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# Cost Heterogeneity and the Destination of Foreign Direct Investment

By

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# Cost Heterogeneity and the Destination of Foreign Direct Investment

## ABSTRACT

This paper first of all develops a theoretical model to examine a number of heterogeneous firms' choice between making export-oriented foreign direct investments (FDI) in a host country and making FDI in another country to serve the market there. It is shown that all firms below a critical level of efficiency invest in the first country, and the other relatively more efficient firms invest in the second host country. The hypothesis is tested using firm-level data on 118,300 Japanese firms covering the entire manufacturing sector. Multinomial logit estimates strongly support our theoretical findings.

**JEL Classifications:** F2, H2

**Keywords:** Cost heterogeneity, oligopoly, foreign direct investment, export-oriented FDI

# 1 Introduction

One of the consequences of globalization is an increased competitiveness in the world economy. Producers are having to find ways to serve the global marketplace in the most efficient possible way. Foreign direct investment (FDI) as a means to reach such a marketplace has been rapidly increasing in popularity. According to UNCTAD, the ratio of inward plus outward foreign direct capital to global gross domestic product is 21%. Rather than controlling inward FDI — which was the order of the 1960s and 70s — more and more countries are trying to attract FDI by creating favorable conditions. During the 1990s, 94% of FDI-related regulations were removed in both developed and developing countries (see UNCTAD (1998)).

The importance of FDI in today's world economy cannot be overemphasized. One reason for FDI is the proximity to consumers. However, this is not the only reason. For example, according to UNCTAD (1998), foreign-affiliate exports now make up about one-third of total world exports. Thus export-oriented FDI has also been increasing in currency. Furthermore, FDI can also take the form of either greenfield investment or cross-border acquisitions.

Because of its enormous importance in global economic activity, FDI has received a great deal of attention from academic economists, and the literature is vast. There are two broad strands in the theoretical literature. The first strand examines the incentives of foreign firms to take part in FDI and their choice among various alternative modes (including direct exports) to serve the intended markets. Brander and Spencer (1987), Ethier (1986), Helpman (1984), Horstmann and Markusen (1992), and Motta (1992) are some of the early papers that belong to this aspect of the literature. The second strand examines competition among host countries for FDI through public policies and analyzes the effects of FDI on the welfare of the host country. Grossman (1984), Haufler and Wooton (1999), Itagaki (1979), Janeba (1995), Lahiri and Ono (1998), and Tsai (1999) are some of the contributions to this part of the literature.

A growing body of recent literature acknowledges the fact that foreign firms are not homogeneous and examines to what extent firm heterogeneity can explain the choice of different modes of reaching the global marketplace.<sup>1</sup> Nocke and Yeaple (2004 and 2004a) consider the choice between cross-border acquisitions and greenfield FDI. In Helpman *et al.* (2004) the choice is between greenfield FDI and exports. Grossman and Helpman (2003) and Antras and Helpman (2004) consider the choice between foreign outsourcing and FDI.

This paper complements this new literature by considering the choice among heterogeneous firms between export-oriented FDI and FDI to serve the market in the host country. This distinction is important as, for example, about a third of Japanese FDI in Asia are export-oriented. We first of all develop a theoretical oligopolistic model with a number of firms who differ in their efficiency levels. Each of the firms has a choice of either making FDI in one host country and export all its output to its home country or investing in a second host country and sell its output in the host country. We characterize an equilibrium where one set of firms make export-oriented FDI and remaining firms invest in the second country. In the theoretical part we develop a number of hypotheses which are then tested, using multinomial logit analysis, for firm-level data from 118,300 Japanese firms covering the entire manufacturing sector there.

Empirical research on FDI has been severely constrained by the lack of availability of firm-level data. In the absence of such data, some of the early studies on FDI focused on host-country factors at aggregate levels (see, for example, Kravis and Lipsey (1982), Wheeler and Mody (1992), and Brainard (1997)). There is now a few micro data sets, and a new literature is growing side-by-side with the theoretical literature on FDI by heterogeneous firms. Head and Ries (2003) found that the Japanese firms investing in low-income countries seem weakly less productive than the firms investing in high-income countries. Their relatively small sample size of 1070 only publicly-listed firms does not properly represent the

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<sup>1</sup>The wider literature on oligopolistic industry with heterogeneous firms is not voluminous either. An early work is Lahiri and Ono (1988). See Lahiri and Ono (2004) for more recent literature.

Japanese manufacturing sector. In the firm-country-year panel study for US FDI by Riker and Brainard (1997), the efficiency levels of firms is not considered at all. Helpman *et al.* (2004) relate intra-industry dispersion of efficiency levels with US firms' choice between FDI and exports. Nocke and Yeaple (2004 and 2004a) examine the role of efficiency levels among US firms in their choice between cross-border acquisitions and greenfield FDI. Finally, using the same data set as this paper, Tomiura (2004) examines Japanese firms' choice between outsourcing, FDI and exports.

