Outward FDI and Performance at Home: Evidence from Japanese Manufacturing Firms

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Abstract: This paper empirically investigates changes in the firm behavior and performance at home before and after investing abroad in two dimensions. One dimension is the type of foreign direct investment (FDI): horizontal FDI and vertical FDI. The other dimension is the firm's domestic activities of interest: the production activity and the non-production activity. From the theoretical standpoint, the impact of outward FDI differs not only by the FDI type, but also between the firm's activities. By exploiting two kinds of firm-level data, this paper provides a more detailed picture of intra-firm changes in the behavior and performance through globalizing production.

***Keywords*:** FDI; multinational enterprises; propensity score matching
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1. Introduction

Due to the growing presence of developing countries as world's workshop, it is believed that developed countries turn out to specialize in non-production activities. For example, Baldwin (2006) states that: *East Asia is one of the wonders of the world. Like some gigantic, impossibly complex and wonderfully efficient factory, the region churns out millions of different products with world-beating price-quality ratios. It does this by sourcing billions of different parts and components from plants spread across a dozen nations. East Asian corporations set up "Factory Asia" and they are running it now.* Such expansion of production activities in developing countries has forced domestic plants to be shut down in developed countries, which induces anxiety over a hollowing out of domestic industry. In particular, around the year 2000, accompanied with acceleration of Japanese foreign direct investments (FDIs) to China, the fear reached a peak in Japan. Meanwhile, major activities in developed countries gradually shift to marketing and research and development (R&D) activities.

In the academic context, such a common perception is supported by the vertical FDI (VFDI) theory. FDIs are classified into two types on the basis of their purposes: horizontal FDI (HFDI) and VFDI. While the HFDI aims at avoiding broadly-defined trade costs by setting up production facilities within markets overseas rather than by exporting from the home country, the VFDI is a corporate strategy to exploit low-cost productive factors abundant in the host country. The VFDI firms are theoretically specified as relocating the activities in which the host country has comparative advantage to developing countries and domestically specializing in those in which the home country has comparative advantage. Since developed countries are often modeled as knowledge-abundant compared to developing countries, the VFDI firms are supposed to specialize in non-production activities or at least knowledge-intensive production activities at home.

In the empirical literature, changes in the firm behavior and performance at home before and after investing abroad have been explored from the perspective of the firm's production, factor inputs, and productivity. First, several studies examine whether multinational enterprises (MNEs) specialize in the production of particular products in which the home country has comparative advantage and, as a result, increase their production at home through investing abroad. This class of studies includes Hijzen et al. (2007) for Japanese multinationals, Navaretti and Castellani (2004) for Italian multinationals, and Navaretti et al. (2006) for French and Italian multinationals. Navaretti et al. (2006) explicitly distinguishes between HFDI and VFDI and find that MNEs increase their domestic production only through conducting the VFDI. The second class of studies explores the changes in the skill-intensity, i.e., the ratio of skilled labor to unskilled labor, of the firm's domestic production. Most of studies including Castellani et al. (2008) for Italian multinationals and Hijzen et al. (2006) for French multinationals find an insignificant impact of VFDI on the skill-intensity, unlike what we argued above. The third class of studies focuses on so-called "learning effect" and examines whether investment abroad raises productivity at home. Examples include Hijzen et al. (2007) for Japanese multinationals, Navaretti and Castellani (2004) and Navaretti et al. (2006) for Italian multinationals. As for French multinationals, Hijzen et al. (2006) and Navaretti et al. (2006) obtain a statistically significant result of the improved productivity through conducting HFDI but not through conducting VFDI.

The aim of this paper is to empirically investigate the impacts of outward FDI on

the firm behavior and performance at home in two dimensions. One dimension is the FDI type: HFDI and VFDI. As illustrated in the next section, since the impacts of investment abroad are different between HFDI and VFDI, it is important to examine such impacts according to the FDI type. Also, the impacts of investment abroad differ between types of the firms' home activities, which are the other dimension: the production activity and the non-production activity. Since we examine the impacts on employment in those two activities separately, our paper is particularly related to the above second class of the literature: whether or not a firm raises the skill-intensity of its domestic production through investing abroad. Compared with the previous studies, this paper investigates the difference in the impacts of outward FDI between the firm's production and non-production activities at home more comprehensively. To be more precise, we further look into the different impacts of outward FDI on not only employment but also wages and productivity between the production and non-production activities. These examinations enable us to know a more detailed picture of intra-firm changes in behavior and performance through globalizing production bases.

We presume that non-production activities such as marketing and R&D activities, in which knowledge-abundant developed countries are publicly expected to gradually specialize, require high-skilled labor. As for non-production activities in manufacturing plants, however, most of them would not require such high-skilled labor. Thus, instead of defining all the activities conducted by white workers as the non-production activity, it appears to be appropriate to distinguish non-production activities in non-manufacturing establishments from those in manufacturing plants. In this paper, all the activities in manufacturing plants and all those in non-manufacturing establishments are classified as the production activity and the non-production activity, respectively. To this end, we construct our dataset by combining two kinds of data on Japanese business activities: ready-made firm-level data and the census of manufactures, which is aggregated on a firm basis. The differences between the two types of firm-level data are regarded as the part that is accounted for by the non-production activity. Using such dataset, we explore the consequences of outward FDI in the two dimensions. In addition, as in the earlier studies, the causality issue of the firm's decision to invest abroad and the firm's performance is addressed by employing propensity score matching method.

