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Supplementary Materials for "Does External Monitoring from Government Improve the Performance of State-Owned Enterprises?"

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This appendix provides more detailed description of SASAC and its strengthened monitoring on SOEs. It also includes a wide range of robustness analysis and checks to ensure that the main results are not contaminated by other driving forces in the data period. Overall, our main results are very robust to these checks.

A Detailed Description of SASAC Monitoring

In this section, we provide more descriptive evidence of "SASAC monitoring" from the following aspects: the regulation, organization, actions taken, and outcomes. A summary of the main functions of SASAC is given in Table OA1.

Regulations. Following the establishment of SASAC at the central and local level, it announced a series of policies and regulations of its practices.[34] These policies and regulations clearly define the responsibilities and measures that SASAC should take to supervise and monitor SOEs. Monitoring business operation, improving operation efficiency, and anti-corruption in transactions are among the most important focuses of SASAC's purposes. For example, in the "Opinions on strengthening the Supervision and Monitoring of Central SOEs' Efficiency" effective in 2004, it clearly stated that SASAC and the SOEs' supervision unit should work together to *"...supervise and monitor the management activities of the supervisee (SOEs top managers), supervise and monitor the SOEs' management efficiency and effectiveness, and correct and punish any illegal activities in SOEs' production and management process".* Importantly, the local SASAC at the province and city-level governments implemented similar policies, sometimes with slight modification to cater to the local industry characteristics.

Organizations. SASAC established a special department, the "Supervision Bureau", which is dedicated to supervising and monitoring the operation of SOEs. On top of that, the Central Commission

[34] Representative policies and regulations include the "Policies, Laws and Regulations: Decree of the State Council of the People's Republic of China. No. 378" effective in 2003, the "Opinions on strengthening the Supervision and Monitoring of Central SOEs' Efficiency" effective in 2004, and the "Interim Measures for the supervision and Monitoring of Central SOEs" effective in 2006. Following central SOEs, the local SASAC at the province and city-level implemented similar measures on SOEs affiliated to them (sometimes with slight modifications).

for Discipline Inspection and National Supervisory Committee set up an in-house bureau in the central SASAC, named "SASAC Discipline Inspection and Supervision Bureau", to work directly in SASAC to strengthen the monitoring of top managers against malfeasance and corruption. Similar organizations are established at the local level SASAC offices accordingly.

At the same time, SASAC required SOEs to establish the "Efficiency Supervision and Monitoring Unit", which is responsible for implementing the policies and regulations of SASAC in order to strengthen the monitoring of operations and transactions in SOEs. This unit is supervised and guided by the "SASAC Discipline Inspection and Supervision Bureau" and "Supervision Bureau". They work together to monitor the SOE to reduce wrongdoings and improve efficiency.

Actions. In accordance with the regulations, SASAC took a series of actions to improve the monitoring on SOEs' operation and transactions, including improving the assessment criteria and index system, dispatching supervisory panels to SOEs regularly and randomly to supervise SOEs' daily operation, more direct participation in formulating the operational budgets and final accounts of SOEs, and helping to establish the "Efficiency Supervision and Monitoring Unit" and work with it to improve SOE performance.

Outcomes. These strong monitoring actions yielded fruitful outcomes. In addition to the examples provided in the paper in Section 2.2, the cases in other provinces and cities also strongly support the monitoring achievement of SASAC wherever we have data. For instance, in *Jiang Shu*, the province-level SASAC investigated 787 cases and punished 93 SOE managers and associated government officials, recovering direct economic losses of 1.5 billion RMB (0.19 billion USD) in 2004. In 2006, the city-level SASAC in *Shen Zhen* investigated 18 cases that violated the law and recovered direct economic losses of 750 million RMB (94 million USD). Overall, the measures taken by SASAC directly strengthened the external monitoring on SOEs.

Table OA1: Main Functions of SASAC

Summary	**Detailed Functions of SASAC**
1. Performs investor's responsibilities	Performs investor's responsibilities, supervises and manages the state-owned assets of the enterprises under the supervision of the central government (excluding financial enterprises), and enhances the management of state-owned assets.
2. Implementable measures to ensure preservation and increment of the value of the state-owned assets	Establishes and improves the index system of the preservation and growth of the value of state-owned assets, and works out assessment criteria; supervises and administers the preservation and growth of the value of the state-owned assets of the supervised enterprises through statistics and auditing; and is responsible for the management work of wages and remuneration of the supervised enterprises and formulates policies regulating the income distribution of the top executives of the supervised enterprises and organizes implementation of the policies.
3. SOE reform and establishment of modern enterprise system	Guides and pushes forward the reform and restructuring of state-owned enterprises, advances the establishment of modern enterprise system in SOEs, improves corporate governance, and propels the strategic adjustment of the layout and structure of the state economy.
4. On top executives of SOE	Appoints and removes the top executives of the supervised enterprises, and evaluates their performances through legal procedures and either grants rewards or inflicts punishments based on their performances; establishes corporate executives selection system in accordance with the requirements of the socialist market economy system and modern enterprise system, and improves incentives and restraints system for corporate management.
5. Dispatches supervisory panels to monitor SOE	In accordance with related regulations, SASAC dispatches supervisory panels to the supervised enterprises on behalf of the state council and takes charge of daily management of the supervisory panels.
6. SOE operational budget, final account, and capital gains	Organizes the supervised enterprises to turn the state-owned capital gains over to the state, participates in formulating management system and methods of the state-owned capital operational budget, and is responsible for working out the state-owned capital operational budget and final account and their implementation in accordance with related regulations.
7. Ensures SOEs to obey laws and safety production	Urges the supervised enterprises to carry out the guiding principles, policies, related laws and regulations and standards for safety production and inspects the results in accordance with the responsibilities as investor.
8. Draft laws, regulations, and rules	Responsible for the fundamental management of the state-owned assets of enterprises, works out draft laws and regulations on the management of the state-owned assets, establishes related rules and regulations and directs and supervises the management work of local state-owned assets according to law.
9. Other tasks	Undertakes other tasks assigned by the State Council.

Source: Official website of the State Asset Supervision and Administration Commission of the State Council, the People's Republic of China.

B Effective Material Services

Our empirical structural model captures the effect of material quality through the input-output quality linkage. However, the material quality may also have an impact by augmenting the effective services provided by materials. That is, higher quality material may provide more material services, which contributes more to production. This section considers an alternative model with both the input-output quality linkage and the effective material services effect. We show that this alternative model is equivalent to our model (with only input-output quality linkage) for the purpose of this study. In particular, the alternative model generates the same estimates of quality-adjusted material prices and productivity as in the main model. It only affects the interpretation of the estimates of the quality-inclusive material prices. That is, if there are both input-output quality linkage and the effective material services effect, the quality-inclusive material input price ($\tilde{p}_{Mjt}$) estimated in our main model is a price measure that is adjusted by the effective material services effect.

Setup and Assumptions. We consider the following generalized production function:

$$\tilde{Q}_{jt} = \tilde{\Omega}_{jt} F(L_{jt}, M_{jt}, K_{jt}) \quad = \quad \tilde{\Omega}_{jt} \left[\alpha_L L_{jt}^{\gamma} + \alpha_M M_{jt}^{\gamma} + \alpha_K K_{jt}^{\gamma} \right]^{\frac{1}{\gamma}}, \tag{28}$$

where the effective *material services* $M_{jt} = \Psi(H_{jt}) M_{0jt}$. So M_{0jt} physical units of material quantity of quality H_{jt} can provide M_{jt} units of material services. Thus the new production function allows input quality to have an impact through the input-output quality linkage via $\tilde{\Omega}_{jt}$ and the effective material services effect via $\Psi(H_{jt})$. If $\Psi(H_{jt}) = 1$, then this new production function degenerates to that in our main model exactly.

Assume that the unit price of *material services* is

$$\tilde{P}_{Mjt} = P_{Mjt} H_{jt}, \tag{29}$$

which is the same as as the pricing equation (5) in our main model. The expenditure to purchase $M_{jt} = \Psi(H_{jt}) M_{0jt}$ units of material services, or equivalently M_{0jt} units of material, is $E_{Mjt} = \tilde{P}_{Mjt} M_{jt}$ by definition. Thus, Eq. (29) implies that the unit price of physical material is $\tilde{P}_{0Mjt} = \frac{E_{Mjt}}{M_{0jt}} = \frac{(P_{Mjt} H_{jt}) M_{jt}}{M_{jt}/\Psi(H_{jt})} = P_{Mjt} \Psi(H_{jt}) H_{jt}$. Intuitively, the impact of quality on the unit price of physical material captures both the effective material service effect via $\Psi(H_{jt})$ and the input-output quality linkage via H_{jt}.

All other model components remain the same as in our main model, including demand function, firm capability $\tilde{\Omega}_{jt}$, and the evolution processes of productivity and material price, as specified in Eq. (1), (3), (4), and (6), respectively.

After observing its capital stock, productivity, quality-adjusted input prices (P_{Mjt}), and wage rate (P_{Ljt}), each firm maximizes its profit by choosing the quantity of labor and material, material quality, and output:

$$\pi(P_{Mjt}, \omega_{jt}, K_{jt}, P_{Ljt}) = \max_{L_{jt}, M_{0jt}, \tilde{Q}_{jt}, H_{jt}} \quad P_{jt}\tilde{Q}_{jt} - \tilde{P}_{0Mjt}M_{0jt} - P_{L_{jt}}L_{jt}, \quad \text{subject to:} \quad (1),\ (28) \text{ and } (29). \tag{30}$$

Note that here the firm chooses the material quantity M_{0jt} to maximize its profit. However, if $\Psi(H_{jt}) = 1$, then this maximization problem degenerates to that in our main model.

Equivalence Result. We can show that this alternative model is equivalent to our main model empirically for our purpose, by rewriting everything in the units of material services (M_{jt}) instead of material quantity (M_{0jt}).

First, it is straightforward that, when defined in the units of material services M_{jt} (instead of M_{0jt}), the production function in Eq. (28) is identical to that in the main model (Eq. (2)).

Second, in the units of material services (M_{jt}), the pricing function (29) is equivalent to that in our main model (Eq. (5)). Note that the price $\tilde{P}_{Mjt}$ in Eq. (29) is still quality-inclusive, because it does not adjust for the input-output quality linkage although it has accounted for effective material service effect.