The layout of the paper is as follows. The following section develops the theoretical framework. Section 3 carries out the econometric analysis, and some concluding remarks are made in section 4.

## 2 A theoretical analysis

There are  $N$  firms belonging to a country (denoted by country  $c$ ) with constant marginal (average variable) costs  $c_i$ ,  $i = 1, \dots, N$ . These firms locate in one of two possible host countries. FDI in one of the host countries — called country  $a$  — is purely export oriented in the sense that outputs by the foreign firms are exported back to country  $c$ .<sup>2</sup> We assume that country  $a$  has unemployment. The other host country — called country  $b$  — receives FDI to serve its own market. That is, outputs by foreign firms in country  $b$  are solely sold in country  $b$ . We shall call this country the consuming country and assume that there is no unemployment in this country. The firms located in countries  $a$  and  $b$  produce two different goods and compete in the Cournot oligopolistic markets in countries  $c$  and  $b$  respectively.

We shall establish an endogenous distribution of the firms in the two host countries, and this sorting equilibrium will be found by equating the profits of a marginal firm in the two countries. We consider a three-stage game. In stage 1, the firms make their location decisions. In stage two, the governments decide on their policy levels, and in the final stage

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<sup>2</sup>Sometimes we shall call the host country where export-oriented FDI is made the export-oriented country.

the firms compete in the output markets in Cournot oligopolistic manners. We work with backward induction in order to achieve a sub-game-perfect equilibrium.

Without loss of generality suppose that firms  $1, \dots, n$  are located in country  $a$  and firms  $n, \dots, N$  are located in country  $b$ . Since the marginal firm, *i.e.*, the  $n$ th firm, is indifferent between locating in the two countries, for characterizing the equilibrium we assume that this firm is located in both countries.

Total demand of goods in the two countries are  $D_b$  and  $D_c$ . Denoting the output of firm  $i$  while operating in country  $j$  by  $x_i^j$ , we have:

$$D_b = \sum_{i=n}^N x_i^b, \quad (1)$$

$$D_c = \sum_{i=1}^n x_i^a. \quad (2)$$

Inverse demand functions in the two countries are:

$$p_c = \alpha_c - \beta_c D_c, \quad (3)$$

$$p_b = \alpha_b - \beta_b D_b. \quad (4)$$

Profits of firms in the two countries are:

$$\pi_i^a(n) = (p_c - c_i + s_a)x_i^a, \quad i = 1, \dots, n, \quad (5)$$

$$\pi_j^b(n) = (p_b - c_j + s_b)x_j^b, \quad j = n, \dots, N, \quad (6)$$

where  $s_a$  is output subsidy in country  $a$  and  $s_b$  is output subsidy in country  $b$ . The argument  $n$  in the notation for profits indicate the allocation of foreign firms between the two countries, *i.e.*, firms  $1, \dots, n$  in country  $a$  and firms  $n, \dots, N$  in country  $b$ .

Assuming Cournot conjectures, first order profit-maximizing conditions in the two

countries are:

$$p_c - c_i + s_a = \beta_c x_i^a, \quad i = 1, \dots, n, \quad (7)$$

$$p_b - c_j + s_b = \beta_b x_j^b, \quad j = n, \dots, N. \quad (8)$$

Solving (7) and (8), we get

$$D_c = \frac{n(\alpha_c + s_a) - \sum_{i=1}^n c_i}{\beta_c(n+1)}, \quad (9)$$

$$x_i^a = \frac{\alpha_c + s_a + \sum_{j=1}^n c_j - (n+1)c_i}{\beta_c(n+1)}, \quad i = 1, \dots, n, \quad (10)$$

$$D_b = \frac{(N-n+1)(\alpha_b + s_b) - \sum_{i=n}^N c_i}{\beta_b(N-n+2)}, \quad (11)$$

$$x_j^b = \frac{\alpha_b + s_b + \sum_{i=n}^N c_i - (N-n+2)c_j}{\beta_b(N-n+2)}. \quad j = n, \dots, N. \quad (12)$$

We make the assumption that either market can support any number of the  $N$  firms.

A sufficient condition that guarantees this is:

**Assumption 1**  $\min(\alpha_c, \alpha_b) > Nc_i, \quad i = 1, \dots, N.$

From equations (10) and (12) it follows that, for given levels of  $s_a$  and  $s_b$ , we have

$$x_i^a \leq x_j^a \iff c_i \geq c_j, \quad i, j = 1, \dots, n, \quad (13)$$

$$x_i^b \leq x_j^b \iff c_i \geq c_j, \quad i, j = n, \dots, N, \quad (14)$$

That is, as one would expect, in each market a firm with a higher cost level produces a lower level of output.

