RIETI Discussion Paper Series 15-E-021

# Impacts of the World Trade Organization on Chinese Exports

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The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 15-E-021

February 2015

# Impacts of the World Trade Organization on Chinese Exports

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## Abstract

Chinese exports dramatically increased in the early 2000s as China reformed its economy to become more free and open via its entry into the World Trade Organization (WTO), which clearly affected the productivity and exports of Chinese firms. This paper, using firm-level panel data from the Chinese electric machinery, electronics equipment, and telecommunications equipment industries, confirms that after the entry into the WTO, the export decision of Chinese firms was accelerated by a rise in productivity that was not uniform among the ownership structures. By disaggregating the firms into three groups—private domestic firms (PDFs), state-owned enterprises (SOEs), and foreign invested enterprises (FIEs)—our empirical estimation reveals that the economic reform via the entry into the WTO had a "productivity effect" on Chinese exports which commonly enhanced firms' exports according to their productivity levels, but had an asymmetric "ownership effect" on their exports among the three groups, which was less favorable for exports of SOEs in comparison with that of FIEs and PDFs.

*Keywords*: Export, Productivity, Ownership, World Trade Organization

*JEL classification*: F1, F5, F6



* This study is conducted under the Project "Global Markets and Japan's Industrial Growth" at Research Institute of Economy, Trade and Industry (RIETI). The authors are grateful to RIETI for their generous support of our research.
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## 1. Introduction

Chinese export dramatically increased in early 2000s when China entered into the World Trade Organization (WTO). It is well known that the nations participating in the WTO removed trade barriers by liberalizing and reforming their economies. China also was not exceptional. The Chinese government significantly restructured and modernized the economy to meet WTO standards and gain acceptance in December 2001. To do so, they enacted policies that reduced import tariffs on a variety of goods, improved market access, and eliminated regulations to export including the trading right system. Chinese accession of the WTO also enabled China to receive the most favorable nation treatment as a member country of the WTO, which improved the access of Chinese exporters to foreign markets. There is no doubt that China's entry into the WTO had a significant impact on its international trade in the 2000s. In the WTO accession, Chinese government also was requested to reform state-owned enterprises (SOEs) whose number was not negligibly small in export. Chinese government aligned domestic regulations with international standards by privatizing and restructuring state-owned enterprises (SOEs) prior to entry into the WTO (an endeavor that was started under Prime Minister Zhu Rongji before negotiations with the WTO). This is a different feature of Chinese exporters from other countries.

Many studies have empirically examined the effect that China's entry into the WTO had on international trade and productivity growth. Branstetter and Lardy (2008) assert that in addition to Chinese achievement of a greater degree of openness to foreign trade in manufactures prior to WTO accession, the additional openings mandated under China's WTO accession agreement likely made China's economy the most open of any large developing country, and China made reasonable progress toward meeting her obligations. In regards to exports, by calculating firm-level total factor productivity (TFP) in China's manufacturing sector, Brandt et al. (2012) show

that Chinese economy recorded a higher TFP growth after the WTO accession than before and a significant part of TFP growth attributed to the effect of firm's entry and exit that China's decentralized reforms have increasingly allowed. Yu and Jin (2014), using Chinese transaction-level trade data and firm-level production data from 2002 to 2006, observe the significant, positive impact of imported intermediate inputs on firm productivity. Elliott and Zhou (2013) show that exporting SOEs are the most productive of all possible firm groupings, though foreign-owned firms are more productive than non-exporting firms. They attribute the high productivity of SOEs not only to greater motivation (especially in larger SOEs), but also to increased competition from international markets.

Although there have been many studies on the effects of China's entry into the WTO on productivity growth and trade, we find few studies examining whether the rapid increase of Chinese exports is related to entry into the WTO and the reformation of Chinese market, in particular the effort of privatizing and restructuring SOEs. Our study endeavors to supply this deficiency in the literature. Our principal question is whether entry into the WTO created a structural change in export decision of Chinese firms and whether it affected differently their export decision among foreign-invested enterprises (FIEs), private domestic firms (PDFs), and SOEs.

We attempt to investigate three issues: (1) whether productivity significantly affects the Chinese firm's decision of export, (2) whether entry into the WTO enhanced their export decision, and (3) whether differently WTO entry affected the export decision of firms with different types of ownership (i.e., PDFs, SOEs, and FIEs). In this study, our analysis uses firm-level data focuses on the electric machinery, telecommunications equipment (one of the largest exporters), and electronics equipment industries as we assume that the effect that joining the WTO had is not homogeneous across industries.

The results of our study indicate the following: (1) Chinese exporters as well as the exporters in other developed countries were more productive than non-exporters, regardless of ownership or WTO membership, (2) entry into the WTO had positive productivity effect which enhanced firms' exports according to a rise of their productivity levels, i.e. a rise of productivity pushed firms to export more strongly than before, (3) the entry into WTO had the different ownership effect on exports among PDFs, FIEs, and SOEs, which was less favorable for SOEs, in comparison with favorable for PDFs and FIEs. In other words, before joining the WTO, under a given productivity PDFs exported the least, but they became more likely to export than SOEs afterward.

