

The Performance of State-Owned Enterprise:
New Evidence from the China Employer-
Employee Survey

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Abstract

Drawing on a random sampling, longitudinal data of manufacturing firms and workers we collected ourselves, China Employer-Employee Survey (CEES), this paper provides a complete analyses about differences of productivity and financial returns between state owned enterprises (SOEs) and private firms in China. We find that, the labor productivity and TFP of SOEs are significantly higher than private firms between 2013 and 2015, which is different from existing papers using Annual Survey of Industrial Firms (ASIF) for earlier period, which only include SOEs and private firms with annual sales above 20 million RMB (USD 308,000). Furthermore, this paper finds that, although better human capital, more market power and better management can explain partially why productivity in SOEs are higher, there remains a large share of the SOE advantage in productivity that is still left unexplained. In stark contrast, we find that, financial returns measured in ROA and ROE are significantly lower for SOEs than private firms.

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The Performance of State-Owned Enterprise:

New Evidence from the China Employer-Employee Survey

1. Introduction

Although it is generally believed that state-owned enterprises (SOEs) are less efficient than private firms (Megginson and Netor, 2001; Djankov and Murrell, 2002; Estrin et al., 2009), it is unclear whether this is the case in China. Some studies found that both the growth rate of productivity and profitability for SOEs were significantly lower than non-SOEs between 1998 and 2007 (Brandt et al., 2012; Johansson and Feng, 2016). However, others (Hsieh and Song, 2015) found that SOEs, especially large ones, have labor productivity similar to that of the average private firm. Moreover, Brandt et al. (2017) found that TFP has grown faster for SOEs than other types of firms since 2011. Perhaps the literature is divided because of the limitations of Chinese enterprise data. As to today, most papers use the Annual Survey of Industrial Firms (ASIF) conducted by the National Bureau of Statistics (NBS) for the period 1998-2013, which only include State-Owned Enterprises (SOEs) and private firms with annual sales above 20 million RMB (USD 308,000).

Drawing on the China Employer-Employee Survey (CEES), a new

data we collected ourselves, we examine differences in productivity and financial returns between SOEs and firms under different forms of ownership. CEES, a new longitudinal study of manufacturing firms and workers in China, has several advantages. First, the CEES samples firms of various sizes in China, creating a sample that is more representative of China's manufacturing sector. Second, this survey not only collected information on the financial performance of firms, but also on firm behaviors from variables related to human capital, market power and firm management. Third, although not critical for this paper, CEES collected data at the employee-level in addition to the firm-level.

We find that SOEs have higher labor productivity and TFP than private firms in China, but their financial returns (ROA and ROE) are lower. Specifically, regression results show that the labor productivity for SOEs was USD 128,450 in 2013-2015, about 68% higher than that of private firms (USD 76,306). Although better human capital, more market power and better management can explain partially why SOEs perform better, there remains a large share of the SOE advantage in productivity that cannot be explained by these observables. However, we also find that our measures of financial returns such as ROA and ROE are lower for SOEs than those of private firms.

In addition to the new CEES dataset, our paper makes an additional contribution by providing a more complete analysis of the differences in

efficiency and financial returns of SOEs and other firms in China. In this paper, we examine differences between SOEs and other firms in terms of efficiency—as measured by labor productivity and total factor productivity (TFP)—and financial returns—as measured by return on assets (ROA) and return on equity (ROE). Generally, existing research has focused on analyses of differences in either TFP or a measure of financial returns (Cai et.al, 2011; Bai et.al, 2009).

There are some possible explanations about both high productivity and low financial returns of SOEs. First, the high productivity of SOEs suggests that Chinese private firms may become “worse” in recent years. Different from exiting paper that found the productivity (and its growth) was significantly lower in SOEs before the year 2007 (Brandt and Zhu, 2010; Brandt et.al, 2012), with the CEES data, our paper find that both labor productivity and TFP of SOEs are significantly higher than private firms, suggesting that productivity growth of Chinese private firms may become slower in the recent decade.

Second, low credit costs of Chinese SOEs may be an reason resulting in both the high productivity and low financial returns of SOEs (Song et.al, 2011; Brandt, 2016). Based on credit benefits from banks and other financial institutions controlled by government, SOEs can invest more on advanced production machinery and increase capital-labor ratio, which make their productivity higher than private firms. However, with

low credit costs and soft budget constraint, SOEs are more likely to over-invest than private firms, which make their returns to investment significantly lower. With the limit of survey data, our paper can't examine this hypothesis under regression analyses. Therefore, we will add more variables representing credit costs (such as loan, interest rate, and bonds) into CEES to examine this hypothesis in future.

Third, measures representing human capital, market power and management are not able to fully account for differences of productivity and financial returns between SOEs and private firms. In regression analyses, our paper only use proportion of highly-educated workers, market share (export dummy), and management score as proxy variables of human capital, market power and management, which may not sufficiently explain the effects of these three factors in differences between SOEs and private firms. Furthermore, under the data limit, our paper is not able to observe annual changes of ownership type, suggesting that we can't compare the differences of productivity (financial returns) between SOEs and those privatized former SOEs, which can effectively decrease selectivity bias in examining the effects of ownership types on productivity and financial returns. Besides that, regression results in this paper only focus on differences of performance in incumbent firms, which don't account for effects of firms' entry and exit on differences between SOEs and private firms. As low-efficient SOEs have stronger

barriers to exit, the difference of performance between SOEs and private firms may be under-estimated in this paper.

The structure of the remainder of this paper is as follows. In section 2, we further explain components of SOE efficiency and present our econometric model. In section 3, we introduce the CEES dataset and report our descriptive results. Section 4 presents our main results on the differences in efficiency between SOEs and other firms. Section 5 explains why SOEs are more productive than private firms. Section 6 examines the differences in financial returns between SOEs and private firms. Section 7 concludes.

2. Methods

2.1 Econometric Specification

To measure the differences between SOEs and firms under other forms of ownership, we estimate the following econometric equation:

$$y_{ijdt} = \beta_0 + \beta_1 SOE_{ijdt} + \beta_2 HTM_{ijdt} + \beta_3 FOR_{ijdt} + Z_{ijdt} \gamma + \gamma_j + \gamma_d + \gamma_t + \varepsilon_{ijdt} \quad (1)$$

The subscripts i , j , d and t represent firm, industry, city and year. The dependent variable, y_{ijdt} , represents one of four performance measures that will be explained later in this section.

