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# Government subsidies, ownership structure and operating performance of state-owned enterprises: evidence from China

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## ABSTRACT

Government subsidies have been used as a policy tool by many countries. Given the importance of government subsidies in the context of Chinese economy and state-owned enterprises (SOEs), this study seeks to understand the role played by government subsidies in the operating performance of Chinese SOEs. Using panel data on Chinese SOEs to construct the fixed-effects regression models, this study examines the effects of government subsidies and explores the moderating role of ownership structure in the correlation between government subsidies and operating performance of SOEs. Government subsidies have improved the operating performance of SOEs through easing financial constraints and stimulating research investment. However, high proportion of state-owned shares is not conducive to the positive effect of subsidies. The heterogeneous analyzes show, for SOEs located in eastern China, at the local level or with a higher R&D level, an increase in state-owned shares is more detrimental to the positive effect of subsidies on their performance. Tax-based-subsidies have significantly positive effect on the operating performance of SOEs, with the state-owned shares exerting a negative moderating effect on this positive correlation. Based on the empirical findings, we propose some policy suggestions for the mixed ownership reform of Chinese SOEs and reasonable allocation of government subsidies.

## KEYWORDS

Government subsidies; ownership structure; Chinese state-owned enterprises; operating performance

## JEL CLASSIFICATION

D21; G32; H71; L25; L32

## 1. Introduction

An essential element of China's development strategy is engagement of the State in the operation of the economy through SOEs. SOEs may be used to provide public goods and services, correct market failures, and pursue certain social and development strategies. Meanwhile, having SOEs as one of the dominant market participants, the motivation of and the pressures for the reform of Chinese SOEs coexist. In 2015, the Central Committee of the Communist Party of China and the State Council issued the 'Guiding Opinions on Deepening the Reform of State-Owned Enterprises'. The report of the 19th National Congress of the Communist Party of China further emphasized on 'deepening the reform of SOEs and developing the economy with a mixed ownership'. On the one hand, China has been emphasizing the vitality of private capital and promoting mixed ownership reform of SOEs. On the other hand, China has been optimizing government subsidy regime to play the positive

role of subsidies in correcting market failure and providing public goods, while trying to avoid misallocation and low efficiency of state resources.

In existing literature, scholars mainly study the effect of government subsidies or ownership structure on the operating performance of enterprises, respectively. Research findings on the relationship between government subsidies and the operating performance of enterprises are diverse and inconsistent. Some studies suggest that government subsidies promote operating performance of enterprises (Liu 2017; Deng et al. 2019) by easing financial constraints, bringing along reputational benefits (Kleer 2010), and stimulating research and development (R&D) activities (Hewitt-Dundas and Roper 2010; Takalo and Tanayama 2010; Shao and Bao 2012; Czarnitzki and Lopes-Bentoac 2014). Besides, some scholars find that tax-based-subsidies have larger positive effect on the operating performance of enterprises than non-tax-based subsidies (Lee, Walker, and Zeng 2014;)

(Lim, Wang, and Zeng 2018). In contrast, some studies suggest that government subsidies may inhibit the operating performance of enterprises by leading to rent-seeking behaviour, short-sighted, and irrational investment, as well as financial dependence and organizational inertia of enterprises (Yu, Hui, and Pan 2010; Wang, Li, and Xing 2014; Zhao et al. 2015; Yang and Wang 2019). Other research attempts to reconcile these conflicting perspectives, and proposes that the relationship between government subsidies and operating performance of SOEs is curvilinear. (Shao and Bao 2012; Li, Wang, and Xi 2019).

Regarding the ownership structure and operating performance of enterprises, scholars mainly focus on the impact of ownership concentration (Wu and Huang 2011), ownership balance (Chen, Xu, and Ba 2014; Santos, Moreira, and Vieira 2015), and ownership attributes (Xu and Chen 2003; Ruan et al. 2014; Ling, Wang, and Han 2016; Ducassy and Guyot 2017; Hao and Gong 2017; Shen and Yang 2019) on operating performance of enterprises.

Although existing studies have certain value for reference, they rarely adopt a comprehensive framework to both examine the effects of government subsidies and ownership structure on the operating performance of enterprises. The moderating effect of the ownership structure is usually ignored in the study of the correlation between government subsidies and operating performance of enterprises. In particular, due to the special ownership structure of SOEs, they are quite different from private enterprises in terms of factor endowment, governance structure, and operating principles. How does the special ownership structure of SOEs influence the effect of government subsidies? In addition, how can the effect of government subsidies be evaluated based on the heterogeneous characteristics of government subsidies and SOEs?

To answer the above questions, this paper uses the data of Chinese state-owned listed enterprises from 2009 to 2019, and incorporates government subsidies, ownership structure, and operating performance indicators into a unified research framework, to conduct

research mainly in the following aspects: First, we develop a fixed-effects regression model to examine the effect of government subsidies on the operating performance of SOEs. Then, we deal with the possible endogenous problem by applying instrumental variable and 2SLS regressions. Second, we conduct two mechanism tests to examine possible mediating role of financial constraints and R&D investment in the correlation between government subsidies and operating performance of SOEs. Third, we examine the moderating role of ownership structure in the correlation between government subsidies and operating performance of SOEs. Forth, we use alternative government subsidy variables, ownership structure variable and operating performance variables, as well as the dynamic system generalized method of moments (GMM), to check the robustness of above baseline regression results. Fifth, we carry out group regressions in consideration of heterogeneity of SOEs, and examine different effects of tax-based and non-tax-based subsidies.

This paper contributes to the literature in several aspects. First, this paper empirically verifies the positive relationship between government subsidies and operating performance of Chinese SOEs. Second, this paper identifies financial constraints and R&D investment as two mediators in the effect of government subsidies on the operating performance of Chinese SOEs. Third, this paper reveals the negative moderating role of ownership structure in the positive correlation between government subsidies and the operating performance of Chinese SOEs, to provide empirical evidence for promoting mixed ownership reform in China. Forth, this paper conducts heterogeneity analyses in terms of the regional, administrative and innovative characteristics of the subsidized SOEs, and examines the effect of tax-based and non-taxed-based government subsidies.

The remainder of the paper is organized as follows: [Section II](#) proposes research hypotheses. [Section III](#) describes the data and methodology. [Section IV](#) discusses the basic estimation results. [Section V](#) provides further heterogeneity analyses. [Section VI](#) concludes.

## II. Research hypotheses

### *Government subsidies and operating performance of SOEs*

SOEs are more likely to be favoured by government policies due to their inherent political connections. In the Chinese context, the central and local governments grant subsidies to SOEs to pursue both economic and socio-political objectives, such as employment creation, infrastructure provision and environmental protection. Government subsidies may positively affect the operating performance of SOEs in two aspects.

(1) Government subsidies can help SOEs ease financial constraints, thereby enhancing their risk resistance and operating performance. In the Chinese context, the SOEs are expected to help achieve social-political objectives such as the employment provision and social responsibility (Bai, Lu, and Tao 2006; See 2009). For example, the SOEs bear a heavy burden from retirement pensions and other social-welfare costs, such as expenses on housing, medical cares and other daily needs. In the interest of social stability, SOEs also shoulder the responsibility of employment provision, which restrict them to lay off redundant workers (Lin, Cai, and Li 1998; Shleifer 1998). Such social-political burdens spend SOE's capital resources, impair SOEs' profitability and make them more dependent on state resources.

In this regard, government subsidies can help SOEs overcome policy-induced expenditures, acting as a direct funding and a substitute for more expensive financing sources. Furthermore, government subsidies can bring along reputation benefits to the SOEs. Government subsidies may serve as a positive signal, implying that the recipient SOEs have good prospects and less uncertainty since they have government backing. Such positive signal may contribute to a decrease in the recipient SOEs' financing cost (Lim, Wang, and Zeng 2018) and further attract external private financiers (Takalo and Tanayama 2010; Wang, Xie, and Jia 2017; Guo 2018).