The rest of this paper is organized as follows: In the next section, we provide a description of the data used in our analysis as well as of the changes in industrial composition and productivity before and after China's entry into the WTO. In the third section, we examine the changes in the productivity of Chinese exporting and non-exporting firms by disaggregating them into three ownership groups. In the fourth section, we empirically examine how significantly China's entry into the WTO affected firms' decisions to export, and conduct alternative estimations to check for robustness. The last section concludes our study.

## 2. Productivity and ownership: A look at statistics

On entering into WTO, China accelerated its policy changes in various aspects so as to adjust its economy to market oriented one. They included not only the simplification of export-import procedure, but also the reduction of the trading right restriction and the favorable treatment to the SOEs. Chinese accession of the WTO also enabled China to receive the most favorable nation treatment as a member country of the WTO, which improved the access of Chinese exporters to foreign markets. It is anticipated that such

policy changes had differential effects on firm's export among PDFs, FIEs, and SOEs.[1] In order to identify how the WTO affected firms with different ownership structures, we divide the firms into three groups: PDFs, SOEs, and FIEs[2] according to the definitions employed by the National Bureau of Statistics of China (NBSC). In order to examine the effect of the WTO on Chinese firms' exports, we concentrate our analysis on firms belonging to the electric machinery, electronics equipment, and telecommunications equipment industries. We construct a firm-level panel data set that covers the years 1998 to 2007 and two digit industries whose Chinese Industry Classification (CIC) numbers are 39 (electric machinery and equipment) and 40 (telecommunications equipment, computers, and other electronics equipment). Our data (from Annual Survey of Industrial Firms carried out by NBSC as part of the Annual Report of Industrial Enterprise Statistics) include all state-owned firms as well as non-state firms with an annual turnover exceeding RMB 5 million. In order to avoid statistical errors, we remove outliers such as firms with negative fixed capital or total value added and firms with fewer than eight employees. Consequently, there are 176,519 observations in our data set ranging from 10,098 firms in 1998 to 29,566 firms in 2007. Based on the industry concordances and deflators presented by Brandt et al. (2012), the nominal value of each variable is deflated by either an input or an output deflator.

[1] In this paper we divided the data into three groups. One might also divide it by region of the firms. As the WTO might have differential effects on firms on the regional factors, we control for region-specific factors by including the region dummy variables as mentioned later, and we focus on the difference in ownership so as to develop previous studies including Branstetter and Lardy (2008) and Elliott and Zhou (2013).

[2] FIEs include firms that are owned by entities in Hong Kong, Macao, or Taiwan and foreign-invested enterprises. Our study uses 25 percent foreign investment as the lower threshold for FIEs (as defined by the NBS for tax subsidies).

Table 1 displays summary statistics based on the firms' classifications by ownership (PDF, SOE, or FIE) and by internationalization mode (exporter or non-exporter). Internationalization modes vary greatly among the different ownership groups. The majority of firms are non-exporting PDFs (48 percent of the firms in our sample), followed by exporting FIEs (23 percent) and exporting PDFs (13 percent). Non-exporting SOEs represent five percent of the sample and exporting SOEs constitute only one percent. FIEs have the largest number of exporters, followed by PDFs and then SOEs.

[Table 1. Summary statistics]

First of all, we investigate whether productivity divides Chinese firms into exporters and non-exporters. For this research, we measure their total factor productivity (TFP) from 1998 to 2007 by using Levinsohn and Petrin's (2003) approach. In order so calculate TFP, we use total value added as a proxy for output, total number of employees for labor, total fixed capital for capital stock, and the total intermediate input cost for intermediate input. The intermediate input cost is used as an instrument for unobservable variable in the regression so as to mitigate endogeneity problems. Figure 1 presents the probability density function for productivity of exporters and non-exporters in 1998 and in 2007. From this, we clearly observe that exporters are more productive than non-exporters in both years, 1998 and 2007. The internationalization mode between exporters and non-exporters sorted by productivity seen in Chinese firms was similar to that observed in the United States, Europe, and Japan[3]. We note that after entry into the WTO, both exporters and non-exporters

[3] Refer to Bernard and Jensen (1999) and Bernard, et al. (2007) for US firms, Mayer and Ottaviano (2004) for EU firms, and Wakasugi (2014) for Japanese firms.

improved their productivity and a rise of productivity even in a small margin sorts firms into exporters and non-exporters.

[Figure 1. Productivity distribution of exporters and non-exporters]

Table 2 reveals that TFP rose differently among all three types of firms between before and after the WTO. We find that TFP for SOEs increased more than it did for the other types of firms: the annual average TFP between 1998 and 2001 for SOEs rose by 0.7 points after the year 2002 when China joined the WTO, while PDFs' and FIEs' rose by only 0.3 points. Figure 2 presents the productivity distribution of PDFs, SOEs, and FIEs in 1998 and 2007. In 1998 the productivity distribution of FIEs ranked highest, followed second by PDFs and lastly by SOEs. Moreover, there was a rightward shift in all three productivity distributions between 1998 and 2007. Particularly, it should be noted that the ranks of the distributions changed; in 2007 the productivity of SOEs which rose more than PDEs and FIEs was almost equal to that of FIEs and PDFs.

