The Impact of State Ownership on the Productivity of China's Agri-food Firms

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Abstract

This study examines the effects of state ownership on the productivity distribution of different quantiles of China's agri-food firms based on data from the Chinese Industrial Enterprises Database between 1998 and 2013. Using panel quantile regression, this study finds that the contribution of state ownership to productivity varies across different quantiles of the productivity distribution. State ownership inhibits total factor productivity (TFP) of firms with low-level productivity but has no effect on TFP for firms with medium- and high-level productivity. Regions play a moderating role on the state ownership-productivity link. Regional economic development alleviates the inhibition of state-owned capital on the TFP of firms with low- and high-level productivity.

Keywords: state ownership, productivity, agri-food firms

1. Introduction

The effect of ownership structures on firms' total factor productivity (TFP) has been debated for decades. Most studies of firm productivity or profitability indicate that private ownership is more efficient than state ownership (Bai et al., 2000; Barbetta et al., 2007; Boardman & Vining, 1989; Ehrlich et al., 1994; Le et al., 2021). Shleifer and Vishny (1997) present an explanation: state-owned enterprises (SOEs) are subject to bureaucratic control with extremely centralized management, and their cash liquidity is limited. On the other hand, Megginson and Netter (2001) argue that state ownership may be more efficient than private ownership in the presence of market failures. Some empirical studies on the public goods sector support this viewpoint (Bhattacharyya et al., 1995). However, previous studies ignore an important problem: the average value of TFP cannot be the representative of the entire distribution of TFP. Most of the previous literature study the effect of ownership structures on TFP through ordinary least squares (OLS) regressions or fixed effects (FE) models in which the dependent variables are represented in the form of average values, ignoring the possible quantile heterogeneity of dependent variables in the causal relationship. This study uses the panel quantile regression proposed by Koenker (2004) to examine the effect of state-owned capital on the TFP distribution of agri-food firms in China. In addition, considering the huge regional differences in the level of economic development in China, we also examine the role regions play in the state ownership-productivity link.

The literature related to the study focuses on the effect of ownership structures on firm productivity. Sappington and Stiglitz (1987) present a basic privatization theorem, stating that the government can achieve the same efficiency goals by contracting out production to private firms under ideal conditions. They also highlight several conditions under which state ownership is superior, such as the government is more risk tolerant than private firms, high contracting costs, limited information about government benefits. Conversely, private ownership is superior if the government's ability to commit to the private sector is stronger than to the state sector, or if the state sector faces hierarchical control. Le et al. (2021) examine the impact of Vietnamese state-owned capital on TFP and find that state ownership is negatively associated with TFP by using data adapted from enterprise surveys and Provincial Competitiveness Index (PCI) surveys 2011-2017. Parida and Madheswaran (2021) study the impact of ownership structures on TFP in four sectors: metallic, non-metallic, coal and petroleum in India and find that the superiority of private firms in three sectors-metallic, non-metallic, and coal-whereas the petroleum sector reports quite the opposite result. Brzić et al. (2021) study the relationship between the proportion of private ownership and productivity in 62 European telecom enterprises from 2012-2019 and find a

positive relationship between the proportion of private ownership and TFP. Walheer and He (2020) use detailed firm-level data to examine how ownership structures affect technical efficiency and technological progress in the Chinese industrial sector, firm ownership is found to be important in explaining the technical efficiency and technological gap among Chinese firms. Foreign-invested firms are the technological leaders which set the standard for technical efficiency. Private ownership is found to dominate state and collective ownership in terms of technical efficiency and technological gaps. Over time, foreign-invested firms lead the way in efficiency, private firms contribute much to the technological progress. In addition, they find that China has successfully revitalized SOEs, although there is still room for improvement. Moreover, there are studies that further examine the role of foreign direct investment (FDI), such as Alka (2020)' study on the issue of foreign ownership in Africa, finding that the foreign ownership has a positive, but statistically insignificant, effect on TFP. Harris (2003) examines productivity differences between domestic and foreign-owned manufacturing plants using 1974-1995 United Kingdom plant data and find that: foreign-owned plants are much more productive than domestically-owned plants. Ramondo's (2009) study for Chilean manufacturing indicates that TFP of foreign-owned plants is approximately 17 percent higher than that of domestic plants. The above literature ignores the issue of ownership structures' effect on the entire distribution of TFP. Teng et al. (2021) use the panel quantile regression and find that the foreign ownership's contribution to productivity is not linear and varies across different quantiles of the productivity distribution based on a sample of 428 small and medium-sized firms listed on the Growth Enterprise Market in the Shenzhen Stock Exchange between 2009 and 2016.

