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A Two-dimensional Analysis of the Impact of Outward FDI on Performance at Home: Evidence from Japanese manufacturing firms

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Abstract: This paper empirically investigates two areas of changes in firm behavior and performance at home before and after investing abroad. The first is the type of foreign direct investment (FDI): horizontal FDI or vertical FDI. The second is the firm's domestic activities of interest: production activity and non-production activity. From a theoretical standpoint, the impact of outward FDIs differs not only by type, but according to the firm's activities. By exploiting two types of firm-level data that enable us to distinguish between production and non-production activities, our work provides a detailed picture of the intra-firm changes in behavior and performance that occur as a result of globalizing production.

Keywords: FDI; multinational enterprises; propensity score matching
JEL Classification: F21; F23

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1. Introduction

Due to the growing presence of developing countries as the workshops of the world, it has been argued that developed countries have begun to specialize in non-production activities. For example, Baldwin (2006) states, "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 the closing of domestic plants in developed countries, which in turn has induced anxiety about the hollowing out of domestic industries. In particular, around the year 2000, the fear reached a peak in Japan, accompanied by the acceleration of Japanese foreign direct investments (FDIs) to China. At the same time, major activities in developed countries gradually began to shift to marketing and research and development (R&D).

From an academic perspective, these kinds of perceptions are supported by the theories of vertical FDI (VFDI). FDIs are classified into two types based on their purpose: horizontal FDIs (HFDI) and VFDIs. While the HFDI aims at avoiding broadly-defined trade costs by setting up production facilities within overseas markets rather than by exporting goods from the home country, the VFDI is a corporate strategy meant to exploit low-cost production factors abundant in the host country. VFDI firms are theoretically specified to relocate the activities in which the host country has a comparative advantage to developing countries, and specialize domestically in those activities in which the home country has a comparative advantage. Since developed countries are often modeled as knowledge-abundant compared to developing countries, VFDI firms are meant to specialize in non-production activities, or at least, knowledge-intensive production activities at home.

In the empirical literature, changes in 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 have examined whether multinational enterprises (MNEs) specialize in producing certain products in which their home country has a comparative advantage and, as a result, whether they 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 distinguish between HFDI and VFDI and find that

MNEs increase domestic production only through conducting VFDI. The second class of studies explores the changes in the firm's skill-intensity, i.e., the ratio of skilled workers to unskilled workers, at home. Most studies (including Castellani et al. (2008) for Italian multinationals and Hijzen et al. (2006) for French multinationals) find the impact of VFDI on skill-intensity to be insignificant, unlike what we argued above. The third class of studies focuses on the so-called "learning effect," and examines whether investment abroad raises productivity levels at home. Examples include Hijzen et al. (2007) for Japanese multinationals and 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 improved productivity by conducting HFDI, but not by conducting VFDI.

The aim of this paper is to empirically investigate the two dimensions of the effects of outward FDI on firm behavior and performance at home. The first dimension deals with the difference between HFDI and VFDI; as illustrated in the following section, because the consequences of investment abroad differ according to type, it is important to distinguish between HFDI and VFDI and examine the results. The effects of investment abroad on performance at home also differ among types of the firms' home activities of interest, which constitute the second dimension of FDI: production activity and non-production activity. Since we examine the impact of outward FDI on employment separately for these two activities, our paper relates particularly to the second class of the literature described above, that studies whether or not a firm raises the skill-intensity at home through investing abroad. Compared with previous studies, this paper investigates the difference of the impact of outward FDI between the firm's production and non-production activities at home comprehensively. To be precise, we highlight the different effects of outward FDI not only on employment but also on wages and productivity. In addition, we focus particularly on the impact of outward FDI in the machinery and equipment manufacturing sectors, which have developed the most extensive international production and distribution networks, along with active cross-border trade and investments.[1]

Our two-dimensional analysis will deepen our comprehensive understanding of the effects of outward FDIs on performance at home. As mentioned above, it is largely believed that increased FDIs to developing countries allow for the investing developed countries to specialize in non-production activities, such as marketing and R&D. Since previous studies have essentially examined only the impact that FDIs to developing

[1] Machinery and equipment manufacturing sector includes general machinery, electric machinery and precision instrument manufacturing sectors.

countries have on production activities at home, it remains unknown whether or not such a public view holds up to rigorous analysis. This paper, hence, explores the impact of outward FDIs not only on production activities but also on non-production activities. Thus, we will be able to say with certainty whether or not FDIs to developing countries result in the specialization of non-production activities, or more skilled-labor-intensive activities inside the developed country.