Welfare in the two countries are

$$W_a = \sum_{i=1}^n c_i x_i^a - s_a \sum_{i=1}^n x_i^a, \quad (15)$$

$$W_b = CS - s_b \sum_{i=n}^N x_i^b, \quad (16)$$



where consumers' surplus in country  $b$  satisfies

$$dCS = -D_b dp_b, \quad (17)$$

The first term in (15) is the wage income generated in country  $a$  by foreign firms,<sup>3</sup> and the second term is the subsidy payments to the foreign firms which are financed by lump-sum taxation. For country  $b$ , there is no wage income as there is no unemployment in that country, but instead the first term is the consumers' surplus.

The two host countries decide optimally the subsidy levels, and the first-order welfare-maximizing conditions are:

$$\frac{dW_a}{ds_a} = \sum_{i=1}^n c_i \frac{dx_i^a}{ds_a} - \sum_{i=1}^n x_i^a - s_a \sum_{i=1}^n \frac{dx_i^a}{ds_a} = 0, \quad (18)$$

$$\frac{dW_b}{ds_b} = -D_b \cdot \frac{dp_b}{ds_b} - \sum_{i=n}^N x_i^b - s_b \sum_{i=n}^N \frac{dx_i^b}{ds_b} = 0, \quad (19)$$

where from (10) and (12), we have

$$\frac{dx_i^a}{ds_a} = \frac{1}{\beta_c (n+1)}, \quad i = 1, \dots, n, \quad (20)$$

$$\frac{dx_i^b}{ds_b} = \frac{1}{\beta_b (N-n+2)}, \quad i = n, \dots, N, \quad (21)$$

Therefore, using (10), (12), (20) and (21), from (18) and (19) we get the optimal levels of subsidies as

$$\hat{s}_a = \frac{2 \sum_{i=1}^n c_i - n \alpha_c}{2n} = \frac{\sum_{i=1}^n c_i}{n} - \frac{1}{2} \alpha_c, \quad (22)$$

$$\hat{s}_b = \frac{-\alpha_b (N-n+1) + \sum_{i=n}^N c_i}{(N-n+1)(N-n+3)} = \frac{\sum_{i=n}^N (c_i - \alpha_b)}{(N-n+1)(N-n+3)}. \quad (23)$$

From assumption 1 and equation (23), it immediately follows that  $\hat{s}_b < 0$ , *i.e.*, the consuming country taxes the foreign firms. This is an extension (to the case of multiple

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<sup>3</sup>Implicitly, we assume that labor is the only factor of production in the oligopolistic sector.

heterogeneous foreign firms) of a result due to Katrak (1976) where it is shown that the optimal policy for a host country toward a foreign monopolist is to tax it. In view of assumption 1,  $\hat{s}_a$  is also negative. Moreover, it can be verified that, controlling for the number of firms in the two countries,  $\hat{s}_b < \hat{s}_a$ . That is, the optimal tax is lower in country  $a$  than in country  $b$ . The reason for this is the presence of unemployment in country  $a$ : the higher are the marginal costs, the greater is employment created. Thus, less efficient firms in country  $a$  receive higher subsidy (pay lower tax) than the more efficient firms in country  $b$ .

Substituting (22) into (10) and (23) into (12), we get

$$x_i^a = \frac{\alpha_c}{2\beta_c(n+1)} + \frac{1}{\beta_c} \cdot \left\{ \frac{1}{n} \sum_{j=1}^n c_j - c_i \right\}, \quad (24)$$

$$x_j^b = \frac{\alpha_b - c_j}{\beta_b(N-n+3)} + \frac{N-n+2}{\beta_b(N-n+3)} \cdot \left\{ \frac{1}{N-n+1} \sum_{i=n}^N c_i - c_j \right\}, \quad (25)$$

From (24) and (25), it follows that

$$x_i^a \leq x_j^a \iff c_i \geq c_j, \quad i, j = 1, \dots, n, \quad (13a)$$

$$x_i^b \leq x_j^b \iff c_i \geq c_j, \quad i, j = n, \dots, N, \quad (14b)$$

That is, the qualitative results in (13) and (14) do not change after the substitution of the optimal values of the subsidies in the expressions for equilibrium output levels.

We shall now prove a lemma which shall be useful in deriving our main result.

**Lemma 1** *Suppose  $c_i = c_{i+1} + \delta$ ,  $i = 1, \dots, N-1$ . Then,  $\pi_n^a(n)$  is a decreasing, and  $\pi_n^b(n)$  an increasing, function of  $n$ .*

Intuitively, an increase in  $n$  increases the number of firms in country  $a$  and reduces that in country  $b$ . This, *ceteris paribus*, would decrease the profits of the marginal firm in

country  $a$  and increase that in country  $b$ . However, given the cost structure, an increase in  $n$  would decrease the average of the marginal costs and the marginal cost of the marginal firms in both countries. This will increase the profits of the marginal firms in both countries. The net effect is that the profits of the marginal firm in country  $a$  increases, and that in country  $b$  decreases, as  $n$  increases.

We are now in a position to state and prove the main theoretical result of the paper. We shall need the following assumption which states that a firm makes a higher profit in a country if it is the only firm there as compared to the case where it exists with all the other firms in the other country.