(2) Government subsidies can act as a motivation for SOEs to invest in R&D activities. The major rationale for such government subsidies is that enterprises may under-invest in R&D

activities under a free market condition due to the externalities generated by R&D activities or the information asymmetry associated with R&D activities (Hall and Lerner 2010). Therefore, government subsidies can act as a policy tool to respond to such market failures (Xie, Tang, and Lu 2009; Guo, Guo, and Iang 2016). On the one hand, R&D activities of enterprises usually have long duration, large capital needs and uncertain prospects. Government subsidies can help enterprises bear the costs and risks of R&D activities (Lee and Cin 2010; Qu et al. 2017). On the other hand, government subsidies can alleviate the 'free-riders' concern. When enterprises first invest in R&D fields, the spillover of R&D outcomes will make other enterprises as 'free-riders' without bearing the initial R&D costs. In this case, government subsidies could make up for indirect loss caused by knowledge spillover in the process of R&D activities (Gil-Moltó, Poyago-Theotoky, and Zikos 2011). Consequently, increasing R&D investment over time enables enterprises to upgrade their innovative capabilities, technical competence and product complexities, and therefore shaping their unique core competitiveness that is key to the operating performance.

Based on above discussions, we propose research hypothesis H1: The effect of government subsidies on the operating performance of SOEs is positive.

### *The moderating role of ownership structure in the effect of government subsidies*

Ownership structure is regarded as an attribute of corporate governance mechanism. Due to their special ownership structure, SOEs are quite different from private enterprises in terms of factor endowments, governance structure, and operating principles, and thus differ in resource allocation and utilization. The effect of government subsidies on the operating performance of SOEs may vary due to different ownership structures.

- (1) With higher state-owned shares in SOEs, the state-owned shareholders have more determining power to shape corporate strategies that conform to their specific will. On the one hand, state-owned shareholders may have social and political policy goals. The

pursuit of non-economic goals by SOEs may weaken the economic incentive of government subsidies. On the other hand, state-owned shareholders may lack the attribute of 'economic man'. They may be less sensitive to market opportunities and have lower awareness of risk aversion than legal person shareholders. For SOEs with concentrated state ownership, they may lack capability to effectively utilize government subsidies in accordance with profit maximization principle, which would erode the economic efficiency of government subsidies.

- (2) With higher state-owned shares in SOEs, the principal-agent problem will be more obvious (Chan and Rosenbloom 2009; Yang, 2014). First, the separation of ownership and management within SOEs will lead to information asymmetry between the owners and managers, leading to the loss of corporate decision-making efficiency. Second, enterprise managers may lack equity-based incentives if the enterprise is largely state-owned or controlled. The incentive incompatibility would make SOE managers more interested in on-the-job personal gains rather than long-term preservation and appreciation of corporate value. Third, the vacant position of state-owned shareholders in daily operation of SOEs would make it difficult to monitor and discipline over managerial behaviours. Such monitoring gap may give rise to moral hazard, slacks and discretionary power of managers.

Based on above discussions, we propose research hypothesis H2: the state-owned shares have a negative moderating role in the positive correlation between government subsidies and the operating performance of SOEs.

### III. Data and methodology

#### Model design and variable description

This paper starts with examining the direct effect of government subsidies on the operating performance of SOEs. We set up Equation (1) as follows:

$$\begin{aligned}
 Roa_{it} = & \alpha_0 + \alpha_1 Subsidy_{it} + \alpha_2 Debt_{it} \\
 & + \alpha_3 Stockholder_{it} + \alpha_4 Creditor_{it} \\
 & + \alpha_5 Employee_{it} + \alpha_6 Board_{it} \\
 & + \alpha_7 Independence_{it} + \alpha_8 Duality_{it} + \alpha_9 Size_{it} + \lambda_j \\
 & + \lambda_k + \lambda_t + \varepsilon_{it}
 \end{aligned} \tag{1}$$

In Equation (1),  $i$  represents the enterprise,  $j$  represents the industry,  $k$  represents the province,  $t$  represents the year.  $Roa$  represents the ratio of net profit to total assets, indicating the operating performance of the SOE.  $Subsidy$  represents the amount of government subsidies granted to the SOE. By drawing on existing research, we consider the following as control variables: (1)  $Debt$  represents SOE's total debt level; (2)  $Stockholder$  represents SOE's sustainability as the ratio of net profit to paid-in capital; (3)  $Creditor$  represents SOE's solvency as the ratio of cash or equivalents to current liabilities; (4)  $Employee$  represents the human cost as the ratio of cash paid to employees to operating income; (5)  $Board$  represents SOE's board size; (6)  $Independence$  represents SOE's board independence; (7)  $Duality$  represents whether the CEO and chairman of the board is the same person in the SOE; (8)  $Size$  represents SOE's total assets. Besides,  $\lambda_j$ ,  $\lambda_k$  and  $\lambda_t$  are fixed effects of industry, province and year, respectively.  $\varepsilon_{it}$  is random disturbance term.

Further, this paper measures the moderating effect of ownership structure. We add the *State* variable that represents the proportion of state-owned shares in the SOE and the interaction term between the *Subsidy* variable and the *State* variable that can measure the moderating effect of state-owned shares in correlation between government subsidies and the operating performance of SOEs. The Equation (2) is as follows:

$$\begin{aligned}
 Roa_{it} = & \alpha_0 + \alpha_1 Subsidy_{it} + \alpha_2 State_{it} \\
 & + \alpha_3 Subsidy_{it} * State_{it} + \alpha_4 Debt_{it} \\
 & + \alpha_5 Stockholder_{it} + \alpha_6 Creditor_{it} \\
 & + \alpha_7 Employee_{it} + \alpha_8 Board_{it} \\
 & + \alpha_9 Independence_{it} + \alpha_{10} Duality_{it} \\
 & + \alpha_{11} Size_{it} + \lambda_j + \lambda_k + \lambda_t + \varepsilon_{it}
 \end{aligned} \tag{2}$$

The variable measurements are shown in Table 1.



**Table 1.** Variable measurements.

Variables	Notation	Definition
Dependent variable	<i>Roa</i>	Ratio of net profit to total assets
Independent variables	<i>Subsidy</i>	Natural logarithm of (1 + subsidy value)
	<i>State</i>	Ratio of state-owned shares to total shares
	<i>Subsidy*State</i>	Interaction term between <i>Subsidy</i> variable and <i>State</i> variable
Control variables	<i>Debt</i>	Natural logarithm of (1 + debt value)
	<i>Stockholder</i>	Ratio of net profit to paid-in capital
	<i>Creditor</i>	Ratio of cash or equivalents to current liabilities
	<i>Employee</i>	Ratio of cash paid to employees to operating income
	<i>Board</i>	Natural logarithm of the number of board members
	<i>Independence</i>	The proportion of independent directors over total board members
	<i>Duality</i>	a dummy, = 1 if the same person serves as CEO and the chairman of the board, = 0 if otherwise
	<i>Size</i>	Natural logarithm of the total assets

### Data sources and descriptive statistics

In this paper, we obtain data from China Stock Market and Accounting Research (CSMAR) Database. Our dataset is composed of publicly listed non-financial enterprises traded either on the Shanghai or the Shenzhen Stock Exchanges. We choose 2009 as the beginning of the sample period to ensure that the sample is not subject to events related to China's Split Share Structure Reform in 2005 and the global financial crisis in 2008. We delete samples with missing data and winsorize certain variables at the 1<sup>st</sup> and 99<sup>th</sup> percentiles to mitigate the effect of outliers. We finally obtain a panel of 4037 firm-year observations of 1184 Chinese SOEs from 2009 to 2019 for our empirical estimations. The panel has an unbalanced structure. Table 2 provides descriptive statistics for the variables constructed from the sample dataset.

