Outward Foreign Direct Investment and Total Factor Productivity: Evidence from China’s Enterprise Data

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Abstract. This study focuses on the impact of China’s outward foreign direct investment on the total factor productivity of companies at a micro level. The data spans from 2005 to 2007 and comes from Chinese manufacturing companies. We use a combination of propensity score matching and Different-in-Different method to empirically examine the effect of OFDI on the TFP. The test results show some evidence. First, OFDI increases the TFP of companies. Second, the promotion of TFP is mainly reflected in the non-state-owned enterprises. The state-owned enterprises’ after-effect productivity improvement is not significant. Third, the impact of OFDI on TFP varies due to the different political risks in foreign host countries, i.e., countries with low corporate political investment risks are better than countries with high political risks.

1. Introduction
Chinese companies have gained a lot of vitality from foreign direct investment (FDI). And in the early stages of China’s economic transformation, FDI eased the problem of insufficient capital in some firms. Nowadays, the strategy of going global and the competitive domestic market as well as the low average profit rate bring some new challenges. Thus, the number of outward foreign direct investment (OFDI) enterprises in China continues to increase. According to the 2014 China Foreign Direct Investment Statistic Bulletin, the outward foreign investment reached a historical highest value of USD 123.12 billion in 2014, achieving a continuous 12-year growth, with an average annual growth rate up to 37.5%. Figure 1 shows the macroeconomic situation of China's outward foreign direct investment from 2002 to 2016.

The total amount of China’s OFDI is still behind some developed countries, although the growth rate is relatively fast. What is the performance of China's outward foreign direct investment enterprises?
The core issue of this paper is what impact the outward direct foreign investment of an enterprise has on its total factor productivity. Is it increasing or decreasing?

There are two types of literatures related to this article. One is the literatures on the heterogeneity of enterprises and OFDI. Helpman, Melitz, and Yeaple (2004) extended the heterogeneity of firms to OFDI, and found that firms with the highest productivity would choose OFDI while those with medium productivity would choose to export. Besides, firms with lower productivity serve the domestic market while the lowest productivity companies quit the market. Tian Wei et al., (2012) used Zhejiang manufacturing company-level data and use the TFP measured by the OP method to reflect the company's productivity, finding that there was a positive relationship between productivity and the probability as well as the scale of OFDI. Chen Jinghua (2015) applied cutting-edge heterogeneity trade theory to the service industry and used industry panel data to find that industry productivity was an important factor affecting OFDI.

In addition, there are many literatures that discuss the relationship between OFDI and reverse technology spillovers at the macro level. They use TFP as a measure of reverse technology spillovers. Most of the literature is based on the analysis of macro data because early micro-enterprise data is more difficult to obtain. Li Mei et al.,(2012), using the provincial panel data, found that OFDI only had a significant positive spillover to TFP, technological progress, as well as technical efficiency in the eastern region, and the majority of the central and western regions failed to benefit from it. Some positive conclusions were also obtained by Wang Shuli et al., (2014). However, while exploring the OFDI behavior of heterogeneous enterprises at the micro level, some scholars have discovered the endogenous problems of the enterprises' OFDI and enterprise productivity. That is, companies with high productivity choose OFDI, and it increases the productivity of enterprises and promotes further OFDI in turn. Jiang Guanhong et al., (2014) used Mahalanobis distance and propensity score matching with the Different-in-Different method to examine the "productivity effect" of OFDI by heterogeneous enterprises, as well as the host country's influence on productivity. Liu Xiaodan (2017) used the OLS estimation method to measure TFP as a way to explore the performance of OFDI in emerging economies. Although the above literature examines the reverse technology spillover effect of OFDI or the relationship between OFDI and enterprise productivity through TFP, it does not directly answer the question about TFP. Therefore, the impact of OFDI on TFP is worthy of further study and is the core of this study.

Compared with the existing research literature, the contribution of this paper mainly lies in: (1) directly answering the question of the impact of OFDI on TFP; (2) examining the core issue from the micro enterprise level and eliminating the biased measurement problem caused by macro data; (3) testing not only the firm level but also the host country level.

