State-Owned Enterprises, Exporting and Productivity in China: A Stochastic Dominance Approach

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Abstract

A popular explanation for China's rapid economic growth in recent years has been the dramatic increase in the number of private domestic and foreign-owned firms and a decline in the state-owned sector. However, recent evidence suggests that China's state-owned enterprises (SOEs) are in fact stronger than ever. In this paper we examine over 78,000 manufacturing firms between 2002 and 2006 to investigate the relationship between ownership structure and the degree of firm-level exposure to export markets and firm-level productivity. Using a conditional stochastic dominance approach we reveal that although our results largely adhere to prior expectations, the performance of state-owned enterprises differs markedly between those that export and those that supply the domestic market only. It appears that China's internationally focused SOEs have become formidable global competitors.

Keywords: Productivity, China, firm-level, State-owned enterprise, heterogeneity, stochastic dominance

JEL: L2, L3, P3, D2

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1. Introduction

A popular explanation for China's rapid economic growth in recent years has been the dramatic increase in the number of private domestic and foreign-owned firms and a decline in the state-owned sector. However, it appears that the demise of China's state-owned enterprises (SOEs) has been greatly exaggerated with evidence suggesting that China's SOEs are stronger than ever (Hsueh 2011). The common perception was that China's SOEs acted as a drag on China's productivity growth by absorbing resources and providing little economic value in return (see e.g. Jefferson *et al.* 1992, 1996, 2000, Lardy 1998, Holz 2002, 2003 and Jefferson and Su 2006). However, the recent phenomenon of "*guo jin min tui*" translated as "the state sector advances and the private retreats" has again focused attention on the performance of China's SOEs.[1]

Although the output share of SOEs is not increasing it has been declining at a much slower rate and it is argued that the state is tightening its grip in a number of strategic and some not so strategic sectors (Economist 2011a).[2] Methods of support used by China's government includes providing cheap credit to local champions, selective rule enforcement and forced consolidation (see Hsueh 2011 for details). In 2008 Fu *et al.* (2008) estimated that the share of industrial output attributable to SOEs fell from 80% in 1978 to just 28% in 2003. More recently, Unirule Institute of Economics put the fall in the state's share of industrial output at 27% (down from 49% in 1999) but noticeably only a little lower than the 2003 estimate (Unirule 2011). For the period 2002 to 2006 we find that the SOE share of employment (value added) fell from around 28% (24%) in 2002 to around 23% (19%) in 2006. However, surprisingly the share of SOEs as a percentage of all firms remains fairly constant at around 14%. For foreign firms this renewed government intervention in support of Chinese companies is a worrying development as Chinese SOEs increasingly flex their muscles across the global economy.

The contribution of this paper is two-fold. First, in the context of the recent trade and productivity literature we briefly discuss the history of economic reform in China and the

[1] The Fortune top 500 companies for 2011 lists 61 mainland Chinese firms of which 59 are state-owned which is an increase from 39/42 in 2010, 19/20 in 2006 and 6/6 in 2003 (Financial Times China 2011).

[2] Whilst strategic sectors such as oil, coal, telecommunications and transport equipment retain a strong SOE presence other sectors such as textiles and papermaking have also witnessed an increase in state involvement. Our data support these findings. Using National Economic Industry Classification (NEIC) 2-digit industries we observe that between 2002 and 2006 the contribution of SOEs as a percentage of industry total value added increased in 19 (Manufacture of leather products), 20 (Manufacture of wood and wood products), 28 (Manufacture of chemical fibres) and 41 (Manufacture of instruments and appliances). The three industries that increased their share of employment between 2002 and 2006 were 14 (Manufacture of food products), 20 (Manufacturing of wood and wood products) and 28 (Manufacture of chemical fibres).

changing role of China's SOEs. Second, we compare the productivity of firms that differ in ownership structure and exposure to international markets which enables us to examine more closely two of the main explanations from the literature for the existence of productivity differentials across and between firms with the same ownership. To do this we measure total factor productivity (TFP) for a large sample of over 78,000 Chinese firms for the period 2002 to 2006. This period is ideal for our study as it follows a government push at the beginning of the century to merge, privatize and restructure China's remaining SOEs.

Our methodological approach is to use conditional stochastic dominance (SD) tests that allow us to examine productivity differentials across the entire distribution of firms. Although non-parametric methods have been used before in the study of firm level productivity and trade (see e.g. Delgado *et al.* 2002, Girma *et al.* 2004a, 2004b and Arnold and Hussinger 2010), as far as we are aware this is the first paper to apply this technique to the productivity differentials by type of ownership so we are able to understand how ownership influences productivity across the entire distribution of firms. Although it is reasonably well established that there is a positive correlation between exporting and higher productivity, what is less well known is how a firm's trade status affects productivity in conjunction with the ownership structure of the firm. For example, do exporting SOEs have higher productivity levels than non-exporting SOEs? The relatively small sample size of previous studies is part of the explanation and is addressed in this paper by the use of a large sample of firms.

Our results show that when the international status of firms is not taken into account the productivity ordering follows the theoretical predictions and previous empirical results with foreign owned firms more productive than domestic and SOEs in that order. However, when we take into account export status, we find that SOEs rise to the top of the productivity performers ahead of even foreign exporters. Interestingly, we find no statistical difference in the productivity levels of exporting or non-exporting foreign and Hong Kong, Taiwan and Macau (HTM) firms in contrast to the large differences for SOEs and domestic firms in China. What our results reveal is that SOEs are not all the same with China's state-owned exporters considerably outperforming others.

The remainder of the paper is organized as follows. First, we provide a brief review of the literature before going on to outline our econometric methodology. Section three provides a

description of the data and some summary statistics whilst section four presents the results. The final section concludes.

2. Literature Review

We begin with a brief overview of economic reform in China and a summary of the changing role of the SOE in China (Fernandez and Fernandez-Stembridge 2006 and Brandt and Rawski 2008 provide a detailed discussion). SOEs remain crucial to the success of the economic reform process started more than three decades ago. This success is not just economic but encompasses the important links between SOEs and the development of a strong financial system and their relationship with employment and social welfare. The relationship between SOEs and the Chinese communist party is also important with political considerations often crucial in determining how SOE reform was implemented.[3]

Started by Deng Xiaoping in 1978 a series of economic reforms were put into place to take advantage of general market principles. Although the first stage consisted largely of agricultural reform and encouragement for private entrepreneurs it was not until the second stage in the late 1980s and early 1990s when the Chinese government began to tackle industry which at the time was entirely state-owned. The process included wide-scale privatizations, the removal of price controls and reducing the regulatory burden. Such reforms were considered an experiment on a vast scale. The major concerns were how to create a modern management system, how to manage joint ventures, how to create a firm structure that would allow firms to compete nationally and internationally and importantly how China was to deal with the surplus labour resulting from economic reform (Fernandez and Fernandez-Stembridge 2006).

The three main stages of reform were firstly management reform (1978-1984), secondly, a dual track production system (1984-1992) and thirdly, ownership reform (post-1992). The first stage was initiated by the selection of a small number of SOEs who were allowed to keep a proportion of their profits to reinvest and innovate. By 1980 this incentive mechanism was rolled out to include over 6,000 medium and large SOEs (accounting for 70% of national industrial profits). In stage 2 SOEs were allowed to sell products outside of the state plan with a premium over the

[3] A description of the impact of the initial reforms to SOEs in the 1980s and 1990s and the special role SOEs play in Chinese society can be found in Hay *et al.* (1994), Woo *et al.* (1994), Perkins (1996), Bai *et al.* (1997), Li (1997), Bai *et al.* (2000) and Steinfeld (2000).

state price of around 20% (known as the Dual Track system). Some hiring decisions were given to the firm. At the end of the second stage formal contractual arrangements between the state and SOEs were introduced.

In the third and most dramatic stage SOEs were allowed to be sold to the public or employees in a wide-scale overhaul of the structure of firms. Crucially, in 1995 at the same time as ownership reform was moving rapidly the government chose between 500 and 1000 large SOEs to remain in government hands. Garnaut *et al.* (2006) showed that by the end of 2001, 86% of SOEs had been restructured and 70% privatized (either fully or partially). At the same time there was a dramatic increase in the number of private enterprises with the National Bureau of Statistics of China (2003) estimating that the number of private firms rose from 440,000 (16.9% of all firms) in 2006 to 1.32 million in 2010 (43.7% of all firms). SOE reform is now largely complete but the effects are still being felt all across China and importantly, large state monopolies persist in certain sectors such as banking, telecommunication and petroleum products.

