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Evidence from Japanese Firms"

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Abstract

This paper examines how differently productivity heterogeneity of firms sorts their export and foreign direct investment (FDI) between North and South as well as between single and multiple destinations. The empirical examinations based on 12,000 Japanese firm-level data present new findings; the rank of productivity differently sorts the internationalization modes between North (North America and Europe) and South (East Asia); the productivity of firms internationalizing in both North America and Europe is remarkably higher than that of firms internationalizing in either North America or Europe, regardless the modes of internationalization, export or FDI, even if the productivity of firms internationalizing in North America is similar to the productivity of firms in Europe. This paper confirms that the difference in wage rate or fixed costs causes different modes of internationalization from the standard theoretical prediction based on the Helpman-Melitz-Yeaple model.

JEL: F10, F14, F23
Keywords: productivity-cutoff, export, FDI, North, South, East Asia

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1. Introduction

There is a complex integration strategy among Japanese multinational firms exporting to or investing in the Northern and Southern countries. It is a fact that almost half of foreign direct investment (FDI) by Japanese multinationals is in North (North America and Europe) and the rest of FDI is in South (Asian countries). North America, and Europe and Asia are major destinations of Japanese export and FDI. But it is noted that the sorting of export and FDI of Japanese firms in North differs from that in Asian countries.

Theoretical and empirical studies including Melitz (2003), Helpman, Melitz and Yeaple (2004; hereafter HMY), and Helpman (2006), assuming horizontal FDI, show that productivity sorts the modes of firm's internationalization, export or FDI, under given variable and fixed costs and market size. The theoretical examinations find that firms with the lowest productivity supply for only the domestic market, firms with higher productivity export, and firms with the highest productivity switch their choice of internationalization mode from export to FDI. These findings are supported by empirical results based on U.S. industry data, which confirms that the higher the firm heterogeneity in productivity, the lower the relative share of exports to foreign production. Grossman, Helpman, and Szeidl (2006), who characterized an industry by the size of the fixed costs of maintaining foreign subsidiaries for production, the costs of transportation, and the consumer demand, derived the equilibrium organizational forms for heterogeneous firms that differ in their productivity levels[1]. In their model, firms headquartered in a northern country supply differentiated final goods to two national markets in North and South, and they present many possible organizational forms that vary among firms according to different combinations of fixed costs, transportation costs, variables costs, and the relative size of the markets.

Following the theoretical studies, we find a wealth of empirical examinations on the modes of internationalization and the firm heterogeneity of productivity have been conducted. Bernard, Redding and Schott (2006) and Bernard and Jensen (2007) show that U.S. firms with the lowest productivity supply for only domestic market, those with higher productivity export,

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[1] The theoretical analysis by Grossman, Helpman, and and Szeidl (2006) presents a pattern of internationalization modes by combining productivity, fixed costs, and transportation costs under the assumption of two heterogeneous countries, North and South.

and those with the highest productivity invest abroad. Mayer and Ottaviano (2007) provided the similar evidence for European firms. Mayer and Ottaviano show that the internationalization of Belgian firms coincides with the productivity rank predicted by the HMY model. As for Japanese firms, Head and Ries (2003) and Tomiura (2007) looked at the sorting pattern of internationalization with respect to productivity by analyzing firm-level data. These empirical investigations examined the modes of internationalization of multinationals to all countries in the world, but did neither distinctly distinguish the modes between the cases in North and South, nor distinguish the modes between the cases in a single country and multiple countries.

This paper, by using Japanese firm-level data, aims to examine whether the order of internationalization modes of Japanese multinationals is determined by productivity level and whether the modes of internationalization are consistent with the theoretical predictions, by comparing the features of firms exporting to and conducting FDI in North America and Europe with those in Asian countries. The paper also examines whether the sorting of internationalization modes caused by firm heterogeneity in productivity is observed even in multiple-country case. These investigations study how differently the relationship between the productivity and the sorting pattern of internationalization is affected by country-specific factors.

Although in the case of export and FDI in North America or Europe the results of empirical examinations support the theoretical prediction of the HMY model regarding the sorting pattern of firms' internationalization based on productivity, in the case in Asian countries, the paper finds that the sorting of internationalization modes is opposite to the case in North. This is not examined in previous studies. Furthermore, we find that the productivity of firms simultaneously internationalized in multiple regions shows a higher level, compared to the productivity of firms internationalizing in a single region. In summary, this paper presents that the other factors than productivity should not be negligible for sorting the internationalization modes.

The remainder of this paper is organized as follows: in Section 2 we present the framework for analyzing the relation between firm heterogeneity in productivity and the internationalization modes. Section 3 introduces statistical facts of the average productivity of Japanese firms corresponding to the choice of internationalization modes. Section 4 presents the

results of empirical examinations on the relationship between the mode of internationalization and productivity. It shows that the internationalization modes of Japanese firms are sharply ranked by productivity in North, but the modes are reversed in Asian countries. Section 5 conducts an alternative test to confirm the robustness of the results in section 4. Section 6 shows that even within North, the productivity of firms internationalizing in multiple regions is apparently different from that of firms in a single region and identify the factors to cause the difference in productivity-cutoff for internationalization between multiple and single regions. Section 7 concludes.

2. Basic Model

We suppose that differentiated goods are supplied to the market under the demand derived from the following CES type utility function[2],

(1) $$u = \left[\int_{l \in D} x(l)^{\alpha} dl \right]^{1/\alpha} , \quad 0 < \alpha < 1,$$

where $x(l)$ is demand for goods l, D is a set of the goods that can be purchased, and α presents a parameter to determine the elasticity of substitution between goods ε. We define $\varepsilon = 1/(1-\alpha)$ and $\varepsilon > 1$.

The demand in country j of goods l is expressed by the following equation,

(2) $$x_j(l) = \frac{p_j(l)^{-\varepsilon} Y_j}{P_j^{1-\varepsilon}},$$

where Y_j is the total expenditure of country j, $p_j(l)$ is the price of goods l, and P_j is the price index of Country j. The price index P_j is given by the following equation,

(3) $$P_j = \left[\int_{l \in D} p_j(l)^{1-\varepsilon} dl \right]^{1/(1-\varepsilon)},$$

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[2] The analytical framework of this section relies on the HMY model.

Firms produce the differentiated goods using labor as only one input factor for production.

The HMY model supposes that there are three different channels through which firms can obtain profits: the supply in home country, exports, and overseas production., and that the same production technology is used for all three channels. Their model assumes that the export channel is accompanied by both transportation costs and fixed costs, while FDI requires fixed costs, but no transportation costs. Fixed costs for exports and overseas production are expressed by f_j^X and f_j^I, respectively. The marginal cost for production in country j, C_j, is defined by $C_j = w_j a$, where a is the labor input coefficient, and w_j is the wage rate of country j. The reciprocal number of the input coefficient, $1/a$, expresses the labor productivity of the firm. In the case of export, the marginal cost for production of exported goods is rewritten as $C_j = \tau_j w_j a$ because export accompanies the transportation cost τ_j, defined as the iceberg type. We assume $\tau_j > 1$.