The rest of this paper is organized as follows: Section 2 provides a theoretical framework for empirical analysis. Section 3 specifies the empirical methodology employed in the paper and introduces our two-dimensional approach by exploiting 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 big picture of the impact of investment abroad on firm behavior and performance. In what follows, we examine the impact of two types of FDIs — HFDI and VFDI — on employment, wages, and cost efficiency for production as well as for non-production activities. To clarify our investigation, we also discuss their impact on output.

In the case of HFDI, a firm makes the decision of whether or not to market its products to the destination country either by exporting the products or by setting up production facilities within the host country and selling them locally. They choose the option with the higher total profit, which is the sum of gross profits from the home and host county markets. A firm can avoid the setup costs of production facilities by exporting its products, while it can save on shipment costs by producing and selling locally through investing abroad, i.e., HFDI. Firms, then, generally choose HFDIs if the fixed cost, i.e., setup costs, is low enough with respect to the shipment cost.

However in the case of VFDIs, the investing firm relocates production activities abroad either in part or completely. The firm's decision of whether or not to relocate depends on joint profits from production activities at home and abroad with respect to the initial profits from integrated production (the whole process of production is located in one country) at home. Integrated production at home enables a firm to save costs on supervision, coordination and control over different activities in different locations. If a portion of production is relocated abroad with VFDIs, the investing firm incurs the costs of shipping semi-finished products across borders, as well as the various costs of connecting these remote activities. As a result, a firm only chooses VFDI if the costs

required to manage cross-border production sharing are low enough, and if the difference in worker wages between the home and host countries are large enough, to take advantage of the benefits of specialization.

FDIs affect the volume of output at home as follows. In the case of HFDIs, because the firm stops the production of goods designed for the destination country after investing, the domestic output decreases unambiguously. However, if the investing firm can enjoy the spillover of knowledge and technology from the overseas plant, as Navaretti et al. (2006) point out, its use of technology might improve. If such benefits are significant enough, domestic output could expand after investing. Moreover in the case of VFDI, as the product/product bundle manufactured by the firm at home changes through investing, domestic output before and after investing abroad is hardly comparable.

FDIs have some influence on employment at home. As for the impact of HFDIs on production workers, while the number of workers is likely to primarily decrease due to the decrease in output, it could increase along with the output expansion due to spillover effects. Nevertheless, wages will stay constant since the production activity *per se* and its required skills remain unchanged before and after investing. In the case of VFDI, the number of workers, in particular, skilled production workers may increase along with the benefits from cross-border production sharing. Furthermore, the specialization in skilled-labor-intensive production activity at home could raise the wages of skilled production workers due to the changes in composition of skilled and unskilled workers. As for the impact on non-production workers, on the other hand, the number of non-production workers primarily increases along with the need of supervision, coordination and control over remotely located activities, irrespective of FDI type. If the above, newly engaged non-production activities through investing abroad require skills different from those initially used before investing, the wages of non-production workers may also change. Furthermore, if the investing firm specializes domestically through VFDI in non-production activities such as marketing and R&D, the demand for non-production workers will increase significantly at home. In addition, if the VFDI firm requires non-production workers to be highly educated, their wages will rise after investing.

The impact on cost efficiency at home is similar to the effects on output. In the case of HFDI, cost efficiency for the entire firm, as well as for the production activity itself, is likely to deteriorate due to the decrease in output (i.e., the violation of scale economy). However, as mentioned above, if the spillover effect is strong, cost efficiency might only see a negligible change, both on the level of production activity and the firm in general. Furthermore, if the number of non-production workers and/or their wages increase,

resulting in mounting fixed costs at the overall level, cost efficiency may decline at the entire firm level as a result of HFDI. As for VFDI, on the other hand, evaluation of the cost efficiency is qualitatively difficult, as it is in the case of output.

