Firm Heterogeneity and Different Modes of Internationalization: Evidence from Japanese Firms[*]

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Abstract

This paper examines why the modes of firm's internationalization deviate from the theoretical prediction presented in Helpman, Melitz, and Yeaple (2004) and makes two empirical contributions by using Japanese firm-level data. In the first part, we confirm that less productive firms conduct FDI in East Asia. This is contradictory to the standard mode of internationalization that the firms switch their modes from export to FDI as their productivity arises. In the second part, we find the productivity of firms internationalizing in multiple regions with similar income level, North America and Europe, is far higher than the productivity of firms internationalizing in only one region even though the productivity cut-off for internationalization is indifferent between regions. The result of this paper assesses the necessity to develop a new model to incorporate the difference in variable costs and market size, and the diseconomy in fixed costs caused by the internationalization across multiple regions.

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1. Introduction

North America, Europe and Asia are major destinations of Japanese firms to export and conduct foreign direct investment (FDI). We find that the modes of firm's internationalization in these regions deviate from the theoretical prediction presented in Helpman, Melitz, and Yeaple (2004). It is noted that modes of export and FDI of Japanese firms in Asian countries differ from the modes of internationalization in North America and Europe, also that the productivity of firms internationalizing in multiple regions differs from that of firms in single region even though the region characteristics are indifferent between North America and Europe.

Theoretical and empirical studies by 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. Their theoretical findings indicate 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. Following the theoretical studies, 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, 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) have demonstrated the sorting pattern of internationalization with respect to productivity. Kimura and Kiyota (2006) have found the strong correlation between productivity, exporting and FDI, by using Japanese firm-level data.

Eaton, Kortum and Kramarz (2004) and Lawless (2009) have focused on firms that export to different destinations using the French and Irish firm-level data, respectively, although they did not take into account FDI. Yeaple (2009) examined the cross-country structure of multinational activity. Yeaple (2009), using firm-level data for U.S. multinational enterprises, shows that country characteristics determine the productivity cut-off, so the more productive

firms own affiliates in a larger number of countries, and also a country attracts progressively smaller and less productive firms as the country becomes more attractive to U.S. multinationals. Yeaple (2009) also demonstrated that the number of countries U. S. multinationals invested in were less than those which the standard HMY model predicted. Although these empirical investigations examined the relation between firm's productivity and the modes of internationalization in different destinations, they did neither specifically focus on firms' internationalization in destination countries whose variable costs are largely different from home country, nor on the productivity of exporters and FDI firms in multiple destination countries.

The purpose of this paper is to examine whether the mode of firm's export or FDI is different from the prediction of the HMY model, and why the reason is. This paper confirms that the sorting of export and FDI in the case of Asian countries is opposite to the theoretical prediction of the HMY model, although the internationalization of Japanese firms in North America and Europe is consistent with it. In the case of export and FDI in North America or Europe, the results of empirical investigation in this paper also confirm that the productivity of firms internationalizing in both regions, North America and Europe, is significantly higher than the productivity of firms internationalizing in only one region even though the productivity cut-off for internationalizing is not different among two regions.

This paper consists of tow parts organized as follows: Section 2 in Part 1 reviews statistical facts of productivity premia of internationalized firms in North (consisting of North America and Europe) and South (consisting of East Asian countries), and shows that the mode of internationalization in South is different from North. In Section 3, we present the framework to analyze the reverse order of internationalization mode, focusing on the difference in variable costs. Section 4 conducts statistical estimation to examine whether the sorting of internationalization modes is different between North and South. The results show that the internationalization modes of Japanese firms are ranked by productivity in North as predicted by the standard theoretical model, but the modes of export and FDI are contradictory to the modes in Asian countries. Section 5 in Part 2, focusing on the North, shows that the productivity premia of firms internationalizing in both North America and Europe is apparently larger than that of firms internationalizing in a single region, and identifies the reasons to require higher

productivity of firms for internationalization in multiple regions than in a single region even though the productivity cut-off for internationalization in each region is indifferent between North America and Europe. Section 6 concludes.

Part 1

2. Modes of Internationalization: North and South

2.1 Statistical Facts

First of all, we look at 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[1] in 2005. The statistical data are based on the firm-level data of 12,000 Japanese manufacturing firms with more than 30 million yen in capital stock and more than 50 employees from "Basic Survey of Japanese Business Structure and Activities"[2].

Table 1

62 % (7,699 firms) of Japanese manufacturing firms have supplied only for the domestic market and entered neither North nor South; roughly 40 % of firms are internationalized. The number of internationalized firms is not small. 7 % of firms (873 firms) export to and 10 % of firms (1,190 firms) conduct FDI in only East Asia, while 2 % of firms (201 firms) export to and 1 % of firms (147 firms) conduct FDI in only North. However, 6 % of firms (764 firms) export both North and South, 8 % of firms (996 firms) conduct FDI in both North and South. 21 % of firms (2639 firms) conduct FDI in East Asia and 11 % of firms (1324 firms) in North, in any case.

Previous studies present that the productivity cut-off for export and FDI varies according to the difference in wage rate, transportation cost or other fixed costs. In this section, we statistically observe the productivity distributions of Japanese internationalizing firms in

[1] FDI includes not only the case of pure FDI but also both FDI and export.