The difference in TFP among three groups presented in Table 2 and Figure 2 confirms the results of previous studies including Brandt et al. (2012) and Elliott and Zhou (2013) which revealed a high productivity of SOEs after China entered the WTO.

[Table 2. Total factor productivity by ownership]

[Figure 2. Productivity distribution of firms by ownership]

### 3. Export and ownership

It is noted that the composition of Chinese firms by ownership dramatically changed in early 2000s. Table 3 displays the number of firms by each category, the changes in the

composition of firms and the fraction of exporters disaggregated by ownership from 1998 to 2007. Number of PDFs and FIEs entered to domestic market, but the number of SOEs fell from 2,024 firms to 476 firms (falling from 20 percent to only 2 percent of the sample) since many SOEs exited from the market, then the average shares of PDF and FIEs increasing from 54 percent to 63 percent and from 30 percent to 33 percent between 1998-2001 and 2002-2007. The average share of SOEs dramatically fell from 16 percent to only 4 percent[4]. Further we find that the number of exporters for PDFs and FIEs has increased more proportionally than the number of non-exporters, then the fraction of exporters also increased for PDFs and FIEs, but the fraction remained even at the same level for SOEs. Our descriptive statistics of the third column in Table 3 surprisingly show that the fraction of exporters for PDFs and FIEs increased more than among SOEs, even though the productivity growth was not higher for PDFs and FIEs than SOEs as presented in Table 2. When firms are forced to exit from the market, it is presumable that less productive firms, then non-exporters rather than exporters, will exit first from the market, and will be followed by more productive exporters. Therefore, we anticipate the fraction of exporters for SOEs should increase in early 2000s in which the number of existing SOEs reduced. However, in comparison with PDFs and FIEs, the fraction of exporters for SOEs actually did not increase in spite of a high rise of their average productivity. It is contradictory to a well-known productivity-export paradigm if WTO membership has affected the export decision of Chinese firms uniformly. We therefore hypothesize that WTO membership might have caused a different effect on firm's decision to export among different ownerships: PDFs, SOEs, and FIEs. In order to investigate this question we conduct a statistical analysis using firm-level panel data.

[4] It should be noted that the sample size increased discontinuously between 2003 and 2004. This is caused by the entry and identification of firms, mainly PDFs in the statistics. Refer to Brandt et al. (2014). In order to avoid the possibility of sample selection bias, we carefully examine the fraction of each group rather than the number of firms.

[Table 3. Number of firms and exporters by ownership]

## 4. Empirical analysis

### 4.1 Analytical framework

In this section, we empirically investigate the impacts that China's entry into the WTO had on the productivity and exports of Chinese firms. We follows the theoretical model by Melitz (2003) and Helpman et al. (2004) which confirms that firms are heterogeneous in productivity; under a given productivity, firms export only if export is profitable, firms are needed to pay additional fixed and variable costs when they export, and productivity cutoff for export is higher when variable and fixed costs become larger[5].

Our goal is to identify whether the effect of entry into WTO on firm's export is different among PDFs, SOEs, and FIEs. We offer the following hypotheses regarding firms' export motivations: First we hypothesize that different types of owners (i.e., private entities, the state, or international entities) may approach international trade differently. SOEs, for instance, have received relatively favorable treatment from Chinese central and local governments in regards to exportation, though they may be inefficiently run due to organizational rigidity. On other hand, PDFs, in spite of their efficient business operations, may have received less favorable treatment. We further hypothesize that FIEs should be more likely to export as they hold a rich stock of knowledge and the appropriate business assets for international trade. Second, we hypothesize that WTO membership affects firms in two ways: (i) As the entry of WTO

[5] The basis for this assumption can be found in the works of Melitz (2003) and Helpman et al. (2004), who contend that firms are heterogeneous in terms of productivity and those that are more productive tend to export while those that are less so supply only domestic markets.

requested China to provide the exporting conditions more equitable for firms and also requested other member countries to offer Chinese firms the treatment as most favorable nation, we expect that their productivity level will more clearly sort their export decision. In other words, the less distortive market due to the entry into the WTO may enhance the magnitude of productivity to choose export, then may increase the marginal propensity of productivity to export for PDFs, SOEs, and FIEs. We name it as "productivity effect" on exports[6], and (ii) The trade liberalization and economic reformation that Chinese government committed at entry into the WTO should have removed trade barriers and reduced the costs for export of PDFs, SOEs, and FIEs. However, SOEs may be different. The reformation of SOEs may have removed favorable treatments given before from SOEs. Consequently, we presume that changes of export cost caused by WTO membership may affect firms' export decision differently based on their ownership status; we term it as the "ownership effect."