Early studies of China's SOEs considered how changes in the productivity of SOEs compared to that of their non-state-owned counterparts after the major economic reforms of the late 1980s. Studies of the growth of TFP conclude that although Chinese SOEs experienced positive TFP growth in the late 1970s and 1980s their growth rates were lower than the growth of firms under alternative ownership structures (Dollar 1990, Gordon and Li 1995 and Jefferson *et al.* 1996).[4]

More recent studies pay attention to explanations of how productivity changes have been achieved (Zhang *et al.* 2001, 2002 and Fu *et al* 2008). Using Data Envelopment Analysis (DEA) all three studies show that SOEs in China have the lowest mean productivity levels while Fu *et al.* (2008) show that the changes in productivity are affected by macroeconomic fluctuations and central government reforms. In particular they show that productivity improved in the 1980s and 2000s but worsened in the 1990s, possibly as a result of increased competition following the initial reforms. One drawback with DEA is that it does not take stochastic components into account hence any random shock is captured by the inefficiency measure. Nolan and Wang (1999) however, present a more positive view and demonstrate that China's large SOEs actually thrived

[4] TFP has been used to evaluate the performance of Chinese firms since the 1980s (Chow 1985 and World Bank 1985). However, there remains some debate about the effectiveness of TFP as a measure of productive efficiency especially for SOEs because of government imposed objectives and other distortions incompatible with the efficient allocation of resources when profit maximization is not the primary objective. However, by the time of our study SOEs are operating under much more transparent rules making measurement of TFP more appropriate.

under the state's policy to promote large businesses as part of a wider policy of strategic integration with the world economy.[5]

One of the central tenets of this paper is the relationship between productivity and firms' exposure to international markets. Using traditional parametric methods Bernard and Jensen (1995) explain productivity differences between exporting and non-exporting firms using individual firm-level data for the US. They find that the labor productivity of exporting firms is about one-third higher than non-exporting firm across all plant sizes. For China, Kraay (2002) also employs parametric regression analysis on a panel of 2,105 large and medium-sized industrial firms between 1988 and 1992 and shows that when measured with both partial labour productivity and TFP, that most Chinese exporters were more productive than the non-exporters.[6] More recently, using parametric regression methods with more than 70,000 manufacturing firms between 2001 and 2005 Sun and Hong (2011) show that foreign-owned and exporting Chinese firms are more productive. However, the size of exporter premium is less significant for foreign owned firms.[7]

More recently, productivity heterogeneity among firms with different level of involvement in international trade has been studied with non-parametric methods. Non-parametric stochastic dominance (SD) techniques allow us to consider productivity differences across the whole distribution of firms (McFadden 1989 and Linton *et al.* 2005). They provide a robust comparison of the entire productivity distribution between exporters and non-exporters which allows the identification of any heterogeneity in the relationship between exporting and the level of productivity. Using a SD test with data from 1,766 representative Spanish manufacturing firms between 1991 and 1996 Delgado *et al.* (2002) reveal a clear superior productivity of exporting over the non-exporting firms. Girma *et al.* (2004b) apply SD techniques for more than 3,700 British manufacturing firms for the period 1990 to 1996 and find evidence to support the theoretical prediction of productivity orderings for firms at different stage of the globalization process. In particular, they found that when using TFP, the productivity distribution of domestic firms that conduct FDI clearly dominates the productivity distribution of domestic exporters and non-exporters that do not invest overseas. What is more, they find that the productivity distribution of domestic exporters is higher than that of non-exporters. Similarly,

[5] Although SOEs make up less than 5% of total firms, they are on average 14 times larger than non-SOEs (NBSC). The strategy in the late 1990s was known as "*zhua da fang xiao*" translated as "manage the large and let go the small".
[6] See Wagner (2007) for a detailed review of the parametric literature.
[7] Sun and Hong (2011) also found that in four out of five specifications that state-owned exporting firms are more productive than the domestic exporting firms although the coefficient is not statistically significant.

Girma *et al.* (2004a) show for a large sample of Irish manufacturing firms for 2000, that the productivity distribution of the firms invested in other countries stochastically dominates firms that do not, regardless of export status. Most recently, Arnold and Hussinger (2010) compare the productivity distributions of 6000 German manufacturing firms between 1996 and 2002 and show that the productivity distribution of the FDI firms dominates both the exporting and non-exporting firms that do not invest overseas and that exporting firms have higher productivity levels than the non-exporting firms.

In a more recent literature conditional stochastic dominance tests have been used. For example, Massoumi and Heshmati (2000), Delgado *et al.* (2002) apply this technique to Swedish income distributions and firm productivity and exports respectively. In our case we condition on location, firm size and industry. Firm size is accepted as an important factor in determining productivity (Bernard and Jensen 1995, Blalock and Gertler 2004, De Loecker 2004 and Alvarez and Lopez 2005). Syverson (2011) also points out how TFP differs across industries. Spatial studies of productivity show that firms that are located close to each other have similar productivity levels (Ciccone and Hall 1996, Fan and Scott 1996, Fingleton 2001 and Rice *et al.* 2006). This is particularly important for China as it has been shown that most productive firms are clustered around the coastal regions where China's "special economic zones" are located (World Bank 2006 and Chen *et al.* 2011).

3. **Methodology**

Studies that use traditional parametric regression analysis consider only the first moment (mean) of the productivity distribution. Such an approach allows a comparison of productivity on average but does not provide any information on relative productivity levels elsewhere in the distribution. Hence, when the distribution of firm level productivities are sufficiently diverse, the relationship observed from an analysis at the mean may not accurately represent the entire distribution, which in turn might give inaccurate conclusions regarding productivity differences across firms. Furthermore, when traditional regression methods are applied to the study of firm-level productivity it assumes that all firms with productivity of a certain level will not export until a critical threshold for exporting is met. This assumption is rather restrictive and unrealistic (Girma *et al.* 2004a and 2004b). Because non-parametric methods are more general and do not just compare the mean and variances in productivity for two different groups of firms but also

compares the entire probability distribution it removes the cut-off level for firms to export and instead allows firms with the same level of productivity to choose either to export or not.

To understand the complex relationship between productivity, international trade and firm ownership we test for first order conditional SD on the productivity distribution of different firms in the form of extended two-sided and one-sided Kolmogorov-Smirnov (KS) tests. In the SD literature a distinction is often made between first and second degree dominance. To establish a dominance relationship between two groups in the first degree no observations from one group should lie to the left of the other group and at least some of the observations in the first group of distributions must lie strictly to the right of another distribution. If this is the case, the mean of the distribution on the right would be higher than that on the left. For example, if exporters' productivity distribution first degree dominates the productivity distribution of non-exporters' then necessarily the mean of the exporters' productivity level is higher than that of non-exporters.[8]

In this paper we apply conditional stochastic dominance techniques conditioning on firm size , geographical location and industry. This is achieved by first regressing individual firm-level TFP that has been demeaned by the industry average, against size according to the classification by the National Bureau of Statistic of China (henceforth NBSC), its location measured by province dummies and controlling for possible industry heterogeneity due to possible clustering of SOEs in certain industries by the inclusion of 2-digit industry dummies. We also include year dummies.[9] The productivity for each firm is then predicted conditional on size, location and industry. The next stage is to take the difference between the actual and predicted productivity which represents the productivity level for each firm after removing the impact of size and location differences. This residual productivity is the variable of interest in our conditional SD tests. The result is a productivity ranking of Chinese firms as if they had identical size and

[8] Higher order stochastic dominance tests are sometimes applied in studies of income and stock prices in order to compare the impact of two distributions on social welfare or individual utility functions. Unlike first order stochastic dominance that compares the position of two cumulative distributions, second order SD compares the areas below these two cumulative distributions up to a given value $\omega \in \Re$. Provided that the social welfare or individual utility function is convex, second order stochastic dominance can be used to help determine which cumulative distribution is more preferable (Kaur *et al.* 1994, Davidson and Duclos 2000 and Cho *et al.* 2007). However, in the case of productivity analysis, the main interest is the comparison of productivity levels across different groups instead of a possible social welfare ranking. For this reason in this paper we only perform tests for first order stochastic dominance.

[9] Although we include 2-digit industry dummies as a control for possible clustering of SEOs in certain industries, as a robustness check we also included the number of SOE employees as a share of total industry employees as an extra control. The correlation between the conditional TFP with our initial controls for size, location and industry and the results using the extra control is 0.992. The stochastic dominance results are almost identical.

location. Abadie (2002) and Maasoumi and Millimet (2003) provide an excellent discussion on the advantages of using conditional SD tests.

Although a detailed discussion on the methodology and implications of SD tests is beyond the scope of this paper we provide a brief summary by way of explanation. Tests for SD assume two sets of strictly stationary and α-mixing samples are draw randomly from two groups of productivity distributions, where one sample, $\omega_1,\ldots, \omega_n$ is randomly drawn from a cumulative distribution $\mathbf{\Omega}_1$ whilst a second sample $\omega_{n+1},\ldots, \omega_N$ is drawn from cumulative distribution $\mathbf{\Omega}_2$. If, for any given percentile, the observations from $\mathbf{\Omega}_1$ are at least as large as the observations from $\mathbf{\Omega}_2$ for the same percentile, then the cumulative productivity distribution of $\mathbf{\Omega}_1$ first degree stochastically dominates the cumulative productivity distribution of $\mathbf{\Omega}_2$. Put simply, $\mathbf{\Omega}_1$ first degree stochastically dominates $\mathbf{\Omega}_2$ if $\mathbf{\Omega}_1(\omega) - \mathbf{\Omega}_2(\omega) \leq 0$ holds for all $\omega \in \mathfrak{R}$ and the inequality holds strictly for at least some observations (ω).

To test for a possible first degree SD relationship between $\mathbf{\Omega}_1$ and $\mathbf{\Omega}_2$ we employ one-sided and two-sided Kolmogorov-Smirnov (KS) tests. First, a two-sided KS test is used to test the null hypothesis that these two cumulative distributions are significantly different from each other.

$$H_0\colon\ \Omega_1(\omega) - \Omega_2(\omega) = 0 \text{ for all } \omega \in \mathfrak{R}$$
$$H_1\colon\ \Omega_1(\omega) - \Omega_2(\omega) \neq 0 \text{ for all } \omega \in \mathfrak{R}$$

The test statistic is as follows:

$$KS_2 = \sqrt{\frac{nm}{N}} \max_{1\leq i\leq N} |\widehat{\Omega_1}(\omega_i) - \widehat{\Omega_2}(\omega_i)|$$

Where $\widehat{\Omega_1}$ and $\widehat{\Omega_2}$ represent the empirical productivity distribution of the groups Ω_1 and Ω_2 respectively and n and m represents the sample size and $N=n+m$.