**Table 2.** Descriptive statistics.

Variables	Mean	Standard deviation	Minimum	Maximum
<i>Roa</i>	0.0309302	0.0548419	-0.223122	0.192685
<i>Subsidy</i>	15.46046	3.774015	0	24.64211
<i>State</i>	0.292714	0.228781	0.000659	0.805624
<i>Debt</i>	21.74451	1.757391	15.32441	29.90024
<i>Stockholder</i>	0.3558724	0.6383716	-6.859921	6.428437
<i>Creditor</i>	0.6339044	0.973934	0.001798	6.624371
<i>Employee</i>	0.125004	0.091185	0.011806	0.503385
<i>Board</i>	2.232993	0.1985	1.386294	2.890372
<i>Independence</i>	0.369247	0.057903	0.090909	0.8
<i>Duality</i>	0.097597	0.296806	0	1
<i>Size</i>	22.47989	1.43914	18.26586	29.95395

The characteristics of sample enterprises are shown in the following figures. As shown in Figure 1, the Chinese SOEs are widely participating in a variety of economic sectors, with a large concentration in the manufacturing sector. There are 617 SOEs operating in the manufacturing sector, accounting for 52% of the sample. Other sectors participated by Chinese SOEs include gas, electricity and water, information transmission, computer service and software, transportation, storage and postal services and so on, covering both primary and services sectors.

As shown in Figure 2, Beijing, Guangdong and Shanghai are regions where most Chinese SOEs are located, accounting for 15%, 10% and 9% of the sample, respectively. Generally speaking, the eastern China has more SOEs than the middle and western China.

As shown in Figure 3, 52% of Chinese SOEs received subsidies totalling less than 50 million RMB. Among those, 320 SOEs (27% of the sample) received subsidies totalling between 10 and 50 million RMB, 126 SOEs (11% of the sample) received subsidies totalling between 1 and 5 million RMB, and 86 SOEs (7% of the sample) received subsidies less than 1 million RMB. The number of Chinese SOEs that received subsidies totalling more than 1000 million RMB is small, only accounting for 5%.

As shown in Figure 4, 380 Chinese SOEs have more than 50% state-owned shares, accounting for 32% of the sample. Among them, 319 SOEs (27% of the sample) have state-owned shares between 50% and 75%, and 61 SOEs (5% of the sample) have state-owned shares more than 75%. Among Chinese SOEs that have less than 50% state-owned shares, 390 SOEs (33% of the sample) have state-owned shares between 25% and 50%, and 414 SOEs (35% of the sample) have state-owned shares less than 25%.

## IV. Empirical results

### Baseline regressions

Table 3 reports the estimation results of Equation (1) with or without fixed effects. The coefficients of *Subsidy* variable are both statistically positive in

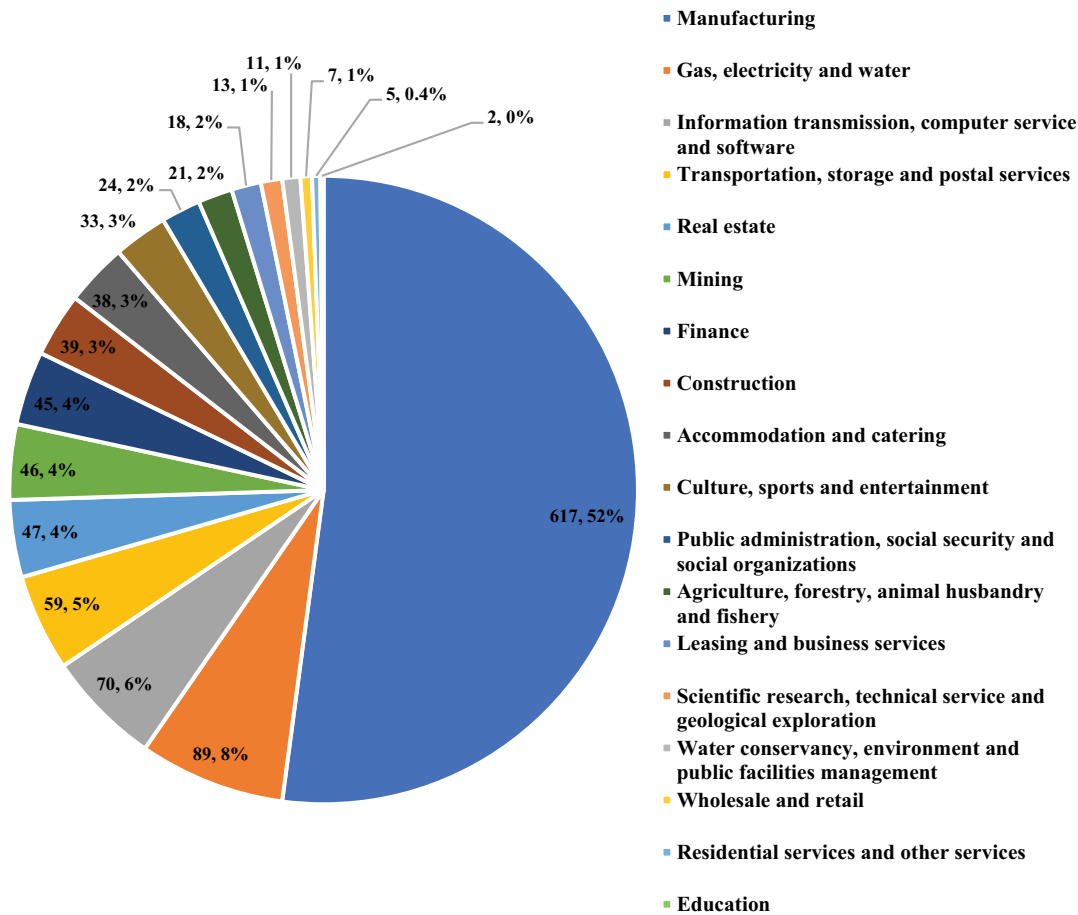


Figure 1. Distribution of sample SOEs by sector.

column (1) and column (2). The results indicate that government subsidies have significantly promoted the operating performance of SOEs. Government subsidies may also have negative effects in certain circumstances, but they still play a larger role in addressing market failures and compensating for social expenditures of Chinese SOEs.

In terms of control variables, the coefficients of *Debt* variable are significantly negative, indicating that a high debt level of SOEs would hinder their operating performance. The coefficients of *Stockholder* variable and *Creditor* variable are significantly positive, indicating the SOEs' sustainability and solvency contribute to daily operating performance. The coefficients of *Employee* variable are significantly negative, indicating the human costs have negative effect on the operating performance of SOEs. This is

in line with our theoretical hypothesis that Chinese SOEs shoulder the social burden of employment creation and maintain redundant workers. The coefficients of *Size* variable are significantly positive, indicating bigger Chinese SOEs have better operating performance. The coefficients of *Board*, *Independence* and *Duality* are not statistically significant.

### Endogenous test

One concern in our study is that government subsidies are likely to be endogenous to the operating performance of enterprises. On the one hand, government subsidies may help promote operating performance of enterprises; on the other hand, satisfactory operating performance of enterprises may prompt the government to provide more support. To alleviate the potential endogenous