The key independent variables in this equation are the ownership measures, which we classify into four types: state-owned enterprises

(SOE_{ijdt}), HTM firms (Hong Kong/Taiwan/Macao-invested firms, HTM_{ijdt}), foreign firms (FOR_{ijdt}) and private firms ($Private_{ijdt}$). With private firms as the control group, we put the other three ownership dummies into equation (1). For comparing differences in efficiency and financial returns between SOEs and private firms, our parameter of interest in regression model (1) is β_1 .

To isolate the effect of state ownership on the performance of firms, we need to control for a series of variables that may be correlated with both ownership and our dependent variables, which are represented by the control vector Z_{ijdt} in equation (1). This vector includes measures such as firms' age, fixed effects for two-digit industrial sectors, cities and years (γ_j , γ_d and γ_t).

2.2 Performance Measures

In our analyses, we use four performance measures: labor productivity, total factor productivity (TFP), returns on assets (ROA) and returns on equity (ROE). Our first measure of performance is labor productivity, which is calculated as sales revenue per worker.

Our second measure of performance is the log of TFP. We obtain residuals from the production function in the Cobb-Douglas functional form as follows:

$$\ln q_{ijdt} = \beta_o + \beta_k \ln k_{ijdt} + \beta_l \ln l_{ijdt} + \gamma_i + v_{ijdt} . \quad (2)$$

The dependent variable of equation (2) is the log of value added (q_{ijdt}), and the independent variables are the log of fixed capital (k_{ijdt}) and labor (l_{ijdt}) respectively. After adding firm fixed effects (γ_i) into the production function model to fully control for the time-invariant heterogeneity between firms, the residual term v_{ijdt} represents the TFP for firm i in period t .³

Our third and fourth outcome measures are returns on assets (ROA) and returns on equity (ROE), which we use to examine the financial returns of firms. These measures are calculated using the ratio of net profit to total assets and the ratio of net profit to equity, respectively.

3. Survey and Data

In this section, we briefly describe the China Employer-Employee Survey which are collected by the authors. To save space, we have a more detailed description in Appendix A. We also summarize key variables for our empirical analysis.

3.1 China Employer-Employee Survey

The China Employer-Employee Survey (CEES) is a new

³ When estimating the production function model specified as equation (2), the coefficients of fixed capital and labor are 0.263 and 0.256, both of which are significant at least 1% level.

longitudinal study on manufacturing firms and workers in China. CEES began in 2015 with a survey of firms and workers in China's most important industrial province, Guangdong, which accounted for 300,000 manufacturing firms (13.4% of all manufacturing firms in the country) and 9.3 million manufacturing workers (19.4% of all manufacturing workers) and accounted for a remarkable 25.9% of the nation's international trade (imports and exports amounted to USD 1.1 trillion). In 2016, we followed up with the firms and workers that were surveyed in Guangdong in 2015 and added new workers to the employee sample in this province. Then, to capture differences between firms in Guangdong and those in China's emerging central region, a second province, Hubei, was added in 2016. Hubei Province produced USD 708.3 billion in gross industrial output and employed 3.4 million manufacturing workers in 2015.

Lists of firms from the third National Economic Census, which was conducted in early 2014, were used as the sampling frame for the survey. Sampling was conducted in two stages, each using probability proportionate-to-size (PPS) sampling, with size defined as the number of employees involved in manufacturing. Thus, the firm sample is representative of the employment size of firms in China. In the first stage, 20 county-level districts were randomly sampled in each province, with probabilities proportionate to manufacturing employment size in each

district. In the second stage, 50 firms were sampled in each district as a target sample, again with probabilities proportionate to employment in each firm. Enumerators then visited the 50 firms in sequence and attempt to survey the first 36 eligible firms (that had production activities in the sampled district). Employees were also randomly selected with stratification (See Appendix A for details). In total, we collected data from 573 firms in Guangdong in 2015 and 1,122 firms from both Guangdong and Hubei provinces in 2016 (Table A1). We had response rates over 80% in both years.

As we sampled from the Third Economic Census that was conducted in 2013, the CEES sample is representative of firms in our two sample provinces. In Table A2, we list several attributes of manufacturing firms in the two sampled provinces for three datasets: the Third Economic Census, the 2016 Statistical Yearbook and CEES. The average number of workers per firm in CEES is 62, which is close to the average figure reported in the census. In contrast, the reported number from the 2016 statistical yearbook is much larger (an average of 307 workers per firm) because the statistical yearbook uses a sample from the Annual Survey of Industrial Firms (ASIF), which refers to firms with sales over 20 million RMB (USD 308,000) annually; as a result, it only covers 56,000 firms, which is less than 10% of all firms in the two provinces. When we examine only firms with these levels of assets, the firms

represented in CEES still better resemble those represented in the census more than the ASIF represented in the statistical yearbook. Finally, for sectoral distributions, we find that CEES resembles the firms represented in the census closely.

The firm and worker questionnaires were designed by the authors together with a team of over 30 researchers. The 2016 firm questionnaire includes seven modules and 1,030 variables, covering the basic situation of firms (including firm accounting data), firm head characteristics, management, production, sales, innovation, quality control and human resources. In 2016, CEES questionnaires also included a management module that was designed for the World Management Survey, which was originally designed by Bloom and Van Reenen (Bloom and Van Reenen, 2007; Bloom et.al, 2016).

