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Firm Productivity and Foreign Direct Investment in the Services Sector: A Firm-Level Analysis using Japanese Data

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Firm productivity and Foreign Direct Investment in the Services Sector:

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Abstract

Using Japanese firm-level data, I examine whether multinational enterprises (MNEs) are more productive than non-MNEs in the services sector. I employ the Kolmogorov-Smirnov (KS) test to compare the overall distribution of productivity by multinational status. The results indicate that MNEs tend to be more productive than non-MNEs in the services sector and suggest that the standard firm heterogeneity model can well explain foreign direct investment (FDI) by firms in the services sector.

Keywords: Services sector; Firm heterogeneity; Multinationals; Foreign direct investment
JEL Classification: F1, F23, L8

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1 Introduction

Multinational services firms are establishing presence more aggressively in all over the world than ever before. However, little is known about MNEs in the services sector, while those in the manufacturing sector are subjects of many studies. Facing shrinking domestic market due to decreasing population, Japanese services firms as well as policy makers have begun to explore foreign markets. It is important to investigate the determinants of foreign direct investment (FDI) by services firms.

Firm-heterogeneity model of trade and FDI by Helpman et al. (2004) predict that MNEs are productive than non-MNEs. This prediction are supported for manufacturing firms by many empirical studies. However, there are little evidence that support the prediction in the services sector.

The purpose of this study is to examine the relationship between firm productivity and foreign engagement in the services sectors, using extensive firm-level data from Japan. The data is collected from a survey conducted by the Japanese Ministry of Economy, Trade, and Industry (METI). I employ the Kolmogorov-Smirnov (KS) test to compare productivity distribution of MNEs with those of non-MNEs. I find that MNEs tend to be more productive than non-MNEs even in the serivces sector. I also find first evidence of the so-called pecking order in the services sector that more productive firms tend to invest in the wider range of foreign regions.

The remainder of this paper is divided into six 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. In Section 6, I report the result of robustness checks. 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 non-parametric approach. Head and Ries (2003) confirm the prediction for listed firms in Japan. These studies analyze firms or plants in the manufacturing sector only.

Recently, studies on trade and FDI in the services sector have been developed. Francois and Hoekman (2010) provide a comprehensive overview

of internationalization in the services sector. Data on trade and FDI in the services sector is limited but has been increasing recently. Francois et al. (2009) have constructed a database on trade and FDI in the services sector. Kimura and Lee (2006), Kolstad and Villanger (2008), and Ramasamy and Yeung (2010) examine the determinants of exports and FDI in services, using aggregated data.

Recent studies conduct firm-level analysis of trade and FDI in the services sector. Using data from the United Kingdom, Breinlich and Criscuolo (2011) find several stylized facts for firm-level exports and imports of services and conclude that existing heterogeneous firm models[*1] for goods trading can be applied to services trading. 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).

This paper contributes the literature in several regards. First, I utilize a non-parametric approach based on the principle of first order stochastic dominance and show that MNEs tend to be more productive than non-MNE even in the services sector. Second, my data have a panel structure covering the year 2001–2008 and they are not restricted to large firms. Third, I provide first evidence that more productive firms tend to invest in the larger number of foreign regions in the services sector, using the non-parametric approach.

3 The data and descriptive statistics

3.1 Data

This section describes the data and provides some basic facts about Japanese MNEs. I use firm-level data from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) by the METI. In this study, I refer 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 my study among the surveys currently available in Japan, and it has been used by many studies including Nishimura et al. (2005), Kimura and Kiyota (2006), and Wakasugi et al.(2008). A more detailed

[*1] Melitz (2003) and Bernard et al. (2007b) are standard theoretical papers. Bernard et al. (2007a) provide a concise survey of recent studies.

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%

Note: Figures for less than four firms are replaced by "x."

explanation is provided in the Appendix 1.

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 latest 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 manufacturing sector in all four host regions: North America, Europe, Asia, and other region[*3]. 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 clearly the most popular destination.