Under the above assumptions, the prices of the goods that firms supply in country j are expressed as follows:

$$(4) \qquad p_j(a) = \frac{C_j}{\alpha}$$

If we assume that the fixed cost for domestic production is zero, the profits of firms are expressed as follows, respectively:

In the case of supply for home market in country i,

$$(5\text{-}1) \qquad \pi_i(a) = (1 - \alpha)\left(\frac{w_i a}{\alpha P_i}\right)^{1-\varepsilon} Y_i$$

In the case of exports to country j,

$$(5\text{-}2) \qquad \pi_j^X(a) = (1 - \alpha)\left(\frac{\tau_j w_i a}{\alpha P_j}\right)^{1-\varepsilon} Y_j - f_j^X$$

In the case of oversea production in country j,

$$(5\text{-}3) \qquad \pi_j^I(a) = (1-\alpha)\left(\frac{w_j a}{\alpha P_j}\right)^{1-\varepsilon} Y_j - f_j^I$$

By denoting $\theta = a^{1-\varepsilon}$, $\dfrac{(1-\alpha)}{(\alpha P_k)^{1-\varepsilon}} Y_k = B_k$, $w_l^{1-\varepsilon} = W_l$, and $T_m = \tau_m^{1-\varepsilon}$ for k, l, $m=i, j$, equations (5-1) to (5-3) are rewritten as follows:

$$(6\text{-}1) \qquad \pi_i(\theta) = W_i B_i \theta$$

$$(6\text{-}2) \qquad \pi_j^X(\theta) = W_i T_j B_j \theta - f_j^X$$

$$(6\text{-}3) \qquad \pi_j^I(\theta) = W_j B_j \theta - f_j^I$$

where we assume $w_i > w_j$, then $W_j > W_i T_i$. From equations (6-2) and (6-3), the productivity-cutoff denoted by θ_1 which satisfies non-negative profit condition of exporting firms is defined as $\theta_1 = \dfrac{f_j^X}{W_i T_j B_j}$, and the productivity-cutoff θ_2 which satisfies non-negative profit condition for FDI firms is defined as $\theta_2 = \dfrac{f_j^I}{W_j B_j}$. The productivity-cutoff $\tilde{\theta}$ which equalizes the net profit of exporting firms to that of FDI firms is defined as $\tilde{\theta} = \dfrac{f_j^I - f_j^X}{(W_j - W_i T_j) B_j}$.

The internationalization modes of firms vary corresponding to firm's productivity under given firm-specific and country-specific factors including wage rate, transportation cost and fixed costs. By comparing the profits between $\pi_j^X(\theta)$ and $\pi_j^I(\theta)$ under the assumption that the fixed costs for FDI are larger than those for export, we can assume two cases corresponding to the differences in wage and transportation cost as follows:

(i) If $\dfrac{f_j^I}{W_j} > \dfrac{f_j^X}{W_i T_j}$, that is $\dfrac{f_j^I}{f_i^X} > \left(\dfrac{w_i \tau_j}{w_j}\right)^{\varepsilon-1}$, then $\theta_1 < \theta_2 < \tilde{\theta}$ [3]

(ii) If $\dfrac{f_j^I}{W_j} < \dfrac{f_j^X}{W_i T_j}$, that is $\dfrac{f_j^I}{f_i^X} < \left(\dfrac{w_i \tau_j}{w_j}\right)^{\varepsilon-1}$, then $\tilde{\theta} < \theta_2 < \theta_1$

The first case presents that the difference of fixed costs exceeds the difference of variable costs consisting of wage rates and transportation costs. The second case is that the difference of variable costs exceeds the difference of fixed costs. Two different productivity-cutoff, θ_2^1 and θ_2^2, are depicted in Figure 1. If the relative wage including transportation cost in home country is higher than that in host country, but is not higher than the relative fixed costs, firms with the highest productivity conducts FDI, and is followed by the exporting firm with lower productivity. However, if the relative wage in home country is higher than the relative fixed costs, the firms conduct FDI without exporting. The latter case is observed if the wage rate in the host country is significantly lower than that in the home country.

Figure 1

From the above analysis, we predict the modes of internationalization according to the productivity-cutoff as follows:

Proposition 1.

Productivity-cutoff differently orders the modes of internationalization under the different market-specific conditions as follows:

(i) If $\dfrac{f_j^I}{f_i^X} > \left(\dfrac{w_i \tau_j}{w_j}\right)^{\varepsilon-1}$ because of a small difference in wage rate between two regions, firms

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[3] $\theta_2 - \tilde{\theta} = \left(f_j^X W_j - f_j^I W_i T_i\right)/\left(W_j B_j (W_j - W_i T_i)\right)$. From $W_j > W_i T_i$, if $f_j^X W_j < f_j^I W_i T_i$, $\theta_2 < \tilde{\theta}$. As $\theta_1 < \theta_2$, $\theta_1 < \theta_2 < \tilde{\theta}$. However, if $f_j^X W_j > f_j^I W_i T_i$, $\theta_1 > \theta_2 > \tilde{\theta}$ from $\theta_2 > \tilde{\theta}$ and $\theta_1 > \theta_2$,

whose productivity θ satisfies $\dfrac{f_j^X}{B_j W_i T_j} < \theta < \dfrac{(f_j^I - f_j^X)}{B_j(W_j - W_i T_j)}$ supply for domestic market and

export, and firms whose productivity satisfies $\theta \geq \dfrac{(f_j^I - f_j^X)}{B_j(W_j - W_i T_j)}$ switch their mode of

internationalization from export to foreign production.

(ii) If $\dfrac{f_j^I}{f_i^X} < \left(\dfrac{w_i \tau_j}{w_j}\right)^{\varepsilon-1}$ because of a large gap of wage rate between two regions, firms whose

productivity θ satisfies $\dfrac{f_j^X}{B_j W_i T_j} < \theta$ supply only for domestic market and conduct foreign

production without export.

The first is a standard case of firm's internationalization corresponding to the productivity-cutoff described in Helpman, Melitz, and Yeaple (2004) and Helpman (2006). The second case, although it has attracted few researches, is noteworthy to present that the mode of internationalization is opposite to the standard case of the HMY model.

3. Modes of Internationalization: North and South

3.1 Firm Distribution

North America, Europe and East Asia are three major regions where Japanese firms export and conduct FDI. We observe the distribution of Japanese firms internationalizing in two regions: North (North America and Europe) and South (East Asia). The matrix in Table 1 shows the distribution of firms corresponding to the internationalization modes: only domestic supply, export and FDI[4] in 2005. The statistical data are based on the firm-level data of 12,000 Japanese manufacturing firms with either more than 30 million yen in capital stock or more than 50 employees from "Basic Survey of Japanese Business Structure and Activities"[5].

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[4] FDI includes not only the case of pure FDI but also both FDI and export.
[5] The analysis hereafter uses the firm-level data of "Basic Survey of Japanese Business Structure and Activities". We acknowledge Research Institute of Economy, Trade and Industry, and Statistics Department, Ministry of Economy, Trade and Industry for granting their permission to use these data.

Among Japanese firms, 62 percent (7,699 firms) have supplied only for the domestic market and entered neither North nor South; roughly only 40 percent of firms are internationalized. The percentage of internationalized firms is not small. 7 percent (873 firms) export to and 10 percent (1,190 firms) conduct FDI in only East Asia, while 2 percent of firms (201 firms) export to and 1 percent (147 firms) conduct FDI in only North. However, 6 percent of firms export both North and South, 8 percent of firms conduct FDI in both North and South. 21 percent of firms conduct FDI in East Asia and 11 percent of firms in North, in any case.

3.2 Productivity Comparison

From Proposition 1, the productivity-cutoff for export and FDI varies according to the difference in wage rate, transportation cost or other fixed costs. In order to find the difference in firms' productivity, here we calculate standard total factor productivity (TFP) of firms based on the firm-level data in 2005. In order to calculate TFP, we use the Cobb-Douglas type production function under the method of Olley and Pakes (1998)[6].

Firstly, we depict the productivity distributions of Japanese internationalizing frims in North and South separately for three types: only domestic supply, export to and FDI in North and South. As Figure 2 presents, the productivity distributions of Japanese exporters and FDI firms in North America and Europe are distinctly different. However, as Figure 3 shows, it is noted that the productivity distributions of Japanese exporters and FDI firms in East Asia almost are overlapped. The latter case is different from the prediction of HMY model although the former case is consistent with the prediction of HMY model.