3.2 Data Summary

A summary of performance measures is reported in Table 1. Based on CEES data, we find that the average annual growth rate in labor productivity (measured by sales revenue per worker) between 2013 and 2015 was 7.7%, which is lower than the 9.8% rate found using the Annual Survey of Industrial Firms (ASIF) conducted by the National Bureau of Statistics (NBS) of 1998-2007 (Brandt and Zhu, 2010). This could be due both to different data sets and different years of data. Similarly, we find

that the average growth rate of TFP for Chinese firms was 0.9% over the same period, which is also substantially lower than the 2.6% growth rate found by Brandt et al. (2012). Although the labor productivity and TFP growth rates appear to have decreased in recent years, measures of ROA and ROE have remained stable over time. Using the CEES data, we find that the average of ROA between 2013 and 2015 was 5.3%, while ROE was 9.7% over the same period. These measures are very close to those found by Hsieh and Song (2015), which used the dataset of ASIF collected between 2008 and 2011.⁴

Table 1 further breaks down the firms by ownership type: that is, private firms, SOEs, HTM firms and foreign firms, where we define firm ownership based on who has a firm's final control rights. About 12% of our firms were SOEs, 62% were private firms, 18% were HTM firms and 8% were foreign firms. We find that the share of SOEs varies between our two sample provinces, as only 7% of the firms in Guangdong were SOEs, while SOEs represented 18% of firms in Hubei.

[Table 1 Here]

Chinese SOEs are also more capital intensive (Lardy, 2014; Naughton, 2017). Table 2 presents the average measures of capital-labor ratios across different firm types directly. For example, using fixed capital per worker as our measure of the capital-labor ratio, we find that the

⁴ See for Figure 9 in Hsieh and Song (2015).

mean measure for SOEs is USD 37,745 per worker, which is 50% higher than those for private firms (USD 25,148 per worker), 107% higher than HTM firms (USD 18,203 per worker), and 46% higher than foreign firms (USD 25,810 per worker).

As shown in Table 2, SOEs are also typically larger than private firms. In terms of employment, the average number of workers employed at SOEs is almost three times as large as that at private firms (920 vs. 311 workers). Although the average labor size of HTM (981 workers) and foreign firms (1,360 workers) are higher than that of SOEs, over 60% of the firms represented in our sample are private firms, which suggests that SOEs are larger than the majority of firms in China. When we evaluate firm size using sales revenue, we find that the average sales revenue of SOEs (USD 94.2 million) almost quadruples that of private firms (USD 24.4 million), 47% higher than HTM firms (USD 63.9 million), but is 34% lower than that of foreign firms (USD 141.8 million).

We also find that, in general, SOEs are older than all other types of firms in China. Specifically, SOEs are 17.3 years old, on average. In contrast, private firms, HTM firms and foreign firms are on average 9.6 years, 13.1 years and 14 years old.

4. Ownership and Productivity

In this section, we examine differences of efficiency (labor

productivity and TFP) between SOEs and other firms using both descriptive statistics and regression analyses.

4.1 Descriptive Results

As can be seen in the descriptive statistics presented in Table 2, SOEs are more productive than most of other firms, particularly private firms. When examining our measure of labor productivity, we find that the mean sales revenue per worker in SOEs (USD 128,450) is considerably higher than the measures found for private firms (USD 76,306), HTM firms (USD 67,867) and foreign firms (USD 117,500) between 2013 and 2015.

Similarly, Table 2 further shows that the mean TFP of SOEs is 0.55, which is considerably higher than the TFP measures of HTM firms (0.24) and private firms (-0.35), but lower than that of foreign firms (1.02). These findings may suggest that SOEs are more productive than private firms and HTM firms. Taken together, these average measures of TFP and labor productivity suggest that SOEs outperform private and HTM firms in China.

[Table 2 Here]

4.2 Regressions

Consistent with descriptive analysis, our regression results

presented in Table 3 show that SOEs are significantly more productive than private and HTM firms. However, different from the mixed descriptive findings, regression results show that SOEs are consistently less productive than foreign firms. As shown by column 1 in Table 3, without controlling for fixed effects or differences in firm characteristics, the mean of labor productivity for SOEs is 56 percentage points higher than that of private firms and even higher than that of HTM firms, although it is less than foreign firms. After adding firms' age, fixed effects of industry, city and year into the estimation model (column 2), we find that the coefficient estimate on the SOEs has decreased by about 50% (from 0.557 to 0.3), while it is still significant at 1% level. These results suggests that, these factors cannot fully explain the impact of SOE ownership on labor productivity.

Results on TFP tell a similar story. When we examine measures of TFP without controlling for firm characteristics (column 3 in Table 3), we find that the TFP of Chinese SOEs is 8.4 percentage points higher than private firms. SOEs are also more productive than HTMs, but their TFP is lower than foreign firms. When we add firms' age, fixed effects of industry, city and year into regression (column 4 in Table 3), we find that the measure TFP for SOEs is consistently significantly higher than that of private firms, but lower than that of foreign firms. Although age and these dummies can explain about part of the difference in TFP between SOEs

and other firms, most of the gap in TFP between SOEs and other types of firms is still left unexplained (column 3 vs. column 4 in Table 3). The effect of firms' age (0.015) is significantly positive at the 5% level, suggesting that older firms are more productive, probably due to survival bias. These results also suggest that, at least in comparison with private firms and HTM firms, SOEs have been relatively more productive in recent years. Our findings are different from those drawing on ASIF or aggregate data from earlier time periods (Brandt et.al, 2012; Brandt and Zhu, 2010), which found that labor productivity and TFP (and their growth rates) were significantly lower in SOEs.

[Table 3 Here]

5. Potential Explanations for the Productivity Gap

In this section, we present three potential explanations for the gaps in productivity between SOEs and other firms. These potential explanations are human capital, market power and management.

5.1 Human Capital

The first explanation for the productivity gaps found between SOEs and other firms is that Chinese SOEs may have higher levels of human capital. Some papers find that there is greater government ownership and control in China in more human-capital-intensive sectors

(Naughton, 2017; Brandt, 2016). This idea is supported by firm-level data extracted from the World Bank Enterprise Survey, which shows that SOEs in China have more skilled workers than private firms (Xu, 2010).

Statistical results in Table A3 find that SOEs do appear to employ workers with higher levels of human capital than other types of firms. The fraction of workers with a high school education is 48% at SOEs, and these fractions are much lower for private firms (35%), HTM firms (27%) and foreign firms (36%). The difference between SOEs and other firms in the number of workers with at least a college education is even more dramatic; it is 16% of workers at SOEs, but is between 4% to 7% for other firms. Considering the higher human capital in SOEs, the high productivity of SOEs may be partially explained by this factor.