A one-sided KS test is then performed to test for possible first degree dominance. Specifically, we test the hypothesis:

$$H_{1.1}\colon \Omega_1(\omega) - \Omega_2(\omega) \leq 0 \text{ for all } \omega \in \mathfrak{R}$$
$$H_{1.2}\colon \Omega_2(\omega) - \Omega_1(\omega) < 0 \text{ for all } \omega \in \mathfrak{R}$$

the test statistic is as follows:

$$KS_1 = \sqrt{\frac{nm}{N}} \max_{1\leq i\leq N} \{\widehat{\Omega_1}(\omega_i) - \widehat{\Omega_2}(\omega_i)\}$$

Next the *p*-values for hypothesis tests are observed. Note that unlike the earlier studies of Girma *et al.* 2004a, 2004b and Arnold and Hussinger 2010 that assume that the random samples are *IID* distributed in this paper this assumption is relaxed. Hence, we adopt the method suggested by Massoumi and Heshmati (2000) and Linton *et al.* (2005) that allows general dependences between the observed samples by using sub-sample bootstrapping for the *p*-values. We bootstrap for the two groups separately. It has been shown by Linton *et al.* (2005) that bootstrapping with a sub-sample is more desirable than bootstrapping with the combined sample as it provides a more accurate test on the boundary of the null. Our results are based on a 1,000 sub-sample bootstrapping procedure.[10]

The results can be categorized into four types:

1. If we cannot reject the null hypothesis which indicates there is no significant difference between these two cumulative distributions.
2. If we can reject the null hypothesis and the alternative $H_{1.2}$ whilst the alternative $H_{1.1}$ cannot be rejected for the given sample we can conclude that the cumulative distribution Ω_1 stochastically dominants the cumulative distribution Ω_2 in the first degree.
3. If we reject the null hypothesis and the alternative $H_{1.1}$ but $H_{1.2}$ cannot be rejected for the given sample we conclude that the cumulative distribution Ω_2 stochastically dominates the cumulative distribution Ω_1 in the first degree.
4. If both the null and alternatives are rejected for the given sample then the two cumulative distributions are significantly different from each other but there is no clear dominance relationship.

4. Description of the data

In this paper we utilize a dataset on more than 78,000 Chinese firms with an annual turnover in excess of RMB 5 Million for the period of 2002 to 2006 drawn from annual surveys of

[10] The same tests were also performed under the IID assumption where the probability distribution for the test statistic can be obtained using asymptotic limiting distribution. See Smirnov (1933) and Conover (1999) for details. The results are similar are available upon request. As the bootstrapped *p*-values allow a more general correlation between the observed samples, which is more robust than the IID assumption, we only report these values.

manufacturing firms carried out by the NBSC as part of the Annual Report of Industrial Enterprise Statistics. Our sample contains approximately 82-87% of total output for the majority of industries (NBSC).[11] Our data contains detailed information on production, capital, labor and a number of financial variables. To avoid complications as a result of firm births and deaths our sample includes only companies that participated in all five years of the monthly survey. A similar approach is adopted by Delgado *et al.* (2002), Girma *et al.* (2004a, 2004b) and Arnold and Hussinger (2010).[12]

Following Brandt *et al.* (2012), to correct for possible coding errors the abnormal observations in terms of negative total value added, fixed capital and firms with less than 8 employees have been removed prior to our estimation of productivity to ensure the regression generates accurate measure for TFP.[13] Following the approach adopted by International Study Group on Exports and Productivity (ISGEP) (2008) to further mitigate for outliers the top and bottom 1% of observations of firm-level productivity have been removed prior to our non-parametric tests for stochastic dominance.

We measure productivity using the Levinsohn and Petrin (2003) approach. We use total value added as the measure for output, total number of employees as measure for labor, total fixed capital for production as measure for capital and the total cost of intermediate input for production as measure for intermediate output, which is used as an instrument for capital in the regression to mitigate possible endogeneity problems. All the monetary values are deflated using deflators from Brandt *et al.* (2012). We further assumed the production function takes a Cobb-Douglas form. For notational simplicity we refer to logged relative TFP as firm-level productivity.

Following the definitions provided by the NBSC we define four categories of ownership: State-owned enterprise; domestically-owned, Hong Kong, Taiwan and Macau (HTM) owned and foreign-owned firms. As a result of the post 1990 reforms that encouraged mergers, restructuring, bankruptcy and the privatization of state owned enterprises the result was considerably fewer SOEs. Subsequently, in 1998 the NBSC changed the definition of SOEs to include those which the state retains a majority share. Similarly, foreign and HTM ownership is

[11] According to NBSC the original dataset contains 85% to 90% of total output in the majority of industries and our sample contains over 97% of the total output from the original dataset. Although the exclusion of small, non-state owned firms biases the sample this bias is considerably less than for other studies of this type.
[12] The exit rate of firms from the survey between 2002 and 2006 is low (less than 0.5%).
[13] An example of an abnormal observation would be firm with a negative figure for value added or fixed capital.

defined as those firms that are majorty-owned by foreign an HTM entities[14]. We further remove 59 firms that do not have a clear ownership structure. The final sample is 78,258 firms for each of five years giving us a total of 391,290 observations. All results were re-estimated using the full untrimmed sample and the results were broadly consistent.[15]

[Table 1(a) about here]

Table 1(a) provides summary statistics for our sample of 78,258 firms. In total we have eight different groups of firms, four different ownership types (domestic, SOE, HTM and foreign) and two trade types (exporters and non-exporters). A large majority of the firms in our data are domestically owned (44,948). Around 14% are majority state-owned (10,956) and a little under 12% of firms are owned by HTM nationals (9,067). Approximately 11% are majority foreign-owned (8,285). Not surprisingly, domestic firms are the largest contributors to total value added (52%), followed by SOEs (19%), foreign firms (16%) and HTM firms (12%). Similarly, when we consider ownership type, SOEs are the most capital rich with a total net fixed capital of RMB 734 million which is almost twice as large as the average for foreign owned firms (RMB 403 million). Hence, SOEs are relatively large in terms of fixed capital and are still the second largest contributor to economic activity in China. SOEs also record the highest valued added per firm on average (RMB 30.5 million) just ahead of foreign firms (RMB 28.7 million). For employment we can see that SOEs employ considerably more workers on average (544 for SOEs compared with 238, 401 and 381 for domestic, HTM and foreign firms respectively).[16]

In terms of trade, Table 1(a) reveals that over 76% of SOEs do not export. This figure is a little lower for domestic firms (73%) and substantially lower for HTM (30%) and other foreign-firms

[14] In this study we use 50% as the lower threshold for foreign and HTM ownership instead of 25% as defined by NBSC for tax subsidies. We believe that the foreign and HTMs owner should have control of business operations in order for the firm to benefit from better management.

[15] The majority threshold also applies to the definition of ownership for foreign owned and HMT firms. Note that for company registration and tax purposes any firm that is more than 25% owned by foreign or HTM firms is classified as foreign or a HTM firm. However, to have control over the day to day running of a firm in China in this paper we set the threshold to be 51%. More recently the ownership of firms operating in China has been further complicated by investment vehicles called a variable interest entity (VIE) (also known as the "Sina" model) where Chinese assets are placed in a Chinese company (run by a Chinese citizen) and the returns are eventually moved to an offshore foreign company via a series of contracts involving a foreign firm based in China (Economist 2011b).

[16] State-owned firms are most prominent in 15 (Manufacture of drink), 16 (Manufacture of tobacco), 23 (Printing and Reproduction of Recorded Media), 25 (Processing crude oil, nuclear fuel), 26 (Chemical raw materials etc), 27 (Manufacture of pharmaceuticals), 28 (Manufacture of chemical fibres), 33 (Manufacture casting of non-ferrous metals), 36 (Manufacture of special equipments), 37 (Manufacture of transportation equipment) and 41 (Manufacture of instruments and appliances) with contribution to total industry value added equals 22%, 97%, 28%, 41%, 26%, 29%, 26%, 26%, 36% and 21% respectively.

(28%). The overall percentage of Chinese firms that export is 36%. This compares with 34% of Chinese firms (Sun and Hong 2011), 31% of German firms (Arnold and Hussinger 2010), 84% of UK firms (Girma *et al.* 2004b), 41% of Spanish firms (Delgado *et al.* 2002), 68% of Irish firms (Girma *et al.* 2004a) and 68% of Chinese firms (Kraay 2002) although it must be noted that these studies used different sampling techniques with datasets containing only large firms (often based on different definitions of "large"). With the exception of Sun and Hong (2011), the average firm in our dataset can be considered small. Hence, care must be taken when making direct comparisons of this type.

The top row in Table 1(a) is a measure of TFP again broken down by ownership and trade status. To mitigate the problem of omitted variable bias associated with OLS estimates of TFP we use the IV estimation procedure provided by Levinsohn and Petrin (2003). The production function estimated by the Levinsohn and Petrin method shows the average coefficient is about 0.24 for labour and 0.21 for capital which are significant at the 1% level for all industries in the sample. Wald tests reject the null hypotheses of constant return to scale in majority of cases. As part of our sensitivity analysis we also calculate an alternative measure of productivity proposed by Buettner (2003). The raw correlation between these two measures is approximately 0.7. As a further sensitivity check we also re-estimated our results using a repeated random 10% sample of firms. To control for possible yearly fluctuations in productivity we compare the distribution of productivity for each year separately. To account for variation across industries, relative productivity measures are constructed by standardizing the log value of TFP by the corresponding 2-digit ISIC industry productivity average. Results using our random sample methodology and the Buettner (2003) measure of TFP are available upon request. Results were generally consistent.

