>
</tr>
<tr>
<td>Employee/the number of firms</td>
<td>994</td>
<td>901</td>
<td>-9.4%</td>
<td>254</td>
</tr>
</tbody>
</table>

Note: The column of "change" reports a percentage change from 1998 to 2007. We do not report collectives/hybrid firms due to the space constraint. The GDP deflator from the World Bank is used to deflate value added.

## 2. Income Variables

<table>
<thead>
<tr>
<th></th>
<th>SOE</th>
<th>Private</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit/value added (%)</td>
<td>5.7%</td>
<td>22.7%</td>
<td>17.0%</td>
<td>20.1%</td>
</tr>
<tr>
<td>Wage bill/value added (%)</td>
<td>29.5%</td>
<td>16.7%</td>
<td>-12.8%</td>
<td>21.2%</td>
</tr>
<tr>
<td>Share of unprofitable firms (%)</td>
<td>33.1%</td>
<td>23.9%</td>
<td>-9.2%</td>
<td>12.8%</td>
</tr>
</tbody>
</table>

Note: The column of "change" reports a percentage-point change from 1998 to 2007. The ratios are calculated from the weighted averages. For example, profits/value added for SOE in 1998 is profits from all SOEs divided by value added from all SOEs.

## 3. Wage and User Cost of Capital

<table>
<thead>
<tr>
<th></th>
<th>SOE</th>
<th>Private</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real wage rate (RMB, 2000 price)</td>
<td>9,133</td>
<td>25,080</td>
<td>174.6%</td>
<td>7,826</td>
</tr>
<tr>
<td>User cost of capital (%)</td>
<td>3.5%</td>
<td>2.0%</td>
<td>-41.6%</td>
<td>4.3%</td>
</tr>
</tbody>
</table>

Note: The column of "change" reports a percentage change from 1998 to 2007. The rates are calculated from the weighted averages. The user cost of capital is total interests paid divided by total liabilities. The GDP deflator from the World Bank is used to deflate wage rate.
Table 2. Between and Within Effects by Ownership

<table>
<thead>
<tr>
<th></th>
<th>Between effect</th>
<th>Within effect</th>
<th>Total change</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOE</td>
<td>-4.3%</td>
<td>-4.6%</td>
<td>-8.9%</td>
</tr>
<tr>
<td>Private</td>
<td>5.2%</td>
<td>-1.4%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Foreign</td>
<td>-2.5%</td>
<td>-0.8%</td>
<td>-3.3%</td>
</tr>
<tr>
<td>Collective</td>
<td>0.6%</td>
<td>-0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Total effect</td>
<td>-0.9%</td>
<td>-7.1%</td>
<td>-8.0%</td>
</tr>
</tbody>
</table>

Table 3. The Overall Estimates for the 28 Sectors

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Each of 28 industries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>$\alpha_s$ (weight on factor inputs)</td>
<td>0.163</td>
</tr>
<tr>
<td>$\sigma_s$ (elasticity of substitution)</td>
<td>1.509</td>
</tr>
<tr>
<td>$a_s$ (weight on labor)</td>
<td>0.798</td>
</tr>
</tbody>
</table>
Table 4. Average Differences in Log Markup, Productivity, and N/K Ratio by Ownership

<table>
<thead>
<tr>
<th>Ownership</th>
<th>ln(ωit)</th>
<th>ln(μit)</th>
<th>ln(Nit/Kit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOEs</td>
<td>-0.090**</td>
<td>-0.105**</td>
<td>-0.043**</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Foreign firms</td>
<td>0.007**</td>
<td>0.010**</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Collective firms</td>
<td>0.012**</td>
<td>0.023**</td>
<td>0.004*</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Private firms</td>
<td>set to 0</td>
<td>set to 0</td>
<td>set to 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Year dummies: Yes, No
Regional dummies: Yes, Yes, Yes
Sector (2-digit CIC) dummies: Yes, Yes, Yes
Observations: 808,424, 54,754, 78,992
R-squared: 0.807, 0.791, 0.794

Notes: (1) Robust standard errors are in the parentheses. (2) ** (*) indicates significant at the 5% (10%) confidence level.
Table 5. Average Differences in Log Markup, Productivity, and N/K Ratio by Ownership Changes