3. Empirical Issues

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

3.1. Basic Methodology

In the existing literature on the impact of investment abroad on firm behavior and performance at home, selection bias has been identified as a sensitive issue. If a firm's decision to invest abroad, i.e., to become multinational, and its performance are jointly determined, the differences in the performance due to investment abroad are hardly distinguishable from those that depend on other, different characteristics between MNEs and non-MNEs. For instance, since investment abroad requires firms to incur a substantial number of fixed costs, only productive firms can become multinational by investing abroad (otherwise known as the selection effect). Therefore, a simple comparison of the ex-post productivity of investing firms with that of non-investing domestic firms is inappropriate. 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 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

[2] The economic application of matching estimators has grown in various fields in recent years: the evaluation of policy intervention in the 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 the impact 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.

(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., E $(y^0_{it} \mid FDI_{it} = 0)$, only if the bracketed terms in the following equation are 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 by Rosenbaum and Rubin (1983) is to find a vector of observable variables X that affect both the performance indicator y and the treatment variable FDI such that:

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

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 the conditional independence assumption (CIA). By using such a vector X, if the investing and non-investing firms have the same propensity score of investing abroad, the difference in performance of those firms purely represent the impact of outward FDI.

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:

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

In this paper, we perform a one-to-one nearest neighbor matching method without replacement, imposing a common support by dropping the 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:

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

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

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 its 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 a difference-in-difference (DID) estimator along the lines 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:

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

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

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

meaning 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.

3.2. Data Structure of the Two-dimensional Approach

The impact of outward FDI on firm behavior and performance are investigated in two dimensions. One dimension consists of the type of FDI: HFDI or VFDI. Following Hijzen et al. (2006), FDIs are simply classified according to destination country; the FDIs in developed countries are regarded as HFDIs, and those in developing countries as

VFDIs.[5] The second dimension consists of the firm's domestic production and non-production activities. As previously argued in Section 2, the impact of outward FDI differs not only according to FDI type, but also between the firm's production and non-production activities. Unfortunately, however, we cannot directly observe the outcomes of non-production activities. Therefore, by comparing outcome indicators at the level of the entire firm, which include both production and non-production activities, we investigate the differences in the impacts of HFDI/VFDI between production and non-manufacturing activities for those firms with manufacturing plants.[6]

We employ two kinds of firm-level data in this paper. One is ready-made firm-level data, the main source of which is the "Basic Survey of Japanese Business Structure and Activities" (METI, 1994-; hereafter BSJBSA).[7] The purpose of the BSJBSA is to statistically capture the overall picture of Japanese corporate firms: the diversification and globalization of corporate activities, and corporate strategies on R&D and other topics. This firm-level data is used to construct variables at the level of the entire firm. The other firm-level data is constructed by aggregating the manufacturing plant-level census data, "Census of Manufactures" (METI, 1909-; hereafter the Census), on a firm basis.[8] 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 in this census at the plant level.[9] The latter aggregated firm-level data is useful in constructing variables for production activity. By employing these two kinds of firm-level data, we examine the impact of outward FDI at the firm level and for production activity separately. In addition, the "Basic Survey of Overseas Business Activities" (METI, 1995- ; hereafter BSOBA) is used to link the information on outward FDI to the above firm-level data. Data on Japanese overseas affiliates, e.g., location, year

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

[6] Data for non-production activity could be obtained as the difference between the entire firm level data and the production activity data. However, the scope of a period of one year covered in the Census is not always the same as that in the BSJBSA. For the Census, survey forms are collected every December. For the BSJBSA, on the other hand, firms are requested to fill in a questionnaire based on the recent accounting term and to submit it up until mid July. As a result, many observations with minus figures for non-production activity exist if we take the difference of the relevant variable between the Census and the BSJBSA. Such a case is observed not only for firms with manufacturing plants only but also for firms with both manufacturing and non-manufacturing establishments. Thus, we decided to examine the impact of FDI at the level of entire firm as well as for production activity.

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

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

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

of establishment, number of employees, and industry classification, are available in the BSOBA.