In terms of ownership, Table 1(a) reveals that foreign-owned firms have the highest average productivity levels followed by HTM-owned firms. SOEs still appear to be more productive on average than domestic firms. When we compare exporters and non-exporters however it is clear that this result is driven by very high average productivity levels for SOE exporters (who have the highest recorded average productivity of all eight possible ownership-trade combinations) between 2002 and 2004 followed more predictably by foreign exporters, foreign non-exporters, HTM exporters and domestic exporters.

As a result of the economic reforms of the 1980s and 1990s, although the contribution of SOEs to the Chinese economy was reduced dramatically, in some key and strategic sectors their presence is still very noticeable. In Tables 1(b) and 1(c) we report TFP, employee and value added numbers for all firms, SOEs, exporters and SOE exporters for each 2-digit manufacturing industry in China for our sample period. The results indicate a significant presence of SOEs (in terms of the number of firms, the number of employees and value added) in industries such as the Manufacturing of Drink; Tobacco; Oil processing; Chemical materials; Pharmaceuticals; Non-ferrous metals; Special equipment; and Transportation equipment. The average firm-level TFP of SOEs in these industries is generally higher than the national average. Tables 1(b) and 1(c) also report the average TFP, employee numbers and value added for all exporting firms and exporting SOEs across different 2-digit industries. Table 1(b) indicates that for the majority of industries, exporting firms have a higher than average TFP which is consistent with the earlier literature on the superior performance of exporting firms (see Delgado *et al.* 2002 and Girma *et al.* 2004b). Furthermore, it indicates that exporting SOEs have a higher TFP than SOEs in general and have a higher TFP than the average exporting firm in 26 out of 30 2-digit industries.

5. Results

Our conditional SD results with bootstrapped *p*-values are provided in Tables 2(a) and 2(b) and 3(a) and 3(b) which present pair wise comparisons of the productivity distributions by state, domestic, HTM and foreign-owned firms with and without participation in international markets. The first three columns of each table report the result for all firms regardless of trade status. Columns 4, 5 and 6 present the exporter results and the final three columns provide the results for non-exporting firms.

[Table 2a and 2b about here]

In line with conventional expectations, the first three columns of tables 2(a) and 2(b) show that when we examine all firms together with no consideration of trade status, the distribution of SOEs' productivity does not dominate the productivity distribution of the other ownership types (top left box in Table 2(a)). When we consider SOE productivity against each ownership type separately we observe that the productivity distribution of the SOEs is below the distribution of foreign owned firms in three out of six years. This means that for any given percentile of firms,

on average SOEs have a lower productivity than the foreign firms. While the productivity distribution between the SOEs and the domestic owned firms and between SOEs and HTM firms are significantly different from each other, there is no clear conclusion regarding which one dominates. Figure 1 summarizes the entire productivity distribution of all four ownership for the period 2002-2006.

[Figure 1 about here]

As we can see, the cumulative distribution of SOEs lies entirely to the left of the cumulative distribution of foreign-owned firms, which means that for any given percentile, SOEs have lower productivity than the foreign firms across the whole distribution. One of the benefits of the stochastic dominance approach is that when we compare the productivity of SOEs against HTM owned firms we can see that the productivity of SOEs are lower for the bottom 80% but not for the top percentiles (above 80%) where the two lines cross in figure 1. This is in line with the KS test results that the productivity differences between the SOE and HTM are statistically different for the whole distribution, but there is no clear dominance relationship. Similarly, the productivity order between SOE and domestic firms is not clear. These two productivity cumulative distributions intercept around the middle percentile which shows that the productivity levels of SOEs are lower than domestic firms for the low productive firms but higher for more highly productive firms. This is again confirmed by KS test results which show that although the productivity distribution of the SOE and domestic firms are significantly different from each other, but there is no clear dominance relationship.

The results are similar when we consider non-exporters only. The last three columns of Tables 2(a) and 2(b) reveal that the productivity levels of non-exporting SOEs lie below the productivity distribution of foreign firms for all years and HTM non-exporting firms for five out of six years. And there is no clear dominance relationship between the SOEs and domestic Chinese non-exporting firms in terms of their productivity. In other words, non-exporting SOEs are generally less productive than other non-exporting firms in China. This result can be seen in Figure 2 which shows the cumulative distribution of SOE lies entirely to the left of both foreign and HTM firms for the period 2002-2006. However, yet again the relationship between the state and domestic owned firms is less clear. In particular, for the entire sample period, domestic are only more productive in the low productive percentiles (below 80%) but less productivity for the top 20 percentiles.

[Figure 2 about here]

However, there is an interesting result when we only consider exporting firms. In this case, from the middle three columns of Tables 2(a) and 2(b) we see that the productivity of SOE exporters dominates the productivity distribution of all other types in at least one year between 2002 and 2004. For any given percentile of exporting firms, the SOEs have a higher productivity level than foreign and HTM firms from 2002 to 2004, and for the domestic firms in 2003. This can be seen from the significant results in each pair wise case and can also be seen in Figure 3 which shows apart from domestic firms at the bottom 10 percentiles, the productivity distribution of SOEs lie to the right of all other types of ownership between 2002 and 2004. However, from Figure 4 we can see that the calculative productivity distribution curves intercept at around 10 percentile, which means for the low productivity firms (bottom 10%) the SOEs are less productive than the other three types of ownership in 2005 and 2006. This is confirmed by our KS test results as shown in Tables 2(a) and 2(b) and that the overall there is no clear dominance relationship of SOEs over the others.

[Figure 3 and 4 about here]

Tables 3(a) and 3(b) provide results for comparisons between domestic, foreign and HTM owned firms. Our results show that foreign-owned firms are more productive than both domestic and HTM owned firms in almost all cases while the relationship between the productivity of HTM-owned and domestic-owned firms is less clear especially for exporters where the domestic firms dominate in 2003, 2004 and 2005. This is shown in Figures 1 to 4. One possible reason for the absence of a difference in the level of productivity between domestic and HTM firms might be explained by the fact a large number of HTM firms are owned by Chinese mainland residents who register the company in Hong Kong and reinvest back into China (round-tripping FDI) in order to take advantage of the a more favourable tax treatment. As these firms are *de facto* domestic firms it is understandable that their productivity levels would not be significantly different from the firms that are registered as domestic.

The presence of strong performing SOEs that can be observed from Table 2(a) and (b) and implies that the productivity ranking among firms of different ownership types differs significantly and is dependent on participation in international trade. To get a better

understanding of this relationship we now make a pair wise comparison between exporters and non-exporters contingent on ownership type. The results are presented in Table 4 and shows that when we compare all firms together without considering ownership, the productivity of exporters first degree stochastically dominates non-exporters in all years which confirms the theoretical predictions of Helpman *et al.* 1994 and the findings by earlier studies.

[Table 4 about here]

However, when different ownership structures are taken into account, the relationship between the productivity and involvement in international markets become more complex. In particular, Table 4 reveals only the state and domestic-owned exporters have a higher productivity than non-exporters across all percentiles. On the other hand, there is no clear evidence of a productivity advantage (i.e. productivity premium) for exporting firms when they are either foreign or HTM owned (which matches the findings of Sun and Hong 2011 using parametric regression). This demonstrates the importance of ownership and international trade in determining the relative productivity advantage across firms.

A sensitivity analysis of our results carried out using the same tests for a measure of TFP suggested by Buettner (2003), full samples without deleting the outliers and a randomly drawn 10% sample from our dataset support our earlier findings. We find that exporting SOEs have higher productivity than all the other types in most cases while for non-exporting SOEs their productivity levels tend to be lower than foreign or HTM owned firms.

Tables 1 (b) and 1(c) reveal considerable industry heterogeneity in terms of the sectoral concentration of SOEs in Chinese manufacturing. The conditional TFP used in our analysis is the residual firm-level differences in TFP after controlling for 2-digit industry specific effects and hence should filter out the effect of relative clustering of SOEs in industries on firm-level TFP. To ensure that the key result that exporting SOEs perform better than other exporters is not being driven by industries with a high concentration of SOEs we included the number of SOE employees as a share of total industry employees as an additional control. The correlation of these two conditional TFP is over 0.90 and the stochastic dominance results also continue to support the superior performance of SOEs over other exporting firms. The results are reported in Table 5.[17]

[17] We would like to thank an anonymous referee and the editor for bringing this possibility to our attention.

[Table 5 about here]

As a further test for robustness we separate our industries into two groups, SOE clustered and SOE non-clustered industries as a further check that our results are not driven by the clustering of SOEs in certain sectors. An industry is classified as SOEs clustered if the share of SOE employees as a percentage to total employees in the industry is in excess of the national average for our sample period (25%). The results are consistent with our main observations and indicate that the superior performance of exporting SOEs is not a result of the clustering of SEOs within key strategic industries. As a further check we also included the total number of SOEs in each industry as a measure of within industry clustering where an industry is classified as SOE clustered if the share of SOEs in the industry is in excess of the national average of 14%. The results were again similar. We do not report these results for reasons of space but they are available from the authors upon request.

6. Conclusions

In this paper we utilize a non-parametric test of conditional SD to examine the impact of firm ownership and trade structure on productivity using a large sample of Chinese medium and large manufacturing firm between 2002 and 2006.

Our results reveal that trade status, especially for Chinese SOEs, has a large impact on productivity between 2002 and 2004, however this productivity premium disappeared after 2005. We show that although foreign-owned firms are more productive than non-exporting firms, exporting SOEs are the most productive of all possible groupings of firms. There are a number of explanations including the substantial levels of support that the Chinese government gives to national champions including grants for research and development, preferential import regulations and priority loan approvals. These factors enable Chinese SOEs to have greater access to foreign technologies and not to be bound by financial constraints which in turn encourages greater investment in new technologies and innovation, hence improves productivity.