[*2]This census is conducted by the Japanese Ministry of Internal Affairs and Communications.

[*3]Middle East, Central and South America, Africa, and Oceania are classified as "other regions" in the METI survey.

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

I restrict my analysis to the services sector. Table 2 provides the list of services industries with the number of firms and the fractions of MNEs in my data. The fraction of MNEs varies across industries within 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. I obtain Japanese parent firms' TFP from an estimated two-digit industry-specific production function, using Levinsohn and Petrin (2003) techniques[*4]. For output, I use Japanese parent firms' real value added, which is deflated using an industry-level deflator. The value added in my data reflects parent firms' domestic and export sales but not foreign affiliates' sales in host countries. I employ Japanese parent firms' hours worked (L)[*5] and fixed tangible assets (K), as inputs.

Following Arnold and Hussinger (2010), I use the relative TFP obtained by dividing the TFP estimates by the average TFP in the respective industry and year, since I compare the TFP for various industries.

[*4] I use transportation and package costs to proxy unobserved productivity shocks since my data does not contain costs for electricity or materials or fuels

[*5] Unlike previous studies, I use hours worked as labor rather than the number of workers. Appendix 1 provides more detailed explanation.

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 important 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. Next section will further examine the relationship between productivity and FDI by comparing overall productivity distribution of non-MNEs and MNEs in the services sector.

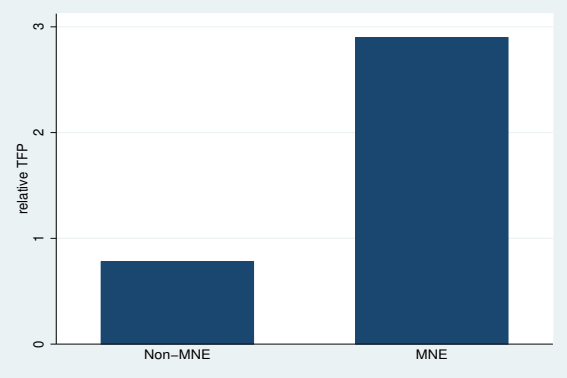

Figure 1: Mean of relative TFP

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.

4 Empirical strategy: Kolmogorov-Smirnov test

This study adopts the nonparametric one-sided and two-sided KS tests to examine the relationship between firm productivity and foreign engagement, following previous studies such as Girma et al. (2004) and Arnold and Hussinger (2010). These tests allow 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, I test the hypothesis that $F_1(\varphi)$ and $F_2(\varphi)$ are identical. The null and alternative hypotheses can be expressed as

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

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

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

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

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

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

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

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

The limiting distributions of both test statistics are known under the assumption of independently drawn samples as described in Darling (1957)[*6].

[*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

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

and that of KS_1 is given by

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

under H_0.

Following previous studies such as Delgado et al. (2002), I test the hypothesis separately for each year from 2001 to 2008, since the independence assumption is likely to be violated if I use pooled observations from several years for the KS test.

5 Results

Using the KS tests, this section examines whether MNEs are more productive than non-MNEs in the services sector. Figure 2 presents the TFP distributions for the year 2008 for both MNEs and non-MNEs. The graph supports the theoretical prediction on productivity ranking. The CDF of MNEs lies entirely to the right of the one corresponding to non-MNEs.

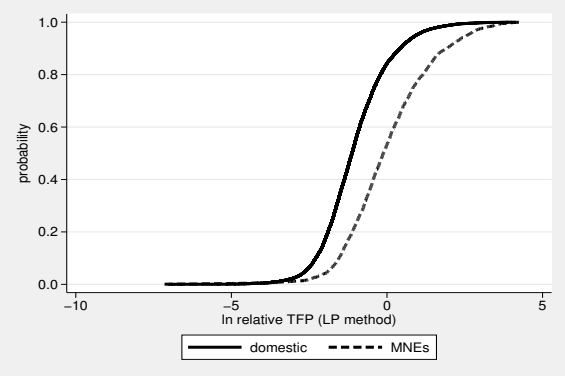

Figure 2: Internationalized status and CDF of productivity in the services sector