### 4.2 Estimation equation

For examining the hypotheses in the section 4.1, we empirically test whether firm's decision to export is affected by entry into the WTO. We follow Roberts and Tybout (1997) and Bernard and Jensen (2004) which examined the factors that increase the probability of exporting. We let the variable $y_{it}^{*}$ be the expected profits of firm $i$ in year $t$, as defined by the following equation:

(1) $$y_{it}^{*} = X_{it}^{'}\beta + \varepsilon_{it},$$

where $X_{it}$ is a vector of variables that includes the firm's level of productivity, credit

[6] Branstetter and Lardy (2008) introduced a progress of market efficiency in China after the WTO.

constraint (defined by the ratio of debts to assets) [7], government subsidies (defined by the ratio of government subsidies to total sales), an ownerships status dummy variable (with FIEs set as the default), and a dummy variable indicating membership in the WTO. Additionally, as our estimation uses panel data, we also include two dummy variables: one is the region dummy variables to control for region-specific factors in provinces and special cities in China, another is the year dummy variables to control for time varying factors common to all firms which control for any other change in the Chinese economy that might have occurred in each year. We specify the profit function as follows:

$$
\begin{aligned}
y^{*}_{i,t} = {} & \alpha_0 + \beta_1 TFP_{i,t} + \beta_2 TFP_{i,t} \cdot WTO_t + \gamma_1 Credit_{i,t} + \gamma_2 Subsidy_{i,t} \\
& + \delta_1 PDSs_{i,t} + \delta_2 SOEs_{i,t} + \delta_{12} PDFs_{i,t} \cdot WTO_t + \delta_{22} SOEs_{i,t} \cdot WTO_t
\end{aligned} \tag{2}
$$

The interaction term between TFP and the WTO dummy is to identify the productivity effect: WTO dummy taking one after entry into the WTO as a proxy of economic and institutional conditions changed after the accession of WTO. The interaction term between the ownership dummies and the WTO variable is to identify the ownership effect

Firm $i$ will decide to export if $y^{*}_{it}$ the expected profits is positive. However ss $y^{*}_{it}$ is unobservable, we instead calculate $y_{it}$ as a binary variable that takes on the value of one when firm $i$ exports. The resulting equation is as follows:

$$
\begin{aligned}
& \text{Prob}(y_{it} = 1 \mid X_{it}) = \text{Prob}(y^{*}_{it} > 0 \mid X_{it}) = \text{Prob}[\varepsilon_{it} > -(X^{'}_{it}\beta_i \mid X_{it}] \\
& = F(X^{'}_{it}\beta)
\end{aligned} \tag{3}
$$

[7] As suggested by Feenstra et al. (2014) who used the statistics defined by the ratio of tangible assets to total assets.

Furthermore, we assume that the idiosyncratic error term, $\varepsilon_{it}$ , has a logistic distribution[8]. Consequently, we estimate the following logistic model:

$$(4) \qquad \text{Prob}(y_{it} = 1 | X_{it}) = \frac{\exp(X_{it}^{'}\beta)}{1 + \exp(X_{it}^{'}\beta)}$$

We conduct the random effects logit estimation with the observations of 176,519 firms.

### 4.3 Results

Table 4 reports our regression results. Column (1) shows the estimation of the basic model without the WTO variable. It includes the productivity variable, the ownership dummy, the credit constraint and government subsidy variables, the region dummies, and the year dummies from 1998 to 2007. Column (2) includes the interaction term between TFP and the WTO dummy in order to identify the productivity effect that WTO membership had on exports. Column (3) further includes the interaction term between the ownership dummies and the WTO variable in order to identify the different effect of WTO membership on exports among three groups. The notable findings from Table 4 are as follows:

First, from column (1) of Table 4 we clearly see that productivity has a significant positive impact on the probability of exporting. Furthermore, the interaction term between TFP and WTO dummy in columns (2) and (3) shows that the productivity effect on exporting is positive and statistically significant when the dummy variable for

[8] We confirm that our main results are robust even when using a normal distribution under a linear probability model.

entry into the WTO is included. Thus, we find that China's participation in the WTO eventually enhanced the exports of Chinese firms due to their rise of productivity. This can be interpreted as a result of elimination of a variety of trade barriers and institutional impediments (such as the unequal treatment firms received from the government).

Second, column (1) reports negative coefficients on the ownership dummy variables; meaning that SOEs tended to export less than FIEs and PDFs were the least[9]. However, as the interaction terms between the ownership dummy and the WTO dummy in column (3) of Table 4 show that the interaction term between WTO and ownership was negative for SOEs, but non-negative for PDFs. This implies that after China's entry into the WTO, the ownership effect on exports was negative for SOEs with 1 percent significance level, but non-negative for PDFs with 10 percent significance level. This suggests that the difference in ownership effects may stem from the asymmetrical impact of trade liberalization and institutional improvements in exporting on PDFs and SOEs. The reformation of SOEs possibly reduced public support that, in turn, reduced the favorable treatment that they had received in exporting. This will be interpreted as a result of the reformation of the Chinese market which improved international trade conditions favorably for FIEs and PDFs, but less favorably for SOEs. As for the debt-asset ratio, we found a positive effect on export probability, unlike Feenstra et al. (2014). It can be interpreted as a result of increasing fixed cost for export. We found no significant effect of government subsidies on export probability, unlike Girma et al. (2009).

[Table 4. Logit estimation results]

[9] We set FIEs as a default for dummies of PDFs and SOEs.