However, to the best of our knowledge, most studies on this topic have not accurately identified the causal effect of state ownership on the entire distribution of TFP. In this context, our study adds to the literature by attempting to determine the effect of state ownership on the distribution of TFP by using a large micro database containing extensive information of agri-food firms, the Chinese Industrial Enterprises Database (CIED), for 1998-2013. First, this study uses the Levinson and Petrin (LP) method for estimating the TFP of each firm; this is because the LP method can solve the simultaneity bias and selectivity bias which exist in the OLS estimation, and it can also avoid the problem of large sample loss due to negative investment value in the Olley and Pakes (OP) method (Olley & Pakes, 1996). Second, we use panel quantile regression to conduct our research. We examine the effect of the proportion of state-owned capital on the distribution of firm productivity by using the 10%, 25%, 50%, 75%, and 90% quantile of TFP as the dependent variables. In addition, we conduct robustness checks by using the TFP measured by the OP method. Finally, we examine the moderating role of regions on the state ownership-productivity link by constructing an interaction term between regional per capita Gross Domestic Product (GDP) and state-owned capital share. Our study has important implications for revealing the relationship between the proportion of state-owned capital and firm productivity in China. SOEs play a crucial role in Chinese manufacturing. Most of them are industry leaders. However, many studies present that the productivity of Chinese SOEs is lower than that of non-SOEs, which indicates that state-owned capital hurts the growth of firm productivity. Thus, we aim to deeply explore the impact of state-owned capital on firm productivity. Our conclusions indicate that there is a nonlinear relationship between the proportion of state-owned capital and firm productivity, and that the proportion of state-owned capital has different effects in firms with different productivity levels, which previous literature do not reveal.

The remainder of this study is organized as follows: the second section presents the methodology for measuring TFP and the panel quantile regression model used, the third section describes the data and descriptive statistics, the fourth section presents the regression results and discussion, and the last section presents conclusions and policy recommendations.

2. Empirical Framework

In this section, we present the theoretical development and TFP measurement method, followed by the panel quantile model in empirical analysis.

2.1 Theoretical Development

We hypothesize there is a nonlinear relationship between state ownership and firm TFP. Most previous studies argue that the state-owned system is a representative of low productivity. This is because firms with a large proportion of state-owned capital have the characteristics of low operating efficiency and high internal costs, which cannot give full play to the development potential of enterprises. However, in China, state banks tend to provide large preferential loans or "policy loans" to SOEs with high-level productivity for various reasons, such as political connections and social ties (Brandt & Li, 2003; Wang et al., 2008), thus the cash flow constraint problem may not exist in high-level productivity SOEs. Firms with high-level productivity may also have strong

managerial capabilities and resource allocation efficiency. Therefore, state ownership may only suppress TFP for low-level productivity firms but has no effect on TFP for medium- and high-level productivity firms.

2.2 Measurement of TFP

Academics typically use OP (Olley & Pakes, 1996) or LP (Levinsohn & Petrin, 2003) methods when measuring TFP based on microdata. Both the OP and LP methods can solve the simultaneity problem and selection problem in OLS estimation, but they differ in the selection of variables that proxy for unobservable productivity shocks. The OP method uses the investment as a proxy, whereas the LP method selects intermediate inputs. In our sample, many investment values are negative, so a considerable number of observations will be lost if we use investment as the proxy variable. Thus, we select the LP method to measure TFP in this study.

