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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

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

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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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1. Introduction

Due to the growing manufacturing presence of developing countries, it has been argued that developed countries have begun to specialize in non-production activities. Baldwin (2006) has noted that "East Asia is one of the wonders of the world.[…] 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 stimulated the closure of domestic plants in developed countries, which in turn has induced anxiety about the hollowing out of domestic industries. In particular, around the turn of the century, such fear reached a peak in Japan due to the acceleration of Japanese foreign direct investments (FDIs) to China. At the same time, the principal activities undertaken in developed countries began gradually to shift towards 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 FDI (HFDI) and VFDI. HFDI aims at avoiding broadly-defined trade costs by setting up production facilities within overseas markets rather than exporting goods from the home country. By contrast, VFDI is a corporate strategy intended to exploit low-cost production factors abundant in the host country. VFDI firms are theoretically expected to relocate 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 assumed to be knowledge-abundant in comparison to developing countries, VFDI firms are assumed 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 changes in the firm's skill-intensity, for instance, through reference to 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 that the impact of VFDI on skill-intensity tends to be insignificant. This differs from the interpretation we provided above.

The third class of studies focuses on the so-called "learning effect," and examines whether investment abroad raises productivity levels at home. Examples of such studies include Hijzen et al. (2007) for Japanese multinationals, and Navaretti and Castellani (2004) and Navaretti et al. (2006) for Italian multinationals. For French multinationals, Hijzen et al. (2006) and Navaretti et al. (2006) obtain a statistically significant result for improved productivity by conducting HFDI, but not by conducting VFDI.

The aim of this paper is to empirically investigate two dimensions of the effects of outward FDI on firm behavior and performance at home. The first dimension deals with the differences between HFDI and VFDI. As we will illustrate in the following section, the consequences of investment abroad differ according to type; it is therefore important to distinguish between HFDI and VFDI and examine the results. The effects of investment abroad on performance at home also differ among the types of firms' home activities of interest, constituting 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, this paper relates particularly to the second class of the literature described above which studies whether or not a firm raises the skill-intensity at home through investing abroad. Compared with previous studies, this paper comprehensively investigates the differences of the impact of outward FDI between the firm's production and non-production activities at home. To be precise, we highlight the different effects of outward FDI not only on employment but also on wages and productivity.

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 FDI to developing countries allows the investing country to specialize in non-production activities, such as marketing and R&D. Since previous studies have essentially examined only the impact that FDI to developing countries has on production activities at home, it remains unknown whether or not such a view holds up to rigorous analysis. This paper therefore explores the impact of outward FDI not only on production activities but also on non-production activities. Thus, we will be able to say with some certainty whether or not FDI to developing countries results in the specialization of non-production activities, or more skilled-labor-intensive activities

inside a developed country.

The paper is organized as follows: Section 2 provides a theoretical framework for the 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 final section concludes.

2. Theoretical Framework

This section discusses the current overall understanding of the impact of investment abroad on firm behavior and performance. In what follows, we examine the impact of two types of FDI: 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 outputs.

In the case of HFDI, a firm makes the decision on 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 country 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, for instance, through HFDI. Firms, then, generally choose HFDI if the fixed costs, such as the setup cost, are low enough with respect to the shipment costs.

On the other hand, in the case of VFDI, the investing firm relocates production activities abroad either in part or completely. The firm's decision on whether or not to relocate is based on the comparison of joint profits from production activities at home and abroad, with the initial profits from integrated production (where the whole process of production is located in one country) at home. Integrated production at home enables a firm to save on the costs of supervision, coordination and control over different activities in different locations. If a portion of production is relocated abroad through VFDI, the investing firm incurs the costs of shipping semi-finished products across borders, as well as the various costs of connecting these remotely located activities. As a result, a firm only chooses VFDI if the costs required to manage cross-border production sharing are sufficiently low, and if the difference in factor prices, such as 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 ceases the production of goods designed for the destination country after investing, the domestic output decreases immediately. Thus, at least the short-run impact of HFDI on domestic output is negative. However, the investing firms can gradually enjoy the spillover of knowledge and technology from their overseas plants, as Navaretti et al. (2006) point out. Therefore, in the long run, investors' technology might improve. If such benefits are significant enough, domestic output could expand in the long-run. On the other hand, in the case of VFDI, the product or product bundle manufactured by the home-based firm changes through relocating some parts of the production processes from home to abroad. Since such changes seem to occur at almost the same time as investing, the impacts of VFDI on outputs will emerge immediately. However, due to such qualitative changes of the production function, it is difficult to compare the *volume* of domestic output before and after VFDI. As long as we focus on the domestically-remaining products, such as skilled-labor-intensive products, the production of those products will increase after VFDI due to the benefits from cross-border production sharing.