The rest of this paper is organized as follows: the next section provides the theoretical framework for empirical analysis. Section 3 specifies the empirical methodology employed in this paper and introduces our two-dimensional approach by exploiting the two types of firm-level data. The empirical results are presented in Section 4, and the last section concludes.

2. Theoretical Framework

This section discusses the entire picture of the impact of investment abroad on the firm behavior and performance by using a simple cost function. We specify a representative investing firm's cost function at home as follows:

$$C = c_P + c_N, \quad \text{where} \quad c_P = awx + f \quad \text{and} \quad c_N = bh.$$

The firm consists of two types of establishments: production plant(s) and non-production establishment(s). x represents a volume of output that the firm produces. c_P and c_N denote costs for production and non-production activities, respectively. The

cost for the production activity consists of variable cost (awx) and fixed cost (f). The latter includes cost for setting up production facilities. w denotes a composite of per-unit labor expenses. In the production activity, two types of labor forces are devoted; skilled labor and unskilled labor. Assuming a simple Cobb-Douglas production function, for example, we will obtain (a constant term is omitted): $w = w_S^{\alpha} w_U^{1-\alpha}$, where w_S and w_U are wages of skilled and unskilled labors, respectively ($w_S > w_U$). α and a are a Cobb-Douglas parameter and a technology parameter. The costs for the non-production activity include management cost, marketing cost, and R&D cost. b is labor requirement and h is unit-labor costs for the non-production activity.[1] The cost function can be rewritten as:

$$C = awx + bh + f.$$

In what follows, we consider two types of FDIs: HFDI and VFDI. In the case of the HFDI, a firm makes a decision on whether to market its products to the destination country by exporting them from the home country or by setting up production facilities within the host country and selling them locally. They choose an option with a higher total profit, which is the sum of gross profits from the home and host county markets. A firm can avoid the setup cost of production facilities by exporting its products from the home country, while the firm can save shipment cost by producing and selling locally through investing abroad, i.e., HFDI. Therefore, a firm conducts HFDI if the fixed cost is low enough with respect to the shipment cost.

The HFDI has the following impacts on the firm behavior at home. The volume of output in the home plant (x) unambiguously decreases because the firm will stop the production of the goods designed for the destination country after conducting HFDI. Since the product/product bundle that the firm manufactures at home does not change, the other parameters in the cost function for the production activity, particularly w, do not change basically. However, if the investing firm can enjoy knowledge/technology spillover from the overseas plant as pointed out in the literature, e.g., Navaretti et al. (2006), its technology might improve, which leads to a decrease in a. The impacts on the labor requirement for the non-production activity (b) also appear to be ambiguous. b rises with increasing need of supervision, coordination and control over the remotely located activities, but might decreases as marketing and R&D activities for the goods designed for the host country are also relocated to the country. The latter point has not been pointed out in the literature, but must be crucial from the marketing point of view that the closer the firm is located to a market, the more precisely and the less costly the firm could know the consumer's preference.

The impacts of the HFDI can be summarized as follows. First, the change in the number of non-production labors is ambiguous while that of production labors is likely to decrease. Second, although wages of production and non-production labors do not change basically, the increasing need of coordination may require non-production labor to be more highly-educated, which results in the rise in wages of non-production labors. Third, the cost efficiency measured by the average costs for both the production activity ($c_P/x = aw + f/x$) and the overall activities ($C/x = aw + (f + bh)/x$) is likely to be deteriorated due to the decrease in output. However, if the spillover effect works strongly or the domestic demand for non-production labor decreases substantially, the cost efficiency for both the production activity and the overall activities might hardly

[1] Including fixed cost also in the non-production activity does not affect the following discussion.

change. On the whole, the impacts of the HFDI on the investing firm's home performance are ambiguous or weak.

In the case of the VFDI, the investing firm relocates production activities abroad completely or partly. In this paper, the VFDI is considered as outward FDI through which the firm relocates unskilled-labor-intensive production activities to developing countries with abundant low-cost labor. The firm's decision on whether to relocate them depends on the joint profit from production activities at home and abroad with respect to the profit from the integrated production initially at home. The integrated production at home enables a firm to save costs for supervision, coordination and control over different activities in different locations. If a portion of production activities is relocated abroad by conducting VFDI, the investing firm incurs cost for the shipment of semi-finished products between the home and host countries as well as various costs to connect remotely located production activities/processes. A firm conducts VFDI if the costs required to manage cross-border production sharing are low enough and the difference in wages of production workers between the home and host countries is large enough to take advantage of the benefits of specialization.

