

Firm Productivity and Foreign Direct Investment in the Services Sector: Non-parametric Test of Pecking Order Hypothesis

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Abstract

Using comprehensive Japanese data on service firms, this study examines the so-called pecking order hypothesis that more productive firms invest in a larger number of destination markets. The use of data on services firms enables us to test the hypothesis more rigorously because services firms that produce non-tradable services cannot conduct foreign direct investment (FDI) by exporting to a third country. To examine the hypothesis, this study compares the overall distribution of productivity by the number of FDI destinations, using the non-parametric Kolmogorov-Smirnov (KS) test. The results are consistent with the hypothesis and show that more productive services firms tend to have their foreign subsidiaries in a larger number of foreign markets.

Keywords: Firm heterogeneity; Multinational enterprises; Foreign direct investment

JEL Classification: F1, F23, L8

1 Introduction

Firm-heterogeneity model of trade and foreign direct investment (FDI) predict that multinational enterprises (MNEs) are more productive than non-MNEs (Helpman et al., 2004). This prediction is supported for manufacturing firms by

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many empirical studies. As shown in Yeaple (2009), the standard firm heterogeneity model based on Helpman et al. (2004) predict the so-called “pecking order” that more productive firms invest in a larger number of foreign markets. For the United States and Japanese manufacturing firms, Yeaple (2009) and Tanaka (2012) present evidence which is consistent with the prediction.

However, it is difficult to empirically examine the pecking order prediction when firms conduct FDI strategies with exporting to a third country, such as export-platform FDI and “hub and spokes” strategy.¹⁾ In the case of export-platform FDI, for example, a firm invest in Mexico and export to the United States from a factory in Mexico. It, therefore, does not have a foreign subsidiary in the United States. In the case of the hub and spokes strategy, for example, a firm invests in Thailand and export to other neighboring countries such as Vietnam and Malaysia from a factory in Thailand, and it does not invest in Vietnam and Malaysia. If a firm can conduct these types of FDI, it has a smaller number of foreign subsidiaries than the standard model of Helpman et al. (2004) predicts. Indeed, Yeaple (2009) finds that large US firms invest in too few foreign locations than the model predicts.

The purpose of this study is to examine the pecking order hypothesis more rigorously through the use of data on service firms. Services firms cannot conduct FDI strategies such as export-platform FDI and the “hub and spokes” strategy due to the nature of services. The nature of services requires the proximity of suppliers and consumption in most cases, as discussed in Francois and Hoekman (2010). The proximity constraints for service transaction makes it impossible for most services firms to export their services to a third country from a foreign subsidiary. Therefore, by using service firms, we properly test the pecking order hypothesis of the standard model that does not consider FDI strategy with exporting to a third country.

Using extensive firm-level data from Japan and the Kolmogorov-Smirnov (KS) test to compare the productivity distribution of services firms, I find first evidence of the pecking order in the services sector that more productive firms

1) See Ekholm et al. (2007) for export-platform FDI and Yeaple (2008) for “hub and spokes” strategy.

tend to invest in the broader range of foreign regions. This finding provides more rigorous support for the pecking order hypothesis of the standard firm heterogeneity model than those of previous studies for manufacturing firms.

The remainder of this paper is divided into five sections. In Section 2, I review the literature. In Section 3, I briefly describe the data and variables used in this paper and present descriptive statistics of the data. In Section 4, I introduce my empirical strategy. In Section 5, I present the results. The summary and conclusion are presented in the final section.

2 Related literature

Many previous empirical studies confirm the theoretical prediction of Helpman et al. (2004) that MNEs are more productive than non-MNEs. Among others, Girma et al. (2005a, b) confirm the prediction for the Republic of Ireland and the United Kingdom using a nonparametric approach. Head and Ries (2003) confirm the prediction for listed firms in Japan. These studies analyze firms or plants in the manufacturing sector only.

There are a few empirical studies that examine the link between productivity and FDI in the services sector. The results are mixed. Buch and Lipponer (2007) provide evidence that MNEs are more productive than exporters in the German banking industry. This evidence is consistent with the standard firm heterogeneity model of exports and FDI provided by Helpman et al. (2004).

On the other hand, there is evidence that is not consistent with the theoretical prediction of Helpman et al. (2004). Bhattacharya et al. (2012) find that exporters are more productive than MNEs in the software services industry in India. Wagner (2011) also finds similar results in the services sector in Germany. Besides, Wagner (2011) finds that firms with FDI and no exports are less productive than firms that are active in the German market only.