As a result, in terms of material services (M_{jt}), the optimization problem defined in Eq. (30) is equivalent to Eq. (7) in our main model, except that now M_{jt} should be interpreted as the effective material services and $\tilde{P}_{Mjt}$ represents the price of the effective material services. Everything else in the main model holds exactly, including the first order conditions and the resulting estimation equations.

In sum, if the true model has both input-output quality linkages and effective material services effect, our main model with only input-output quality linkages still generates the same estimates of the quality-adjusted input prices (p_{Mjt}) and productivity (ω_{jt}), which are our main focus. All parameter estimates remain the same too. It only affects how we interpret the quality-inclusive material prices ($\tilde{p}_{Mjt}$) in our model. That is, if there are both input-output quality linkage and the effective material services effect, the quality-inclusive material input price ($\tilde{p}_{Mjt}$) estimated in our main model is a price measure that is adjusted by the effective material services effect.

C A Model of External Monitoring and Firm Performance

We describe a stylized theoretical model to demonstrate the mechanism through which the strength of external monitoring can create a specific type of distortion, by influencing a firm's input prices and productivity. We discuss broader possibilities of distortions and frictions faced by manufacturing firms and their implications to our econometric model in the end of this Appendix.

In the theoretical model, a firm makes two layers of decisions sequentially: first by a top manager and then by a production unit. The top manager chooses her efforts, which determine input prices and productivity. Then, observing the input prices and productivity, the production unit chooses quantities of labor and material to maximize firm profit. The top manager is self-interested and her choices are made to maximize her own payoff: her share of the firm profit (performance payment)[35] plus the kickback in material procurement, net of the costs of exerting the effort and the expected punishment for taking kickbacks, which depend on the strength of external monitoring.

Specifically, the top manager chooses two types of effort: procurement effort (e_M) and productivity effort (e_ω). Higher procurement effort helps the top manager to bargain for a better (lower) price for material inputs, which increases firm profits and thus increases her performance payment. Meanwhile, the top manager may take a kickback in the procurement, as a percentage (x) of the procurement value. If the manager bargains hard (exerting a high level of e_M) for lower input prices, she would get a lower kickback rate. That is, x is a function of e_M and $\partial x/\partial e_M < 0$). The manager may be caught and subject to punishment due to taking a kickback. It is natural to assume that the expected punishment for taking a kickback, $c(x(e_M), \theta)$, increases strictly in external monitoring strength θ and endogenous kickback rate x. At the same time, the productivity effort, e_ω, represents the effort the top manager exerts to improve production efficiency, by way of promoting firm culture or workers' morale. It directly affects the firm productivity. We assume that productivity (ω) increases in e_ω: $\partial\omega/\partial e_\omega > 0$. Both of these efforts incur the usual effort costs: $C_M(e_M)$ for procurement effort and $C_\omega(e_\omega)$ for productivity effort.[36]

Given the effort levels exerted by the top manager (thus p_M and ω), firm profit maximized by the production unit is denoted as $\pi(p_M(e_M), \omega(e_\omega))$, as will be discussed in Eq. (7) in Section 3.2, and the

[35] This includes the immediate payoff to the manager if the firm performs well, or future payoff in the broader forms of, for example, better career path etc. For easy reference, we simply call it performance payoff.

[36] To illustrate the idea, we assume that external monitoring incurs punishment only on procurement corruption, but not on shirking in productivity effort. This assumption is reasonable for two reasons. First, in practice it is much more difficult to detect and punish productivity shirking than procurement corruption. Second, the simplified model yields the same qualitative prediction on the impact of external monitoring on input prices and productivity, compared with an augmented model that also allows for punishment for productivity shirking.

associated expenditure on material input as $E_M(p_M(e_M), \omega(e_\omega))$.[37] The top manager's maximization problem is thus as follows:

$$\max_{\{e_M, e_\omega\}} \Pi(e_M, e_\omega) - C_M(e_M) - C_\omega(e_\omega) - C(e_M, \theta), \tag{31}$$

where the total payoff to the top manager from the performance payment and kickback is written as $\Pi(e_M, e_\omega) \equiv \pi(p_M(e_M), \omega(e_\omega)) + x(e_M)E_M(p_M(e_M), \omega(e_\omega))$,[38] and $C(e_M, \theta) \equiv c(x(e_M), \theta)$ is the expected punishment to the top manager for taking a kickback. We assume $\Pi''_{e_M e_M} < 0$, $\Pi''_{e_\omega e_\omega} < 0$ and $\Pi''_{e_M e_\omega} > 0$. That is, the total payoff function for the top manager has decreasing marginal returns to efforts and the two types of effort are complementary to promote the total payoff. We assume the effort cost functions as well as the corruption punishment function are convex with respective to the exerted effort: $C''_M > 0$, $C''_\omega > 0$, and $C''_{e_M e_M} > 0$. Importantly, we further assume $C''_{\theta e_M} < 0$. This is reasonable, because when external monitoring is stronger (i.e., larger θ), the marginal expected punishment is larger for lower e_M (thus higher corruption level x). Under these assumptions, we have the following proposition:

Proposition 1 (Impact of External Monitoring) *Stronger external monitoring increases both material procurement and productivity efforts, resulting in lower material input prices and higher productivity.*

Proof. To fix this idea, we focus on interior solution under regularity conditions, and assume all functions are differentiable up to second order whenever necessary.

The first-order conditions associated with the top manager's optimization problem (31) are:

$$e_M: \quad \Pi'_{e_M} - C'_M(e_M) - C'_{e_M}(e_M, \theta) = 0, \tag{32}$$

$$e_\omega: \quad \Pi'_{e_\omega} - C'_\omega(e_\omega) = 0. \tag{33}$$

Taking total differentiation of the first-order condition associated with e_ω with respect to θ yields

$$\Pi''_{e_M e_\omega} \frac{\partial e_M}{\partial \theta} + \left[\Pi''_{e_\omega e_\omega} - C''_\omega(e_\omega)\right] \frac{\partial e_\omega}{\partial \theta} = 0 \tag{34}$$

Given the assumptions on the total payoff function and the effort cost functions, we have $\Pi''_{e_M e_\omega} > 0$

[37] To highlight the impact of external monitoring, we ignore other determinants of profit for now.

[38] To simplify the notation, we normalize the profit and cost functions by the profit share parameter in the performance payment to the top manager, so that firm profit share to the top manager now is 1 after normalization.

and $\Pi''_{e_\omega e_\omega} - C''_\omega(e_\omega) < 0$ in Equation (34). As a result, we have

$$\text{sign}(\frac{\partial e_M}{\partial \theta}) = \text{sign}(\frac{\partial e_\omega}{\partial \theta}) \tag{35}$$

Similarly, taking total differentiation of the first-order condition associated with e_M with respect to θ, we have

$$\Pi''_{e_M e_\omega} \frac{\partial e_\omega}{\partial \theta} + \left[\Pi''_{e_M e_M} - C''_M(e_M) - C''_{e_M e_M}(e_M, \theta)\right] \frac{\partial e_M}{\partial \theta} \quad = \quad C''_{\theta e_M}(e_M, \theta). \tag{36}$$

Solving out $\frac{\partial e_\omega}{\partial \theta}$ from Equation (34) and replacing it in the above equation lead to

$$\left\{ \frac{\Pi''_{e_M e_\omega} \Pi''_{e_M e_\omega}}{\left[\Pi''_{e_\omega e_\omega} - C''_\omega(e_\omega)\right]} + \left[\Pi''_{e_M e_M} - C''_M(e_M) - C''_{e_M e_M}(e_M, \theta)\right] \right\} \frac{\partial e_M}{\partial \theta} \quad = \quad C''_{\theta e_M}(e_M, \theta). \tag{37}$$

Since we have assumed $C''_{\theta e_M}(e_M, \theta) < 0$ and the term in the bracket on the left hand side is also negative. As a result, we have

$$\frac{\partial e_M}{\partial \theta} > 0.$$

Because $\text{sign}(\frac{\partial e_M}{\partial \theta}) = \text{sign}(\frac{\partial e_\omega}{\partial \theta})$ as shown above in Equation (35), we also have $\frac{\partial e_\omega}{\partial \theta} > 0$.

Because material prices decrease in procurement effort and productivity increases in productivity effort, firms facing stronger external monitoring on their management naturally have lower material prices and higher productivity. ■

The intuition is straightforward. Stronger external monitoring increases the expected punishment to corruption, which incentivizes the top manager to reduce procurement corruption (i.e., by increasing procurement effort). Although the external monitoring does not have a *direct* impact on productivity effort, it has an *indirect* impact: the complementarity between procurement and productivity efforts incentivizes the manager to increase productivity effort, as a response to the increased procurement effort induced by stronger external monitoring. As a result, both efforts are higher when external monitoring is stronger, and consequently, the firm pays lower material prices and has higher productivity.

Three predictions directly follow from Proposition 1. First, because SOEs faces lower external monitoring than non-SOEs, Proposition 1 implies that SOEs pay higher input prices and have lower productivity:

Conjecture 1 (SOE vs. non-SOE) *SOEs pay higher input price and have lower productivity compared with non-SOEs, other things being equal.*

Second, the establishment of SASAC directly improved the external monitoring on SOEs (but not on private firms), so we expect that SASAC has a positive impact on SOE performance in terms of productivity and input prices, relative to non-SOEs:

Conjecture 2 (SASAC Effect) *The establishment of SASAC reduced material input prices and increased productivity of SOEs, other things being equal.*

Moreover, if external monitoring does have an impact on SOE performance, then higher monitoring costs, which increase the difficulty of monitoring and thus reduce monitoring strength, serve as a barrier for SOE performance:

Conjecture 3 (Monitoring Costs and SOE Performance) *Higher monitoring costs reduce SOE performance, through the input prices and productivity channels, other things being equal.*

Discussion. This stylized theoretical model is one of possible ways to characterize the mechanism through which the strength of external monitoring can create distortions in individual firm's input prices and productivity. We emphasize that, conditional on input prices and productivity, the *production unit* of the firm makes optimal production decisions. However, *at the firm level*, such conditional-optimal decisions may not be optimal generally, due to the distortions in input prices and productivity within the firm and frictions in the market.