First, we use the Cobb-Douglas (CD) function as the production function, taking the following logarithm:

$$y_{it} = \alpha_L \cdot l_{it} + \alpha_K \cdot k_{it} + u_{it} \tag{1}$$

In Equation (1), y represents the logarithmic form of the firm's total output, l represents the logarithmic form of the number of employees in the firm, k represents the logarithmic form of capital stock, and i and t represent the individual firm and year, respectively. u_{it} represents the logarithmic form of TFP. The level of TFP is calculated as follows:

$$TFP_{it} = \ln Y_{it} - \alpha_K \ln K_{it} - \alpha_L \ln L_{it} \tag{2}$$

The gross industrial output value of firms is applied as the proxy variable of output (Y_{it}), capital stock as the proxy variable of capital (K_{it}), and the practitioners of firms as the proxy variables of labor (L_{it}). This study calculates the TFP of China's agri-food firms according to the LP method (Levinsohn & Petrin, 2003). There are two benefits to this approach: (a) The firm is affected by their observable efficiency in the process of deciding the input of production factors; that is, the observable part of the residual item u_{it} is related to the input of production factors during the current period (simultaneity bias). The objective of using the LP method to solve the problem of simultaneity bias is to build an intermediate inputs function as a proxy for observable efficiency impact; that is, firms will make an intermediate inputs decision based on the current observable efficiency. (b) The other problem is selectivity bias. It tends to be easier for those with lager capital stock to face productivity shock and are therefore more likely to stay in the database. Consequently, the lack of data may be due to nonrandom factors; the capital stock will be associated with the residual term, resulting in bias. The LP method solves the problem of selection bias by constructing a survival probability function to estimate the exit and entry of firms. The above process mainly consists of three steps.

In the first step, Levinsohn and Petrin (2003) consider that part of u_{it} in Equation (1) is observable by firms. This part is assumed to be g_{it}. Then $u_{it} = g_{it} + e_{it}$, where, e_{it} is truly unobservable technical shocks, that is, the total factor productivity. The LP method assumes that firms decide the intermediate inputs situation according to the current productivity situation; that is, it uses the current intermediate inputs of the firm as the proxy variable of the unobservable technical shocks. Next, the LP method constructs the relationship between intermediate inputs and TFP that can be observed by the firm. If the firm is expected to have a higher productivity level in the future, it will choose to increase the intermediate inputs. The specific investment function is as follows:

$$m_{it} = m_t(g_{it}, k_{it}) \tag{3}$$

Then we present the inverse function of Equation (3) as follows:

$$g_{it} = g_t(m_{it}, k_{it}) \tag{4}$$

Substituting Equation (4) into Equation (1) produces the following:

$$y_{it} = \alpha_L \cdot l_{it} + \alpha_K \cdot k_{it} + g_t(m_{it}, k_{it}) + e_{it} \tag{5}$$

In the second step, $\alpha_K \cdot k_{it} + g_t(m_{i,t}, k_{i,t})$ of Equation (5) can be defined as the contribution of capital to the output and uses ω_{it} instead, followed by the specific form set. The LP method constructs a fourth order polynomial that contains the firm's capital stock and intermediate inputs, then estimates them to obtain unbiased estimates of labor input, which is a nonparametric estimation, and finally solves the problem of simultaneous deviations.

In the third step, the LP method uses a survival probability function to estimate the entry and exit of firms to solve the problem of sample selectivity bias. The specific approach uses the residuals obtained in the second step as dependent variables and capital stock and intermediate inputs as independent variables. The probit model is estimated as follows:

$$y_{it} - \widehat{\beta}_L \cdot l_{it} = \alpha_K \cdot k_{it} + g_t(\widehat{\omega_{t-1}} - \alpha_K \cdot k_{i,t-1}, Pr_{i,t-1}) + \mu_{it} + e_{it} \tag{6}$$

The LP method controls the sample selection bias and obtains a consistent estimate of capital by estimating Equation (6). In this study, we estimate TFP by using Equation (7) as a specific form of the production function.

$$\ln Y_{it} = \beta_0 + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \beta_A age_{it} + \sum_t \delta_t year_t + \sum_m \lambda_m reg_m + \sum_n \eta_n ind_n + \varepsilon_{it} \qquad (7)$$

The regression uses the LP semi-parametric three-step regression method, with the state variables being $\ln K_{it}$ and firm age (age_{it}). The free variables are $\ln L_{it}$, regional dummy variable (reg_m), and sub-industry dummy variable (ind_n). The control variable is time trend variable ($year_t$). The proxy variable is the investment variable ($\ln M_{it}$). The exit variable is *exit* depending on whether the firm is out of data. The estimated β_K and β_L can be obtained by regression of Equation (7), then the TFP at the firm level can be estimated based on Equation (2). Figure 1 shows the distribution of Chinese agri-food firms' TFP calculated by LP method.