Based on these changes in outputs, we can summarize the two-dimensional impacts of FDIs as follows. FDIs will have some influence on employment at home. In the case of HFDI, while the number of production workers is likely to primarily decrease due to the output decrease in the short run, it could increase along with the output expansion due to spillover effects in the longer term. Nevertheless, their wages will stay constant since the production activity *per se* and the required skills remain unchanged before and after investing. In the case of VFDI, the number of production workers, in particular, skilled production workers may increase immediately along with the benefits from cross-border production sharing. Also, since skilled workers are generally expected to have higher wages than unskilled workers, the specialization in skilled-labor-intensive production activities at home could immediately raise the wages of production workers due to changes in the composition of skilled and unskilled workers.

The impacts on non-production workers are as follows. In the short run, their number may primarily increase along with the need for supervision, coordination and control over remotely located activities, irrespective of FDI type. In addition, if such newly engaged non-production activities require skills that differ from those initially used before investing, the wages of non-production workers may also change. Furthermore, in the case of HFDI, the spillover effects might also be available in non-production activities (particularly R&D activities) in the long run, resulting in an

increased need for non-production workers in the long run. In the case of VFDI, the immediate specialization in non-production activities at home may contribute to increase the number of domestic non-production workers.

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 in the short run, due to the decrease in output (i.e., the violation of scale economies). However, as mentioned above, if the spillover effect is strong, the cost efficiency might only see a negligible change in the long run, both for the production activity and for the entire firm. Furthermore, the increase of the total payment for non-production workers (i.e., the increase of the number of non-production workers or the rise in their wages) leads to a rise in fixed costs, resulting in deteriorating cost efficiency at the entire firm level. As for VFDI, on the other hand, the cost efficiency will improve immediately after VFDI both for the production activity and for the entire firm due to the scale effects based on the benefits from cross-border production sharing. Furthermore, in the case of VFDI, if the total payment for non-production workers increases significantly, then the overall level of cost efficiency may not improve so greatly. However, it is worth noting that the evaluation of cost efficiency is qualitatively difficult in the case of VFDI, since it accompanies the relocation of a portion of production processes, meaning the production function is not exactly the same before and after the investment.

3. Empirical Issues

This section begins by specifying the basic empirical methodology employed in this paper, and explains 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 firm's decision to invest abroad and its performance are jointly determined, the differences in performance due to the investment abroad are hardly distinguishable from those that depend on different inherent characteristics between MNEs and non-MNEs. For instance, since investment abroad requires firms to incur a substantial amount of fixed costs, only productive firms can become multinational by investing abroad (i.e., 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 employed by Rosenbaum and Rubin (1983).[1]

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}).[2] 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 firms that 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 on average have 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 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., the propensity score of investing abroad. In other words, X is assumed to capture all the inherent differences in performance between the treated group (investing firms) and the control group (non-investing

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[1] 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.

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

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 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:

$$P_{ht} = P(FDI_{ht} = 1|X_{ht}),\ h = i, j.^{3}$$

Then, for the investing firm i in year t with propensity score P_{it}, the 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 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 differences 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 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 the 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 ordinary least squares (OLS):

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[3] The method to estimate the propensity score of investing abroad is explained in the following subsection.