2. Methodology and data

2.1. Model

In the same way as previous studies on OFDI and corporate productivity, OFDI firms may have higher TFP before they do the investment than those do not invest because of the "self-selection effect". Therefore, the key of this paper is to select the appropriate company as a control group. Based on the existing literature, this paper adopts the method of "propensity score matching" and "double difference method" (DID) to solve the deviation problem of sample selectivity in traditional research. The OFDI enterprises are regarded as the experimental group, while the enterprises that have not invested directly in foreign countries are regarded as the control group. The actual effect $\delta$ is:

$$\delta = E(\delta_i|du_i=1) - E(\Delta TFP_i^0|du_i=1)$$

Among them, $du$ and $dt$ are two binary dummy variables constructed by us. $du$ indicates whether the company directly invested abroad or not. If $du = 1$ indicates the experimental group, otherwise $du = 0$; $dt$ denotes a time dummy variable. If $dt = 1$ indicates the period after the OFDI, otherwise $dt = 0$. In the formula (1), $E(\Delta TFP_i^0|du_i=1)$ is actually a "counterfactual" phenomenon. At this point, we use
matching methods to find the most similar control group for experimental firm and use their TFP change, i.e., $E(\Delta \text{TFP}_{\text{i}|\text{du}_i=0})$ instead of OFDI firms in (1). The new formula is:

$$
\delta = E(\delta|\text{du}_i=1) - E(\Delta \text{TFP}_{\text{i}|\text{du}_i=1}) - E(\Delta \text{TFP}_{\text{i}|\text{du}_i=0})
$$

(2)

Here, the specific test model is as follows:

$$
\text{TFP}_t = \alpha_0 + \alpha_1 \text{du} + \alpha_2 \text{dt} + \delta \text{du} \times \text{dt} + \varepsilon
$$

(3)

In the above formula, du and dt are the same as defined above. The coefficient $\delta$ of the cross product (du×dt) in formula (3) is the impact of OFDI on total factor productivity. If $\delta > 0$, it suggests that the enterprise’s investment has increased the TFP of the company.

2.2. Data and Variable Description
The corporate data of this paper comes from the “List of Foreign Investment Enterprises (Organizations)” (hereinafter referred to as the “List”) provided by the Ministry of Commerce website and “China Industrial Enterprise Database”. The “List” lacks specific corporate information such as output, capital, employees, etc. Therefore, the “List” is matched with the database of industrial companies to complete the data of OFDI enterprises. In order to ensure data consistency, we exclude the combined outliers and retain the companies with first OFDI after eliminating information of companies with no data for the previous period of OFDI referring to Jiang Guanhong et al., (2014). We eventually obtain 699 experimental group companies. The final data range selected for this paper is from 2005 to 2007.

In this paper, Levinsohn and Petrin (2003) method is used to avoid the endogenous nature caused by traditional OLS method while calculating the TFP of enterprises. We use industrial added value instead of output to estimate it. In addition, considering the robustness of the results in practical tests, we add other control variables in formula (3), such as the per capita capital, the age, and the size of the company, whether the company exports, whether the company has foreign shares, and whether the company has research and development inputs, etc.

3. Empirical Results

3.1. Matching and Matching Results of the Control Group
This section uses the one-to-two proximity method matching in the propensity score matching. Based on the recent literature, we select the company’s TFP, capital density, firm size, and the industry to which the enterprise belongs as matching variables. The purpose of the matching of the control group is to obtain the best similar enterprise when the experimental group does not have OFDI. Therefore, we use the characteristics and samples of the OFDI experimental firms in the previous period to match control group. The companies in 2004, 2005 and 2006 in the industrial enterprise database are matched by year in matching. The matching results are shown in Table 1.

| Before Matching | After Matching | Matching numbers |
|-----------------|----------------|------------------|
| Experiment | control | T Value | Experiment | control | T Value | experiment | control | |
| 04  | 7.093  | 6.29  | 0.00*** | 7.070  | 7.047  | 0.85 | 230  | 132842  | 456 |
| 05  | 7.232  | 6.519 | 0.00*** | 7.212  | 7.233  | 0.84 | 247  | 132386  | 494 |
| 06  | 7.566  | 6.672 | 0.00*** | 7.566  | 7.579  | 0.92 | 220  | 132348  | 437 |

b *** , **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Same as below.

Before the match, there was a significant difference in TFP between the experimental group and the control group, and the TFP of the control group companies was significantly lower than that of the experimental group. After matching, the TFP of the experimental group and the control group are very close, and the T values are all around 0.9. The assumption that the sample groups of the experimental
group and the control group are equal to each other is acceptable, indicating that the matching is successful and the next step can be continued.

3.2. Initial Regression

Based on the DID and the matched sample, the total sample test is first performed on formula (3). The test results are shown in Table 2. First, the column (1) in Table 2 shows that when no control variable is added, the coefficient of the core explanatory variable $du \times dt$ is 0.116, and it is significant at the statistical level of 5%. In column (2), after adding the company's characteristic variables such as the size, the age, and the capital intensity of the company as the control variables, the $du \times dt$ coefficient is still positive and significant. Since time, area, and industry differences may have an impact on the total factor productivity of firms, the effects of time, region, and industry differences are controlled in columns (3), (4), and (5) respectively, and the coefficients of $du \times dt$ are all significantly positive.