2.3 Econometric Model

We introduce the panel quantile regression model, including individual-specific FE and year-specific FE to conduct our research. Most empirical studies examine the effect of the independent variable on the average value of the dependent variable. The average value can describe the entire distribution in case the dependent variable is a dummy variable, but if the dependent variable is a continuous variable like TFP, examining the average value to reveal changes in the entire distribution is difficult. It can be seen from Figure 1 that the distribution of TFP in Chinese agri-food firms reflects many marginal values on the left and compactness in the middle. Therefore, we would like to study how state-owned capital affects the entire distribution of TFP, not just the average value. Quantile regression is a very useful method to understand the changes in the distribution. We refer to Koenker (2004) to set the specific panel quantile regression model as follows:

$$Quantile(TFP_{it}|State_{it}, X_{it}) = \beta_0 + \beta_1 State_{it} + \boldsymbol{\beta} X_{it} + year_t + individual_i + \varepsilon_{it} \qquad (8)$$

In Equation (8), we use the 10%, 25%, 50%, 75%, and 90% quantiles of TFP as dependent variables. $State_{it}$ represents the state-owned capital share of firm "*i*" in period "*t*." X_{it} is a sector of control variables comprising firm size (*Size*), firm age (*Age*), firm export (*Exp*), research and development (R&D) investment (*RD*), and foreign direct investment (*FDI*). $year_t$ and $individual_i$ represent year-specific FE and individual-specific FE, respectively. ε_{it} is the error term.
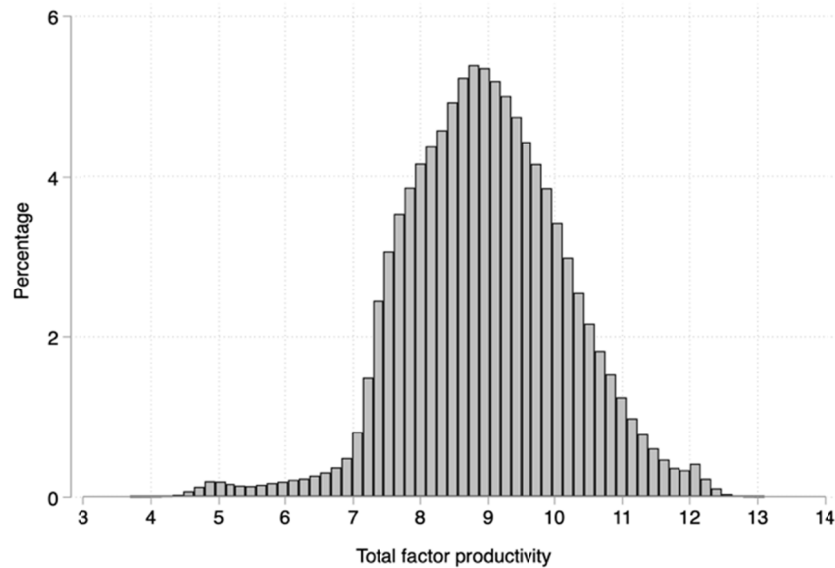

Figure 1. The distribution of agri-food firms' TFP

3. Data and Descriptive Statistics

We use 1998-2013 CIED which is maintained by the National Bureau of Statistics of China to study the impact of state ownership on the TFP of agri-food firms. This panel data counts the data of all state-owned firms and non-state-owned firms above a certain threshold in revenues (firms with annual sales of more than five million RMB, which was changed subsequently in 2011 to more than twenty million RMB). The most valuable characteristics of the database are representativeness and exhaustiveness, it contains a wide range of information

such as basic information of production and sales, financial indicators, etc. There are extensive studies using CIED to study Chinese issues (Aghion et al., 2015; Brandt et al., 2017; Hsieh & Klenow, 2009). We choose firms in agri-food industry which includes twelve sub-categories (Note 1) as research objects. It covers agriculture and industries closely related to agriculture, such as grain milling, feed processing, sugar processing, frozen processing of aquatic products, processing of vegetables, fruits, and nuts, and liquid milk, etc.