The impacts of the VFDI on the firm behavior at home are presumed to be as follows. If the firm specializes in the skilled-labor-intensive production activity at home by conducting VFDI, wages of workers in the production activity (w) would rise due to the changes in composition of skilled and unskilled labor. Furthermore, the production labor inputs, i.e., the sum of skilled and unskilled production workers, might not be largely decreased if the firm can enjoy the expanding output by taking advantage of the benefits of cross-border production sharing. In the meantime, as the firm needs more non-production labor to manage cross-border production sharing, non-production labor requirement (b) would increase. The non-production labor may also be required to be more highly-educated, which results in the rise in wages of non-production labor. It should be noted, however, as the product/product bundle that the firm manufactures at home changes through conducting VFDI, the domestic output (x) before and after investing abroad is hardly comparable. The evaluation of the cost efficiency is therefore qualitatively difficult in the case of the VFDI.

These predictions on the sign of the effects of outward FDI on the firm behavior at home are tabulated in Table 1. We can point out many elements with conflicting effects on each performance variable, and the impact of outward FDI appears to be not straightforward. It is therefore necessary to empirically examine the impact of outward FDI, which is left to the next section.

=== Table 1 ===

3. Empirical Issues

This section begins by specifying the basic empirical methodology employed in this paper and explain the details of our two-dimensional approach.

3.1. Basic Methodology

In the literature of the impact of investment abroad on the firm behavior and performance at home, the selection bias has been pointed out as a sensitive issue. If the firm's decision to invest abroad, i.e., to become multinational, and the firm performance

are jointly determined, differences in the firm performance due to investment abroad are hardly distinguishable from those depending on other different characteristics between MNEs and non-MNEs. For instance, since investment abroad requires firms to incur a substantial amount of fixed cost, only the productive firms can become multinational by investing abroad (selection effect). Therefore, a simple comparison of the ex-post productivity of the investing firms with that of non-investing domestic firms is not appropriate. To control for such possible selection bias, this paper adopts matching techniques, specifically, the propensity score matching method of Rosenbaum and Rubin (1983).[2]

Our empirical procedures are as follows. The goal of this paper is to evaluate the causal effect of outward FDI on the firm performance/outcome indicators (y_{it}).[3] Let $FDI_{it} \in \{0, 1\}$ be a dummy variable which takes the value of one if firm i invested abroad for the first time in year t or zero otherwise. Note that the firms that had invested abroad prior to year t are excluded from our sample so as to focus exclusively on the impact of becoming multinational. The average effect of outward FDI on the performance of the firms that have actually invested abroad, i.e., the average treatment effect on the treated (ATT), is defined as:

$$\text{ATT} \equiv \text{E}\,(y^1_{it} - y^0_{it} \mid FDI_{it} = 1) = \text{E}\,(y^1_{it} \mid FDI_{it} = 1) - \text{E}\,(y^0_{it} \mid FDI_{it} = 1),$$

where y^1_{it} and y^0_{it} are the performance of firm i in year t for the cases with and without investing abroad, respectively. As is well known, we cannot observe the last term, i.e., the performance that firms would have on average experienced if they had not invested abroad. We can obtain a consistent estimator of the ATT by replacing the last term by the observable performance of non-investing firms, i.e., $\text{E}\,(y^0_{it} \mid FDI_{it} = 0)$, only if the term in curly brackets in the following equation is equal to zero.

$$\begin{aligned}\text{ATT} = \text{E}\,(y^1_{it} \mid FDI_{it} = 1) &- \text{E}\,(y^0_{it} \mid FDI_{it} = 0) \\ &+ \{\text{E}\,(y^0_{it} \mid FDI_{it} = 0) - \text{E}\,(y^0_{it} \mid FDI_{it} = 1)\}.\end{aligned}$$

Otherwise, the estimates suffer from so-called sample selection bias.

The solution advocated in Rosenbaum and Rubin (1983) is to find a vector of observable variables X affecting both the performance indicator y and the treatment variable FDI such that:

$$\{y^1, y^0\} \perp FDI \mid X, \quad 0 < P(FDI = 1 \mid X) < 1,$$

where $\perp$ represents mathematical independence, and $P(FDI=1|X)$ denotes the predicted probability conditional on X, i.e., propensity score, of investing abroad. In other words, X is assumed to capture all the inherent differences in performance between the treated group, i.e., the investing firms, and the control group, i.e., the non-investing domestic firms. This assumption is called conditional independence assumption (CIA). By using such a vector X, if firms have the same propensity score of investing abroad, the difference in performance of those firms purely represent the impact of outward FDI.

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[2] The economic application of matching estimator has been growing in recent years in various fields: the evaluation of policy intervention on labor market (Heckman et al., 1998; Blundell and Costa Dias, 2002), the effects of export or FDI on corporate performance (De Loecker, 2007; Navaretti and Castellani, 2004), and the effects of environmental regulation on the birth ratio of plants at the county level (List et al., 2003). The propensity score matching method becomes one of the most useful methods for analyzing impacts of an event, along with the traditional instrument variable method.