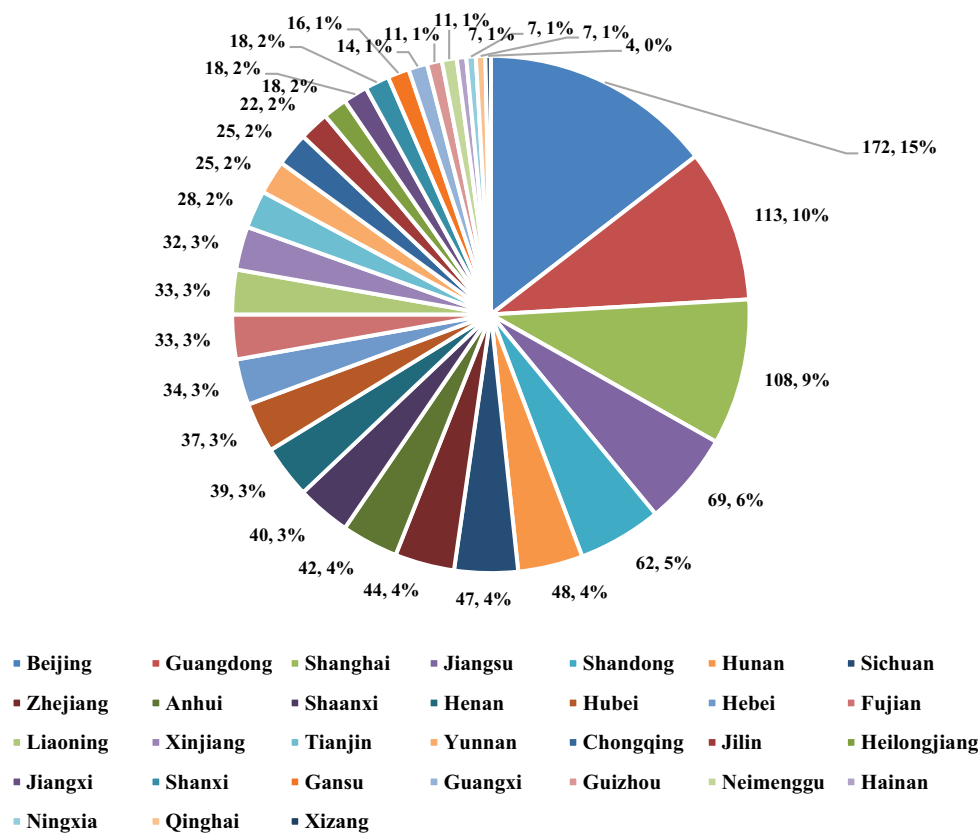


Figure 2. Distribution of sample SOEs by region.

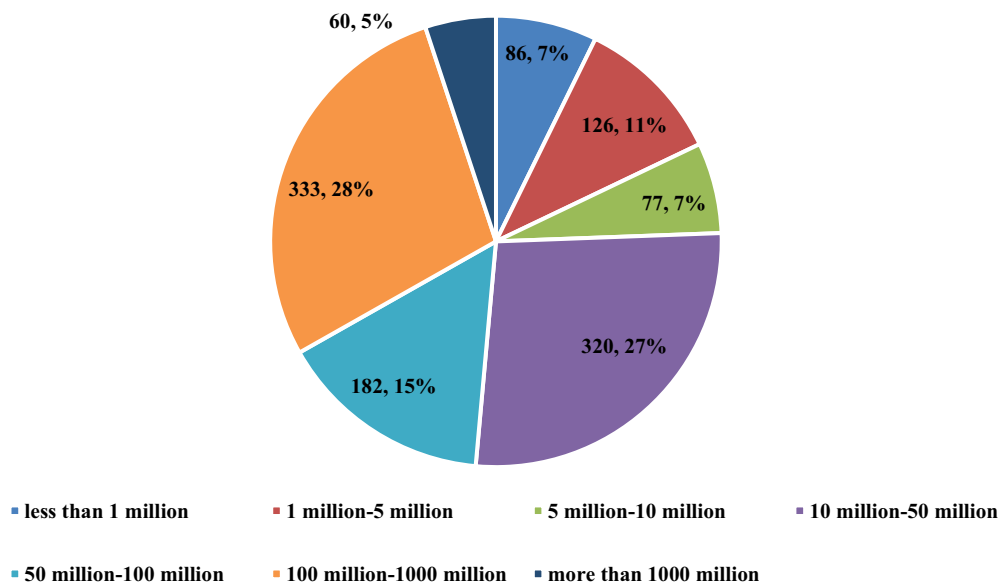


Figure 3. Distribution of sample SOEs by the amount of subsidies.

problem, we use one-period lagged *Subsidy* variable as an instrumental variable in 2SLS estimation (Reed 2015; Bellemare, Masaki, and Pepinsky 2017). As shown in Table 4, we conduct several

postestimation tests. The D-W-H test suggests that the *Subsidy* should be treated as an endogenous variable. The Kleibergen-Paap rk LM statistics reject the under-identification hypothesis. The



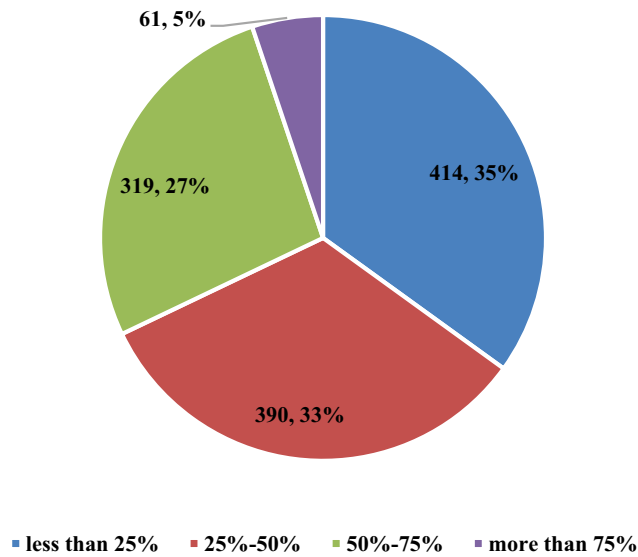


Figure 4. Distribution of sample SOEs by state-owned shares.

Table 3. Baseline regressions.

Variables	(1)	(2)
Subsidy	0.480*** (0.186)	0.651*** (0.206)
Debt	-0.0164*** (0.00101)	-0.0167*** (0.00110)
Stockholder	0.0495*** (0.00207)	0.0482*** (0.00199)
Creditor	0.00187** (0.000774)	0.00119* (0.000789)
Employee	-0.0277*** (0.00726)	-0.0568*** (0.0106)
Board	-0.00217 (0.00299)	0.00141 (0.00310)
Independence	-0.00349 (0.00931)	-0.00323 (0.00970)
Duality	-0.00305 (0.00188)	-0.00259 (0.00195)
Size	0.0135*** (0.00125)	0.0127*** (0.00130)
Constant	0.0721*** (0.0104)	0.0705*** (0.0142)
Industry FE	No	Yes
Province FE	No	Yes
Year FE	No	Yes
Observations	4,037	4,037
R-squared	0.563	0.611

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

Cragg-Donald Wald F statistics and Kleibergen-Paap rk Wald F statistics reject the weak identification hypothesis. The results of these tests reveal the reliability of the instrumental variable. When considering the endogenous problem, the coefficients of *Subsidy* variable are still significantly positive.

Table 4. Endogenous test.

Variables	(1)	(2)
Subsidy	0.337* (0.721)	0.543* (0.147)
Debt	-0.0162*** (0.00121)	-0.0165*** (0.00160)
Stockholder	0.0477*** (0.00245)	0.0467*** (0.00224)
Creditor	0.00202* (0.00104)	0.00169 (0.00106)
Employee	-0.0341*** (0.00910)	-0.0636*** (0.0132)
Board	0.00376 (0.00339)	0.00872** (0.00353)
Independence	0.00499 (0.0112)	0.00534 (0.0116)
Duality	-0.00229 (0.00226)	-0.00143 (0.00228)
Size	0.0131*** (0.00156)	0.0122*** (0.00160)
Constant	0.0675*** (0.0129)	0.0659*** (0.0202)
D-W-H	14.3142 (0.0009)	12.8207 (0.0003)
Kleibergen-Paap rk LM	139.785 (0.0000)	41.339 (0.0000)
Cragg-Donald Wald F	191.624 (0.0000)	53.195 (0.0000)
Kleibergen-Paap rk Wald F	96.643 (0.0000)	29.516 (0.0000)
Industry FE	No	Yes
Province FE	No	Yes
Year FE	No	Yes
Observations	2,671	2,671
R-squared	0.575	0.632

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

### Mediating effect analyses

In this section, we explore how government subsidies affect the operating performance of SOEs via two channels according to our research hypotheses.