It is possible to observe the average productivity of firms corresponding to each mode although it is not easy to directly observe the productivity-cutoff corresponding to each mode of internationalization. Here, we calculate the average productivity of firms corresponding to each

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[6] The calculation of TFP is based on Wakasugi et al. (2008).

mode of internationalization. Table 2 shows the statistics of average TFP of the firms corresponding to each mode of internationalization. From Table 2, we find the interesting statistical facts as follows:

(i) The productivity of internationalizing firms exceeds the productivity of firms supplying only for domestic market.

(ii) The productivity of firms conducting FDI in North exceeds the productivity of exporters to North.

(iii) The productivity of firms conducting FDI in South is lower than the productivity of exporters to South.

Table2

The observations (i) and (ii) provide a statistical evidence that the internationalization of Japanese firms in North America and Europe is consistent with the HMY model if the rank of average productivity is assumed to reflect the ranking of productivity-cutoff.

However, the observation (iii) is different. In average of TFP, firms exporting to and conducting FDI in North are ranked according to the productivity level, but those in South are oppositely ranked. Two different features of productivity distribution suggest that the careful handling of region-specific factors including wage, transportation costs, market size, and fixed costs is important for sorting the internationalization modes by productivity. In fact, the wage rate of East Asia is lower than Japan, although it is not much different among North America, Europe and Japan. Nevertheless, little attention has been given to them so far in the HMY model. We find few empirical examinations controlling for the dispersion of these variables among different regions since it is not easy to incorporate a variety of variable costs, fixed costs and market size in empirical studies of the sorting of internationalization modes.

4. Empirical Test for Internationalization in North and South

4.1 Estimation Method

The purpose of this section is to investigate statistically (i) whether the difference in firm-level productivity matches with the order of internationalization modes, and (ii) whether the relation

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between productivity and the modes of internationalization supports the theoretical prediction of the HMY model after controlling for firm- and industry-specific factors.

Estimation is based on the following equation:

$$
(7) \quad \ln TFP_i = \alpha + \sum_{s=1}^{8} \beta_s D_{i,s} + \gamma_1 \ln(K_i / L_i) + \gamma_2 \ln(SL_i / L_i)
$$
$$
+ \gamma_3 \ln(Age_i) + \sum_m \delta_m H_{i,m} + \varepsilon_i
$$
$$
s = 1, 2 \cdots, 8, \quad m = 1, \cdots, n
$$

The dependent variable, $\ln TFP_i$ is the logarithm of firm i's TFP, which is defined by $TFP_i = \dfrac{Y_i}{K_i^{\alpha} L_i^{\beta}}$, and $D_{i,s}$ presents a dummy variable indicating the following internationalization modes:

(i) $D_{i,1} = 1$, $D_{i,s} = 0$ *for* $s \neq 1$, for the case of export only to North

(ii) $D_{i,2} = 1$, $D_{i,s} = 0$ *for* $s \neq 2$, for the case of export only to South

(iii) $D_{i,3} = 1$, $D_{i,s} = 0$ *for* $s \neq 3$, for the case of export to both North and South

(iv) $D_{i,4} = 1$, $D_{i,s} = 0$ *for* $s \neq 4$, for the case of local production only in North

(v) $D_{i,5} = 1$, $D_{i,s} = 0$ *for* $s \neq 5$, for the case of local production only in South

(vi) $D_{i,6} = 1$, $D_{i,s} = 0$ *for* $s \neq 6$, for the case of local production in North and export to South

(vii) $D_{i,7} = 1$, $D_{i,s} = 0$ *for* $s \neq 7$, for the case of local production in South and export to North

(viii) $D_{i,8} = 1$, $D_{i,s} = 0$ *for* $s \neq 8$, for the case of local production in both North and South.

K_i / L_i is the capital labor ratio, SL_i / L_i is the ratio of skilled workers to total workers, Age_i is the operating period of the firm. These variables control for firm-specific factors other than productivity[7]. $H_{i,m}$ is the dummy variable of industry m to which firm i belongs, α is the constant term, and ε_i is the error term.

The coefficient of each dummy variable β presents the degree to which the

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[7] The inclusion of these variables to control for firm-specific factors is observed in previous studies, For example, see Aw and Lee (2008).

productivity of internationalizing firms exceeds the productivity of firms only supplying for domestic market. The estimation is conducted by the ordinary least square method (OLS). The estimation is conducted on firm-level data maintained by the Ministry of Economy, Trade and Industry on 12,000 Japanese manufacturing firms: "Basic Survey of Japanese Business Structure and Activities" in 2001 and 2005. TFP, the dependent variable, is calculated by the method of Olley and Pakes (1998).

4.2 Estimated Results

Table 3 shows the estimated results. Every estimated coefficient for each mode of internationalization presents a high statistical significance with one percent. They are summarized by the following:

(i) Both the productivity of firms with exports to either North or South and the productivity of firms with FDI in either North or South are significantly higher than the productivity of firms supplying for only the domestic market, and the productivity of firms with FDI in both North and South is significantly higher than the productivity of firms that export to both regions.

(ii) Although the productivity of firms with FDI in North is higher than the productivity of firms with export to North, the productivity of firms with FDI in South is lower than the productivity of firms with export to South.

(iii) The productivity of firms internationalizing in both regions, North and South, is higher than the productivity of firms internationalizing in only one region, either North or South, regardless the modes of internationalization, export or FDI.

These results completely are consistent with the average TFP corresponding to each internationalization mode.

Table 3

5. Alternative Test

In order to confirm the robustness of the estimated results in the previous section, we conduct an alternative test to investigate the relationship between the modes of internationalization and the productivity, based on Multinomial Logit model. Here, we examine

whether the rank of productivity level coincides with the choice of modes of internationalization in North, and is reversal in South. According to the potential choice of internationalization modes expressed in Table 1, we categorize the internationalization modes as follows:

(i) the case of only domestic supply; (ii) the case of export only to North; (iii) the case of export only to South; (iv) the case of export to both North and South; (v) the case of local production with FDI only in North; (vi) the case of local production only in South; (vii) the case of export to South and local production in North; (viii) the case of export to North and local production in South; and (ix) the case of local production in both North and South. We assume that the firm chooses the optimal mode of internationalization among the potential choices so as to maximize its profit, ceteris paribus. That is, the actual choice of internationalization mode by firm is observed from the statistical data as a result of profit-maximizing strategy of the firm.

We assume that the profit of firm i choosing the mode s π_{is} is expressed by the following equation.

(8) $$\pi_{i,s} = \alpha_{0,s} + \sum_{j} \beta_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s} + \varepsilon_{i,s}, \quad s = 1,2,\cdots,9, \quad m = 1,2,\cdots,n$$

where $\pi_{i,s}$ is the profit of firm i under the internationalization strategy s, and α_0 is the constant term. $Z_{i,j,s}$ present firm-specific factors that affect the choice of internationalization modes. As for firm-specific factors we use the capital-labor ratio, skilled labor intensity, and the operating terms of firm. $\beta_{j,s}$ is the parameter corresponding to each variable; $H_{i,m}$ is a dummy variable indicating the industry m to which firm i belongs; δ_m is the parameter indicating the degree to which industrial characteristics affect the choice of internationalization mode; and $\varepsilon_{i,s}$ is an error term.