### 4.4 Robustness check

In this section we check the robustness of our results in three ways. We defined WTO dummy by the period dummy which is equal to one if the year is after 2002. It does not specify the effect of entry of the WTO, but implies only a proxy of the WTO effect. If the period dummy equal to one for other periods than after 2002 also presents a similar effect as WTO dummy in equation (2), the estimated results of WTO dummy do not necessarily represent the effect of entry into the WTO. In order to examine whether WTO dummy for the period after 2002 is a proper proxy representing the WTO effect, we estimate equation (2) with the period dummy which is equal to one for after 2000 or 2004, instead of $WTO$ dummy.

Table 5 reports three notable results. The first is that the coefficient of the interaction term between TFP and the period dummy neither for the period after 2000 in Column (1) nor for the period after 2004 in Column (2) shows any significant productivity effect on firm's export. This implies that the period dummies representing other years than the year of WTO entry do not show the productivity effect on export of Chinese firms. The second is that the coefficient of the interaction term between PDF and the period dummy neither for the period after 2000 nor for the period after 2004 shows the estimated results with any statistical significance. No ownership effect on PDF's export for other periods than the period after 2002 appeared. The third is that the effect of WTO entry on Chinese SOE's export was negative in both 2000 and 2004 with a statistical significance. The coefficient of the interaction term between SOE and the period dummy magnified from minus 0.6444 in Column (1) to minus 0.7254 in Column (2), with a statistical significance. This suggests that the period dummy includes other factors than the entry into WTO which negatively affect SOE's export. Taking into account the reformation of state-owned enterprises that started earlier than the entry into WTO and expanded thereafter, the magnification of negative coefficient matches

with the fact that the negative effect on SOE's export had begun before the entry into WTO and was accumulated at least for two years after the entry into WTO. The findings above support that WTO dummy for the period after 2002 is a proper proxy to represent the effect of the entry into WTO on firm's export.

[Table 5. Estimation results with other year dummies]

Our estimation of the equation (2) is conducted by logit random effects model. We check whether the results vary from other methods. Table 6 shows the results estimated by using a linear probability random effects model (LPM). In order to facilitate better comparisons, all of the right- and left-hand side variables are the same as those in Table 4. Columns (2) and (3) confirm that the WTO's productivity effect is large and significant and the ownerships of PDFs and SOEs present a lower tendency to export than FIEs. Column (3) reveals that the effect of WTO entry is different between PDFs and SOEs that is negative with a high statistical significance for SOEs although the coefficient of the interaction term between PFDs and WTO dummy shows a low statistical significance. In the estimated coefficients in columns (1) through (3), our principal findings from the logit model are qualitatively unaffected.

[Table 6. LPM estimation results]

The results reported in Table 4 may have an endogeneity problem. In order to check it, we estimate the logit model with the same explanatory variables as those in Table 4, but with one year lagged. Table 7 shows the results. Columns (2) and (3) confirm that the WTO's productivity effect is large and significant, and that the PDFs and SOEs present a lower tendency to export than FIEs. Column (3) reveals that the effect of WTO entry is negative with a high statistical significance for SOEs while

positive for PDFs although with a low statistical significance. The robustness check for the explanatory variables with one year lagged finds that the principal findings presented in Table 4 are qualitatively unaffected in this case also.

[Table 7. Estimation results on lagged variables]

## 5. Conclusion

This paper is the first step to investigate whether entry into the WTO created a structural change in export decision of Chinese firms and whether it affected differently their export decision among FIEs, PDFs, and SOEs. We examined how China's policy change via the entry into the WTO affected firms' productivity and export, by using Chinese firm-level panel data from the electric machinery, electronics equipment, and telecommunications equipment industries. The results of our statistical analysis reveal that a rise of productivity of Chinese firms affected more strongly their export decision after the entry into the WTO, but their export decision was not uniform among ownership structures. When we disaggregate the firms into three groups (PDFs, SOEs, and FIEs), we find that in comparison with the increasing number of exporters and their export fraction for PDFs and FIEs, neither the number of firms nor the fraction of exporters for SOEs increased in spite of a high rise of their productivity after the entry of the WTO. By disaggregating the firms into three groups, PDFs, SOEs, and FIEs, our empirical estimation reveals that the economic reform via the entry into the WTO had "productivity effect" on Chinese exports which commonly enhanced firms' exports according to their productivity levels, but it had an asymmetric "ownership effect" on their exports among three groups, which was less favorable to the exports for SOEs in comparison with FIEs and PDFs.

Our examination, although providing an interesting finding of the effect of

Chinese trade policy changes on firm's productivity and export under the disaggregation of ownership structures, has some remaining subjects. Joining the WTO caused various and significant structural changes in the Chinese economy. Our study analyzed the effect that this event had on the exports of Chinese firms by using the information of ownership and used WTO membership as a proxy of the policy changes after the WTO entry. Instead, our paper does not explicitly identify which specific policy changes entailed in China acceptance to the WTO has caused the observed effects on firms' exports. Further research to specify those remains.

The results of our analysis also may not be generalized. We focused on the electric machinery, electronics equipment, and telecommunications equipment industries, because these industries constituted a great deal of the rapid growth in Chinese exports which occurred after the entry into the WTO. Nevertheless, it is possible that our results include a bias due to industry-specificity. This may be solved by developing our study across the industries.

