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Can New Private Shareholders Help Improve SOEs' Total Factor Productivity? Evidence from the Chinese Listed SOEs*

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Using entropy-balancing technique and difference-in-differences approach, this paper assesses impact of further privatization on SOEs' TFP. We find that SOEs' TFP significantly enhances following the introduction of new private shareholders, and this holds in particular for the SOEs who transfer a larger number of shares to new private shareholders and allow them to appoint top managers. We further show that the marginal productivity gains for SOEs with different extents of privatization are various, there are diminishing marginal benefits of further appointing top managers, but not so of further increasing private shares. Finally, we also explore some underlying mechanisms.

Key Words: New private shareholders; Total factor productivity; Entropy balancing; Difference-in-differences approach.

JEL Classification Numbers: G32, D24, P31.

1. INTRODUCTION

Privatization is an effective means for transition economies to reform SOEs and establish a market-oriented economy. However, unlike most of other countries in transition, China has adopted a gradual privatization strategy (Chen et al., 2006). Although a large number of small and inefficient SOEs were privatized in the 1990s reform, the Chinese government still controls a lot of large SOEs today. Because of the socialist system and the existing political constraints, the Chinese government has not been ready to dump most of the large SOEs' control rights. In particular, Pres-

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ident Jinping Xi proposed to make SOEs bigger and stronger after he took power in China. Moreover, in 2013, the Third Plenary Session of the 18th CPC (Communist Party of China) Central Committee put forward the mixed-ownership reform, calling on SOEs to perfect corporate governance and enhance efficiency by introducing non-state shareholders. To the best of our knowledge, around more than 50% firms controlled by the Chinese government have already been mixed-ownership enterprises before 2013, and this phenomenon holds in particular for the listed SOEs. From this perspective, the ongoing mixed-ownership reform implies that a great many of SOEs that have been partially privatized would introduce new private capital to achieve further privatization.

Naturally, this begs the question whether further privatization without ownership changes could engender incremental gains for SOEs. Unfortunately, little is known about this question although a large body of literature studies the impact of privatization on firm performance (See, e.g., Megginson et al., 1994; Djankov and Murrell, 2002; Jefferson and Su, 2006; Bai et al., 2009; Estrin et al., 2009). This paper fills the gap in this topic by investigating how new private shareholders affects SOEs' total factor productivity (TFP). Outcomes of this paper may help people fully understand the benefits of SOEs' gradual privatization and provide implication for other economies with many SOEs.

To test empirically whether new private shareholders influence firm TFP, we take advantage of the data of China's state-owned shares transfer and auction, which provides economic nature of both the transferor and transferee, and the equity transaction time as well. We restrict our attention to shares transfer from state shareholders in an SOE to private investors (shares transfer hereafter). Considering that firms with certain characteristics may be more likely to introduce private shareholders, we adopt a firm fixed effect model and construct a matched sample using the entropy-balancing approach.

We use three complementary variables to measure further privatization. The first is a binary variable that identifies state shareholders of an SOE transferred their equity to private investors in year t. The second variable controls for differences in the number of shares transferred to new private investors. And the third variable is the percentage of top management (including directors, supervisors and managers) assigned by newly introduced private shareholders. The latter two variables can reflect the power of new private shareholders participating in firm decision-making to some extent.

We obtain firm-level TFP by estimating a production function. Simultaneity bias and selectivity bias are two identified challenges when estimating production function. To alleviate such concerns, authors often use methods of Olley and Pakes (1996; OP hereafter) and Levinsohn and Petrin (2003; LP hereafter) to estimate it. Unlike the approaches of OP and LP,

Wooldridge (2009; WD hereafter) combined the generalized method of moments (GMM) with the LP method to overcome problem with identification in the LP first-stage estimation. Thus, we utilize OP and WD estimation methods to obtain firm-level TFP in our main tests.

By using the entropy-balanced sample to perform a difference-in-difference (DID) analysis, we find that new private shareholders can improve firm TFP. First, after the new private shareholders entered, the TFP of firms increases by about 100.2%-107.2%. Second, results that control for the number of shares transferred to new private investors indicate that each additional 1% of the shares transferred to new private investors improves firm TFP by about 5.9%-6.2%. In addition, the TFP of firms will increase by about 6.53%-6.64% with each additional 1% of top management appointed by new private shareholders.

We further investigate whether the marginal benefits of further privatization varied with the extent of privatization. We first define the extent of privatization in terms of ownership structure, and find that SOEs with initial private shares at a lower level (less than 10%) or a higher level (greater than 30%) could benefit more from further introducing private investors. Then, we define the extent of privatization from the aspect of top management governance, and find that the marginal effect of further appointing top managers is diminishing. In particular, the marginal effect is largest when the percentage of top managers appointed by initial private shareholders is 0%, and is significant and positive when such percentage is no more than 7.5%.

We next conduct a variety of robustness tests. First, some unobserved and time-variant firm-specific factors may still cause our estimation biased. As such, we use firms privatized in later years rather than firms that remain state-controlled as an alternative control sample. Second, production function may not be the same for different industries. To address this concern, we estimate production function for each industry and then recalculate TFP at the firm level. Third, we randomly assign a false treated year for each treatment firm and perform a placebo test. The results show no significant differences in TFP among treatment and control firms around these false treated years. Fourth, as propensity score matching (PSM) is commonly used to address the observable selectivity issue nowadays, we also employ it to reconstruct our matched sample. All the results in robustness tests are qualitatively similar to those in our baseline model.

Last, we explore three potential mechanisms through which the new private shareholders may enhance firm TFP. The first mechanism is based on the reduction of government intervention following further privatization, we use firms' long-term investment to measure it. The results indicate an increase in long-term investment after the introduction of new private investors. The latter two mechanisms are based on improvement in man-

agement practices. Consistently, we find that excess perks decrease and compensation incentives improve following the introduction of new private investors.

Our findings add to the crowded literature on the effect of privatization. A number of studies focus on the impact of initial privatization on firm performance (See, e.g., Megginson et al., 1994; Sun and Tong, 2003; Wang, 2005; Gupta, 2005; Wolf and Pollitt, 2008), but the incremental effect of further privatization after the initial privatization has not received sufficient attention. China provides an ideal setting for us to study such question, because its large SOEs typically be privatized through primary offerings, and then achieve further privatization by transferring state-owned shares or issuing new shares to private investors. There are a few studies related to this paper. Chen et al. (2008) and Yang et al. (2010) study on control transfers from the state to the private after SOEs' initial privatization through IPO listing, and find a positive performance improvement. Using a RDD approach, Chen et al. (2019) explores the impact of control rights' mutation from the state to the private on firm innovation. In our study, we focus on share transfers from the state to the private without ownership changes after SOEs' initial privatization, and our results indicate that further privatization without ownership changes could also improve firm performance. The more related literature to this study may be Liao et al. (2014), they compare performance changes of SOEs and non-SOEs before and after China's second privatization policy (the Split-Share Structure Reform), using Wilcoxon-test method. Unlike to them, however, we examine the effects of firm-level further privatization using a DID approach. More importantly, we attempt to explore the heterogeneous marginal effects of further privatization under various initial extents of privatization. Therefore, our study is quite different from those further privatization studies mentioned above. To the best of our knowledge, this study is the first in the privatization literature that explores the incremental effects of further privatization without ownership changes and the relationship between marginal effects of further privatization and initial extents of privatization.

2. INSTITUTIONAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

2.1. Institutional Background

In 2013, the Third Plenary Session of the 18th CPC Central Committee proposed to actively develop the mixed-ownership economy, and pointed that mixed-ownership characterized by cross-shareholding of public capital and non-public capital is a critical form of realizing China's basic economic system. The purpose of this mixed-ownership reform is to further improve the governance and operating efficiency of SOEs by introducing

non-state shareholders. In fact, mixed ownership is not a new concept in China. The Chinese government carried out the first privatization policy in 1990s, during which most large SOEs were partially privatized and became mixed-ownership firms through share issue privatization (SIP). Then, the government in 1999 first formally proposed to develop mixed-ownership economy, which provides a reasonable name for the coexistence of state capital and non-state capital. In order to solve the split-share problem left over by the first privatization, the Chinese government initiated the Split-Share Structure Reform in 2005, remarking the secondary privatization (Liao et al., 2014). Although a series of prior reforms have played a positive role in boosting SOEs' efficiency and productivity, problems such as government intervention and lacks of incentives and monitoring have not been effectively resolved. Therefore, mixed-ownership reform in the new era aims at attracting other capitals to help improve corporate governance, strengthen incentives and monitoring, and introduce management skill and technology, thus improving SOEs' competitiveness.

It is very important to recognize that most SOEs have already been a mixed-ownership firm after the first and the second privatization. According to the State-owned Assets Supervision and Administration Commission of the State Council (SASAC hereafter), by the end of 2016, mixed-ownership enterprises controlled by the central and local governments accounted for 68.9% and 47%, respectively. In addition, almost all listed SOEs have a mixed ownership structure, and the average shareholding of private shareholders is above 10%. Another important phenomenon is that the privatization of SOEs in China has never stopped, and most of them are partially privatized and only a few SOEs are completely privatized each year. Therefore, whether SOEs can improve their productivity through further mixed-ownership reform (further privatization), especially for SOEs that are still controlled by the state after further privatization, is a very important topic at present. Earlier studies considering the effect of the Chinese privatization focus on the relationship between initial SIP or ownership transfers from the state to the private and accounting performance (Sun and Tong, 2003; Wang, 2005; Chen et al., 2006; Chen et al., 2008; Yang et al., 2010). This paper tries to examine whether further privatization is able to improve the TFP of SOEs that have been partially privatized. As TFP is a key source of sustainable economic growth, we only focus on the improvement of TFP rather than accounting performance.

2.2. Hypothesis Development

Whether private shareholders played a positive role in partially privatized SEOs concerns only a few. Even so, we find supporting evidence in a few literatures. First, private shareholders could exercise restrictions on government behavior (Eckel and Vining, 1985), thus reducing govern-

ment intervention. On one hand, the cost of government intervention in SOEs rises with the increase of the proportion of private shares (Sappington and Stiglitz, 1987). In particular, private shareholders who possess more shares and appoint top executives have right to speak in SOEs (Cai et al., 2018) and could exert influence on major firm decisions such as employment and investment, etc. On the other hand, transferring shares to private shareholders would dilute state ownership, harming advantages of SOEs in obtaining credit and tax incentives. Therefore, survival pressure and private shareholders' concern for profitability will force enterprises to improve efficiency (Eckel and Vining, 1985).