[2] 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.

North and South separately by three types: non-internationalization, export to and FDI in North and South. In order to calculate total factor productivity (TFP) of firms, we estimate the Cobb-Douglas type production function under the method of Olley and Pakes (1996),[3] using the firm-level data for the period 1997-2005 from "Basic Survey of Japanese Business Structure and Activities." As Figure 1 presents, the productivity distributions of Japanese exporters and FDI firms in North America and Europe in 2005 are distinctly different. However, as Figure 2 shows, it is noted that the productivity distributions of Japanese exporters and FDI firms in East Asia in 2005 are almost overlapped. This is contrast to the US and European exporters and FDI firms whose productivity distributions are distinctly sorted according to the theoretical prediction of HMY model[4]. The case in South is different from the prediction of HMY model although the former case in North is consistent with the prediction of HMY model.

Figure 1 and Figure 2

It is possible to observe the average productivity of firms corresponding to each mode although it is not easy to directly observe the productivity cut-off corresponding to each mode of internationalization. Here, we calculate the average productivity of firms corresponding to each 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) However, the productivity of firms conducting FDI in South is lower than the productivity of exporters to South.

[3] The calculation of TFP is based on Wakasugi et al. (2008). By using the method of Olley and Pakes (1996), we estimate the total factor productivity (TFP) under the Cobb-Douglas type production function.
[4] Refer to Bernard, Redding and Schott (2006), Bernard and Jensen (2007), and Mayer and Ottaviano (2007).

Table2

The statistical facts presented in (i) and (ii) provide evidences 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 cut-off. However, the statistical fact presented in (iii) is different from the prediction of the model. 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 sorting of productivity 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.

2.2 Productivity Premia and Modes of Internationalization

We investigate statistically whether the difference in firm-level productivity premia affects the order of internationalization modes after controlling for firm- and industry-specific factors. Estimation is based on the following equation:

$$\ln TFP_{i,t} = \alpha + \sum_{s=1}^{8} \beta_s D_{i,s,t} + \gamma_1 \ln(K_{i,t} / L_{i,t}) + \gamma_2 \ln(SL_{i,t} / L_{i,t}) + \gamma_3 \ln(Age_{i,t}) + \sum_m \delta_m H_{i,m,t} + \varepsilon_{i,t} \quad (1)$$

$$s = 1, 2 \cdots, 8, \quad m = 1, \cdots, n, \quad t = time\ subscript\ for\ 2005$$

The dependent variable, $\ln TFP_{i,t}$ is the logarithm of firm *i*'s TFP, which is defined by $TFP_{i,t} = \frac{Y_{i,t}}{K_{i,t}^{\alpha} L_{i,t}^{\beta}}$. We use the figures of TFP calculated in the previous section. $D_{i,s,t}$ 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.

Here we omit the time subscript from the dummy variable $D_{i,s,t}$. $K_{i,t}/L_{i,t}$ is the capital labor ratio, $SL_{i,t}/L_{i,t}$ is the ratio of skilled workers which is defined as the ratio of workers in the headquarter office to total workers, $Age_{i,t}$ is the firm's period of operation. These variables control for firm-specific factors other than productivity[5]. $H_{i,m,t}$ is the dummy variable for industry *m* to which firm *i* belongs, α is the constant term, and $\varepsilon_{i,t}$ is the error term. As for $TFP_{i,t}$, the firm-level productivity, we use the figures calculated by the method of Olley and Pakes (1996).

The coefficient of each dummy variable β presents how largely the productivity premia of internationalizing firms in North America, Europe and Asia exceeds the productivity of non-internationalizing firms[6]. The estimation of equation (1) is conducted by OLS methods on firm-level data of 12,000 Japanese manufacturing firms: "Basic Survey of Japanese Business Structure and Activities" in 2005, maintained by the Ministry of Economy, Trade and Industry.

Table 3 shows the estimated results. Every estimated coefficient for each mode of internationalization presents a high statistical significance. 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

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

[6] Non-internationalizing firms imply the firms which do not internationalize in any regions.

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 of the modes of internationalization, export or FDI.

Table 3

3. Basic Model

In this section, we present an analytical framework to examine how productivity of firm sorts the mode of internationalization. Here, we suppose that differentiated goods are supplied to the market under the demand derived from the following CES type utility function[7],

$$(2) \qquad u = \left[\int_{l \in D} x(l)^{\alpha} dl \right]^{1/\alpha} \quad , \quad 0 < \alpha < 1 ,$$

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 ε between goods. We define $\varepsilon = 1/(1-\alpha)$ and $\varepsilon > 1$.