If we assume that the error terms in equation (8) conform to the Weibull distribution, the probability of the choice of internationalization modes is expressed by Multinomial Logit model. Consequently, the probability that firm i chooses internationalization strategy s is expressed as follows:

$$(9) \qquad P_i^s = \frac{\exp\left[\alpha_{0,s} + \sum_j \beta_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s}\right]}{\sum_{s=1}^{9} \exp\left[\alpha_{0,s} + \sum_j \beta_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s}\right]}$$

When we assume zero profit for the firm that supplies only for the domestic market, the probability of firm i choosing internationalization mode s is rewritten as follows:

$$(10) \qquad P_i^s = \frac{\exp\left[\tilde{\alpha}_{0,s} + \sum_j \tilde{\beta}_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \tilde{\delta}_{m,s} H_{i,m,s}\right]}{1 + \sum_{s=1}^{8} \exp\left[\tilde{\alpha}_{0,s} + \sum_j \tilde{\beta}_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \tilde{\delta}_{m,s} H_{i,m,s}\right]}$$

Table 4 presents the estimated results showing:

(i) TFP significantly affects the probability of choosing every mode of internationalization;

(ii) The estimated coefficient for FDI in North is higher than that for export to North, which completely supports the theoretical prediction of the HMY model and is consistent with the results shown in Table 2 and Table 3;

(iii) The estimated coefficient for FDI in South however is lower than that for export to South, which presents the reversal case of the HMY model mentioned as the second case of Proposition 1, is actually observed in East Asia, and is also consistent with the results shown in Table 2 and Table 3;

(iv) The coefficient of TFP corresponding to export to both regions is higher than that for export to a single region, and the coefficient of TFP corresponding to FDI in both regions is also higher than that in a single region.

Table 4

The disaggregation of the productivity distributions of firms with export and FDI by the destinations, East Asia and Northern regions, presents that the productivity distributions of

Japanese exporters and FDI firms in South are not distinctly sorted, in comparison with those in North. This is contrast to the European exporters and FDI firms whose productivity distributions are distinctly different. The internationalization of European firms coincides with the rank of productivity as predicted by the HMY model[8].

6. Internationalization in Multiple Regions

6.1 A Model

From the estimation results in the previous section, we observe that productivity of firms internationalizing in multiple regions is always higher than that of firms internationalizing in single region regardless the modes of internationalization. Aw and Lee (2008) presents this in their empirical examination of the internationalization of Taiwanese firms to US and China. However, as mentioned in the previous section of this paper, we have to note that North and South should be disaggregated for the estimation of relationship between firm's productivity and the modes of internationalization. Two different features of productivity distribution of Japanese internationalizing firms in North and South suggest that the careful handling of region-specific factors including wage, transportation costs, market size, and fixed costs is important for sorting the internationalization modes by productivity.[9]. Wakasugi and Tanaka (2009) examined the choice of export and FDI of Japanese firms in North America and Europe. This section is purposed to examine further this issue based on our previous study.

Here, we twist the model in Section 2 to investigate what internationalization modes in two regions the firms choose corresponding to their productivity. Let us assume that firms exporting to or conducting FDI in two foreign markets, region 1 and region 2. The profits of firms expressed by equations (6-1)-(6-3) are rewritten as follows:

In the case of supply in home market,

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[8] Refer to Mayer and Ottaviano (2007).

[9] Aw and Lee (2008) look at Taiwanese firms that internationalize in two different regions: the U.S. and China. Their findings suggest that the productivity of firms investing in China is higher than an exporter's productivity, the productivity of firms investing in North America is higher than that for firms investing in China, and the productivity of firms internationalizing to both countries is the highest. But their examination is based on only a small number of firms in limited industries. Their analysis, as based on the countries among which the variable costs, transportation costs and fixed costs vary, is not clear when it comes to identifying what factors actually affect the relationship between productivity and the sorting pattern of internationalization.

(11-1) $\quad \pi^D(\theta) = W_i B_i \theta$

In the case of export to two regions,

(11-2) $\quad \pi_1^X(\theta) + \pi_2^X(\theta) = W_i(T_1 B_1 + T_2 B_2)\theta - f_{1+2}{}^X$

In the case of FDI in two regions,

(11-3) $\quad \pi_1^I(\theta) + \pi_2^I(\theta) = (W_1 B_1 + W_2 B_2)\theta - f_{1+2}{}^I$

where f_{1+2}^X and f_{1+2}^I are the fixed costs of firms with export to and FDI in both region 1 and 2. For the case in which firms export to or conduct FDI in both regions, we induce the following proposition on the modes of internationalization sorted by the productivity-cutoff by comparing the profits between $\pi_1^X(\theta) + \pi_2^X(\theta)$ and $\pi_1^I(\theta) + \pi_2^I(\theta)$.

Proposition 2.

Productivity-cutoff orders the modes of internationalization in multiple regions as follows:

If $\quad \dfrac{f_{1+2}^X}{W_i(T_1 B_1 + T_2 B_2)} < \theta < \dfrac{(f_{1+2}^I - f_{1+2}^X)}{[(W_1 - W_i T_1)B_1 + (W_2 - W_i T_2)B_2]}$, *firms with the productivity*

θ *supply for domestic market and export to both regions.*

If $\quad \theta \geq \dfrac{(f_{1+2}^I - f_{1+2}^X)}{[(W_1 - W_i T_1)B_1 + (W_2 - W_i T_2)B_2]}$, *firms with the productivity* θ *switch their mode*

of internationalization from export to foreign production.

6.2 Productivity Distribution of Firms in North America and Europe

For the analysis of the relationship between productivity of Japanese firms and their internationalization modes in multiple regions, we concentrate North America and Europe. This is to avoid the noisy effects caused by the different variable costs among regions. The matrix in Table 5 shows the distribution of firms corresponding to the internationalization modes: only

domestic supply, export and FDI in 2005[10]. The statistical data are based on the firm-level data of 12,000 Japanese manufacturing firms from "Basic Survey of Japanese Business Structure and Activities"

Table 5

Among Japanese firms, 78 percent (9,762 firms) have entered neither North America nor Europe; roughly only 20 percent of firms are internationalized in North America or Europe. The percentage of internationalized firms is not large. 10 percent (1,204 firms) of firms export to and 10 percent (1,216 firms) conduct FDI in North America, while the figures for firms with exports to and FDI in Europe are 10 percent (1,302 firms) and 6 percent (669 firms), respectively. Moreover, it is notable that 6 percent (748 firms) of firms export to both regions and 5 percent (591 firms) conduct FDI in both regions.

6.3 Comparison of Productivity

.Figure 4 that presents the statistics of average TFP of the firms corresponding to each mode of internationalization in Table 5[11] shows interesting statistical facts as follows:

(i)   The productivity of internationalizing firms always exceeds the productivity of domestic firms.

(ii)   The productivity is almost equal between firms exporting to North America and those exporting to Europe.

(iii)   The productivity of firms exporting to both regions is far higher than that of firms exporting to either one of two regions.

(iv)   The productivity of firms with FDI in both regions is far higher than that of firms with FDI in either one of two regions, but not both.

Figure 4

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[10] As the same as the previous section, FDI includes not only the case of pure FDI but also both FDI and exports.
[11] By using the method of Olley and Pakes (1998), we estimate the total factor productivity (TFP) under the Cobb-Douglas type production function.

The observations (i) and (ii) provide a statistical evidence that the internationalization of Japanese firms in North America and Europe is consistent with the HMY model if the rank of average productivity is assumed to reflect the ranking of productivity-cutoff. However, (iii) and (iv) are not well explained by the standard HMY model, if it is assumed that North America and Europe are identical regions in variable and fixed costs for internationalization of Japanese firms.