Bearing this spirit, our econometric model in Section 3.2 allows for potential distortions in capital, productivity, input prices, and wage rates across firms. This feature is important for the purpose of this study, because SOEs and non-SOEs (or even firms within each group generally) may differ substantially in their capital stock, productivity, and ability/incentive to secure better input prices. For example, SOEs may have better access to the financial market, leading to lower capital costs of SOEs relative to non-SOEs; some firms (SOEs or non-SOEs) may pay higher wage rates than other firms due to different reasons; firms facing different external monitoring strength, as the main focus discussed in this section, may differ substantially in their input prices and productivity. In the paper, we further discuss the detailed advantages of our econometric approach in Section 3.2.2 and show that its limitations are unlikely to affect our analysis.

D Flexible Labor Choice Assumption

The methodology to estimate productivity and input prices requires that the *production unit* of each firm chooses labor and material quantity to maximize profit, given firm productivity, input prices, and capital. Similar assumptions are commonly employed in a broad set of applications in related literature (e.g., Katayama et al., 2009; Epple et al., 2010; Gandhi et al., 2016; De Loecker, 2011; De Loecker and Warzynski, 2012; Zhang, 2016; Doraszelski and Jaumandreu, 2013). This Appendix provides evidence to show that this assumption is reasonable in the context of China during the sample period.

While flexible material choice is well accepted, the assumption of flexible labor choice is more controversial, especially in the United States and European countries with strong labor unions and high hiring/firing costs. In China, however, this is not an unrealistic assumption for several reasons. First, generally there is a lack of effectively-enforced laws and regulations to protect workers in China. This was especially true during the period (1998-2007) under consideration. An initial labor law, effective January 1995 (ended by the end of 2007) contained vague provisions for the protection of workers, but released enterprises from the original restrictions and served to promote business freedom. As a result, the labor market in China is significantly less restrictive than the United States and European economies.[39] Second, the labor market in China is very competitive due to the high volume of labor supply, which favors firms. Third, labor unions in China are very weak, and in most cases they are controlled by firms rather than workers. These factors together result in much lower hiring and firing costs and labor is much more flexible in China than in United States and European countries where labor protection laws, regulations, and unions are much stronger. Even for SOEs, after waves of incremental reforms and restructuring from the late 1970s to the mid-1990s, the responsibility for output decisions was shifted from the state to firms, and firms were allowed to retain more of their profits (e.g., Groves et al., 1994; Li, 1997; Xu, 2011). As a result, the profit objectives of SOEs and non-SOEs have been more aligned than ever. So we assume that the production units of both SOEs and non-SOEs optimally choose labor and material inputs, given their possibly distorted productivity, capital, and input prices.

E Limited Impact of Labor Friction on Our Results

In estimating input prices and productivity, we assume that labor is a flexible input for both SOEs and non-SOEs. Appendix D provided evidence to show that this assumption is reasonable in the context of China during the sample period. However, if this assumption does not hold and labor flexibility in SOEs and non-SOEs changes over time, how would it affect our estimates of input prices and productivity and, more importantly, our regression results regarding the effect of external monitoring? Although we emphasize (in Online Appendix E.4 below) that the timeline of SOE reforms suggests that labor friction is unlikely to drive our main results, we answer the question theoretically and empirically in

[39] Using scores of different countries on the Employment Protection legislation indicator developed by the OECD to gauge the strictness of labor laws, Allard and Garot (2010) show that during 1994 to 2007 the labor market in China was fairly deregulated: it was significantly less restrictive than the United State and protective European economies.

this appendix. Theoretically, we explicitly show how labor inflexibility/friction may bias our estimates of input prices and productivity. Empirically and more importantly, we show that the impact of this bias is negligible on our main results in the application. Finally, as an alternative method of addressing this issue, we adopt the idea in Hsieh and Song (2015) to use labor share as a proxy for labor friction and control for it in regressions, and we show that our results are robust. .

E.1 Theoretical Consideration

Using a theoretical model, we explicitly show how labor friction may bias our estimates of input prices and productivity, and more importantly, why the bias can be small in magnitude.

There are different ways to model labor friction. Hsieh and Song (2015) model labor friction as overhead/redundant labor; Berkowitz et al. (2017) model it as an outcome of political pressure (i.e., an objective of SOEs beyond profit). In this subsection, we consider the situation in Hsieh and Song (2015) to demonstrate our key idea, but the result carries over to the case considered by Berkowitz et al. (2017) where SOEs hire more labor because of their objective of labor employment (in addition to the profit objective). Thus, an important implication is that our results from this section can also address the potential issue that SOEs have different objectives or face political pressure compare with non-SOEs.

Specifically, we consider a version of the production function (2) with redundant labor f_{jt}:

$$\tilde{Q}_{jt} = \tilde{\Omega}_{jt} \left[\alpha_L (L_{jt} - f_{jt})^{\gamma} + \alpha_M M_{jt}^{\gamma} + \alpha_K K_{jt}^{\gamma} \right]^{\frac{1}{\gamma}}, \tag{38}$$

That is, only $L_{jt} - f_{jt}$ out of total labor L_{jt} is effective in production. f_{jt} represents the redundant workers who produce zero marginal product but cannot be fired because of labor friction. f_{jt} can vary across firms and over time and, for the demonstration purpose, we assume that it is exogenously given for each firm.[40] The redundant workers receive the same wage rate as other workers. The rest of the setup is the same as in Section 3.2.1.

By defining the effective labor as $L^*_{jt} = L_{jt} - f_{jt}$ and substituting it into the production function, we have a similar profit maximization problem as in (7). The firm maximizes its profit by choosing

[40] One way to model how f_{jt} can be endogenous chosen is to assume that firms face political pressure to hire excess labor. That is, hiring excess labor is a part of the firm's objective function. This is the case considered by Berkowitz et al. (2017). The predictions in this section carry over to this case.

effective labor quantity, the quantity and quality of material inputs, and output:

$$\max_{L^*_{jt},M_{jt},\tilde{Q}_{jt},H_{jt}} \quad P_{jt}\tilde{Q}_{jt} - \tilde{P}_{Mjt}M_{jt} - P_{L_{jt}}L^*_{jt} - P_{L_{jt}}f_{jt},$$
$$\text{subject to:} \quad (1),\ (38) \text{ and } (5). \tag{39}$$

Compared with (7), the firm's problem is to choose L^*_{jt} (the effective labor) rather than L_{jt} (the total labor). Because f_{jt} is sunk, it does not influence the optimal decision of other variables (i.e., $L^*_{jt}, M_{jt}, \tilde{Q}_{jt}, H_{jt}$). As a result, the first-order conditions are the same as that in our main model, except that they should be evaluated at the effective labor. This is intuitive: with redundant labor creating a wedge, the marginal product of labor evaluated at the total labor is no longer equal to the marginal cost of labor (i.e., wage rate) at optimum.

Thus, to make our estimation procedure work, we should evaluate the marginal product of labor at the effective labor (i.e., $L^*_{jt} = L_{jt} - f_{jt}$) in the first-order conditions. Therefore, all the inferred measures carry to the model with redundant labor, with L_{jt} replaced by L^*_{jt}. Here we write these measures (12), (13), (18), and (19) in the Appendix of the paper explicitly to show how they are related to labor:

$$\ln \tilde{P}_{Mjt} = A + (1 - \frac{1}{\gamma})\ln E_{Mjt} + \frac{1}{\gamma}\ln P_{Ljt} - (1 - \frac{1}{\gamma})\ln L^*_{jt}, \tag{40}$$

$$\ln \tilde{\Omega}_{jt} = B + [1 - \frac{1}{\gamma}(1 + \frac{1}{\eta})]\ln\left(\frac{E_{Mjt}}{\sigma^*_{Mjt}}\right) + \frac{1}{\gamma}(1 + \frac{1}{\eta})\ln P_{Ljt} + (1 + \frac{1}{\eta})(\frac{1}{\gamma} - 1)\ln L^*_{jt}, \tag{41}$$

$$p_{Mjt} = C + \frac{1}{\eta\gamma}\ln\left(\frac{E_{Mjt}}{P_{Ljt}}\right) + [1 - \frac{1}{\gamma}(1 + \frac{1}{\eta}) - \frac{1}{\theta}]\ln \sigma^*_{Mjt} + \frac{1}{\eta}(1 - \frac{1}{\gamma})\ln L^*_{jt}, \tag{42}$$

$$\omega_{jt} = \ln \tilde{\Omega}_{jt} - \frac{1}{\theta}\ln\left[\frac{1}{1 - \sigma^*_{Mjt}}\right], \tag{43}$$

where $A = \frac{1}{\gamma}\ln\left[\frac{\alpha_M}{\alpha_L}\right]$, $B = \ln\frac{\eta}{1+\eta} - \frac{1}{\gamma}(1 + \frac{1}{\eta})\ln\alpha_L$, $C = \ln\frac{\eta}{1+\eta} + \frac{1}{\eta\gamma}\ln\alpha_L + \frac{1}{\gamma}\ln\alpha_M$, and σ^*_{Mjt} is the output elasticity of material input evaluated at L^*_{jt} and the resulting material quantity.

Ignoring labor friction in the production estimation means using the total labor L_{jt} (and its implied σ_{Mjt}) rather than effective labor L^*_{jt} (and its implied σ^*_{Mjt}) . Intuitively, this overstates the labor input and consequently understates the inferred material quantity input (because of the substitution across inputs). As a result, given the observed material expenditure, this produces an upward bias in the quality-inclusive material price ($\tilde{P}_{Mjt}$). Mathematically, according to (40), this upward bias can be seen from $L^*_{jt} < L_{jt}$ and $0 < \gamma < 1$ (implied by the estimates in Tables OA5 and OA6 of the appendix in the paper). Because material quantity (M_{jt}) is underestimated and so is the output elasticity of material σ_{Mjt} (this is straightforward from the definition of σ_{Mjt} given $\gamma > 0$), the firm capability $\tilde{\Omega}_{jt}$ is overestimated (i.e., using less material but producing the same observed output). This can be seen from (41), given $(1+\frac{1}{\eta})(\frac{1}{\gamma}-1)>0$ and $1-\frac{1}{\gamma}(1+\frac{1}{\eta})>0$ as implied by the estimates in Tables OA5 and OA6.