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

$$(3) \qquad x_j(l) = \frac{p_j(l)^{-\varepsilon} Y_j}{P_j^{1-\varepsilon}} ,$$

where Y_j is the total expenditure of country *j*, $p_j(l)$ is the price of goods *l* , and P_j is the

[7] The analytical framework of this section follows the model presented in Helpma, Melitz, and Yeaple (2004).

price index of country *j*. The price index P_j is given by the following equation,

$$(4) \qquad P_j = \left[\int_{l \in D} p_j(l)^{1-\varepsilon} dl \right]^{1/(1-\varepsilon)},$$

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*. We assume that productivity parameter *a* is randomly drawn from Pareto distribution with cumulative distribution function $G(a)$. 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:

$$(5) \qquad p_j(a) = \frac{C_j}{\alpha}$$

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*,

$$(6\text{-}1) \qquad \pi_i^D(a) = (1-\alpha)\left(\frac{w_i a}{\alpha P^D{}_i} \right)^{1-\varepsilon} Y^D{}_i$$

In the case of exports to country *j*,

$$\pi_j^X(a) = (1-\alpha)\left(\frac{\tau_j w_i a}{\alpha P^X{}_j}\right)^{1-\varepsilon} Y^X{}_j - w_i f_j^X \tag{6-2}$$

In the case of oversea production in country *j*,

$$\pi_j^I(a) = (1-\alpha)\left(\frac{w_j a}{\alpha P^I{}_j}\right)^{1-\varepsilon} Y^I{}_j - w_j f_j^I \tag{6-3}$$

By denoting $\theta = a^{1-\varepsilon}$ and $B_k^h = (1-\alpha)(\alpha P_k^h)^{\varepsilon-1} Y_k^h$, for *h*=*D*, *X*, *I*, and *k* = *i*, *j*, equations (6-1) to (6-3) are rewritten as follows:

$$\pi_i^D(a) = \left(\frac{1}{w_i}\right)^{\varepsilon-1} B_i^D \theta \tag{7-1}$$

$$\pi_j^X(\theta) = \left(\frac{1}{w_i \tau_i}\right)^{\varepsilon-1} B_i^X \theta - w_i f_j^X \tag{7-2}$$

$$\pi_j^I(\theta) = \left(\frac{1}{w_j}\right)^{\varepsilon-1} B_j^I \theta - w_j f_j^I \tag{7-3}$$

where we assume $w_i > w_j$. From equations (7-2) and (7-3), the productivity of firm which satisfies non-negative profit condition for exporting exceeds the productivity cut-off θ^X defined as $\theta^X = \frac{w_i f_j^X}{B^X{}_j}(w_i \tau_j)^{\varepsilon-1}$, and the productivity of firm which satisfies non-negative profit condition for FDI exceeds the productivity cut-off θ^I defined as $\theta^I = \frac{w_j f_j^I}{B^I{}_j}(w_j)^{\varepsilon-1}$. Further, the productivity cut-off $\tilde{\theta}$ which equalizes the net profit of exporting firms to that of

FDI firms is defined as $\tilde{\theta} = (w_j f_j^I - w_i f_j^X) / \left(B_j^I (\frac{1}{w_j})^{\varepsilon-1} - B_j^X (\frac{1}{w_i \tau_{ji}})^{\varepsilon-1} \right)$.

The internationalization modes of firms vary corresponding to firm's productivity under given firm-specific and region-specific factors including wage rate, transportation cost and fixed costs. While the HMY model examines the internationalization modes only under the horizontal FDI (HFDI) in North, we relax their assumption by assuming both HFDI in North and vertical FDI (VFDI) in South.

For the case of HFDI in North, in addition to the assumption $w_i \tau_j > w_j$, we assume $w_j f_j^I > w_i f_j^X$ and $B_j^X = B_j^I$. It is presumable that the wage rate in North is not largely different from home country and the fixed costs for foreign production in North is not lower than the fixed costs for export. Then, productivity cut-off between export and FDI is determined by $\tilde{\theta} = (w_j f_j^I - w_i f_j^X) / \left(B_j^I (\frac{1}{w_j})^{\varepsilon-1} - B_j^X (\frac{1}{w_i \tau_{ji}})^{\varepsilon-1} \right)$.

For the case of foreign production in South, we further assume lower fixed cost, $w_j f_j^I < w_i f_j^X$, and smaller market size, $B_j^X > B_j^I$, which are different from those in HFDI case. These assumptions reflect the economy of South in which the wage rate is so low and the market size is not large, in particular smaller for foreign production than for export. Productivity cut-off between export and FDI is determined by

$$\tilde{\theta} = (w_i f_j^X - w_j f_j^I) / \left(B_j^X (\frac{1}{w_i \tau_{ji}})^{\varepsilon-1} - B_j^I (\frac{1}{w_j})^{\varepsilon-1} \right).$$

Under these assumtions, we predict the modes of internationalization according to the productivity cut-off as follows:

Proposition 1.

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

(i) If $w_i \tau_j > w_j$, $w_j f_j^I > w_i f_j^X$, and $B_j^X = B_j^I$, *firms whose productivity* θ *satisfies* $\frac{w_i f_j^X}{B^X{}_j} (w_i \tau_j)^{\varepsilon-1} < \theta < (w_j f_j^I - w_i f_j^X) / \left(B_j^I (\frac{1}{w_j})^{\varepsilon-1} - B_j^X (\frac{1}{w_i \tau_{ji}})^{\varepsilon-1} \right)$ *supply for domestic market and export, and firms whose productivity satisfies*

$\theta \geq (w_j f_j^I - w_i f_j^X) / \left(B_j^I (\frac{1}{w_j})^{\varepsilon-1} - B_j^X (\frac{1}{w_i \tau_{j\,i}})^{\varepsilon-1} \right)$ *switch their mode of internationalization from export to foreign production.*