The next step is the processing of the data: First, we match the raw data year by year according to the firm code, the firm name and the legal representative name to get the 1998-2013 Chinese agri-food firms dataset (Brandt et al., 2012). Second, we fill in the missing values such as gross industrial output value according to the accounting standards. Third, we refer to Jefferson et al. (2008) and Cai and Liu (2009) to clean up the data using the following procedures: (a) Excluding the data if firm yield, capital stock, state capital or other key variables are missing, zero, or negative; (b) Excluding the data if the number of employees in a firm is less than 8; (c) Excluding the data if the firm is established before 1950; (d) Excluding the data if the capital stock is greater than the total assets; (e) Deflating the firm level continuous variables by 0.5% to eliminate the influence of outliers; (f) Deflating nominal variables using different price indices for different regions with the base period of 1998, such as using the producer price index for total industrial output value, the price indices of investment in fixed assets for capital stock, and the consumer price index for export values of firms. After processing, we get the data with 1 198 018 observations, containing 213 228 firms. Table 1 shows the description and basic statistics of main variables. In the China's agri-food industry, the average share of state-owned capital in firms is 6.3 percent.

Table 1. Descriptive statistics

Variables	Description	Observations	Mean	Std. dev.
TFP	The TFP calculated by using LP method (Logarithmic form)	1 198 018	8.972	1.204
State	Proportion of state-owned capital of firms	1 198 018	0.063	0.230
Y	The firm's industrial output value	1 198 018	82 397.257	169 764.949
L	The number of employees in firms	1 198 018	253.063	374.261
K	Capital stock of firms	1 198 018	18 539.103	47 288.775
M	The value of firms' intermediate inputs	1 198 018	65 870.129	138 004.601
Size	Total asset of firms	1 198 018	50 343.747	124 196.067
Age	The number of years since the establishment of firms	1 198 018	10.303	9.132
Exp	Export value of firms	1 198 018	11 147.858	38 080.178
RD	Research and Development (R&D) expenditure	1 198 018	72.627	753.625
FDI	Dummy variable, 1 = foreign-invested firm, 0 else	1 198 018	0.202	0.401

Note. The unit of *Yield*, *Capital*, *M*, *Size*, *Exp*, and *RD* is 1 000 RMB yuan.

4. Results

In this section, we first analyze the baseline results of the effect of state-owned capital share on TFP of agri-food firms based on the panel quantile model. Second, we perform a robustness check by using TFP measured by the OP method. Finally, we discuss whether differences in regional economic developments can explain the effect of state ownership.

4.1 Baseline Results

Table 2 reports the baseline result of state ownership's impact on the TFP over China's agri-food firms. We examine the impact of state ownership on TFP at the 10%, 25%, 50%, 75%, and 95% quantile, respectively. We additionally run two-way FE regressions as a reference. State-owned capital share is significantly negative at the 10% and 25% quantile of TFP, with values of -0.051 and -0.072, respectively, and is insignificant at the 50%, 75%, and 90% quantile of TFP. This indicates that for every 1% increase in the state-owned capital share, the TFP of firms in the 10% and 25% quantile decreases by 5.1% and 7.2%, respectively, and that the state-owned capital share has no significant effect on the TFP of firms in the 50%, 75%, and 90% quantile. The results of the FE regression indicate that, overall, the state-owned capital share has a significant negative effect on the TFP of firms, which is consistent with most previous literature. Our study further demonstrates that the state-owned capital share does not have a suppressive effect on the TFP of all agri-food firms. Instead, the suppressive effect of the state-owned capital share is mainly reflected in firms with relatively low-level TFP while having no

significant effect on firms with medium- and high-level TFP. The regression results in Table 2 verify our findings.

