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FDI, Ownership structure, and Productivity◆

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Abstract

The standard firm heterogeneity model of FDI considers the case of whole ownership of foreign affiliates. However, there exist many partially-owned foreign affiliates. This paper builds a model based on Helpman et al. (2004) to allow various ownership structures and posits some testable hypotheses on the relationship between productivity and ownership shares/structures. The empirical part corroborates these hypotheses, showing that high productivity firms have higher ownership share in their affiliates and lower productivity firms tend to opt for joint-ventures with wholesalers and/or local/3rd country partners.

Keywords: FDI, Productivity, Ownership share
JEL classification: F20, F23

◆ This study is conducted as a part of the Project "Studies on Foreign Direct Investment and Trade in relation to FDI" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). This study utilizes the micro data of the questionnaire information based on "the Basic Survey of Japanese Business Structure and Activities" and "the Survey on Overseas Business Activities", which are conducted by the Ministry of Economy, Trade and Industry (METI). The author is grateful for helpful comments and suggestions by Alan V. Deardorff, Michael J. Ryan and Discussion Paper seminar participants at RIETI.
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1. INTRODUCTION

The standard firm heterogeneity model of foreign direct investment (FDI) (Helpman et al., 2004) only considers the case of wholly-owned foreign affiliates but there are many examples of partially-owned foreign affiliates. About half of Japanese firms' FDI are joint ventures. We find that Japanese general trading companies (*Sogo Shosha*)[1]engaged in FDI as a shared owner in many cases. This study constructs a model that yields testable hypotheses on the shared ownership of FDI projects and examines it with Japanese firm-level data.

Literature

Several studies have investigated the ownership structure of FDI. The closest to our study is Raff et al. (2009). To explain why multinational firms often share ownership of a foreign affiliate with a local partner, they constructed a Cournot model with asymmetric information on the local partner firms' asset values, which are to be invested into possible joint ventures. In their model, a firm does not have to incur fixed costs of FDI if it chooses shared ownership with local partners. However, shared ownership results in reduced productivity of the foreign affiliate. The model predicts that the multinational's ownership share increases in its productivity, with the most productive multinationals choosing not to rely on a foreign partner at all. Raff et al. (2012) use Japanese firm-level data to examine how a firm's productivity affects its foreign market entry strategy. They find that more productive firms tend to choose greenfield investment in a wholly-owned subsidiary rather than establishing a foreign presence through the acquisition of a local firm. Asiedu and Esfahani (2001), using FDI data of U.S. multinationals, showed that ownership structure depends on the relative productivities of transnational enterprises' assets, local entrepreneurs' capabilities, and host country's physical infrastructure and institutional setting.

Interestingly, they found that merely removing equity restrictions has little effect on improving the country's environment for foreign investment, while a more effective means of attracting foreign investment in such situations is to improve the country's physical and institutional infrastructure. Desai et al. (2004), also using FDI data of U.S. multinationals', showed that the proportion of whole ownership increased over time because of the increased importance of intrafirm transactions. Bircan (2019) examined the ownership structure and productivity of multinational affiliates and their effects on the domestic industry. Using the data of Turkish manufacturers, they showed that multinational

[1] Many studies, such as Ahn et al. (2011) and Akerman (2018) examined the facilitating role of wholesalers in international trade. However, only a few studies have investigated the role of wholesalers in FDI.

presence in an industry increases physical productivity while lowering the prices of local firms, especially when there are majority-owned affiliates.

Whereas Raff et al. (2009) analyzed shared ownership in a Cournot-Nash game, we construct a monopolistic competition model by modifying Helpman et al. (2004) and derive testable hypotheses. We then use a large firm-level dataset of Japanese firms to corroborate our theoretical prediction.

2. THEORY

2.1. Model

We present a partial equilibrium model, based on Helpman et al. (2004), to investigate the role of shared ownership on FDI. There are *J* countries indexed by *j*. The preferences of the consumer are the same everywhere, given by

$$\boldsymbol{u_j = \left[\int_{\omega\in\Omega_j} q_j(\omega)^{\alpha}\, d\omega\right]^{\frac{1}{\alpha}}, \qquad 0<\alpha<1,} \tag{1}$$

where $q_j(\omega)$ is the quantity of good ω consumed in country *j* and α determines the elasticity of substitution across differentiated goods, $\sigma = \frac{1}{1-\alpha} > 1$. These preferences generate the following demand curve in country *j*:

$$\boldsymbol{q_j(\omega) = \frac{p_j(\omega)^{-\sigma} Y_j}{P_j^{1-\sigma}},} \tag{2}$$

where $p_j(\omega)$ is the price of good ω in country *j* and Y_j is the gross national expenditure of country *j*. P_j is the price index of country *j*, given by

$$\mathbf{P_j = \left[\int_{\omega\in\Omega_j} p_j(\omega)^{1-\sigma}\, d\omega\right]^{\frac{1}{1-\sigma}}.}$$

Each firm produces a single good using a single input called labor. The price of labor in country *j* is w_j. Firms are heterogeneous in terms of their productivity φ. A firm incurs fixed overhead labor costs f_D and faces wage w_h at home when it produces for the domestic market. Firms supply their products to foreign countries. For simplicity, we do not consider exports and assume that firms choose FDI to serve foreign markets. If a firm chooses to serve a foreign market $j \neq h$ via FDI, it incurs additional fixed costs $f_I > f_D$ and faces local wage w_j.

As is well-known, a firm facing demand curve (2) will optimally charge a price $p_j(\varphi) = w_j/(\alpha\varphi)$ in country *j*. Then, it obtains revenues of

$$\boldsymbol{R_j(\varphi) = A_j c_j \varphi^{1-\sigma}} \tag{3}$$

where $c_j(\varphi) = w_j/\varphi$ is the marginal cost of serving country *j* for a firm with productivity φ from country *h* and $A_j \equiv \alpha^{\sigma-1} E_j P_j^{\sigma-1}$ is the mark-up adjusted demand level. Profits from the domestic market are

$$\boldsymbol{\pi_D(\varphi) = w_h^{1-\sigma} A_h \varphi^{\sigma-1} - f_D.} \tag{4}$$

Profit is increasing in firm productivity index $\varphi^{\sigma-1}$.