[3] The term "outcome" here means the firm's ex-post performance after investing abroad.

We first estimate the propensity score of investing abroad for both investing firm *i* and non-investing domestic firm *j* in year *t* as follows:

$$P_{ht}=P(FDI_{ht}=1|X_{ht}),\ h=i,\ j.$$[4]

Then, for investing firm *i* in year *t* with propensity score P_{it}, non-investing firm *j* in year *t* with propensity score P_{jt} is selected as an appropriate counterfactual such that:

$$|P_{it} - P_{jt}| = \min \{P_{it} - P_{kt}\},\ \text{where } k\in \{l|\ FDI_{lt} = 0\}.$$

In this paper, we perform one-to-one nearest neighbor matching method without replacement, imposing a common support by dropping observations of the treated group whose propensity score is higher than the maximum or lower than the minimum propensity score of the control group.

Next, we assess the impact of outward FDI by examining the difference in performance between the treated and control groups. The ATT estimator is given by:

$$\alpha_{ATT} = \frac{1}{n}\sum\nolimits_{i\in I}\left[y_{it}^{1} - y_{jt}^{0}\right],$$

where *I* is a set of investing firms within a common support and *n* is the number of those firms. Note that, as we employ the one-to-one nearest neighbor matching method without replacement, investing firm *i* is matched exclusively with the nearest non-investing firm *j* in terms of propensity score. If the factors that are not accounted for by *X* affect the firm's decision to invest abroad as well as the firm performance, the above ATT estimator loses its consistency. To control for the remaining selection bias due to unobservable factors such as firm characteristics and common macro effects, instead of the ATT estimator, we employ difference-in-difference (DID) estimator along the line of Heckman et al. (1997). The DID estimator compares changes in performance of firm *i* one year before and *s* years after investing abroad with those of the corresponding firm *j* as follows:

$$\alpha_{DID} = \frac{1}{n}\sum\nolimits_{i\in I}\left[(y_{i,t+s}^{1} - y_{i,t-1}^{1}) - (y_{j,t+s}^{0} - y_{j,t-1}^{0})\right].$$

The DID estimator can be obtained as α by estimating the following equation using OLS:

$$\left(y_{h,t+s} - y_{h,t-1}\right) = \delta + \alpha d_{h,t} + \varepsilon_{h,t},$$

where $d_{h,t}$ is a dummy variable which takes the value of one if firm *h* invested abroad, i.e., *h*=*i*, in year *t* or zero otherwise, i.e., *h*=*j*. The OLS regression is conducted for each of the years from the year of investing abroad (*t*) to three years after the investment (*t*+3).

The validity of the estimation of propensity score and the matching based on the estimated propensity score is also statistically tested. If the investing firm is matched with the non-investing firm which has the nearest propensity score in an appropriate way, the distribution of *X* must be almost the same for the treated and control groups. This condition is known as the balancing property:

$$FDI \perp X \mid P(FDI = 1 \mid X),$$

which means that, for a given propensity score, the investing and non-investing firms should be on average identical. To check whether the balancing property is satisfied, we test the equality of means for all variables *X* between the investing and non-investing firms.

[4] How to estimate the propensity score of investing abroad is explained in the following subsection.

3.2. Two-dimensional Approach

The impacts of outward FDI on the firm behavior and performance are investigated in two dimensions. One dimension is the type of FDI: HFDI and VFDI. Following Hijzen et al. (2006), FDIs are classified simply according to the destination country; the FDIs in developed countries are regarded as HFDI and those in developing countries as VFDI.[5] The other dimension is the firm's domestic activities of interest: production and non-production activities. As argued in Section 2, the impact of outward FDI differs not only by the FDI type but also between the firm's production and non-production activities. We presume that non-production activities such as marketing and R&D activities require high skills. Most of non-production workers in manufacturing plants, however, would engage in activities that do not necessarily require such high skills. Therefore, in this paper, we classify all the activities in manufacturing plants and all those in non-manufacturing establishments as the production activity and the non-production activity, respectively. Such a way of classification would enable us to capture the non-production activity as what we generally imagine.

To examine impacts of outward FDI at the production activity level and the non-production activity level separately, two kinds of firm-level data are exploited. One is ready-made firm-level data, the main data source of which is the firm-level survey, "Basic Survey of Japanese Business Structure and Activities" (METI, 1994- ; hereafter BSJBSA). The purpose of the BSJBSA is to statistically capture the overall picture of Japanese corporate firms in terms of the diversification and globalization of corporate activities and corporate strategies on R&D and others.[6] This firm-level data are used in constructing variables at the overall activity level. The other firm-level data are constructed by aggregating the manufacturing plant-level census data, "Census of Manufactures" (METI, 1909-), on a firm basis.[7] Data on establishments located within Japan, e.g., location, the number of employees, the value of tangible assets, and the value of shipments, are available at the plant level in this census.[8] The latter aggregated firm-level data are useful in constructing variables at the production activity level. The differences between the overall activity data and the production activity data are regarded as the part that is accounted for by the non-production activity, and are used in calculating performance indicators at the non-production activity level. Consequently, we have three kinds of firm-level data in hand: the overall activity data, the production activity data, and the non-production activity data. In addition, "Basic Survey of Overseas Business Activities" (METI, 1995- ; hereafter BSOBA) is used so as to link the information on outward FDI to the above firm-level data. Data on Japanese overseas affiliates, e.g., location, the year of establishment, the number of employees, industry classification, are available in the BSOBA.