To examine whether human capital can explain the productivity gap, we add variables representing human capital (the proportion of workers with a high school education,⁵ the proportion of workers with at least a college education) into the regression model and observe how the coefficients estimating the impact of SOE ownership on firm-level efficiency (labor productivity and TFP) change. The results in columns 1 and 5 of Table 4 show that, when we introduce these two variables into the econometric equations examining labor productivity and TFP, the coefficients on the human capital variable are robust and significantly

⁵ These include both academic and vocational high schools.

positive at the 5% level. Furthermore, compared to the results that do not take human capital into consideration (columns 2 and 4 in Table 3), the coefficient of SOEs on labor productivity has decreased by about 37% (from 0.3 to 0.19) and that on TFP has decreased by 18% (from 0.062 to 0.051). These regression results show that, although measures of human capital can effectively and partially explain why SOEs are more productive than private firms, the efficiency gap between Chinese SOEs and private firms are still left some unexplained.

5.2 Market Power

The second potential explanation for the productivity gap between SOEs and other firms in China is that SOEs may have much greater market power. Some papers find that, in comparison to private firms, Chinese SOEs have much more control over manufacturing inputs (such as land, natural resources, transportation, communication and intermediate/production equipment), which places them in a monopolistic position. The Chinese government has also maintained substantial control of upstream sectors and producers of large intermediate goods and machinery (Naughton, 2017). Therefore, Chinese SOEs may perform better as a result of the higher prices they can charge due to greater market power.

Summary statistics in Table A3 show that SOEs are less likely to

export but they have higher market power (domestically). Specifically, 33% of SOEs export, which is slightly higher than private firms (28%) but drastically lower than HTM firms (80%) and foreign firms (83%). Furthermore, 58% of SOEs has a market share over 10%, which is higher than all other firms (private, 46%; HTM, 46%; foreign, 49%). These mean that, SOEs are less likely to compete in the international market but have stronger market power domestically.

To examine whether market power can explain the productivity gap, we add the variables representing international competition and domestic market power, an export dummy and the domestic market share, into the regression model. Results in columns 2 and 6 of Table 4 find that, when introducing these variables representing market power into econometric equation, the coefficient estimate of the impact of SOE ownership on labor productivity has decreased by 7% (from 0.3 to 0.28) and that on TFP has decreased by 5% (from 0.062 to 0.059). Both coefficients on the SOE dummy remain statistically significant at the 1% level. In summary, these regression results show that, although measures of market power can effectively and partially explain why SOEs' productivity is higher on average than private firms, the gap between SOEs and private firms in labor productivity are still left some unexplained.

5.3 Management

Besides human capital and market power, SOEs may be more productive than other types of firms in China due to better management practices. Some papers find that, generally, the management of Chinese SOEs has improved substantially since reforms began in the late 1990s (Hsieh and Song, 2015; Huang et.al, 2017). This is because most SOEs were corporatized or decentralized (shifting management responsibilities to lower levels of government) following the reforms in order to decrease monitoring costs and eliminate principal-agent problems. Because better management has been shown to have positive effects on firm efficiency (Bloom and Reenen, 2007; Bloom et.al, 2013), it is likely that the efficiency of SOEs improved following these reforms.

To develop our measure of firm management quality, we followed the procedure used by the World Management Survey (Bloom and Reenen, 2007). Specifically, we calculate a management score based on the average 16 self-reported items covering topics related to targets setting, performance incentives, and performance monitoring. The total score is presented as a number ranging between 0 and 1, where a higher score represents better management practices.

The descriptive results presented in Table A3 suggest that SOEs are better managed than firms under other types of ownership in China. Specifically, we find that the average management score at SOEs (0.621) is 12% higher than that at private firms (0.553), 13% higher than that at

HTM firms (0.551) and even slightly higher than that at foreign firms (0.614).

To examine whether differences in management quality can explain the productivity gap between SOEs and other firms, we add management scores into our regression model. Results in columns 3 and 7 of Table 4 show that the coefficients of management on both labor productivity and TFP are positive and significant at the 1% level, suggesting that management matters for firm efficiency. In comparison to the regressions that do not control for management quality (columns 2 and 4 in Table 3), the coefficients on the SOE dummy in the labor productivity (TFP) regressions have decreased slightly, but remain significantly positive at least at the 1% level (columns 3 and 7 in Table 4). The results show that while more positive management practices can partially explain why SOEs are more productive than private firms in China, they still cannot fully explain the productivity gap.

Finally, in columns 4 and 8 in Table 4, we add all three factors, human capital, market power and management, into econometric equation. Compared to estimates in Table 3 (columns 2 and 4), the coefficient estimates of SOE dummy on labor productivity and TFP have decreased by 44% (from 0.3 to 0.169) and 29% (from 0.062 to 0.044) respectively. These mean that, although these factors can effectively and partially explain the high productivity of SOEs in China, there is some still left

unexplained. Also interestingly, the coefficients on the SOE dummy in columns 4 and 8 are close to those in columns 1 and 5, suggesting that human capital, among the three factors, is the most important one in explaining part of the productivity gap between SOEs and other firms.

[Table 4 Here]

6. Financial Returns

Although we find that SOEs perform comparably better in measures of firm efficiency, the financial returns of SOEs are lower than all other firms. The results presented in Table A3 show that the mean ROA of SOEs is 3.6%, lower than that of private firms (5.5%), HTM firms (4.2%) and foreign firms (7.3%). The pattern for ROE is the same. These findings of the relative lower financial performance of SOEs are very similar to those found by Hsieh and Song (2015). Specifically, these authors found that a capital productivity gap exists between state-owned firms and other types of firms, although the gap began to close between 1998 and 2011.

Regression results reported in Tables 5 and 6 confirm that SOEs are less profitable than other firms. For example, in the first column of Table 5, we estimate differences in ROA between SOEs and other firms without controlling for any firm characteristics. Similar to descriptive statistics shown in Table A3, we find that the ROA of Chinese SOEs is

significantly lower than private, HTM and foreign firms. The coefficients on most ownership dummies are significant at 5% level, except foreign firms (column 1 in Table 5). ROA is the highest for foreign firms, followed by private and HTM firms. In columns 2-5, when we add other control variables sequentially, the profitability gap between SOEs and Non SOEs remain large and significant. Finally, Table 6 show that the results for ROE are similar.