2.2. Ownership choice

(i) Wholly-owned foreign affiliates

Helpman et al. (2004) implicitly assumed that firms incur all the fixed costs of FDI, f_I. However, there are many examples of shared ownership in FDI projects. Therefore, we assume that a firm can choose either whole ownership or shared ownership.[2]

First, we present the case of a wholly-owned foreign affiliate, which Helpman et al. (2004) considered. If a firm establishes a wholly-owned affiliate in country *j*, the profit from FDI is given by

$$\boldsymbol{\pi_W(\varphi) = w_j^{1-\sigma} A_j \varphi^{\sigma-1} - f_I,} \tag{5}$$

where the firm incurs the entire fixed costs of FDI, f_I. Here too, profit from FDI is increasing in firm productivity index $\varphi^{\sigma-1}$. The level of profit is also increasing in the mark-up adjusted demand level

[2] This study does not consider the possibility that firms can borrow from financial markets to cover fixed costs.

A_j and decreasing in wage w_j in country j. From equation (5), we can derive the zero-profit cutoff for wholly-owned FDI as

$$\widehat{\boldsymbol{\varphi}}_{\boldsymbol{j}}^{\boldsymbol{\sigma-1}} = \frac{\boldsymbol{f_I}}{\boldsymbol{w_j}^{\boldsymbol{1-\sigma}}\boldsymbol{A_j}}. \tag{6}$$

A firm with productivity $\varphi > \widehat{\varphi}_j$ can serve foreign market j via a wholly-owned affiliate.

(ii) Shared ownership with a partner

Next, we consider the case of shared ownership in an FDI project. A firm can invest in a foreign country with various kind of partners. We, however, generally present the case of shared ownership as a simple extension of Helpman et al. (2004). Empirical part of this study disassembles the shared ownership by the partners such as general trading companies and local or third-country partners.

We assume that a firm decides to invest in an FDI project jointly with an experienced partner, such as a general trading company or with a local partner in country j. If a firm establishes a partially-owned affiliate with the partner, the profit from FDI is given by

$$\boldsymbol{\pi_S(\varphi)} = \boldsymbol{\lambda w_j^{1-\sigma} A_j (\gamma\varphi)^{\sigma-1} - \lambda\mu f_I - f_S}, \tag{7}$$

where the firm's ownership ratio is shown as $\lambda \in (0,1)$. The firm incurs λ of the fixed costs of FDI (μf_I) and obtains λ of the operating profits. In addition to the fixed cost of FDI, the firm incurs a fixed cost for shared ownership $\boldsymbol{f_S}$, which reflects the fact that it is costly for the firm to find a partner. Following Raff et al. (2009), we assume that shared ownership results in a decrease in the productivity of the foreign affiliate, as shown in $\gamma \in (0,1)$. This could be because of differences in language and corporate culture between the firm and its partner. For simplicity, we assume that the firm's ownership ratio λ is exogenously given in this sub-section. This assumption is relaxed in the next sub-section. We also assume $0 < \mu < 1$, which ensures that the fixed cost of FDI for shared ownership μf_I is lesser than the fixed cost of full ownership f_I. It reflects that the partner has the knowledge and other intangible assets to set up an affiliate in a foreign country and that there are economies of scope across investment projects of the same company. Therefore, the experienced partner can effectively reduce the fixed cost of FDI. Note that no firm chooses shared ownership with a partner company when there are no economies of scope, i.e. when $\mu = 1$. Besides, we assume

$$\boldsymbol{\lambda f_I(\gamma^{\sigma-1} - \mu) > f_S}, \tag{8}$$

which ensures the existence of shared ownership in FDI projects, as the following analysis will clarify. In the case of shared ownership, the zero-profit cutoff productivity for FDI is given by

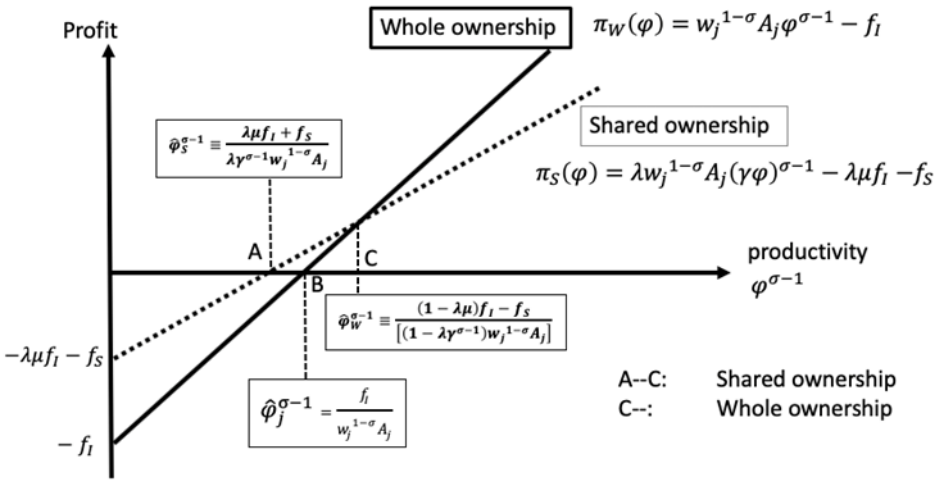
$$\widehat{\boldsymbol{\varphi}}_{\boldsymbol{S}}^{\boldsymbol{\sigma-1}} \equiv \frac{\boldsymbol{\lambda\mu f_I + f_S}}{\boldsymbol{\lambda\gamma^{\sigma-1} w_j^{1-\sigma} A_j}}. \tag{9}$$

The zero-profit cutoff productivity for shared ownership is irrelevant to the exogeneous ownership ratio λ. At the same time, it increases when the role of the partner is smaller, that is, when μ is higher. From assumption (8), the zero-profit cutoff productivity for shared ownership is lower than the zero-profit cutoff productivity for whole ownership. Figure 1 shows profit from FDI as the function of firm productivity. Firms that choose shared ownership are less productive than those that choose whole ownership. A firm opts for whole ownership if its productivity exceeds the cutoff for whole ownership:

$$\widehat{\boldsymbol{\varphi}}_{\boldsymbol{W}}^{\boldsymbol{\sigma-1}} \equiv \frac{\boldsymbol{(1-\lambda\mu) f_I - f_S}}{\boldsymbol{\left[(1-\lambda\gamma^{\sigma-1}) w_j^{1-\sigma} A_j\right]}}. \tag{10}$$

For a firm with productivity above $\hat{\varphi}_W$, profits from the wholly-owned FDI project exceed the profits from the partially-owned one. From assumption (8), $\widehat{\boldsymbol{\varphi}}_{\boldsymbol{W}} > \widehat{\boldsymbol{\varphi}}_{\boldsymbol{S}}$, implying that more productive firms tend to establish wholly-owned affiliates rather than partially-owned affiliates.