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 confirms the theoretical prediction more formally. Column 3 of Table 3 presents the results of the two-sided KS tests, which test the null hypothesis for the equality of distributions between non-MNEs and MNEs. The null hypothesis is rejected at 1% significance level for all years. From the result in column 4 of Table 3, I cannot reject the null hypothesis that the productivity distribution of MNEs stochastically dominates that of non-MNEs. These results from both tests indicate that the distributions for MNEs dominate that of Non-MNEs. I, therefore, can conclude that MNEs are likely to be more productive than non-MNEs even in the services sector.

Table 3: KS tests statistics for services

	Non-MNEs vs. MNEs			
	N. of firms		Statistic	
			Two-sided	One-sided
year	N	I	H_0: equality	H_0: N < I
2001	13334	1275	0.403	0.000
	(91.3)	(08.7)	[0.000]	[1.000]
2002	12998	1324	0.388	0.000
	(90.8)	(09.2)	[0.000]	[1.000]
2003	12569	1346	0.396	0.000
	(90.3)	(09.7)	[0.000]	[1.000]
2004	13296	1522	0.380	0.000
	(89.7)	(10.3)	[0.000]	[1.000]
2005	12928	1488	0.358	0.000
	(89.7)	(10.3)	[0.000]	[1.000]
2006	13388	1503	0.360	0.000
	(89.9)	(10.1)	[0.000]	[1.000]
2007	13862	1596	0.355	0.000
	(89.7)	(10.3)	[0.000]	[1.000]
2008	14035	1645	0.354	-0.003
	(89.5)	(10.5)	[0.000]	[0.978]

Notes: KS tests for non-MNEs (N) vs. MNEs (I). Asymptotic P-values are shown in brackets. The share of each firm type in all types is shown in parenthesis.

6 Number of FDI destinations

This section examines the 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 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 vary across firms from zero to four in our data. The majority of firms do not have their 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.

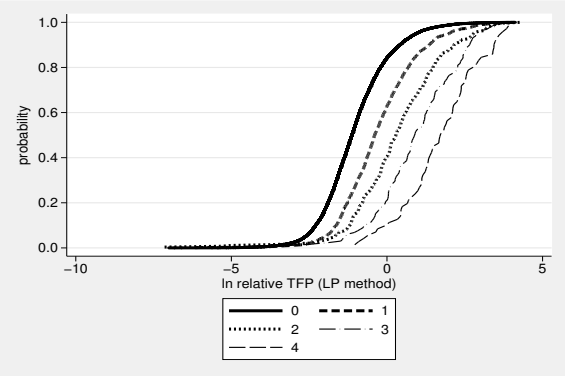

Figure 3: The number of FDI Destinations and CDF of productivity in the services sector

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.

Figure 3 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 are 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. Table 4 presents the KS tests statistics. The results also confirm the theoretical prediction. We can conclude that more productive firms tend to invest in a larger number of foreign regions in the services sector.

Table 4: 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 parenthesis.

7 Robustness check

This section conducts a number of robustness checks. First, this section focuses on a more narrowly defined services sector, while the above analysis employs a broader definition. In the above analysis, the services sector includes not only pure services industries but also wholesale and retail industries as shown in Table 2. I focus on data on the personal services activities industry, since firms in this industry is pure services firms in the sense that they are assumed to provide services directly to foreign consumers[*7]. Figure 4 presents the CDF of productivity by MNE status in the personal services industry and supports the model's prediction that MNEs are more productive than non-MNEs.