Second, private shareholders have the motivation to monitor and incentivize managers because they care about firm profitability (Eckel and Vining, 1985). Gupta (2005) demonstrates that SOEs' expenditures on R&D and fixed assets increase after a rise in private shares, which he attributes to the lesson of agency problems. Vining and Boardman (1992) and Majumdar (1998) show that mixed-ownership firms perform better than fully state-owned firms, Xu and Wang (1999) and Sun and Tong (2003) find that the profitability of privatized firms is positively correlated with the proportion of legal person shares. These four papers imply that private shareholders could play an active role in SOEs. In addition, Xu and Wang (1999) also suggest that SOEs should introduce other types of shareholders to achieve diversified ownership, thus promoting the reform of incentive mechanisms. Zhang et al. (2020) investigate effects of the ongoing mixed-ownership reform in China and find that the innovation of SOEs increases significantly after 2013, which they attribute to the possible improvement of corporate governance and reduction of government intervention following the introduction of private capital. Therefore, based on the arguments above, this paper proposes the following hypotheses:

H1: There will be a positive relationship between introducing new private shareholders and TFP of SOEs.

H2: There will be a positive relationship between the percentage of shares transferred to new private shareholders and TFP of SOEs.

H3: There will be a positive relationship between the percentage of top managers appointed by newly introduced private shareholders and TFP of SOEs.

3. SAMPLE AND DESCRIPTIVE STATISTICS

Our sample is based on the Chinese A-share listed SOEs from 2003 to 2018, except for financial firms. To identify SOEs that introduce new private shareholders, we use the data of China's state-owned shares transfer and auction from CSMAR database, the data provides information on the

economic nature of transferor and transferee of a firm,[1] number and date of state-owned shares transfer, etc. We restrict our sample to the state-owned shares transferred from state shareholders in an SOE to private investors.[2] We add up the percentage of shares transferred if state shareholders of an SOE transfer shares to private shareholders multiple times in a year.

Then, we match the processed data above with the ultimate controlling shareholder data—from the CSMAR and CCER database and we cross-checked the multi-source data—and delete the samples that control rights are transferred from the state to the private after shares transfer. Meanwhile, we also delete firms that have more than one firm-year shares transfers during sample period, and firms with state-owned shares transferred being less than 5% (there are 7 such firms and we think their major aims are not to introduce new private investors). We identify 162 SOEs that carry out one firm-year shares transfer and maintain state-controlled between 2003 and 2018.

The percentage of private shares among the top 10 shareholders is from the CSMAR, CCER and RESSET database and is cross-checked, while the price index information is from China Province Economic Statistical Yearbook. Information on top managers holding positions in other firms, accounting information and other information are from the CSMAR database. Continuous variables are winsorized at the 1% and 99% levels.

3.1. Defining Treatment Variables

we define the 162 SOEs that carry out shares transfer during 2003 to 2018 as treatment firms, and the other listed SOEs as control firms. To adopt a DID method, we also introduce a time effect variable, Post, which equals one for treatment firms following the state-owned shares transfer. In addition, the percentage of state-owned shares transferred in 162 firms ranges from 5.14% to 48.97% and the variance is 13.10, indicating that the number of shares transferred among firms varies greatly. Meanwhile, among the 162 shares transfer firms, 96 firms have top managers appointed by newly introduced private shareholders in the event year. Therefore, to control for variation in the degree of private shareholders participating in firm decision-making, we introduce another two variables, ShrPer and TopMngPer. The former is the percentage of shares transfer of treatment firms, and the latter is the percentage of top managers appointed by new

[1]The data consists of five types of economic nature, namely, state-owned economy, collective economy, private economy, Hong Kong, Macao and Taiwan economy and foreign economy. We define shareholders with the latter three economic nature as private shareholders.

[2]there are four types of state-owned shares transfer, including state shareholders in an SOE transfer shares to other state investors, state shareholders in an SOE transfer shares to private investors, state shareholders in a private firm transfer shares to other state investors, and state shareholders in a private firm transfer shares to private investors.

private shareholders in year t in the treatment firms.[3] Following Cai et al. (2018), top managers appointed by private shareholders are defined as top managers who hold a position in a legal person shareholder or who are a natural person shareholder per se. Then, we collect such appointment information by hand based on the CSMAR database of top managers holding positions in other firms.

3.2. Measuring Firm-Level TFP

Total factor productivity is defined as the surplus productivity after deducting the contribution of observable inputs such as labor and capital. There have been a number of methodologies developed to estimate firm-level TFP over the past years. Using OLS method to estimate a production function is the earliest approach, but it faces both selection and simultaneity bias. To address such problems, Olley and Pakes (1996) proposed a semi-parametric method to estimate the coefficients of input variables. Based on OP, Levinsohn and Petrin (2003) suggest using intermediate inputs instead of investment as the proxy for unobserved productivity shock. Unlike the approaches of OP and LP, which use a two-step estimation, Wooldridge (2009) implements the LP method in a generalized method of moments (GMM) framework by using one-step estimation, and he argues that the GMM with one-step method can effectively solve the serial correlation and heteroskedasticity problems. Therefore, in the main test of the influence of new private shareholders on firm TFP, we utilize OP and WD estimation methods to obtain firm-level TFP. Details on the estimation procedures of these two methods are shown in Appendix A. In particular, we also present in Appendix A the output elasticity of inputs estimated by other widely used methods, and demonstrate that changing TFP estimation methods would not affect our main conclusions.

The Cobb-Douglas production function used to estimate firm-level TFP is written in general as:

$$\ln Y_{it} = \alpha + \beta_i \ln L_{it} + \beta_k \ln K_{it} + \omega_{it} + \varepsilon_{it} \tag{1}$$

Where $\ln Y$ is the natural logarithm of output measured by value added, LnL the natural logarithm of labor measured by staff numbers, $\ln K$ the natural logarithm of capital measured by the book value of fixed assets, ω_{it} is the observed productivity shock and may influence variable inputs in year t, ε_{it} the measurement error. All the monetary values are deflated by price index to eliminate impact of inflation. Specifically, the output is deflated by regional producer price index, the capital and investment deflated by

[3]We notice that the newly introduced private shareholders do not appoint top managers every year in some treatment firms following the shares transfer.

regional fixed asset investment price index, the intermediate inputs and other monetary values deflated by regional consumer price index.

Then, firm-level TFP in logarithmic form can be written as:

$$\ln \mathrm{TFP}_{it} = \ln Y_{it} - \beta_i \ln L_{it} - \beta_k \ln K_{it} \tag{2}$$

3.3. Control Variables

Following prior literature on the factors affecting TFP (Hill and Snell, 1989; Huergo and Jaumandreu, 2004; De Loecker, 2007; Syverson, 2011; Giannetti et al., 2015; Orlic et al., 2018), we control for several variables, such as size, age, leverage, export, labor quality, stock volatility, capital intensity, ownership concentration, management stockholdings and ROA. As for the relationship between competition and productivity, there are two conflicting views. Some authors argue that competition stimulates firms to enhance productivity to avoid exit (Holmes and Schmitz, 2010), while others insist that competition leads to dissipation of innovation rents, thus reducing firm's willingness to innovate and improve productivity (Romer, 1990). Such conflicting views may be resulted from the non-linear correlation between competition and productivity. Therefore, we further control for industry competition and its quadratic form. Table 1 presents the detail definitions of variables used in the production function and baseline test.

3.4. Entropy-Balancing Matching

One commonly accepted view is that governments tend to privatize SOEs with some characters first (Djankov and Murrell, 2002; Gupta et al., 2008; Chen et al., 2021). To address sample selection induced by observable firm-specific factors, we create a synthetic control sample for treatment firms using entropy-balancing matching method. Entropy balancing is a new matching technique proposed by Hainmueller (2012), and it has been used in more recently accounting and financial literature (see, e.g., Chapman et al., 2019; Chahine et al., 2020). Compared to PSM, entropy balancing has three main advantages. First, in the widely used PSM method, researchers may not be able to attain complete covariate balance. In comparison, the covariate balance is directly incorporated into a weight function in entropy-balancing method, which just requires researchers to prespecify balance constraints, and then, exact balance can be achieved automatically and quickly. Second, only the first moment balance can be achieved using PSM method. However, researchers can obtain a higher covariate balance including the first, second and third moments balance of covariates between treatment firms and control firms using entropy-balancing approach. Third, lots of control observations are excluded from our sample when we use PSM method, causing information loss. In contrast, entropy balancing reweights

TABLE 1.

Variable definitions.

Variable name	Variable definition
$\ln Y$	Logarithm of firm value added
$\ln L$	Logarithm of the number of employees
$\ln K$	Logarithm of the book value of the fixed assets
$\ln I$	Logarithm of the expenses for purchase and construction of fixed assets, intangible assets and other long-term assets
$\ln M$	Logarithm of the expenses for material and other inputs
$\ln$ TFP_OP	Logarithmic form of firm-level TFP obtained by estimating production function using OP method
$\ln$ TFP_WD	Logarithmic form of firm-level TFP obtained by estimating production function using WD method
Treat	An indicator variable that equals one if a firm transfers state-owned shares to private investors between 2003-2018
ShrPer	Percentage of shares transferred from the state shareholders to the private shareholders
TopMngPer	Percentage of top managers appointed by new private shareholders
Post	An indicator variable that equals one since the year when the firm transfers state-owned shares to private investors
Size	Logarithm of the total assets
Age	Logarithm of the number of years since the firm was listed on the exchange
Lev	Total liability divided by the total assets
Export	An indicator variable that equals one if a firm is engaged in export business
Quality	Logarithm of cash payments to and on behalf of employees divided by the number of employees
Volatility	Standard deviation of a firm's daily stock returns
CapIntensity	Logarithm of the book value of fixed assets divided by the number of employees
SHHI	Sum of squares of the stockholdings of top 10 shareholders in a firm
MgmHoldings	Number of shares held by the management divided by the total shares outstanding
Competition	One divided by the sum of squares of the sales shares of all firms in a given industry and a given year
Competition2	Quadratic form of variable Competition
ROA	Earnings before interest and tax divided by the total assets

each observation according to the prespecified moments, and thus preserve our full sample.

Given the advantages of entropy balancing, we use such technique to match firms. As for the covariates used to match, following Hainmueller, we include all control variables used in our baseline model and their (excluding Competition2) pairwise first order interactions to achieve a strong balance. In addition, squared terms of the binary variable Export are excluded. Since most selectivity bias is determined by the first and second moments (Hainmueller, 2012), we adjust the mean and variance of covariate variables (interactions only adjust mean) of control firms to make them equal those of treatment firms. Covariate balance tests are output to check whether differences in firm characteristics between treatment and control firms are eliminated. To keep space brief, we only present the results of balance tests for covariates used in the baseline model (see Table 2), while complete results of balance tests for all covariates are shown in Table 17 in Appendix B.