6.4 Empirical Test of Internationalization Modes in Multiple Regions

In this section, we investigate whether the productivity-cutoff orders the modes of internationalization with a statistical significance after controlling for firm-specific and industry-specific factors. Estimation is based on the same equation as equation (7):

(12)
$$\ln TFP_i = \alpha + \sum_{s=1}^{8} \beta_s D_{i,s} + \gamma_1 \ln(K_i / L_i) + \gamma_2 \ln(SL_i / L_i)$$
$$+ \gamma \ln(Age_i) + \sum_m \delta_m H_{i,m} + \varepsilon_i$$
$$s = 1, 2 \cdots, 8, \quad m = 1, \cdots, n$$

The dependent variable, $\ln TFP_i$ is the logarithm of firm i's TFP, which is defined by

$TFP_i = \dfrac{Y_i}{K_i^\alpha L_i^\beta}$, and D_{is} presents a dummy variable indicating the following

internationalization modes:

(i) $D_{i,1} = 1$, $D_{i,s} = 0$ *for* $s \neq 1$, for the case of export only to North America

(ii) $D_{i,2} = 1$, $D_{i,s} = 0$ *for* $s \neq 2$, for the case of export only to the Europe

(iii) $D_{i,3} = 1$, $D_{i,s} = 0$ *for* $s \neq 3$, for the case of export to only both North America and Europe

(iv) $D_{i,4} = 1$, $D_{i,s} = 0$ *for* $s \neq 4$, for the case of local production only in North America

(v) $D_{i,5} = 1$, $D_{i,s} = 0$ *for* $s \neq 5$, for the case of local production only in Europe

(vi) $D_{i,6} = 1$, $D_{i,s} = 0$ *for* $s \neq 6$, for the case of local production in only North America and export to only Europe

(vii) $D_{i,7} = 1$, $D_{i,s} = 0$ for $s \neq 7$, for the case of local production in only Europe and export to only North America

(viii) $D_{i,8} = 1$, $D_{i,s} = 0$ for $s \neq 8$, for the case of local production in only both North America and Europe.

K_i / L_i is the capital labor ratio, SL_i / L_i is the ratio of skilled workers to total workers, Age_i is the firm's period of operation. These variables control for firm-specific factors other than productivity[12]. $H_{i,m}$ is the dummy variable of industry m to which firm i belongs, α is the constant term, and ε_i is the error term.

6.5 Estimated Results

The estimation is conducted by OLS methods on firm-level data maintained by the Ministry of Economy, Trade and Industry on 12000 Japanese manufacturing firms: "Basic Survey of Japanese Business Structure and Activities" in 2001 and 2005. Table 6 shows that every estimated coefficient for each dummy variable presents a high statistical significance of one percent. They are summarized by the following:

(i) Both the productivity of firms with exports to either North America or Europe and the productivity of firms with FDI in either North America or Europe are significantly higher than the productivity of firms supplying for only the domestic market.

(ii) The productivity of firms with FDI is higher than the productivity of firms with exporting.

(iii) The productivity of firms internationalizing in both North America and Europe is higher than the productivity of firms internationalizing in either North America or Europe, regardless of the modes of internationalization, export or FDI.

(iv) The productivity of firms with FDI in both North America and Europe is significantly higher than the productivity of firms that export to both regions.

Table 6

The estimated results clearly present that the modes of internationalization of Japanese

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[12] The inclusion of the variables to control for firm-specific factors is also seen in previous studies, i.e., Aw and Lee (2008).

firms are ordered by the productivity from only domestic supply to export to North America or Europe, export to both North America and Europe, and to FDI in both North America and Europe.

Based on the estimated results, we further statistically test whether the productivity of firms internationalizing to North America significantly differs from the productivity of firms internationalizing to Europe. Table 7 shows the difference in two coefficients between North America and Europe in export and FDI, and its standard error, for the estimation in 2001.

Table 7

From the statistical test, we conclude that (i) there is no significant difference in productivity between firms with export to North America and firms with export to Europe; (ii) There is no significant difference in the productivity between firms with FDI in North America and firms with FDI in Europe. (i) and (ii) express that the productivity of firms internationalizing in North America is not different from the productivity of firms internationalizing in Europe.

These statistical analyses present that region 1 and region 2 are identical for exporters and FDI firms. In other words, it is assumed that $W_1 = W_2$, $T_1 = T_2$, $B_1 = B_2$, $f_1^X = f_2^X$, and $f_1^I = f_2^I$ in equations (11-2) and (11-3). Under this assumption, the model for internationalization of firms in two regions expressed by equations (11-1)-(11-3) is same as the model expressed by (6-1)-(6-3). Then, the internationalization modes of firms in multiple regions according to productivity-cutoff are thought to be identical to those in a single region. However, we find that (iii) there is a significant difference in productivity between firms that export to two regions and firms that export to only one region, either North America or Europe; and (iv) there also exists a significant difference in productivity between firms with FDI in two regions and firms with FDI in only one region, either North America or Europe.

6. 6 Alternative Test

In order to confirm the robustness of the estimated results of equation (12), we conduct an alternative test to investigate the relationship between the modes of internationalization and

productivity, based on Multinomial Logit model. Based on the same method in section 5, we examine whether the order of productivity level coincides with the choice of modes of internationalization to North America and Europe.

We assume that the profit of firm *i*, $\pi_{i,s}$ is expressed by the following equation.

(13) $$\pi_{i,s} = \alpha_{0,s} + \sum_{j} \beta_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s} + \varepsilon_{i,s}, \quad s = 1,2,\cdots,9, \quad m = 1,2,\cdots,n$$

where all variables are same as those in equation (8).

The internationalization modes which firms choose are categorized as follows: (i) the case of only domestic supply; (ii) the case of export only to North America; (iii) the case of export only to the Europe; (iv) the case of export to both North America and Europe; (v) the case of local production with FDI only in North America; (vi) the case of local production only in Europe; (vii) the case of export to Europe and local production in North America; (viii) the case of export to North America and local production in Europe; and (ix) the case of local production in both North America and Europe. We assume that the firm chooses the optimal mode of internationalization among the potential choices so as to maximize its profit, ceteris paribus. That is, the actual choice of internationalization mode by firm is observed from the statistical data as a result of profit-maximizing strategy of the firm.

We also assume that the error terms in equation (13) conform to the Weibull distribution. The probability of the choice of internationalization modes is expressed by a Multinomial Logit model. The estimation is based on the data of 12,000 Japanese manufacturing firms exporting to or conducting FDI in North America or Europe maintained by the Ministry of Economy, Trade and Industry "Basic Survey of Japanese Business Structure and Activities" in 2005.

Table 8.

Table 8 presents the estimated results as follows:
(i) TFP significantly determines the choice of internationalization modes;

(ii) The estimated coefficient for FDI is higher than that for export, which completely supports the theoretical prediction of the HMY model and is consistent with the estimated of equation (12);

(iii) The coefficient of TFP of firms exporting to both regions is higher than that for firms exporting to a single region, and the coefficient of TFP conducting FDI in both regions is also higher than that in a single region.

All the estimated results on the relationship between productivity and the choice of modes of internationalization under a Multinomial Logit model are consistent with the estimated results expressed in Table 6. Our alternative test supports completely the results of estimation of equation (12).

6.7 Discussion

In spite of the symmetrical features between North America and Europe for Japanese internationalizing firms, we however observe that the productivity of firms internationalizing to both regions is significantly higher than the productivity of firms internationalizing to only one region. This fact is a puzzle to which little attention has been given in previous research. In this section, we discuss why the productivity of firms with internationalization in two regions exceeds the productivity of firms in one region.

The estimated results expressed in Table 6 and Table 7 suggest that the assumptions of $f_{1+2}^X = f_1^X + f_2^X$ and $f_{1+2}^I = f_1^I + f_2^I$ are not applicable to the internationalization modes of Japanese firms in both North America and Europe.

From the estimated results in the previous section, it is assumed that the fixed costs denominated by market size and transportation costs increase more proportionately than the increase in number of export destinations as follows:

$$(14) \qquad \frac{f_{1+2}^X}{T_1 B_1 + T_2 B_2} > \frac{f_1^X}{T_1 B_1} \quad \text{and} \quad \frac{f_{1+2}^X}{T_1 B_1 + T_2 B_2} > \frac{f_2^X}{T_2 B_2}.$$

It is also assumed that the productivity of firms exporting to North America is almost equal to the productivity of firms exporting to Europe. That is;

$$(15) \qquad \frac{f_1^X}{T_1 B_1} = \frac{f_2^X}{T_2 B_2}$$

From (14) and (15), we obtain $f_{1+2}^X > f_1^X + f_2^X$. This means that if the productivity-cutoff for export is identical between North America and Europe, the difference in fixed costs between f_{1+2}^X and $(f_1^X + f_2^X)$ is crucial in determining the difference in productivity-cutoff between firms with export to single and multiple regions. In other words, it is predicted that the fixed costs for exporting to both regions increase disproportionately larger than the sum of the fixed costs for exporting to either region.