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[5] Developed countries here include European countries, Canada, and the United States; the other countries are regarded as developing countries.

[6] All the firms with more than 50 employees and with capital of more than 30 million yen are included in the survey.

[7] For the details of the data construction, see Matsuura et al. (2008).

[8] Plants with less than 30 employees are excluded from the sample in this paper, because they do not provide the information on capital, which is indispensible for estimating the productivity measure, TFP.

In the matching analysis, we estimate the propensity score of conducting HFDI and VFDI for all the firms in our sample form the year 1993 to the year 2004 by running a multinomial logit regression. As explanatory variables in the logit regression, the firm's characteristics (*X*), which affect the firm performance (*y*) as well as the firm's decision on whether to invest abroad (*FDI*), are required to be included. Specifically, we include the number of employees, the capital-labor ratio, the proportion of R&D expenditure in total sales, the export dummy variable which takes the value of one if a firm engages in exporting, profit per sales, productivity, and the firm's age. While the productivity is calculated at the firm's production activity level, other explanatory variables are obtained at the firm's overall activity level. All these explanatory variables are in logarithmic forms except for the export dummy and are lagged one year using data during 1992-2003 so as to avoid to some extent the simultaneity issue between the firm's decision to invest abroad and the firm's characteristics. Industry and year dummies are also included in the regression.

The outcome indicators to be examined are the number of production/non-production labors, wages of production/non-production labors, productivity of the overall/production activity. As for the productivity measure, following Caves et al. (1982, 1983) and Good et al. (1983), the TFP index is calculated both at the overall activity level and the production activity level:

$$TFP_{it} = \left(\ln Q_{it} - \overline{\ln Q_t}\right) - \sum_{j=1}^{J} \frac{1}{2}\left(s_{ijt} + \overline{s_{jt}}\right)\left(\ln X_{ijt} + \overline{\ln X_{jt}}\right)$$
$$+ \sum_{s=1}^{t}\left(\overline{\ln Q_s} - \overline{\ln Q_{s-t}}\right) - \sum_{s=1}^{t}\sum_{j=1}^{J} \frac{1}{2}\left(\overline{s_{js}} + \overline{s_{js-1}}\right)\left(\overline{\ln X_{js}} - \overline{\ln X_{js-1}}\right) \quad ,$$

where Q_{it}, s_{ijt}, and X_{ijt} denote the gross output, the cost share of factor input *j*, and factor input *j* of firm *i* in year *t*, respectively. Variables with an upper bar denote the industrial averages, which are calculated as geometric means by industries for respective years. The first two terms on the right hand side of the equation denote the cross-sectional TFP index based on the Thiel=Tornqvist specification, with respect to the industrial average. Since this cross-sectional TFP index is not comparable across years, the growth rate of the industrial average TFP is also incorporated in the equation as the third and fourth terms.[9] To obtain the TFP index at the production activity level by aggregating the plant-level data on a firm basis, the TFP growth rate at the firm level is calculated as sales-weighted average of the TFP growth rate at the plant level.

Lastly, it should be noted that we restrict our sample only to firms with the positive number of non-production labors. As argued above, the number of non-production labors is calculated by subtracting the number of labors in the production activity data from that in the overall activity data. Conceptually, if a firm has only manufacturing plants, i.e., a firm does not have any non-production establishment such as those only with marketing function, the numbers of labors reported in the two data sources are exactly the same. But, because the primary purpose of this paper is to compare the impact of outward FDI between production and non-production activities, we need to focus on the firms with non-production establishments as well as manufacturing plants. The same modification applies to data on wages of non-production labors, which are calculated by dividing the total payment for them by their number. We drop the firms for which the total payment for labor reported in the

[9] For the details of the calculation of the TFP index, see Matsuura et al. (2008).

production activity data exceed that reported in the overall activity data.

4. Empirical Results

This section presents empirical results of the matching analysis, in particular, tests for changes in the firm behavior and performance before and after investing abroad. Before that, the simple sample means of our performance/outcome indicators are to be compared between investing firms and non-investing domestic firms.

4.1. Simple Comparison

Table 2 provides an overview of the firms in our sample. The number of firms investing abroad for the first time through HFDI or VFDI in each year is listed in the table. There are few HFDI firms during the sample period, 1993-2004, and Japanese firms seem to have hesitated to invest abroad for the first time since the latter half of the 1990s. There are two possible reasons for such a small number though some may be skeptical about the findings. The one reason is that most of Japanese multinationals conducted their first outward FDIs in the latter half of the 1980s, just after the Plaza accord. The other is that our dataset linked with the BSJBSA, in which small enterprises are not surveyed (see footnote 5), does not cover all the Japanese firms.