TABLE 2.

Balance tests for covariates used in the baseline model before and after matching.

Variables	Mean			Variance			SDiff_Pre	SDiff_Post
	Treated	Controls		Treated	Controls			
		Pre	Post		Pre	Post		
Size	21.345	21.968	21.346	1.613	1.757	1.614	−0.490	−0.000
Age	2.390	2.267	2.390	0.325	0.469	0.325	0.216	0.000
Lev	0.538	0.512	0.538	0.053	0.041	0.053	0.115	−0.000
Export	0.368	0.454	0.368	0.233	0.248	0.233	−0.179	−0.000
Quality	10.794	10.994	10.795	0.720	0.584	0.720	−0.235	−0.000
Volatility	0.030	0.030	0.030	0.000	0.000	0.000	0.056	−0.000
CapIntensity	0.049	0.125	0.049	1.031	0.845	1.031	−0.075	−0.000
SHHI	0.167	0.210	0.167	0.016	0.018	0.016	−0.335	−0.000
MgmHoldings	0.008	0.003	0.008	0.001	0.000	0.001	0.167	0.000
Competition	46.405	41.907	46.400	938.995	923.386	938.720	0.147	0.000
Competition2	3092.029	2679.479	3091.645	$116.8e^5$	$994.9e^5$	$110.7e^5$	0.121	0.000
ROA	0.040	0.049	0.040	0.007	0.004	0.007	−0.107	−0.000

Note: SDiff_Pre and SDiff_Post denote standardized differences between the treated and control groups before and after matching, respectively.

3.5. Parallel Trend Test and Descriptive Statistics

we should first test whether TFP between the treatment and control firms satisfies parallel trend assumption before using the DID analysis. Specifically, we estimate the dynamic effect of shares transfer on SOEs' TFP relative to the year of shares transfer. The regression we use to

estimate is written as follows:

$$\ln \mathrm{TFP}_{it} = \alpha_0 + \sum_{\tau=1}^{3} \beta_{-\tau} D_{it-\tau} + \beta D_{it} + \sum_{\tau=1}^{3} \beta_{+\tau} D_{it+\tau} + \theta X_{it-1} + \mu_i + \lambda_t + \varepsilon_{it} \tag{3}$$

Where $D_{it-\tau}$ equals one for firms in the τth year before shares transfer, $D_{it+\tau}$ equals one for firms in the τth year after shares transfer, and Dit equals one for firms in the year of shares transfer. X_{it-1} are a series of control variables included in the baseline model. μ_i and λ_t denote firm and year fixed effects, respectively. After the regression, we plot the average treatment effect of each year, see Figure 1. As shown, the coefficients on the year dummies before shares transfer are not significantly different from zero, satisfying parallel trend assumption. It is worth noting that SOEs' TFP begin to increase in the year of shares transfer, significantly positive at the 1% level. Moreover, this effect persists to the third year after shares transfer, implying that new private shareholders play a long-lasting role in an SOE.

FIG. 1. The dynamic impact of new private shareholders on the firm TFP. The dependent variable is ln TFP_OP. We consider a 6-year window from 3 years before shares transfer to 3 years after shares transfer. The dashed lines represent 95% confidence intervals.

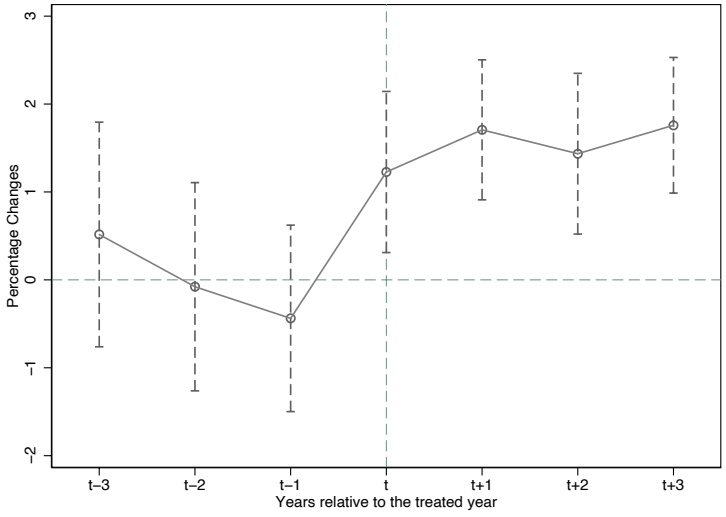


Table 3 presents the summary statistics of the main variables used in our paper. The dependent variable, ln TFP has a lower value estimated by OP method and a higher value estimated by WD method, which indicates that

utilizing various methodologies to estimate firm-level TFP is the essential prerequisite for producing reliable results.

TABLE 3.

Descriptive statistics.

Variables	N	Mean	S.D.	Min	Median	Max
ln TFP_OP	15,654	0.039	4.451	−23.651	0.846	7.181
ln TFP_WD	15,654	3.855	4.455	-18.948	4.750	10.153
Treat	15,654	0.146	0.353	0.000	0.000	1.000
ShrPer	15,654	3.575	9.986	0.000	0.000	48.974
TopMngPer	15,654	0.009	0.043	0.000	0.000	0.300
Post	15,654	0.104	0.305	0.000	0.000	1.000
Size	15,654	21.962	1.359	18.955	21.790	26.000
Age	15,654	2.412	0.559	0.693	2.485	3.367
Lev	15,654	0.522	0.209	0.076	0.527	1.208
Export	15,654	0.452	0.498	0.000	0.000	1.000
Quality	15,654	11.036	0.754	9.104	11.043	13.381
Volatility	15,654	0.029	0.009	0.013	0.027	0.069
CapIntensity	15,654	0.131	0.937	−2.188	0.094	2.675
SHHI	15,654	0.197	0.131	0.017	0.168	0.593
MgmHoldings	15,654	0.004	0.018	0.000	0.000	0.147
Competition	15,654	42.944	30.984	2.179	40.762	124.592
Competition2	15,654	2804.158	3332.484	4.750	1661.508	15523.264
ROA	15,654	0.047	0.067	−0.263	0.046	0.250

4. MAIN RESULTS

4.1. Introducing New Private Shareholders and Firm TFP

To test the effect of new private shareholders on SOEs' TFP, we estimate the following fixed effect model:

$$\ln \mathrm{TFP}_{it} = \alpha_0 + \beta_1 \mathrm{Treat}_{it} * \mathrm{Post}_{it} + \theta X_{it-1} + \mu_i + \lambda_t + \varepsilon_{it} \qquad (4)$$

Where ln TFP is the logarithm of firm-level TFP measured by ln TFP_OP and ln TFP_WD, respectively. Treat is a vector of treatment variables among which, Treat is an indicator variable that equals one if a firm transfers state-owned shares to private investors between 2003-2018, ShrPer is the percentage of shares transferred from the state shareholders to the private shareholders, and we set it zero in control firms, TopMngPer is the percentage of top managers appointed by the newly introduced private shareholders, and we set it zero in control firms. Post is an indicator variable that equals one since the year when the firm transfers state-owned

shares to private investors, and we set it zero in control firms. X is a series of control variables mentioned in Section 3.3, all are lagged for one to avoid reverse causality. μ_i and λ_t are firm and year fixed effects, respectively.

Table 4 reports the results from estimating model (4). The dependent variable in Columns (1) - (3) is ln TFP_OP. Column (1) shows that the coefficient for the interaction term of Treat and Post is 1.072, positive and significant at the 1% level. The implication of this effect is that the SOEs' productivity level increases by about 107.2% relative to the pre-shares-transfer period. In Column (2), we consider the variation in the percentage of shares transferred. As shown, the coefficient for the interaction term of ShrPer and Post is 0.062, significant at the 1% level, the economic implication is that each additional 1% of the shares transferred to new private investors would bring an increase in TFP by about 6.2%. In Column (3), we use another variable, TopMngPer, to control for new private shareholders' right to speak in an SOE. The coefficient for TopMngPer $*$ Post is 6.644 and significant at the 1% level, implying that an additional 1% of top management appointed by new private shareholders increases firm TFP by 6.64%. The results are similar to Columns (1) - (3) when we use ln TFP_WD as dependent variable, see Columns (4) - (6). Collectively, our results support the view that introducing new private shareholders is beneficial to SOEs' TFP, and the larger the right of new private shareholders to speak, the more the SOEs' productivity will increase. In addition, we find that Quality, SHHI, MgmHoldings and ROA are positively correlated with firm TFP, while Lev and CapIntensity are negatively correlated with firm TFP. Besides, there is a U-shaped relationship between competition and firm TFP. The signs of control variables are consistent with previous literature.

4.2. The Heterogeneity in Marginal Effects of New Private Shareholders on Firm TFP

An interesting question we want to explore now is if the listed SOEs in China have the similar extent of privatization? The intuition is that marginal effects of further privatization on TFP should be different in firms with different extents of privatization. We first present the summary statistics for extent of privatization of SOEs in our sample (see Table 5). The extent of privatization is defined from the aspects of ownership structure and top management governance, respectively.

We can see two main facts on the extent of privatization of listed SOEs in China. First, the great majority of listed SOEs yet have a low-level extent of privatization. On average, the percentage of shares held by private shareholders in SOEs is just 12.47%, and SOEs with private shares less than 10% accounts for 59.50%. In addition, the average percentage of top managers appointed by private shareholders in SOEs is quite low, just

TABLE 4.

The effect of new private shareholders on firm TFP.