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

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 along two dimensions. One dimension consists of the type of FDI: HFDI or VFDI. Following Hijzen et al. (2006), FDIs are simply classified according to the destination country; the FDIs to developed countries are regarded as HFDIs, and those to developing countries as VFDIs.[4] 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 for the entire firm, which include both production and non-production activities, with the corresponding indicators for the production activity, we attempt to detect the differences in the impacts of HFDI/VFDI between production and non-production activities.[5] We focus on firms which have at least one manufacturing plant.

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

[5] Data for non-production activities could be obtained as the difference between the entire-firm-level data (obtained from the BSJBSA) and the production-activity data (obtained from the Census). However, the scope of a period of one year covered in the BSJBSA is not always the same as that in

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).[6] 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 for 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.[7] Data on establishments located within Japan (including, location, the number of employees, the value of tangible assets, and the value of shipments) are available in this census at the plant level.[8] The latter aggregated firm-level data is useful in constructing variables for the production activity. By employing these two kinds of firm-level data, we examine the impact of outward FDI on the entire firm and on the 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, including the location, year of establishment, number of employees, and industry classification, are available in the BSOBA (see also Appendix A).

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

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the Census. For the BSJBSA, firms are requested to complete a questionnaire based on the recent accounting term and to submit it by mid July. For the Census, on the other hand, survey forms are collected every December. As a result, if we take the difference of the relevant variable between the BSJBSA and the Census, there exist many observations with minus figures for the non-production activity. 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 on the entire firm, in comparison with that on the production activity.

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

[7] For the details of the data construction, see Appendix A.

[8] 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.

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 for the production activity, other explanatory variables are obtained at the entire firm level. All of these explanatory variables are in logarithmic form and are lagged one year using data compiled during 1991-2004, so as to avoid to 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.

Based on the discussion in Section 2, the outcome indicators to be examined two-dimensionally include: the number of workers, workers' wages, and productivity at the entire firm level and for the production activity. While data at the entire-firm-level are taken from the BSJBSA, data for the production activity are 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. Our measures of wages are constructed as the average wage per worker for the entire firm and that for the production activity.

As for the productivity measure, following Caves et al. (1982, 1983) and Good et al. (1983), the total factor productivity (TFP) index is calculated at the entire firm level and for the 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. In the case of a multi-plant firm, we need to aggregate the plant-level data on a firm basis so as to obtain the TFP index for the production activity. The production-activity TFP growth rate is calculated as the sales-weighted average of the plant-level TFP growth rates (see also Appendix B).

4. Empirical Results

This section presents the empirical results of the matching analysis: in particular, tests for changes in firm behavior and performance before and after investing abroad. Before that, the simple sample means of the 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 the levels and growth rates of certain outcome indicators from the perspective of the firm's 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.[9] As argued above, this kind of comparison cannot distinguish between the selection effect and the learning effect. Nonetheless, it could be 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,

[9] 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.

both at the entire firm level and for the production activity. In particular, the outcomes for incumbent MNEs are outstanding among the firms' investment statuses. The HFDI and VFDI firms follow incumbent MNEs, and the figures for domestic firms are the smallest. Exceptions are found in the comparison of TFP: the overall TFP is greater for the VFDI firms than for the HFDI firms; the production-activity TFP is the highest for the HFDI firms.

The means of growth rates, on the other hand, are shown in the lower part of the table. For the 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, the VFDI firms achieve the highest growth rate, followed by the 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 entire firm level, the growth rate is higher for the HFDI firms than for the VFDI firms. Since the VFDI firms experience a slower decrease in the number of workers for the production activity than the HFDI firms, the 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 the overall and production-activity wages.

4.2. Matching Analysis

Table 2 provides us with many valuable observations, 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 (selection effect) or due to a positive impact of investment abroad (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 were selected by estimating the propensity score of investing abroad for each firm and by matching the investing firms with the non-investing domestic firms. The results of a 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 the 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 also be useful for examining the selection effect. A significantly positive result for the TFP index in the HFDI equation is consistent with the hypothesis proposed by Helpman et al. (2004). According to this, 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 the firm's decision to invest abroad[10].