The impact on the quality-adjusted input price p_{Mjt} and productivity ω_{jt} is slightly more subtle, but the magnitude of the impact can be small. Intuitively, the inferred p_{Mjt} is the difference between the quality-inclusive material price ($\tilde{P}_{Mjt}$) and material quality. Note that material quality choice depends on productivity ω_{jt} (i.e., (17)), thus it can be partially controlled by $\tilde{\Omega}_{jt}$. Since both $\tilde{P}_{Mjt}$ and $\tilde{\Omega}_{jt}$ are overestimated, their impact on p_{Mjt} offset, leaving the direction of the bias in p_{Mjt} indecisive and small. Mathematically, according to (42), the upward bias force comes from $\frac{1}{\eta}(1-\frac{1}{\gamma})\ln(L_{jt})$ because $\frac{1}{\eta}(1-\frac{1}{\gamma})>0$; the downward bias force comes from $[1-\frac{1}{\gamma}(1+\frac{1}{\eta})-\frac{1}{\theta}]\ln(\sigma_{Mjt})$ because $[1-\frac{1}{\gamma}(1+\frac{1}{\eta})-\frac{1}{\theta}]>0$ and σ_{Mjt} is underestimated. Thus, p_{Mjt} can be either overestimated or underestimated, depending on which force dominates. Similarly, according to (43), productivity (ω_{jt}) is essentially firm capability $\tilde{\Omega}_{jt}$ after controlling for output elasticity of material (σ_{Mjt}). The overestimated $\tilde{\Omega}_{jt}$ and underestimated σ_{Mjt} (note that $\theta<0$ in our estimation results) partially offset each other's bias and leave the bias in ω_{jt} indecisive and small.

Of course, the theoretical analysis only considers the bias caused by variables (i.e., using total labor versus effective labor), keeping the parameters of the production and demand functions unchanged. In practice, the parameter estimates will also be biased, and the overall impact is a combination of both. In the following subsection, we show that empirically the overall impact is small and it is unlikely that labor friction is driving our main results in the application.

E.2 Empirical Validation

A direct implication from the above subsection is that differences in labor flexibility between SOEs and non-SOEs may produce gaps in the estimates of input prices and productivity. For this reason, we do not explain the gaps between the two groups of firms as a casual result of monitoring differences. Instead, in the paper, we use variations in the time and spacial dimensions to identify the effect of monitoring. So if the labor friction differences between SOEs and non-SOEs do exist but are unchanged over time, then such differences will be canceled in our Difference-in-Difference design. However, SOEs' labor flexibility may have improved more over time relative to non-SOEs. Even if this is the case, we show in this subsection that ignoring such change has negligible impact on main results in the application.

To see this, we conduct empirical exercises to quantify the sensitivity of our results to labor friction: how different our regression results would be if we observe the amount of redundant labor (and thus effective labor) and take it into account in the estimation. Specifically, suppose the redundant labor of each SOE in the pre-SASAC period is 5 percent more than that in the post-SASAC period. To take this into account, in our new estimation procedure, we reduce the number of workers (and thus labor expenditure) of each SOE in pre-SASAC periods by 5 percent (while keeping everything else unchanged) and estimate the entire structural model (to obtain new parameter estimates as well as input price and productivity measures) and the monitoring effect.

Note that the choice of the three levels of redundant labor is reasonable because Hsieh and Song (2015, footnote 20, page 329) point out that *"according to a survey conducted by the Chinese Academy of Social Science in 1995, the narrowly defined redundant workers – that is, those who are idle and have no definite position – accounted for more than 10 percent of total employment in about half of the state-owned firms"*. Because the majority cut of redundant labor happened before 2000 in the national movement of layoff redundant SOEs workers, the redundant labor in our data period (especially after 2000) should be much smaller. Moreover, it is unlikely that SOEs completely removed all their labor frictions in a few years after 2003, the actual decline in redundant labor of SOEs should be even smaller. That said, we still experimented with 2.5 and 10 percents of redundant workers, and the results are similar and are explained as follows.

Table OA2: Exercises: Gauge the Impact of Potential Labor Friction in SOEs

	Difference between SOEs and non-SOEs					
	Before SASAC				Difference: before and after SASAC	
	$\ln \tilde{P}_M$	$\ln \tilde{\Omega}$	p_M	ω	p_M	ω
Data (ignore redundant)	1.320	0.951	0.043	-0.323	-0.076	0.296
2.5% redundant	1.284	0.920	0.047	-0.325	-0.077	0.300
5% redundant	1.251	0.891	0.053	-0.324	-0.078	0.301
10% redundant	1.174	0.825	0.062	-0.323	-0.083	0.306

Table OA2 compares the estimated productivity and input prices in the data (the first row) and those from the hypothetical scenarios with different level of redundant labor in SOEs before SASAC (the last three rows). For each scenario, the differences between SOEs and non-SOEs are reported in terms of mean productivity and input prices. As predicted in Online Appendix E.1 and reported in the first two columns of the table, both of the quality-inclusive input prices and productivity are overestimated if labor friction is ignored. Notably, columns 3 shows that p_{Mjt} is underestimated (but the difference is small), suggesting that the downward bias force dominates slightly; column 4 shows that ω_{jt} from different scenarios are almost the same, meaning that the upward and downward forces of bias almost completely offset. The last two columns of the table shows the "Difference-in-Difference" result: they report the difference of the gaps between SOEs and non-SOEs before and after SASAC. These results

Table OA3: Results after Accounting for Labor Friction (Redundant Labor)

	2.5% redundant labor		5% redundant labor		10% redundant labor	
	input price	productivity	input price	productivity	input price	productivity
SOE	0.065***	-0.200***	0.067***	-0.205***	0.070***	-0.216***
	(0.001)	(0.007)	(0.001)	(0.007)	(0.001)	(0.007)
SASAC*SOE	-0.021***	0.100***	-0.022***	0.105***	-0.026***	0.115***
	(0.002)	(0.010)	(0.002)	(0.009)	(0.002)	(0.009)
SOE*Dist	0.003***	-0.007***	0.003***	-0.007***	0.003***	-0.006***
	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)
SASAC*SOE*Dist	-0.005***	0.003	-0.005***	0.003	-0.005***	0.003
	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)
SASAC*Dist	YES	YES	YES	YES	YES	YES
Dist	YES	YES	YES	YES	YES	YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	392900	392900	392900	392900	392900	392900
Adjusted R^2	0.970	0.966	0.970	0.967	0.970	0.966

Standard errors (clustered at the firm level) are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

imply that the monitoring effect of SASAC in our regressions would be more significant if labor friction is explicitly accounted for.

To verify this is true, in Table OA3, we report the regression results after allowing for different level of labor friction explicitly in our estimation. Each block of the table presents the regression results for the scenario where there is a certain percent of redundant labor and it is taken into account in the estimation. Overall, the results are quantitatively and qualitatively similar to our baseline results of Table 5 in the paper. As expected from the above analysis, the results after controlling for the redundant workers show slightly larger effects of external monitoring, suggesting our baseline results are robust to the potential labor friction issue and the actual external monitoring effect might be larger if labor friction is observed and explicitly accounted for.

E.3 Controlling for Labor Friction using Proxy

An alternative method of addressing the issue is to use proxy to control for the unobserved labor friction. The idea is drawn from Hsieh and Song (2015, Equation 18, page 329): labor friction is positively associated with labor share. Following this idea, we control for labor share in all regressions as a proxy for labor friction. The results, as reported in Table OA4, show that our results are robust.

The aggregate-level analysis in Hsieh and Song (2015) also support that our estimated SASAC effect is

Table OA4: Robustness Check: Control for Labor Friction (using Labor Share)

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.082***	0.066***	-0.268***	-0.216***	-0.182***	-0.143***
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.030***	-0.012***	0.071***	0.046***	0.073***	0.025***
	(0.001)	(0.002)	(0.004)	(0.009)	(0.004)	(0.008)
SOE*Dist		0.004***		-0.008***		-0.006***
		(0.000)		(0.002)		(0.001)
SASAC*SOE*Dist		-0.004***		0.002		0.012***
		(0.001)		(0.003)		(0.002)
Labor Friction*SOE	YES	YES	YES	YES	YES	YES
Labor Friction	YES	YES	YES	YES	YES	YES
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	392900	873414	392900	873414	392900
Adjusted R^2	0.750	0.779	0.640	0.668	0.327	0.339

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

not driven by the changes in labor friction. Using the same data, Hsieh and Song (2015, Figure 11, page 330) show that labor friction (including its difference between SOEs and non-SOEs) changed smoothly at the aggregate level. This is in contrast to the sharp improvement of SOEs in term of all three key measure as shown in Figure 5 in our paper. This suggests that our results regarding external monitoring are not simply driven by the change of SOEs' labor friction.

E.4 Arguments from SOE Reform Timeline

As extra arguments, we emphasize that the timeline of SOE reforms suggests that labor friction (i.e., redundant workers) is unlikely to drive our main results. As discussed in Naughton (2006), there was a large wave of layoffs of excess SOE workers in 1990s, with about over 2 million SOE workers being laid off. The peak of the layoff happened during 1998-2000. So the redundant labor is less a problem after 2000. Also, in 1996, over 6000 SOEs went to bankruptcy – this is more than the total number of all bankrupted SOEs in the previous nine years.[41] Surviving SOEs had much improved situation regarding labor flexibility during our data period (1998-2007). Our robust results based on the subsample using the surviving SOEs (i.e., excluding privatized SOEs) support that labor friction is not driving our main results.

[41]Source in Chinese: http://news.163.com/special/reviews/reformation01.html

F Input Prices Reflected by Material/Labor Expenditure Ratio

Our method of estimation described in Section 3.2.2 is a structural approach to infer key measures from observable data. In particular, input prices (both the quality-inclusive and quality-adjusted measures) are essentially inferred from the ratio of material to labor expenditure (adjusted for wage rate and other variables). In this section, we show how the changes in inferred input prices are associated with the patterns of material and labor expenditure ratio in the raw data. This suggests that although the inferred measures are from a structural model, they are firmly data-based and indeed reflect important patterns of the raw data .