This paper examines whether more productive firms have their foreign subsidiaries in a larger number of foreign markets in the services sector, using Japanese data. It contributes to the literature in several regards. First, the data used in this study are richer than those in previous studies. They cover various services industries, have a panel structure covering the years 2001–2008, and they include both small and large firms. Second, this study utilizes a non-parametric approach based on the principle of first-order stochastic dominance

to compare the overall productivity distributions of service firms. By so doing, this study provides evidence of the pecking order hypothesis that more productive firms tend to invest in a larger number of foreign regions in the services sector.

3 The data and descriptive statistics

3.1 Data

This section describes the data and provides some basic facts about Japanese MNEs. This study uses firm-level data from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) by the Japanese Ministry of Economy, Trade, and Industry (METI). It refers to this survey as “the METI survey.” The survey covers both manufacturing and non-manufacturing industries. The targets of the METI survey are firms with more than 50 employees and more than 30 million yen in capital. The survey, therefore, excludes small firms. Nevertheless, it is the most comprehensive for the present study among the surveys currently available in Japan. Many studies, including Nishimura et al. (2005), Kimura and Kiyota (2006), and Wakasugi et al. (2014), have used it. Appendix 1 provides a more detailed explanation of the data.

Table 1 presents the distribution of Japanese firms in the data across three sectors: (i) agriculture and related industries, (ii) manufacturing, and (iii) services. The number of firms in the whole sample is 29,355 for the year 2008, the last year in our data. The manufacturing sector accounts for 46.4% of it, while the services sector accounts for 53.4%. The share of agriculture and related industries accounts for only 0.2%.

Table 1 also reveals that in the sample, the fraction of MNEs in the services sector, which is only 10.5%, is much lower than that in the manufacturing sector, 36.6%. The *Establishment and Enterprise Census 2006*²⁾ also shows that the fraction of MNEs in the services sector is lower than that in the manufacturing sector.

In the sample, the fraction of MNEs in the services sector is lower than that in the manufacturing sector in all four host regions: North America, Europe,

2) This census is conducted by the Japanese Ministry of Internal Affairs and Communications.

Table 1: Distribution of firms (Japan, 2008)

	Agriculture and related industries	Manufacturing	Services	Total
Number of firms	51	13,624	15,680	29,355
Share of each sector	0.2%	46.4%	53.4%	100.0%
Fraction of firms with domestic affiliates	49.0%	36.6%	36.7%	36.7%
with foreign affiliates	9.8%	23.7%	10.5%	16.6%
in North America	x	9.3%	3.4%	6.1%
in Europe	x	5.3%	1.8%	3.4%
in Asia	x	21.4%	9.1%	14.8%
in other region	x	2.5%	1.0%	1.7%

Notes: Figures for less than four firms are replaced by “x.”

Asia, and other region³⁾. The most popular destination is Asia for both manufacturing and services sectors with the fraction of MNEs investing in this region being 21.4% and 9.1%, respectively. The second most popular destination is North America again for both sectors, followed by Europe. The fraction of MNEs investing in these two regions is less than 10% for both sectors, which indicates that Asia is the most popular destination.

This study restricts the analysis to the services sector. Table 2 provides the list of services industries with the number of firms and the fractions of MNEs in the data. The fraction of MNEs varies across industries within the sector. The wholesale trade industry has the largest fraction of MNEs among the services industries.

3.2 The measurement of firm productivity

This section explains the measure of total factor productivity (TFP) used in this study. This study obtains Japanese parent firms’ TFP from an estimated two-digit industry-specific production function, using Levinsohn and Petrin (2003) techniques⁴⁾. For output, this study uses Japanese parent firms’ real value added, which is deflated using an industry-level deflator. The value added in the data

3) Middle East, Central and South America, Africa, and Oceania are classified as “other regions” in the METI survey.

4) This study uses transportation and package costs to proxy unobserved productivity shocks since my data does not contain costs for electricity or materials or fuels.

Table 2: List of services industries and the fraction of MNEs (Japan, 2008)

Industry code	Description	N. of firms	Fraction of MNEs
25	construction	376	0.072
26	electricity, gas and water supply	123	0.114
27	wholesale trade	5728	0.165
28	retail trade	3522	0.043
29	finance and insurance	86	0.058
30	real estate	56	0.089
31	transport	133	0.098
32	telecommunications	53	0.113
33	education, health, and research	119	0.092
34	business services	2493	0.087
35	personal service activities	2991	0.085
	Total	15680	0.105

reflects parent firms' domestic and export sales but not foreign affiliates' sales in host countries. This study employs Japanese parent firms' hours worked (L)⁵⁾ and fixed tangible assets (K), as inputs.