As shown by 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 (the HFDI/VFDI firms) and the control group (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 based on the estimated propensity score has been done successfully.[11]

=== Table 4 ===

4.2.2 DID Estimator

The next step is to estimate the DID estimator using OLS in order to assess the impact of outward FDI. Specifically, we statistically examine the difference in changes

[10] In the multinomial logit estimation, we implicitly assume that the independence from irrelevant alternatives holds. To test its validity, we conducted the Hausman specification test by excluding the choice of HFDI or VFDI, and the null hypothesis that there is no systematic change in the coefficients was not rejected.

[11] 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 reconfirmed.

between investing firms and their counterfactuals in performance/outcome variables one year before and one/three years after investing abroad. The impacts one and three years after investment are taken as the short-run and long-run impacts, respectively.

Results for HFDI, that is, FDI to developed countries, are reported in Table 5. First, HFDI does not significantly affect TFP in the production activity and the number of production workers. In other words, as a result, there are few impacts on production activities. These results might imply that the positive impacts resulting from knowledge spillovers offset the negative impacts from stopping the home production targeting the host country markets. The spillover effects from production activities may become available since the earlier period than our expectation.[12]

=== Table 5 ===

Second, in spite of few changes in the number of production workers, the overall number of workers increases in the long run. That is, the number of non-production workers does not change in the short run but does increase in the long run. The short-run results imply that HFDI does not require investors to newly hire a significant number of supervision/coordination staff, at least in the short run. The increase in the long run might be attributed to the increased need for R&D activities due to the spillover effects from the non-production activities abroad. Such an increase in the number of non-production workers leads to a rise in fixed costs at the entire firm level, which contributes partly to offsetting the rise of the overall TFP due to the spillover effects for both production and non-production activities. As a result, TFP is not significantly changed at the entire firm level.

Third, investing firms do not experience significant changes in wages both at the entire firm level and for the production activity. As mentioned in Section 2, since HFDI will not change the product/product bundle *per se*, the HFDI firms do not experience changes in production workers' skills and thus their wages. Taking this into account, the insignificant impact of HFDI on wages at the entire firm level may indicate that wages for non-production workers also remain unchanged. That is, despite the increased demand for non-production workers in the long run, the HFDI firms do not need those workers to be more highly educated or highly skilled than those hired before investing.

[12] One may argue that this result is just because investors had not exported to their future host economy before investing. But, we obtain the qualitatively same result even if we restrict sample to firms which have already got engaged in exporting at time t-1.

The results for VFDI, that is, FDI to developing countries, are reported in Table 6. There are three noteworthy points. First, production workers increase in the short run but do not change in the long run. This somewhat puzzling result may indicate how VFDI firms adjust production workers at home: they first increase the demand for skilled labor and then decrease that for unskilled labor. Still, the smaller impact on the overall number of workers than on the number of production workers may indicate that the number of non-production workers does not increase at all both in the short and long run. This implies that VFDI does not require investors to hire a significant number of coordination staff and that VFDI does not yield the significant specialization in non-production activities such as R&D activities at home.

=== Table 6 ===

Second, wages for production workers rise significantly both in the short and long run, though those at the entire firm level do not change in the short run. The former result is consistent with our expectation that the average wages of production workers rise immediately due to the specialization in skilled-labor-intensive processes at home. The insignificant short-run result for the entire-firm-level wages implies at least that non-production workers' wages do not rise in the short run. In other words, not only does VFDI not increase the number of non-production workers, but it does not require investors to replace the existing non-production workers with the more highly-educated ones in the short run.

Third, TFP rises only for the production activity in the short run. The results for the overall TFP, as well as the long-run result for the production-activity, are insignificant, which are not consistent with our expectation because the total payment for non-production workers does not seem to change, as we found above. In other words, we do not detect significantly positive impacts on TFP at the entire firm level, despite that the rise of TFP due to the benefits from the vertical division of labor is not offset by the rise of the total payment for non-production workers. Our way of constructing the TFP measure would be of the sources of these unexpected results. As examined in Section 2, for the detailed analysis of the impacts of VFDI on output and cost efficiency at home, it is necessary to use the TFP measure constructed based on the product-level data rather than the firm/plant-level data and then to focus on its change in the domestically remained product.