<table>
<thead>
<tr>
<th>Ownership Changes</th>
<th># of firms</th>
<th>ln(ω_{it})</th>
<th>ln(μ_{it})</th>
<th>ln(N_{it}/K_{it})</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOE in 1998 to SOE in 2007</td>
<td>3,944</td>
<td>-0.008</td>
<td>-0.022**</td>
<td>0.020**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>SOE in 1998 to Foreign in 2007</td>
<td>272</td>
<td>0.001</td>
<td>0.003</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>SOE in 1998 to Collective in 2007</td>
<td>403</td>
<td>-0.013</td>
<td>0.037**</td>
<td>-0.014</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.013)</td>
<td>(0.016)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>SOE in 1998 to Private in 2007</td>
<td>3,412</td>
<td>set to 0</td>
<td>set to 0</td>
<td>set to 0</td>
</tr>
<tr>
<td>Regional dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector (2-digit CIC) dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>8,037</td>
<td>7,924</td>
<td>8,044</td>
<td>7,932</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.196</td>
<td>0.451</td>
<td>0.059</td>
<td>0.076</td>
</tr>
</tbody>
</table>

Notes: (1) Robust standard errors are in the parentheses. (2) ** (*) indicates significant at the 5% (10%) confidence level.
Table 6. Log Labor Shares for Pooled Estimations

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>2SLS (IV)</th>
<th>Difference</th>
<th>AB-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 4</td>
</tr>
<tr>
<td>Political weight on excess employment (δφ)</td>
<td>0.480 (0.003)</td>
<td>0.458 (0.003)</td>
<td>0.431 (0.003)</td>
<td>0.442 (0.003)</td>
</tr>
<tr>
<td>Markup composite (δμ)</td>
<td>-0.375 (0.002)</td>
<td>-0.380 (0.002)</td>
<td>-0.393 (0.002)</td>
<td>-0.390 (0.002)</td>
</tr>
<tr>
<td>Substitution effects (δσ)</td>
<td>-0.763 (0.005)</td>
<td>-0.748 (0.005)</td>
<td>-0.785 (0.005)</td>
<td>-0.762 (0.005)</td>
</tr>
<tr>
<td>Year dummies</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regional dummies</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector (2-digit CIC) dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm dummies</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Observations</td>
<td>759,671</td>
<td>759,671</td>
<td>759,671</td>
<td>759,671</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.194</td>
<td>0.2</td>
<td>0.23</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Notes: (1) Robust standard errors are in the parentheses. (2) Model 3 is equation (19). (3) All coefficients are statistically significant at the 5% confidence level.
Table 7. Log Labor Shares for Each Year and Each Region

<table>
<thead>
<tr>
<th></th>
<th>All regions</th>
<th>4 Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
</tr>
<tr>
<td>Political weight on excess employment ($\delta^{\phi}_{1998}$)</td>
<td>0.541</td>
<td>0.544</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Time difference in weight ($\delta^{\phi}_{2007-1998}$)</td>
<td>-0.212</td>
<td>-0.104</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>Markup composite ($\delta^{\mu}$)</td>
<td>-0.393</td>
<td>-0.393</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Substitution effects ($\delta^{\sigma}$)</td>
<td>-0.783</td>
<td>-0.730</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Regional dummies</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sector (2-digit CIC) dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>759,671</td>
<td>117,716</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.230</td>
<td>0.243</td>
</tr>
</tbody>
</table>

Notes: (1) Robust standard errors are in the parentheses. (2) See equation (20). (3) All coefficients are significant at the 5% level.
### Table A-1. Between and Within Effects

<table>
<thead>
<tr>
<th></th>
<th>Between effect</th>
<th>Within effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership</td>
<td>-0.95%</td>
<td>-7.05%</td>
</tr>
<tr>
<td>Export status</td>
<td>0.08%</td>
<td>-8.08%</td>
</tr>
<tr>
<td>Sector (2-digit)</td>
<td>0.57%</td>
<td>-8.57%</td>
</tr>
<tr>
<td>Sector (3-digit)</td>
<td>0.33%</td>
<td>-8.33%</td>
</tr>
<tr>
<td>Province</td>
<td>-0.11%</td>
<td>-7.89%</td>
</tr>
<tr>
<td>Region</td>
<td>-0.10%</td>
<td>-7.90%</td>
</tr>
</tbody>
</table>