Figure 1: Whole ownership versus shared ownership



How large μ will be in the host country is an empirical question—it can vary across countries and industries. The decrease in realized productivity can be high in developing countries such that γ is lower in those countries, given that considerable information and communication problems arise from the immature legal system and other reasons, such as the low education level. The effect of market size on the number of partially-owned firms is ambiguous since the larger market attracts both wholly-owned and partially-owned FDI. The impact of wage on the number of shared ownerships is also vague since lower wages attract both types of FDI.

(iii) Endogenous ownership ratio

We have so far assumed a constant ownership ratio as exogenously given. In reality, there are various ownership ratios as a result of the firms' choice. We, therefore, now consider the situation where a firm can choose its ownership ratio, λ. To relate ownership ratio and firm profit, we assume that the extent of decrease in the fixed cost of FDI depends on the ownership ratio:

$$\boldsymbol{\mu = \lambda^{\delta}, \qquad \delta > 0.} \tag{11}$$

The rationale for this assumption comes from local partners' incentives. When the parent company's ownership ratio $\boldsymbol{\lambda}$ is high, the ownership ratio of the local partner will be low. Given the lower participation rate, there is less incentive for the local partner to exert much effort to reduce the fixed FDI cost, thus $\boldsymbol{\mu}$ will be high. This assumption leads to the following profit function for shared ownership.

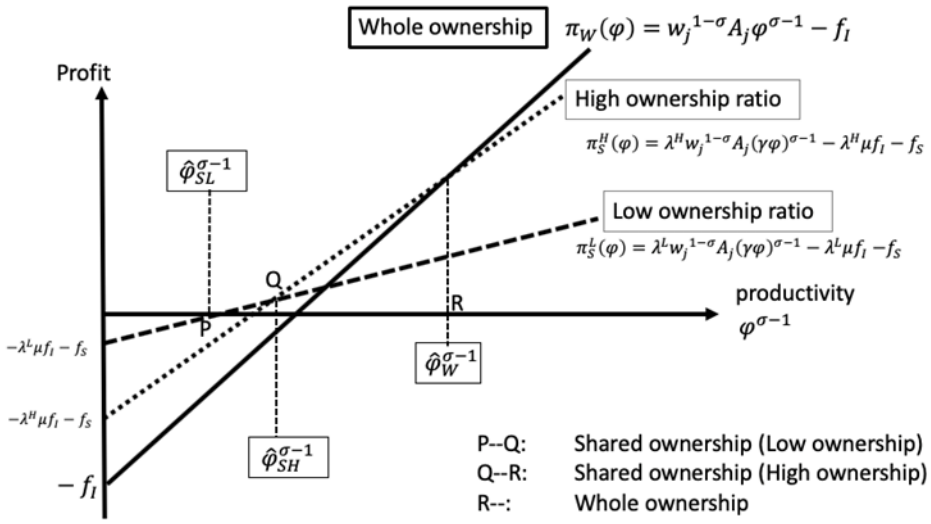
$$\boldsymbol{\pi_S(\varphi) = \lambda w_j^{1-\sigma} A_j (\gamma\varphi)^{\sigma-1} - \lambda^{1+\delta} f_I - f_S.} \tag{12}$$

The optimal ownership ratio is given by

$$\boldsymbol{\hat{\lambda} \equiv \left[\frac{w_j^{1-\sigma} A_j (\gamma\varphi)^{\sigma-1} - f_S}{(1+\delta) f_I} \right]^{\frac{I}{\delta}},} \tag{13}$$

which is increasing in firm productivity and market size and decreasing in local wage and fixed cost of FDI. Figure 2 presents a simple discrete example to illustrate the relationship between firm productivity and ownership ratio. Firms with lower productivity choose a lower ownership ratio, while firms with higher productivity choose a higher ownership ratio. Firms with the highest productivity choose whole ownership. While Figure 2 shows a discrete example, firms are assumed to continuously choose their ownership ratio as equation (13) shows.

Figure 2: Firm productivity and choice of ownership ratio



3. DATA

We use firm-level data from Basic Survey of Japanese Business Structure and Activities (BSJBSA or *Keizaisangyosho Kigyo Katsudo Kihon Chosa* in Japanese), conducted by the Ministry of Economy, Trade, and Industry (METI), for computing total factor productivity (TFP). METI conducts the survey to acquire a quantitative understanding of Japanese enterprises' diversification and internationalization. It also uses it to plan various administrative policies from a broad perspective and obtain the necessary data for implementing these policies. The survey covers enterprises with 50 or more employees and with a paid-up capital or investment fund of over 30 million yen, that operate in mining, manufacturing, wholesale and retail trade, and food and beverage business (excluding "other eating and drinking places").[3]

We also use firm-level data from the Survey on Overseas Business Activities (SOBA or *Kaigai Jigyo Katsudo Kihon Chosa* in Japanese), also administered by METI, to investigate the FDI activities

[3] Directly taken from METI website.

of Japanese firms. The objective of this survey is to present the actual conditions of overseas business activities of Japanese corporations that serve as a basis for improving future industrial and trade policies. The survey is separated into two parts. One is the basic survey, which is detailed and carried out every three years. The other is the trend survey, which is comparatively less detailed and carried out in between the basic surveys. The survey targets are: a) parent companies—Japanese corporations that own or have owned overseas affiliates in the past, excluding those in the financial and insurance industries or real estate industry (hereafter, parent companies) and b) overseas affiliates—subsidiaries and sub-subsidiaries are collectively called "overseas affiliates:"

1. A foreign affiliate in which a Japanese corporation has invested capital of 10% or more;

2. A foreign affiliate in which a "subsidiary," funded more than 50% by a Japanese corporation, has invested capital of more than 50%; or

3. A foreign affiliate in which a Japanese corporation and a subsidiary, funded more than 50% by a Japanese corporation, have invested capital of more than 50%.[4]

Overseas Japanese companies (hereafter, OJC database) compiled by Toyo Keizai Inc., a private company, are used to identify detailed ownership structures. The OJC database is based on the annual questionnaire survey conducted by Toyo Keizai. The data are available since 1991 and includes information on ownership, such as major shareholders' names, capital shares, among others.