In the matching analysis, we estimate the propensity score of conducting HFDI and VFDI for all the firms in our sample from 1992 to 2005 by running a multinomial logit regression. As explanatory variables in the logit regression, the firm's characteristics (X), which affect firm performance (y) as well as the firm's decision on whether to invest abroad (*FDI*), are required. Specifically, following the previous studies listed in the introductory section, we include productivity, the number of employees, the capital-labor ratio, the proportions of advertisement and R&D expenditures in total sales, and the firm's age. While productivity is calculated at the level of the firm's production activity, other explanatory variables are obtained at the level of the firm's overall activity. All of these explanatory variables are in logarithmic forms and are lagged one year using data compiled during 1991–2004, so as to at least avoid some extent the issue of simultaneity between the firm's decision to invest abroad and its characteristics. Industry and year dummies are also included in the regression.

The outcome indicators to be examined include: the real sales [Remark 1] the number of workers, workers' wages, and productivity at the firm level and for the production activity. While data at the level of the firm is taken from the BSJBSA, data for production activity is basically taken from the Census, except for the figures on the number of production workers. The BSJBSA provides the number of workers organized by the type of activity; therefore, we can directly obtain the number of production workers from the BSJBSA. As discussed in Section 2, we do not empirically examine in this paper the impact on sales from non-production activities such as license fees, although the results of the impact on overall sales is also reported for the sake of completeness. As for the productivity measure, following Caves et al. (1982, 1983) and Good et al. (1983), the TFP index is calculated at both the level of the firm and production activity:

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

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.[10] To obtain the TFP index for production activity by aggregating the plant-level data on a firm basis, the firm-level TFP growth rate is calculated as the sales-weighted average of the plant-level TFP growth rate.

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 levels and growth rates of our performance/outcome indicators are to be compared between the investing and non-investing domestic firms.

4.1. Simple Comparison

Table 1 provides an overview of the firms in our sample. The number of firms in each year that invested abroad for the first time via either HFDI or VFDI is listed. Incumbent MNEs are firms which had already invested abroad before the year of interest. Few HFDI firms exist during the sample period (1992–2004), and Japanese firms seem to have hesitated to invest abroad for the first time since the latter half of the 1990s. This trend might reflect the fact that the investors in developed countries conducted their first FDI in the latter half of the 1980s, just after the Plaza accord.

=== Table 1 ===

Table 2 reports the means of levels and growth rates of certain outcome indicators from the perspective of the firm's sales, employment, wages, and cost efficiency/productivity (TFP). The means of their levels and growth rates are listed by the firm's investment status, i.e., domestic, HFDI, VFDI, or incumbent MNEs, as well as by its home activities, i.e., those at the entire firm level, or those only for production.[11] As argued above, this kind of comparison cannot distinguish between selection effects or learning effects and overall changes. Nonetheless, it could be

[10] For the details of the calculation of the TFP index, see Matsuura et al. (2008).
[11] To maintain consistency with Table 1, the performance indicator for the HFDI and VFDI firms in Table 2 is calculated using observations before and after investing abroad.

invaluable to examine the cross-sectional differences in firm performance according to investment status and home activities.

=== Table 2 ===

The means of levels are reported in the upper part of the table. We found that all figures are certainly larger for investing firms than for non-investing domestic firms, both at the entire firm level and for production activity. In particular, the volume of sales for incumbent MNEs is outstanding among the firm's investment statuses. The HFDI and VFDI firms follow incumbent MNEs, and the sales figures for domestic firms are the smallest both at the firm level and for production activity. Exactly the same pattern can be observed for the number of workers, average wages and TFP. One exception is that the overall TFP for VFDI firms is greater than that for HFDI firms.

The means of growth rates, on the other hand, are shown in the lower part of the table. For HFDI and VFDI firms, the growth rate is defined as the log of the difference between the year before investing aboard and the investment year. As for TFP and sales, VFDI firms achieve the highest growth rate, followed by HFDI firms and domestic firms, though in the case of VFDI, it is qualitatively difficult to compare the figures before and after investing. As for the number of workers at the firm level, however, the growth rate of HFDI firms is higher than that of VFDI firms. Since VFDI firms experience a more rapid decrease in the number of workers in production activity compared with HFDI firms, HFDI firms would experience a higher growth rate for the number of non-production workers. HFDI firms also display the highest growth rate for both overall and production-activity wages.