#### The mediating effect: easing financial constraints

It is argued that government subsidies can ease enterprise's financial constraints, and thus promoting the enterprise's operating performance. We use the SA index that was developed by (Hadlock and Pierce 2010) to measure the enterprise's financial constraints. As shown in Equation (3), *Size* equals the natural logarithm of the SOE's total assets, and *Age* equals the years of establishment of the SOE. The absolute value of SA index tends to increase for SOEs with higher degree of financial constraints.<sup>1</sup>

$$SA = -0.737*Size + 0.043*Size^2 - 0.040*Age \quad (3)$$

<sup>1</sup>The SA index indicates that financial constraints fall sharply as young and small firms start to mature and grow. Eventually, these relations appear to level off.

**Table 5.** Mediating effect: easing financial constraints.

Variables	Roa	SA index	Roa
	(1)	(2)	(3)
Subsidy	0.651*** (0.206)	0.892** (0.299)	0.560*** (0.206)
SA			0.00291* (0.00231)
Debt	-0.0167*** (0.00110)	0.0153** (0.00767)	-0.0166*** (0.00110)
Stockholder	0.0482*** (0.00199)	0.0110* (0.00656)	0.0482*** (0.00199)
Creditor	0.00119* (0.000789)	0.0501*** (0.00504)	0.00133* (0.000803)
Employee	-0.0568*** (0.0106)	0.0771 (0.0647)	-0.0566*** (0.0107)
Board	0.00141 (0.00310)	0.0454** (0.0227)	0.00154 (0.00308)
Independence	-0.00323 (0.00970)	0.324*** (0.0778)	-0.00229 (0.00976)
Duality	-0.00259 (0.00195)	0.000667 (0.0118)	-0.00259 (0.00195)
Size	0.0127*** (0.00130)	0.0468*** (0.00870)	0.0128*** (0.00131)
Constant	0.0705*** (0.0142)	-5.320*** (0.109)	0.0550*** (0.0198)
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	4,037	4,037	4,037
R-squared	0.611	0.481	0.612

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

Table 5 presents the estimation results of the multi-step models, proving a mediating effect of financial constraints on the correlation between government subsidies and operating performance of SOEs. The positive effect of government subsidies on the operating performance of SOEs is partly realized through easing financial constraints of SOEs.

#### **The mediating effect: stimulating R&D investment**

It is argued that government subsidies can stimulate enterprise's R&D activities, and thus promoting the operating performance of enterprises. We incorporate R&D investment of SOEs in the estimation, which is measured by the natural logarithm of R&D expenditure of the SOE. Table 6 presents the estimation results of multi-step models, proving that government subsidies can promote the operating performance of SOEs partly through stimulating the R&D investment of SOEs.

#### **Moderating effect analysis**

As discussed in our research hypothesis H2, we argue that the state-owned shares may have a negative moderating role in the positive correlation between

**Table 6.** Mediating effect: stimulating R&D investment.

Variables	Roa	R&D investment	Roa
	(1)	(2)	(3)
Subsidy	0.651*** (0.206)	0.191*** (0.323)	0.632*** (0.207)
R&D			0.103* (0.732)
Debt	-0.0167*** (0.00110)	-0.477*** (0.185)	-0.0166*** (0.00110)
Stockholder	0.0482*** (0.00199)	0.302** (0.154)	0.0482*** (0.00199)
Creditor	0.00119* (0.000789)	0.358** (0.155)	0.00115* (0.000789)
Employee	-0.0568*** (0.0106)	-2.512* (1.474)	-0.0566*** (0.0107)
Board	0.00141 (0.00310)	0.447 (0.601)	0.00136 (0.00310)
Independence	-0.00323 (0.00970)	-1.238 (2.024)	-0.00311 (0.00970)
Duality	-0.00259 (0.00195)	-0.0593 (0.331)	-0.00258 (0.00194)
Size	0.0127*** (0.00130)	1.149*** (0.213)	0.0126*** (0.00130)
Constant	0.0705*** (0.0142)	-15.64*** (2.425)	0.0721*** (0.0143)
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	4,037	4,037	4,037
R-squared	0.611	0.573	0.612

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

government subsidies and the operating performance of SOEs. Table 7 reports the estimation results of

**Table 7.** Moderating effect: state-owned shares.

Variables	(1)	(2)	(3)
Subsidy	0.480*** (0.186)	0.651*** (0.206)	0.964*** (0.311)
State			0.357*** (0.124)
Subsidy*State			-0.121* (0.0735)
Debt	-0.0164*** (0.00101)	-0.0167*** (0.00110)	-0.0169*** (0.00110)
Stockholder	0.0495*** (0.00207)	0.0482*** (0.00199)	0.0477*** (0.00198)
Creditor	0.00187** (0.000774)	0.00119* (0.000789)	0.000690 (0.000783)
Employee	-0.0277*** (0.00726)	-0.0568*** (0.0106)	-0.0579*** (0.0106)
Board	-0.00217 (0.00299)	0.00141 (0.00310)	0.00227 (0.00308)
Independence	-0.00349 (0.00931)	-0.00323 (0.00970)	-0.000829 (0.00940)
Duality	-0.00305 (0.00188)	-0.00259 (0.00195)	-0.00233 (0.00194)
Size	0.0135*** (0.00125)	0.0127*** (0.00130)	0.0130*** (0.00130)
Constant	0.0721*** (0.0104)	0.0705*** (0.0142)	0.0576*** (0.0148)
Industry FE	No	Yes	Yes
Province FE	No	Yes	Yes
Year FE	No	Yes	Yes
Observations	4,037	4,037	4,037
R-squared	0.563	0.611	0.617

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

equation (2). The coefficient of the interaction term *Subsidy\*State* is significantly negative in column (3), indicating that the positive effect of government subsidies on the operating performance of SOEs is negatively moderated by state-owned shares. This is consistent with our research hypothesis. The non-economic motivations of state-owned shareholders may make them prioritize the political, social and administrative goals rather than the basic economic goal of profit maximization, and thus hindering the economic efficiency of government subsidies.

#### IV.V. Robustness tests

##### Two alternative proxy variables of government subsidies

We use two alternative proxy variables of government subsidies to test whether the positive effect of government subsidies on the operating performance

of SOEs is robust. *Subsidy2* variable is calculated as the ratio of government subsidies to SOE's gross profits, and *Subsidy3* variable is calculated as the ratio of government subsidies to SOE's total assets (Deng et al. 2021). These two proxy variables can measure the relative intensity of government subsidies. To eliminate the influence of SOE's size.

Robustness results are shown in Table 8, which are broadly consistent with the baseline regression results. In column (1) and column (3), the coefficients of *Subsidy2* variable and *Subsidy3* variable remain significantly positive, respectively, indicating the positive correlation between government subsidies and operating performance of SOEs. In column (2) and column (4), the coefficients of the interaction terms *Subsidy2\*State* and *Subsidy3\*State* remain statistically negative, confirming the negative moderating effect of state-owned shares.