Regarding the control variables, the coefficient of firm size is significantly positive at all quantiles of TFP, indicating that firm size promotes the TFP of agri-food firms. The coefficient of firm age is significantly negative at the 10%, 25% quantile of TFP, insignificant at the 50% and 75% quantile, and significantly positive at the 90% quantile, indicating that for firms with low TFP, younger firms are more productive compared to mature firms. Firm age has no effect on firms with medium-level TFP, and for firms with high-level TFP, mature firms have higher productivity compared to younger firms. The coefficients of firm exports and R&D investments are significantly positive at all quantiles, indicating that exports and R&D investments increase the TFP of agri-food firms. The coefficients of FDI are significantly negative at the 10%, 25%, and 90% quantile and insignificant at the 50% and 75% quantile, indicating that FDI reduces the TFP of low- and high-level productivity firms, whereas it has no significant effect on the TFP of medium-level productivity firms.

Table 2. The impact of ownership structure on TFP based on panel quantile regression

Variables	Dependent variable: TFP ($P_{\#}$)					
	TFP (P_{10})	TFP (P_{25})	TFP (P_{50})	TFP (P_{75})	TFP (P_{90})	TFP (FE regression)
State	-0.051**	-0.072***	-0.015	9.237	4.459	-0.088***
	(0.020)	(0.014)	(0.012)	(47.843)	(5.372)	(0.009)
ln (*Size*)	0.324***	0.337***	0.343***	0.332***	0.270***	0.357***
	(0.006)	(0.004)	(0.003)	(0.012)	(0.004)	(0.002)
ln (*Age*)	-0.151***	-0.094***	-0.004	0.028	0.137***	0.394***
	(0.004)	(0.004)	(0.004)	(0.017)	(0.011)	(0.005)
ln (*Exp*)	0.030***	0.023***	0.019***	0.014***	0.012***	0.018***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)
ln (*RD*)	0.030***	0.030***	0.036***	0.036***	0.018***	0.023***
	(0.003)	(0.002)	(0.002)	(0.013)	(0.002)	(0.001)
ln (*FDI*)	-0.091***	-0.021**	-0.005	-0.032	-0.027***	-0.003
	(0.012)	(0.008)	(0.007)	(0.020)	(0.010)	(0.005)
Cons.	5.347***	4.202***	4.359***	4.551***	4.843***	4.637***
	(0.033)	(0.034)	(0.030)	(0.036)	(0.061)	(0.021)
Individual FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
TFP (no state capital)	7.660 (P_{10})	8.237 (P_{25})	8.989 (P_{50})	9.789 (P_{75})	10.52 (P_{90})	9.048 (Mean)
Pseudo-R^2	0.128	0.112	0.203	0.215	0.149	0.847
Observations	1,198,018	1,198,018	1,198,018	1,198,018	1,198,018	1,198,018

Note. Standard errors in parentheses. ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.1$. $P_{\#}$ represents the "#" th percentile of TFP.

4.2 Robustness Check

In this section, we use the TFP measured by the OP method as a robustness check. The regression results are shown in Table 3. The coefficients of *State* are essentially consistent with the baseline results: the values are -0.080 and -0.043 at the 10% and 25% quantile, respectively. The coefficients are both insignificant at the 75% and 90% quantile. The only difference is the result for the 50% quantile, where the coefficient value for *State* is -0.027, whereas the coefficient for the baseline regression is not significant. Considering that the median value of TFP measured by either the LP or OP method is smaller than the mean value, the results in Table 3 still indicate that the increase in the state-owned capital share suppresses the TFP of low-level productivity firms and has no significant effect on the firms with medium- and high-level productivity firms.