For the case of FDI, also by applying the estimated results in Table 6 and Table 7 to the difference in productivity-cutoff for FDI between both regions and one region, we find that the fixed costs denominated by market size and transportation costs increase with an increase in number of FDI regions as follows:

$$(16) \qquad \frac{(f_{1+2}^I - f_{1+2}^X)}{[B_1(W_1 - W_i T_1) + B_2(W_2 - W_i T_2)]} > \frac{f_1^I - f_1^X}{B_1(W_1 - W_i T_1)}$$

and $\quad \dfrac{(f_{1+2}^I - f_{1+2}^X)}{[(W_1 - W_i T_1)B_1 + B_2(W_2 - W_i T_2)]} > \dfrac{f_2^I - f_2^X}{B_2(W_2 - W_i T_2)}$

From the estimated results in Table 6 and Table 7, it is assumed that the productivity of FDI firms in North America is almost identical to the productivity of FDI firms in to Europe as follows:

$$(17) \qquad \frac{f_1^I - f_1^X}{B_1(W_1 - W_i T_1)} = \frac{f_2^I - f_2^X}{B_2(W_2 - W_i T_2)}$$

From (16) and (17), we obtain $(f_{1+2}^I - f_{1+2}^X) > (f_1^I - f_1^X) + (f_2^I - f_2^X)$. That is, if the productivity-cutoff for FDI is identical between North America and Europe, the difference in

fixed costs between $(f_{1+2}^I - f_{1+2}^X)$ and $(f_1^I - f_1^X) + (f_2^I - f_2^X)$ is crucial in determining the difference in productivity-cutoff between firms with FDI in single and two regions. This implies that the fixed costs for FDI in both regions increase disproportionately larger than the fixed costs for FDI in either region.

Such a diseconomy of regional extension to the fixed costs will be caused by several factors. A higher cost to coordinate the exporters to multiple markets or the foreign subsidiaries in multiple regions is thought as a reason to cause such a disproportional increase of fixed costs with the increase of number of regions.

7. Conclusion

Difference in wage rate between home and host countries or fixed costs for operations causes different internationalization modes from the theoretical prediction of the HMY model. This paper examines statistically how differently the modes of internationalization of Japanese firms according to the productivity are ordered by different wage rate in East Asia and how differently they are ordered in multiple regions in North America and Europe from the theoretical prediction of the HMY model.

The results of the empirical analysis based on the firm-level data of 12,000 Japanese firms show that in North the mode of internationalization shifts from domestic supply to export, and from export to FDI, as the productivity of firms rises. This completely coincides with the theoretical prediction of the HMY model. However, it is predictable that firms conduct FDI without export if the wage rate is largely different between Japan and host countries. Our statistical examinations find that the productivity of firms conducting FDI is lower than exporting firms in East Asia.

It is also predictable that the productivity of firms internationalizing in multiple regions is higher than that of firms internationalizing in a single region if fixed costs for operation increase with an increase of number of destinations. Our empirical analysis shows that the productivity of Japanese firms internationalizing in both North America and Europe is higher than that of firms internationalizing in either North America or Europe, regardless the modes of internationalization, export or FDI. Our examination concludes that the increasing fixed costs with the number of destinations are a factor to cause the difference in productivity-cutoff

between two cases.

This paper confirms that the difference in wage rate or fixed costs causes different internationalization modes of firms from the standard theoretical prediction based on the Helpman-Melitz-Yeaple model.

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Table 1. Internationalization Modes and Distribution of Japanese Firms, 2005

		North America & Europe				
		Domestic	Export	Export & FDI	FDI	Total
Asia	Domestic	7699	201	62	85	8047
		(0.62)	(0.02)	(0.00)	(0.01)	(0.64)
	Export	873	764	163	18	1818
		(0.07)	(0.06)	(0.01)	(0.00)	(0.15)
	Export & FDI	655	431	815	45	1946
		(0.05)	(0.03)	(0.07)	(0.00)	(0.16)
	FDI	535	22	21	115	693
		(0.04)	(0.00)	(0.00)	(0.01)	(0.06)
	Total	9762	1418	1061	263	12504
		(0.78)	(0.11)	(0.08)	(0.02)	(100.00)

Figures in parentheses present percent.

Table 2. Average Productivity of Japanese Internationalizing Firms

	Domestic	Export	FDI
North America & Europe	8.83	10.07	11.89
East Asia		10.98	10.50

Table 3. Estimation: Productivity and the Modes of Internationalization

	Dependent variable: log of TFP for 2001		Dependent variable: log of TFP for 2005	
Dummy variables for				
Export to only North	0.116	***	0.112	**
	[0.029]		[0.038]	
Export to only South	0.059	***	0.132	***
	[0.016]		[0.020]	
Export to both North and South	0.173	***	0.236	***
	[0.017]		[0.022]	
FDI in only North	0.200	***	0.222	***
	[0.033]		[0.045]	
FDI in North and Export to South	0.232	***	0.280	***
	[0.030]		[0.041]	
FDI in only South	0.045	***	0.117	***
	[0.015]		[0.017]	
Export to North. & FDI in South	0.123	***	0.267	***
	[0.024]		[0.027]	
FDI in both North & South	0.380	***	0.413	***
	[0.016]		[0.019]	
Log (K/L)	-0.070	***	-0.051	***
	[0.005]		[0.003]	
Log (Skilled L/L)	0.071	***	0.089	***
	[0.005]		[0.006]	
Log (age)	-0.057	***	-0.120	***
	[0.007]		[0.008]	
Constant	2.147	***	2.147	***
	2.149		[0.057]	
Observations	12744		12283	
Adj R-squared	0.166		0.258	

RobN.A.t standard errors in brackets. IndN.A.try dummies are suppressed.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Choice of Internationalization Modes and Productivity, 2005

Explanatory variables	Export to only North	Export to only South	Export to both North and South	FDI in only North	FDI in only South	FDI in North and Export to South	Export to North. & FDI in South	FDI in both North & South
Log (TFP(-1))	0.563 ***	0.358 ***	0.784 ***	0.857 ***	0.315 ***	0.839 ***	0.880 ***	1.435 ***
	[0.151]	[0.075]	[0.081]	[0.176]	[0.066]	[0.156]	[0.101]	[0.077]
Log (K / L(-1))	0.189 ***	0.087 ***	0.153 ***	0.204 ***	0.167 ***	0.358 ***	0.397 ***	0.664 ***
	[0.095]	[0.026]	[0.029]	[0.060]	[0.024]	[0.062]	[0.041]	[0.033]
Log (Skilled L / L(-1))	0.182 *	0.238	0.469 ***	0.132	0.196 ***	0.620	0.431 ***	0.584 ***
	[0.094]	[0.049]	[0.054]	[0.107]	[0.042	[0.109]	[0.068]	[0.051]
Industry dummy	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-26.836 ***	-3.543 ***	-3.811 ***	-4.836 ***	-27.583 ***	-27.589 ***	-27.273 ***	-6.902 ***
	[0.830]	[0.618]	[0.627]	[0.746]	[1.112]	[1.112]	[1.200]	[1.037]
Observations	11279							
Pseudo R-squared	0.107							

Standard errors in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%
Notes: Industry dummies are suppressed.
Both-Domestic is the base outcome.