Furthermore, state ownership itself might be the reason for the higher productivity for exporting firms. It is well understand in theoretical literature that the main objective of FDI is to maximize

profits by gaining market access and/or reducing production costs (Helpman *et al.* 1994 and Head and Ries 2003) which means that foreign and HTM firms make investment decisions based primarily on future profits. This is also true for privately owned domestic firms. However, investment by SOEs can be based on a different set of motives and may be purely strategic to promote future growth and to facilitate spillovers from the state to the private sector. This motivation could be especially true for large SOEs.

Higher productivity of exporting SOEs could also be a result of increased competition from the exposure to international markets. It has been shown theoretically and empirically that the productivity of exporters is closely linked to the level of competition in the market (Levinsohn 1993, MacDonald 1994 and Bottasso and Sembenelli 2001). If SOEs export to high income countries, whilst others export primarily to developing countries, then the higher levels of competition from exposure to high income country markets will force SOEs to improve their productivity levels.

There are two alternative explanations for the higher levels of productivity for SOEs in 2002 and 2004. The first explanation is possible "creative accounting" by foreign and HTM firms operating in China undertaken to minimize tax liabilities. If firms that import large amounts of intermediate inputs artificially increase the price of inputs, it will reduce profits in China by overstating the cost of inputs which as a consequence would generate a downward bias on our measure of productivity. This may be an explanation for why no clear productivity advantage was identified for exporting foreign and HTM firms which are more able to implement transfer-pricing.

The second explanation is that the superior productivity enjoyed by SOEs between 2002 and 2004 may well be a result of distortion in the export structure of firms where the majority of exporters from non-state owned firms are concentrated in "process trade" which is low in value added and hence generates a low value of TFP. Hence, it is possible that the observed SOE productivity premium could represent an imbalance between the state and non-state owned firms in their involvement in the global value chain. Investigation of these important explanations as well as possible deterministic factors for superior productivity by exporting SOEs observed in this study remains a topic for future research.

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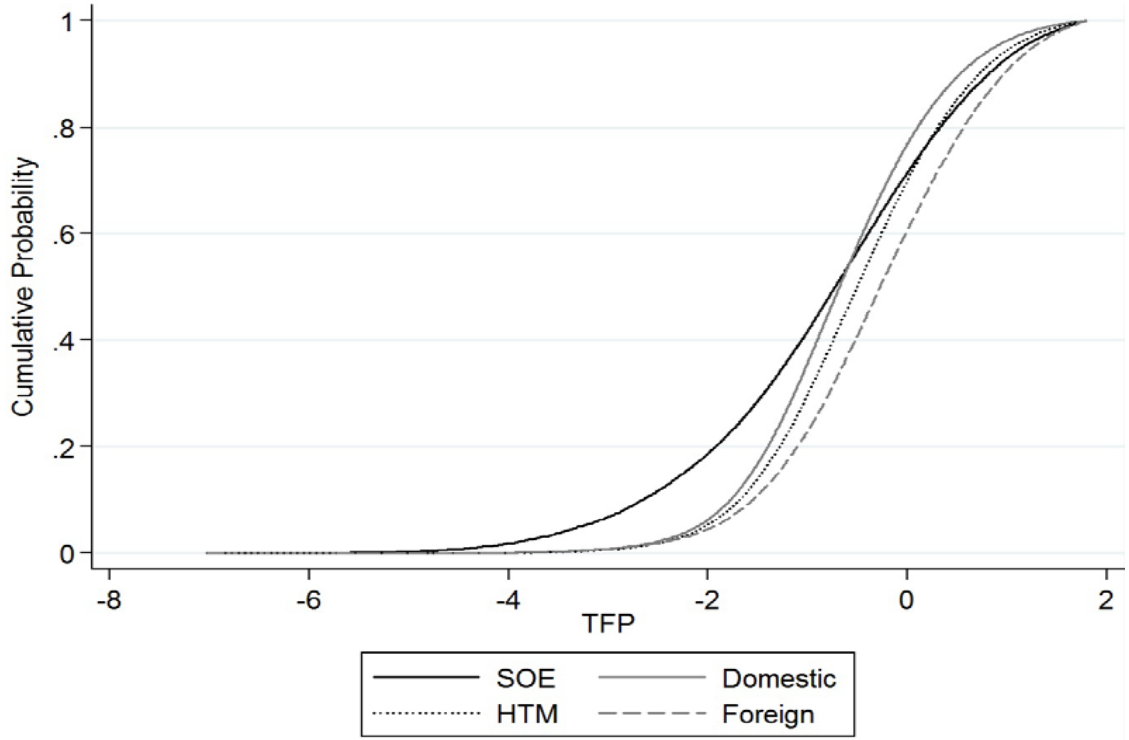
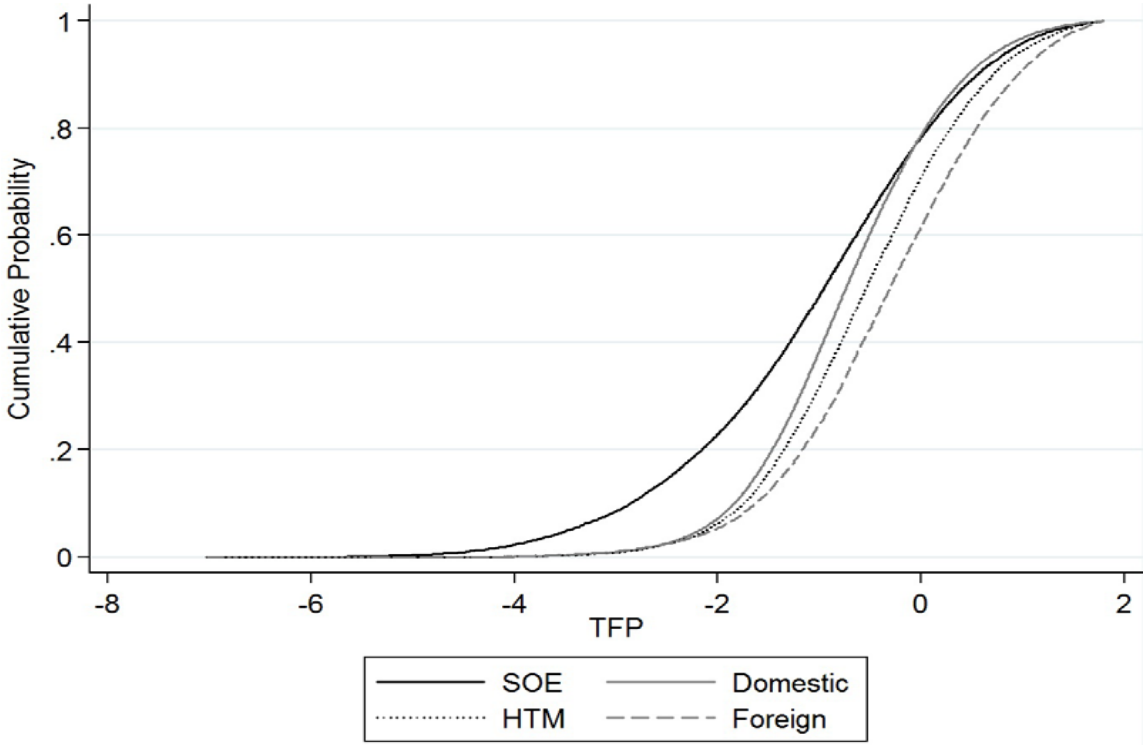
Figure 1: SOE versus all other ownership structures 2002-2006



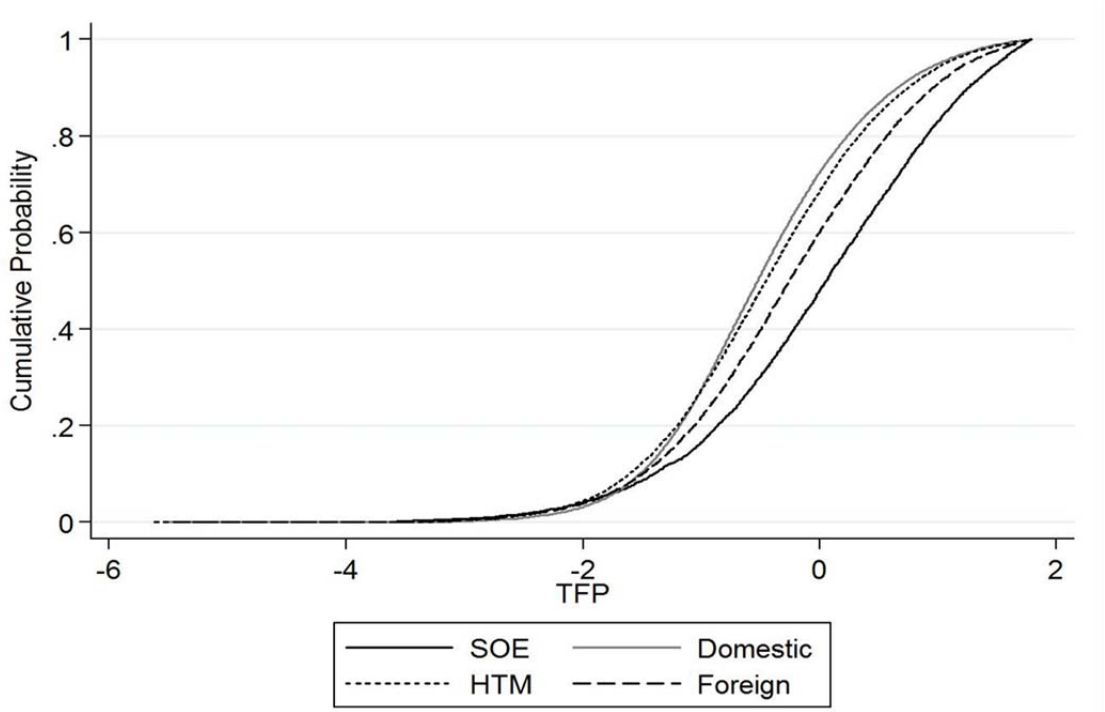
Note: The figure is for logged relative TFP to 2-digit industry average