|                | (1)       | (2)       | (3)       | (4)       | (5)       |
|----------------|-----------|-----------|-----------|-----------|-----------|
| $du$           | -0.005    | -0.187*** | -0.187*** | -0.183*** | -0.183*** |
|                | (-0.08)   | (-7.19)   | (-7.18)   | (-7.02)   | (-7.06)   |
| $dt$           | 0.056     | -0.054**  | -0.091*** | -0.086*** | -0.082*** |
|                | (1.15)    | (-2.53)   | (-3.72)   | (-3.64)   | (-3.45)   |
| $du \times dt$| 0.116**   | 0.081**   | 0.081**   | 0.081**   | 0.080**   |
|                | (2.09)    | (2.21)    | (2.21)    | (2.28)    | (2.27)    |
| size           | 0.719***  | 0.716***  | 0.724***  | 0.720***  |
|                | (116.04)  | (114.36)  | (106.65)  | (104.28)  |
| age            | -0.001    | -0.001    | -0.002**  | -0.002**  |
|                | (-1.16)   | (-1.29)   | (-2.38)   | (-2.53)   |
| $K_l$          | -0.048*** | -0.048*** | -0.058*** | -0.059*** |
|                | (-6.18)   | (-6.23)   | (-6.80)   | (-6.94)   |
| $D_{ex}$       | -0.191*** | -0.190*** | -0.167*** | -0.146*** |
|                | (-9.22)   | (-9.16)   | (-7.58)   | (-6.55)   |
| $D_{rd}$       | -0.063*** | -0.050*** | -0.057*** | -0.052*** |
|                | (-3.41)   | (-2.67)   | (-3.02)   | (-2.76)   |
| $D_{foreign}$  | 0.048**   | 0.050**   | 0.036*    | 0.038*    |
|                | (2.26)    | (2.35)    | (1.69)    | (1.79)    |
| Constant       | 7.281***  | -0.506*** | -0.501*** | -0.328    |
|                | (212.5)   | (-8.12)   | (-7.5)    | (-1.50)   |

It can be seen that the $du$ and $dt$ coefficients are all significant, indicating that the experimental group has no better TFP performance than the control group without OFDI. In addition, with the change of time, the total factor productivity of enterprises has not been significantly increased and it may be caused by the smaller time span of this study. Judging from other control variables, the size factor of enterprises is significantly positive, indicating that the higher the company's sales, the higher the total factor productivity. The coefficient of firm age is significantly negative. This may be due to the fact that the management system of a long-established company is more limited and affects its TFP. The capital density of enterprises is significantly negative, which is more in line with the reality that...
many Chinese companies have participated in international trade competition by relying on labor-intensive rather than capital-intensive comparative advantages during the sample period (Qiao Jing et al., 2015). The coefficient of export dummy variable is significantly negative, it verifies the “productivity paradox” that many scholars regard as the export of Chinese companies. There is a significant negative coefficient of R&D dummy variable, and it may be explained by the fact that the company’s previous R&D investment will be recorded as part of the cost, thus weakening the TFP of the company. The coefficient of foreign investment dummy variable is positive, indicating that foreign shares have significantly increased the TFP of the company. In short, the outward foreign direct investment of enterprises has significantly increased the total factor productivity of them.

3.3. The Impact of Ownership and Host Country Differences

Whether the enterprise is state-owned or not is an important factor affecting the total factor productivity of enterprises. According to the (6) and (7) columns in Table 3, it can be seen that the coefficient of the core explanatory variable of non-state-owned enterprises is significantly positive, indicating that OFDI promotes total factor productivity significantly. The core explanatory variable of state-owned enterprises is negative and not robust.

When companies invest in different host countries, their TFP may change accordingly. Investment host countries are another important factor affecting the “productivity effect” of OFDI firms. Dai Xiang (2016) found that Chinese companies “going out” to developed countries to carry out direct foreign investment have no significant role in promoting productivity whether in the short-term or long-term. In recent years, Chinese enterprises have blindly invested in developed countries. They have neither international experience nor talented people who are good at business management, and thus have repeatedly failed. Therefore, the situation of the destination country of the investment may have a greater impact on the total factor productivity of the company. Column (8) shows that the du×dt term is negative and not robust, while column (9) shows that the du×dt term is positive but not significant, suggesting that companies invest countries with high and medium political risk will not significantly increase their TFP. However, as can be seen from column (10), the du×dt term is significant and robust, and the host country with low political risk can significantly increase the TFP of investment enterprises. In short, the nature of corporate ownership and the destination country of outward foreign investment have an important impact on the improvement of total factor productivity.