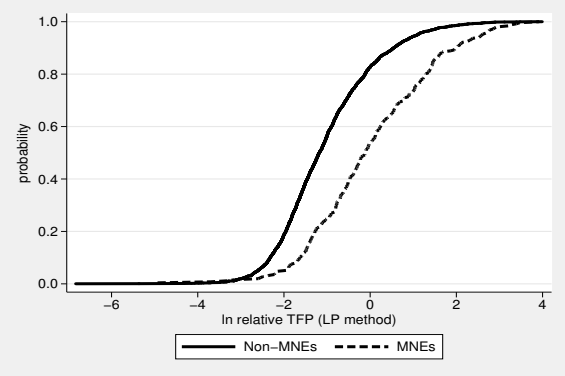

Figure 4: Internationalized status and CDF of productivity in the personal services industry

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.

I also conduct the KS tests to examine whether MNEs are more productive than non-MNEs in the personal services industry. The results are shown in Table 5. I can reject the null hypothesis of the two-sided tests but cannot reject that of the one-sided tests at conventional levels for all years. These results are consistent with the firm heterogeneity model and the previous results.

[*7]Tanaka (2011) provides the results from the other services industries. Almost all results are consistent with the theoretical prediction.

Table 5: KS tests statistics for personal services

	Non-MNEs vs. MNEs			
	N. of firms		Statistic	
			Two-sided	One-sided
year	N	I	H_0: equality	H_0: N < I
2001	2334	148	0.468	-0.002
	(94.0)	(06.0)	[0.000]	[0.998]
2002	2308	170	0.413	-0.004
	(93.1)	(06.9)	[0.000]	[0.996]
2003	2234	172	0.399	-0.009
	(92.9)	(07.1)	[0.000]	[0.977]
2004	2360	206	0.418	-0.003
	(92.0)	(08.0)	[0.000]	[0.997]
2005	2273	201	0.376	-0.002
	(91.9)	(08.1)	[0.000]	[0.998]
2006	2416	219	0.390	0.000
	(91.7)	(08.3)	[0.000]	[1.000]
2007	2637	247	0.337	0.000
	(91.4)	(08.6)	[0.000]	[1.000]
2008	2737	254	0.354	-0.003
	(91.5)	(08.5)	[0.000]	[0.995]

Notes: KS tests for non-MNEs (N) vs. MNEs (I). Asymptotic P-values are shown in brackets. The share of each firm type in all types is shown in parenthesis.

As a second robustness check, I conduct the KS tests using labor productivity instead of TFP. The results are similar to the previous results and support theoretical predictions. Third, the results excluding firms with employees in the manufacturing or mining sections from the sample yield the same results as the previous ones. Finally, I have replicated the results using only MNEs whose foreign subsidiaries have the same industry code as the Japanese parent firm.

8 Concluding remarks

This study is the first attempt in examining the relationship between productivity distribution and multinational status in the services sectors. Little is known about the determinants of FDI by firms in the services sector, while many previous studies have focused on FDI by firms in the manufacturing sector. This study reveals that MNEs in the services sector tend to be more productive than non-MNEs. This result suggests that firms in the services sector must incur huge costs for foreign engagement as those in the manufacturing sector do, and that only a minority of productive firms in the services sector can incur these costs and supply foreign consumers with their services.

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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 32,265[*8]—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 number of hours worked by employees in foreign affiliates. I 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. I constructed the total working hours as the number of each type of workers 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* as shown in Morikawa (2010). Sales includes both domestic and export sales, while they do not include local sales by foreign affiliates.

3. Labor productivity: real value added per hour worked. Value added are calculated as the sum of operating profit, 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 cost of sales and SGA (Selling and General Administrative expenses).

[*8] `http://www.meti.go.jp/statistics/tyo/kikatu/result-2/h21kakuho/pdf/riyochu.pdf`

4. TFP: total factor productivity. I estimate TFP as the residual of Cobb-Douglas production function with K and L inputs. I use real value added as the output. Production function coefficients are estimated separately for two-digit industries, using Levinsohn and Petrin (2003) method. I use transportation and package costs to proxy unobserved productivity shocks.