Variables	(1) ln TFP_OP	(2) ln TFP_OP	(3) ln TFP_OP	(4) ln TFP_WD	(5) ln TFP_WD	(6) ln TFP_WD
Treat ∗ Post	1.072***			1.002***		
	(3.069)			(2.874)		
ShrPer ∗ Post		0.062***			0.059***	
		(4.199)			(3.990)	
TopMngPer ∗ Post			6.644***			6.530***
			(3.432)			(3.380)
Size	−0.182	−0.177	−0.199	−0.031	−0.026	−0.047
	(−1.013)	(−0.982)	(−1.106)	(−0.173)	(−0.144)	(−0.260)
Age	−0.043	−0.133	−0.021	0.015	−0.072	0.032
	(−0.130)	(−0.399)	(−0.062)	(0.046)	(−0.216)	(0.094)
Lev	−1.680**	−1.621**	−1.608**	−1.673**	−1.618**	−1.604**
	(−2.399)	(−2.330)	(−2.298)	(−2.391)	(−2.326)	(−2.295)
Export	0.089	0.070	0.088	0.110	0.092	0.110
	(0.377)	(0.300)	(0.376)	(0.468)	(0.395)	(0.469)
Quality	0.715***	0.692***	0.695***	0.643***	0.621***	0.623***
	(3.678)	(3.601)	(3.594)	(3.315)	(3.237)	(3.228)
Volatility	−16.149	−17.256	−17.308	−16.535	−17.581	−17.657
	(−1.355)	(−1.448)	(−1.451)	(−1.391)	(−1.479)	(−1.484)
CapIntensity	−0.617***	−0.618***	−0.617***	−0.518***	−0.519***	−0.517***
	(−4.025)	(−4.032)	(−4.039)	(−3.374)	(−3.378)	(−3.382)
SHHI	4.634***	4.836***	4.473***	4.532***	4.726***	4.381***
	(4.686)	(4.902)	(4.556)	(4.591)	(4.800)	(4.470)
MgmHoldings	12.646*	11.872*	15.131**	12.640*	11.889*	15.033**
	(1.925)	(1.825)	(2.290)	(1.923)	(1.825)	(2.274)
Competition	−0.028**	−0.027**	−0.030**	−0.027**	−0.026**	−0.029**
	(−2.116)	(−2.013)	(−2.236)	(−2.067)	(−1.965)	(−2.177)
Competition2	0.000*	0.000*	0.000**	0.000*	0.000*	0.000*
	(1.861)	(1.776)	(1.966)	(1.854)	(1.771)	(1.949)
ROA	6.666***	6.484***	6.589***	6.731***	6.557***	6.652***
	(4.399)	(4.306)	(4.369)	(4.436)	(4.347)	(4.405)
Constant	0.853	1.267	1.266	1.759	2.158	2.181
	(0.181)	(0.269)	(0.271)	(0.374)	(0.459)	(0.467)
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	15,654	15,654	15,654	15,654	15,654	15,654
R^2	0.359	0.362	0.360	0.366	0.368	0.367

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively.

3.30%, and SOEs in which private shareholders do not appoint top managers accounts for 74.96%. Such a fact demonstrates that China's large SOEs need to be further privatized to further improve their productivity. Second, the extent of privatization among SOEs varies greatly. In particular, the standard deviation of percentage of private shares in SOEs is 12.616, and the max value of it is 53.04%. Meanwhile, the standard deviation of percentage of top managers appointed by private shareholders is large as well, and its max value reaches 50%.

TABLE 5.

Summary statistics for extent of privatization of SOEs.

Panel A: Summary statistics for extent of privatization		
	Percentage of shares held by private shareholders (%)	Percentage of top managers appointed by private shareholders (%)
Mean	12.468	3.302
S.D.	12.616	7.270
Min	0.530	0.000
Max	53.040	50.000
p50	7.390	0.000
p75	17.420	2.857
N	15,654	15,654

Panel B: Distribution of different extents of privatization		
	Distribution of private shares	
Extent of privatization	N	% of total
$0\% <$ private shares $< 10\%$	9315	59.50%
$10 \leq$ private shares $< 20\%$	2952	18.86%
$20 \leq$ private shares $< 30\%$	1453	9.28%
$30 \leq$ private shares $< 40\%$	1117	7.14%
$40 \leq$ private shares $< 53.04\%$	817	5.22%
Total	15,654	100%
	Distribution of top managers appointed by private shareholders	
Extent of privatization	N	% of total
appoint top managers $= 0\%$	11734	74.96%
appoint top managers $> 0\%$	3920	25.04%
Total	15,654	100%

Given the two facts on the extent of privatization of SOEs in China, we next investigate whether marginal effects of further privatization on firm TFP vary by extent of privatization, and SOEs with what extent of privatization could benefit more from further privatization? To test such

questions, we construct the following model based on equation (4):

$$\begin{aligned}\ln \mathrm{TFP}_{it} &= \alpha_0 + \beta_1 \mathrm{Treat}_{it} * \mathrm{Post}_{it} * \mathrm{PrivDgr}_{it-1} + \beta_2 \mathrm{Treat}_{it} * \mathrm{Post}_{it} \\ &\quad + \beta_3 \mathrm{PrivDgr}_{it-1} + \theta X_{it-1} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{5}$$

Where PrivDgr is the extent of privatization, measured by two variables. One is a category variable—denoted by PrivDgr1—that equals one if the percentage of shares held by initial private shareholders in a firm is greater than 0% and less than 10%, two if the percentage is greater than 10% and less than 20%, three if the percentage is greater than 20% and less than 30%, four if the percentage is greater than 30% and less than 40%, and five if the percentage is greater than 40%.[4] Another is a continuous variable—denoted by PrivDgr2—that equals the percentage of top managers appointed by initial private shareholders. Note that we use lagged PrivDgr to measure control firms' initial privatization extent, and PrivDgr one year before shares transfer to measure treated firms' initial privatization extent.

4.2.1. Marginal effects when we define privatization extent in terms of ownership structure

According to China's company law, shareholders who individually or jointly own more than 10% of shares have rights to convene an interim shareholders' meeting, in which they could vote on some major issues of the firm. Therefore, we use 10% as an interval to divide percentage of shares held by initial private shareholders into five categories and use them to measure firms' privatization extent.

Table 6 presents the results of marginal effects of shares held by new private shareholders on firm TFP under different extents of privatization. As shown, the effect of each additional 1% of the shares transferred to new private shareholders on firm TFP first decreases with the rise of firms' privatization extent. However, when a firm's privatization extent reaches between 30% and 40%, the marginal effect of additional 1% private shares on firm TFP begins to raise, and then begins to decrease again. Therefore, the results indicate that SOEs in which the initial private shareholders held a lower percentage of shares (less than 20%) or a higher percentage of shares (more than 30%) could benefit from further increasing private shares.

[4]We find that marginal effects of further privatization on TFP do not increase or decrease continually by the percentage of shares held by initial private shareholders. Thus, we use category variable rather than continuous variable when we define privatization extent in terms of ownership structure.

TABLE 6.

Marginal effects of shares transferred to new private shareholders on firm TFP.

Variables	(1) ln TFP_OP		(2) ln TFP_WD	
	dy/dx	t-statistic	dy/dx	t-statistic
ShrPer $*$ Post				
at: $0\% <$ PrivDgr1 $< 10\%$	0.073^{***}	3.752	0.070^{***}	3.580
$10\% \leq$ PrivDgr1 $< 20\%$	0.053^{***}	2.787	0.051^{***}	2.715
$20\% \leq$ PrivDgr1 $< 30\%$	-0.028	-0.561	-0.034	-0.679
$30\% \leq$ PrivDgr1 $< 40\%$	0.414^{***}	2.670	0.416^{***}	2.673
$40\% \leq$ PrivDgr1 $< 53.04\%$	0.207^{*}	1.810	0.210^{*}	1.825
Control Variables	YES		YES	
Firm FE	YES		YES	
Year FE	YES		YES	
N	15,654		15,654	
R^2	0.365		0.372	

Note: ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief.

Results in Table 6 could be interpreted by the Chinese company law. First, according to Articles 43 and 103 of China's company law, a resolution on seven major issues such as amending company's articles of association must be approved by shareholders representing more than two-thirds of the voting rights.[5] In other words, shareholders who own more than 33.34% shares could influence decisions on seven major issues, especially on firms' articles of association. Therefore, private shares reaching more than 33.34% implies that they could have veto power on firms' many major issues related to operation and finance. It is noted that, the initial privatization extent between 30% and 40% consists of a key point 33.34%, which may be responsible for the marginal benefit of additional 1% private shares being the most pronounced, given that the marginal effect of additional 1% private shares that causes PrivDgr1 from less than 33.34% to more than 33.34% is extraordinarily large. Second, according to Article 103, many resolutions of shareholders' meeting must be carried by half of the voting rights held by the shareholders present at the meeting. That is, shareholders who own more than 50% shares have veto power on lots of important issues such as profit distribution plans, appointment and

[5]A firm's seven major issues refer to amending articles of association, changing registered capital, merger, demerger, dissolution or altering corporate form, buying (selling) major assets that exceed 30% of the total assets within one year, and providing credit guarantees that exceed 30% of the total assets within one year.

removal of directors. Obviously, the initial privatization extent between 40% and 53% contains an important point 50%, and thus further increases in private shares could enable some SOEs' privatization extend to achieve more than 50%. From this perspective, the marginal impact of additional 1% private shares at $40\% \leq \text{PrivDgr1} < 53\%$ ranking second is reasonable. Third, according to Article 101, shareholders who hold more than 10% of a firm's shares could request to convene an interim shareholders' meeting. In other words, shareholders who hold more than 10% shares could vote on important issues in time by calling on a shareholders' meeting, which is conducive to safeguarding their interests. As we all know, the initial privatization extent between 0% and 20% contains an important point 10%, implying that further increases in private shares could result in total private shares in some SOEs achieving more than 10%. This may be why we also see a significant marginal impact of additional 1% private shares at $0\% < \text{PrivDgr1} < 10\%$ and $10\% \leq \text{PrivDgr1} < 20\%$. However, the Chinese company law does not provide clear articles about the rights that shareholders should have when their shareholdings achieve more than 20%, and we attribute the insignificant marginal impact of additional 1% private shares at $20\% \leq \text{PrivDgr1} < 30\%$ to this.

4.2.2. Marginal effects when we define privatization extent in terms of management governance

In this section, we use the percentage of top managers appointed by initial private shareholders to measure privatization extent. Table 7 reports the results of marginal effects of top managers appointed by new private shareholders on firm TFP under various extents of privatization. As shown, the effect of each additional 1% of top managers appointed by new private shareholders on firm TFP diminishes with the rise of firms' privatization extent. Specifically, the marginal effect of further appointing top managers is the largest when initial private shareholders have not appointed top managers in a firm. In addition, the marginal effect is positive when the extent of privatization is less than 15%, but becomes negative when the extent of privatization exceeds 15%. More importantly, new private shareholders appointing top managers could significantly improve firm TFP when the extent of privatization is no more than 7.5%.

One caveat with these results is that the estimated marginal effect may not be so accurate at higher extent of privatization—when $\text{PrivDgr2} \geq 5\%$—because the number of firms in our sample with higher extent of privatization is small, that is, the 75th percentile of top managers appointed by private shareholders is just 2.86%, and nearly 75% of SOEs do not have

such kind of top managers. Therefore, one should be cautious when using 7.5% and 15% as the significant and positive threshold of marginal effects. Even so, our results are meaningful, which demonstrate that the lower the percentage of top managers appointed by private shareholders, especially when it is 0%, the greater the effect of allowing new private shareholders to appoint top managers, otherwise, the effect of further appointing top managers is trivial and even negative.