**Table 8.** Robustness analyses.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy2	0.0885*** (0.0119)	0.123*** (0.0741)				
State		0.0162*** (0.00223)		0.0172*** (0.00252)		
Subsidy2*state		−0.326* (0.658)				
Subsidy3			0.165*** (0.0430)	0.215** (0.0867)		
Subsidy3*state				−0.175* (0.194)		
Subsidy					0.651*** (0.206)	0.997*** (0.317)
Shares						0.308*** (0.109)
Subsidy*shares						−0.109* (0.0654)
Debt	−0.0162*** (0.00109)	−0.0165*** (0.00110)	−0.0168*** (0.00107)	−0.0171*** (0.00107)	−0.0167*** (0.00110)	−0.0167*** (0.00110)
Stockholder	0.0481*** (0.00199)	0.0477*** (0.00198)	0.0481*** (0.00197)	0.0476*** (0.00195)	0.0482*** (0.00199)	0.0476*** (0.00198)
Creditor	0.00128 (0.000784)	0.000795 (0.000779)	0.00114 (0.000776)	0.000639 (0.000768)	0.00119* (0.000789)	0.000640 (0.000789)
Employee	−0.0559*** (0.0106)	−0.0569*** (0.0106)	−0.0568*** (0.0106)	−0.0580*** (0.0106)	−0.0568*** (0.0106)	−0.0568*** (0.0106)
Board	0.00121 (0.00310)	0.00219 (0.00308)	0.00109 (0.00310)	0.00207 (0.00308)	0.00141 (0.00310)	0.00188 (0.00310)
Independence	−0.00292 (0.00958)	−0.000343 (0.00939)	−0.00442 (0.00963)	−0.00220 (0.00947)	−0.00323 (0.00970)	−0.000557 (0.00946)
Duality	−0.00259 (0.00195)	−0.00230 (0.00194)	−0.00257 (0.00194)	−0.00226 (0.00194)	−0.00259 (0.00195)	−0.00240 (0.00194)
Size	0.0129*** (0.00130)	0.0132*** (0.00131)	0.0138*** (0.00130)	0.0141*** (0.00130)	0.0127*** (0.00130)	0.0129*** (0.00130)
Constant	0.0682*** (0.0142)	0.0603*** (0.0144)	0.0615*** (0.0144)	0.0529*** (0.0146)	0.0705*** (0.0142)	0.0568*** (0.0146)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,037	4,037	4,037	4,037	4,037	4,037
R-squared	0.610	0.615	0.612	0.617	0.611	0.616

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

### An alternative proxy variable of ownership structure

We use an alternative measurement of state-owned shares to test whether their negative moderating effect in the positive correlation between government subsidies and the operating performance of SOEs is robust. Since most state-owned shares are non-tradable, we use the *Shares* variable that is calculated as the ratio of non-tradable shares to total shares. Estimation results are shown in column (6) of Table 8, which are broadly consistent with the baseline regression results. The coefficient of the interaction term *Subsidy\*Shares* is statistically negative, indicating that the non-tradable shares have a negative moderating effect in the positive correlation of government subsidies on the operating performance of SOEs.

### Two alternative proxy variables of operating performance

We use two alternative measurements of operating performance to test whether the positive effect of government subsidies is robust. First, we use the variable *Roe* that is calculated as the ratio of net profit to shareholders' equities. As shown in column (1) of Table 9, the coefficient of *Subsidy* variable is significantly positive, and in column (2) of Table 9, the coefficient of the interaction term *Subsidy\*State* is statistically negative at the 10% level. The results are broadly consistent with that of baseline regressions.

Second, we use the variable *Tobin's Q* that is calculated as the market value divided by the asset value of the SOE. Since market valuation is usually based on the expected cash flows and the risks, which indicates corporate performance in the future, we propose an existence of a time-lag effect of government subsidies on *Tobin's Q* value. As shown in column (3) of Table 9, the coefficient of *Subsidy* variable is significantly positive, indicating the positive effect of government subsidies on one-period lagged *Tobin's Q*. As shown in column (4) of Table 9, the coefficient of the interaction term *Subsidy\*State* is statistically negative at the 10% level, indicating the negative moderating role of state ownership still exists in the positive correlation of government subsidies and the one-period lagged *Tobin's Q*.<sup>2</sup>

Table 9. Robustness analyses.

Variables	Roe (1)	Roe (2)	L.Tobin's Q (3)	L.Tobin's Q (4)
Subsidy	0.334** (0.162)	0.469* (0.244)	0.0199*** (0.00467)	0.0115* (0.00659)
State		0.0794 (0.0751)		0.377 (0.243)
Subsidy*State		-0.494* (0.456)		-0.0274* (0.0154)
Debt	-0.0241*** (0.00623)	-0.0241*** (0.00622)	-0.0717** (0.0359)	-0.0731** (0.0361)
Stockholder	0.176*** (0.0229)	0.176*** (0.0230)	0.0338 (0.0256)	0.0351 (0.0256)
Creditor	0.0123* (0.00369)	0.0123*** (0.00362)	0.0442* (0.0241)	0.0437* (0.0241)
Employee	-0.137*** (0.0449)	-0.137*** (0.0451)	-0.929* (0.535)	-0.923* (0.535)
Board	0.00120 (0.0191)	0.000839 (0.0191)	0.0532 (0.144)	0.0410 (0.147)
Independence	0.0550 (0.0796)	0.0545 (0.0793)	0.592 (0.507)	0.571 (0.518)
Duality	0.000677 (0.0119)	0.000550 (0.0118)	0.0561 (0.0670)	0.0511 (0.0670)
Size	0.0116* (0.00694)	0.0116* (0.00697)	0.0523* (0.0424)	0.0546* (0.0427)
Constant	0.150* (0.0790)	0.130 (0.0805)	1.865*** (0.585)	1.763*** (0.598)
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	4,037	4,037	1,834	1,834
R-squared	0.290	0.290	0.173	0.174

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

### Estimations using the two-step system GMM

In the system GMM model, the one-period lag of the dependent variable is included as a proxy variable for some omitted variables. Besides, the system GMM model selects exogenous instrumental variables from the historical changes of regression variables and tests the over-identifying restrictions through the Hansen test to check whether the instrumental variables are overall exogenous, which can partly control for potential endogenous problem. Our GMM model passes both the Arrellano-Bond test and the Hansen test.

Results are shown in Table 10. The coefficients of the one-period lagged dependent variable *RoA* are significantly positive in column (1) and column (2), indicating that the profitability of SOEs is continuous over time. SOEs can obtain relatively stable long-term profits, through government support and the optimization of corporate governance structure. In terms of key explanatory variables, the coefficients of *Subsidy* variable in column (1) and column (2) are significantly positive, and the coefficient of the interaction term *Subsidy\*State* in

<sup>2</sup>We also use the current value of *Tobin's Q* to run the regression. However, the coefficient of the interaction term *Subsidy\*State* is not statistically significant.

**Table 10.** System GMM analysis.

Variables	(1)	(2)
L.roa	0.194*** (0.0541)	0.131** (0.0618)
Subsidy	0.225* (0.268)	0.360** (0.181)
State		0.132** (0.0619)
Subsidy*State		−0.746** (0.355)
Debt	−0.0114*** (0.00156)	−0.0126*** (0.00264)
Stockholder	0.0492*** (0.00468)	0.0482*** (0.00459)
Creditor	0.00143 (0.00123)	0.00131 (0.00156)
Employee	−0.0387*** (0.0136)	−0.0854* (0.0460)
Board	0.00318 (0.00448)	0.00491 (0.00562)
Independence	0.00745 (0.0133)	0.00246 (0.0335)
Duality	−0.00304 (0.00274)	−0.00113 (0.00340)
Size	0.00715*** (0.00186)	0.00619** (0.00293)
Constant	0.0876*** (0.0170)	0.0732*** (0.0253)
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
AR(2)	0.386	0.623
Hansen test	0.219	0.515

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

column (2) is significantly negative, which are consistent with the findings from the baseline regressions.

## V. Heterogeneity analyses

This paper further explores whether the effect of government subsidies on the operating performance of SOEs depends on the heterogeneous characteristics of SOEs. Specifically, we classify SOEs based on geographical regions, administrative levels and R&D levels. We also examine the different effects of tax-based and non-tax-based government subsidies.

### Regressions by geographical region

China is a vast country with distinct differences in capital, technology, resources and institutional environment across different regions. Given China's size and geographical diversity, the regions have played different roles in promoting the country's economic development. The eastern China

has always been ahead of other regions in terms of economic development and modernization. In this regard, according to the location of headquarters, we divide SOEs into those in eastern China (including eight provincial-level locations: Beijing, Tianjin, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, and Guangdong) and those in central and western China.