=== Table 2 ===

Table 3 reports the simple sample means of some performance/outcome indicators from the perspective of the firm's employment, wages, and cost efficiency/productivity. The means are listed by the firm's investment status, i.e., domestic, HFDI, or VFDI, and by the home activities, i.e., the overall activity level, the production activity level, or the non-production activity level. As argued above, this kind of comparison cannot distinguish selection effects or learning effects from the overall changes. Nonetheless, it might be still invaluable to examine cross-sectional differences in the firm performance according to their investment status and home activities.

=== Table 3 ===

First, the employment figures are surely larger for investing firms than non-investing domestic firms in both production and non-production activities. In particular, the volume of employment at the non-production activity level for the VFDI firms is outstanding, compared with that for not only the domestic firms but also the HFDI firms. This may indicate that the VFDI is a form of the investment that requires a lot of non-production workers. Another interesting finding is that the number of production labors exceeds that of non-production labors only for the HFDI firms. It can be pointed out that two types of FDIs have different features in terms of the type of intensively-used labor.

Second, the wage figures are also higher for the investing firms. As is consistent with the usual expectation, in any investment status, non-production labors receive the higher wages than production labors on average. Comparing among the investment states, we can find that wages of both production and non-production labors are much higher in the HFDI firms than in not only domestic firms but also the VFDI firms. In

particular, wages of non-production labors in the HFDI firms are outstanding. Although we interpreted above that the HFDI is a production-labor-intensive investment and does require less non-production labor compared with the VFDI, non-production labor in the HFDI firms may be highly-educated and high-skilled and, as a result, deserve better salaries. What may be not consistent with our expectation is that wages of non-production labors are lower in the VFDI firms than in domestic firms. Given the fact that the VFDI firms have relatively a large number of non-production labors, one possible interpretation is that most of workers may engage in the non-production activities that do not require high skills and the *average* wages are at the lowest level.

Third, the investing firms have higher TFP than the domestic firms. It may be interesting that the HFDI firms have higher TFP than the VFDI firms in both the overall activity and the production activity, particularly in the production activity. The differences in TFP among firms are attributed to not only differences in inherent technology but also changes in the product/product bundle manufactured by each firm. Yet, at least, we would say that the major products manufactured by the HFDI firms require relatively high technology.

Table 3 provides us valuable facts, but we need to further differentiate between selection and learning effects. In the simple comparison above, for example, we cannot know that the HFDI firms are production-labor-intensive by nature or increase the demand for production labor relative to non-production labor after investing abroad. Also, relatively high TFP in the HFDI firms may be due to their inherent attributes or due to a positive impact of investment abroad. The differentiation of these effects would turn out to be possible in the matching analysis.

4.2. Matching Analysis

To explore exclusively the learning effect of outward FDI, the matching analysis is conducted. The first step of the analysis is to select appropriate counterfactuals by estimating the propensity score of investing abroad for each firm and to match non-investing domestic firms with investing firms. The results of multinomial logit regression for the firm's decision to conduct HFDI/VFDI are reported in Table 4. The results seem to be good enough. Almost all the estimated coefficients have expected signs, and pseudo R-square is as high as the previous studies referred to in the introductory section. The significantly positive result for the TFP index in the HFDI equation are consistent with the hypothesis proposed by Helpman, Melitz, and Yeaple (2004): only firms with higher productivity can afford to pay expenses for investing abroad. In the VFDI equation, on the other hand, the estimated coefficient for TFP is positive but insignificant. As for other variables, we can conclude that large-scale firms in terms of the number of labors, capital-intensive firms, firms with good profitability, and exporting firms are more likely to invest abroad. However, R&D intensity and firm's age do not have significant effects on the firm's decision to invest abroad.

=== Table 4 ===

As in Navaretti et al. (2006), the matching of investing and non-investing firms is performed by year and sector. In order to confirm the validity of the estimation of propensity score of conducting the HFDI/VFDI and the matching based on the estimated propensity score, the balancing property of firm-specific explanatory

variables used in the multinomial logit regression is checked. Specifically, differences in the means of the firm-specific variables between the treated group, i.e., the HFDI/VFDI firms, and the control group, i.e., the non-investing domestic firms that are selected appropriately, are statistically tested. Results reported in Table 5 show that there are no significant differences in the means of all the firm characteristics, indicating that the specification of the propensity score function is plausible and the matching has been done successfully. As a further examination, the matching is also performed for each stratum by dividing the sample into several strata, in which the firms are similar in the propensity score, and the validity of the estimation of and the matching based on the propensity score is confirmed.

=== Table 5 ===

The next step is to estimate the DID estimator using OLS so as to assess the impact of outward FDI. Specifically, we statistically examine the difference in changes in the performance/outcome variables one year before and *s* years after investing abroad between the investing firms and their counterfactuals.