(ii) If $w_i \tau_j > w_j$, $w_j f_j^I < w_i f_j^X$, and $B_j^X > B_j^I$, *firms whose productivity* θ *satisfies* $\frac{w_j f_j^I}{B^I{}_j} (w_j)^{\varepsilon-1} < \theta < (w_i f_j^X - w_j f_j^I) / \left(B_j^X (\frac{1}{w_i \tau_{j\,i}})^{\varepsilon-1} - B_j^I (\frac{1}{w_j})^{\varepsilon-1} \right)$ *supply only for domestic market and foreign production, and firms whose productivity satisfies* $\theta \geq (w_i f_j^X - w_j f_j^I) / \left(B_j^X (\frac{1}{w_i \tau_{j\,i}})^{\varepsilon-1} - B_j^I (\frac{1}{w_j})^{\varepsilon-1} \right)$ *switch their mode of internationalization from foreign production to export.*

The first case depicted in Figure 3 presents the standard modes of internationalization, corresponding to the productivity cut-off presented in Helpman, Melitz, and Yeaple (2004) and Helpman (2006). The second case presents the adverse productivity cut-off to the standard mode as depicted in Figure 4.

Figure 3 and Figure 4

By synthesizing two cases in North and South, we theoretically predict the order of net profit, and then, the sorting of firm's internationalization modes from foreign production in South, export to South, export to North and to foreign production in North as firm's productivity rises. The order of net profits of firms internationalizing in North and South is depicted in Figure 5.

Figure 5

4. Empirical Examination: North and South

In the previous section, we theoretically confirm that the net profit of firms is ordered from VFDI in South, export to South, export to North, and to HFDI in North along with a rise of thier productivity, and that firms switch their internationalization mode according to the same order.

In order to confirm empirically the effect of productivity on the net profit, we statistically investigate how a rise of productivity level significantly affects the net profit of internationalization based on Multinomial Logit model. Here, we examine whether the productivity level determines the choice of modes of internationalization in North and 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 net profit of firm *i* choosing the mode *s*, π_{is}, is expressed by the following equation.

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

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. Firm-specific factors include not only TFP but also such control variables as 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.

The coefficient of productivity shows the effect of firm's productivity on the net profit corresponding to each strategy. Form the theoretical model we predict that the coefficients are ordered from VFDI in South at smallest, export to South, export to North to HFDI in North at

largest.

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 results of estimation showing:

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

(ii) The estimated coefficient of TFP for FDI in North is higher than that for export to North;

(iii) The estimated coefficient for FDI in South however is lower than that for export to South and far lower than that for export to North;

These results all are consistent to the theoretical prediction derived from Proposition 1.

Table 4

It is noteworthy that the results of our estimation confirms that more productive firms tend to export to South rather than conduct FDI in South, while more productive firms tend to

conduct FDI in North rather than export to North. As long as the authors know, this is the first finding that is seen in case of vertical FDI between North and South. The difference in variable costs is a reason to cause the different productivity cut-off for FDI between South and North. It is predicted that a large difference in wages between Japan and Asian countries causes to lower the productivity cut-off for FDI in South.

In addition to the effect of different variable costs on the firm's internationalization mode, the results estimated in this section confirm that productivity of firms internationalizing in multiple regions is higher than that of firms internationalizing in single region regardless of the modes of internationalization. Aw and Lee (2008) found the similar mode of internationalization in their empirical examination of Taiwanese firms' export to and FDI in US and China[8].

Different internationalization modes of Japanese firms between 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. North and South should be disaggregated when we examine the relationship between firm's productivity and the modes of internationalization.

Part 2[9]

5. Internationalization in Multiple Regions

5.1 Statistical Facts

In the previous Part, we find that 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. For the analysis of the relationship between productivity of Japanese firms and their internationalization modes in multiple regions,

[8] 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.

[9] Part 2 is jointly written by Wakasugi and Tanaka.

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

Table 5 presents the statistics of average TFP of the firms corresponding to each mode of internationalization. It shows interesting statistical facts as follows:

(i) The productivity of internationalizing firms exceeds the productivity of non-internationalization 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

[10] As the same as the previous section, FDI includes not only the case of pure FDI but also both FDI and exports.

These observations, presented in (i) and (ii) provide statistical evidences that the internationalization of Japanese firms in North America and Europe is consistent with the HMY model, presenting that firms switch their mode from non-internationalization to export, and from export to FDI as the productivity of firms arises. However, the relation between productivity and internationalization mode described in (iii) and (iv) is puzzle, if it is assumed that North America and Europe are identical regions for internationalization of Japanese firms. Little attention has been attracted to them so far in the HMY model.

5.2 Productivity Premia of Export and FDI

Here, we investigate whether the modes of internationalization in North America and Europe correspond to the order of productivity after controlling for firm-specific and industry-specific factors. Estimation is based on the same equation as equation (1):

$$\ln TFP_i = \alpha + \sum_{s=1}^{8} \beta_s D_{i,s} + \gamma_1 \ln(K_i / L_i) + \gamma_2 \ln(SL_i / L_i) + \gamma \ln(Age_i) + \sum_m \delta_m H_{i,m} + \varepsilon_i \quad (11)$$

$$s = 1, 2 \cdots, 8, \quad m = 1, \cdots, n$$

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.