4. ANALYSES

This section provides an overall picture of the ownership structure of Japanese FDI and productivity distribution by ownership ratio.

4.1. *Ownership structure of Japanese overseas affiliates*

Table 1 shows the 2017 ownership structures of wholly-owned affiliates (58%), joint ventures (JVs) with other Japanese firms (4%) only, i.e., without non-Japanese partners, joint ventures with Japanese firms with the Japanese firms' combined share being more than or equal to 50 percent (23%), and joint ventures with Japanese firms with the Japanese firms' combined share being less than 50 percent (14%). Figure 3 shows the number of firms over time, with whole ownership showing a steady increase over 27 years. JVs with local or third country partners increased until 1999 and has stayed almost constant since then. All other types are stable. Decomposing the number of affiliates by host countries shows one in the U.S. in Figure 4, whereas Figure 5 is for China. The numbers of affiliates and share of each type are stable in the U.S. The same is true for other developed countries. On the contrary, in China, whole ownership increased substantially after 2001 when China joined the WTO.

[4] Directly taken from METI website.

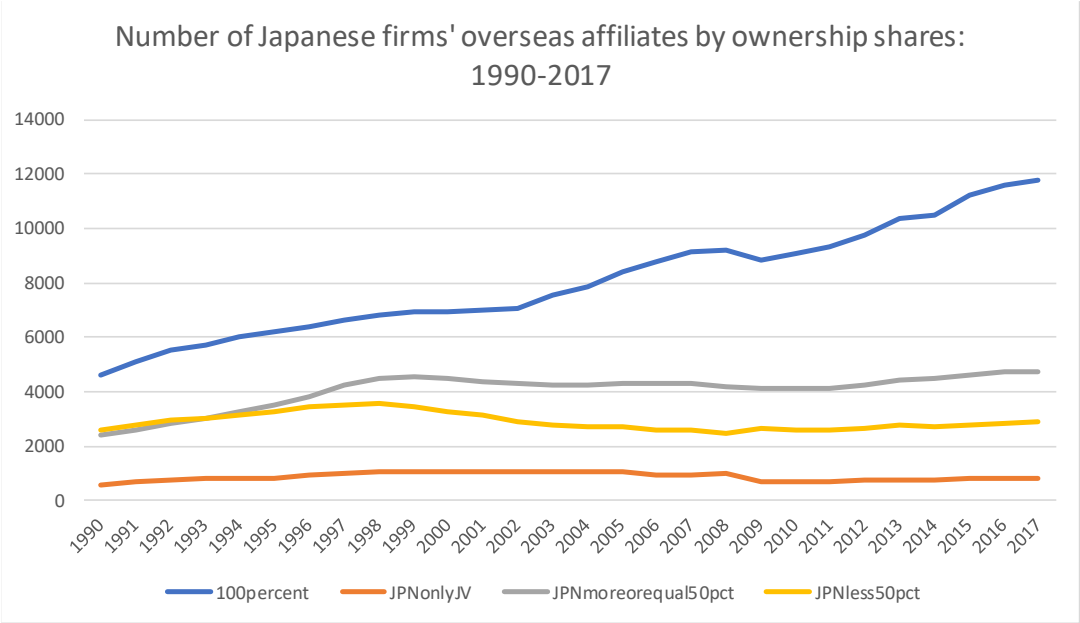
While China's accession to the WTO encouraged foreign firms' entry, deregulation of foreign ownership shares in many industries by the Chinese government also must have contributed to this drastic increase in whole ownership. The number of whole ownerships steadily increased in other developing countries too, especially in Asian countries, but far less dramatically than in China. As China is an exception, in the next section, estimation analyses are done including and excluding China.[5]

Table 1: Ownership structure of Japanese multinationals

	Year 2017	Share
100percent	11804	58%
JPNonlyJV	810	4%
JPNmoreorequal50pct	4725	23%
JPNless50pct	2903	14%
Total	20242	

Source: OJC (Toyo Keizai Inc.)

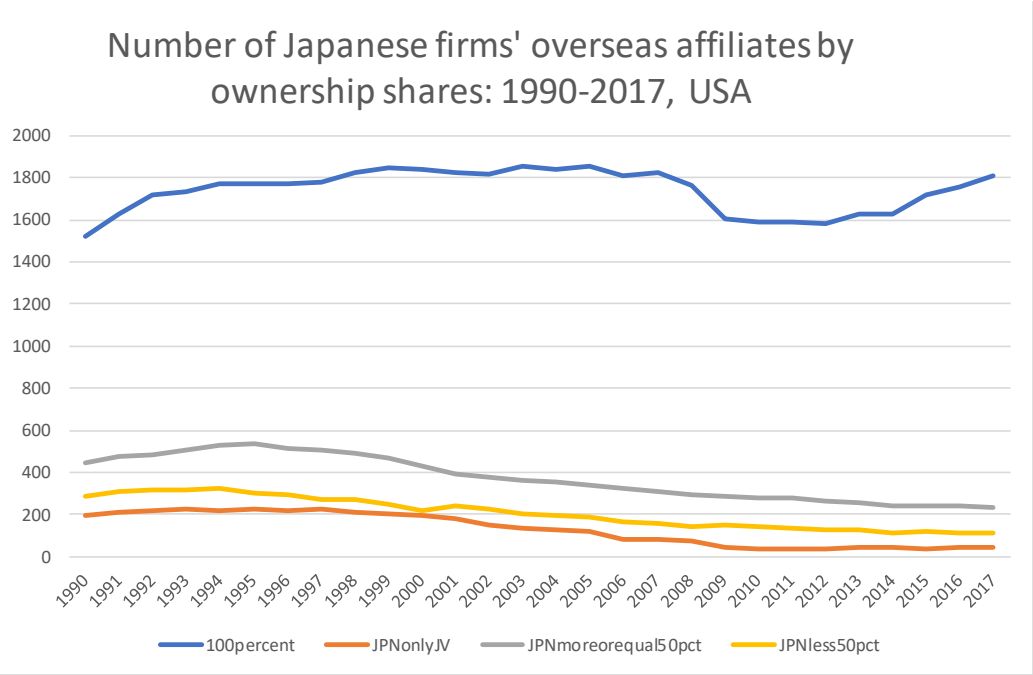
Figure 3: Number of Japanese firms' overseas affiliates by ownership share: 1990–2017



Source: OJC (Toyo Keizai Inc.)