**Assumption 2**  $\pi_1^a(1) > \pi_1^b(1)$  and  $\pi_N^a(N) < \pi_N^b(N)$ .

**Proposition 1** *Suppose that the marginal costs increase by a constant increment  $\delta$ . Then there exists a unique  $n$  such that all firms with marginal costs more than or equal to  $c_n$  locate themselves in country  $a$  and the rest locate in country  $b$ .*

Proof: Without loss of any generality assume that  $c_1 > c_2 > \dots > c_N$  and that  $c_i = c_{i+1} + \delta$ .

Consider first a situation where firm 1 (the most inefficient firm) is located in country  $a$  and all the firms (including firm 1) are located in country  $b$ . From assumption 2 we know that firm 1 makes more profit when it is in country  $a$  than when it is in country  $b$  with all the other firms. That is,  $\pi_1^a(1) > \pi_1^b(1)$ . Next consider the case where firms 1 and 2 are located in country  $a$  and all other firms (including firm 2) are located in country  $b$ . From Lemma 1, we know that  $\pi_2^a(2) < \pi_1^a(1)$  and  $\pi_2^b(2) > \pi_1^b(1)$ . If  $\pi_2^a(2) < \pi_2^b(2)$ , the equilibrium allocation is where only firm 1 locates itself in country  $a$ , and the rest in country  $b$ . If not, we continue to bring the highest-cost firm from country  $b$  to country  $a$  until for some  $n$  we have  $\pi_{n+1}^a(n+1) < \pi_{n+1}^b(n+1)$ , and in this case firms 1,  $\dots$ ,  $n$  locate in country  $a$  and firms  $n+1, \dots, N$  in country  $b$ . The existence of a unique  $n$  is assured because of Lemma 1 and Assumption 2. The equilibrium is depicted in figure 1: point A is the equilibrium.  $\square$

[Figure 1 here]

The above proposition predicts that relatively inefficient firms make export-oriented FDI, and the more inefficient firms serve the markets in the host countries. One intuitive reason for the above result is that the export-oriented host country makes it more attractive for the less efficient firms to invest there as it suffers from unemployment and less efficient firms, *ceteris paribus*, create more employment.

We now consider two comparative-static exercises. First, as the distance between two consecutive marginal costs  $\delta$  increases, from (A.1)-(A.4) it follows that, for each  $n$ ,  $\pi_n^a(n)$  increases and  $\pi_n^b(n)$  decreases. In figure 1, the new equilibrium is given by point B, and it should be clear that equilibrium value of  $n$  increases. Noting that an increase in  $\delta$  increases the dispersion of the marginal costs and our model predicts that increased dispersion in efficiency levels will increase export-oriented FDI and decreases FDI in consuming countries. An increase in  $\delta$  makes the firms more attractive for the export-oriented country as they create more employment and less attractive for the consuming country as increased inefficiency decreases consumers' surplus. This raises the profit of the marginal firm in country  $a$  and reduces that in country  $b$  resulting a switch for some firms from country  $b$  to  $a$ .

Finally, consider an increase in  $c_1$  which will shift the distribution of marginal costs to the right. From (A.1)-(A.4) we find that such an increase will not change  $\pi_n^a(n)$ , but will decrease  $\pi_n^b(n)$ . The equilibrium point will move to point C in figure 1 increasing the equilibrium value of  $n$ . This result predicts that a decrease in the average efficiency level will increase export-oriented FDI.

Having derived a few theoretical predictions about the location of FDI, in the next section we shall test these hypotheses using firm-level data from Japan.

### 3 An empirical investigation

This section is devoted to an empirical investigation of our theoretical predictions. The most important testable hypothesis derived from our theoretical model is that relatively less efficient firms are more likely to make export-oriented FDI. Another prediction is that a higher dispersion in the efficiency levels results in more export-oriented FDI and less FDI to serve the host markets. We will test these hypotheses directly using firm-level data.

#### 3.1 Description of data

We derive firm-level data from the *Basic Survey of Commercial and Manufacturing Structure and Activity* (*Sho-Kogyo Jittai Kihon Chosa* in Japanese).<sup>4</sup> This survey covers 118,300 Japanese manufacturers without any firm-size thresholds in all manufacturing industries,<sup>5</sup> and contains a range of data for the year 1998, such as sales, the number of employees, capital, R&D spending, the number of personal computers used in the firm, and industry classification.<sup>6</sup> The number of firms in our sample is much larger than those used by previous studies on FDI, ensuring that the survey provides an accurate representation of the entire manufacturing sector in Japan.

The survey captures FDI in terms of the number of foreign subsidiaries/affiliates. Regarding regional destinations of FDI, Asia is considered separately from the rest of the world, while no further geographical disaggregation is available in the survey.<sup>7</sup> As FDI from Japan predominantly go either into US, EU, and Asia, we take Asian countries to be export-oriented ones and the rest of the world as consuming countries, corresponding to the

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<sup>4</sup>The access to micro-data files was made possible by by Ministry of Public Management, Government of Japan (Permission No. 428). The micro-data tabulations were done by one of the authors. Any researcher can have access to the same data set as long as she/he obtains individual official permission from the government in advance.