TABLE 7.

Marginal effects of top managers appointed by new private shareholders on firm TFP.

Variables	(1) ln TFP_OP		(2) ln TFP_WD	
	dy/dx	t-statistic	dy/dx	t-statistic
TopMngPer $*$ Post				
at: PrivDgr2 = 0%	7.856^{***}	3.985	7.699^{***}	3.912
PrivDgr2 = 2.5%	6.624^{***}	3.430	6.526^{***}	3.386
PrivDgr2 = 5%	5.391^{**}	2.569	5.353^{**}	2.557
PrivDgr2 = 7.5%	4.159^{*}	1.709	4.180^{*}	1.725
PrivDgr2 = 10%	2.927	1.018	3.007	1.051
PrivDgr2 = 12.5%	1.694	0.501	1.834	0.545
PrivDgr2 = 15%	0.462	0.117	0.661	0.169
PrivDgr2 = 17.5%	−0.770	−0.171	−0.513	−0.114
PrivDgr2 = 20%	−2.003	−0.393	−1.686	−0.332
PrivDgr2 = 22.5%	−3.235	−0.567	−2.859	−0.504
PrivDgr2 = 25%	−4.468	−0.707	−4.032	−0.642
PrivDgr2 = 27.5%	−5.700	−0.821	−5.205	−0.755
PrivDgr2 = 30%	−6.932	−0.917	−6.378	−0.849
PrivDgr2 = 32.5%	−8.165	−0.997	−7.551	−0.928
Control Variables	YES		YES	
Firm FE	YES		YES	
Year FE	YES		YES	
N	15,654		15,654	
R^2	0.362		0.369	

Note: ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief.

4.3. Robustness Tests

4.3.1. Changing control firms

In our bassline analysis, we employ entropy-balancing approach and firm fixed effects model to address selection bias induced by some observable and unobservable firm-specific factors. However, there may be some unobserved

and time-variant factors that simultaneously influence further privatization and firm productivity. To address such selection issue, we follow Frydman et al. (1999) who use firms privatized in later years rather than firms that remain controlled by the state as the control group. Specifically, we restrict the sample period to 2003-2017. In other words, firms that were privatized during 2003-2017 are put into a treatment group with those privatized in 2018 classified into a control group. Table 8 reports the results from re-estimating model (4) using alternative sample. As shown, there are still significant positive relationship between further privatization and firm TFP, implying that unobserved factors that change with time do not affect the robustness of our results.

TABLE 8.

Regression results using alternative sample.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	ln TFP_OP	ln TFP_OP	ln TFP_OP	ln TFP_WD	ln TFP_WD	ln TFP_WD
Treat ∗ Post	1.350***			1.288***		
	(3.053)			(2.917)		
ShrPer ∗ Post		0.081***			0.078***	
		(4.509)			(4.352)	
TopMngPer ∗ Post			6.536***			6.448***
			(3.136)			(3.104)
Constant	−4.184**	−4.676**	−3.318*	−0.675	−1.157	0.160
	(−2.248)	(−2.495)	(−1.804)	(−0.365)	(−0.622)	(0.087)
Control Variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	2,157	2,157	2,157	2,157	2,157	2,157
R^2	0.267	0.274	0.267	0.277	0.284	0.278

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief.

4.3.2. Estimating production function for each industry

Different industries may adopt different production technologies. To solve this heterogeneity problem, we re-estimate the production function by one-digit industry and by two-digit industry for manufacturing. Then, we calculate the firm-level TFP by using industry-level production function coefficients, denoted by ln TFP_OP2 and ln TFP_WD2. Table 9 shows the regression results from estimating model (4) using alternative measurements for TFP. As we can see, positive relationship still holds between

introducing new private capital and firm TFP, and such effect is more pronounced among firms who transfer a large number of shares or allow private shareholders to appoint top managers.

TABLE 9.

Regression results using alternative measurements for TFP.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	ln TFP_OP2	ln TFP_OP2	ln TFP_OP2	ln TFP_WD2	ln TFP_WD2	ln TFP_WD2
Treat ∗ Post	1.694***			1.448***		
	(4.196)			(3.268)		
ShrPer ∗ Post		0.090***			0.093***	
		(5.612)			(5.238)	
TopMngPer ∗ Post			8.260***			7.794***
			(3.341)			(3.306)
Constant	8.234	8.786*	8.632*	14.748**	15.414**	15.172**
	(1.570)	(1.680)	(1.646)	(2.435)	(2.559)	(2.504)
Control Variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	15,654	15,654	15,654	15,654	15,654	15,654
R^2	0.699	0.701	0.699	0.741	0.743	0.742

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief.

4.3.3. Placebo tests

We conduct a placebo test by randomly selecting a year for each treatment firm as its falsified treatment time. Specifically, we first group the observations into firms and randomly select one year from all the unique years of each firm as its treatment time. Then, we re-define Post according to the falsified treatment time, denoted by Post_False. Table 10 presents the regression results of the placebo test. As shown, the coefficients of Treat ∗ Post_False, ShrPer ∗ Post_False and TopMngPer ∗ Post_False are no longer significant. In other words, there are not positive effects of new private shareholders on SOEs' TFP when we base on falsified treatment time, suggesting that the results in this paper are not driven by accident.

4.3.4. Propensity score matching analysis

Nowadays, propensity score matching is widely used in literature to address selectivity bias issue, although it has many shortcomings. Therefore, we also use propensity score approach to match firms. As we have a panel

TABLE 10.

Placebo tests by setting falsified treatment time.

Variables	(1) ln TFP_OP	(2) ln TFP_OP	(3) ln TFP_OP	(4) ln TFP_WD	(5) ln TFP_WD	(6) ln TFP_WD
Treat ∗ Post_False	−0.048			−0.068		
	(−0.189)			(−0.270)		
ShrPer ∗ Post_False		−0.005			−0.007	
		(−0.558)			(−0.691)	
ToMngPer ∗ Post_False			1.477			1.418
			(0.783)			(0.752)
Constant	0.498	0.475	0.581	1.420	1.393	1.507
	(0.106)	(0.101)	(0.124)	(0.303)	(0.297)	(0.321)
Control Variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	15,654	15,654	15,654	15,654	15,654	15,654
R^2	0.357	0.357	0.357	0.364	0.365	0.365

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief.

data with firm-year observations, following the procedures used by Heyman et al. (2007) and Lu (2016), the matching of firms is based on every year data. First, we estimate a logit model with the dummy variable Treat as dependent variable. The covariates used to match include all the control variables in the baseline model and the industry and region dummy variables. After that, we match treatment firms and control firms based on propensity scores using one to one nearest neighbor matching without replacement. Table 11 reports the regression results using the propensity score matched sample. As shown, the positive and significant correlations between treatment variables and firm TFP continue to hold.

5. UNDERLYING MECHANISMS

We have thus far found that an SOE's TFP may enhance by introducing new private shareholders, then, another extremely important question is how new private shareholders affect firm TFP. We now explore three potential channels through which new private shareholders may improve TFP. The first mechanism is based on a decrease in government intervention caused by the dilution of state ownership following further privatization, and we use the change of long-term investment to measure it. The

TABLE 11.

Regression results based on propensity score matched sample.

Variables	(1) ln TFP_OP	(2) ln TFP_OP	(3) ln TFP_OP	(4) ln TFP_WD	(5) ln TFP_WD	(6) ln TFP_WD
Treat ∗ Post	0.949**			0.893**		
	(2.083)			(1.969)		
ShrPer ∗ Post		0.056***			0.054***	
		(2.839)			(2.698)	
TopMngPer ∗ Post			5.792**			5.708**
			(2.428)			(2.411)
Constant	−6.854	−6.689	−6.407	−5.546	−5.388	−5.102
	(−1.522)	(−1.488)	(−1.427)	(−1.238)	(−1.204)	(−1.141)
Control Variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	4,394	4,394	4,394	4,394	4,394	4,394
R^2	0.067	0.070	0.068	0.065	0.068	0.066

Note: t-value is presented in (). We use heteroscedastic robust standard errors. ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief.

latter two mechanisms focus on improvement in terms of monitoring and incentivizing top management.

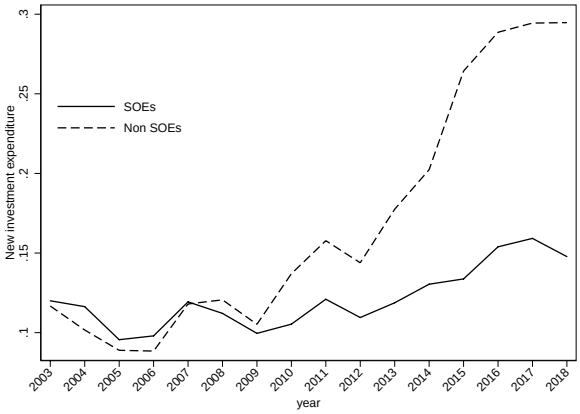
5.1. Long-Term Investment

It is well known that government intervention causes distortion of SOEs' investment behavior, but consensus has not been reached concerning whether SOEs are over-invested or under-invested. Some authors argue that managers in SOEs tend to reduce investment to avoid adverse impacts of high-risk on promotion. However, other authors insist that government officials could pursue individual interests and political goals—such as GDP growth, employment and social stability—by making SOEs overinvest.

Figure 2 shows the average long-term investment trends of the listed state-owned firms and private firms in China from 2003 to 2018. A firm's long-term investment each year is measured by the total spending on fixed assets, intangible assets, other long-term assets, acquisitions of subsidiaries and equity and debt investment scaled by lagged total assets. We can draw two inferences from Figure 2. First, there was little difference between the annual average investment of SOEs and non-SOEs before 2009. Second, the annual average investment of private firms has far exceeded that of SOEs since 2009, implying that SOEs are under-invested compared with private firms. Thus, our result supports the "insufficient investment" view, and is

consistent with prior literature, such as Megginson and Netter (2001) who find that SOEs rarely overinvest and capital investment increases significantly after privatization.

FIG. 2. The annual average new investment expenditures of listed SOEs and non-SOEs in China from 2003 to 2018. We use the total spending on fixed assets, intangible assets, other long-term assets, acquisitions of subsidiaries and equity and debt investment scaled by lagged total assets to measure a firm's annual new investment expenditures.