As shown in Table 11, the coefficients of *Subsidy* variable in regression (1) are significantly positive, while the coefficients of *Subsidy* variable in regression (2) are not statistically significant. The results indicate that government subsidies have a stronger positive effect on the operating performance of SOEs located in eastern China (Wen and Huang 2020; Li 2022). In general, the eastern China enjoys relatively strong economic bases and higher degree of marketization, providing more mature market environment for SOEs (Jian et al. 2020). On the one hand, the governance capacity is more advanced in eastern China, where the market plays a decisive role in the development of enterprises and the government is more capable of dealing with market failures. In such environment, government subsidies might

**Table 11.** Regressions by geographical region.

Variables	(1) Eastern China		(2) Central and Western China	
Subsidy	0.456* (0.237)	0.886*** (0.335)	0.930 (0.302)	0.880 (0.554)
State		0.0437*** (0.0142)		0.0143 (0.0206)
Subsidy*State		−0.176** (0.0825)		0.0163 (0.125)
Debt	−0.0166*** (0.00127)	−0.0169*** (0.00126)	−0.0132*** (0.00188)	−0.0132*** (0.00188)
Stockholder	0.0415*** (0.00208)	0.0411*** (0.00207)	0.0606*** (0.00425)	0.0600*** (0.00425)
Creditor	0.00207** (0.00102)	0.00158 (0.00100)	0.000999 (0.00117)	0.000675 (0.00116)
Employee	−0.0585*** (0.0143)	−0.0586*** (0.0144)	−0.0570*** (0.0153)	−0.0610*** (0.0154)
Board	0.000912 (0.00473)	0.00163 (0.00468)	0.000502 (0.00381)	0.00119 (0.00377)
Independence	0.0189 (0.0140)	0.0203 (0.0134)	−0.0303** (0.0132)	−0.0260* (0.0132)
Duality	−0.00225 (0.00236)	−0.00192 (0.00234)	−0.00143 (0.00321)	−0.00117 (0.00322)
Size	0.0126*** (0.00156)	0.0131*** (0.00157)	0.0103*** (0.00225)	0.0102*** (0.00225)
Constant	0.0507** (0.0203)	0.0352* (0.0209)	0.0634*** (0.0213)	0.0577*** (0.0220)
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	2,241	2,241	1,796	1,796
R-squared	0.587	0.593	0.695	0.699

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.



**Table 12.** Regressions by administrative level.

Variables	(1) Central SOEs		(2) Local SOEs	
Subsidy	1.196*** (0.293)	0.937** (0.390)	0.322* (0.273)	0.806* (0.439)
State		0.00112 (0.0172)		0.0484*** (0.0164)
Subsidy*State		-0.0909 (0.1000)		-0.188* (0.0992)
Debt	-0.0154*** (0.00174)	-0.0160*** (0.00176)	-0.0171*** (0.00140)	-0.0170*** (0.00138)
Stockholder	0.0475*** (0.00336)	0.0471*** (0.00336)	0.0493*** (0.00227)	0.0487*** (0.00224)
Creditor	0.00276* (0.00156)	0.00214 (0.00160)	0.000679 (0.000854)	0.000302 (0.000831)
Employee	-0.0410** (0.0169)	-0.0399** (0.0167)	-0.0578*** (0.0133)	-0.0598*** (0.0133)
Board	0.0107* (0.00565)	0.0113** (0.00560)	-0.00260 (0.00364)	-0.00126 (0.00362)
Independence	0.0196 (0.0140)	0.0191 (0.0138)	-0.0263* (0.0152)	-0.0213 (0.0143)
Duality	0.00965** (0.00382)	0.00974** (0.00382)	-0.00541** (0.00228)	-0.00500** (0.00225)
Size	0.0105*** (0.00197)	0.0111*** (0.00201)	0.0135*** (0.00166)	0.0134*** (0.00164)
Constant	0.0445* (0.0245)	0.0421* (0.0245)	0.0887*** (0.0187)	0.0702*** (0.0196)
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1,517	1,517	2,520	2,520
R-squared	0.655	0.659	0.630	0.637

The data in brackets are robust standard errors. \*\*\* \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

be allocated in a more rational and efficient way. On the other hand, market competition is the main driver to improve SOEs' operating efficiency (Li 1997). Facing with fierce competition, SOEs in eastern China have more motivation to innovate and strengthen sustainable growth, which would avoid short-sighted investment and organizational inertia to some extent. In this regard, government subsidies can better play a role to help SOEs ease financial constraints, especially in high risky R&D fields, and achieve economies of scale in sectors with promising market prospects.

However, the coefficient of the interaction term *Subsidy\*State* is significantly negative in regression (1) but is not statistically significant in regression (2). The results indicate that in eastern China the negative moderating role of state-owned shares is stronger. The more advanced economy in eastern China could have played a greater role in promoting the participation of SOEs in sufficient market competition, which help them optimize resource allocation, stimulate technological innovation, and increase total factor productivity in a highly competitive market environment. Nonetheless, a high proportion of state-owned shares may hinder the

full participation of SOEs in market competition, making them fail to make full use of market advantages in eastern China.

### Regressions by administrative level

According to the administrative level of SOEs, we divide the sample into central and local SOEs. As shown in Table 12, the coefficients of *Subsidy* variable in regression (1) and regression (2) are both positive. The results show that for both central and local SOEs, although their corporate governance may be different, an increase in government subsidies can promote their operating performance.

However, the coefficient of the interaction term *Subsidy\*State* is not statistically significant in regression (1) and is significantly negative in regression (2). The results indicate that an increase in state-owned shares in local SOEs impedes the positive effect of government subsidies, while the impeding effect is not significant for central SOEs. The Chinese central and local governments may have different policy imperatives and supervision capabilities, which may affect the way that SOEs are managed and operated. First, the supervision faced by central and local SOEs is different. The central SOEs directly face strict supervision from China's central government departments (especially the State-owned Assets Supervision and Administration Commission of the State Council), while the supervision faced by the local SOEs may vary depending on the level of economic development and administrative capacity of the region where they are located. As central SOEs face stricter supervision, they are more concerned about the preservation and appreciation of corporate values, and are more inclined to allocate government subsidies reasonably and effectively based on the principle of value maximization, which can offset the 'non-economic man' nature of 'state-owned elements'. Second, the central and local governments may have different motivation for subsidizing SOEs. Although local governments care about economic efficiency, they are sometimes driven by political incentives. Since the number of SOEs under their jurisdiction is viewed as a performance indicator of the local government officials, they possibly have the inclination to rescue insolvent or ailing SOEs, in order to avoid



those SOEs being bankruptcy or delisted. Such non-economic motivation would hinder the efficient allocation of government subsidies.

### Regressions by R&D level

We divide the sample SOEs by R&D level. If the accumulated R&D investment of the SOE is greater than the median value of the sample, which SOE is identified with higher R&D level, and others identified with lower R&D level. As shown in Table 13, the coefficients of *Subsidy* variable in regression (1) and regression (2) are significantly positive. The results show that an increase in government subsidies can promote the operating performance of SOEs with different R&D levels.

When considering the effect of *State* variable, the results show that for SOEs with higher R&D level, the coefficient of interaction term *Subsidy\*State* is significantly negative, indicating the negative moderating role of state-owned shares on the relationship between government subsidies and corporate performance; while for SOEs with lower R&D level, this moderating effect is not statistically significant. Our results reveal that for Chinese SOEs with

higher R&D level, government subsidies can help them deal with larger capital demand, greater technological uncertainty and longer investment return period, and motivate them to continue R&D investment. However, high state-owned shares may restrict SOE's efficient R&D decisions, and thus is not conducive to fully employ the economic incentive of government subsidies.