The calculation is conducted by OLS methods 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 2005. Table 6 shows that every estimated coefficient of each dummy variable for the internationalization mode is statistically significant. They are summarized as follows:

(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 statistical analysis clearly confirms that the modes of internationalization of Japanese 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 premia of firms internationalizing to North America significantly differs from the productivity premia of firms internationalizing to Europe. The second column in Table 7 shows the difference in two coefficients between North America (denoted by NA) and Europe (EU) in export (EX) and FDI (FDI), and the third column its standard error.

Table 7

From the statistical test, we conclude that (i) there is no significant difference in productivity premia between firms with export to North America and firms with export to Europe; (ii) There is no significant difference in the productivity premia 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 and the productivity of firms internationalizing in Europe is indifferent.

5.3 Empirical Estimation: Two Regions in North

We examine how firm's productivity determines the choice of internationalization modes in two regions with same regional characteristics, by modifying the HMY model. Let us assume that firms export to or conduct FDI in two foreign markets, region 1 and region 2. By eliminating *h* and denoting $W_i = (1/w_i)^{\varepsilon-1}$, $T_j = (1/\tau_j)^{\varepsilon-1}$, $j = 1, 2$, $B_j = (1-\alpha)(\alpha P_j)Y_j$, $j = 1, 2$, the profits of firms expressed in equations (7-1)-(7-3) are rewritten as follows:

In the case of supply in home market,

(12-1) $\pi_i^D(\theta) = W_i B_i \theta$

In the case of export to two regions,

(12-2) $\pi_1^X(\theta) + \pi_2^X(\theta) = W_i(T_1 B_1 + T_2 B_2)\theta - f_{1+2}^X$

In the case of FDI in two regions,

(12-3) $\pi_1^I(\theta) + \pi_2^I(\theta) = (W_1 B_1 + W_2 B_2)\theta - f_{1+2}^I$

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 cut-off, 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 cut-off orders the modes of internationalization in multiple regions as follows:

If $\frac{f_{1+2}^{X}}{W_i(T_1B_1+T_2B_2)} < \theta < \frac{(f_{1+2}^{I}-f_{1+2}^{X})}{[(W_1-W_iT_1)B_1+(W_2-W_iT_2)B_2]}$, *firms with the productivity* θ *supply for domestic market and export to both regions.*

If $\theta \geq \frac{(f_{1+2}^{I}-f_{1+2}^{X})}{[(W_1-W_iT_1)B_1+(W_2-W_iT_2)B_2]}$, *firms with the productivity* θ *switch their mode of internationalization from export to foreign production.*

We empirically investigate the relationship between the modes of internationalization and productivity, based on Multinomial Logit model. Based on the same method in section 3, 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.

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

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 of TFP for FDI is higher than that for export, which is consistent with statistical facts;

(iii) The coefficient of TFP of firms exporting to both regions is higher than that of 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.

These results on the relationship between productivity and the choice of modes of internationalization under a Multinomial Logit Model clearly confirm that the modes of internationalization of Japanese firms are ordered by the productivity from non-internationalization to export to North America or Europe, export to both North America and Europe, and to FDI in both North America and Europe, and that the productivity of firms internationalizing to both regions is significantly higher than the productivity of firms internationalizing to either one 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 statistical findings expressed in Table 6.

5.4 Discussion

In this section, we discuss why the productivity of firms with internationalization in both two regions exceeds the productivity of firms in only one region. The statistical test of productivity premia presented in Table 7 shows that the productivity premia of firms exporting to North America is almost equal to the productivity premia of firms exporting to Europe. As we

assumed productivity parameter a to be randomly drawn by each firm from a given Pareto distribution with cumulative distribution function G(a), the skewnwss of the productivity distribution is given commonly to all sample firms regardless of their destination regions. Therefore, it is predictable that both regions will be indifferent in the productivity cut-off for export. In order to check whether the productivity cut-off for export is indifferent between North America and Europe, we observe the productivity distribution of exporting firms in the lowest 5% among the exporters to each region for 2005. From the distribution of firm's TFP, we find that the TFP of the lowest 5% exporters to only North America (TFP value is 4.00) is almost same as that of the lowest 5% exporters to only Europe (TFP value is 3.90). From these evidences, we find that not only the average productivity premia of exporters but also the productivity cut-off for export are indifferent between North America and Europe. Therefore, we assume:

$$\frac{f_1^X}{T_1 B_1} = \frac{f_2^X}{T_2 B_2} \tag{14}$$

In comparison of firm's productivity for exporting between both regions and one region, the estimated results of equation (11) present that the productivity of firms internationalizing to both regions is significantly higher than the productivity of firms internationalizing to only one region. By using the observed order of firm's productivity to compare the rank of the productivity cut-off for export between single and multiple regions, we conclude that the fixed costs denominated by market size and transportation costs increase with an increase in number of export regions as follows:

$$\frac{f_{1+2}^X}{T_1 B_1 + T_2 B_2} > \frac{f_1^X}{T_1 B_1} \quad \text{and} \quad \frac{f_{1+2}^X}{T_1 B_1 + T_2 B_2} > \frac{f_2^X}{T_2 B_2}. \tag{15}$$

From (14) and (15), we obtain $f_{1+2}^X > f_1^X + f_2^X$. That is, if the productivity cut-off for export is identical between North America and Europe as suggested above, the difference in fixed costs between f_{1+2}^X and $(f_1^X + f_2^X)$ is crucial in determining firm's 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 each region.