We next test whether long-term investment is a channel through which introducing private shareholders enhance TFP. Table 12 reports the results of the potential long-term investment channel. As shown, introducing new private capital results in an increase in long-term investment, significant at 5% level. The larger the number of shares transferred to or the number of top managers appointed by new private shareholders, the more a firm invests in long-term projects, significant at 1% and 10% level, respectively. Results in Table 12 may indicate that new private shareholders could further influence SOEs' investment decisions, and thus improving TFP. Our results are inconsistent with Chen et al. (2021), who conjecture that large privatized SOEs tend to reduce capital investment after privatization. Maybe two reasons could explain: First, they use a dummy indicator to measure privatization, and so, in fact, they horizontally compare the capital investment between SOEs and privatized firms. However, we focus on the longitudinal comparison using a DID method, and thus our results show the real change of firms' investment after privatization. Second, the calculations of investment are different. They use fixed assets investment while we use the sum of investment in all long-term assets including fixed assets, intangible assets, acquisitions of subsidiaries, etc. In

our opinion, intangible assets and other long-term assets may contribute more to an SOE's productivity improvement.

TABLE 12.

The impact of new private shareholders on TFP: Long-term investment channel.

Variables	(1) INew	(2) INew	(3) INew
Treat ∗ Post	0.023**		
	(2.257)		
ShrPer ∗ Post		0.001***	
		(3.113)	
TopMngPer ∗ Post			0.113*
			(1.869)
Constant	1.180***	1.184***	1.179***
	(8.822)	(8.863)	(8.822)
Control Variables	YES	YES	YES
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
N	14,835	14,835	14,835
R^2	0.488	0.489	0.488

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief. Following prior literature, we control firm size, leverage, cash holdings, sales growth, annually stock returns, age, long-term investment last year, firm and year fixed effects. The number of observations is less than 15654 because the data of some control variables are missing.

5.2. Excess Perks

Good management practices are another key source of TFP improvement. For example, Bloom and Van Reenen (2010) provide evidence that firms with higher management quality tend to be more productive. As monitoring and incentives are two critical components of management practices, in section 5.2 and 5.3 we test whether SOEs provide more monitoring and incentives to executives after introducing new private shareholders.

Abnormal perk is a very desirable variable to measure the monitoring role of private shareholders. As a socialist country, the Chinese government usually exsert regulation on cash compensations of top managers in SOEs to keep fair income distribution. To incentivize executives, most of the Chinese SOEs provide perks to top managers. However, getting excess perks for managers is very common due to the absence of owners' monitor-

ing. Excess or abnormal perks are considered as transferring resources from the firm, which hurts firm's operating efficiency and productivity (Luo et al., 2011; Cai et al., 2011). The intuition is that the abnormal perks should be influenced if new private shareholders indeed play an additional role in monitoring executives. To this end, we first estimate abnormal perks using the model of Luo et al. (2011) that is written as:

$$\begin{aligned}\frac{\text{Mexpense}_{it}}{\text{Asset}_{it-1}} &= \beta_0 + \beta_1 \frac{1}{\text{Asses}_{it-1}} + \beta_2 \frac{\Delta\text{Sales}_{it}}{\text{Asset}_{it-1}} + \beta_3 \frac{\text{PPE}_{it}}{\text{Asset}_{it-1}} \\ &+ \beta_4 \frac{\text{Inv}_{it}}{\text{Asset}_{it-1}} + \beta_5 \ln \text{Emp}_{it} \end{aligned} \tag{6}$$

Where Mexpense_{it} is perks excluding regular expenses and cash payment, which is calculated as administrative expenses minus the sum of bad debt expenses, unrealized holding gains or losses for inventory and cash compensation for top managers. Asset_{it-1} is total assets lagged for one. ΔSales_{it} is sales revenue this period minus sales revenue last period. PPE_{it} is book value of fixed assets. Inv_{it} is book value of inventories. $\ln \text{Emp}_{it}$ is natural logarithm of the number of employees. we estimate the model by year and industry, and define the residuals as abnormal perks.

Then, we test the excess perks channel through which introducing private shareholders affect firm TFP. Because China has implemented a series of anti-corruption policies including eight rules that restricts the perks of government officials and top managers in SOEs since 2013, so we conjecture that the excess perks before 2013 are more common, and the monitoring effect of private shareholders should be more prominent during this period. Table 13 reports the results of the excess perks channel. As shown, introducing private shareholders can inhibit the excess perks of top executives before 2013. In addition, appointing top managers by new private shareholders have no significantly negative effect on excess perks before 2013, the reason may be that perks are related to the individual interests of top managers per se. Surprisingly, the situation is opposite after 2013. It seems contrary to our expected direction. In fact, the mean value of excess perk before 2013 and after 2013 are 0.11 and -0.12, respectively, indicating that administrative expenses per unit assets of SOEs before 2013 exceed the normal level while after 2013 they are lower than the normal level. Such fact confirms that anti-corruption results in excessive reduction in administrative costs. Therefore, results in Table 13 indicate that both positive and negative excess perks are detrimental to firm TFP, and new private shareholders could play a monitoring role when the excess perks are positive and could make the administrative expenses return to normal

level when the excess perks are negative. In either case, excess perks maybe a potential mechanism between introducing new private shareholders and firm TFP.

TABLE 13.

The impact of new private shareholders on TFP: Excess perks channel.

Variables	Before 2013			After 2013		
	(1)	(2)	(3)	(4)	(5)	(6)
	Ab_Perk	Ab_Perk	Ab_Perk	Ab_Perk	Ab_Perk	Ab_Perk
Treat ∗ Post	−0.455**			1.009***		
	(−2.343)			(3.632)		
ShrPer ∗ Post		−0.017**			0.045***	
		(−2.462)			(3.215)	
TopMngPer ∗ Post			−1.461			2.988**
			(−1.312)			(2.227)
Constant	17.045***	17.073***	17.131***	8.758*	9.057*	9.930**
	(6.862)	(6.880)	(6.919)	(1.786)	(1.847)	(2.024)
Control Variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	8,812	8,812	8,812	6,133	6,133	6,133
R^2	0.600	0.600	0.599	0.728	0.728	0.727

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief. Following prior literature, we control firm size, operating cash flow, sales growth, leverage, age, percentage of shares held by the largest shareholder, board size, percentage of independent directors, total pay for the three highest-paid managers, percentage of shares held by managers, firm and year fixed effects. The number of observations is less than 15654 because the data of some firms' Ab_Perk and control variables are missing.

5.3. Pay-Performance Sensitivity

Following the logic of traditional wisdom, we use pay-performance sensitivity to measure incentives to executives. Previous literature shows that the pay-performance sensitivity increases after privatization, and pay for performance could significantly enhance firm productivity. Therefore, we try to investigate whether new private capital introduced by an SOE is also able to enhance top managers' pay-performance sensitivity, and thus improving firm TFP. To conduct the potential mechanism test, we need to measure the pay-performance sensitivity of an individual firm, but few studies have provided such measurement method except Abowd (1990) who first used a dummy variable to measure it. Abowd considers the pay to be sensitive to performance if both executive pay and firm performance

are above (under) their annul industry median. Following the wisdom of Abowd, we argue that if executive pay declines (raises) following the reduction (increase) in performance, then pay is sensitive to performance. Therefore, we define two indicator variables, one is DownPPS that equals one if pay declines following the reduction in performance and zero otherwise, another is UpPPS that equals one if pay raises following the increase in performance and zero otherwise.

TABLE 14.

The impact of new private shareholders on TFP: Pay-performance sensitivity channel.

Variables	(1) DownPPS	(2) DownPPS	(3) DownPPS	(4) UpPPS	(5) UpPPS	(6) UpPPS
Treat ∗ Post	−0.030			0.052*		
	(−1.303)			(1.843)		
ShrPer ∗ Post		−0.002**			0.002**	
		(−2.027)			(2.064)	
TopMngPer ∗ Post			−0.134			0.054
			(−1.151)			(0.356)
Constant	−0.950***	−0.955***	−0.949***	1.705***	1.709***	1.699***
	(−3.367)	(−3.384)	(−3.361)	(5.029)	(5.038)	(5.011)
Control Variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	15,100	15,100	15,100	15,100	15,100	15,100
R^2	0.125	0.126	0.125	0.131	0.132	0.131

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. The coefficients of the control variables are not reported to keep brief. Following prior literature, we control firm size, leverage, sales growth, percentage of shares held by the largest shareholder, board size, percentage of independent directors, whether the chairman of the board and the CEO are the same person, an indicator that equals one if a firm's headquarter is located in eastern China, an indicator that equals one if a firm's headquarter is located in central China, firm and year fixed effects. The number of observations is less than15654 because the data of some firms' executive pay and control variables are missing.

Table 14 reports the results of the pay-performance sensitivity channel. As shown in Column (2), the percentage of shares transferred to new private shareholders is negatively associated with DownPPS, indicating that the more shares transferred to new private shareholders, the less executive pay falls following the decrease in performance, namely, a higher degree of pay stickiness. One reason may be that pay stickiness is an incentive mechanism that motivates executives to engage in high-risk and high-return projects. Columns (4) and (5) show that there is a significant positive relationship between Treat ∗ Post or ShrPer ∗ Post and UpPPS, while no

significant positive effect of TopMngPer $*$ Post on UpPPS, suggesting that new private shareholders holding higher shares is conducive to enhancing UpPPS, but the appointment of directors does not have such effect. Collectively, transferring more shares to new private investors could promote an SOE to design a more incentive compensation contract.

6. CONCLUSIONS

This paper has employed the data on transfer of state-owned shares to investigate how newly introduced private shareholders influence firm TFP. The DID analysis based on an entropy-balanced sample indicates that, following the introduction of new private shareholders, firm TFP estimated by using OP and WD method increase by about 107.2% and 100.2%, respectively. These results are more prominent when we consider the number of shares transferred to and the number of top managers appointed by new private shareholders. Our results are robust to a series of alternative checks, including changing the control sample, alternative measurements for TFP, placebo tests by randomly selecting a falsified treatment year for each firm, and propensity score matching analysis.

We also try to explore the marginal effects of further privatization on TFP under various extents of privatization. The results show that the marginal effects of further increasing private shares decrease first and then increase. Specifically, further increasing private shares has a larger marginal benefit for SOEs with initial private shares less than 10% and greater than 30%. In addition, the marginal effects of further appointing top managers display a diminishing law. That is, SOEs whose initial private shareholders have not appointed top managers benefit most from the top managers appointed by new private shareholders.