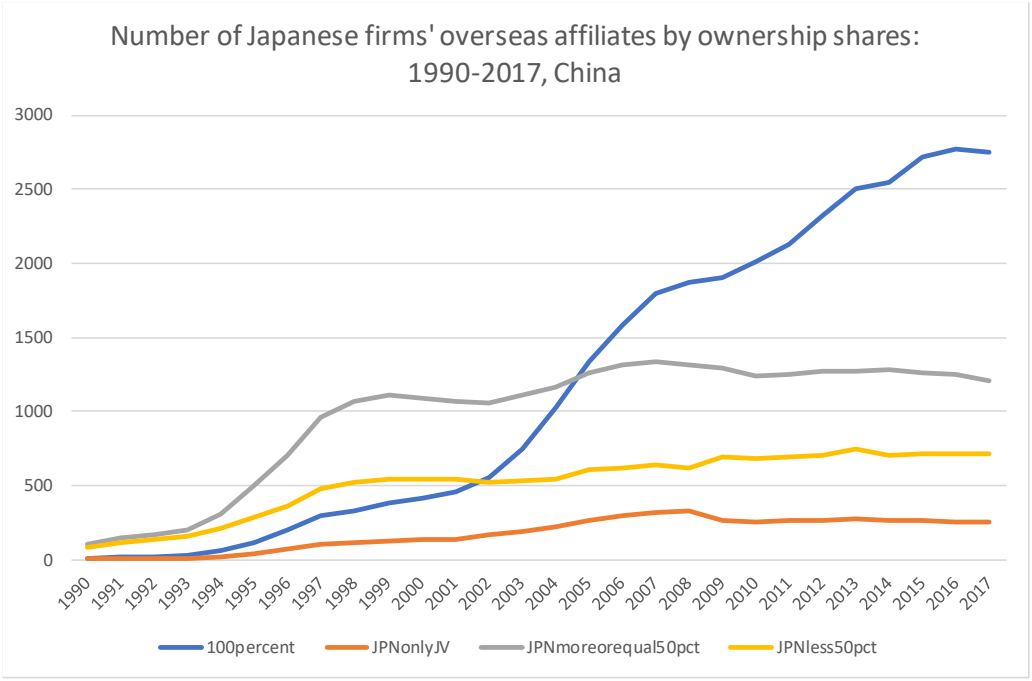
[5] We do not show the graphs for other countries for the sake of brevity. They are available upon request to the authors.

Figure 4: Number of Japanese firms' overseas affiliates by ownership share: 1990–2017, U.S.



Source: OJC (Toyo Keizai Inc.)

Figure 5: Number of Japanese firms' overseas affiliates by ownership share: 1990–2017, China



Source: OJC (Toyo Keizai Inc.)

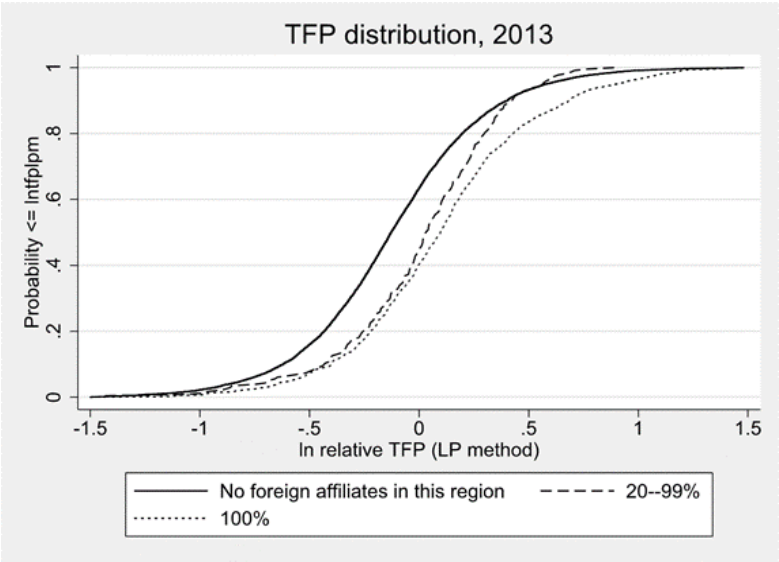
4.2. *Parent firms' productivity and ownership share in their affiliates*

We compare productivity distributions by ownership type. We use total factor productivity (TFP)—for measuring productivity—from an estimated two-digit industry-specific production function, using Levinsohn and Petrin (2003) techniques with BSJBSA. We use transportation and package costs to proxy unobserved productivity shocks. For output, we use Japanese parent firms' real value-added, deflated using an industry-level deflator. The value-added reflects parent firms' domestic and export sales but not the foreign affiliates' sales in host countries. We employ Japanese parent firms' number of hours worked (L) and fixed tangible assets (K) as inputs. Following Arnold and Hussinger (2010), we use relative TFP obtained by dividing TFP estimates by the average TFP in the respective industry and year, since we compare the TFPs for various industries.

Results using data from BSJBSA

Using firm-level data from BSJBSA, we divide the Japanese manufacturing firms into three types: (i) firms without a foreign affiliate in North America or Europe (non-MNE: non-multinational enterprise), (ii) firms with a partially-owned foreign affiliate in North America or Europe (POS), (iii) firms with a wholly-owned foreign affiliate in North America or Europe (WOS). We focus on North America and Europe since our model assumes horizontal FDI. Figure 6 presents the cumulative distribution function (CDF) of relative TFP by each firm type in the manufacturing sector. The TFP distribution of firms without a foreign affiliate lies entirely to the left (lower-productivity) side of the other types of firms. The distribution of firms with a partially-owned foreign affiliate lies between the distribution of firms without a foreign affiliate and of firms with a wholly-owned foreign affiliate. These support the theoretical prediction of productivity ranking.