To see this, note that the inferred quality-inclusive input price, (12) in the appendix of the paper, depends on the material to labor expenditure ratio (E_{Mjt}/E_{Ljt}):

$$\ln \tilde{P}_{Mjt} \quad = \quad \frac{1}{\gamma}\ln\left(\frac{\alpha_M}{\alpha_L}\right) + (1-\frac{1}{\gamma})\ln\left(\frac{E_{Mjt}}{E_{Ljt}}\right) + \ln P_{Ljt}, \tag{44}$$

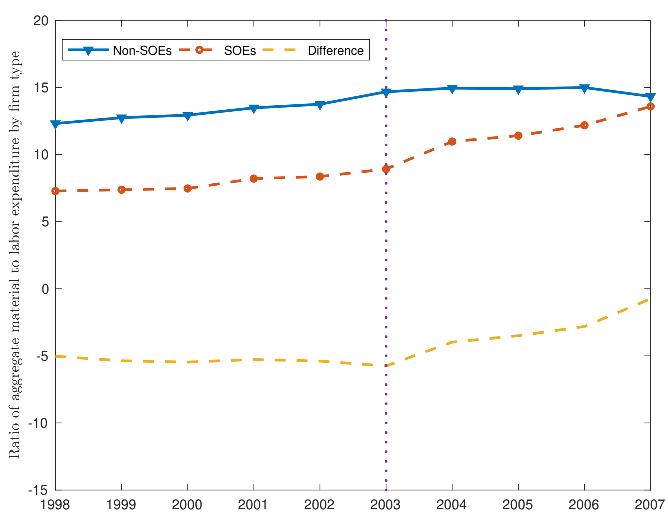
The quality-adjusted input price, (19), also depends on the material to labor expenditure ratio,

$$p_{Mjt} \quad = \quad C + \frac{1}{\eta\gamma}\ln\left(\frac{E_{Mjt}}{E_{Ljt}}\right) + [1-\frac{1}{\gamma}(1+\frac{1}{\eta}) - \frac{1}{\theta}]\ln(\sigma_{Mjt}) + \frac{1}{\eta}\ln(L_{jt}), \tag{45}$$

$$\tag{46}$$

where $C = \ln\frac{\eta}{1+\eta} + \frac{1}{\eta\gamma}\ln\alpha_L + \frac{1}{\gamma}\ln\alpha_M$. Note that our estimated parameters show that $(1-\frac{1}{\gamma}) < 0$ and $\frac{1}{\eta\gamma} < 0$. Hence, an increase in the material to labor expenditure ratio implies a decrease in input prices (conditional on all other variables).

Figure OA1: Material to labor expenditure ratio, by group



In Figure OA1, we show patterns of the aggregate material to labor expenditure ratio for SOEs and non-SOEs. The ratio increases over time for both SOEs and non-SOEs, rationalizing the decreasing input prices in our estimation results. The ratio is lower for SOEs than that of non-SOEs, suggesting SOEs use relatively higher input prices, as we have documented. Importantly, the gap of the ratio significantly shrunk immediately after 2003, which is in sharp contrast to the steady gap before 2003. The majority of the change is due to the rising ratio of SOEs rather than the dropping ratio of non-SOEs. This is consistent with the change of the gap in our estimated input prices (as suggestive evidence of SASAC's impact) in Figure 5 in the paper. Overall, the comparison suggest that the input prices are firmly data-based and indeed reflect important patterns of the raw data, although they are estimated from a structural model.

G Alternative Explanations and Robustness

Although the establishment of SASAC was the main and largest policy shocks regarding SOE during the data period, it was accompanied by several other contemporaneous policy measures which may confound our estimation results. This subsection provides evidence that our results are not driven by these policy measures.

G.1 Privatization and Internal Incentive/Monitoring

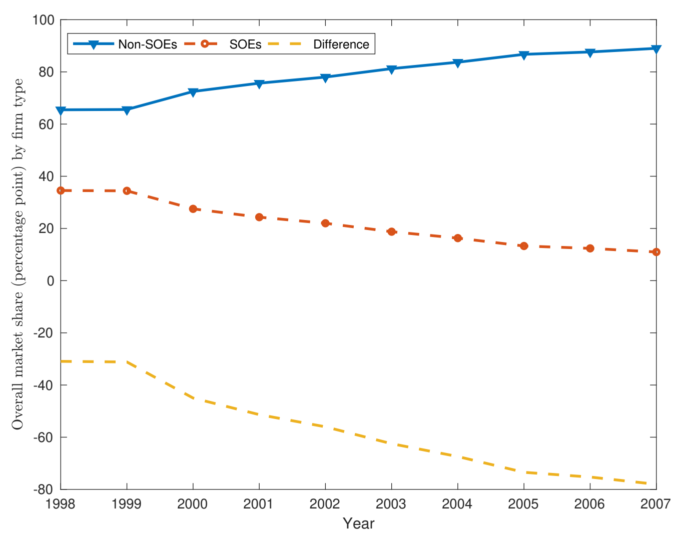
Privatization comes with not only improved monitoring and corporate governance, but also radical changes in many other aspects that potentially have an impact on both productivity and input prices. Given that many firms were privatized during the data period, it is a valid concern that the estimated impact of SASAC might be contaminated or even driven by privatization. In addition, as discussed in Section 2, the central government formed ten guidelines for SOE reform and development in the Fourth Plenary Sessions of 15th Central Committee of the Communist Party in September 1999. These guidelines emphasized the integration of privatization, monitoring, market competition, and establishment of modern enterprise system to improve SOE performance. These policies might have improved the internal monitoring and incentive due to improved corporate governance, contributing to reduced input prices and increased productivity over time.

To rule out this possibility, we drop all observations that involve a change in ownership status during the data period. The remaining sample, as a result, contains all observations that are always SOEs or always non-SOEs from its first to the last year in the sample. Estimation results using this subsample would be free from the privatization concern. We report the results in Table OA7. All the main results are robust. In particular, SOEs still underperform in terms of both input prices and productivity compared with non-SOEs, consistent with the baseline results. SASAC reduces the input prices of SOEs by 4.6 percent and improves their productivity by 13.9 percent, relative to non-SOEs. Both estimates are very close to the baseline results in Table 3. The monitoring costs also play a similar role as in the baseline results. These findings confirm that the estimated impact of SASAC on SOEs is unlikely to be driven by privatization.

G.2 Market Power/Competition

The reduction of entry barrier in many industries before 2002 may changed the market power of SOEs, which might well contribute to the change of input prices and (revenue) productivity. If SOEs' market power in the product and input markets increased over time, our estimated SASAC effect could be confounded. To address this issue, we have already controlled for firm size in all baseline regressions. As robustness checks, we carefully secure our results from the potential changes in market power in the following four aspects. First, we show that the results are robust in Table OA8 after controlling

Figure OA2: Overall market shares, by group



for domestic market structure, as captured by the industry-year specific Herfindahl-Hirschman Index (HHI). Second, we include firm-level market share and its interaction with the SOE dummy to capture any potential extra benefits to SOEs (relative to non-SOEs) arising from market power. We also include SOEs' aggregate market share at the industry-city level and its interactions with a SOE dummy in the regressions to capture any potential extra benefits to SOEs (relative to non-SOEs) due to their privileges of being a part of the local SOE cluster. The estimation results in Table OA9 are quantitatively similar to our baseline results. Third, we follow Hsieh and Song (2015) to define non-pillar industries,[42] which are less likely to be associated with "State Capitalism" (i.e., Chinese government sought to maintain the dominance of SOEs). In Table OA11, our main results are robust in the non-pillar industries, suggesting that the monitoring effect is unlikely to be driven by State Capitalism.[43] Finally, in fact, Chinese SOEs faced increasing competition (and thus their market power reduced) over the time period of our consideration in almost all industries. In particular, Hsieh and Song (2015) shows that this is the case even for pillar industries.[44] Consistently, across all industries under consideration, we show in Figure OA2 that the overall SOE market share decreased from around 35 percent in 1998 to less than 10 percent in 2007, while the market share of non-SOEs increased significantly. Importantly, the smooth evolution is in contrast to the sharp change of the estimated input prices and productivity in Figure 5 of the paper. These evidence suggests that changing market power is unlikely to drive our results.

G.3 Restructuring

Chinese SOEs experienced a significant wave of restructuring led by the policy "grasp the large and let go of the small" (Hsieh and Song, 2015). This policy was first formally announced in 1995 at the Fifth Plenum of the Fourteenth Party Congress,[45] with some experiments before that and the first batch of 55 industrial groups being established in 1991. The policy was strengthened in 1997 with another 63 industrial groups being allowed to be established, and further enhanced in 1999 in the Fourth Plenum of the Fifteenth Party Congress. The three years (1997-1999) marked the peak of the reform, with relatively smooth improvement afterwards. The timing and relatively smooth progress after 2000 contrast to the radical improvement of SOE performance in 2004 as shown in Figure 5 of the paper, suggesting that our estimated effect of SASAC is unlikely to be driven by restructuring.

Empirically, because "let go of the small" means to privatize small, less performing SOEs, the result using the subsample that excludes privatized firms in Table OA7 suggests that the monitoring effect is not driven by the effect of "let go of the small". We provide further evidence in the following three

[42] Hsieh and Song (2015) (in their Table 6, page 337) define pillar industries as industries of energy (extraction/processing of petroleum, electric and heat power), metal (ferrous and nonferrous), chemical, transport equipment, and communication equipment. Other industries are defined as non-pillar industries.

[43] Interestingly, the interaction term of SASAC, SOE, and local (industry-city) SOE market share is insignificant, further suggesting that there is little "State Capitalism" (working as changing market power) in the non-pillar industries over time.

[44] (Hsieh and Song, 2015, page 336): *"although the goal of the Chinese government was to restrict entry by private firms in the strategic or pillar industries, private firms have actually entered in many of the industries where the state has sought to maintain the dominance of state-owned firms."* They show that although SOEs have a dominant share (measured as value-added share), the state's share has shrunk over 1998-2007 in almost all pillar industries (and the the decline in non-pillar industries is even more dramatic).

[45] Refer to the "Proposals on Formulating the Ninth Five-Year Plan for National Economic and Social Development and the Vision of 2010".

aspects to show that "grasp the large" does not drive the monitoring effect either. First, the "grasp the large" policy aimed to restructure 1000 large SOEs into larger industrial groups. Although we do not have the detailed list of restructured firms, we do know the revenue threshold of restructuring firms is 500 million RMB (equivalent to 63 million USD in 2000). We identify 1251 SOEs with revenue over this threshold and drop them in the regressions, and we show that the monitoring effect is robust in Table OA10. Second, restructuring was less likely to happen in non-pillar industries. We follow Hsieh and Song (2015) (in their Table 6, page 337) to define non-pillar industries as industries other than energy (extraction/processing of petroleum, electric and heat power), metal (ferrous and nonferrous), chemical, transport equipment, and communication equipment. We show in Table OA11 that the SASAC effect is significant in non-pillar industries. Third, SOEs that are associated with central, provincial, and city level governments are monitored by SASAC at different tiers, respectively. In Table OA12, we shows that the SASAC has largest effect on city-level SOEs, while the effect is smaller in central and province-level SOEs, which were more likely to undergo restructuring. This result is robust after controlling for market share of individual firms as a proxy for market power. This further supports that restructuring ("grasp the large" in particular) is not driving the results of monitoring.