4.2. Matching Analysis

Table 2 provides us with valuable facts, but we need to further differentiate between selection and learning effects. In the simple comparison above, for example, the relatively high TFP shown by FDI firms may be due to their inherent attributes (the selection effect) or due to a positive impact of investment abroad (the learning effect). In order to exclusively explore the learning effect of outward FDIs, a matching analysis is conducted.

4.2.1 Propensity Score Estimation

As a first step, appropriate counterfactuals are selected by estimating the propensity score of investing abroad for each firm and by matching the non-investing

domestic firms with the investing firms. The results of multinomial logit regression for the firm's decision to conduct HFDI/VFDI are reported in Table 3. The results seem to be good enough. Almost all of the estimated coefficients have expected signs, and pseudo R-square is as high as in the previous studies referred to in the introductory section. By using these estimators, the propensity score of conducting HFDI/VFDI is calculated for each firm.

=== Table 3 ===

This regression can be also useful for examining the selection effect. The significantly positive result for the TFP index in the HFDI equation is consistent with the hypothesis proposed by Helpman et al. (2004); only firms with higher productivity levels can afford to pay the expenses of investing abroad. In the VFDI equation, on the other hand, the estimated coefficient for TFP is positive, but insignificant. In short, in terms of productivity, the selection effect can be detected only in the case of HFDI. Such a selection effect can be also found for other variables. Large-scale firms, in terms of the number of workers, and capital-intensive firms are more likely to invest abroad. However, R&D and advertisement intensities do not have a significant effect on a firm's decision to invest abroad.

As shown in Navaretti et al. (2006), the matching of investing and non-investing firms is performed by year and sector. In order to confirm whether the choice of matching algorism is appropriate or not, we check the balancing property of firm-specific explanatory variables used in the multinomial logit regression. 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 have been appropriately selected) are statistically tested. The results reported in Table 4 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 that the matching has been done successfully. To examine this further, matching is also performed for each stratum by dividing the sample into several strata in which the firms are similar in propensity score. The validity of the estimation and the matching based on the propensity score is hence confirmed.

=== Table 4 ===

4.2.2 DID Estimator

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

Results for the HFDI, i.e., FDI to developed countries, are reported in the left part of Table 5. First, the HFDI does not significantly affect sales from production activity. Also, the TFP index does not significantly change as a result of conducting HFDI either at the firm level or for production activity. These results imply that the output expansion and productivity enhancement resulting from knowledge spillover offset the output decrease and productivity deterioration. Second, while the HFDI has a significantly negative effect on the number of production workers, it does not affect the number of employees at the entire firm level. The former indicates that the spillover effects enable firms to produce the same amount of output as before, but with a smaller number of production workers. Taking these results into consideration, the latter may suggest that the number of non-production workers has increased due to the increased need for more supervision, coordination and control over the remotely located activities, as well as the need for marketing and R&D activities. Third, investing firms do not experience significant changes in wages both at the firm level and the level of production activity. As mentioned in Section 2, since the HFDI will not change the product/product bundle *per se*, HFDI firms do not experience changes in production worker's skills and thus their wages. Taking this into account, the insignificant impact of HFDI on wages at the firm level may indicate that wages for non-production workers remain unchanged. That is, despite the increased demand for non-production workers, the HFDI firms do not need the workers to be more highly educated and highly skilled than those hired before investing. In addition, the increase of non-production workers may lead to a rise in fixed costs, which contributes partly to offsetting the rise of TFP due to the spillover effects. As a result, TFP is not significantly changed at the firm level.

=== Table 5 ===

The results for VFDI, i.e., FDI to developing countries, are reported in the right section of the table. As expected, they differ from the results for HFDI. First, the production activity sales and the number of both overall and production activity workers increase significantly one year after investing. This would be because the benefits of cross-border production sharing are larger than the aforementioned negative impact of the relocation of processes that use low-skilled workers intensively, though in the case of

VFDI, it is qualitatively difficult to evaluate the impact on production-activity sales. Still, the smaller impact on the number of the overall workers than that on the number of production activity workers may indicate that the number of non-production workers does not increase at all. Second, wages for production workers rise significantly, though those at the entire firm level do not change. The former result is consistent with our expectation that production activities are skilled-labor-intensive, and thus on average raise the wages of production workers. In addition, taking the latter result into consideration, we can at least say that wages for non-production workers do not rise. Lastly, the TFP index is not significantly affected by the VFDI at the entire firm level, but is improved for production activity. Again, it is qualitatively difficult to interpret the effects on TFP, but it may be said that VFDI firms change their products to ones that require a higher degree of technology and efficiency.