[Table 5 and 6 Here]

7. Conclusions

Drawing on the China Employer-Employee Survey (CEES), a new data we collected ourselves, our paper examines differences in productivity and financial returns between SOEs and other firms under different ownership types. In comparison with existing dataset such as Annual Survey of Industrial Firms (ASIF) conducted by the National Bureau of Statistics (NBS), CEES has several advantages. First, with probability proportionate-to-size (PPS) sampling method, CEES creates a sample that is more representative of China's manufacturing sector. Second, this survey collected information of both financial performance and firm behaviors, such as human capital, market power and management quality, which contributes us to further explain differences of performance between SOEs and private firms. Third, different from ASIF that most papers used, CEES collected data at the employee-level in

addition to the firm-level.

Based on the new CEES dataset, our paper provides a complete analysis of the differences in productivity and financial returns of SOEs and other firms in China. On one hand, we find that Chinese SOEs have higher labor productivity and TFP, which is 30 and 6.2 percentage points higher than private firms with benchmark regressions. On the other hand, we find that, better human capital, more market power and better management can explain partially (44 and 29 percent respectively) why labor productivity and TFP in SOEs are higher, in which human capital is the most important one explaining the productivity gap. However, there remains a large share of the SOE advantage in productivity that is left unexplained. In stark contrast, we find that financial returns measured in ROA and ROE are significantly lower for SOEs than private firms.

There are still some puzzles left that need future research. On one hand, measures representing human capital, market power and management may not sufficient account for differences of productivity and financial returns between SOEs and private firms. On the other hand, the dummies representing ownership types (SOE, private, HTM and foreign-invested firms) are cross-sectional, which make it difficult to find a perfect control group decreasing selectivity bias. Besides that, as low-efficient SOEs have stronger barriers to exit, the high productivity and low financial returns in SOEs may be under-estimated.

The policy implications of this paper are clear. On one hand, the finding of high productivity in SOEs suggests that private firms may become “worse” in recent years. Although most papers using ASIF data found that productivity (and its growth) had been significantly higher for private firms in the first three decades of China’s economic reform since 1978 (e.g Brandt and Zhu, 2010), the findings of our paper suggest that, productivity growth of Chinese private firms may become slower in the recent decade, which may have negative impacts for sustainable economic development. Hence, government should make more policies to stimulate productivity growth of private firms.

On the other hand, credit constraint may be an important reason on private firms’ disadvantage in productivity. In China, most banks and other financial institutions are controlled by government, which are inclined to provide more credit benefits to SOEs rather than private firms. Therefore, in comparison with SOEs, private firms have less financial resources to introduce advanced machinery (such as computer numerical controlled machine and industrial robot), which make them less productive than SOEs. In contrast, although SOEs can have higher productivity through financial supports of government, they are induced to over-invest under the soft budget constraint, making returns to investment significantly lower.

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Table 1 Summary statistics of performance measures and ownership distributions in CEES (2013-2015 panel)

Classifications	All Firms	Guangdong	Hubei
	(N=2,485)	(N=1,331)	(N=1,154)
	Mean (Std.)	Mean (Std.)	Mean (Std.)
<u>1. Measures of efficiency</u>			
Labor productivity (2013-2015)	85.4 (104.2)	71.9 (91.2)	100.0 (115.0)
Annual growth rate of labor productivity	7.7 (57.0)	7.7 (67.2)	7.7 (44.2)
TFP (2013-2015)	0.0 (1.5)	0.0 (1.6)	-0.1 (1.5)
Annual growth rate of TFP	0.9 (9.6)	0.7 (11.8)	1.1 (6.4)
<u>2. Measures of financial returns</u>			
ROA (% , 2013-2015)	5.3 (9.4)	5.0 (9.3)	5.5 (9.5)
ROE (% , 2013-2015)	9.7 (21.5)	10.9 (23.2)	8.9 (20.3)
<u>3. Ownership Distributions</u>			
SOE (0-1 dummy)	0.12 (0.33)	0.07 (0.25)	0.18 (0.38)
Private (0-1 dummy)	0.62 (0.49)	0.50 (0.50)	0.76 (0.43)
HTM (0-1 dummy)	0.18 (0.39)	0.31 (0.46)	0.04 (0.19)
Foreign (0-1 dummy)	0.08 (0.26)	0.12 (0.32)	0.02 (0.12)

Notes: statistical analyses are based on the “China Employer-Employee Survey” (CEES) data. The numbers in brackets are standard deviations. For labor productivity, it is measured as sales revenue (thousand USD) per worker. For TFP, it is measured as residuals subtracting labor, capital from value-added, when controlling firm fixed-effects. For measures of financial return such as ROA and ROE, they are reported about percentages. SOEs are defined as state-owned enterprises. HTM firms are defined as Hong Kong/Taiwan/Macao invested firms.

Table 2 Statistical differences between SOEs and Non SOEs (2013-2015 panel)

Classification	SOE	Private	HTM	Foreign
	(N=298) Mean (Std.)	(N=1,546) Mean (Std.)	(N=452) Mean (Std.)	(N=189) Mean (Std.)
<u>1. Efficiency</u>				
Labor productivity (thousand USD)	128.4 (128.3)	76.3 (95.0)	67.9 (94.2)	117.5 (122.4)
TFP	0.55 (1.42)	-0.35 (1.46)	0.24 (1.63)	1.02 (1.35)
<u>2. Capital-labor ratio</u>				
Fixed capital per worker (thousand USD)	37.7 (39.1)	25.1 (30.5)	18.2 (26.7)	25.8 (34.0)
Total assets per worker (thousand USD)	139.5 (121.4)	81.5 (89.1)	58.2 (74.5)	93.3 (101.3)
<u>3. Firm size</u>				
Employment (person)	920 (1102.2)	311 (589.1)	981 (1142.5)	1,360 (1126.7)
Sales revenue (million USD)	94.2 (132.8)	24.4 (63.4)	63.9 (103.4)	141.8 (151.6)
<u>4. Firm Age</u>				
Firms' age (year)	17.3 (11.7)	9.6 (6.3)	13.1 (6.8)	14.0 (6.3)

Notes: statistical analyses are based on the “China Employer-Employee Survey” (CEES) data. The numbers in brackets are standard deviations. SOEs are defined as state-owned enterprises, and HTM firms are defined as Hong Kong/Taiwan/Macao invested firms. For labor productivity, it is measured as sales revenue per worker. For TFP, it is measured as residuals subtracting labor and capital from value-added, when controlling firm fixed-effects. For capital labor ratio, it is measured as fixed capital per worker and total assets per worker respectively.