Table 5. Distribution of Japanese Internationalizing Firms in North America and Europe, 2005

		North America			
		Domestic	Export	FDI	Total
EU	Domestic	9762	392	349	10503
		(78.07)	(3.13)	(2.79)	(84.00)
	Export	278	748	276	1302
		(2.22)	(5.98)	(2.21)	(10.41)
	FDI	44	64	591	699
		(0.35)	(0.51)	(4.73)	(5.59)
	Total	10084	1204	1216	12504
		(80.65)	(9.63)	(9.72)	(100.00)

Figures in parentheses present percent.

Table 6. Estimation: Internationalization Modes in Multiple Regions

| | Dependent variable: log of TFP | |
	2001	2005
Dummy variables for		
Export to only N.A.	0.090 ***	0.163 ***
	[0.023]	[0.028]
Export to only EU	0.111 ***	0.140 ***
	[0.026]	[0.033]
Export to both N.A. & EU	0.183 ***	0.234 ***
	[[0.017]	0.022]
FDI in only N.A.	0.213 ***	0.204 ***
	[0.026]	[0.030]
FDI in N.A. and Export to EU	0.227 ***	0.252 ***
	[0.027]	[0.034]
FDI in only EU	0.241 ***	0.227 ***
	[0.065]	0.082]
Export to N.A. & FDI in EU	0.121 *	0.226 ***
	[0.063]	[0.068]
FDI in both N.A. & EU	0.454 ***	0.486 ***
	[0.019]	[0.024]
Log (K/L)	-0.071 ***	-0.051 ***
	[0.003]	[0.003
Log (Skilled L/L)	0.072 ***	0.093
	[0.005]	[0.006]
Log (age)	-0.056 ***	-0.117
	[0.065]	[0.008]
Industry dummy	yes	yes
Constant	2.166	2.163 ***
	[0.044]	[0.057]
Observations	12744	12283
R-squared	0.170	0.0.256

RobN.A.t standard errors in brackets. IndN.A.try dummies are suppressed.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Difference in Coefficients

| Modes of Internationalization	Difference in TFP		S.E.
EX(NA) vs. EX(EU)	0.021		0.034
FDI(NA) vs.FDI(EU)	0.028		0.069
EX-Both vs. Ex-One			
NA	0.093	***	0.028
EU	0.072	**	0.031
FDI-Both vs. FDI-One			
NA	0.241	***	0.030
EU	0.213	***	0.067
FDI-EU・EX-NA vs. FDI-NA・EX-EU	0.106		0.068
FDI-Both vs. FDI-EU・EX-NA	0.333	***	0.065
FDI-Both vs. FDI-NA・EX-EU	0.227	***	0.032

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8. Choice of Internationalization Modes in Multiple Regions, 2005

|	Export & FDI for Europe & North America							
	NX	XN	XX	NI	IN	XI	IX	II
Log (TFP(-1))	0.621 ***	0.594 ***	0.795 ***	0.727 ***	1.057 ***	0.924 ***	1.057 ***	1.619 ***
	[0.108]	[0.127]	[0.090	[0.118]	[0.332]	[0.124]	[0.332]	[0.94]
Log(K / L)(-1)	0.150 ***	0.129 **	0.255 ***	0.321 ***	0.050	0.454 ***	0.374 ***	0.781 ***
	[0.039]	[0.045]	[0.031]	[0.045]	[0.102]	[0.053]	[0.105]	[0.043]
Log (Skilled L / L)(-1)	0.269 ***	0.343 ***	0.412 ***	0.321 ***	0.341	0.456 ***	0.929 ***	0.564 ***
	[0.070]	[0.083]	[0.054]	[0.075]	[0.210]	[0.084]	[0.199]	[0.063]
Industry dummy	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-5.260 ***	-5.002 ***	-5.414 ***	-4.253 ***	-28.645 ***	-27.979 ***	-29.688 ***	-28.775 ***
	[1.045]	[1.060]	[1.029]	[0.598]	[1.424]	[0.796]	[1.302]	[0.768]
Observations	11279							
Pseudo R-squared	0.125							

Standard errors in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%
Notes: Industry dummies are suppressed.
XX indicates the case for export to North Amerina and export to Europe. NN is the base outcome.

Figure 1. Productivity-cutoff and the Modes of Internationalization

Net Profit,
Fixed Costs

Domestic supply

FDI (case ii)

FDI(case i)

Export

θ_2^2

0

θ_1

θ_2^1

$\tilde{\theta}$

f_j^X

f_j^I
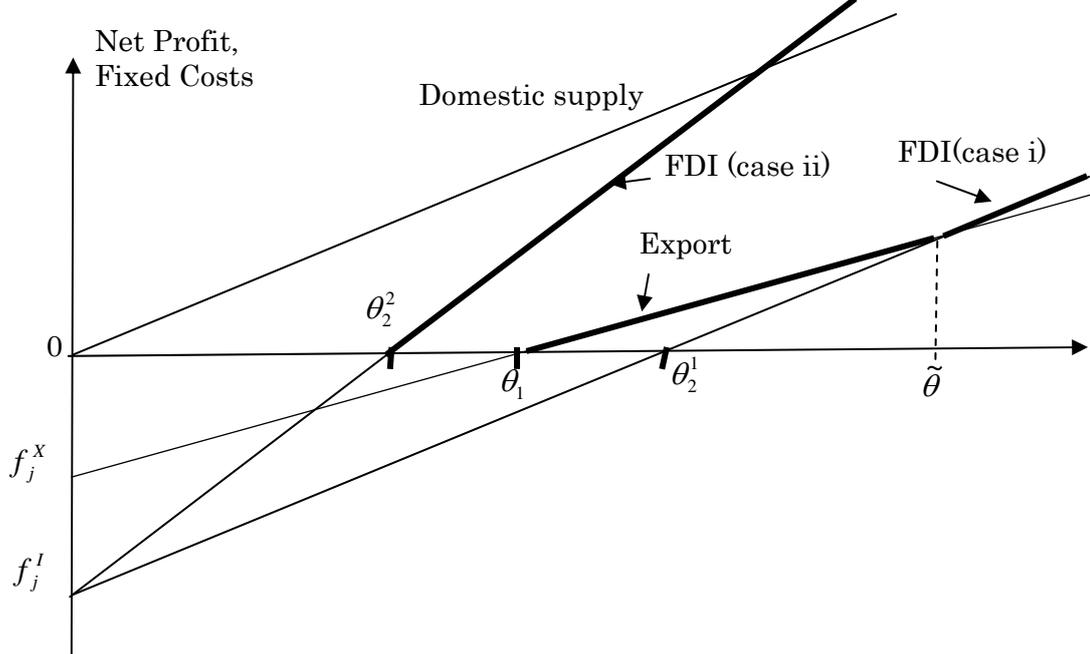
(Note) Case i shows the small difference in wage rate between home and host countries. Case ii shows the large difference.

Figure 2. Productivity distribution of Japanese exporters and FDI firms: North America and Europe

Producivity distribution of Japanese FDI firms and exporters (TFP)
North America & Europe, 2005

Density

.8
.6
.4
.2
0

———— Domestic firms
- - - - Pure exporters
·········· FDI firms

0   1   2   3   4   5
Log of Total Factor Productivity

Note: TFP is estimated by the Olley-Pakes method.