We then conduct further analyses. First, we exclude firms who display no non-production establishments. Conceptually, if a firm has only manufacturing plants, the same values are reported for the common data items in the firm-level and plant-level data. Thus, the figures for the production activity become identical to those at the entire firm level. But, because the primary purpose of this paper is to compare the impact of outward FDI in production and non-production activities, we need to focus on the firms with non-production establishments as well as manufacturing plants. To do so, we restrict our sample to firms with at least one non-production establishment. The results are reported in Table 6. In the case of VFDI, the difference from Table 5 appears only in the number of production workers. While Table 5 shows an increase, it remains unchanged in Table 6. As mentioned in Section 2, from a theoretical point of view, the impact of VFDI on production workers is ambiguous. If the decrease in unskilled workers is greater than the increase in skilled workers, the impact of the VFDI on the number of production workers becomes negative. Thus, we can at least conclude that the former effect is not larger than the latter.

=== Table 6 ===

Second, we focus on the impact of FDI in the machinery and equipment sector, sectors on which most of Japanese FDIs are concentrated. To this end, we restrict the treatment group to machinery and equipment. We then construct the counterfactual control group with the propensity score explained in Section 4.2, and estimate the DID estimator. Table 7 reports the effects of HFDI and VFDI on outcome indicators for machinery and equipment manufacturing firms. On the whole, the results are quite

similar to Table 6. Three results are especially noteworthy. First, the HFDI has almost no impact on the firm's home performance in the machinery and equipment sector. Second, the impact of the VFDI on TFP both at the firm level and for production activity is much larger than what was reported in Table 6. These results may suggest that since it is easier for machinery and equipment manufacturing firms to fragment their production process, the efficiency gains from an international division of labor become larger than those of other manufacturing firms. Third, the VFDI does not affect wages for production workers, but raises those at the level of the entire firm. In addition, since the impact on the number of overall workers and production-activity workers is quite similar, the share of non-production workers must hardly be changed. Thus, with these two facts, we see that the wage level for non-production workers could increase due to VFDI.

=== Table 7 ===

In short, our findings are as follows. In the case of HFDI, cost efficiency (TFP) shows no change either at the entire firm level or for production activity. The number of production workers decreases, while that of non-production workers increases, as a result of HFDI. Still, the wage rates for both types of workers remain unchanged. On the other hand, the VFDI does not affect the number of either type of worker. The specialization involved in skilled-labor-intensive processes raises the wages for production workers, while the wages for non-production workers remain unchanged.

5. Concluding Remarks

This paper empirically investigates two dimensions of changes in firm behavior and performance before and after investing abroad. One dimension is the difference depending on the type of FDI: HFDI or VFDI. The other dimension is different effects of outward FDIs on different scopes of the firm's activities at home: the entire firm level or production activity only. The impact of outward FDIs differs not only by FDI type but also between the firm's production and non-production activities.

Our findings can be summarized as follows. In the case of HFDI, the empirical results of constant cost efficiency (TFP) imply that the positive impact of knowledge spillover offsets the negative impact of the home production reduction, i.e., the violation of scale economy. As is consistent with the theoretical prediction, however, such a decrease of home production reduces the number of production workers whose wages

remain unchanged. On the other hand, the number of non-production workers increases significantly, and their wages do change. These results imply that the HFDI yields additional non-production activities that do not require non-production workers to possess a higher skill set than before.

In the case of VFDI, the number of production workers does not change before or after investing. This result implies that the benefits of cross-border production sharing offset the negative impact of the relocation of unskilled-labor-intensive processes to the host country. In addition, as is consistent with the theoretical prediction, the specialization of skilled-labor-intensive production processes raises wages for production workers. On the other hand, VFDI has no impact on non-production activities in terms of the number of workers and their wages. These results imply that VFDI does not yield any additional non-production activities, and does not qualitatively alter existing non-production activities.