Table 3. Robustness check by using OP method to calculate TFP

Variables	Dependent variable: TFP ($P_\#$) calculated by using OP method				
	TFP (P_{10})	TFP (P_{25})	TFP (P_{50})	TFP (P_{75})	TFP (P_{90})
State	-0.080***	-0.043***	-0.027***	0.012	0.032
	(0.019)	(0.013)	(0.010)	(0.014)	(0.020)
ln (*Size*)	0.210***	0.164***	0.139***	0.111***	0.080***
	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)
ln (*Age*)	-0.157***	-0.101***	-0.027***	0.053***	0.113***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.006)
ln (*Exp*)	0.028***	0.018***	0.013***	0.009***	0.007***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
ln (*RD*)	0.027***	0.023***	0.023***	0.014***	0.012***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
ln (*FDI*)	0.028***	-0.008	-0.005	-0.015**	-0.024***
	(0.010)	(0.008)	(0.007)	(0.008)	(0.009)
Cons.	3.614***	3.609***	3.687***	4.139***	4.818***
	(0.037)	(0.027)	(0.026)	(0.032)	(0.048)
Individual FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
TFP (no state capital)	5.243 (P_{10})	5.753 (P_{25})	6.350 (P_{50})	7.004 (P_{75})	7.609 (P_{90})
Pseudo-R^2	0.127	0.184	0.145	0.151	0.198
Observations	1,198,018	1,198,018	1,198,018	1,198,018	1,198,018

Note. Standard errors in parentheses. ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.1$. $P_\#$ represents the "#" th percentile of TFP.

4.3 The Effect of Regional Economic Development

The level of economic development varies significantly across different regions of China, with the eastern region having a huge economic advantage over the central and western regions. Thus, the effect of state ownership may vary across regions. First, we construct the *PerGDP* variable based on the GDP per capita of 31 provinces in China's mainland for each year from 1998 to 2013 based on the China Statistical Yearbook and deflate it by using the Consumer Price Index (CPI) for the base period of 1998. Second, we construct the interaction term of the state-owned capital share and the regional GDP per capita variable *PerGDP* to add to the panel quantile regression of Equation (8), the results of which are shown in Table 4.

Table 4. Results of regional heterogeneity

Variables	Dependent variable: TFP (P_#)				
	TFP (P_{10})	TFP (P_{25})	TFP (P_{50})	TFP (P_{75})	TFP (P_{90})
State*ln (*PerGDP*)	0.304**	0.184***	0.110	-0.036	0.116**
	(0.135)	(0.059)	(0.877)	(0.066)	(0.048)
ln (*PerGDP*)	10.446***	10.053***	10.030	10.155***	10.120***
	(0.789)	(0.807)	(6.357)	(0.751)	(1.267)
State	-1.922***	-0.855***	-0.674	-0.579***	-0.543***
	(0.546)	(0.167)	(3.038)	(0.173)	(0.104)
ln (*Size*)	0.429***	0.332***	0.255***	0.290***	0.258***
	(0.009)	(0.007)	(0.086)	(0.017)	(0.010)
ln (*Age*)	-0.285***	-0.142***	0.122***	-0.056***	0.029
	(0.018)	(0.014)	(0.029)	(0.016)	(0.020)
ln (*Exp*)	0.027***	0.028***	0.005	0.021***	-0.007***
	(0.001)	(0.001)	(0.004)	(0.002)	(0.002)
ln (*RD*)	0.004	0.029***	0.025***	0.100***	0.053***
	(0.005)	(0.004)	(0.006)	(0.011)	(0.006)
ln (*FDI*)	-0.115***	-0.021	-0.087*	-0.065**	-0.086***
	(0.022)	(0.015)	(0.050)	(0.032)	(0.030)
Cons.	4.616***	3.391***	3.077***	2.267***	2.051***
	(0.058)	(0.066)	(0.062)	(0.074)	(0.119)
Individual FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
TFP (no state capital)	7.660 (P_{10})	8.237 (P_{25})	8.989 (P_{50})	9.789 (P_{75})	10.520 (P_{90})
Pseudo-R^2	0.136	0.113	0.205	0.219	0.152
Observations	1,198,018	1,198,018	1,198,018	1,198,018	1,198,018

Note. Standard errors in parentheses. ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.1$. $P_{\#}$ represents the "#" th percentile of TFP.

The coefficients of the interaction term are significantly positive at the 10%, 25%, and 90% quantile, respectively, indicating that the higher the level of regional GDP, the less inhibitory the effect of state-owned capital share on the TFP of firms at these quantiles. The coefficient of *PerGDP* is significantly positive at all quantiles, indicating that the increase in regional GDP per capita has a boosting effect on TFP at all quantiles, which may be due to the regions with high-level economic development having advantages over regions with low economic levels in terms of policy support, market system, and regulation level. The difference in business operating environment affects firm productivity. The coefficient of *State* differs from the baseline results in two aspects: (a) The *State* coefficients are significantly negative at the 75% and 90% quantile, having values of -0.579 and -0.543, respectively, whereas the coefficients of the baseline regression are not significant at these two quantiles. (b) The absolute values of the *State* coefficients are higher than those of the baseline results at all quantiles.