G.4 Change of Privileges

Another possible factor that may drive our result is the privilege of SOEs endowed by the government of China. If the strength of political connections between SOEs and government is increasing over time, then such connections may fortify the privilege of SOEs in input and output markets and enable them to have lower input prices and higher (revenue-based) productivity. If this is true, the result might be contaminated. However, this is unlikely to be the case for several reasons. First, such an increase in privilege, if any, must have happened exactly the same time as the establishment of SASAC (2004 as the cutoff year) to explain the striking jumps presented in Figure 5. This would be a strong coincidence, considering SASAC was designated to enhance the monitoring and supervision of SOEs, which might have decreased (rather than increased) SOEs' privilege. Second, even if there was indeed a sharp increase in SOEs' privilege exactly at the time when SASAC was established, it is more likely the privilege would be given to SOEs closer to the government, which would enlarge the difference between close-by SOEs and remote SOEs after SASAC. Consequently, $\beta_{SASAC*SOE*Dist}$ would be positive for input price and negative for productivity if this is true, which contradicts the findings. Finally, SOEs' privilege may actually have decreased on average over time. For instance, the average of subsidy-to-output ratio decreased from 1.24 percent (pre-SASAC) to 1.15 percent (post-SASAC) for SOEs; in contrast, the ratio for non-SOEs increased from 0.28 percent (pre-SASAC) to 0.31 percent (post-SASAC). Overall, increased privilege of SOEs, if any, alone cannot explain the patterns we have documented.

G.5 Reduction of Labor Friction

The potentially differential labor friction between SOEs and non-SOEs may produce gaps in their estimated input prices and productivity. For this reason, we do not explain the gaps between the two groups of firms as a casual result of monitoring differences. Instead, we use differences in the time and spacial dimensions to identify the effect of monitoring. If the labor flexibility differences exist but they are unchanged over time, then they will not affect our main results in the application in the Difference-in-Difference design. Thus, the issue boils down to how the potential reduction of SOEs' labor friction (relative to non-SOE) affect our estimates of input prices and productivity and, consequently, our regression results regarding the monitoring effect. We address this issue in four aspects. First, we theoretically show how labor friction could affect our estimates of input prices and productivity. Second and more importantly, we empirically show that the impact caused by ignoring the changes in labor friction is negligible quantitatively in our application. Third, following the idea of Hsieh and Song (2015, Equation 18, page 329), we use labor share as a proxy for labor friction and control for it in all regressions, and our results are robust. Finally, the timeline of SOE reforms also suggests that labor friction is unlikely to drive our main results. Refer to Online Appendix E for more details.

G.6 Potential Differential Pre-trend

To ensure further that the results are not driven by the differential pre-trend (especially for productivity), we design a two-step approach to remove the potential pre-trend and re-estimate the regression specifications. In the first step, we estimate the pre-trend of the dependent variables (input prices, productivity, and TFP) for SOEs and non-SOEs, separately using data in and before 2002, by including a time trend together with firm characteristics and a series of industry and time dummies in each regression. Then we construct the detrended dependent variables by subtracting from the original measures (input prices, productivity, and TFP) their pre-trend estimates *for all years*. Under the assumption that the pre-trend does not change after SASAC, this treatment removes the differential pre-trend between SOEs and non-SOEs. In the second step, we estimate regression specifications using the detrended dependent variables. The estimation results are reported in Table OA13. Again, all the main results are very similar to the baseline results in Tables 3 and 5. In particular, SOEs on average pay 6.9 percent more for input prices and have 23.1 percent lower productivity compared with non-SOEs before SASAC. SOEs with higher monitoring costs, as proxied by the distance to their oversight governments, have higher input prices with elasticity 0.003, and lower productivity with elasticity -0.007. The coefficient on the interaction term, $SASAC * SOE * DIST$, is almost the same as that reported in the baseline results as well. The coefficients on $SASAC * SOE$, although quantitatively smaller, are of the same sign and order of magnitude as the baseline results. In total, this suggests that the main results are not driven by the pre-trends of the two firm groups.

G.7 Balanced Panel

A potential concern is that the results might be driven by change in the composition of firms due to entry and exit in the data period. Indeed, entrants and exiters may be different from incumbents in input prices and productivity, and there were substantial entries and exits during the data period.[46] To address this concern, we run the regression specifications using a balanced panel, by dropping all firms that entered or exited during the data period. The estimation results are reported in Table OA14. In general, the results are consistent with the main results. SOEs pay higher input prices and have lower productivity relative to non-SOEs. Before SASAC, on average SOEs' input prices are 5.4 percent higher and productivity is 16 percent lower, both of which are at similar orders of magnitude as that estimated in the main results (i.e., 7.6 and 23.9 percent respectively) in Table 3. We also find that SASAC reduces the input price and productivity gaps between SOEs and non-SOEs substantially, by 3.0 and 10.8 percentage points, respectively. The results are again very close to the main results (3.9 and 12.6 percentage points, respectively) in Table 3. The impact of monitoring costs on firm performance is similar to the main results as well. Firms with larger external monitoring costs have higher input prices and lower productivity. The establishment of SASAC in general had a larger impact on SOEs with larger oversight distance, consistent with the main results. The results based on the traditional TFP measure are also quantitatively similar to the main results. In sum, these findings suggest that our main results are not driven by the firm entry and exit during the data period.

G.8 World Trade Organization

China joined WTO at the end of 2001. In principle, this might have had an impact on all firms in China—for example, firms were able to access a larger variety of material inputs by importing directly

[46]The data set we use surveys private firms with annual sales above five million RMB (about six hundred thousand USD) and all SOEs. We define entrant and exiting as a firm enters or exits the dataset. This definition does not necessarily imply actual entry/exit of firms.

or purchasing from middlemen, and thus input prices could be lowered. In all of the regressions we controlled for year dummies, so the WTO effect (if common to all firms) is controlled in the analysis. Still, it is possible that the WTO membership might have had different impacts on SOEs and non-SOEs. If WTO has a larger impact on SOEs than non-SOEs in productivity and input prices, then the estimated impact of SASAC on SOE performance might be contaminated by the differential WTO effect. To examine this possibility, we estimate an extended specification by adding $WTO_t * SOE_{jt}$ to (22) and (25). If WTO has any heterogeneous impact on SOEs and non-SOEs, this additional term would pick it up. We report the estimation results in Table OA15. All the main results are robust to this additional control. The large gap in input prices and productivity between SOEs and non-SOEs remains, and the magnitude is very close to the baseline results in Tables 3 and 5. The establishment of SASAC improves SOEs' productivity and input prices, relative to non-SOEs. The magnitude of the improvement is also close to the baseline results. In addition, the monitoring costs play a similar role as in the baseline analysis.

As for the WTO effect, we do find that WTO improves the productivity of SOEs more than non-SOEs. An explanation for this effect is the increased competition after WTO, forcing SOEs, which performed worse before WTO, to improve efficiency more. But the impact of WTO on SOEs is much smaller than that of SASAC, by about one-third. Meanwhile, we find a significant but small impact of WTO on SOEs' input prices relative to non-SOEs. Compared with non-SOEs, WTO reduces SOEs' input prices by 1.0 percent on average, which is less than one-third of the impact of SASAC (3.3 percent). This small WTO impact again might be driven by the intensified competition following WTO, which forces SOEs to secure lower prices in material procurement but at a very limited magnitude. This finding confirms the result that strengthened external monitoring following SASAC had major impacts on input prices and productivity after 2004.

G.9 Alternative Definition of SOE

In the main results, following Huang et al. (forthcoming) and many others, we define a firm as an SOE if its share of state ownership exceeds 30 percent. Alternatively, an SOE can be defined based on the firm's registered ownership type. In our main analysis, we choose not to use this way to define SOEs because it is very noisy—some former SOEs do not change their registered ownership type after ownership restructuring. An alternative is to combine the information on state share and registered ownership type. Following Hsieh and Song (2015), we define a firm as an SOE if its state share is over 50 percent or it is registered as controlled by the state. Hsieh and Song (2015) show that the revenue share and number of SOEs calculated using this definition are very close to those reported in the *China Statistical Yearbook*. We estimate regression specifications using this definition and find that the results are very robust, as reported in Table OA16.

G.10 Transition Period of SASAC

In our analysis, we use 2004 as the cutoff year to define the impact of SASAC: all observations in and after 2004 are considered as being treated by SASAC. However, the establishment of SASAC took some time. Although the central government-level SASAC was established in March 2003, many of its policies and regulations were formed and announced latter in the same year. Meanwhile, province-level SASACs were established during the period between March 2003 and early 2004. Two questions emerge: (1) were firms affected by SASAC in 2003? and (2) were there other factors, such as transition costs that affected firm performance during the transition year (2003)? We check the robustness of our results to these two questions by estimating the regression specifications using a subsample after dropping the observations in the transition year (2003). The results are reported in Table OA17. All the main results of our interest are very close to those in the baseline specification. Quantitatively, the estimates of the impact of SASAC re slightly larger than those in the baseline. For example, after dropping the transition year, SASAC reduces SOEs' input prices by 4.2 percent and increase productivity by 13.8 percent. These values are slightly larger than those in the baseline (3.9 and 12.6 percent). These findings are reasonable, because if SASAC already had some impact during the transition year 2003, then dropping the observations in that year would naturally increase the estimated effect of SASAC.

G.11 Importing and Exporting

As is well-documented in the literature, importing and exporting may have positive impacts on productivity. Grieco et al. (2019) document that importers may have advantages in input prices. If Chinese firms were expanding imports and exports over time, then the estimate of the effect of SASAC would pick up the impact of the increased importing and exporting. To address this potential problem, we further control for lagged import and export dummies in the estimation of (22) and (25), and report the results in Table OA18.[47] We find that all the main parameters of interest are very similar to the baseline results, qualitatively and quantitatively, showing that the results are robust to controlling for importing and exporting.

[47]The firm-level trade participation information is from the records of imports and exports from Chinese Customs. We have access to the data from 2000 to 2006 (rather than from 1998 to 2007). As a result, the number of observations is smaller than the previous ones.