Figure 6: TFP distribution by ownership structure in North America and Europe



Source: BSJBSA (METI)

We further examine productivity ranking with nonparametric one-sided and two-sided Kolmogorov-Smirnov (KS) tests, which allow us to compare and rank the distributions of firm performance, based on the concept of first-order stochastic dominance. Following Delgado et al. (2001), many studies have employed KS tests. It is a stricter test of productivity differences as it considers all moments of distribution than just comparing mean levels of productivity.

First, by the two-sided KS statistic, we can test the null hypothesis that two distributions, F1(φ) and F2(φ), are identical. Second, the one-sided KS test examines the hypothesis that one distribution, F1(φ), stochastically dominates another one, F2(φ). If we can reject the null hypothesis for the two-sided test, but not for the one-sided test, we can conclude that F1(φ) stochastically dominates F2(φ). Following previous studies, such as Delgado et al. (2002), we test the hypotheses separately for each year from 2008 to 2013, since the independence assumption is likely to be violated if we use pooled observations from several years for the KS test.

Table 2 shows the results of KS test with the number of each firm type. We compare TFP distribution of non-MNEs with those of POS. The two-sided KS test statistic rejects the null hypothesis that the TFP distributions of non-MNEs and POS are identical. From the one-sided KS test statistic, we cannot reject the null hypothesis that the TFP distribution of POS stochastically dominates that of non-MNEs. Both the two- and one-sided KS tests indicate that the TFP distribution of POS stochastically dominates that of non-MNEs. Similarly, we can conclude that the TFP distribution of WOS stochastically dominates that of POS. These results support our theoretical prediction.

Table 2: Kolmogorov–Smirnov test statistics: TFP (L.P. method)

Year	No. of firms		Statistic				Statistic	
			Two-sided	One-sided			Two-sided	One-sided
	Non-MNE	POS	H0: equality	H0: N<POS	POS	WOS	H0: equality	H0: POS<WOS
2008	10390	937	0.130	-0.022	937	2297	0.095	-0.032
	(76.3)	(6.9)	[0.002]	[0.831]	(6.9)	(16.9)	(0.094)	(0.704)
2009	10104	922	0.137	-0.027	922	2294	0.166	-0.038
	(75.9)	(6.9)	[0.001]	[0.748]	(6.9)	(17.2)	(0.000)	(0.603)
2010	10037	897	0.169	-0.005	897	2383	0.136	-0.007
	(75.4)	(6.7)	[0.000]	[0.989]	(6.7)	(17.9)	(0.005)	(0.986)
2011	10123	897	0.126	-0.022	897	2544	0.147	-0.016
	(74.6)	(6.6)	[0.006]	[0.838]	(6.6)	(18.8)	(0.002)	(0.924)
2012	9827	958	0.128	-0.010	958	2630	0.158	-0.007
	(73.3)	(7.1)	[0.002]	[0.960]	(7.1)	(19.6)	(0.000)	(0.984)
2013	9624	933	0.216	-0.023	933	2696	0.119	-0.006
	(72.6)	(7.0)	[0.000]	[0.783]	(7.0)	(20.3)	(0.009)	(0.985)

Source: BSJBSA (METI)

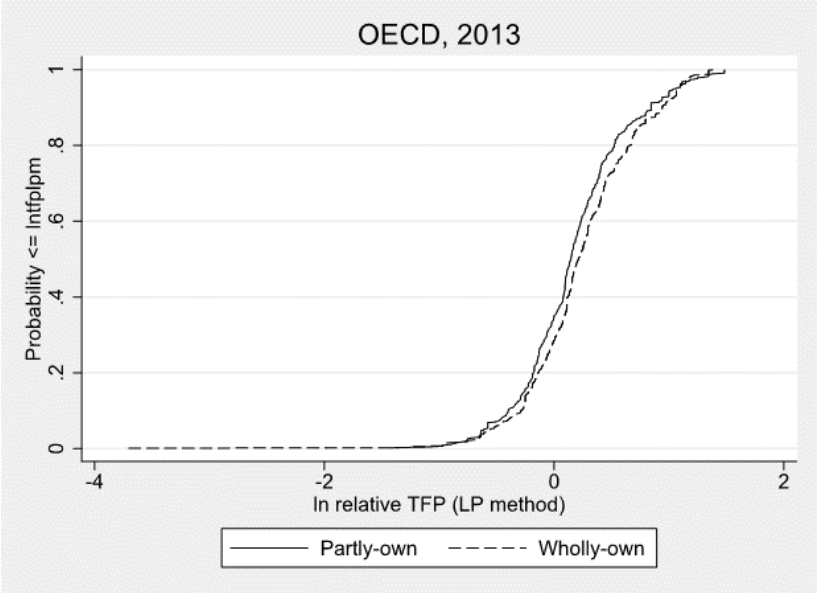
Notes: The table shows the Kolmogorov–Smirnov test statistics for Japanese firms without a foreign affiliate in developed regions (non-MNE) versus MNEs with a partially-owned foreign affiliate in developed areas (POS), MNEs with a partially-owned foreign affiliate (POS) versus MNEs with a wholly-owned foreign affiliate (WOS).

Asymptotic P-values are shown in brackets. The share of each firm type is shown in parentheses. Developed regions include North America and Europe.

Results using data from BSJBSA and SOBA

We also compare Japanese parent firms' productivity distribution, using the merged BSJBSA-SOBA dataset. Using the host country's name from SOBA, we identify Japanese firms that have foreign affiliates in OECD countries. The OECD's FDI Regulatory Restrictiveness Index (FDI Index) shows that the degree of ownership restrictions in OECD countries tends to be substantially lower than in non-OECD countries. We, therefore, compare Japanese firms with foreign affiliates to those without foreign affiliates in OECD countries. Figure 7 shows the cumulative density function of Japanese MNEs' TFP by type of ownership and indicates that the TFP of MNEs with a partially-owned foreign affiliate tends to be distributed over a lower range than that of MNEs with a wholly-owned foreign affiliate. The productivity ordering is consistent with the model.