Combining the results of the interaction term coefficients, leads us to the following conclusion: Among firms with high levels of TFP, the promotion effect of regional economic development on firms' TFP hedges the inhibiting effect of state-owned capital share. The inhibiting effect of state-owned capital share on TFP of firms with high-level productivity is offset when considering the effect of regional economic development. In the case of low-level TFP firms, although the effect of regional economic development dilutes the inhibitory effect of the state-owned capital share, the effect of regional economic development is not sufficient to completely offset the inhibitory effect of state-owned capital share. This is because the inhibitory effect on low-level productivity firms is stronger compared to that of high-level productivity firms, resulting in the state-owned capital share still having a significant suppressive effect on the TFP of low-level productivity firms, which is presented in the baseline results.

5. Conclusions and Policy Implications

What is the impact of state ownership on the TFP of Chinese agri-food firms? Unlike previous literature that focuses on changes of the average value of TFP, this study focuses on changes in the entire distribution of TFP.

We study this issue by using a panel quantile regression model with time and individual FE based on data from the Chinese Industrial Enterprise Database from 1998 to 2013 and drawing the following main conclusions: First, for every 1% increase in the state-owned capital share, the TFP of firms in the 10% and 25% quantile decreases by 5.1% and 7.2%, respectively, and that the state-owned capital share has no significant effect on the TFP of firms in the 50%, 75%, and 90% quantile. Second, the higher the level of regional economic development, the lower the depressive effect of state-owned capital share on the TFP of firms with low- and high-level productivity. In addition, we find that regional economic development has a significant enhancing effect on firms' TFP. Among firms with a high level of TFP, the promotion effect of regional economic development on firms' TFP hedges the inhibiting effect of state-owned capital share. The inhibiting effect of state-owned capital share on TFP of firms with high-level productivity is offset when considering the effect of regional economic development. In the case of low-level TFP firms, although the effect of regional economic development dilutes the inhibitory effect of the state-owned capital share, the effect of regional economic development is not sufficient to completely offset the inhibitory effect of state-owned capital share. This is because the inhibitory effect on low-level productivity firms is stronger compared to that of high-level productivity firms, resulting in the state-owned capital share still having a significant suppressive effect on the TFP of low-level productivity firms, which is presented in the baseline results.

Our findings have the following policy implications. First, the government should take measures to reduce the share of state-owned capital in low-productivity firms. The proportion of state-owned capital hinders the TFP growth of low-productivity firms, mainly because low-productivity firms cannot obtain the policy preferences of high-productivity firms, and state ownership limits firms' operating efficiency. The government should consider how to release the state-owned capital of low-productivity firms incrementally, such as transforming SOEs into mixed firms or private firms through state-owned reform. Second, the share of state-owned capital in regions with high levels of economic development can be appropriately increased in firms with high-level TFP. Our study shows that the regional economic development level and the share of state-owned capital have a synergistic effect in firms with high-level productivity. In the regions with a higher level of economic development, the policies supporting facilities are more complete, and firms do not need to pay a lot of money to maintain their relationship with the government and banks. Appropriately increasing the proportion of state-owned capital of enterprises can bring more policy benefits, such as in loan facilitation. These policies can help firms improve their competitiveness and stimulate increased R&D investment, thereby increasing productivity.

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Notes

Note 1. According to the NBS, the 12 subindustries of the agri-food industry are: food processing industry (13); food manufacturing industry (14); wine, beverage and refined tea manufacturing industry (15); tobacco processing industry (16); textile industry (17); garment and apparel industry (18); leather, fur, feathers and their products, and footwear industry (19); wood processing and wood, bamboo, rattan, palm and grass products industry (20); furniture manufacturing industry (21); paper and paper products industry (22); printing and reproduction of recording media (23); and rubber products industry (29).

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