For the case of FDI, the statistical test of productivity premia presented in Table 7 also shows that the productivity premia of FDI firms in North America is almost identical to the productivity premia of FDI firms in to Europe. In order to check whether the productivity cut-off for FDI is indifferent between North America and Europe, we observe the productivity distribution of FDI firms of the lowest 5% among FDI firms to each region for 2005. From the distribution of firm's TFP, we find that the TFP of the lowest 5% FDI firms in only North America (TFP value is 4.61) is almost same as that of the lowest 5% FDI firms in only Europe (TFP value is 4.49). From these evidences, we also find that not only the average productivity premia of FDI firms but also the productivity cut-off for FDI is indifferent between North America and Europe. Therefore, we assume:

$$(16) \qquad \frac{f_1^I - f_1^X}{B_1(W_1 - W_i T_1)} = \frac{f_2^I - f_2^X}{B_2(W_2 - W_i T_2)}$$

We compare the rank of the productivity cut-off for FDI between single and multiple regions. From the observed order of firm's productivity, we find that the fixed costs denominated by market size and transportation costs increase with an increase in number of FDI regions as follows:

$$(17) \qquad \frac{(f_{1+2}^I - f_{1+2}^X)}{[B_1(W_1 - W_i T_1) + B_2(W_2 - W_i T_2)]} > \frac{f_1^I - f_1^X}{B_1(W_1 - W_i T_1)}$$

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

From (14) and (15), 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 cut-off 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 firm's FDI in single and two regions. We predict that the fixed costs for FDI in both regions increase disproportionately larger than the fixed costs for FDI in either region.

Such a disproportionate increase of the fixed costs is caused by the diseconomies of scope across export destinations and production locations. A higher cost to coordinate firm's activities for exporting to multiple markets or production of foreign subsidiaries among multiple regions is thought as a reason of such a disproportional increase of fixed costs with the increase of number of regions. The fixed costs are both theoretically and empirically an important issue to be examined further.

6. Conclusion

We examined whether modes of Japanese firm's internationalization deviate from the theoretical prediction presented in Helpman, Melitz, and Yeaple (2004). This paper makes two empirical contributions by using Japanese firm-level data. First, we confirm that less productive firms conduct FDI in East Asia. This is contradictory to the standard mode of internationalization that the firms switch their modes from export to FDI as their productivity arises. Difference in variable costs including wage rate and transport costs between home and host countries is a factor to cause a deviation from the theoretical prediction of the HMY model. This paper examines statistically how differently market-specific factors affect the productivity cut-off, and affects the modes of firm's internationalization in East Asia, North America and Europe, based on the firm-level data of 12,000 Japanese firms. The results 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 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 in East Asia is lower than exporting firms. This causes an indistinct sorting of modes of internationalization of Japanese firms in South.

Second, we conduct estimation on how differently the modes of firm's internationalization in multiple regions in North America and Europe are ordered by firm's productivity. The results demonstrate that the productivity of firms internationalizing in multiple

regions with similar income level, North America and Europe, is far higher than the productivity of firms internationalizing in only one region regardless of the modes of internationalization, export or FDI, even though the productivity cut-off for internationalization is indifferent between regions. It is predictable if fixed costs for operation increase with an increase of number of destinations. The results of our examination suggest that the increasing fixed costs with the number of destinations are a factor to require higher firm's productivity because of the diseconomies of scope across export destinations and production locations. This paper points out the necessity to develop the HMY model to incorporate differences in variable and fixed costs.

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Table 1. Distribution of Japanese Internationalizing Firms in North and South, 2005

		North America & Europe			
		Non-internationalization	Export	FDI	Total
East Asia	Non-internationalization	7699 (61.57)	201 (1.61)	147 (1.18)	8047 (64.36)
	Export	873 (6.98)	764 (6.11)	181 (1.45)	1818 (14.54)
	FDI	1190 (9.52)	453 (3.62)	996 (7.97)	2639 (21.11)
	Total	9762 (78.07)	1418 (11.34)	1324 (10.59)	12504 (100.00)

Figures in parentheses present percent.

Table 2. Average Productivity of Japanese Internationalizing Firms

	Non-internationalization	Export	FDI
North America & Europe	8.83	10.07	11.89
East Asia		10.98	10.50

Table 3. Productivity Premia of Export and FDI

	Dependent variable: log of TFP for 2005	
Dummy variables for		
Export to only North	0.112	**
	[0.038]	
Export to only South	0.132	***
	[0.020]	
Export to both North and South	0.236	***
	[0.022]	
FDI in only North	0.222	***
	[0.045]	
FDI in North and Export to South	0.280	***
	[0.041]	
FDI in only South	0.117	***
	[0.017]	
Export to North and FDI in South	0.267	***
	[0.027]	
FDI in both North and South	0.413	***
	[0.019]	
Log (K/L)	-0.051	***
	[0.003]	
Log (Skilled L/L)	0.089	***
	[0.006]	
Log (age)	-0.120	***
	[0.008]	
Constant	2.147	***
	[0.057]	
Observations	12283	
Adj R-squared	0.258	

Robust standard errors in brackets.
Industry 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.
Non-internationalization is the base outcome.
All firm characteristics are lagged one year, that is, they are for year *t-1* .