Source: Authors' calculations based on METI, Basic Survey of Japanese Business Structure and Activities.
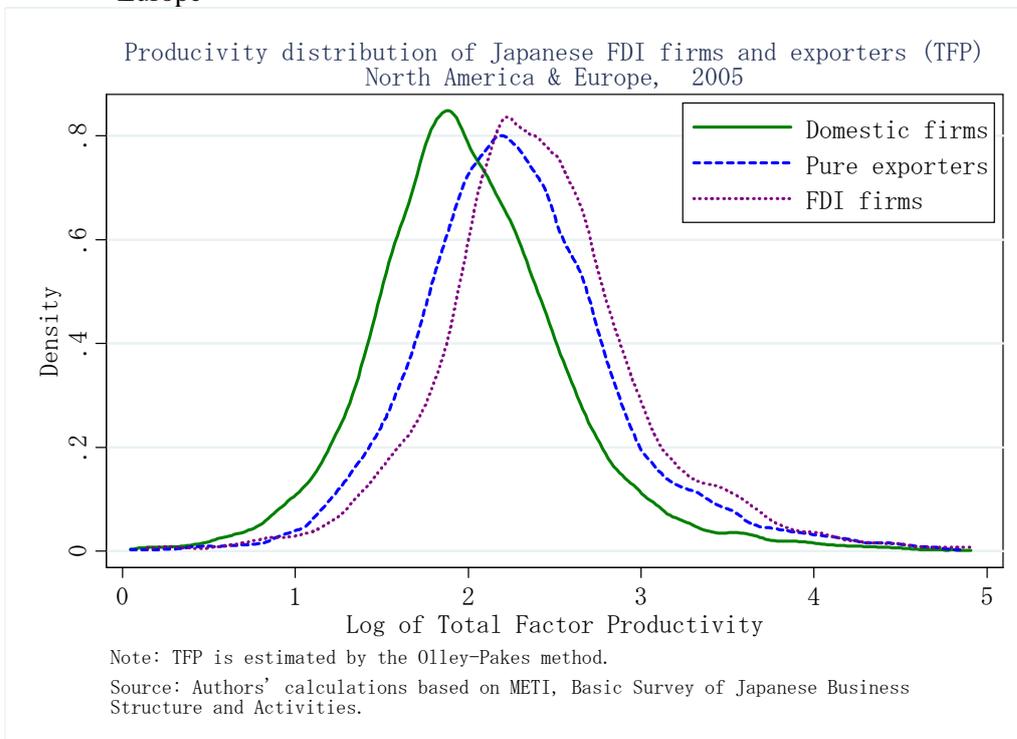
Figure 3. Productivity distribution of Japanese exporters and FDI firms: East Asia

Producivity distribution of Japanese FDI firms and exporters (TFP)
Asia, 2005

Legend:
— Domestic firms
- - - Pure exporters
⋯⋯ FDI firms

Density (y-axis) vs Log of Total Factor Productivity (x-axis)

Note: TFP is estimated by the Olley-Pakes method.
Source: Authors' calculations based on METI, Basic Survey of Japanese Business Structure and Activities.
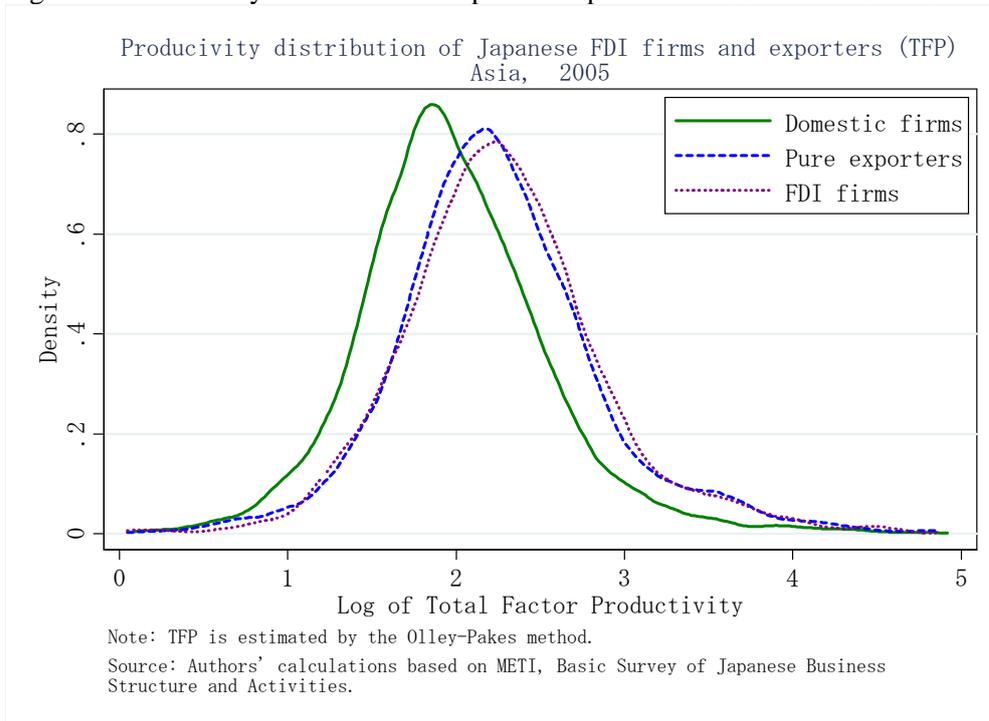
Figure 4. Internationalization Mode and Average Productivity in Multiple Regions

TFP values by Mode of Internationalization:
- Both Domestic: 9.22
- EX-NA: 11.26
- EX-EU: 11.02
- EX-Both: 14.47
- FDI-NA: 10.91
- FDI-EU: 13.38
- FDI-NA & EX-EU: 11.94
- FDI-EU & EX-NA: 13.19
- FDI -Both: 15.85
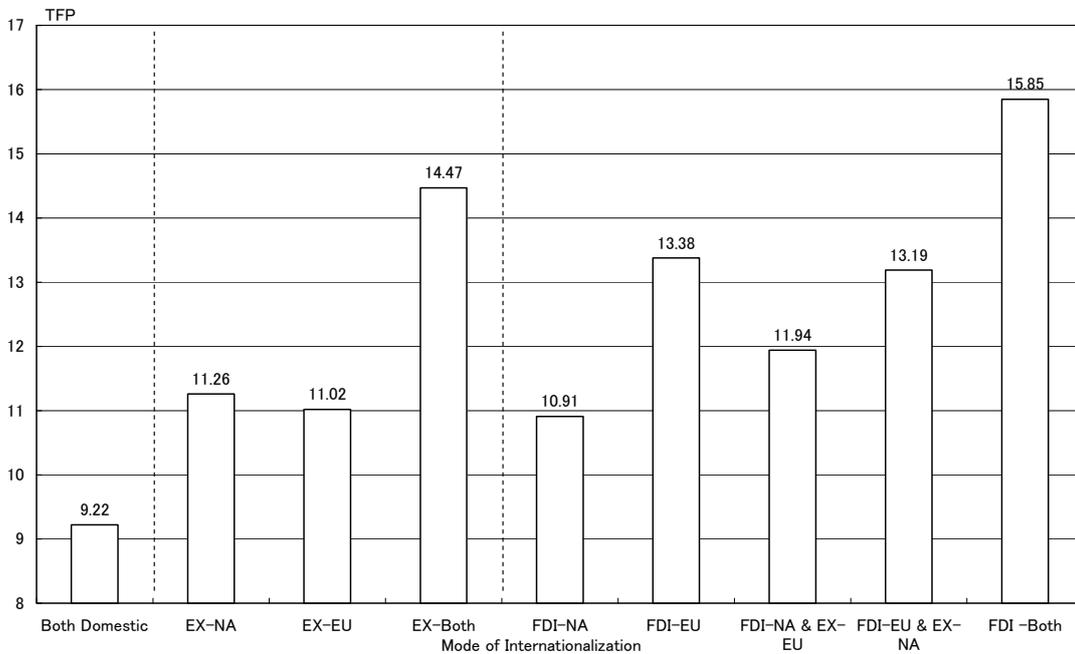
Note: EX-NA expresses export to North America, EX=EU export to Europe, FDI-NA FDI in North America, FDI-EU FDI in Europe, EX-Both and FDI-Both export to both North America and Europe, FDI in both North America and Europe, respectively.

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