We then conduct one robustness check.[13] We exclude firms which do not have any non-production establishment. Conceptually, if a firm has only manufacturing plants, the same values are reported for the common data items in the firm-level data and in the plant-level data (aggregated on a firm basis). In other words, the figures for the production activity become identical to those at the entire firm level. In such a case, while the impacts on the production activity are still valid, those at the entire firm level cannot be exactly evaluated. In order to address this problem at the entire firm level, we restrict our sample to firms with at least one non-production establishment. The results for the impacts at the entire firm level are reported in Table 7. The substantial difference from the baseline results appears only in the number of workers in the case of VFDI. While Table 6 shows an increase in the number of workers, it remains unchanged in Table 7. However, as before, we can still say that the number of non-production workers does not increase both in the short and long run.

=== Table 7 ===

In short, our findings can be summarized as follows. On the whole, HFDI hardly affects the firm's performance at home. Only the non-production workers increase in the long run. Since the HFDI firms are thought to cease domestic production of the goods sold in foreign countries, the results of a few changes at home will be desirable for the investors' government. Also, VFDI does not change home outcomes drastically from the long-run viewpoint. The only remarkable change is that production specialization in skilled-labor-intensive activities raises wages in the production activity. For developed countries, in which workers' wages are much higher than in developing countries, these shifts to skilled-labor-intensive activities would be important for economic development.

5. Concluding Remarks

This paper empirically investigated two dimensions of changes in firm behavior and performance before and after investing abroad. One dimension has been the differences upon the type of FDI: HFDI or VFDI. The other dimension was the different effect of outward FDIs on the different scope of the firm's activities at home: the entire

[13] The other robustness check is the use of the productivity measure proposed by Levinsohn and Petrin (2003). We obtained qualitatively the same results as in the case of the TFP index and thus do not report them.

firm level or production activity only. As a result, our careful empirical analysis reveals that the impact of outward FDIs differs not only by the 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, there are few impacts on production workers and cost efficiency both in the short and long run. This result implies that the positive spillover effects immediately offset the negative impacts of the violation of scale economies in production activities. For non-production activities, on the other hand, the spillover effects increase the number of non-production workers gradually, though these non-production workers need not to be more skilled than those hired before investing. Also, in the case of VFDI, there are few changes in firms' performance at home. The number of workers does not dramatically change for both production and non-production activities. However, we found qualitative changes in production activities. The immediate rise in wages for production workers implies a compositional change in production workers. Keeping the total number of production workers constant, the share of skilled-production workers increases. In sum, it can be said that FDI to developed countries (HFDI) and FDI to developing countries (VFDI) raise demand for non-production workers and that for skilled-production workers, respectively.

Our empirical assessment provides various avenues for future research. First, the more disaggregated level analysis is necessary to closely examine the impacts of VFDI on some outcomes. In this paper, we have noted the difficulties in comparing the firm's ex-ante productivity and output with its ex-post productivity and output in the case of the VFDI firms. Since those in one product category are not qualitatively comparable with those in other product categories, the firm-level examination on the impact of VFDI becomes empirically vacuous. Changes in the VFDI firm's productivity before and after investing abroad includes not only the learning effect but also various elements attributed to changes of the 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/processes before and after investing abroad. If the VFDI firm relocates unskilled-labor-intensive activities abroad and domestically specializes in skilled-labor-intensive activities, the comparison of its pre- and post-investing productivities in the skilled-labor-intensive activities would enable us to get a better grasp of the consequences of VFDI.

Second, 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 impacts between FDI and outsourcing has not yet been investigated. This is most likely due to a lack of appropriate data. Investigating this issue might be the next step towards further understanding the consequences of production globalization.

The third issue to be examined consists of the impact of differences among other types of FDI. While in this paper we have focused on HFDI and VFDI, recent theoretical and empirical studies have placed 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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Appendix A. Data Construction Procedure

As we explained in Section 3, we used two kinds of firm-level data in this paper. One is ready-made firm-level data obtained from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) and the other is the data constructed by aggregating plant-level data from the Census of Manufactures (the Census). In addition, we obtained information on overseas affiliates from the Basic Survey of Oversea Business Activities (BSOBA).