### Regressions by tax-based subsidies and non-tax-based subsidies

We divide government subsidies into two forms of tax-based subsidies and non-tax-based subsidies. Tax-based subsidies are granted according to prescribed tax policies and regulations, including the rebates of various taxes, such as the value-added tax, consumption tax or export tax. Non-tax-based subsidies may take various forms such as direct cash payments, loan guarantees, and debt forgiveness. In our estimation, the value of tax-based (non-tax-based) subsidies are calculated by adding up the amount of tax (non-tax) subsidy projects included in the CSMAR database. Then, we construct the *Tax* variable that is calculated as the natural logarithm of (1 plus tax-based subsidy value), and construct the *Nontax* variable that is calculated as the natural logarithm of (1 plus non-tax-based subsidy value). As shown in Table 14, the results in column (1) and column (2) indicate that tax-based subsidies have positive effect on the operating performance of SOEs, with the state-owned shares exerting negative moderating effect on this positive correlation. However, the above findings do not hold for non-tax-based subsidies. Previous studies (e.g. (Lee, Walker, and Zeng 2014; Lim, Wang, and Zeng 2018)) reveal that Chinese tax-based subsidies are more transparent, objective and predictable than non-tax-based subsidies. The tax-based subsidies are generally offered according to China's industrial and regional development policies, and are often given to firms that invest in projects or operate in sectors favoured by government policies. In contrast, due to the limited fiscal resources of governments, enterprises eligible for non-tax-based subsidies must be selected and this selection process can involve a certain degree of subjectivity and is prone to the influence of political connections or government officials' discretion.

**Table 13.** Regressions by R&D level.

Variables	(1) SOEs with lower R&D level		(2) SOEs with higher R&D level	
Subsidy	0.767** (0.315)	1.328*** (0.510)	0.537** (0.251)	0.651* (0.355)
State		0.0464* (0.0178)		0.0203 (0.0162)
Subsidy*State		-0.193 (0.107)		-0.0461* (0.0953)
Debt	-0.0140*** (0.00155)	-0.0141*** (0.00154)	-0.0186*** (0.00153)	-0.0189*** (0.00153)
Stockholder	0.0529*** (0.00353)	0.0524*** (0.00352)	0.0440*** (0.00234)	0.0437*** (0.00233)
Creditor	0.00224* (0.00116)	0.00191* (0.00116)	-0.000965 (0.00112)	-0.000517 (0.00112)
Employee	-0.0414*** (0.0142)	-0.0430*** (0.0143)	-0.0709*** (0.0157)	-0.0725*** (0.0156)
Board	-0.00492 (0.00450)	-0.00408 (0.00446)	0.00524 (0.00420)	0.00590 (0.00421)
Independence	-0.00278 (0.0143)	-0.00158 (0.0141)	0.00800 (0.0137)	0.00989 (0.0134)
Duality	-0.00660** (0.00332)	-0.00610* (0.00332)	0.00270 (0.00213)	0.00289 (0.00213)
Size	0.0102*** (0.00176)	0.0103*** (0.00176)	0.0139*** (0.00175)	0.0143*** (0.00178)
Constant	0.0831*** (0.0195)	0.0678*** (0.0204)	0.0848*** (0.0263)	0.0750*** (0.0270)
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	2,019	2,019	2,018	2,018
R-squared	0.619	0.624	0.649	0.652

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

**Table 14.** Regressions by form of subsidies.

Variables	(1)	(2)	(3)	(4)
Tax	0.161*** (0.0243)	0.393*** (0.118)		
Tax*State		−0.567** (0.236)		
Nontax			0.104 (0.167)	0.0487 (0.173)
Nontax*State				0.104 (0.715)
State		0.0165*** (0.00225)		0.0161*** (0.00231)
Debt	−0.0162*** (0.00103)	−0.0163*** (0.00109)	−0.0162*** (0.00103)	−0.0165*** (0.00109)
Stockholder	0.0493*** (0.00206)	0.0476*** (0.00198)	0.0493*** (0.00207)	0.0477*** (0.00199)
Creditor	0.00177** (0.000776)	0.000860 (0.000779)	0.00178** (0.000777)	0.000789 (0.000779)
Employee	−0.0276*** (0.00750)	−0.0570*** (0.0106)	−0.0283*** (0.00748)	−0.0571*** (0.0106)
Board	−0.00209 (0.00296)	0.00251 (0.00308)	−0.00208 (0.00297)	0.00224 (0.00310)
Independence	−0.00290 (0.00924)	−0.000206 (0.00938)	−0.00302 (0.00925)	−0.000567 (0.00939)
Duality	−0.00306 (0.00189)	−0.00227 (0.00194)	−0.00312 (0.00189)	−0.00230 (0.00194)
Size	0.0134*** (0.00124)	0.0128*** (0.00132)	0.0135*** (0.00125)	0.0132*** (0.00132)
Constant	0.0744*** (0.0106)	0.0663*** (0.0145)	0.0711*** (0.0112)	0.0613*** (0.0150)
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	4,037	4,037	4,037	4,037
R-squared	0.565	0.616	0.564	0.615

The data in brackets are robust standard errors. \*\*\*, \*\* and \* represent passing significance tests at the levels of 1%, 5%, and 10%, respectively.

In addition, (Lim, Wang, and Zeng 2018) suggest that the Chinese government uses non-tax-based subsidies to achieve its social policy objectives at the expense of enterprises' profitability. These differences in the grant of tax-based and non-tax-based subsidies indicate that tax-based subsidies are more scientifically designed and allocated, which can better play a positive role in promoting operating performance of enterprises than non-tax-based subsidies.

## VI. Conclusions and policy implications

In this paper, we find that government subsidies have in general promoted the operating performance of Chinese SOEs, but an increase in state-owned shares hinders such a positive effect. Our findings reveal that adjustment in ownership structure of SOEs is important to build an effective corporate governance system, ensuring that the

role of ownership control is effectively played and the government subsidies are efficiently allocated and utilized.

The analyses based on the heterogeneous characteristics of SOEs show that, for SOEs located in eastern China, at the local level or with higher R&D level, an increase in state-owned shares is more detrimental to the positive effect of government subsidies. In addition, tax-based-subsidies have significantly positive effect on the operating performance of SOEs, with the state-owned shares exerting negative moderating effect on this positive correlation. However, this finding does not hold for non-tax-based subsidies.

We have policy recommendations as follows. First, the positive effect of government subsidies on the operating performance of SOEs should be fully exploited. This study shows that government subsidies generally have a positive effect on the operating performance of SOEs, but still admits the possibility of any negative effect caused by government subsidies. Therefore, government subsidies need to be more scientifically and reasonably designed and allocated. At the first place, an effective subsidy screening mechanism should be strengthened, which should prioritize subsidies to enterprises with promising development prospects and pioneering R&D activities, while gradually withdrawing subsidies to insolvent or ailing SOEs without credible restructuring plans. In addition, an open and transparent subsidy operating mechanism should be strengthened, to closely monitor the allocation of subsidies. Meanwhile, the transparency of subsidies should be improved to prevent rent-seeking and compensation fraud.

Second, the ownership structure of Chinese SOEs can be improved. Our research shows that an increase of state-owned shares impedes the positive effect of government subsidies. Chinese SOEs could increase managerial ownership to avoid problems such as incentive incompatibility and moral hazard. In addition, external non-state-owned equities could be appropriately introduced into SOEs. In this regard, the government should provide a convenient policy environment for mixed ownership reform for SOEs.

Third, from the perspective of heterogeneity, in more advanced and competitive regions, *i.e.*, eastern China, the government should give more autonomy to SOEs to fully mobilize their own management dynamics. In addition, the local subsidy system should be improved to avoid subsidies to loss-making SOEs and political motivation of subsidies. Furthermore, SOEs with higher R&D level should be more market-driven through the reduction of state-owned shares to better explore the R&D efficiency. Last, Chinese government should give full play to tax-based subsidies to promote the performance of SOEs, and pay attention to the negative moderating effect of state-owned shares among it.

Fourth, our research shows that SOEs with higher sustainability, stronger solvency and larger asset size have better operating performance; while SOEs with higher debt level and human costs, have lower operating performance. Therefore, SOEs need to improve internal capital management and maintain reasonable debt level, as well as rationally increasing corporate size and optimizing structure of human resources.

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