Table 3 Productivity differences between SOEs and Non SOEs

	Labor productivity (in logs)		TFP (in logs)	
	(1)	(2)	(3)	(4)
SOE dummy	0.557*** (0.081)	0.300*** (0.084)	0.084*** (0.011)	0.062*** (0.012)
HTM dummy	-0.166*** (0.059)	0.097 (0.063)	0.053*** (0.010)	0.060*** (0.011)
Foreign dummy	0.559*** (0.081)	0.532*** (0.087)	0.127*** (0.012)	0.101*** (0.014)
Firms' age (in logs)		0.231*** (0.041)		0.015** (0.006)
Industry Fixed Effects		Yes		Yes
City Fixed Effects		Yes		Yes
Year Fixed Effects		Yes		Yes
Observations	2,485	2,485	2,485	2,485
R-squared	0.041	0.235	0.067	0.166

Notes: the numbers in brackets are robust standard errors. *, ** and *** represent the significance at 10%, 5% and 1% levels respectively. HTM firms are defined as Hong Kong/Taiwan/Macao invested firms. SOEs are defined as state-owned enterprises.

Table 4 Potential explanations about productivity differences between SOEs and Non SOEs

	Labor Productivity (in logs)				TFP (in logs)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SOE dummy	0.190** (0.083)	0.280*** (0.082)	0.271*** (0.083)	0.169** (0.081)	0.051*** (0.012)	0.059*** (0.012)	0.053*** (0.012)	0.044*** (0.012)
HTM dummy	0.120* (0.062)	0.064 (0.066)	0.118* (0.062)	0.109* (0.065)	0.060*** (0.011)	0.053*** (0.011)	0.065*** (0.011)	0.060*** (0.011)
Foreign dummy	0.513*** (0.083)	0.499*** (0.089)	0.518*** (0.086)	0.485*** (0.086)	0.097*** (0.014)	0.094*** (0.015)	0.100*** (0.014)	0.092*** (0.014)
Firms' age (in logs)	0.225*** (0.041)	0.215*** (0.041)	0.221*** (0.041)	0.207*** (0.041)	0.014** (0.006)	0.013** (0.006)	0.011* (0.006)	0.009 (0.006)
Workers having high school education (%)	0.579*** (0.088)			0.504*** (0.087)	0.029** (0.014)			0.012 (0.014)
Workers with at least college education (%)	0.971*** (0.239)			0.913*** (0.233)	0.153*** (0.033)			0.133*** (0.031)
Export dummy		0.104* (0.054)		0.066 (0.054)		0.022*** (0.008)		0.016** (0.008)
Market share (11-100%)		0.220*** (0.044)		0.190*** (0.044)		0.010 (0.007)		0.006 (0.007)
Management score (0-1 ratio)			0.748*** (0.160)	0.460*** (0.161)			0.184*** (0.025)	0.164*** (0.026)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485
R-squared	0.259	0.244	0.242	0.268	0.180	0.170	0.189	0.200

Notes: the numbers in brackets are robust standard errors. *, ** and *** represent the significance at 10%, 5% and 1% levels respectively. HTM firms are defined as Hong Kong/Taiwan/Macao invested firms. SOEs are defined as state-owned enterprises.

Table 5 ROA differences between SOEs and Non SOEs

	ROA (percentages)					
	(1)	(2)	(3)	(4)	(5)	(6)
SOE dummy	-0.023*** (0.006)	-0.025*** (0.007)	-0.024*** (0.007)	-0.025*** (0.007)	-0.026*** (0.007)	-0.025*** (0.007)
HTM dummy	-0.011* (0.006)	-0.003 (0.007)	-0.004 (0.007)	-0.003 (0.008)	-0.003 (0.007)	-0.003 (0.008)
Foreign dummy	0.015 (0.009)	0.017* (0.010)	0.017* (0.010)	0.017* (0.010)	0.016 (0.010)	0.017* (0.010)
Firms' age (in logs)		-0.005 (0.004)	-0.005 (0.004)	-0.005 (0.004)	-0.005 (0.004)	-0.005 (0.004)
Workers having high school education (%)			-0.009 (0.008)			-0.011 (0.008)
Workers with at least college education (%)			-0.009 (0.014)			-0.010 (0.015)
Export dummy				-0.001 (-0.005)		-0.001 (-0.005)
Market share (11-100%)				0.003 (0.004)		0.004 (0.004)
Management score (0-1 ratio)					0.013 (0.013)	0.018 (0.013)
Industry Fixed Effects		Yes	Yes	Yes	Yes	Yes
City Fixed Effects		Yes	Yes	Yes	Yes	Yes
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes
Observations	2,485	2,485	2,485	2,485	2,485	2,485
R-squared	0.010	0.062	0.062	0.062	0.062	0.063

Notes: the numbers in brackets are robust standard errors. *, ** and *** represent the significance at 10%, 5% and 1% levels respectively. HTM firms are defined as Hong Kong/Taiwan/Macao invested firms. SOEs are defined as state-owned enterprises.

