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How Does FDI Affect Performance at Home? An Activity-level Analysis for Japanese Electrical Machinery and Electronics Firms

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Abstract

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***Keywords*:** Productivity; FDI; Japan; electrical machinery and electronics industry
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1. Introduction

A topic that has received considerable attention in recent years is the impact of Japanese multinational firms' foreign direct investment (FDI) in East Asia on their performance at home. Much of the focus has been on firms from the machinery sector, which have invested in countries throughout the region and have built extensive production and distribution networks. These international production networks forged by Japanese firms have come to play a significant role in their host economies, span a wide range of countries, and represent a sophisticated web of different types of transactions ranging intra-firm to arm's-length transactions.

However, the impact of the formation of such international production networks on performance at home is not quite clear. On the one hand, the relocation of production has forced Japanese firms to concentrate their domestic activities on specific production processes such as upstream processes and to shut down activities engaged in processes that have been moved abroad. The latter development has attracted much public attention, giving rise to concerns over the "hollowing out" of domestic industry that peaked around the year 2000, when Japanese firms accelerated the transfer of production to China. On the other hand, against such concerns over "hollowing out" must be weighed the potential improvements in firm performance and productivity at home resulting from outward FDI. Indeed, the active vertical division of labor with Japanese affiliates in China has resulted in a rapid increase in Japanese exports to China.

Against this backdrop, a substantial body of empirical literature has grown up examining the impact of FDI on firm performance and productivity at home, although the results obtained remain inconclusive. Examples of studies in this field include Navaretti et al. (2004, 2006) for Italy, Hijzen et al. (2007) and Ito (2007) for Japan, and Hijzen et al. (2006) and Navaretti et al. (2006) for France. Hijzen et al. (2007) and Ito (2007), both analyzing the impact of Japanese FDI on domestic productivity at the firm level, do not find a robust improvement.

Another consideration in this context is that the effect of FDI on productivity at home may differ depending on the type of FDI, i.e., whether it is vertical FDI (VFDI) or horizontal FDI (HFDI). From a theoretical point of view, the impact of HFDI on productivity at home is ambiguous. On the one hand, HFDI may have a positive effect on home productivity through knowledge or technologies gained from operating abroad. On the other hand, the relocation and hence fragmentation of production potentially reduces economies of scale. In contrast, the effect of VFDI unambiguously should be positive due to the vertical division of labor, making it possible to locate processes in countries that have a comparative advantage in them.

Based on this reasoning, there are several papers that have explored the effects of HFDI and VFDI separately, but their results seem to be inconsistent with the above theoretical predictions. Navretti et al. (2006), for instance, distinguish between FDI in developed and developing economies, with the former assumed to represent HFDI and the latter VFDI. Hijzen et al. (2006), in contrast, define VFDI as investments in developing countries by firms in industries in which the investing country has a comparative disadvantage, and HFDI as investments in developed countries by firms in industries in which the investing country has a comparative advantage. Using French firm-level data in both cases, the two studies find that HFDI significantly enhances firms' domestic productivity, while VFDI has no significant effect.

A possible reason for these counterintuitive results lies in the data they use. An important difference between the two types of FDI is whether there is a change in investors' main activity at home after the investment abroad. In contrast with HFDI, VFDI changes firms' main activity at home, such as from a downstream activity to an upstream activity. Since such a change in activities implies a change in firms' home production function *per se*, it is inappropriate to compare *firms'* productivity before and after the VFDI is conducted. This means that the firm-level analyses of the previous studies do not present an adequate picture of the impact of VFDI.

The aim of this paper is to re-examine the impact of FDI on productivity at home by employing data on FDI in the Japanese electrical machinery and electronics industry. In contrast with previous studies relying on firm-level data, this paper employs activity-level data that are constructed for this purpose, not ready-made firm-level data. For example, if a firm has more than one activity such as an upstream activity and a downstream activity, we treat these activities as different observations. The use of activity-level data enables us to compare productivity in an activity before and after an overseas investment was conducted and thus to eliminate any influence of a change in activity in the assessment of the impact of FDI. In order to highlight the advantages of using activity-level data in the measurement of the productivity impact of FDI, we also conduct a sensitivity analysis by estimating the same model using firm-level data. Doing so, we find that the choice of the data unit makes a significant difference in our estimate of the impact of FDI.

The rest of this paper is organized as follows. The next section theoretically discusses the impact of HFDI and VFDI on productivity at home, while Section 3 outlines our empirical methodology. In Section 4, we provide our empirical results, and Section 5 concludes.

2. The impact of FDI on domestic performance

This section provides theoretical considerations on the impact of FDI on the productivity of domestic activities. We begin by discussing the nature of the different types of FDI and then consider the ways in which horizontal and vertical FDI affect productivity at home.