<sup>5</sup>This paper focuses on manufacturing, though commercial sectors are also covered by the survey.

<sup>6</sup>The *Basic Survey of Business Structure and Activities* (*Kigyō Katsudō Kihon Chosa* in Japanese) also contain similar data, but only for limited numbers of large firms (defined as those with more than fifty employees and capital of more than thirty million yen).

<sup>7</sup>Foreign affiliates with ownership shares of less than twenty percent are not identified with geographical disaggregation.

classification in theoretical section. This approximation is consistent with stylised facts that many Japanese firms invest in Asia for the export-platform purpose and in US and EU for the proximity to consumers. For example, the aggregate statistics from the *Basic Survey of Overseas Business Activities* (*Kaigai Jigyo-katsudo Kihon Chosa*, in Japanese) confirm that more than ninety percent of the output produced by Japanese-owned manufacturing affiliates located in North America or in Europe are sold within the region, but one-third of the output produced by Japanese manufacturing affiliates in Asia are exported to other regions.<sup>8</sup> This contrast justifies our assumption.

### 3.2 Summary statistics

Some descriptive statistics are summarized in Table 1. We can exploit rich cross-firm variability in our sample, as the standard deviations are much larger than the averages. Among the firms that invest abroad, on average, a firm has nine foreign affiliates, six of them being located in Asia.

Table 2 reports intra-industry dispersions of productivity and the share of export-oriented countries in FDI for each industry, directly calculated from our firm-level data. The industries are defined at the two-digit level because some of the three-digit industries include very few firms. Our theoretical model predicts that a higher intra-industry efficiency dispersion results in more firms investing in export-oriented countries. Descriptive statistics shown in Table 2 clearly supports our prediction. Here, we measure the dispersion in terms of the coefficient of variations, which is defined as the standard deviations divided by the mean. The efficiency is here measured in the labor productivity (sales divided by the number of regular employees) because no cost data are available at the firm level. More inter-firm dispersion in productivity within each industry is associated with higher share of

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<sup>8</sup>The share of intra-region sales in 2002 (the most recent year currently available) are 94.7% for North America, 93.3% for Europe, and 66.8% for Asia. This contrast remains stable over the years. Basic Survey of Overseas Business Activities is the unique data source for intra-firm trade, but its sample size is severely limited. Our survey has no intra-firm trade data but covers sufficient number of firms to be representative of the whole manufacturing.

firms investing in Asia. For example, the productivity tends to be especially dispersed across firms in export-dependent industries investing heavily in Asia such as textiles, apparels, and electric machinery. On the other hand, the transport equipment industry is characterized by relatively low intra-industry productivity dispersion and high propensity to invest for proximity to consumers. The correlation between these two variables is as high as 0.327 if we exclude the miscellaneous industries for which intra-industry measures cannot be appropriately defined.<sup>9</sup> Thus, by using firm-level data for Japan, in line with Helpman *et al.* (2004) we can tentatively confirm an important role of intra-industry dispersion in the firm's efficiency levels for their FDI decision. As noted before, whereas Helpman *et al.* (2004) are concerned with choice between FDI and exports, we analyze the choice between two types of FDI.

To further examine the productivity effects not summarized by the descriptive data presented in this subsection, the next subsection directly estimates a multinomial response model formalizing each firm's choice of FDI destinations.

### 3.3 Empirical specifications

A firm chooses one of the following three options: (a) investing only or mostly in export-oriented countries, (b) investing only or mostly in consuming countries, or (c) staying in the home country and therefore not taking part in FDI. Our theoretical model focused only on (a) and (b); Helpman *et al.* (2004) on the other hand considered (b) and (c). In reality, the choice often involves all three options. To allow for purely domestic firms, we add the third option. As a robustness check, we also estimate the binomial Logit model where a firm's choice is only between options (a) and (b). This is done for the sub-sample of firms that do take part in FDI.

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<sup>9</sup>The correlation remains positive (0.15) even if the miscellaneous industries (34) are included.

We estimate the Multinomial Logit model specified as follows.

$$P(y = j/x) = \frac{\exp(x\beta_j)}{1 + \sum_{k=1}^3 \exp(x\beta_k)}, \quad (j = 1, 2, 3).$$

The choice of the firm is denoted by  $y$ . To take account that some firms simultaneously invest in both regions, a firm is defined to invest mostly in consuming countries (export-oriented countries, respectively) when the number of the firm's foreign affiliates located in consuming countries is larger (no less) than that in export-oriented countries.

Since we include industry dummies to control for any inter-industry variations, and since most of the variations in wages are likely to be across industries, we can regard the ordering of firms in cost as the same as that in labor productivity by assuming that wage rates are the same across firms within the same industry.