Following Arnold and Hussinger (2010), this study uses the relative TFP obtained by dividing the TFP estimates by the average TFP in the respective industry and year, since it compares the TFP for various industries.

Figure 1 presents the average productivity of non-MNEs and MNEs in the services sector. Figure 1 shows that on average, MNEs are more productive than non-MNEs in the services sector. This fact suggests that productivity is essential for firms when considering investing abroad, even in the services sector, and that the standard firm heterogeneity model can well explain FDI in the services sector. Section 5 will further examine the relationship between productivity and FDI by comparing the overall productivity distribution of firms in the services sector.

4 Empirical strategy: Kolmogorov-Smirnov test

This study adopts the non-parametric one-sided and two-sided KS tests to examine the relationship between firm productivity and foreign engagement,

5) This study uses hours worked as labor rather than the number of workers. Appendix 1 provides a more detailed explanation.

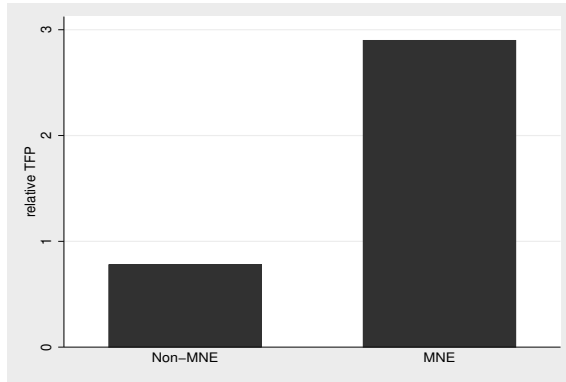


Figure 1: Mean of relative TFP

Note: The data are for Japanese firms in 2008. The graph displays the mean level of relative total factor productivity for MNEs and non-MNEs.

Data Source: The Ministry of Economy, Trade, and Industry (METI), the Basic Survey of Japanese Business Structure and Activities.

following previous studies such as Girma et al. (2004) and Arnold and Hussinger (2010). These tests allow us to compare and rank the distributions of measures of firm performance, based on the concept of first-order stochastic dominance. Following Delgado et al. (2001), many studies in trade literature have employed KS tests. The KS test is a stricter test of productivity differences than just comparing mean levels of productivity since it considers all moments of the distribution.

Let $F_1(\varphi)$ and $F_2(\varphi)$ denote two cumulative distribution functions (CDF) for two comparison groups. The first-order stochastic dominance of $F_1(\varphi)$ relative to $F_2(\varphi)$ is defined as $F_1(\varphi) - F_2(\varphi) \leq 0$ uniformly in $\varphi \in \mathbb{R}$, with strict inequality for some φ . Graphically, this implies that $F_1(\varphi)$ lies entirely to the right (higher-productivity side) of $F_2(\varphi)$.

First, by the two-sided KS statistic, this study tests the hypothesis that $F_1(\varphi)$ and $F_2(\varphi)$ are identical. The null and alternative hypotheses can be expressed as

$$\begin{aligned}
 H_0 : F_1(\varphi) - F_2(\varphi) &= 0 \quad \text{for all } \varphi \in \mathbb{R} \\
 \text{vs. } H_1 : F_1(\varphi) - F_2(\varphi) &\neq 0 \quad \text{for some } \varphi \in \mathbb{R}.
 \end{aligned} \tag{1}$$

Second, the one-sided KS test examines the following hypotheses:

$$\begin{aligned} H_0 : F_1(\varphi) - F_2(\varphi) \leq 0 \quad \text{for all } \varphi \in \mathbb{R} \\ \text{vs. } H_1 : F_1(\varphi) - F_2(\varphi) > 0 \quad \text{for some } \varphi \in \mathbb{R}. \end{aligned} \quad (2)$$

If we can reject the null hypothesis for the two-sided test, but not for the one-sided test, we can conclude that $F_1(\varphi)$ stochastically dominates $F_2(\varphi)$.