Figure 2: Non-exporters by ownership structure 2002-2006



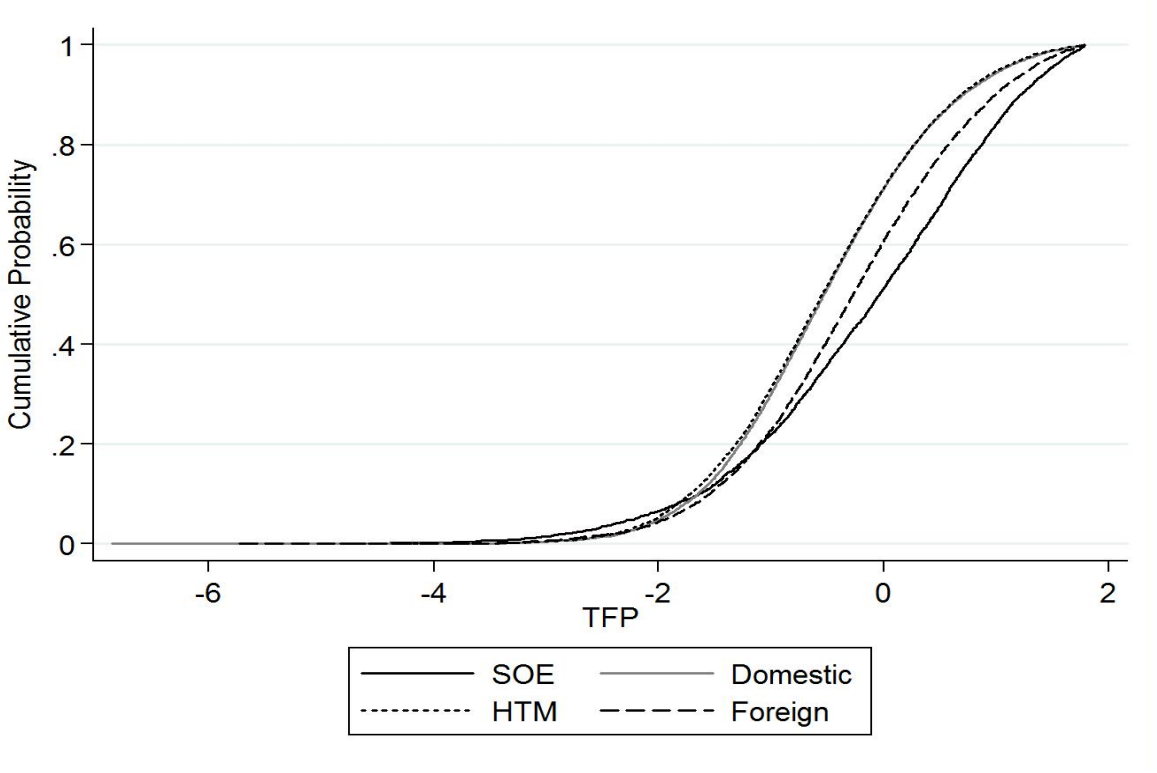
Note: The figure is for logged relative TFP to 2-digit industry average

Figure 3: Exporters by ownership structure 2002-2004



Note: The figure is for logged relative TFP to 2-digit industry average

Figure 4: Exporters by ownership structure 2005-2006



Note: The figure is for logged relative TFP to 2-digit industry average

Table 1a: Summary Statistics (total number of firms 78,258 for the period 2002-2006)

SOEs												
	All Firms (Firm No. 10,956)				Exporters (23.40%)				Non-exporters (76.60%)			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
TFP	0.87	1.05	0.001	5.999	1.42	1.33	0.001	5.999	0.70	0.87	0.001	5.999
Employment	544	979.28	20	11364	1078	1460.81	20	11364	403	672.53	20	11193
Export Value	11.9	62.86	0.000	1,524	50.7	122.15	0.001	1,524	0.000	0.00	0.00	0.000
Value Added	30.6	82.41	10	2,045	61.5	117.46	22	1,995	21.5	64.74	10	2,045
Fixed Capital	73.4	205.42	1.0	3,702	155.9	318.02	1.5	3,702	48.2	146.58	1.0	3,568
Domestic Firms												
	All Firms (Firm No. 44,948)				Exporters (27.18%)				Non-exporters (72.82%)			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
TFP	0.78	0.81	0.001	5.999	0.90	0.89	0.001	6.000	0.73	0.76	0.001	5.997
Employment	238	377.28	20	11325	347	528.78	20	11115	197	290.39	20	11325
Export Value	8.5	34.31	0.0	1,494	31.1	60.22	1.0	1,494	0.0	0.00	0.00	0.000
Value Added	14.6	28.91	22.0	1,349	18.8	34.60	39.0	907	13.0	26.31	22.0	1,349
Fixed Capital	15.3	48.68	1.0	3,855	20.1	59.69	1.0	2,445	13.5	43.74	1.0	3,855
Hong Kong, Taiwan and Macau (HTM) Firms												
	All Firms (Firm No. 9,067)				Exporters (69.68%)				Non-exporters (30.32%)			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
TFP	0.92	0.92	0.001	5.993	0.92	0.92	0.004	5.993	0.90	0.92	0.001	5.988
Employment	401	624.42	20	10988	478	703.21	20	10988	221	316.56	20	7530
Export Value	39.7	91.61	0.0	1,530	56.9	105.27	1.0	1,530	0.0	0.00	0.00	0.000
Value Added	19.3	33.47	15.0	643	20.1	34.40	65.0	643	17.2	31.15	15.0	597
Fixed Capital	24.2	68.48	1.0	3,126	24.9	72.23	3.0	2,995	22.3	58.92	1.0	3,126
Foreign Firms												
	All Firms (Firm No. 8,285)				Exporters (71.57%)				Non-exporters (28.43%)			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
TFP	1.14	1.09	0.003	5.998	1.15	1.09	0.003	5.994	1.11	1.08	0.004	5.998
Employment	381	617.19	20	11125	432	678.08	20	11125	252	395.66	20	10588
Export Value	50.8	124.72	0.0	1,531	71.0	142.49	1.0	1,531	0.0	0.00	0.00	0.0
Value Added	28.7	48.00	34.0	1,220	29.6	49.69	64.0	1,220	26.2	43.36	34.0	569
Fixed Capital	40.3	107.55	2.0	3,768	41.4	114.99	2.0	3,768	37.5	85.96	10.0	2,235

Export Value, Value Added and Fixed Capital are measured in ¥1million.

Table 1(b): Average relative TFP for Chinese manufacturing firms by 2-digit industry (average of 2002-2006)

NEIC (National Economic Industrial Classification)	Total number of firms	SOEs (%)[1]	Exporters (%)	SOEs that export (%)	Relative TFP[2]			
					All firms	SOE	Exporter	SOE exporter
13 Manuf. agricultural products	3,933	13	27	11	0.82	0.60	0.89	1.03
14 Manuf. food products	1,827	14	31	19	0.77	0.63	0.91	1.14
15 Manuf. drink products	1,277	19	17	13	0.81	0.79	0.93	1.31
16 Manuf. tobacco	73	74	15	17	0.92	1.12	1.79	2.01
17 Manuf. textile	6,744	5	49	48	0.89	1.12	1.00	1.48
18 Manuf. apparel, footwear etc.	3,765	3	72	44	0.87	0.82	0.88	0.93
19 Manuf. leather products, fur etc.	1,951	1	72	47	0.85	0.80	0.88	0.94
20 Manuf. wood and wood products	1,082	9	40	18	0.85	0.74	0.88	1.28
21 Furniture manufacturing	857	5	53	27	0.86	0.52	0.98	0.85
22 Manuf. pulp and paper	2,521	5	15	8	0.81	0.87	1.06	1.18
23 Printing and reproduction media	1,823	33	11	3	0.79	0.61	1.16	1.09
24 Manuf. cultural, education, prod.	1,188	4	82	47	0.87	0.81	0.90	1.29
25 Processing crude oil, nuclear fuel	466	15	09	21	0.91	1.44	1.30	1.94
26 Chemical raw materials etc.	6,174	12	27	28	0.80	1.06	1.06	1.56
27 Manuf. pharmaceuticals	1,987	17	28	27	0.84	0.97	1.08	1.52
28 Manuf. chemical fibres	406	10	21	28	0.88	1.29	1.11	1.63
29 Manuf. rubber products	1,033	7	41	33	0.74	0.87	0.91	1.43
30 Manuf. plastic products	3,709	5	38	15	0.84	0.73	1.01	1.15
31 Manuf. non-metal products	6,912	12	19	10	0.85	0.84	1.07	1.43
32 Manuf. and casting of ferrous metals	1,566	08	15	22	0.81	1.04	1.21	1.79
33 Manuf. casting of non-ferrous metals	1,533	12	24	37	0.86	0.99	1.17	1.27
34 Manuf. Metal products	3,992	7	38	28	0.81	0.86	0.92	1.48
35 Universal equipment manufacturing	5,966	12	33	30	0.80	0.94	1.03	1.51
36 Manuf. of special equipment	3,056	18	29	26	0.82	0.88	1.11	1.61
37 Manuf. transportation equipment	3,686	20	28	27	0.78	0.95	1.11	1.67
39 Manuf. electric machines etc.	5,003	08	38	28	0.79	0.82	0.92	1.28
40 Manuf. telecom equipment etc.	2,720	14	60	42	0.79	0.85	0.89	1.13
41 Manuf. instruments and appliances	1,298	16	52	29	0.77	0.79	0.82	1.21
42 Manuf. arts and crafts and other manuf.	1,638	5	75	20	0.85	0.85	0.88	0.83
43 Recycling of waste and scrap	69	5	5	0	0.80	1.12	0.70	0.00
All industries	78,258	14	45	24	0.82	0.87	0.97	1.42

Source: Author's own calculations. Note: [1] SOEs as a percentage of all firms. [2] Average firm-level TFP relative to the industry average.