**Acknowledgements**

We gratefully acknowledge the comments and discussions on an earlier version of this paper from Masahisa Fujita, Ran Jing, Kozo Kiyota, Qing Liu, Masayuki Morikawa, Hitoshi Sato, Wen Xiao, Kai Xu, Xiaopeng Yin, Wei Zhao, and participants of Yokohama International Workshop, and 2014 Annual Workshop of Institute of International Economics at Zhejiang University, and the workshop at RIETI. Wakasugi also appreciates the financial support of a Grant-in-Aid for Scientific Research (No. 24243034).

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Table 1. Summary statistics

| Ownership | | All | | | | Exporters | | | | Non-exporters | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Variables | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| PDFs | Number | 107140 (60.7%) | | | | 22651 (12.8%) | | | | 84489 (47.9%) | | | |
| | TFP | 5.31 | 1.05 | -3.48 | 10.89 | 5.45 | 1.06 | -2.84 | 10.89 | 5.27 | 1.04 | -3.48 | 10.68 |
| | Employment | 214.87 | 713.80 | 9 | 45,271 | 484.57 | 1,452.60 | 9 | 45,271 | 142.56 | 236.04 | 9 | 18,363 |
| | Export | 12,442.13 | 312,977.40 | 0 | 65,800,000 | 58,851.69 | 678,685.90 | 1 | 65,800,000 | 0 | 0 | 0 | 0 |
| | Value added | 20,941.31 | 216,659.00 | 0.96 | 26,500,000 | 51,961.14 | 462,885.20 | 2.00 | 26,500,000 | 12,625.08 | 41,929.22 | 0.96 | 2,412,879 |
| SOEs | Number | 11567 (6.6%) | | | | 2298 (1.3%) | | | | 9269 (5.3%) | | | |
| | TFP | 4.39 | 1.55 | -3.77 | 9.69 | 5.20 | 1.39 | -2.51 | 9.40 | 4.19 | 1.52 | -3.77 | 9.69 |
| | Employment | 540.38 | 1,251.63 | 9 | 35,035 | 1,459.31 | 2,377.82 | 9 | 35,035 | 312.56 | 540.74 | 9 | 16,552 |
| | Export | 20,161.02 | 253,790.70 | 0 | 10,600,000 | 101,480.60 | 562,195.60 | 3 | 10,600,000 | 0 | 0 | 0 | 0 |
| | Value added | 30,795.21 | 195,039.00 | 0.96 | 7,456,662 | 108,411.50 | 417,627.60 | 3.00 | 7,456,662 | 11,552.35 | 48,799.93 | 0.96 | 2,065,331 |
| FIEs | Number | 57812 (32.8%) | | | | 41044 (23.3%) | | | | 16768 (9.5%) | | | |
| | TFP | 5.42 | 1.23 | -5.78 | 11.63 | 5.44 | 1.24 | -5.78 | 11.63 | 5.37 | 1.23 | -3.74 | 10.67 |
| | Employment | 522.34 | 1,619.50 | 9 | 188,151 | 637.05 | 1,830.29 | 9 | 188,151 | 241.56 | 855.49 | 9 | 94,149 |
| | Export | 207,766.30 | 1,838,133.00 | 0 | 198,000,000 | 292,646.60 | 2,175,837.00 | 1 | 198,000,000 | 0 | 0 | 0 | 0 |
| | Value added | 68,556.98 | 401,860.90 | 1.01 | 31,600,000 | 83,083.80 | 468,162.80 | 1.01 | 31,600,000 | 32,998.83 | 136,083.80 | 1.01 | 7,558,937 |

(Note) Percent figures represent each group's share of the total number of firms.

Table 2. Total factor productivity by ownership

| | | TFP | | |
|---|---|---|---|---|
| | | PDFs | SOEs | FIEs |
| Year | 1998 | 5.00 | 4.06 | 5.02 |
| | 1999 | 5.01 | 4.09 | 5.06 |
| | 2000 | 5.09 | 4.20 | 5.19 |
| | 2001 | 5.12 | 4.28 | 5.19 |
| | 2002 | 5.19 | 4.43 | 5.31 |
| | 2003 | 5.30 | 4.57 | 5.38 |
| | 2004 | 5.24 | 4.57 | 5.30 |
| | 2005 | 5.38 | 4.90 | 5.49 |
| | 2006 | 5.46 | 5.09 | 5.65 |
| | 2007 | 5.55 | 5.59 | 5.72 |
| 1998-2001 Average (a) | | 5.05 | 4.16 | 5.12 |
| 2002-2007 Average (b) | | 5.35 | 4.86 | 5.48 |
| Changes [b]-[a] | | 0.30 | 0.70 | 0.36 |