Results for the HFDI, i.e., FDI to developed countries, are reported in the upper part of Table 6. First, the HFDI does not affect significantly the number of not only non-production labors but also production labors. As mentioned in Section 2, there are two opposing effects on the number of non-production labors through conducting the HFDI. The increased need for more supervision, coordination and control over the remotely located activities leads to a growing demand for non-production labor while the relocation of marketing or R&D activities decreases the demand for non-production labor. These opposing effects may cancel each other out, resulting in a statistically insignificant result. As for production labor, although the production shift of the good designed for the host country should decrease the demand for production labor at home, we do not find significantly negative impact of the HFDI. A possible interpretation of this result is that the investing firms tend to reallocate workers, for example, to the production of the good for domestic use, rather than firing them immediately. Indeed, such tendency has been one of the well-known public views on Japanese employment practice: the speed of employment adjustment is slow in Japan, compared with other developed countries such as the US.

=== Table 6 ===

Second, with respect to the counterfactuals, the investing firms do not experience significant changes in wages of both production and non-production labors, which is consistent with our expectation explained in Section 2. The HFDI will affect the volume of the good produced at home but will not change the product/product bundle *per se*, and the HFDI firms are expected not to experience changes in labor quality and wages for the production activity. As for the insignificant impact of the HFDI on the wages of non-production labors, the HFDI firms seem not to require more highly-educated and high-skilled labor at home after investing abroad. The one possible interpretation of this result is that the coordination and control over the remotely located activities do not actually need such high skills that the workers deserve higher wages. The other is that, given the result of the multinomial logit regression that firms with higher productivity

are more likely to conduct the HFDI, the skills of workers engaging in the non-production activity of the HFDI firms may be high enough even before investing abroad. With the above result of the simple comparison analysis in mind, the latter interpretation appears to be more plausible.

Third, the TFP index is not significantly changed through conducting the HFDI at the overall activity level but is deteriorated at the production activity level in three years after investing abroad. The latter result implies that knowledge spillover effects are weak, that is, the decrease in a technology parameter *a* is not large enough to offset a rise in fixed cost per output. As for the improvement of TFP at the overall activity level, it is necessary that not only are spillover effects strong, but the total payment to non-production labor (*bh*) per output decreases drastically. Since both the number of non-production labors and their wages do not change significantly, as observed above, the total payment to non-production labor hardly changes. Thus, the efficiency at the overall activity level does not improve through conducting the HFDI though it would be good enough that the efficiency at the overall activity level has not been worsened.

The results for the VFDI, i.e., FDI to developing countries, are reported in the lower part of Table 6. As is expected, they are slightly different from the results for the HFDI firms. First, the number of production workers is not affected by conducting the VFDI while that of non-production labors is significantly increased in three years after investing abroad. The primary impact of the VFDI on employment in the production activity is considered to be a decrease in the number of production workers through specializing in a specific part of production processes at home. The insignificant result for the number of production workers can be interpreted as indicating that such a decrease is offset to some extent by increased demand for the production labor thanks to the output expansion by taking advantage of the benefits of cross-border production sharing. As for the number of non-production labors, the significant increase would be due to increased need for management of cross-border production sharing. Combined with the fact revealed in the above simple comparison analysis, a relatively large number of non-production labors in the VFDI firms are attributed at least partly to the learning effect through conducting the VFDI. These results are consistent with what is publicly believed in Japan: further integration to the East Asian region induces Japanese firms to specialize in non-production activities at home.

Second, as with the result for the number of labors, the VFDI do not affect the wages for production workers but raise those for non-production labors in three years after investing abroad. The former result is not consistent with our expectation that production activities are expected to be skilled-labor-intensive and wages of production workers are to rise through conducting the VFDI. A possible interpretation of this result is qualitatively the same as the case of employment. In Japan, the required level of skills in production processes may not be a crucial determinant of the wage level of workers, particularly that of production workers. Combined with the employment practice mentioned above, Japanese VFDI firms seem to reallocate the existing production workers to the processes that require higher skills, holding their wage levels unchanged. On the other hand, the reallocation of non-production labors appears to be relatively difficult. Even in Japan, it seems that wage levels of specialists (unfortunately, except for those of academic researchers!) depend more on the level of their knowledge and skills, compared with the case of production workers. Thus, a new employment of skilled workers in the non-production activity would significantly raise the (average)

wages of non-production labors.

Lastly, the TFP index is not significantly affected by the VFDI at the production activity level but is improved at the overall activity level for a year after investing abroad. As discussed in Section 2, however, the interpretation of this result is qualitatively difficult because the changes in productivity include not only technological change but also the change in product/product bundle manufactured by the firm at home. Nonetheless, it would be good for the VFDI firms that their productivity at the overall activity level improves through investing abroad.