Table 1(c): Average firm-level employment and value added in Chinese manufacturing firms by 2-digit industry (average of 2002 – 2006)

NEIC (National Economic Industrial Classification)	Employees							Value added[1.]						
	All firms	SOE	SOE (%)	Exporters	Exporter (%)	SOE exporter	SOE exporter (%)	All firms	SOE	SOE (%)	Exporter	Exporter (%)	SOE exporter	SOE exporter (%)
13 Manuf. agricultural products	202	218	14	290	39	492	3	18.26	15.58	11	22.59	33	37.01	3
14 Manuf. food products	256	303	16	334	40	597	6	17.99	17.18	13	23.67	40	37.33	5
15 Manuf. drink products	317	481	29	312	17	584	5	30.27	34.91	22	37.23	21	60.74	5
16 Manuf. tobacco	712	842	88	1160	24	1240	22	244.6	320.01	97	575.94	34	663.29	35
17 Manuf. textile	367	1109	16	465	62	1633	12	15.4	29.69	11	19.05	61	43.85	8
18 Manuf. apparel, footwear etc.	366	542	5	399	78	571	2	11.87	13.91	04	12.41	75	16.28	2
19 Manuf. leather products, fur etc.	491	488	1	567	83	517	1	16.1	15.24	1	17.25	78	17.71	1
20 Manuf. wood and wood products	215	401	16	251	47	608	4	10.62	13.62	11	11.32	42	25.03	4
21 Furniture manufacturing	273	212	4	366	71	378	2	12.36	7.88	4	15.79	67	15.68	2
22 Manuf. pulp and paper	211	436	11	318	22	1152	2	12.54	19.54	8	18.82	22	33.75	1
23 Printing and reproduction media	172	176	33	321	21	249	1	9.07	7.56	28	16.44	20	16.05	2
24 Manuf. cultural, education, prod.	462	343	3	513	91	546	2	13.27	12.41	4	14.33	89	22.79	3
25 Processing crude oil, nuclear fuel	424	971	35	1179	25	1796	14	61.52	159.88	41	145.55	22	281.99	15
26 Chemical raw materials etc.	236	661	34	350	40	1088	16	18.88	39.22	26	30.04	42	68.29	13
27 Manuf. pharmaceuticals	312	491	27	460	41	911	14	29.36	41.02	24	44.08	41	76.66	12
28 Manuf. chemical fibres	347	1337	39	716	43	2906	24	29.74	87.14	29	52.03	37	144.71	14
29 Manuf. rubber products	341	660	14	513	61	1055	7	15.52	24.23	11	22.27	58	46.84	7
30 Manuf. plastic products	206	253	6	312	57	524	2	11.71	12.16	5	16.11	52	24.39	1
31 Manuf. non-metal products	273	443	19	374	26	967	4	13.41	17.09	15	18.78	26	38.16	3
32 Manuf. and casting of ferrous metals	335	1,033	26	591	26	1893	11	34.97	77.95	2	66.25	28	163.06	9
33 Manuf. casting of non-ferrous metals	295	853	34	574	47	1394	21	29.83	63.23	26	58.71	47	102.91	16
34 Manuf. Metal products	223	362	11	327	56	678	6	12.53	18.33	1	16.71	51	40.5	6
35 Universal equipment manufacturing	256	556	27	375	48	982	14	14.17	22.84	2	21.66	50	43.32	11
36 Manuf. of special equipment	297	588	36	479	46	1178	19	17.14	24.69	26	28.14	47	54.08	15
37 Manuf. transportation equipment	378	790	43	626	46	1509	22	21.23	37.38	36	37.28	48	77.19	20
39 Manuf. electric machines etc.	294	485	13	479	62	1031	7	19.76	26.84	1	27.73	54	56.08	6
40 Manuf. telecom equipment etc.	527	612	16	705	81	928	10	35.15	45.9	18	45.71	79	73.18	12
41 Manuf. instruments and appliances	305	412	22	414	70	786	12	15.22	19.51	21	18.34	62	36.05	11
42 Manuf. arts and crafts and other manuf.	360	507	7	398	83	593	2	11.56	18.7	8	12.05	78	17.33	1
43 Recycling of waste and scrap	164	90	3	72	2	0	0	11.23	14.79	6	10.5	4	0	0
All industries	299	544	25	437	59	1078	12	17.84	30.59	20	23.51	56	61.49	1

Source: Authors own calculations. Note:[1.] Value Added is measured in ¥1million

Table 2(a) Tests for Conditional Stochastic Dominance (SOE versus All other firms and Foreign owned firms)

SOEs vs All other	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Other firms dominates		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Other firms dominate		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Other firms dominate
2006	0.122	0.122	-0.032	0.181	0.017	-0.181	0.151	0.165	-0.008
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.00)
2005	0.129	0.129	-0.036	0.172	0.032	-0.172	0.158	0.158	-0.007
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)
2004	0.125	0.125	-0.034	0.190	0.008	-0.190	0.156	0.156	-0.008
	(0.000)	(0.000)	(0.000)	(0.000)	(0.067)**	(0.000)	(0.000)	(0.000)	(0.000)
2003	0.122	0.122	-0.047	0.193	0.004	-0.193	0.156	0.156	-0.017
	(0.000)	(0.000)	(0.000)	(0.000)	(0.157)***	(0.000)	(0.000)	(0.000)	(0.000)
2002	0.106	0.106	-0.089	0.267	0.006	-0.267	0.137	0.137	-0.052
	(0.000)	(0.000)	(0.000)	(0.000)	(0.014)*	(0.000)	(0.000)	(0.000)	(0.000)
SOEs vs Foreign	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Foreign firms dominate		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Foreign firms dominates		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Foreign firms dominate
2006	0.183	0.183	-0.004	0.102	0.017	-0.102	0.227	0.227	0.000
	(0.000)	(0.000)	(0.023)*	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.933)***
2005	0.174	0.174	-0.004	0.102	0.034	-0.102	0.235	0.235	-0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.239)***
2004	0.167	0.167	-0.002	0.112	0.005	-0.112	0.248	0.248	-0.000
	(0.000)	(0.000)	(0.115)***	(0.000)	(0.304)***	(0.000)	(0.000)	(0.000)	(0.614)***
2003	0.156	0.156	-0.003	0.114	0.004	-0.114	0.233	0.233	0.000
	(0.000)	(0.000)	(0.022)*	(0.000)	(0.110)***	(0.000)	(0.000)	(0.000)	(0.797)***
2002	0.116	0.116	-0.011	0.194	0.004	-0.194	0.180	0.180	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.091)**	(0.000)	(0.000)	(0.000)	(0.167)***

1. *P*-value in brackets. ***, **, * indicates we cannot reject the hypothesis at 10%, 5% and 1% significant level respectively.

Table 2(b) Tests for Conditional Stochastic Dominance (SOE versus Domestic and HTM owned firms)

SOEs vs Domestic	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Domestic firms dominate		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Domestic firms dominate		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Domestic firms dominate
2006	0.114	0.114	-0.044	0.195	0.019	-0.195	0.147	0.147	-0.010
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2005	0.125	0.125	-0.048	0.188	0.037	-0.188	0.155	0.155	-0.015
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2004	0.122	0.122	-0.050	0.213	0.013	-0.213	0.154	0.154	-0.014
	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
2003	0.120	0.120	-0.067	0.216	0.010	-0.216	0.153	0.153	-0.028
	(0.000)	(0.000)	(0.000)	(0.000)	(0.021)*	(0.000)	(0.000)	(0.000)	(0.000)
2002	0.118	0.118	-0.105	0.299	0.008	-0.299	0.135	0.135	-0.069
	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)
SOEs vs HTM	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: SOEs dominate	$H_{1.2}$: HTM firms dominate		$H_{1.1}$: SOEs Dominate	$H_{1.2}$: HTM firms dominate		$H_{1.1}$: SOEs dominate	$H_{1.2}$: HTM firms dominate
2006	0.130	0.130	-0.036	0.229	0.015	-0.229	0.169	0.169	-0.004
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.133)***
2005	0.128	0.128	-0.034	0.208	0.023	-0.208	0.169	0.169	-0.003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.027)*
2004	0.126	0.126	-0.028	0.213	0.001	-0.213	0.168	0.168	-0.003
	(0.000)	(0.000)	(0.001)	(0.000)	(0.748)***	(0.000)	(0.000)	(0.000)	(0.187)***
2003	0.117	0.117	-0.035	0.219	0.003	-0.219	0.173	0.173	-0.004
	(0.000)	(0.000)	(0.005)	(0.000)	(0.057)**	(0.000)	(0.000)	(0.000)	(0.011)*
2002	0.109	0.109	-0.050	0.268	0.006	-0.268	0.147	0.147	-0.010
	(0.000)	(0.000)	(0.000)	(0.000)	(0.015)*	(0.000)	(0.000)	(0.000)	(0.009)

1. *P*-value in bracket. ***, **, * indicates we cannot reject the hypothesis at 10%, 5% and 1% significant level respectively.