Table 6 ROE differences between SOEs and Non SOEs

	ROE (percentages)					
	(1)	(2)	(3)	(4)	(5)	(6)
SOE dummy	-0.050*** (0.014)	-0.062*** (0.016)	-0.057*** (0.016)	-0.061*** (0.016)	-0.062*** (0.016)	-0.057*** (0.016)
HTM dummy	-0.028* (0.014)	-0.041** (0.018)	-0.042** (0.018)	-0.040** (0.018)	-0.041** (0.018)	-0.041** (0.018)
Foreign dummy	0.028 (0.021)	-0.001 (0.024)	-0.001 (0.024)	-0.000 (0.025)	-0.001 (0.024)	-0.000 (0.025)
Firms' age (in logs)		0.001 (0.009)	0.001 (0.009)	0.002 (0.009)	0.001 (0.009)	0.001 (0.009)
Workers having high school education (%)			-0.035* (0.018)			-0.035* (0.019)
Workers with at least college education (%)			-0.016 (0.031)			-0.017 (0.031)
Export dummy				-0.004 (0.012)		-0.003 (0.012)
Market share (11-100%)				-0.007 (0.010)		-0.006 (0.010)
Management score (0-1 ratio)					-0.001 (0.031)	0.014 (0.032)
Industry Fixed Effects		Yes	Yes	Yes	Yes	Yes
City Fixed Effects		Yes	Yes	Yes	Yes	Yes
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes
Observations	2,485	2,485	2,485	2,485	2,485	2,485
R-squared	0.009	0.056	0.058	0.057	0.056	0.058

Notes: the numbers in brackets are robust standard errors. *, ** and *** represent the significance at 10%, 5% and 1% levels respectively. HTM firms are defined as Hong Kong/Taiwan/Macao invested firms. SOEs are defined as state-owned enterprises.

Appendix A: China Employer-Employee Survey

The China Employer-Employee Survey (CEES) is a new longitudinal study on manufacturing firms and workers in China. Existing firm datasets have limited information and/or fail to acquire a representative sample of firms and workers. The CEES project seeks to provide a new data source that can overcome these limitations. The goals of CEES are to conduct the world's most comprehensive employer-employee survey in China, to create a longitudinal dataset that tracks changes in the situation of both employers and employees over time and to create a high-quality dataset that can provide a platform for evidence-based studies of the Chinese economy by economists and policy-makers worldwide.

A.1 Surveyed Provinces

CEES began in 2015 with a survey of firms and workers in China's most important industrial province, Guangdong, which is located on the coast of China near Hong Kong. In 2015, Guangdong accounted for more manufacturing firms (0.3 million) and manufacturing workers (9.3 million) than any other province in China. As a proportion of the national totals, Guangdong had 13.4% of all manufacturing firms and 19.4% of all manufacturing workers in the country and accounted for a remarkable 25.9% of the nation's international trade (imports and exports amounted

to USD 1.1 trillion). CEES surveyed in 19 county-level districts in Guangdong (in 13 of the 21 sub-provincial/prefectural districts). The sampled county-level districts account for 90% of gross industrial output and 86% of employment in Guangdong's manufacturing sector. In 2016, we followed up with the firms and workers that were surveyed in Guangdong in 2015 and added new workers to the employee sample in this province.

Then, to capture differences between firms in Guangdong and those in China's emerging central region, a second province, Hubei, was added in 2016. Hubei Province has the highest gross industrial output per capita in central China. It produced USD 708.3 billion in gross industrial output and employed 3.4 million manufacturing workers in 2015, accounting for 4% and 6.6% of the national totals, respectively. In 2016, CEES surveyed firms in 20 county-level districts in Hubei (in 13 out of a total of 17 prefectural/city-level districts). These county-level districts account for 89% of gross industrial output and 90% of employment in Hubei's manufacturing sector.

A.2 Stratified Sampling

Lists of firms from the third National Economic Census, which was conducted in early 2014, were used as the sampling frame for the survey. Sampling was conducted in two stages, each using probability

proportionate-to-size (PPS) sampling, with size defined as the number of employees involved in manufacturing. Thus, the firm sample is representative of the employment size of firms in China. In the first stage, 20 county-level districts were randomly sampled in each province, with probabilities proportionate to manufacturing employment size in each district. In the second stage, 50 firms were sampled in each district as a target sample, again with probabilities proportionate to employment in each firm. Enumerators then visited the 50 firms in sequence and attempt to survey the first 36 eligible firms (that had production activities in the sampled district).

Employees were also randomly selected with stratification. To do so, we first asked firms to provide a list of all employees enrolled at the end of the previous year, with middle and senior managers listed separately. We then randomly selected 10 employees in each firm (6-9 for smaller firms), among which 3 (2 for smaller firms) were middle and senior managers. If selected employees could not participate (e.g., were not working on site during the survey period), they were replaced with the worker whose name was closest to theirs on the list of workers. This process was carried out until the targeted number of sampled employees was reached.

A.3 Response Rates and Sample Sizes

In total, we collected data from 573 firms in Guangdong in 2015 and 1,122 firms from both Guangdong and Hubei provinces in 2016 (Table A1). We had high response rates in both years. Among the 696 firms that were eligible to be surveyed in Guangdong in 2015, the response rate for the baseline survey was 82% (573 firms). Of the firms that were surveyed in Guangdong in 2015, we were able to successfully follow up with 85% of the firms in 2016 (487 firms).⁶ In addition to following up with firms in 2016, we also attempted to survey firms that were included in our original target sample, but had not participated in the 2015 baseline survey. From this, an additional 50 firms participated in the 2016 survey, yielding a total sample of 537 firms in Guangdong in 2016. When surveying began in Hubei in 2016, we successfully collected data from 585 of the 703 targeted firms, a response rate of 83%. Taking the samples from both provinces together, 85% of the targeted firms were successfully interviewed in 2016 (1,122 out of 1,326 firms).

The baseline surveys included 4,838 workers in Guangdong in 2015 and 4,114 workers in Hubei in 2016 (Table A1). In both provinces, about 90% of the workers who were initially sampled participated in the survey. In 2016, 53% of the workers surveyed in Guangdong in 2015 were successfully re-interviewed. This relatively low follow-up rate can be attributed to firm attrition and high worker turnover. Based on the

⁶ Of the 15% attrition, 10% was due to refusal and 5% was due to exit or relocation.

turnover rate in each firm, new replacement workers were added to the sample from firms that participated in the 2015 survey in Guangdong (in addition to workers from the 50 replacement firms sampled in 2016).