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

			North America			
			Non-internationalization	Export	FDI	Total
Europe	Non-internationalization	N	9762	392	349	10503
			(78.1)	(3.1)	(2.8)	(84.0)
		TFP	9.22	11.26	10.91	9.36
	Export	N	278	748	276	1302
			(2.2)	(6.0)	(2.2)	(10.4)
		TFP	11.02	14.47	11.94	13.2
	FDI	N	44	64	591	699
			(0.4)	(0.5)	(4.7)	(5.6)
		TFP	13.87	13.19	15.85	15.48
	Total	N	10084	1204	1216	12504
			(80.7)	(9.6)	(9.7)	(100.0)
		TFP	9.29	13.36	13.54	10.10

Figures in parentheses present percent of the number of firms.

N is the number of firms.

Table 6. Productivity Premia of Export and FDI in Multiple Regions

	Dependent variable: log of TFP	
Dummy variables for		
Export to only N.A.	0.163	***
	[0.028]	
Export to only EU	0.140	***
	[0.033]	
Export to both N.A.and EU	0.234	***
	0.022]	
FDI in only N.A.	0.204	***
	[0.030]	
FDI in N.A. and Export to EU	0.252	***
	[0.034]	
FDI in only EU	0.227	***
	0.082]	
Export to N.A and FDI in EU	0.226	***
	[0.068]	
FDI in both N.A. and EU	0.486	***
	[0.024]	
Log (K/L)	-0.051	***
	[0.003	
Log (Skilled L/L)	0.093	
	[0.006]	
Log (age)	-0.117	
	[0.008]	
Industry dummy	yes	
Constant	2.163	***
	[0.057]	
Observations	12283	
R-squared	0.256	

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

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.

Table 7. Difference in Productivity Premia

Modes of Internationalization	Difference in TFP	S.E.
EX-NA vs. EX-EU	0.023	0.043
FDI-NA vs.FDI-EU	0.023	0.087
EX-Both vs. Ex-One		
NA	0.071 **	0.034
EU	0.094 **	0.038
FDI-Both vs. FDI-One		
NA	0.282 ***	0.037
EU	0.259 ***	0.085
FDI-EU･EX-NA vs. FDI-NA･EX-EU	0.026	0.075
FDI-Both vs. FDI-EU･EX-NA	0.260 ***	0.072
FDI-Both vs. FDI-NA･EX-EU	0.234 ***	0.040

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

S.E. shows standard error.

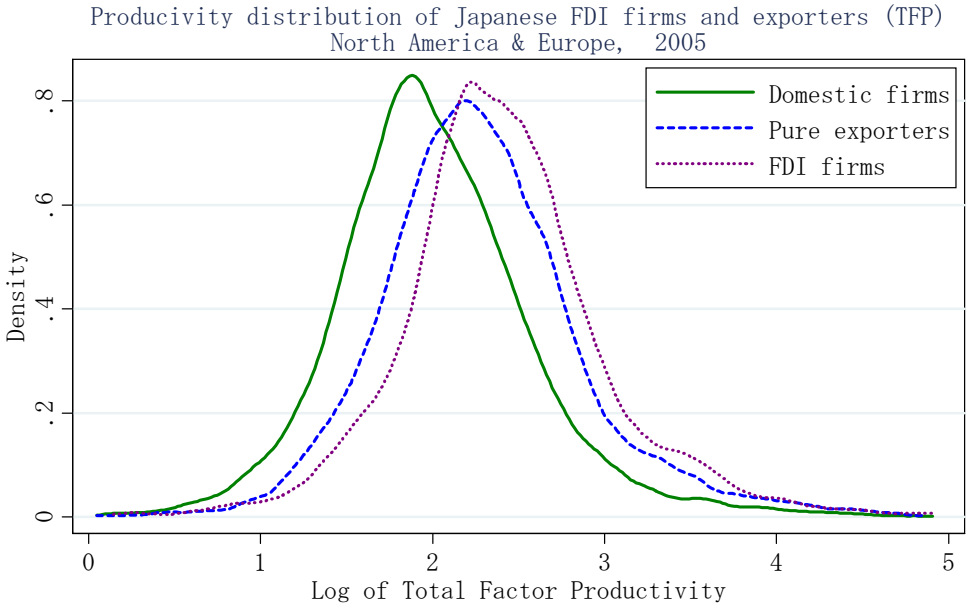
Note: EX-NA expresses export to North America, EX-EU export to Europe, FDI-NA FDI in North America, FDI-EU FDI in Europe, EX-Both and FDI-Both export to both North America and Europe, FDI in both North America and Europe, respectively.

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.
All firm characteristics are lagged one year, that is, they are for year *t-1* .