Table 3(a) Tests for Conditional Stochastic Dominance (Domestically-owned firms versus Foreign owned and HTM owned firms)

Foreign vs Domestic	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No differences between the two distributions	H_1: One type dominates	
		$H_{1.1}$: Foreign firms dominate	$H_{1.2}$: Domestic firms dominate		$H_{1.1}$: Foreign firms dominate	$H_{1.2}$: Domestic firms dominate		$H_{1.1}$: Foreign firms dominate	$H_{1.2}$: Domestic firms dominate
2006	0.137	0.001	-0.137	0.104	0.006	-0.104	0.151	0.006	-0.151
	(0.000)	(0.291)***	(0.000)	(0.000)	(0.003)***	(0.000)	(0.000)	(0.052)**	(0.000)
2005	0.136	0.001	-0.136	0.095	0.006	-0.095	0.172	0.002	-0.172
	(0.000)	(0.264)***	(0.000)	(0.000)	(0.012)*	(0.000)	(0.000)	(0.203)***	(0.000)
2004	0.150	0.002	-0.150	0.104	0.011	-0.104	0.196	0.001	-0.196
	(0.000)	(0.224)***	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.687)***	(0.000)
2003	0.156	0.002	-0.156	0.106	0.017	-0.106	0.209	0.004	-0.209
	(0.000)	(0.071)**	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.098)**	(0.000)
2002	0.171	0.003	-0.171	0.115	0.025	-0.115	0.207	0.003	-0.207
	(0.000)	(0.143)***	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.145)***	(0.000)
HTM vs Domestic	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: HTM firms dominate	$H_{1.2}$: Domestic firms dominate		$H_{1.1}$: HTM firms dominate	$H_{1.2}$: Domestic firms dominate		$H_{1.1}$: HTM firms dominate	$H_{1.2}$: Domestic firms dominate
2006	0.019	0.001	-0.019	0.053	0.053	-0.002	0.047	-0.047	0.000
	(0.000)	(0.750)***	(0.000)	(0.000)	(0.000)	(0.008)	(0.825)***	(0.000)	(0.000)
2005	0.024	0.003	-0.024	0.054	0.054	-0.000	0.063	0.004	-0.063
	(0.000)	(0.214)***	(0.000)	(0.000)	(0.000)	(0.845)***	(0.000)	(0.160)***	(0.000)
2004	0.051	0.004	-0.051	0.035	0.035	-0.001	0.092	0.004	-0.092
	(0.000)	(0.035)*	(0.000)	(0.000)	(0.000)	(0.074)**	(0.000)	(0.166)***	(0.000)
2003	0.050	0.007	-0.050	0.052	0.052	-0.006	0.106	0.001	-0.106
	(0.000)	(0.012)*	(0.000)	(0.000)	(0.000)	(0.116)***	(0.000)	(0.565)***	(0.000)
2002	0.089	0.002	-0.089	0.036	0.033	-0.036	0.109	0.003	-0.109
	(0.000)	(0.189)***	(0.000)	(0.000)	(0.016)*	(0.000)	(0.000)	(0.426)***	(0.000)

1. *P*-value in bracket. ***, **, * indicates we cannot reject the hypothesis at 10%, 5% and 1% significant level respectively.

Table 3(b) Tests for Conditional Stochastic Dominance (HTM owned firms versus Foreign-owned firms)

HTM vs Foreign	All firms			Exporting firms			Non-Exporting firms		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominate	
		$H_{1.1}$: HTM firms dominate	$H_{1.2}$: Foreign firms dominate		$H_{1.1}$: HTM firms dominate	$H_{1.2}$: Foreign firms dominate		$H_{1.1}$: HTM firms dominate	$H_{1.2}$: Foreign firms dominate
2006	0.131	0.131	-0.004	0.143	0.143	-0.004	0.109	0.109	-0.007
	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)	(0.027)*	(0.000)	(0.000)	(0.051)**
2005	0.117	0.117	-0.001	0.121	0.121	-0.002	0.115	0.115	-0.002
	(0.000)	(0.000)	(0.364)***	(0.000)	(0.000)	(0.290)***	(0.000)	(0.000)	(0.260)***
2004	0.102	0.102	-0.001	0.104	0.104	-0.002	0.120	0.120	-0.000
	(0.000)	(0.000)	(0.201)***	(0.000)	(0.000)	(0.209)***	(0.000)	(0.000)	(1.000)***
2003	0.112	0.112	-0.002	0.111	0.111	-0.001	0.116	0.116	-0.008
	(0.000)	(0.000)	(0.235)***	(0.000)	(0.000)	(0.597)***	(0.000)	(0.000)	(0.012)*
2002	0.088	0.088	-0.003	0.082	0.082	-0.003	0.105	0.105	-0.005
	(0.000)	(0.000)	(0.151)***	(0.000)	(0.000)	(0.240)***	(0.000)	(0.000)	(0.099)**

1. *P*-value in bracket. ***, **, * indicates we cannot reject the hypothesis at 10%, 5% and 1% significant level respectively

Table 4 Tests for Conditional Stochastic Dominance (Exporter versus Non-exporter)

			2006	2005	2004	2003	2002
All firms	H_0: No difference between the two distributions		0.104	0.096	0.100	0.094	0.116
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	H_1: One type dominates	$H_{1.1}$: Exporter dominates	0.000	0.000	0.000	0.000	0.000
			(0.011)*	(0.332)***	(0.247)***	(0.858)***	(0.848)***
		$H_{1.2}$: Non-exporter dominates	-0.104	-0.096	-0.100	-0.094	-0.116
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SOE	H_0: No difference between the two distributions		0.277	0.254	0.297	0.280	0.319
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	H_1: One type dominates	$H_{1.1}$: Exporter dominates	0.001	0.000	0.000	0.000	0.000
			(0.312)***	(0.474)***	(0.550)***	(0.499)***	(0.650)***
		$H_{1.2}$: Non-exporter dominates	-0.277	-0.254	-0.297	-0.280	-0.319
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Domestic	H_0: No difference between the two distributions		0.094	0.093	0.083	0.087	0.104
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	H_1: One type dominates	$H_{1.1}$: Exporter dominates	0.001	0.001	0.002	0.000	0.000
			(0.163)***	(0.047)*	(0.044)*	(0.312)***	(0.068)**
		$H_{1.2}$: Non-exporter dominates	-0.094	-0.093	-0.083	-0.083	-0.104
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
HTM	H_0: No difference between the two distributions		0.040	0.047	0.037	0.054	0.017
			(0.000)	(0.000)	(0.000)	(0.000)	(0.014)*
	H_1: One type dominates	$H_{1.1}$: Exporter dominates	0.040	0.047	0.037	0.054	0.009
			(0.000)	(0.000)	(0.000)	(0.000)	(0.284)***
		$H_{1.2}$: Non-exporter dominates	-0.029	-0.013	-0.027	-0.001	-0.017
			(0.001)	(0.069)**	(0.006)	(0.798)***	(0.057)**
Foreign	H_0: No difference between the two distributions		0.030	0.036	0.056	0.054	0.030
			(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
	H_1: One type dominates	$H_{1.1}$: Exporter dominates	0.024	0.036	0.056	0.054	0.030
			(0.003)	(0.001)	(0.000)	(0.000)	(0.003)
		$H_{1.2}$: Non-exporter dominates	-0.030	-0.015	-0.001	-0.007	-0.007
			(0.001)	(0.044)*	(0.083)**	(0.089)**	(0.261)***

1. *P*-value in bracket. ***, **, * indicates we cannot reject the hypothesis at 10%, 5% and 1% significant level respectively.

Table 5: Test for Conditional Stochastic Dominance (controlling for possible SOE clustering by the share of SOE employees in total industry employment)

	SOEs vs Non-SOEs			SOEs vs Domestic		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Other firms dominates		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Other firms dominate
2006	0.204	0.015	-0.204	0.221	0.017	-0.221
	(0.000)	(0.003)	(0.000)	(0.000)	(0.004)	(0.000)
2005	0.203	0.027	-0.203	0.221	0.031	-0.221
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2004	0.233	0.005	-0.233	0.259	0.010	-0.259
	(0.000)	(0.190)***	(0.000)	(0.000)	(0.028)*	(0.000)
2003	0.244	0.004	-0.244	0.268	0.006	-0.268
	(0.000)	(0.061)**	(0.000)	(0.000)	(0.065)**	(0.000)
2002	0.265	0.006	-0.265	0.296	0.008	-0.296
	(0.000)	(0.019)*	(0.000)	(0.000)	(0.005)	(0.000)
	SOES vs Foreign			SOEs vs HTM		
	H_0: No difference between the two distributions	H_1: One type dominates		H_0: No difference between the two distributions	H_1: One type dominates	
		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Foreign firms dominate		$H_{1.1}$: SOEs dominate	$H_{1.2}$: Foreign firms dominates
2006	0.130	0.017	-0.130	0.245	0.012	-0.245
	(0.000)	(0.001)	(0.000)	(0.000)	(0.007)	(0.000)
2005	0.128	0.029	-0.128	0.234	0.023	-0.234
	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)
2004	0.155	0.002	-0.155	0.248	0.0004	-0.248
	(0.000)	(0.609)***	(0.115)	(0.000)	(0.846)***	(0.000)
2003	0.166	0.004	-0.166	0.263	0.003	-0.263
	(0.000)	(0.060)**	(0.022)*	(0.000)	(0.047)*	(0.000)
2002	0.193	0.005	-0.193	0.270	0.005	-0.270
	(0.000)	(0.069)**	(0.000)	(0.000)	(0.018)*	(0.000)

1. *P*-value in bracket. ***, **, * indicates we cannot reject the hypothesis at 10%, 5% and 1% significant level respectively