Our way of linking these three longitudinal datasets is as follows. First, we linked the plant-level data from the Census and the ready-made firm-level data from the BSJBSA. Although both surveys are conducted by Ministry of Economy, Trade and Industry (METI), each survey uses its own firm identification (ID) code, and no correspondence table to match the Census codes with those of the BSJBSA is available. We therefore refer to the names of firms, their telephone numbers, and other information such as addresses so as to match the firm codes based on different data sources. The result of linking the Census with the BSJBSA in this way is satisfactory: the successfully matched number of manufacturing firms is more than 95 percent of the total number of manufacturing firms covered in the BSJBSA. Next, data obtained from the BSOBA were linked with those from the BSJBSA by referring to the names of firms, their addresses, and the number of employees.

Appendix B. Construction of Variables Used for the TFP Index

Output, intermediate input, labor input, and deflators

Real gross output is measured as shipments deflated by the output deflator, while intermediate input is the cost of materials deflated by the input deflator. Labor input is measured by the total number of employees. All output and input deflators are obtained from the Japan Industrial Productivity (JIP) Database 2009 (See Fukao et al. (2006) for details).

Capital stock

As in Matsuura et al. (2008), we constructed the net capital stock by deflating the nominal book values of tangible assets with capital stock deflator. The capital stock deflator is defined as the ratio of the net stock by industry to the book value of industry-level tangible assets. Net capital stocks by industry are from the JIP Database 2009, while the book values of capital by industry are obtained by aggregating the individual data from the Census.

Cost shares

Labor costs are defined as total salaries and intermediate input costs as the sum of raw materials, fuel, electricity and subcontracting expenses for consigned production. The cost shares for labor and intermediate inputs are defined as the ratio of the cost paid for each factor to the total production cost. The capital cost share is calculated as a residual.

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Table 1. The Number of New Investing Firms

Year	Domestic firms	HFDI	VFDI	Incumbent MNEs	Total
1992	6,634	9	16	856	7,515
1993	7,652	6	31	936	8,625
1994	7,653	13	63	974	8,703
1995	7,112	11	63	1,021	8,207
1996	7,652	9	49	1,122	8,832
1997	7,352	7	20	1,146	8,525
1998	7,168	4	5	1,125	8,302
1999	7,305	2	7	1,144	8,458
2000	7,116	3	7	1,133	8,259
2001	6,720	3	22	1,136	7,881
2002	6,444	1	18	1,117	7,580
2003	6,381	0	12	1,117	7,510
2004	5,949	2	10	1,093	7,054
Total	91,138	70	323	13,920	105,451

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

Table 2. The Means of Outcome Variables: Manufacturing Industry

	TFP		# of Workers		Wage	
	Overall	Production	Overall	Production	Overall	Production
Level						
Domestic firm	0.928	0.933	163.1	118.8	4.26	4.20
HFDI	0.962	1.067	514.7	335.1	4.96	4.99
VFDI	0.964	0.973	373.9	226.1	4.62	4.50
Incumbent MNEs	1.007	1.044	933.2	559.4	5.44	5.03
Total	0.939	0.948	206.0	146.1	4.40	4.30
Growth						
Domestic firms	-0.056	0.002	-0.005	-0.142	0.016	0.001
HFDI	-0.006	-0.008	0.002	-0.075	0.072	0.014
VFDI	-0.002	0.017	0.000	-0.047	0.051	0.007
Incumbent MNEs	-0.025	0.007	-0.015	-0.103	0.018	0.001
Total	-0.051	0.003	-0.006	-0.136	0.017	0.001