As for the regressor vector  $x$  explaining a firm's choice  $y$ , we use the firm's labor productivity  $Q/L$ . To check the robustness, we also use three other alternative proxies for productivity. They are firm size (in sales), domestic market share,<sup>10</sup> and ATPF (Approximate Total Factor Productivity) defined by:<sup>11</sup>

$$\text{ATPF} = \ln \frac{Q}{L} - \frac{1}{3} \cdot \ln \frac{K}{L}.$$

To control for other relevant factors, we also estimate alternative specifications which additionally include capital-labor ratio (physical tangible assets divided by the number of regular employees), R&D intensity (R&D-sales ratio), the computer-usage intensity (the number of personal computers used in the firm normalized by the firm size), and the intra-industry productivity dispersion.<sup>12</sup>

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<sup>10</sup>The size of a firm or its share in the home market are good proxies because in most models these variables are positively related with productivity.

<sup>11</sup>For the definition of ATPF, see, for example, Griliches and Mairesse (1990).

<sup>12</sup>All the explanatory variables, except dummies, are in logarithm. Before taking logarithm, we add one to R&D intensity and PC-usage intensity to take care of a large number of firms with zero R&D spending or no computers.



### 3.4 Estimation results

The estimation results from the multinomial response model are reported in Table 3. Inter-firm heteroskedasticity is taken into account in the estimations. The coefficient on productivity is statistically significant at any conventional significance levels. As the response probability of the choice  $j$  relative to the base category (no FDI in the first five cases) is given by  $p_j/p_0 = \exp(x\beta_j)$ , the significantly positive estimate on the productivity indicates that more efficient firms are more likely to invest abroad rather than choosing the domestic option (no FDI).

Furthermore, we find that the productivity coefficient is larger for FDI in consuming countries than FDI in export-oriented countries in all cases reported in Table 3. As the log-odds ratio of any two choices is given by  $\log[p_j/p_k] = x(\beta_j - \beta_k)$ , this implies that a higher productivity of a firm is associated with a firm's choice of FDI in consuming countries relative to the choice of FDI in export-oriented countries. Thus, high productivity leads firms to choose FDI in consuming countries compared not only with the no FDI option but also with the choice of investing in export-oriented countries.

To get an economic sense of the magnitude of the estimates, we calculate the effect of productivity changes on the relative response probability. As the difference in the productivity coefficient estimate, which is interpreted as the elasticity of odd ratio with respect to productivity, is estimated at around 0.2. The probability of a firm choosing FDI in consuming countries relative to that in export-oriented countries (Asia) increases from 0.45 to 0.59 when the productivity of a firm rises by one-standard deviation from the mean in our sample.<sup>13</sup> Thus, the impact of productivity on a firm's destination choice of FDI is quite sizable.

Our principal finding is not affected by the use of alternative productivity measures,

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<sup>13</sup>The mean relative probability is calculated from the share of ROW relative to Asia in terms of the average number of foreign affiliates. Other figures are also derived from Table 1.

as reported in rows (2), (3) and (4) of Table 3. Row (5) of the same table shows that the inclusion of other controls does not affect our results. The estimated sign indicate that the probability of investing in consuming countries compared with export-oriented countries is higher when the firm’s capital-labor ratio, R&D intensity, or the computer usage intensity is higher.

On the effect of intra-industry productivity dispersion on a firm’s choice, we confirm our theoretical prediction. We use two alternative definitions of dispersion: coefficient of variation in row (6) and standard deviation in row (7). As reported in these two rows, when the inter-firm dispersion within an industry is larger, a firm in the industry invests in export-oriented/consuming countries with higher/lower probability, *ceteris paribus*. This relation is found statistically significant at any conventional significance levels. Even with this dispersion as an additional right hand side variable, the estimated coefficient on the productivity remains higher for FDI in consuming countries than FDI in export-oriented countries. It is also worth noting that in both row (6) and row (7), the coefficient for dispersion is positive for export-oriented countries and negative for consuming countries. Thus, whereas a higher dispersion increases the probability of investing in export-oriented countries relative to investing only at home, it decreases the probability of investing in consuming countries relative to staying at home. This contrast is interesting as it indicates that it is important to distinguish between the two types of FDI we consider here.

In the theoretical section we also predicted that a decrease in average productivity (an increase in  $c_1$ ) increases FDI in export-oriented country and decreases that in the consuming country. In order to test this prediction, we include average industry productivity as one of the regressors in row (7). The result demonstrates that the probability of investing in export-oriented countries increases significantly when the average productivity level decreases, supporting our theoretical prediction.<sup>14</sup>

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<sup>14</sup>It should be noted that average productivity does not have a statistically significant impact on decreasing the probability of investing in consuming countries, though the sign is as predicted. The effect for the export-oriented country is statistically significant.

As the final robustness check, we exclude all the firms without FDI and concentrate on the binary choice between options (a) and (b) described above. As reported in the last row of the table, our main results remain the same. Consequently, our finding is robust to the inclusion of a large number of purely domestic firms.