5. Concluding Remarks

This paper empirically investigated changes in the firm behavior and performance before and after investing abroad in two dimensions. One dimension is the FDI type, i.e., HFDI or VFDI. The other dimension is the scope of the firm-level sample data, i.e., the overall activity level, the production activity level, or the non-production activity level. The impact of outward FDI differs not only by the FDI type but also between the firm's production and non-production activities. Our two-dimensional examinations succeeded in providing new insights into the intra-firm changes in the behavior and performance through globalizing production.

We have pointed out the difficulty in comparing the firm's ex-ante productivity with its ex-post productivity in the case of the VFDI firms. Since productivity in one product is not qualitatively comparable with that in the other product, the firm-level examination on the impact of the VFDI on the firm's productivity becomes empirically vacuous. Changes in the VFDI firm's productivity before and after investing abroad includes not only learning effect but also various elements attributed to changes in product/product bundle that the firm manufactures at home. To extract only the learning effect, we will need to focus on the productivity changes in the same product before and after investing abroad. If the VFDI firm relocate labor-intensive activities abroad and domestically specialize in non-labor-intensive activities, the comparison of its pre- and post-investing productivities in the non-labor-intensive activities would enable us to get a better grasp of consequences of the VFDI.

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Table 1. The Expected Sign in Impacts of FDIs, by Firms' Home Activity

Activity	HFDI	VFDI
Employment		
Production	-	-/0/+
Non-production	-/0/+	+
Wages		
Production	0	+
Non-production	0/+	0/+
Efficiency		
Overall	-/0/+	n.a.
Production	-/0/+	n.a.

Note: "n.a." means "not available".

Table 2. The Number of New Investing Firms

Year	HFDI	VFDI
1993	5	23
1994	8	46
1995	12	49
1996	7	37
1997	7	15
1998	4	5
1999	2	4
2000	2	6
2001	3	21
2002	0	15
2003	0	11
2004	1	7
Total	51	239

Table 3. The Firm Performance/outcome Variables: Sample Means

	Domestic	HFDI	VFDI
Labors: person			
Production	181	413	399
Non-production	233	360	403
Wages: million yen			
Production	4.78	5.90	5.30
Non-production	9.84	13.29	8.81
TFP			
Overall	0.97	1.02	1.01
Production	0.94	1.11	1.00

Table 4. Probability of Investing abroad: Multinomial-logit

	HFDI	VFDI
TFP	0.738**	0.102
	(0.33)	(0.22)
ln Labors	0.527***	0.547***
	(0.13)	(0.06)
ln KL ratio	0.694***	0.259***
	(0.17)	(0.08)
ln (Profit/Sales)	1.430***	1.067**
	(0.55)	(0.53)
ln (R&D/Sales)	0.552	-3.512
	(0.59)	(3.59)
Export dummy	0.721**	0.835***
	(0.33)	(0.16)
ln Age	-0.360	0.142
	(0.38)	(0.20)
Year Dummy	YES	YES
Industry Dummy	YES	YES
Number of obs	50,315	
LR chi2	456.825	
Pseudo R2	0.129	

Notes: Standard errors are in parentheses. ***, **, and * show 1%, 5%, and 10% significance, respectively.

Table 5. Testing for the Balancing Property: Test for Differences in Means

	Mean		
	Treated	Control	t-value
HFDI			
TFP	1.063	1.077	-0.18
ln Labors	6.111	6.179	-0.35
ln KL ratio	2.804	2.759	0.37
ln (Profit/Sales)	0.075	0.050	1.59
ln (R&D/Sales)	0.029	0.017	1.62
Export dummy	0.633	0.714	-0.86
ln Age	3.740	3.822	-1.18
VFDI			
TFP	0.979	0.971	0.28
ln Labors	6.069	5.996	0.77
ln KL ratio	2.461	2.421	0.52
ln (Profit/Sales)	0.041	0.039	0.38
ln (R&D/Sales)	0.013	0.012	0.40
Export dummy	0.586	0.643	-1.20
ln Age	3.787	3.797	-0.30

Table 6. The Effect of Investing abroad on Performance at Home: Means

	t	*t* +1	*t* +2	*t* +3
HFDI (FDI to Developed Countries)				
Labors				
Production	-0.020	0.002	-0.008	0.032
Non-production	-0.056	-0.076	0.088	0.161
Wages				
Production	0.015	0.008	0.034	-0.016
Non-production	0.088	0.118	0.456	0.313
Total Factor Productivity				
Overall	-0.004	-0.032	-0.039	-0.022
Production	0.020	-0.021	-0.045	-0.113*
VFDI (FDI to Developing Countries)				
Labors				
Production	0.023	0.040	0.005	0.013
Non-production	0.081	0.065	0.128	0.194*
Wages				
Production	-0.019	0.024	0.010	0.006
Non-production	0.129	0.149	0.109	0.232*
Total Factor Productivity				
Overall	0.027**	0.025*	0.024	-0.003
Production	0.007	0.009	0.025	0.002

Notes: The DID estimates obtained through the OLS regression by the FDI type for each of the performance/outcome variables are reported. ***, **, and * show 1%, 5%, and 10% significance, respectively.