Table 3. Number of firms and exporters by ownership

| Year | Total Number | Composition | | | Fraction of exporters | | |
|---|---|---|---|---|---|---|---|
| | | PRIs | SOEs | FIEs | PRIs | SOEs | FIEs |
| 1998 | 10098 | 0.52 | 0.20 | 0.28 | 0.182 | 0.198 | 0.664 |
| 1999 | 10831 | 0.52 | 0.18 | 0.30 | 0.178 | 0.210 | 0.666 |
| 2000 | 11377 | 0.55 | 0.14 | 0.31 | 0.194 | 0.198 | 0.689 |
| 2001 | 12690 | 0.58 | 0.10 | 0.31 | 0.200 | 0.187 | 0.715 |
| 2002 | 13643 | 0.61 | 0.08 | 0.31 | 0.212 | 0.189 | 0.706 |
| 2003 | 15495 | 0.61 | 0.06 | 0.33 | 0.224 | 0.194 | 0.711 |
| 2004 | 23888 | 0.63 | 0.04 | 0.34 | 0.227 | 0.163 | 0.758 |
| 2005 | 23255 | 0.62 | 0.03 | 0.35 | 0.225 | 0.210 | 0.715 |
| 2006 | 25676 | 0.64 | 0.02 | 0.34 | 0.222 | 0.220 | 0.705 |
| 2007 | 29566 | 0.64 | 0.02 | 0.34 | 0.201 | 0.248 | 0.705 |
| 1998–2001 Average (a) | 11249 | 0.54 | 0.16 | 0.30 | 0.189 | 0.198 | 0.684 |
| 2002–2007 Average (b) | 21921 | 0.63 | 0.04 | 0.33 | 0.219 | 0.204 | 0.717 |
| Changes: [b]–[a] | 10672 | 0.08 | −0.12 | 0.03 | 0.030 | 0.006 | 0.033 |

Table 4. Logit estimation results

| Logit estimation | Dependent variable: export (binary) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| TFP | 0.2956 *** | 0.1945 *** | 0.2074 *** |
| | (0.0136) | (0.0224) | (0.0225) |
| TFP*WTO dummy | | 0.1360 *** | 0.1177 *** |
| | | (0.0241) | (0.0242) |
| Credit constraint | 0.1178 ** | 0.1169 ** | 0.1214 ** |
| | (0.0510) | (0.0510) | (0.0512) |
| Government subsidy | 0.0125 | 0.0089 | −0.0044 |
| | (0.3115) | (0.3011) | (0.3025) |
| PDF dummy | −5.4170 *** | −5.4217 *** | −5.5137 *** |
| | (0.0547) | (0.0548) | (0.0741) |
| SOE dummy | −4.6055 *** | −4.6436 *** | −4.4120 *** |
| | (0.0942) | (0.0943) | (0.1063) |
| PDF dummy*WTO dummy | | | 0.1023 * |
| | | | (0.0618) |
| SOE dummy*WTO dummy | | | −0.7000 *** |
| | | | (0.1123) |
| Region dummy | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes |
| Constant | −3.0001 *** | −2.4808 *** | −2.562711 *** |
| | (0.1706) | (0.1932) | (0.1958) |
| Number of observations | 176516 | 176516 | 176516 |

(Note) The dependent variable is the indicator taking on the value one if firm exports and zero otherwise. Robust standard errors are in parentheses. *, **, and *** represent the statistical significance at 10%, 5%, and 1%, respectively. The dummies for provinces/special cities and each year are included in the model but omitted from the table.

Table 5. Estimation results with other period dummies

| Logit estimation | (1) Period dummy = 1 if the year is after 2000 | | | (2) Period dummy = 1 if the year is after 2004 | | |
|---|---|---|---|---|---|---|
| | Coefficient | Standard error | | Coefficient | Standard error | |
| TFP | 0.2338 | 0.0488 | *** | 0.2132 | 0.0252 | *** |
| TFP*period dummy | 0.0112 | 0.0491 | | 0.0482 | 0.0286 | |
| Credit constraint | 0.0288 | 0.0593 | | 0.0258 | 0.0587 | |
| Government subsidy | −2.1885 | 0.7153 | *** | −2.1614 | 0.7104 | *** |
| PDF dummy | −6.2594 | 0.1367 | *** | −6.1495 | 0.0860 | *** |
| SOE dummy | −5.0094 | 0.1827 | *** | −5.3249 | 0.1282 | *** |
| PDF dummy*period dummy | 0.1105 | 0.1226 | | −0.0083 | 0.0692 | |
| SOE dummy*period dummy | −0.6444 | 0.1727 | *** | −0.7254 | 0.1499 | *** |

(Note) The dependent variable is the indicator taking on the value one if firm exports and zero otherwise. *** represents the statistical significance at 1%. The dummies for provinces/special cities and each year are included in the model but omitted from the table.

Table 6. LPM estimation results

| LPM | Dependent variable: export (binary) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| TFP | 0.0175 *** | 0.0109 *** | 0.0121 *** |
| | (0.0008) | (0.0013) | (0.0013) |
| TFP*WTO dummy | | 0.0091 *** | 0.0073 *** |
| | | (0.0014) | (0.0014) |
| Credit constraint | 0.0055 ** | 0.0055 ** | 0.0057 ** |
| | (0.0023) | (0.0023) | (0.0023) |
| Government subsidy | 0.0020 | 0.0003 | −0.0005 |
| | (0.0145) | (0.0145) | (0.0145) |
| PDF dummy | −0.3653 *** | −0.3651 *** | −0.3647 *** |
| | (0.0032) | (0.0032) | (0.0044) |
| SOE dummy | −0.3204 *** | −0.3229 *** | −0.3066 *** |
| | (0.0057) | (0.0057) | (0.0065) |
| PDF dummy*WTO dummy | | | −0.0004 |
| | | | (0.0037) |
| SOE dummy*WTO dummy | | | −0.0402 *** |
| | | | (0.0065) |
| Region dummy | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes |
| Constant | 0.3170 *** | 0.3509 *** | 0.3410 *** |
| | (0.0102) | (0.0115) | (0.0117) |
| Number of observations | 176519 | 176519 | 176519 |
| R-square | 0.2827 | 0.2826 | 0.2826 |

(Note) The dependent variable is the indicator taking on the value one if firm exports and zero otherwise. Robust standard errors are in parentheses. *, **, and *** represent the statistical significance at 10%, 5%, and 1%, respectively. The dummies for provinces/special cities and each year are included in the model but omitted from the table.