We further test underlying channels through which the newly introduced private shareholders may affect firm TFP. Mechanism variables are constructed based on the government intervention view and the manager view, respectively. On the one hand, we use long-term investment to measure government intervention. The results show an increase in long-term investment following the introduction of new private shareholders. On the other hand, excess perks and pay-performance sensitivity are used to measure monitoring and incentives for top management. We find that there is a decrease in excess perks and an improvement in incentive compensation after further privatization, but these two mechanisms work only when the newly introduced private shareholders hold higher shares.

We can draw two lessons from our study. First, using more sophisticated econometric method, we find that introducing new private shareholders without ownership changes could generate positive effects, which is consistent with Gupta (2005). Moreover, such result provides an important implication to the ongoing mixed-ownership reform in China, namely, advancing SOE reform through calling for SOEs to introduce other capitals is not a bad (maybe a sub-optimal) strategy for China who is experiencing economic transformation. Second, granting new private shareholders a higher percentage of shares and allowing them to appoint more top executives could enable them to play a more active role in SOEs, which may be the key points to the success of SOEs' mixed-ownership reform.

There is at least one limitation in our paper. Transferring state-owned shares to private investors is just one means of SOEs' mixed-ownership reform. Although shares transfer could help us to evaluate the impact of newly introduced private shareholders, we cannot clearly determine the overall effect of further introducing private capital. To have a better understanding about the effect of new private shareholders in SOEs, we also need to study other means of introducing new private capital such as issuing new shares to private investors.

APPENDIX A

A.1. ESTIMATION OF A FIRM'S TFP USING THE OP METHOD

OP method uses current investment as the proxy for unobserved productivity shock, so we construct firm investment equation as follows:

$$\ln I_{it} = I(\omega_{it}, \ln K_{it}) \tag{A.1}$$

Where, ω_{it} is a firm's TFP, $\ln I_{it}$ is the logarithm of firm investment, $\ln K_{it}$ is the logarithm of capital input.

Then, productivity could be denoted by the inverted form of equation (A.1):

$$\omega_{it} = h(\ln I_{it}, \ln K_{it}) \tag{A.2}$$

Substituting equation (A.2) into equation (1), we have:

$$\begin{aligned} \ln Y_{it} &= \alpha + \beta_l \ln L_{it} + \beta_k \ln K_{it} + h(\ln I_{it}, \ln K_{it}) + \varepsilon_{it} \\ &= \alpha + \beta_l \ln L_{it} + \varphi(\ln I_{it}, \ln K_{it}) + \varepsilon_{it} \end{aligned} \tag{A.3}$$

Where, $\varphi(\ln I_{it}, \ln K_{it}) = \beta_k \ln K_{it} + h(\ln I_{it}, \ln K_{it})$. Following Olley and Pakes (1996), the $\varphi(\cdot)$ function is approximated by fourth-degree polynomials of $\ln I_{it}$ and $\ln K_{it}$. By estimating equation (A.3), we can obtain the estimated coefficient of labor $\hat{\beta}_l$.

Substituting $\hat{\beta}_l$ into (1), we could obtain the following equation:

$$\begin{aligned} \ln Y_{it} - \hat{\beta}_l \ln L_{it} &= \alpha_0 + \beta_k \ln K_{it} + \omega_{it} + \varepsilon_{it} \\ &= \alpha_0 + \beta_k \ln K_{it} + g(\omega_{it-1}) + e_{it} \end{aligned} \tag{A.4}$$

Because $\omega_{it} = \varphi_{it} - \beta_k \ln K_{it}$, so we substitute it into (A.4) and have:

$$\ln Y_{it} - \hat{\beta}_l \ln L_{it} = \alpha_0 + \beta_k \ln K_{it} + g(\varphi_{it-1} - \beta_k \ln K_{it-1}) + e_{it} \tag{A.5}$$

Given that the OP method also uses firms' survival probabilities to correct the estimation results, so we rewrite equation (A.5) as:

$$\ln Y_{it} - \hat{\beta}_l \ln L_{it} = \alpha_0 + \beta_k \ln K_{it} + g(\varphi_{it-1} - \beta_k \ln K_{it-1}, \hat{P}_{it-1}) + e_{it} \tag{A.6}$$

Where, $g(\cdot)$ is approximated by fourth-degree polynomials of φ_{it-1}, $\ln K_{it-1}$ and $\hat{P}_{it-1} \cdot \hat{P}_{it-1}$ is a firm's survival probabilities. by estimating equation (A.6), We could obtain the coefficient of capital $\hat{\beta}_k$.

Finally, we calculate firm-level TFP in logarithmic form by Substituting $\hat{\beta}_l$ and $\hat{\beta}_k$ into (2).

A.2. ESTIMATION OF A FIRM'S TFP USING THE WD METHOD

Wooldridge (2009) noted that two-step estimation in LP method is too complicated, and thus he proposed a joint estimation in the generalized method of moments (GMM) framework.

Following him, we assume productivity is a unknow function of intermediate input (proxy variable) and capital input (state variable), namely,

$$\omega_{it} = h(\ln M_{it}, \ln K_{it}) \tag{A.7}$$

Where, $\ln M_{it}$ denotes the intermediate inputs measured by the logarithm of the expenses for material and other inputs.

Substituting equation (A.7) into equation (1), we have:

$$\begin{aligned} \ln Y_{it} &= \alpha + \beta_l \ln L_{it} + \beta_k \ln K_{it} + h(\ln M_{it}, \ln K_{it}) + \varepsilon_{it} \\ &= \alpha + \beta_l \ln L_{it} + \varphi(\ln M_{it}, \ln K_{it}) + \varepsilon_{it} \end{aligned} \tag{A.8}$$

Where $\varphi(\ln M_{it}, \ln K_{it}) = \beta_k \ln K_{it} + h(\ln M_{it}, \ln K_{it})$.

Following Wooldridge, we restrict productivity's dynamic to a first order Markov chain process:

$$E(\omega_{it}|\omega_{it-1}, \ldots, \omega_{it-T}) = E(\omega_{it}|\omega_{it-1}), \quad t = 2, 3, \ldots, T. \tag{A.9}$$

Also, we assume that ω_{it} is an unknown function of ω_{it-1}:

$$E(\omega_{it}|\omega_{it-1}) = g(\omega_{it-1}) \tag{A.10}$$

Based on the above assumptions, we could construct a system GMM to estimate β_l and β_k together:

$$\ln Y_{it} = \alpha + \beta_l \ln L_{it} + \beta_k \ln K_{it} + h(\ln M_{it}, \ln K_{it}) + \varepsilon_{it} \tag{A.11}$$

$$\ln Y_{it} = \alpha + \beta_l \ln L_{it} + \beta_k \ln K_{it} + g[h(\ln M_{it-1}, \ln K_{it-1})] + u_{it} \tag{A.12}$$

Where $g(\cdot)$ is approximated by second-degree polynomials, and $h(\ln M_{it}, \ln K_{it}) = \gamma_0 + c(\ln M_{it}, \ln K_{it}) * \gamma$. It is worth noting that $h(\ln M_{it}, \ln K_{it})$ is a linear combination of functions in $(\ln M_{it}, \ln K_{it})$, and c_{it} is the addend of this linear combination.

We use the residuals estimated from (A.11) and (A.12) to set the moment conditions, denoted by r_{it},

$$E(Z_{it} * r_{it}) = 0 \tag{A.13}$$

Instruments used for equation (A.11) and (A.12) are equation (A.14) and (A.15), respectively,

$$Z1_{it} = (1, \ln L_{it}, \ln K_{it}, c_{it}) \tag{A.14}$$

$$Z2_{it} = (\ln L_{it-1}, \ln K_{it-1}, c_{it-1}) \tag{A.15}$$

A.3. TFP RESULTS OF DIFFERENT METHODS

We present the estimated coefficients of labor and capital using various methods in Table 15 so as to compare differences among them easily. In addition to the results estimated by OP and WD methods, we also present

the results estimated by other methods such as the OLS, LP, ACF (Ackerberg et al., 2015) and DLW (De Loecker and Warzynski, 2012).

As shown in Table 15, the coefficient of capital estimated by OP is higher than that estimated by OLS, whereas the coefficient of labor in OP is lower than that in OLS. Result in column (2) is consistent with Olley and Pakes (1996) who argue that selection and simultaneity problem would cause an underestimation of the coefficient of capital. The coefficient of capital in LP is significantly greater than that in OP, while the coefficient of labor in LP is just slightly lower than that in OP. Thus, firm-level TFP estimated by LP would be quite lower compared with that by OP. The coefficient of labor in column (5) is quite greater than in column (3). In contrast, the coefficients of labor in columns (2) and (4) are very close. Results in columns (2)-(5) may indicate that labor input is more sensitive to intermediate input relative to investment. Thus, using investment as the proxy variable may receive more precise estimates, namely, OP method is better than LP. In addition, the coefficients of labor (capital) estimated by LP version of ACF, WD and DLW have small differences from each other.

TABLE 15.

Coefficients of labor and capital using different estimation methods.

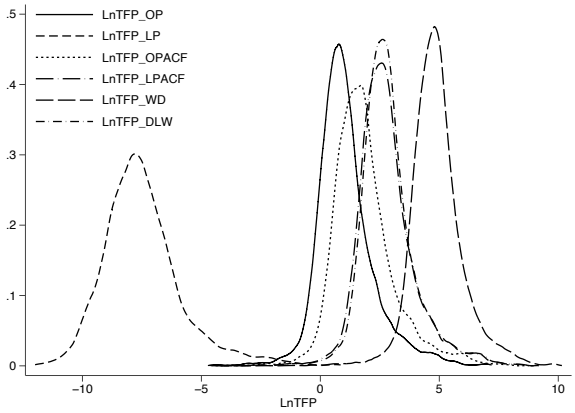
Variables	(1) OLS	(2) OP	(3) LP	(4) OP_ACF	(5) LP_ACF	(6) WD	(7) DLW
$\ln L$	0.672^{***}	0.368^{***}	0.337^{***}	0.382^{***}	0.764^{***}	0.703^{***}	0.686^{***}
	(17.80)	(6.36)	(4.19)	(8.85)	(4.00)	(15.95)	(18.77)
$\ln K$	0.553^{***}	0.808^{***}	1.234^{***}	0.614^{***}	0.601^{***}	0.595^{***}	0.574^{***}
	(17.70)	(8.88)	(13.94)	(12.24)	(3.71)	(24.05)	(19.18)
N	15,654	15,654	15,654	15,654	15,654	15,654	15,654

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. OP_ACF and LP_ACF denote OP version and LP version of the ACF method, respectively.