G.12 Firm Fixed Effects

In the main results, we have controlled for a series of dummies (including province, industry, and year) and firms' registration affiliation type in all the regressions. We think that is enough to control for cross-section fixed effects, because conditional on the same industry, province, year, and registration affiliation type, the unobserved/uncontrolled heterogeneity across individual firms should be small. Given that we further controlled for a set of firm-level characteristics such as firm age, size, and capital intensity, we believe the baseline results are soundly based.

Nonetheless, to ensure further the results are robustness to firm fixed effects, we estimate two fixed effects specifications using data containing all the observations without privatized firms:

$$Y_{jt} = \beta_{soe*SASAC}\left(SOE_{jt} * SASAC_t\right) + \beta_z Z_{jt} + \lambda_f + \lambda_t + \varepsilon_{jt}. \quad (47)$$

$$\begin{aligned} Y_{jt} = {} & \beta_{soe*SASAC}\left(SOE_{jt} * SASAC_t\right) + \beta_{SASAC*Dist}\left(SASAC_t * *Dist_{jt}\right) \\ & + \beta_{soe*SASAC*Dist}\left(SOE_{jt} * SASAC_t * Dist_{jt}\right) + \beta_z Z_{jt} + \lambda_f + \lambda_t + \varepsilon_{jt}, \end{aligned} \quad (48)$$

where λ_f captures the firm-level fixed effect. Compared with the main regression in (22), we have dropped the SOE_{jt} term, province fixed effects, industry fixed effects, oversight distance, and the interaction $Dist_{jt} * SOE_{jt}$, because by definition there is no variation in these terms after controlling for firm fixed effects. Moreover, because the full panel dataset is unbalanced, with an average firm tenure of 3.63 years only, the estimates of the fixed-effects model naturally would have a high standard deviation. To avoid this issue, in the regressions we only keep firms that were included in the data for at least five years. This yields a smaller sample of 467,274 observations.

We report the results in Table OA19. In general, the results are consistent with the main results. In all the regressions, we find a negative and significant effect of SASAC on input prices paid by SOEs and a positive and significant effect on productivity, relative to non-SOEs. The quantitative impacts are of similar orders of magnitude compared with the baseline results in Table 3. The role of monitoring costs is also qualitatively similar to our main results in Table 5. Overall, the main results are robust when firm fixed effects are included.

Table OA5: Production Function and Evolution Processes Estimates

Parameter	Agri. Prod.	Food	Textile	Apparel	Leather	Timber	Paper	Printing	Cultural	Chemical
η	-5.894	-6.156	-8.132	-8.888	-8.560	-6.430	-7.922	-7.560	-9.373	-6.684
	(0.034)	(0.064)	(0.050)	(0.089)	(0.112)	(0.065)	(0.089)	(0.106)	(0.176)	(0.039)
σ	1.210	1.440	1.555	1.815	2.382	1.669	1.445	2.643	2.059	1.555
	(0.015)	(0.039)	(0.022)	(0.046)	(0.102)	(0.060)	(0.028)	(0.135)	(0.108)	(0.019)
α_L	0.042	0.076	0.077	0.126	0.100	0.074	0.067	0.122	0.117	0.058
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
α_M	0.920	0.886	0.892	0.843	0.873	0.900	0.891	0.836	0.853	0.905
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
α_K	0.038	0.038	0.032	0.031	0.027	0.026	0.042	0.042	0.030	0.037
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
$\frac{1}{1-\theta}$	0.167	0.290	0.351	0.430	0.558	0.423	0.294	0.571	0.504	0.342
	(0.001)	(0.003)	(0.001)	(0.001)	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
f_0	3.353	1.238	1.434	1.042	0.765	1.676	1.418	0.295	0.823	1.370
	(0.048)	(0.032)	(0.018)	(0.017)	(0.020)	(0.036)	(0.035)	(0.015)	(0.024)	(0.020)
f_{soe}	-0.199	-0.160	-0.069	-0.114	-0.208	-0.090	-0.092	-0.044	-0.102	-0.062
	(0.008)	(0.010)	(0.008)	(0.015)	(0.024)	(0.021)	(0.011)	(0.007)	(0.027)	(0.006)
f_{SASAC}	0.230	0.184	0.177	0.165	0.194	0.332	0.196	0.090	0.152	0.197
	(0.006)	(0.007)	(0.004)	(0.005)	(0.008)	(0.011)	(0.006)	(0.006)	(0.008)	(0.004)
f_1	0.702	0.782	0.656	0.616	0.672	0.555	0.716	0.886	0.647	0.722
	(0.004)	(0.006)	(0.004)	(0.006)	(0.008)	(0.009)	(0.007)	(0.006)	(0.011)	(0.004)
g_0	0.049	-0.038	-0.025	-0.042	-0.059	-0.103	-0.012	-0.038	-0.037	-0.034
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.005)	(0.001)	(0.003)	(0.003)	(0.001)
g_{soe}	0.033	0.027	0.012	0.011	0.021	0.037	0.013	0.014	0.023	0.016
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)
g_{SASAC}	-0.027	-0.019	-0.007	-0.005	-0.012	-0.022	-0.009	-0.009	-0.006	-0.014
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
g_1	0.934	0.955	0.953	0.935	0.940	0.909	0.967	0.973	0.954	0.968
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.005)	(0.002)	(0.002)	(0.004)	(0.001)
#Obs	105955	42308	156914	87878	44174	35809	53812	36528	24505	133420

Table OA6: Production Function Evolution Processes Estimates (continued)

Parameter	Medical	Rubber	Plastic	Machinery	Transp.	Telecom.	Measuring	Waste	Energy
η	-6.020	-7.253	-8.387	-7.449	-8.147	-8.844	-7.966	-7.102	-6.842
	(0.079)	(0.111)	(0.080)	(0.048)	(0.084)	(0.112)	(0.151)	(0.136)	(0.121)
σ	1.280	2.704	1.606	1.990	1.671	1.463	1.405	1.998	2.555
	(0.027)	(0.193)	(0.025)	(0.046)	(0.032)	(0.018)	(0.032)	(0.131)	(0.041)
α_L	0.081	0.088	0.071	0.089	0.093	0.090	0.110	0.086	0.154
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
α_M	0.860	0.883	0.886	0.880	0.863	0.852	0.832	0.891	0.722
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
α_K	0.058	0.029	0.044	0.031	0.044	0.058	0.058	0.023	0.124
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$\frac{1}{1-\theta}$	0.208	0.567	0.363	0.484	0.386	0.304	0.280	0.537	0.563
	(0.002)	(0.004)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.006)	(0.001)
f_0	1.478	0.640	1.222	0.781	0.605	0.747	0.895	1.158	0.192
	(0.041)	(0.025)	(0.022)	(0.013)	(0.015)	(0.019)	(0.030)	(0.047)	(0.009)
f_{soe}	-0.056	-0.064	-0.099	-0.034	-0.027	-0.038	-0.055	-0.122	-0.005
	(0.009)	(0.016)	(0.011)	(0.007)	(0.006)	(0.008)	(0.010)	(0.032)	(0.005)
f_{SASAC}	0.108	0.167	0.186	0.158	0.113	0.158	0.105	0.366	0.030
	(0.007)	(0.008)	(0.005)	(0.004)	(0.005)	(0.005)	(0.007)	(0.021)	(0.005)
f_1	0.792	0.762	0.680	0.743	0.833	0.818	0.793	0.584	0.961
	(0.006)	(0.010)	(0.006)	(0.004)	(0.005)	(0.005)	(0.007)	(0.015)	(0.004)
g_0	-0.021	-0.041	-0.024	-0.044	-0.025	-0.010	-0.014	-0.090	-0.027
	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.009)	(0.003)
g_{soe}	0.016	0.011	0.017	0.019	0.013	0.012	0.011	0.037	-0.005
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)	(0.001)
g_{SASAC}	-0.012	-0.018	-0.010	-0.010	-0.007	-0.007	-0.009	-0.029	-0.006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)
g_1	0.951	0.973	0.952	0.970	0.980	0.991	0.958	0.912	0.992
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.008)	(0.002)
#Obs	36614	21574	85589	136895	81922	71614	32750	13051	41107

Table OA7: Robustness Check: Firms with no Privatization

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.102***	0.082***	-0.327***	-0.267***	-0.261***	-0.230***
	(0.001)	(0.002)	(0.005)	(0.009)	(0.004)	(0.007)
SASAC*SOE	-0.046***	-0.022***	0.139***	0.119***	0.115***	0.049***
	(0.001)	(0.003)	(0.006)	(0.012)	(0.005)	(0.010)
SOE*Dist		0.005***		-0.010***		-0.004*
		(0.001)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.006***		0.002		0.019***
		(0.001)		(0.003)		(0.003)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	776413	314870	776413	314870	776413	314870
Adjusted R^2	0.966	0.969	0.966	0.966	0.729	0.707

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA8: Robustness Check: Control for Competition in Domestic Market

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.076***	0.064***	-0.239***	-0.196***	-0.191***	-0.165***
	(0.001)	(0.001)	(0.003)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.039***	-0.019***	0.125***	0.095***	0.094***	0.035***
	(0.001)	(0.002)	(0.004)	(0.010)	(0.004)	(0.008)
SOE*Dist		0.003***		-0.007***		-0.004**
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.003		0.015***
		(0.001)		(0.003)		(0.002)
HHI	-0.002***	-0.002***	0.029***	0.020***	0.009***	0.009***
	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873367	392854	873367	392854	873367	392854
Adjusted R^2	0.967	0.970	0.966	0.966	0.726	0.708

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA9: Robustness Check: Control for Market Share

	(1) input price	(2) productivity	(3) TFP	(4) input price	(5) productivity	(6) TFP
SOE	0.067***	-0.230***	-0.175***	0.071***	-0.239***	-0.188***
	(0.002)	(0.007)	(0.006)	(0.002)	(0.007)	(0.006)
SASAC*SOE	-0.010***	0.041***	0.013	-0.011***	0.043***	0.017**
	(0.002)	(0.010)	(0.008)	(0.002)	(0.010)	(0.008)
SOE*Dist	0.003***	-0.007***	-0.004**	0.003***	-0.006***	-0.003**
	(0.000)	(0.002)	(0.002)	(0.000)	(0.002)	(0.002)
SASAC*SOE*Dist	-0.005***	0.003	0.015***	-0.005***	0.003	0.015***
	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)
MktSh * SOE	0.009	0.082	0.028	0.028	-0.004	-0.028
	(0.049)	(0.085)	(0.117)	(0.049)	(0.084)	(0.117)
Local SOE MktSh * SOE				-0.015***	0.032***	0.045***
				(0.001)	(0.006)	(0.005)
Local SOE MktSh				YES	YES	YES
MktSh	YES	YES	YES	YES	YES	YES
SASAC*Dist	YES	YES	YES	YES	YES	YES
Dist	YES	YES	YES	YES	YES	YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	392900	392900	392900	392900	392900	392900
Adjusted R^2	0.768	0.660	0.240	0.768	0.661	0.241