## 4 Conclusion

In view of the enormous importance of foreign direct investment (FDI) in the highly integrated world economy today, not surprisingly the literature on FDI is voluminous. Many different aspects of it have been examined using many different theoretical frameworks. In recent years, there have been an recognition that different types of firm heterogeneities can to an extent explain different modes of serving the global market place such as direct exports, outsourcing, greenfield FDI, cross-border acquisitions etc.

In this paper, we developed a theoretical model where a number of firms which differ in their efficiency levels, make a choice between export-oriented FDI and FDI for serving the market in the host country. Thus our model complements the existing literature by extending the set of options for foreign firms. Our theoretical model predict that relatively less efficient firms are more likely to make export-oriented FDI. To be more specific, we find an equilibrium allocation of firms between the two host countries such that firms at the lower end of the efficiency distribution make FDI in a host country and export all their outputs back to their home country, and the firm at the higher end of the efficiency distribution invest to serve the market in the host country. In the second half of the paper we test our theoretical prediction empirically, using multinomial logit analysis, for the Japanese manufacturing sector. We find that our data set strongly support the theoretical predictions we derived in this paper.

	Average	Standard Deviation
FDI total	9.387	14.564
FDI in Asia	6.468	7.761
Productivity	18.47	28.29
Firm size	2,629	45,975

**Notes:** FDI is measured by the number of foreign affiliates with ownership shares no less than 20%. Productivity is labor productivity (sales over the number of regular employees). Firm size is in sales (in million yen). The statistics are calculated only over firms for which there are data.

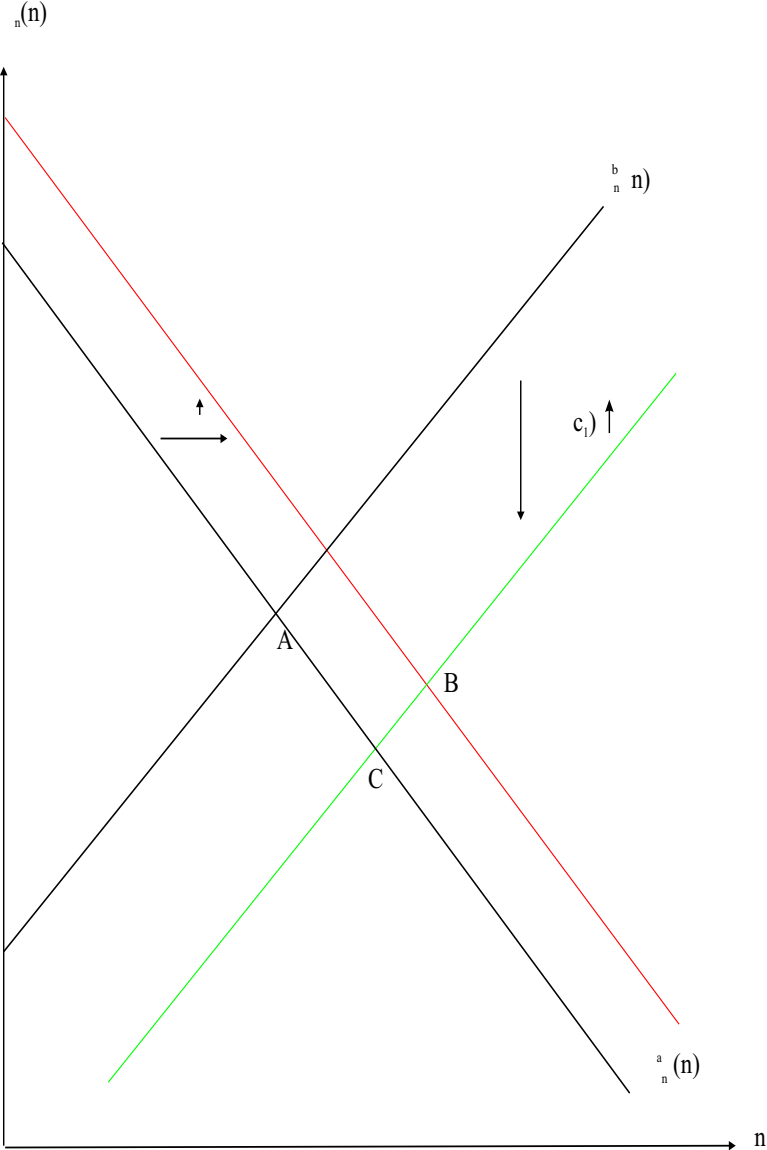
Industry	Intra-industry Dispersion of Productivity	% Share of Export-oriented Countries in FDI
12. Food manufacturing	0.905	68.9
13. Beverages, Tobacco & Feed	0.704	53.9
14. Textile	1.121	82.5
15. Apparel & Textile products	1.118	92.6
16. Timber & Wooden products	0.685	65.0
17. Furniture & Fixture	0.551	75.5
18. Pulp & Paper products	0.558	61.7
19. Printing & Publishing	0.691	60.9
20. Chemical products	0.647	67.4
21. Petroleum & Coal products	1.009	61.9
22. Plastic products	0.732	91.2
23. Rubber products	0.579	78.9
24. Leather & Fur products	0.729	88.9
25. Ceramic, Stone & Clay products	0.655	75.3
26. Iron & Steel	0.614	75.3
27. Nonferrous Metals	0.688	85.1
28. Metal products	0.604	76.8
29. General Machinery	0.633	63.2
30. Electric Machinery	0.795	77.4
31. Transportation Equipment	0.566	65.3
32. Precision Instruments	0.533	64.7
34. Miscellaneous manufacturing	1.805	70.4
Correlation	0.327	