Table 7. Estimation results on lagged variables

| Logit estimation on one year lag variables | Dependent variable: export (binary) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| TFP | 0.2443 *** | 0.1571 *** | 0.1719 *** |
| | (0.0179) | (0.0312) | (0.0313) |
| TFP*WTO dummy | | 0.1105 *** | 0.0910 *** |
| | | (0.0324) | (0.0327) |
| Credit constraint | 0.0256 | 0.0264 | 0.0304 |
| | (0.0584) | (0.0582) | (0.0596) |
| Government subsidy | −2.1878 *** | −2.1810 *** | −2.1741 *** |
| | (0.7130) | (0.7133) | (0.7127) |
| PDF dummy | −6.1481 *** | −6.1541 *** | −6.2804 *** |
| | (0.0715) | (0.0716) | (0.0985) |
| SOE dummy | −5.4823 *** | −5.5144 *** | −5.2912 *** |
| | (0.1199) | (0.1202) | (0.1381) |
| PDF dummy*WTO dummy | | | 0.1417 * |
| | | | (0.0804) |
| SOE dummy*WTO dummy | | | −0.5992 *** |
| | | | (0.1356) |
| Region dummy | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes |
| Constant | −1.6351 | −1.7671 *** | −1.7450 *** |
| | (0.2143) | (0.2180) | (0.2187) |
| Number of observations | 123119 | 123119 | 123119 |

(Note) The dependent variable is the indicator taking on the value one if firm exports and zero otherwise. Robust standard errors are in parentheses. *, **, and *** represent the statistical significance at 10%, 5%, and 1%, respectively. The dummies for provinces/special cities and each year are included in the model but omitted from the table.

Figure 1. Productivity distribution of exporters and non-exporters (1998 and 2007)

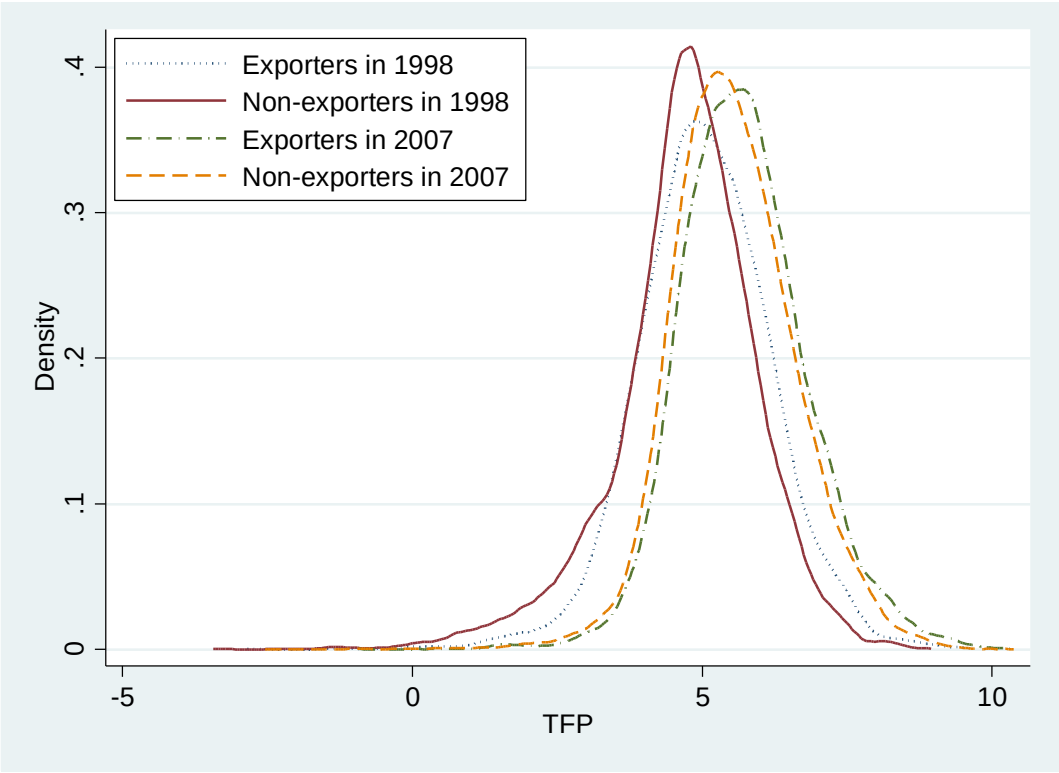

Figure 2. Productivity distribution of Chinese firms (1998 and 2007, by ownership)