Figure 7: TFP distribution by ownership structure in OECD countries



Source: BSJBSA and SOBA (METI)

Table 3 presents the KS test statistics, using the merged BSJBSA-SOBA dataset. For all the years, we reject the null hypothesis that the TFP distributions of POS and WOS are identical, but we cannot reject the null hypothesis that the TFP distribution of WOS stochastically dominates that of POS. Therefore, we can conclude that the TFP distribution of WOS stochastically dominates that of POS, as predicted by the model.

Table 3: Kolmogorov–Smirnov test statistics: TFP (L.P. method)

Year	No. of firms		Statistic	
			Two-sided	One-sided
	POS	WOS	H0: equality	H0: N<POS
2008	302	1101	0.138	-0.005
	(21.4)	(77.9)	[0.001]	[0.990]
2009	261	1008	0.127	-0.028
	(20.4)	(78.9)	[0.004]	[0.736]
2010	273	1026	0.107	-0.013
	(20.9)	(78.4)	[0.024]	[0.934]
2011	309	1138	0.119	-0.009
	(21.2)	(77.9)	[0.004]	[0.965]
2012	346	1215	0.108	-0.008
	(22.0)	(77.1)	[0.007]	[0.971]
2013	372	1226	0.096	-0.009
	(23.1)	(76.1)	[0.016]	[0.958]

Notes: The table shows the Kolmogorov–Smirnov test statistics for MNEs with a partially-owned foreign affiliate (POS) versus MNEs with a wholly-owned foreign affiliate (WOS) in OECD countries. Asymptotic P-values are shown in brackets. The share of each firm type is shown in parentheses.

5. ESTIMATION ANALYSES

Here, we conduct the estimation analyses for the above mentioned testable hypotheses: whether high productivity firms are likely to have a higher ownership share in their affiliates; whether high productivity firms are likely to choose whole ownership; whether high productivity firms are unlikely to invest in the form of joint ventures with wholesalers; and whether high productivity firms are unlikely to invest in the form of joint ventures with local and/or third country partner firms. As the OJC dataset does not include the information needed to compute productivity, we combine it with the BSJBSA dataset. The period of study is 2001–2013, for which we were able to calculate the TFP. As ownership share is determined at the time of investment, analyses are carried out with the information of affiliates that appear first in the dataset. For example, an affiliate of a Japanese automobile producing company in Thailand is recorded from 2001 onwards. The ideal would be to have the information at the time of establishment in 1962, but there is no data available at that point. Hence, we use the information from 2001. For multiple affiliates in the same country by the same parent firm, affiliates with the maximum share ratio are used for the estimation because the theory suggests that the constraint is on the maximum ownership shares (more plainly, firms can choose less ownership shares than the maximum share ratio it can afford). To better examine the relationship between

productivities and ownership shares, we confine the data for the analyses to those firms that are not considered financially constrained by using the debt-stock ratio, the standard measure of financial constraint, being less than or equal to 1.[6] Following Yeaple (2009), we take a reduced-form approach since it is difficult to find an empirical analog for every variable in the model. For instance, it is challenging to specify the difference in $\boldsymbol{\gamma}$ and fixed cost of FDI. Instead, we include country-industry fixed effects as well as country-year fixed effects into the estimation equation.

The first estimation equation is

$$Ownership\ \ Share_f = \beta_0 + \beta_1 Productivity_f + u_{ci} + u_{it} + u_{ct} + \varepsilon_f,$$

where $Ownership\ \ Share_f$ is the percentage of ownership share of the largest shareholder (parent firm), $Productivity_f$ is the productivity of the parent firm. u_{ci}, u_{it}, u_{ct} are country-industry fixed effects, industry-year fixed effects, and (host) country-year fixed effects, respectively. ε_f is i.i.d. error. For productivity measures, we use labor productivity defined as sales divided by the number of employees, TFP by Levinsohn-Petrin method and TFP index. The logarithms of all these productivity measures are used for the estimation. The results are in Table 4. Columns (1) to (3) are for the entire sample of all countries, columns (4) to (6) exclude China because it is an exceptional case as shown in sub-section 4.1., and columns (7) to (9) are for OECD countries only because, as argued earlier, our theory fits into horizontal FDI rather than vertical FDI. The coefficient estimates of all the variables (lnlp (log of labor productivity), lntfplpn (log of TFP by L.P. method), lntfpindex (log of TFP index) show statistically significant positive signs. The higher the parent firms' productivity, the higher their ownership share in affiliates.

Second, we estimate a binary choice of whole ownership and partial ownership with the following linear probability model.[7] The estimation equation is

$$\text{Indicator}(0\ \ or\ \ 1) = \beta_0 + \beta_1 Productivity_f + u_{ci} + u_{it} + u_{ct} + \varepsilon_f,$$

where Indicator is 1 when the dependent variable—the indicator of whether the parent firm has chosen whole ownership—is "yes" and 0 otherwise. $Productivity_f$ represents parent firm's productivity and u_{ci}, u_{it}, u_{ct} represents country-industry fixed effects, industry-year fixed effects, and country-year fixed effects, respectively. ε_f is i.i.d. error. The estimation results are in Table 5. As in the last estimations, we estimate for the entire sample (all countries), excluding China, and only for OECD. All the coefficient estimates are statistically significant with positive signs. The binary choice estimation between whole ownership and joint ventures with wholesalers are also done. Here, the dependent variable is 1 if the affiliate is a joint venture with wholesalers. We define an affiliate as a

[6] We show the case of the debt-stock ratio being less than 1, considered healthy in accounting. We also estimated the cases of the threshold being less than or equal to 1.5, 2, and 3, all of which yield similar qualitative results. With the sub-sample of a high debt-stock ratio more than the mean of 2.3, the estimation yields statistically insignificant coefficient estimates.