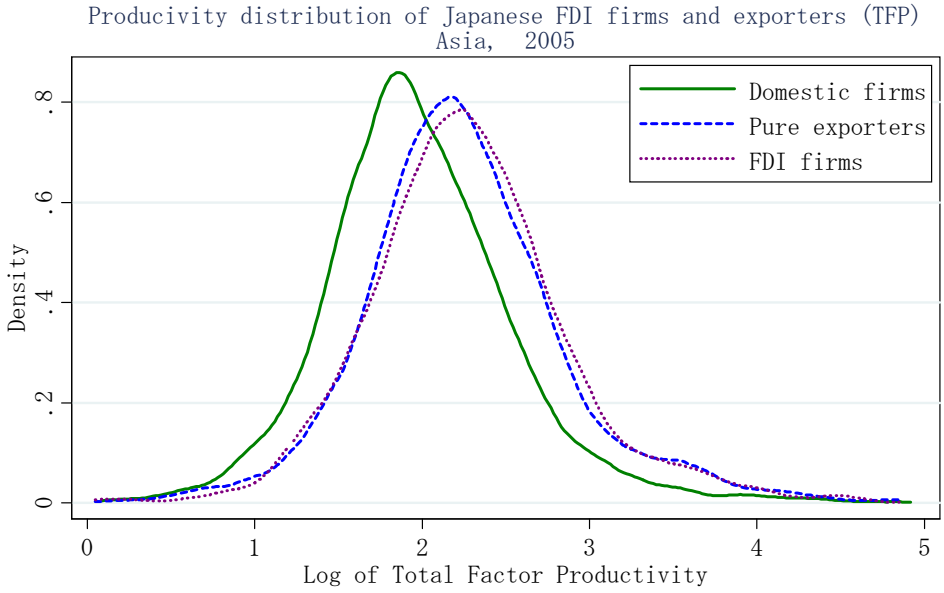
Figure 1.



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

Source: Authors' calculations based on METI, Basic Survey of Japanese Business Structure and Activities.

Figure 2.



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. Net profit and productivity cut-off for export and foreign production in North

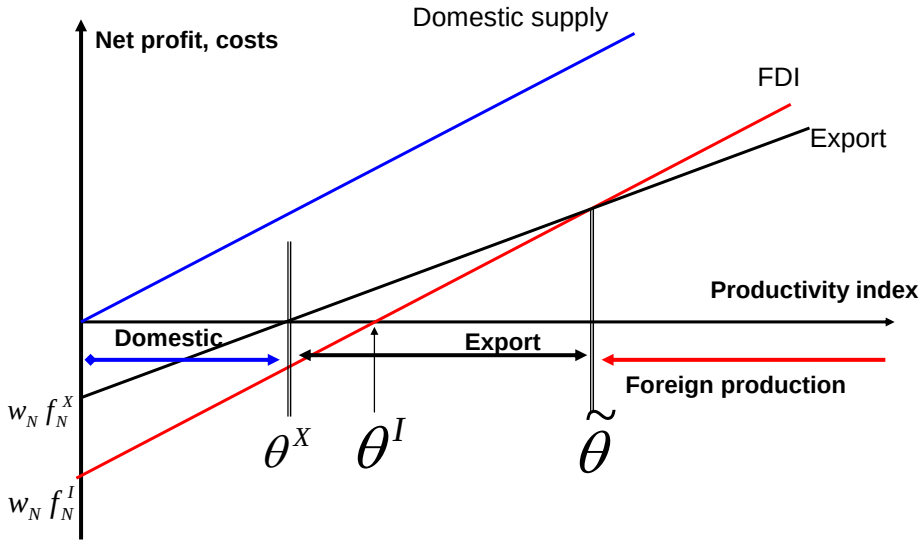


Figure 4. Net profit and productivity cut-off for export and foreign production in South

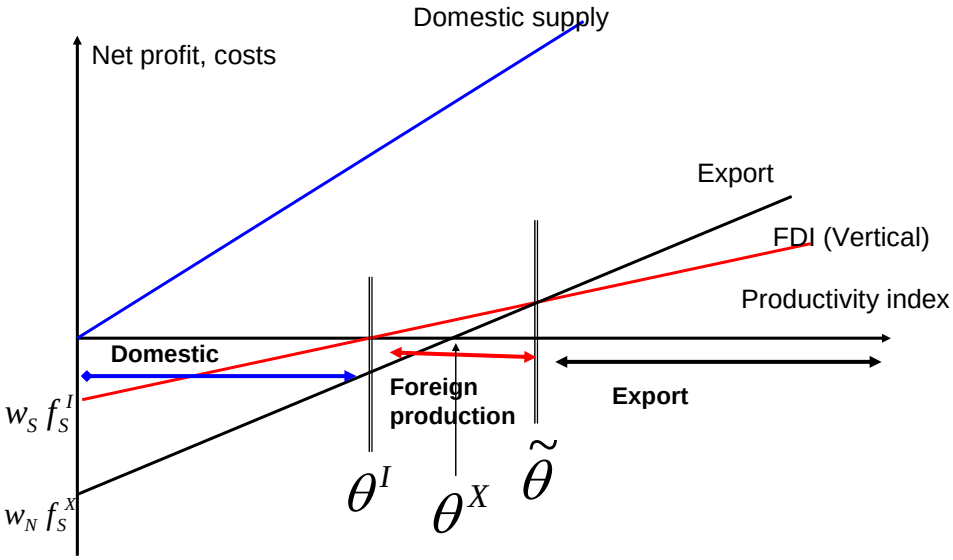


Figure 5. Synthesized internatinzalization modes of firms in North and South