We suggest the following two topics for future research. First, while FDI is one important channel for accelerating global production, international outsourcing through arm's length transactions is another growing channel. Nevertheless, the micro-data studies on the impact of international outsourcing are quite limited. To our knowledge, the comparison of the impact between FDI and outsourcing has not yet been investigated, most likely due to a lack of appropriate data. Investigating this issue might be the next step toward further understanding the consequences of globalizing production.

The second issue to be examined consists of the impact differences among other types of FDI. While in this paper we focus on HFDI and VFDI, recent theoretical and empirical studies have placed their emphasis on the complex structure of global production by MNEs. For example, Ekholm et al. (2007), Grossman et al. (2006), and Yeaple (2003) have attempted to develop theoretical models in a three-country setting rather than the traditional two-country framework. Considering these new forms may help to further refine the analysis of the global impact of FDIs.

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Table 1. The Number of New Investing Firms

Year	Domestic firms	HFDI	VFDI	Incumbent MNEs	Total
1992	6,636	9	16	857	7,518
1993	7,654	6	31	937	8,628
1994	7,655	13	63	975	8,706
1995	7,112	12	63	1,022	8,209
1996	7,652	9	49	1,125	8,835
1997	7,352	7	20	1,149	8,528
1998	7,168	4	5	1,128	8,305
1999	7,305	2	7	1,147	8,461
2000	7,116	3	7	1,136	8,262
2001	6,720	3	22	1,139	7,884
2002	6,498	1	18	1,128	7,645
2003	6,330	0	12	1,108	7,450
2004	6,074	2	10	1,123	7,209
Total	91,272	71	323	13,974	105,640

Notes: HFDI and VFDI are the number of new investing firms. MNEs are those firms which had already invested aboard before the year in question.

Table 2. The Means of Outcome Variables: Manufacturing Industry

	TFP		Number of Workers		Wages		Sales	
	Overall	Production	Overall	Production	Overall	Production	Overall	Production
Level								
Domestic Firms	0.938	0.938	163.1	118.8	4.26	4.20	4,003	2,713
HFDI Firms	0.971	1.057	522.6	340.7	4.97	4.99	18,146	12,714
VFDI Firms	0.999	0.992	373.9	226.1	4.62	4.50	11,695	6,551
Incumbent MNEs	1.019	1.055	932.8	558.4	5.44	5.03	36,369	19,595
Total	0.950	0.954	206.1	146.1	4.40	4.31	5,383	3,537
Growth								
Domestic Firms	-0.056	0.002	-0.005	-0.142	0.017	0.001	-0.006	-0.018
HFDI Firms	-0.006	-0.010	0.001	-0.074	0.072	0.014	0.013	-0.015
VFDI Firms	-0.002	0.017	0.000	-0.047	0.051	0.007	0.024	-0.009
Incumbent MNEs	-0.026	0.007	-0.015	-0.102	0.018	0.001	-0.001	-0.016
Total	-0.052	0.003	-0.006	-0.136	0.017	0.001	-0.005	-0.018

Notes: Number of workers (persons); Wages and Sales (millions of yen). Performance variables for the HFDI and VFDI firms are measured one year before investment. The growth rate for the HFDI and VFDI firms is defined as the difference of values between the year before investing and the investing year.

Table 3. Probability of Investing Abroad: Multinomial-logit

	Coef.	Std. Err.	z	P>|z|
HFDI				
TFP	0.880	0.295	2.99	0.003
ln (Number of workers)	0.817	0.102	8.01	0.000
ln KL ratio	0.554	0.144	3.84	0.000
ln (Advertisement/sales)	-1.465	7.246	-0.20	0.840
ln (R&D/sales)	0.716	0.482	1.49	0.137
ln Age	-0.102	0.300	-0.34	0.734
VFDI				
TFP	0.220	0.182	1.21	0.226
ln (Number of workers)	0.647	0.049	13.08	0.000
ln KL ratio	0.268	0.068	3.97	0.000
ln (Advertisement/sales)	1.247	2.920	0.43	0.669
ln (R&D/sales)	0.055	1.188	0.05	0.963
ln Age	0.276	0.154	1.79	0.074
Year dummy	Yes			
Industry dummy	Yes			
Number of obs	91,666			
LR chi2	653.38			
Pseudo R2	0.1198			