As we sampled from the Third Economic Census that was conducted in 2013, the CEES sample is representative of firms in our two sample provinces. In Table A2, we list several attributes of manufacturing firms in the two sampled provinces for three datasets: the Third Economic Census, the 2016 Statistical Yearbook and CEES. The average number workers per firm in CEES is 62, which is close to the average figure reported in the census; in contrast, the reported number from the 2016 statistical yearbook is a much larger (an average of 307 workers per firm) because the statistical yearbook uses a sample of Annual Survey of Industrial Firms (ASIF).

ASIF refers to firms with sales over 20 million RMB (USD 308,000) annually and, as a result, only covers 56,000 firms, which is less than 10% of all firms in the two provinces. When we examine only firms with these levels of assets, the firms represented in CEES still better resemble those represented in the census more than the ASIF represented in the statistical yearbook. Finally, for sectoral distributions, we find that CEES resembles the firms represented in the census closely.

A.4 Questionnaire Design

The firm and worker questionnaires were designed by the four PIs together with a team of over 30 researchers. The 2016 firm questionnaire includes seven modules and 1,030 variables, covering the basic situation of firms (including firm accounting data), firm head characteristics, management, production, sales, innovation, quality control and human resources. The employee questionnaire includes five modules and 443 variables, covering personal background, current job, work history, social insurance and personality traits.

In 2016, CEES questionnaires also included a management module that was designed for the World Management Survey, which was originally designed by Nicholas Bloom and Van Reenen. An innovation of the CEES is that it is the first survey to ask both CEOs and employees questions about management practices in their firms.

Table A1 Sample size and response rates of CEES survey in Hubei and Guangdong provinces of China

	Number of observations	Response rate
Firm survey 2015 (Guangdong only)	573	82%
Firm survey 2016	1,122	85%
New sample (Hubei)	585	83%
Follow up sample (Guangdong)	487	85%
New sample (Guangdong)	50	--
Worker survey 2015 (Guangdong only)	4,838	88%
Worker survey 2016	9,103	80%
New sample (Hubei)	4,114	89%
Follow up sample (Guangdong)	2,575	53%
New sample (Guangdong)	2,414	94%

Table A2 Characteristics of CEES vs. the Census and Yearbook (Hubei and Guangdong provinces of China)

	The 3 rd National Economic Census	2016 Statistical Yearbook	2016 CEES
Number of firms (thousand)	361.13	56.45	1.12
Employment (person)	69	307	62
Assets (million USD)	4.7	30.4	8.0
Industrial output (million USD)		43.3	7.7
Profit (million USD)		2.4	0.5
Profit rate (profit/sales, %)		5.5	6.5
Type of Industry (%)			
Farm and sideline food processing	5	7	5
Food manufacturing	2	2	1
Wine, beverage and refined tea manufacturing	2	2	2
Textile Industry	6	6	6
Clothing	6	4	7
Leather, fur, feathers and footwear industry	2	2	4
Wood processing and wood product industry	3	3	1
Furniture manufacturing	2	2	2
Paper and paper product industry	2	2	1
Printing	3	2	3
Education, art, sport and entertainment product	3	3	3
Chemical industry	5	7	2
Pharmaceutical industry	1	2	2
Rubber and plastic products industry	6	5	3
Nonmetallic mineral products industry	9	10	10
Ferrous metal industry	2	3	1
Nonferrous metal industry	1	2	1
Metal product industry	8	6	7
General equipment manufacturing industry	10	7	4
Special equipment manufacturing industry	6	5	4
Automobile manufacturing industry	2	4	6
Railway, ship and other transportation equipment manufacturing	1	1	1
Electrical machinery and equipment	6	7	8
Computer, communications and other electronic equipment	3	3	11
Instrument manufacturing industry	1	1	3
Others	3	2	2

Notes: Calculations from CEES data are weighted using both the firm size weight in a county (the probability of a firm being in a sample is proportional to its employment size) and the employment weight within a firm in 2013. Statistical Yearbook tabulations are based on the Annual Survey of Industrial Firms (ASIF) conducted by the National Bureau of Statistics (NBS) with SOEs and other firms having sales revenue exceeding 20 million RMB (USD 308,000). The Third National Economic Census (carried out in 2013) tabulations are from *The Statistical Bulletin for the Third National Economic Census*. Industries are classified according to the two-digit code of the *Industrial Classification for National Economic Activities (GB/4754-2011)*.

Table A3 Statistical differences of other attributes between SOEs and Non SOEs (2013-2015 panel)

Classification	SOE	Private	HTM	Foreign
	(N=298)	(N=1,546)	(N=452)	(N=189)
	Mean (Std.)	Mean (Std.)	Mean (Std.)	Mean (Std.)
1. <u>Human Capital</u>				
workers with high school education	0.48 (0.27)	0.35 (0.28)	0.27 (0.22)	0.36 (0.26)
workers with at least college	0.16 (0.18)	0.05 (0.12)	0.04 (0.08)	0.07 (0.14)
2. <u>Market Power</u>				
Export dummy	0.33 (0.47)	0.28 (0.45)	0.80 (0.40)	0.83 (0.37)
Market share of 0-10%	0.42 (0.50)	0.54 (0.50)	0.54 (0.50)	0.51 (0.50)
Market share of 11-100%	0.58 (0.50)	0.46 (0.50)	0.46 (0.50)	0.49 (0.50)
3. <u>Management</u>				
Management Score	0.621 (0.14)	0.553 (0.16)	0.551 (0.15)	0.614 (0.11)
4. <u>Financial Return</u>				
ROA (%)	3.6 (8.7)	5.5 (9.0)	4.2 (9.8)	7.3 (9.7)
ROE (%)	5.7 (20.6)	10.4 (20.9)	7.8 (22.3)	12.1 (23.3)

Notes: statistical analyses are based on the “China Employer-Employee Survey” (CEES) data. The numbers in brackets are standard deviations. SOEs are defined as state-owned enterprises, and HTM firms are defined as Hong Kong/Taiwan/Macao invested firms. For measures of financial return such as ROA and ROE, they are reported about percentages.