[7] Estimations using Probit model are also done, which yield very similar qualitative results.

joint venture with wholesalers, when the second and/or the third largest shareholder of the affiliate are firms classified under "wholesale and trade." The choice is between whole ownership versus joint venture with wholesalers. The expected sign of the coefficients on productivity is negative because our theory predicts that the higher the productivity of the parent firm, the more likely the firm chooses whole ownership rather than a joint venture with Japanese wholesalers (i.e., No.2 or No.3 shareholders variable taking the value 0). The estimation results are in Table 6. Except for the case of log of TFP by L.P. method (lntfplpn) for the entire sample (column 2), all the other cases show statistically significant negative signs. Finally, Table 7 shows the estimation results of the binary variable of joint ventures with local or third country investor. The expected sign for coefficient estimates is negative in this estimation also—the more productive the parent firm, the less likely the affiliate is a joint venture with local and/or third country firms. All the coefficient estimates are statistically significant with negative signs.

Table 4: Productivity and ownership shares of the largest shareholder (parent) firm

VARIABLES	(1) AllCountry_1 parent1_share	(2) AllCountry_2 parent1_share	(3) AllCountry_3 parent1_share	(4) ExcludingChina_1 parent1_share	(5) ExcludingChina_2 parent1_share	(6) ExcludingChina_3 parent1_share	(7) OECD_1 parent1_share	(8) OECD_2 parent1_share	(9) OECD_3 parent1_share
lnlp	3.872***			4.195*			3.154*		
	(0.950)			(2.001)			(1.367)		
lntfplpn		4.963***			6.159*			3.696*	
		(1.174)			(2.844)			(1.563)	
lntfpindex			2.225*			2.656+			3.560*
			(1.005)			(1.587)			(1.457)
Country-Industry fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year-Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,243	1,013	1,243	750	590	750	347	271	347
Adjusted R-squared	0.194	0.158	0.182	0.282	0.212	0.268	0.328	0.432	0.330

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 5: Productivity and whole ownership of the largest shareholder (parent) firm (binary choice model: linear)

VARIABLES	(1) AllCountry_1 wholly_owned	(2) AllCountry_2 wholly_owned	(3) AllCountry_3 wholly_owned	(4) ExcludingChina_1 wholly_owned	(5) ExcludingChina_2 wholly_owned	(6) ExcludingChina_3 wholly_owned	(7) OECD_1 wholly_owned	(8) OECD_2 wholly_owned	(9) OECD_3 wholly_owned
lnlp	0.107***			0.104***			0.0923**		
	(0.0218)			(0.0268)			(0.0329)		
lntfplpn		0.124***			0.150***			0.107*	
		(0.0270)			(0.0342)			(0.0419)	
lntfpindex			0.0770***			0.0969***			0.109**
			(0.0231)			(0.0270)			(0.0350)
Country-Industry fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year-Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,241	1,011	1,241	748	587	748	347	271	347
R-squared	0.542	0.532	0.534	0.635	0.597	0.633	0.526	0.508	0.530

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 6: Productivity and propensity to form a joint venture with Japanese wholesalers (binary choice model: linear)

VARIABLES	(1) AllCountry_1 No2orNo3ShareWhole	(2) AllCountry_2 No2orNo3ShareWhole	(3) AllCountry_3 No2orNo3ShareWhole	(4) ExcludingChina_1 No2orNo3ShareWhole	(5) ExcludingChina_2 No2orNo3ShareWhole	(6) ExcludingChina_3 No2orNo3ShareWhole	(7) OECD_1 No2orNo3ShareWhole	(8) OECD_2 No2orNo3ShareWhole	(9) OECD_3 No2orNo3ShareWhole
lnlp	-0.0422**			-0.0451**			-0.0536**		
	(0.0142)			(0.0167)			(0.0198)		
lntfplpn		-0.0269			-0.0365+			-0.0453*	
		(0.0172)			(0.0197)			(0.0229)	
lntfpindex			-0.0388*			-0.0505**			-0.0457*
			(0.0152)			(0.0167)			(0.0213)
Country-Industry fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year-Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,133	926	1,133	689	540	689	325	251	325
R-squared	0.565	0.558	0.564	0.597	0.524	0.599	0.124	0.127	0.112

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 7: Productivity and propensity to form a joint venture with local or third-country firms (binary choice model: linear)

VARIABLES	(1) AllCountry_1 WithLocalor3rdPartner	(2) AllCountry_2 WithLocalor3rdPartner	(3) AllCountry_3 WithLocalor3rdPartner	(4) ExcludingChina_1 WithLocalor3rdPartner	(5) ExcludingChina_2 WithLocalor3rdPartner	(6) ExcludingChina_3 WithLocalor3rdPartner	(7) OECD_1 WithLocalor3rdPartner	(8) OECD_2 WithLocalor3rdPartner	(9) OECD_3 WithLocalor3rdPartner
lnlp	-0.0835***			-0.0904***			-0.0867**		
	(0.0211)			(0.0269)			(0.0331)		
lntfplpn		-0.108***			-0.139***			-0.107*	
		(0.0262)			(0.0351)			(0.0426)	
lntfpindex			-0.0515*			-0.0693*			-0.0985**
			(0.0223)			(0.0273)			(0.0351)
Country-Industry fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year-Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,219	992	1,219	735	583	735	349	273	349
R-squared	0.525	0.500	0.519	0.585	0.539	0.580	0.546	0.519	0.548

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

CONCLUDING REMARKS AND DISCUSSION

The standard firm heterogeneity model of FDI considers only the case of fully-owned foreign affiliates. However, there are many examples of partially-owned foreign affiliates. This study builds a model based on Helpman et al. (2004) to allow for various ownership structures and posits some testable hypotheses on the relationship between productivity and ownership shares/structure. The empirical part corroborates these hypotheses, showing that higher productivity firms tend to have a higher ownership share in their affiliates and lower productivity firms tend to opt for joint ventures with wholesalers and/or local/3rd country partners. Our finding of less productive firms' choosing joint ventures with Japanese wholesalers or with local/third country partners suggests that very low productive firms that do not have enough productivity to invest abroad might be able to invest if the government facilitates a matching between them and wholesalers and/or local/third country firms. This study focuses on the relationship between firm productivity and ownership choice of foreign affiliates. However, other factors, such as financial constraints and protection of intellectual property might also affect ownership choice. Future studies should investigate effects of these factors on firms' ownership choice of foreign affiliates.

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