The KS test statistics for the two-sided test are given by

$$KS_2 = \sqrt{\frac{nm}{N}} \max_{1 \leq i \leq N} |F_{1,n}(\varphi_i) - F_{2,m}(\varphi_i)|, \quad (3)$$

where n and m are the sample sizes from the empirical distributions of $F_1(\varphi)$ and $F_2(\varphi)$, respectively, and $N = n + m$. The KS test statistics for the one-sided test is

$$KS_1 = \sqrt{\frac{nm}{N}} \max_{1 \leq i \leq N} \{F_{1,n}(\varphi_i) - F_{2,m}(\varphi_i)\}. \quad (4)$$

The limiting distributions of both test statistics are known under the assumption of independently drawn samples as described in Darling (1957)⁶. Following previous studies such as Delgado et al. (2002), this study tests the hypothesis separately for each year from 2001 to 2008, since the independence assumption is likely to be violated if we use pooled observations from several years for the KS test.

5 Results

Using the KS test, this section presents the empirical relationship between the number of FDI destinations and firm productivity. As shown in Yeaple (2009), the firm heterogeneity model based on Helpman et al. (2004) predicts a “pecking order” such that firms with higher productivity have their affiliates in a larger number of countries, while less productive firms invest in a smaller number of countries. In other words, firms with higher productivity can enter even less

6) Smirnov (1939) proposed these statistics. Kolmogorov (1933) and Smirnov (1939) showed that under the assumption that all the observations are independent, the limiting distribution of KS_2 is given by

$$\lim_{n \rightarrow \infty} P(KS_2 > v) = -2 \sum_{k=1}^{\infty} (-1)^k \exp(-2k^2 v^2)$$

and that of KS_1 is given by

$$\lim_{n \rightarrow \infty} P(KS_1 > v) = \exp(-2v^2)$$

under H_0 .

attractive countries because their productivity will exceed the cut-off productivity for a larger number of countries, while less productive firms can enter more attractive countries only.

The METI survey asks a firm whether it has a subsidiary in the following four foreign regions: Asia, North America, Europe, and other regions. Therefore, the number of FDI destinations varies across firms from zero to four in our data. The majority of firms do not have foreign subsidiaries. For these non-MNEs, the number of FDI destinations is zero. Among MNEs, one-region MNEs, i.e., MNEs with subsidiaries in one foreign region, are the majority. Four-region MNEs, i.e., MNEs with subsidiaries in four foreign regions, are a minority.

Figure 2 presents the TFP distribution by the number of FDI destinations in the services sector for the year 2008. The figure shows that the more destinations firms invest in, the higher productivity ranges they are distributed over. The TFP distribution of non-MNEs is located on the left side of that of MNEs. The distribution of four-region MNEs is located on the right side of those of the other types of MNEs. These results are consistent with the theoretical prediction that the most productive firms can enter even the least attractive foreign regions, while the less productive firms can enter more attractive regions only.

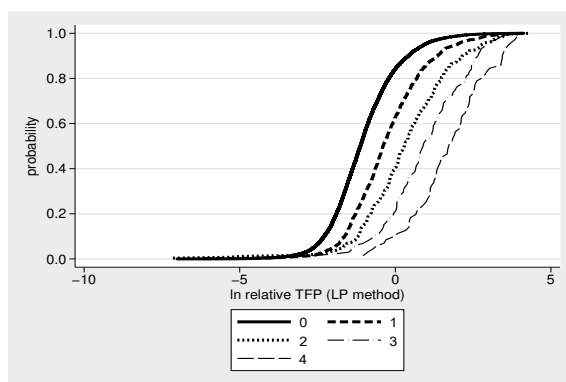


Figure 2: The number of FDI Destinations and CDF of productivity in the services sector

Note: The data are for Japanese firms in 2008.

Data Source: The Ministry of Economy, Trade, and Industry (METI), the Basic Survey of Japanese Business Structure and Activities.

Table 3 presents the KS test statistics. Column 3 of Table 3 presents the results of the two-sided KS tests, which test the null hypothesis for the equality of TFP distributions between two groups of firms. The null hypothesis is rejected at a 1% significance level for all pairs of groups. From the result in column 4 of Table 3, we cannot reject the null hypothesis of the one-sided KS tests that the productivity distribution of firms investing in a larger number of foreign markets stochastically dominates that of firms investing in a smaller number of foreign markets.

These results from both tests indicate that the distributions for services firms investing in more foreign locations dominate that of services firms investing in fewer foreign locations. The results, therefore, confirm the theoretical prediction. Also, we obtain qualitatively similar results when we use the data on other years: 2001–2007. We can conclude that more productive firms tend to invest in a larger number of foreign regions in the services sector.