Notes: Number of workers (persons); Wages (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	0.891	0.294	3.03	0.002
ln (# of Workers)	0.809	0.103	7.87	0.000
ln KL ratio	0.553	0.145	3.82	0.000
ln (Advertise/Sales)	-1.375	7.202	-0.19	0.849
ln (R&D/Sales)	0.727	0.481	1.51	0.131
ln Age	-0.107	0.302	-0.35	0.723
VFDI				
TFP	0.222	0.182	1.22	0.223
ln (# of Workers)	0.647	0.049	13.08	0.000
ln KL ratio	0.268	0.068	3.97	0.000
ln (Advertise/Sales)	1.251	2.918	0.43	0.668
ln (R&D/Sales)	0.052	1.197	0.04	0.966
ln Age	0.276	0.154	1.79	0.074
Year dummy	Yes			
Industry dummy	Yes			
Number of obs	91,531			
LR chi2	647.48			
Pseudo R2	0.119			

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

	Mean			
	Treated	Control	t-value	p-value
HFDI				
TFP	1.071	1.044	0.39	0.697
ln (# of Workers)	6.187	6.213	-0.16	0.873
ln KL ratio	2.718	2.623	0.88	0.380
ln (Advertise/Sales)	0.007	0.006	0.52	0.602
ln (R&D/Sales)	0.029	0.089	-0.9	0.370
ln Age	3.764	3.739	0.39	0.695
VFDI				
TFP	0.973	0.989	-0.64	0.524
ln (# of Workers)	5.916	5.867	0.65	0.513
ln KL ratio	2.448	2.534	-1.31	0.192
ln (Advertise/Sales)	0.006	0.006	0.17	0.862
ln (R&D/Sales)	0.013	0.015	-1.19	0.235
ln Age	3.753	3.769	-0.54	0.586

Table 5. The Impact of HFDI on Performance at Home

	Overall		Production	
	$t+1$	$t+3$	$t+1$	$t+3$
TFP				
Coef	-0.012	0.015	-0.013	0.008
[Std.Err.]	[0.022]	[0.026]	[0.042]	[0.062]
N	118	104	132	120
R-squared	0.120	0.117	0.027	0.108
Number of workers				
Coef	0.018	0.302***	-0.133	-0.058
[Std.Err.]	[0.027]	[0.108]	[0.110]	[0.108]
N	118	104	120	112
R-squared	0.079	0.202	0.137	0.045
Wages				
Coef	0.021	-0.025	-0.001	-0.045
[Std.Err.]	[0.035]	[0.050]	[0.029]	[0.036]
N	118	104	132	120
R-squared	0.077	0.200	0.150	0.223

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. The Impact of VFDI on Performance at Home

	Overall		Production	
	$t+1$	$t+3$	$t+1$	$t+3$
TFP				
Coef	0.008	0.009	0.044**	0.031
[Std.Err.]	[0.011]	[0.018]	[0.018]	[0.021]
N	532	428	608	514
R-squared	0.089	0.031	0.024	0.019
Number of workers				
Coef	0.061***	0.029	0.147**	0.090
[Std.Err.]	[0.020]	[0.029]	[0.057]	[0.067]
N	532	428	542	452
R-squared	0.049	0.041	0.033	0.021
Wages				
Coef	0.007	0.069**	0.029**	0.031*
[Std.Err.]	[0.024]	[0.030]	[0.015]	[0.018]
N	532	428	608	514
R-squared	0.092	0.089	0.043	0.085

Note: See Table 5.

Table 7. Impact of Investing Abroad on the Home Performance at the Overall Level: Excluding Firms without Non-production Establishments

	Horizontal FDI		Vertical FDI	
	$t+1$	$t+3$	$t+1$	$t+3$
TFP				
Coef	0.021	0.014	0.011	0.001
[Std.Err.]	[0.023]	[0.028]	[0.013]	[0.019]
N	98	84	438	350
R-squared	0.113	0.119	0.099	0.040
Number of workers				
Coef	0.058	0.240**	0.028	-0.014
[Std.Err.]	[0.038]	[0.091]	[0.019]	[0.033]
N	98	84	438	350
R-squared	0.075	0.287	0.073	0.049
Wages				
Coef	0.037	-0.069	0.016	0.078**
[Std.Err.]	[0.043]	[0.058]	[0.027]	[0.033]
N	98	84	438	350
R-squared	0.111	0.277	0.105	0.082

Note: See Table 5.