Table 4. Testing for the Balancing Property: Differences in Means

	Mean			
	Treated	Control	t-value	p-value
HFDI				
TFP	1.067	1.037	0.44	0.662
ln (Number of workers)	6.203	6.233	-0.18	0.857
ln KL ratio	2.722	2.645	0.77	0.440
ln (Advertisement/sales)	0.007	0.010	-0.86	0.392
ln (R&D/sales)	0.029	0.085	-0.85	0.398
ln Age	3.766	3.731	0.53	0.600
VFDI				
TFP	0.973	0.991	-0.74	0.458
ln (Number of workers)	5.916	5.867	0.64	0.520
ln KL ratio	2.448	2.545	-1.45	0.148
ln (Advertisement/sales)	0.006	0.006	0.26	0.797
ln (R&D/sales)	0.013	0.015	-0.85	0.394
ln Age	3.753	3.755	-0.08	0.934

Table 5. The Impact of Investing Abroad on Performance at Home

	HFDI				VFDI			
	t	*t*+1	*t*+2	*t*+3	*t*	*t*+1	*t*+2	*t*+3
TFP								
Overall	-0.007	-0.016	-0.035	0.049	0.025	0.011	0.030	0.031
Productior	0.037	-0.011	0.008	0.015	0.029*	0.042**	0.038**	0.030
Number of workers								
Overall	0.029	0.063	0.067	0.281***	0.021	0.047**	0.041*	0.041
Productior	-0.254**	-0.228**	-0.208*	-0.083	0.055	0.121**	0.114**	0.108*
Sales								
Overall	0.058	0.106*	0.031	0.314**	0.037**	0.075***	0.064**	0.078**
Productior	-0.009	-0.018	-0.017	0.026	0.020	0.084**	0.097**	0.121**
Wages								
Overall	0.023	0.002	-0.051	-0.019	0.016	0.020	0.025	0.052*
Productior	0.000	-0.020	0.037	-0.010	0.001	0.033**	0.033**	0.020

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.

Table 6. Impact of Investing Abroad on Performance at Home: Excluding Firms without Non-production Establishments

	HFDI				VFDI			
	t	*t*+1	*t*+2	*t*+3	*t*	*t*+1	*t*+2	*t*+3
TFP								
Overall	-0.009	0.036	-0.002	0.036	0.026	0.024	0.010	-0.007
Productior	0.059	0.002	0.022	0.068	0.029	0.031*	0.034*	0.021
Number of workers								
Overall	-0.004	0.039	0.058	0.195**	0.015	0.055**	0.033*	0.032
Productior	-0.292**	-0.224*	-0.211	-0.098	0.033	0.078	0.086	0.080
Sales								
Overall	0.026	0.103**	0.081	0.224**	0.031*	0.078***	0.067***	0.063*
Productior	0.002	0.007	0.053	0.173	0.015	0.062	0.087*	0.081
Wages								
Overall	0.004	-0.020	-0.031	-0.065	0.005	0.025	0.024	0.053
Productior	0.024	-0.042	0.021	-0.018	-0.003	0.029*	0.044**	0.023

Note: See Table 5.

Table 7. The Impact of Investing Abroad on Performance at Home: The Machinery and Equipment Manufacturing Industry

	HFDI				VFDI			
	t	*t*+1	*t*+2	*t*+3	*t*	*t*+1	*t*+2	*t*+3
TFP								
Overall	-0.060	-0.057	0.080	0.017	0.080**	0.011	0.026	0.089
Productior	0.006	-0.036	-0.036	-0.007	0.095***	0.107***	0.110***	0.099***
Number of workers								
Overall	0.137	0.183	0.130	0.528*	0.046	0.062*	0.026	0.032
Productior	-0.326	-0.300	-0.463	0.095	0.103	0.166*	0.082	0.125
Sales								
Overall	0.191	0.193	-0.005	0.515	0.096**	0.136***	0.072	0.154**
Productior	-0.057	-0.071	-0.129	-0.067	0.082**	0.206***	0.188**	0.190***
Wages								
Overall	-0.077	-0.046	-0.068	-0.117	0.038	0.082*	0.069*	0.121***
Productior	0.019	0.061	0.081*	0.080	-0.011	0.008	0.012	-0.026

Note: See Table 5.