Table 1: Kolmogorov-Smirnov tests statistic: the number of FDI destination (2008)

N. of firms		Statistic	
		Two-sided	One-sided
N	I_1	H_0 : equality	H_0 : $N < I_1$
14035	1165	0.322	-0.003
-89.5	(07.4)	[0.000]	[0.973]
I_1	I_2	H_0 : equality	H_0 : $I_1 < I_2$
1165	273	0.239	-0.009
-7.4	(01.7)	[0.000]	[0.963]
I_2	I_3	H_0 : equality	H_0 : $I_2 < I_3$
273	135	0.383	-0.001
-1.7	(00.9)	[0.000]	[1.000]
I_3	I_4	H_0 : equality	H_0 : $I_3 < I_4$
135	72	0.254	-0.007
-0.9	(00.5)	[0.000]	[0.972]

Notes: The data are for Japanese firms in 2008. The Table shows the Kolmogorov-Smirnov tests statistics for non-MNEs (N) vs. MNEs with subsidiaries in one region (I_1), MNEs with subsidiaries in one region (I_1) vs. MNEs with subsidiaries in two regions (I_2), MNEs with subsidiaries in two regions (I_2) vs. MNEs with subsidiaries in three regions (I_3), MNEs with subsidiaries in three regions (I_3) vs. MNEs with subsidiaries in four regions (I_4). Asymptotic P-values are shown in brackets. The share of each firm type in all types is shown in parentheses.

6 Concluding remarks

This study is an attempt to test the pecking order hypothesis that more productive firms invest in more foreign markets, using the data on service firms. The proximity burden that most services firms cannot export their services to a third country from a foreign subsidiary provides us an ideal setting to test the pecking order hypothesis of the standard firm heterogeneity model of exports and FDI that does not consider the possibility of FDI strategy with exporting to a third country.

Using the data on Japanese services firms and the non-parametric KS test, this study finds that more productive firms tend to have their foreign subsidiaries in more regions. This finding supports the pecking order hypothesis and thereby, the standard firm heterogeneity model of Helpman et al. (2004).

While this study provides preliminary evidence that supports the pecking order hypothesis, several robustness checks are required. In the above analysis, the services sector includes not only pure services industries but also wholesale and retail industries. A future study needs to focus on more narrowly defined services industries such as the personal services activities industry since firms in such an industry are pure services firms in the sense that they are assumed to provide services directly to foreign consumers. As another robustness check, it is better to conduct the KS tests using alternative productivity measures such as labor productivity.

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Appendix 1: Data

This appendix describes the data sources.

The firm-level data are from *the Basic Survey of Japanese Business Structure and Activities* (BSJBSA), which is an annual survey conducted by the Ministry of Economy, Trade, and Industry (METI). METI requires all firms in the selected industries with more than 50 employees and more than 30 million yen in capital to respond to the survey. While the number of target enterprises is 38,042, the number of enterprises that responded in 2009 is 32,265⁷⁾—the survey aimed to obtain data on the previous financial year, 2008. The response rate is therefore 84.8%. The response rate in our sample period, 2001–2008, is almost stable.

The variables used in this study are as follows.

1. Labor (L): the number of total working hours of all kinds of workers in Japan by firm. Labor does not include the number of hours worked by employees in foreign affiliates. We use hours rather than the number of workers because working hours substantially vary across three kinds of workers which the survey contains: regular employees, part-time workers, and dispatched workers. Moreover, firms in the services sector employ more part-time workers than those in the manufacturing sector. We constructed the total working hours as the number of each type of worker multiplied by its average working hours. The industry average hours for regular employees and part-time workers are provided by the Ministry of Health, Labor and Welfare's *Monthly Labor Survey*, while the country average hours for dispatched workers are calculated as yearly wage divided by hourly wage, both of which are taken from the *General Survey on Dispatched Workers*.
2. Real sales: Sales divided by deflator. The industry deflator is taken from the Cabinet Office's *System of National Accounts (SNA) Statistics*. Sales include both domestic and export sales, while they do not include local sales by foreign affiliates.
3. Value added: Value added is calculated as the sum of operating profit,

7) <http://www.meti.go.jp/statistics/tyo/kikatu/result-2/h21kakuho/pdf/riyochu.pdf>

depreciation cost, total wage, welfare costs, rents, and taxes. Operating profit is defined as sales minus operating cost, where the operating cost is the sum of the cost of sales and SGA (Selling and General Administrative expenses).