| Table 3. The Impact of Ownership and Host Country Differences |
|-------------------------------------------------------------|
| (6) | (7) | (8) | (9) | (10) |
| State-Owned | Non-State-Owned | High Risk | Medium Risk | Low Risk |
| du | -0.018 | -0.191*** | -0.350*** | -0.162*** | -0.178*** |
| dt | 0.019 | -0.088*** | 0.027 | -0.083 | -0.116*** |
| du×dt | -0.035 | 0.084** | -0.002 | 0.033 | 0.097** |
| Constant | 0.004 | -0.326 | -0.23 | -0.021 | 0.126 |
| Firm Variables | YES | YES | YES | YES | YES |
| Year_FE | YES | YES | YES | YES | YES |
| Sector_FE | YES | YES | YES | YES | YES |
| Region_FE | YES | YES | YES | YES | YES |
| N | 244 | 3924 | 370 | 864 | 2810 |
| R²_a | 0.927 | 0.81 | 0.851 | 0.823 | 0.821 |
| F | 29.586 | 89.656 | 18.389 | 26.624 | 71.645 |
The International Guide to National Risks (ICRG) prepared by the New York International Reporting Group provides national political risk measurement indicators. They include national political stability, investment environment, laws and regulations, etc. The guideline gives each index a certain percentage to calculate scores. This paper calculates according to the national indicator data provided by ICRG, and finally defines 0-59.9 as high risk, 60-69.9 as medium risk, and 70 or higher as low risk.

4. Conclusions
OFDI has always been a hot topic in the world, and the development of emerging economies such as China has led more and more attention to the situation of OFDI in developing countries. Nowadays, the competition between China's OFDI enterprises has become increasingly fierce. It is worth mentioning that China’s economic development has entered a new normal. It has been very difficult for China’s economy to continue to grow by relying on capital and labor input because of the disappearing demographic dividend. TFP is the key source to promote economic growth and help the country get rid of the “middle income trap”.

Then, what impact does the OFDI of enterprises have on the TFP of enterprises? The answer to this question is both theoretical and practical. This paper uses the data of China’s OFDI enterprises from 2005 to 2007 to test the impact of OFDI on TFP. The following points have been found. First, there is a “productivity effect” for Chinese enterprises' outward direct investment, which significantly enhances the overall TFP. Secondly, the promotion of TFP is mainly reflected in non-state-owned enterprises. For state-owned enterprises, their TFP afterwards is not significantly improved. Thirdly, there are differences in the promotion of total factor productivity among different host countries. In particular, a host country with a low corporate political investment risk can significantly increase firm’s TFP. A host country with a high or medium investment political risk cannot significantly increase it. In general, outward foreign direct investment of enterprises can promote the improvement of total factor productivity of enterprises.

Acknowledgement
This research was financially supported by Xi'an Social Science Planning Fund Project(18J161) and China Postdoctoral Science Fund Project(2018M633446).

References
[1] Helpman, Elhanan, M. J. Melitz and S. R. Yeaple, Export versus FDI with Heterogeneous Firms 2004 J. American Economic Review 94.1 300-16.
[2] Levinsohn, James and A. Petrin, Estimating Production Functions Using Inputs to Control for Unobservables 2003 J. Review of Economic Studies 70.2 317-41.
[3] Chen Jinghua, Industry Heterogeneity, Total Factor Productivity and Outward Foreign Direct Investment in Service Industry: An Empirical Test Based on China's Service Industry Panel 2015 J. World Economic Research 9 86-93.
[4] Dai Xiang, OFDI and Productivity Growth at Home: A Firm-Level Empirical Investigation of China 2016 J. World Economic Research 2 78-89.
[5] Jiang Guanhong, Jiang Dianchun, Outward Foreign Direct Investment in China's Industrial Enterprises and Enterprise Productivity Progress 2014 J. World Economy 9 53-76.
[6] Li Mei, Liu Shichang, Regional Difference and Threshold Effect of Reverse Technology Spillovers in OFDI: Threshold Regression Analysis Based on Chinese Provincial Panel Data 2012 J. Management World 1 21-32.
[7] Liu Xiaodan,Yi Changjun, The Impact of OFDI on Emerging Economies' Enterprise Performance:Based on the Analysis of Propensity Score Matching 2017 J. World Economic Research 3 68-77.
[8] Qiao Jing, Hu Bing, Influences of OFDI on Export of Chinese Manufacturing Firms: Evidence from Difference-in-Difference Approaches Based on Propensity Score Matching 2015 J. International Trade Issues 4 126-36.
[9] Tian Wei, Yu Miaojie, Enterprise Productivity and Enterprises "Going Out" OFDI: An Empirical Study Based on Data at The Company Level 2012 *J. Economics Quarterly* **11.2** 383-408.

[10] Wang Shuli, Xiang Jiaojiao, Reverse Technology Spillovers of Outward Foreign Direct Investment and Total Factor Productivity: An Empirical Analysis Based on Different Investment Incentives 2014 *J. International Trade Issues* **9** 109-19.