The kernel density of firm-level TFP obtained by various estimation methods is shown in Figure 3. As we can see, there are various distributions of TFP among seven methods. In particular, TFP estimated by the LP method is quite lower than those estimated by other methods, and TFP estimated by the WD method is slightly higher than those using other methods. In a word, the TFP results of different methods are relatively close except that of LP method.

In order to illustrate that our main conclusions are robust to other productivity estimation methods, in Table 16, we report the regression results of model (4) using TFP estimated by LP, OP_ACF, LP_ACF and DLW

FIG. 3. Kernel density of firm-level TFP obtained by using different methods. This figure shows the distribution of firm-level TFP. ln TFP_OP, ln TFP_LP, ln TFP_OPACF, ln TFP_LPACF, ln TFP_WD and ln TFP_DLW denote the logarithm of firm TFP obtained by using OP, LP, OP_ACF, LP_ACF, WD and DLW estimation methods, respectively.



methods. As shown, whatever method is used to estimate TFP, our main results still hold.

TABLE 16.

Regression results of baseline model using TFP estimated by other methods.

Variables	(1) ln TFP_LP	(2) ln TFP_OPACF	(3) ln TFP_LPACF	(4) ln TFP_DLW
Panel A: Results using the independent variable Treat ∗ Post				
Treat ∗ Post	1.218***	1.116***	1.090***	1.072***
	(3.544)	(3.274)	(3.198)	(3.123)
Panel B: Results using the independent variable ShrPer ∗ Post				
ShrPer ∗ Post	0.069***	0.065***	0.064***	0.064***
	(4.678)	(4.411)	(4.318)	(4.302)
Panel C: Results using the independent variable TopMngPer ∗ Post				
TopMngPer ∗ Post	6.907***	6.815***	6.753***	6.808***
	(3.544)	(3.530)	(3.499)	(3.512)

Note: t-value is presented in (). ***, ** and * denote significance levels of 1%, 5% and 10%, respectively. Number of observations, firm and year fixed effects, and coefficients of control variables and constant are not reported to keep brief.

APPENDIX B

TABLE 17.

Balance tests for covariates and their interactions before and after matching.

Variables	Mean			Variance			SDiff_	SDiff_
	Treated	Controls		Treated	Controls		Pre	Post
		Pre	Post		Pre	Post		
Size	21.345	21.968	21.346	1.613	1.757	1.614	−0.490	−0.000
Age	2.390	2.267	2.390	0.325	0.469	0.325	0.216	0.000
Lev	0.538	0.512	0.538	0.053	0.041	0.053	0.115	−0.000
Export	0.368	0.454	0.368	0.233	0.248	0.233	−0.179	−0.000
Quality	10.794	10.994	10.795	0.720	0.584	0.720	−0.235	−0.000
Volatility	0.030	0.030	0.030	0.000	0.000	0.000	0.056	−0.000
CapIntensity	0.049	0.125	0.049	1.031	0.845	1.031	−0.075	−0.000
SHHI	0.167	0.210	0.167	0.016	0.018	0.016	−0.335	−0.000
MgmHoldings	0.008	0.003	0.008	0.001	0.000	0.001	0.167	0.000
Competition	46.405	41.907	46.400	938.995	923.386	938.720	0.147	0.000
Competition2	3092.029	2679.479	3091.645	$116.8e^5$	$994.9e^5$	$110.7e^5$	0.121	0.000
ROA	0.040	0.049	0.040	0.007	0.004	0.007	−0.107	−0.000
Size × Size	457.231	484.339	457.252	3060.491	3533.095	3038.813	−0.490	−0.000
Size × Age	51.127	49.958	51.124	169.057	248.703	169.185	0.090	0.000
Size × Lev	11.493	11.315	11.493	24.044	21.628	23.739	0.036	−0.000
Size × Export	7.978	10.043	7.978	110.050	122.010	109.957	−0.197	−0.000
Size × Quality	230.699	241.873	230.707	650.748	675.327	649.709	−0.438	−0.000
Size × Volatility	0.646	0.651	0.646	0.049	0.055	0.050	−0.023	−0.000
Size × CapIntensity	1.320	3.134	1.322	468.670	418.490	467.335	−0.084	−0.000
Size × SHHI	3.602	4.666	3.603	7.971	9.456	7.999	−0.377	−0.000
Size × MgmHoldings	0.169	0.070	0.169	0.342	0.130	0.343	0.168	0.000
Size × Competition	991.024	915.935	990.932	437548.610	442138.420	436326.620	0.114	0.000
Size × ROA	0.884	1.091	0.884	3.025	1.752	2.975	−0.119	−0.000
Age × Age	6.037	5.607	6.037	5.552	6.785	5.703	0.182	0.000
Age × Lev	1.298	1.187	1.298	0.428	0.388	0.428	0.169	0.000
Age × Export	0.868	1.045	0.868	1.423	1.519	1.431	−0.148	0.000
Age × Quality	25.927	25.034	25.926	47.920	65.223	48.852	0.129	0.000
Age × Volatility	0.072	0.066	0.072	0.001	0.001	0.001	0.201	0.000
Age × CapIntensity	0.122	0.302	0.122	6.305	4.896	6.583	−0.072	−0.000
Age × SHHI	0.382	0.454	0.382	0.092	0.098	0.087	−0.237	−0.000
Age × MgmHoldings	0.018	0.005	0.018	0.004	0.001	0.004	0.194	0.000
Age × Competition	110.729	95.907	110.714	6905.430	6239.792	6599.642	0.178	0.000
Age × ROA	0.099	0.107	0.099	0.043	0.022	0.041	−0.039	0.000
Lev × Lev	0.342	0.302	0.342	0.074	0.047	0.077	0.146	−0.000
Lev × Export	0.200	0.235	0.200	0.086	0.084	0.085	−0.121	−0.000

TABLE 17—*Continued*

Variables	Mean			Variance			SDiff_	SDiff_
	Treated	Controls		Treated	Controls		Pre	Post
		Pre	Post		Pre	Post		
Lev × Quality	5.786	5.625	5.786	6.186	5.091	6.082	0.065	−0.000
Lev × Volatility	0.016	0.015	0.016	0.000	0.000	0.000	0.121	−0.000
Lev × CapIntensity	0.027	0.077	0.027	0.390	0.277	0.414	−0.079	−0.000
Lev × SHHI	0.089	0.106	0.089	0.007	0.006	0.006	−0.204	−0.000
Lev × MgmHoldings	0.003	0.001	0.003	0.000	0.000	0.000	0.150	0.000
Lev × Competition	24.815	21.379	24.813	371.411	341.595	414.771	0.178	0.000
Lev × ROA	0.016	0.021	0.016	0.003	0.001	0.003	−0.094	−0.000
Lev × Quality	3.972	5.004	3.972	27.326	30.298	27.316	−0.197	−0.000
Export × Volatility	0.011	0.014	0.011	0.000	0.000	0.000	−0.155	−0.000
Export × CapIntensity	−0.006	0.075	−0.006	0.373	0.379	0.337	−0.132	−0.000
Export × SHHI	0.065	0.092	0.065	0.013	0.018	0.013	−0.233	−0.000
Export × MgmHoldings	0.004	0.002	0.004	0.000	0.000	0.000	0.090	0.000
Export × Competition	20.674	23.811	20.672	1019.990	1079.549	1039.275	−0.098	0.000
Export × ROA	0.015	0.021	0.015	0.003	0.002	0.002	−0.120	−0.000
Quality × Quality	117.240	121.445	117.242	347.840	287.629	344.384	−0.225	−0.000
Quality × Volatility	0.327	0.327	0.327	0.014	0.015	0.014	0.006	−0.000
Quality × CapIntensity	0.836	1.667	0.837	125.301	107.429	126.928	−0.074	−0.000
Quality × SHHI	1.800	2.321	1.800	1.907	2.260	1.897	−0.377	−0.000
Quality × MgmHoldings	0.086	0.036	0.086	0.090	0.034	0.089	0.166	0.000
Quality × Competition	496.918	456.732	496.871	110018.180	109789.560	109207.530	0.121	0.000
Quality × ROA	0.446	0.548	0.446	0.810	0.447	0.800	−0.114	−0.000
Volatility × Volatility	0.001	0.001	0.001	0.000	0.000	0.000	0.034	−0.000
Volatility × CapIntensity	0.001	0.003	0.001	0.001	0.001	0.001	−0.063	−0.000
Volatility × SHHI	0.005	0.006	0.005	0.000	0.000	0.000	−0.265	−0.000
Volatility × MgmHoldings	0.000	0.000	0.000	0.000	0.000	0.000	0.149	0.000
Volatility × Competition	1.404	1.254	1.404	1.213	1.134	1.153	0.137	0.000
Volatility × ROA	0.001	0.001	0.001	0.000	0.000	0.000	−0.081	−0.000
CapIntensity × CapIntensity	1.033	0.861	1.033	2.140	1.630	2.136	0.118	−0.000
CapIntensity × SHHI	0.011	0.039	0.011	0.044	0.059	0.045	−0.132	−0.000
CapIntensity × MgmHoldings	−0.000	−0.000	−0.000	0.001	0.000	0.001	−0.002	0.000
CapIntensity × Competition	1.428	6.523	1.429	3149.366	2356.187	3294.676	−0.091	−0.000
CapIntensity × ROA	0.002	0.006	0.002	0.009	0.006	0.010	−0.047	−0.000
SHHI × SHHI	0.044	0.062	0.044	0.004	0.005	0.004	−0.269	−0.000
SHHI × MgmHoldings	0.001	0.000	0.001	0.000	0.000	0.000	0.118	0.000
SHHI × *Competition*	7.892	8.450	7.892	75.669	78.785	80.382	−0.064	0.000
SHHI × ROA	0.008	0.011	0.008	0.000	0.000	0.000	−0.179	−0.000

TABLE 17—*Continued*

Variables	Mean			Variance			SDiff_ Pre	SDiff_ Post
	Treated	Controls		Treated	Controls			
		Pre	Post		Pre	Post		
MgmHoldings × MgmHoldings	0.001	0.000	0.001	0.000	0.000	0.000	0.145	0.000
MgmHoldings × Competition	0.358	0.153	0.358	2.407	0.933	2.248	0.132	0.000
MgmHoldings × ROA	0.001	0.000	0.001	0.000	0.000	0.000	0.094	0.000
Competition × ROA	1.903	1.901	1.903	24.437	13.301	25.174	0.000	0.000
ROA × ROA	0.009	0.006	0.009	0.000	0.000	0.000	0.171	0.000

Note: SDiff_Pre and SDiff_Post denote standardized differences between the treated and control groups before and after matching, respectively.

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