**Notes:** The first column lists two-digit industries. The second column measures intra-industry dispersion in terms of the coefficient of variations. The third column is the percentage share of firms with more affiliates in Asia than in other regions. All figures are defined for firms investing overseas. The miscellaneous industries (34) are excluded from the cross-industry correlation.

Table 3: Results from Multinomial Logit model				
Model #	Explanatory variables ↓	FDI in Consuming Countries	FDI in Export-oriented Countries	STATISTICS
(1)	Productivity	1.390 (0.031)	1.169 (0.021)	Pseudo R <sup>2</sup> =0.141 # Firms =118,300
(2)	Firm size	1.192 (0.021)	0.951 (0.013)	Pseudo R <sup>2</sup> =0.337 # Firms =118,300
(3)	Domestic Market Share	1.158 (0.021)	0.934 (0.013)	Pseudo R <sup>2</sup> =0.324 # Firms =118,300
(4)	ATFP	0.914 (0.030)	0.802 (0.020)	Pseudo R <sup>2</sup> =0.072 # Firms =95,645
(5)	Productivity Capital/Labor R&D/Sales PC/Sales	1.119 (0.038) 0.474 (0.027) 9.830 (1.569) 2.537 (0.337)	0.925 (0.024) 0.311 (0.017) 8.385 (1.146) 0.568 (1.207)	Pseudo R <sup>2</sup> =0.144 # Firms =95,645
(6)	Productivity Capital/Labor R&D/Sales PC/Sales Coefficient of Variation	1.067 (0.035) 0.402 (0.026) 11.681 (1.739) 2.901 (0.474) -0.562 (0.173)	0.902 (0.023) 0.240 (0.016) 9.974 (1.265) 2.051 (0.505) 0.254 (0.077)	Pseudo R <sup>2</sup> = 0.109 # Firms =95,645
(7)	Productivity Capital/Labor R&D/Sales PC/Sales St. Deviation Av. Industry Productivity	1.091 (0.035) 0.416 (0.026) 11.804 (1.756) 2.940 (0.442) -0.485 (0.169) -0.020 (0.229)	0.936 (0.023) 0.260 (0.016) 10.180 (1.282) 2.046 (0.528) 0.351 (0.076) -1.204 (0.143)	Pseudo R <sup>2</sup> =0.111 # Firms =95,645
(8)	Productivity	0.241 (0.078)		Pseudo R <sup>2</sup> =0.082 # Firms =3,495

**Notes:** The base category is no FDI for the first seven cases, while the last row reports the binomial estimate relative to FDI in export-oriented countries, excluding no-FDI firms. Heteroskedasticity-robust standard errors are in parentheses. Industry dummies are included in all cases except (6) and (7). All the explanatory variables, except dummies, are in logarithm.

Figure 1: The Equilibrium Distribution of Firms



## Appendix: Proof of Lemma 1

When  $c_i = c_{i+1} - \delta$ , equations (24) and (25) reduce to

$$x_n^a = \frac{\alpha_c}{2\beta_c(n+1)} + \frac{1}{\beta_c} \cdot \frac{(n-1)\delta}{2}, \quad (\text{A.1})$$

$$x_n^b = \frac{\alpha_b - c_n}{\beta_b(N-n+3)} - \frac{N-n+2}{\beta_b(N-n+3)} \cdot \frac{(N-n)\delta}{2}, \quad (\text{A.2})$$

From (5), (6), (7) and (8), we get

$$\pi_n^a(n) = \beta_c (x_n^a)^2, \quad (\text{A.3})$$

$$\pi_n^b(n) = \beta_b (x_n^b)^2. \quad (\text{A.4})$$

From (A.2) and (A.4) it immediately follows that  $\pi_n^b(n)$  is an increasing function of  $n$ . From (A.1), it can be shown that  $x_n^a$  is a decreasing function of  $n$  if  $\alpha_c > (n+1)^2\delta$ . However, since  $c_{n+2} = c_1 - (n+1)\delta > 0$ , from assumption 1 it follows that  $\alpha_c > (n+1)^2\delta$  and thus  $x_n^a$  (and  $\pi_n^a(n)$ ) is indeed a decreasing function of  $n$ .  $\square$

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