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA10: Drop Large (Potentially Restructured) SOEs

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.074***	0.070***	-0.260***	-0.230***	-0.191***	-0.182***
	(0.002)	(0.001)	(0.009)	(0.007)	(0.005)	(0.005)
SASAC*SOE	-0.015***	-0.011***	0.077***	0.043***	0.029***	0.016**
	(0.003)	(0.002)	(0.013)	(0.010)	(0.008)	(0.008)
SOE*Dist	0.004***	0.003***	-0.013***	-0.008***	-0.003*	-0.003*
	(0.001)	(0.000)	(0.002)	(0.002)	(0.001)	(0.002)
SASAC*SOE*Dist	-0.006***	-0.004***	0.007*	0.002	0.013***	0.014***
	(0.001)	(0.001)	(0.004)	(0.003)	(0.002)	(0.002)
SASAC*Dist	YES	YES	YES	YES	YES	YES
Dist	YES	YES	YES	YES	YES	YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity		YES		YES		YES
Observations	533860	386798	533860	386798	533860	386798
Adjusted R^2	0.521	0.736	0.262	0.651	0.135	0.203

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA11: SASAC and SOE performance: Non-pillar Industries

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.095***	0.081***	-0.342***	-0.250***	-0.198***	-0.171***
	(0.003)	(0.002)	(0.009)	(0.005)	(0.005)	(0.004)
SASAC*SOE	-0.040***	-0.018***	0.141***	0.037***	0.073***	0.037***
	(0.002)	(0.002)	(0.009)	(0.007)	(0.005)	(0.006)
SASAC*SOE*Local MktSh	-0.001	-0.001	0.007	0.019	-0.009	-0.003
	(0.005)	(0.003)	(0.020)	(0.015)	(0.011)	(0.011)
Local MktSh Interactions	YES	YES	YES	YES	YES	YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity		YES		YES		YES
Observations	880769	268938	880769	268938	880769	268938
Adjusted R^2	0.496	0.733	0.254	0.643	0.142	0.209

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA12: SASAC and SOE Performance: Tiered Structure

	(1) input price	(2) productivity	(3) TFP	(4) input price	(5) productivity	(6) TFP
City SOE	0.072***	-0.121**	-0.195***	0.081***	-0.147***	-0.214***
	(0.011)	(0.049)	(0.040)	(0.011)	(0.049)	(0.040)
Provincial SOE	-0.032***	0.031***	0.092***	-0.046***	0.041***	0.122***
	(0.002)	(0.009)	(0.008)	(0.002)	(0.011)	(0.009)
Central SOE	-0.040***	0.113***	0.089***	-0.054***	0.156***	0.127***
	(0.003)	(0.013)	(0.012)	(0.004)	(0.017)	(0.017)
SASAC*City SOE				-0.033***	0.085***	0.073***
				(0.001)	(0.005)	(0.004)
SASAC*Provincial SOE				0.036***	-0.045***	-0.071***
				(0.003)	(0.014)	(0.012)
SASAC*Central SOE				0.032***	-0.105***	-0.077***
				(0.005)	(0.020)	(0.021)
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	873414	873414	873414	873414	873414
Adjusted R^2	0.717	0.630	0.206	0.718	0.630	0.207

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA13: Robustness Check: Control for Potential Pre-trend

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.082***	0.069***	-0.275***	-0.231***	-0.205***	-0.179***
	(0.001)	(0.001)	(0.003)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.031***	-0.011***	0.072***	0.040***	0.073***	0.013
	(0.001)	(0.002)	(0.004)	(0.010)	(0.004)	(0.008)
SOE*Dist		0.003***		-0.007***		-0.004**
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.003		0.015***
		(0.001)		(0.003)		(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	392900	873414	392900	873414	392900
Adjusted R^2	0.717	0.759	0.629	0.659	0.203	0.223

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA14: Robustness Check: Balanced Panel

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.054***	0.040***	-0.160***	-0.104***	-0.132***	-0.099***
	(0.002)	(0.003)	(0.008)	(0.014)	(0.006)	(0.010)
SASAC*SOE	-0.030***	-0.015***	0.108***	0.053***	0.090***	0.038***
	(0.002)	(0.004)	(0.008)	(0.017)	(0.007)	(0.013)
SOE*Dist		0.004***		-0.017***		-0.008***
		(0.001)		(0.004)		(0.003)
SASAC*SOE*Dist		-0.004***		0.016***		0.017***
		(0.001)		(0.005)		(0.004)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	133902	84825	133902	84825	133902	84825
Adjusted R^2	0.972	0.974	0.967	0.967	0.810	0.810

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA15: Robustness Check: Control for WTO Effect

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.080***	0.068***	-0.262***	-0.217***	-0.198***	-0.173***
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.033***	-0.012***	0.090***	0.059***	0.084***	0.021**
	(0.001)	(0.002)	(0.005)	(0.010)	(0.004)	(0.008)
SOE*Dist		0.003***		-0.007***		-0.004**
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.004		0.016***
		(0.001)		(0.003)		(0.002)
WTO*SOE	-0.010***	-0.011***	0.060***	0.058***	0.018***	0.022***
	(0.001)	(0.001)	(0.004)	(0.004)	(0.003)	(0.004)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	392900	873414	392900	873414	392900
Adjusted R^2	0.967	0.970	0.966	0.966	0.726	0.708

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA16: Robustness Check: Alternative SOE Defintion by Hsieh and Song (2015)

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.083***	0.068***	-0.270***	-0.216***	-0.212***	-0.179***
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.038***	-0.019***	0.123***	0.102***	0.094***	0.035***
	(0.001)	(0.002)	(0.004)	(0.009)	(0.004)	(0.008)
SOE*Dist		0.004***		-0.011***		-0.006***
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.002		0.016***
		(0.001)		(0.003)		(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	392900	873414	392900	873414	392900
Adjusted R^2	0.967	0.970	0.966	0.967	0.727	0.710

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA17: Robustness Check: Drop Transition Year 2003

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.079***	0.066***	-0.251***	-0.206***	-0.197***	-0.167***
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.006)
SASAC*SOE	-0.042***	-0.020***	0.138***	0.106***	0.097***	0.036***
	(0.001)	(0.002)	(0.005)	(0.010)	(0.004)	(0.008)
SOE*Dist		0.004***		-0.007***		-0.005***
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.003		0.016***
		(0.001)		(0.003)		(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	787430	343274	787430	343274	787430	343274
Adjusted R^2	0.967	0.970	0.966	0.966	0.725	0.707

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA18: Robustness Check: Control for Import and Export

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.073***	0.063***	-0.231***	-0.188***	-0.183***	-0.161***
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.006)
SASAC*SOE	-0.031***	-0.013***	0.109***	0.082***	0.073***	0.021**
	(0.001)	(0.002)	(0.004)	(0.010)	(0.004)	(0.009)
SOE*Dist		0.003***		-0.007***		-0.002
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.004***		0.002		0.013***
		(0.001)		(0.003)		(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Lag IMP & EXP	YES	YES	YES	YES	YES	YES
Observations	649795	301626	649795	301626	649795	301626
Adjusted R^2	0.967	0.970	0.966	0.966	0.725	0.709

Standard errors are in parentheses.

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA19: Robustness Check: Firm Fixed Effects

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SASAC*SOE	-0.020***	-0.007***	0.146***	0.115***	0.055***	-0.006
	(0.001)	(0.002)	(0.005)	(0.011)	(0.006)	(0.011)
SASAC*SOE*Dist		-0.004***		0.001		0.022***
		(0.001)		(0.003)		(0.003)
SASAC*Dist		-0.002***		0.004**		0.004***
		(0.000)		(0.002)		(0.001)
Size	YES	YES	YES	YES	YES	YES
R&D,K-intensity	YES	YES	YES	YES	YES	YES
Observations	467274	216457	467274	216457	467274	216457
Adjusted R^2	0.483	0.451	0.688	0.671	0.042	0.033

Standard errors are in parentheses.

Controled for constant and year fixed effects in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA20: Robustness Check: Further Control for Oversight Distance in the Markov Process of Productivity and Input Prices

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.075***	0.062***	-0.242***	-0.200***	-0.190***	-0.165***
	(0.001)	(0.001)	(0.003)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.039***	-0.018***	0.128***	0.097***	0.095***	0.035***
	(0.001)	(0.002)	(0.004)	(0.010)	(0.004)	(0.008)
SOE*Dist		0.003***		-0.007***		-0.004**
		(0.000)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.004		0.015***
		(0.001)		(0.003)		(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	392900	873414	392900	873414	392900
Adjusted R^2	0.967	0.970	0.965	0.966	0.726	0.708

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table OA21: Robustness Check: Nonparametric Markov Process of Productivity and Input Prices

	(1) input price	(2) input price	(3) productivity	(4) productivity	(5) TFP	(6) TFP
SOE	0.097***	0.083***	-0.155***	-0.122***	-0.190***	-0.165***
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.005)
SASAC*SOE	-0.051***	-0.030***	0.079***	0.055***	0.095***	0.035***
	(0.001)	(0.003)	(0.004)	(0.010)	(0.004)	(0.008)
SOE*Dist		0.003***		-0.004**		-0.004**
		(0.001)		(0.002)		(0.002)
SASAC*SOE*Dist		-0.005***		0.003		0.015***
		(0.001)		(0.003)		(0.002)
SASAC*Dist		YES		YES		YES
Dist		YES		YES		YES
Age, Size	YES	YES	YES	YES	YES	YES
R&D, K-intensity	YES	YES	YES	YES	YES	YES
Observations	873414	392900	873414	392900	873414	392900
Adjusted R^2	0.939	0.940	0.953	0.955	0.726	0.708

Standard errors in parentheses

Added constant and fixed effects of province, year, industry and registration affiliation in all regressions.

* $p < .10$, ** $p < .05$, *** $p < .01$