The literature on FDI distinguishes two kinds of FDI, horizontal and vertical. HFDI essentially is conducted to gain access to local markets. Especially in the manufacturing sector, it often aims at avoiding trade costs in the broadest sense by setting up production facilities within the target market/country rather than by exporting from the home country. In the case of HFDI, production activities in the host country are more or less the same as those in the home country.

On the other hand, VFDI seeks to exploit international factor price differences. This means that firms relocate those activities or production processes that are relatively intensive in the factor in which the host country has a comparative advantage. Thus, from a theoretical point of view, there should be little or no overlap between activities at home and abroad in the case of VFDI. In addition, HFDI and VFDI differ in terms of the destination of final sales: while HFDI targets the local market of the host country (or region), the final sales destination of VFDI is third countries and/or the home country. Although in practice multinational enterprises (MNEs) pursue a variety of motives when investing abroad and the activities of overseas affiliates consequently cannot always be easily classified as clearly falling into one or the other category, the distinction between horizontal and vertical FDI is very useful for the analysis of MNE behavior.

Whether firms engage in FDI, and whether such FDI is of the horizontal or vertical type, is likely to be determined by a number of factors, including relative factor prices, the production technology (returns to scale), fixed investment costs abroad, and broadly-defined trade costs. In the absence of factor cost differentials, FDI is likely to be of a horizontal nature. Firms supply their products through HFDI rather than exporting from the home country when broadly defined trade costs are high.

On the other hand, when there are substantial factor cost differentials between the host and the home country, FDI is likely to be of a vertical nature. Firms can benefit from fragmenting their production processes and relocating labor intensive processes to countries with lower factor prices. Since relocated labor intensive processes are typically downstream activities such as the assembly of final products, international fragmentation often requires intra-firm trade between upstream activities such as the production of parts and components at home and relocated downstream activities. Thus, low shipment costs may be another determining factor of VFDI.

Next, we consider to the different ways in which FDI affects the productivity of home activities. HFDI changes the average cost of home activities through the following channels. First, HFDI unambiguously decreases the level of home production because it replaces the production of goods designated for the host country. If we assume firms use an increasing-returns-to-scale technology, this decrease obviously raises the average cost as depicted in Figure 1, where X_{pre} and X_{post} are the quantities of home production before and after the relocation of production abroad. In this case, the productivity of home activities unambiguously decreases.[1] Second, however, there may be knowledge or technology spillovers from the overseas activity to the home activity, as pointed out in previous studies such as Navaretti et al. (2006). If such spillover effects exist and the home activity enjoys a sufficient decrease in marginal costs, the average cost declines, as depicted in Figure 2. In sum, the impact of HFDI on the productivity of home activities depends on the existence and magnitude of knowledge/technology spillovers from host countries.

[1] Home activity fixed costs rise even further if the costs of establishing the overseas affiliate are also born by the unit, in which case the negative effect on productivity would be even greater.

=== Figures 1and 2 ===

In contrast, the impact of VFDI on productivity at home is less ambiguous. We restrict our attention only to the cost structure of an upstream activity at home which is linked with a downstream activity relocated abroad as part of international fragmentation. VFDI affects the average cost through its impact on the quantity of production of upstream products. International fragmentation with intra-firm trade through VFDI enables firms to reduce their total operating cost and consequently reduces the price of their final products as a result of the relocation of production processes to countries with low factor prices. The decrease in the price of final products increases the total production quantity of such firms and thus also increases the production of upstream activities at home, because the increase in downstream production abroad leads to an increase in the export of upstream parts and components for use in downstream activities. Again, assuming an increasing-returns- to-scale technology, the average cost of home upstream activities decreases, as depicted in Figure 3, and the productivity in such activities thus rises.

=== Figure 3 ===

So far, we have only examined the impact of FDI on the *level* of productivity in home activities. In fact, almost all preceding studies have focused exclusively on the impact on the productivity level. However, FDI might also affect the *growth* of productivity. HFDI, for example, as mentioned above, may involve knowledge and/or technological spillovers, which may affect productivity growth. A substantial number of studies on spillover effects have shown that the presence of MNEs in a country has a positive effect on the productivity growth of host country firms (e.g., Görg and Greenaway, 2004; Crespo and Fontoura, 2007). It may therefore be hypothesized that there are also knowledge and/or technology spillovers from the host country via the foreign affiliate to activities at home affecting not only the level but also the growth of productivity

VFDI may similarly affect productivity growth through offshoring. Hijzen et al. (2008), for example, suggest that specializing in skill-intensive production stages through offshoring generates higher productivity growth due to larger learning-by-doing effects than in the case of no offshoring. Consequently, both HFDI and VFDI may affect not only the level but also the growth of productivity in activities at home. Given these considerations, in the empirical analysis we examine the impact of outward FDI on both the level and the growth of productivity at home, focusing on Japanese manufacturing firms.

3. Empirical Issues

In this section, we begin by explaining our empirical methodology to examine the impact of FDI on performance at home. We then briefly describe our data sources and explain how we construct our productivity measure.

3.1. Empirical Methodology

To examine the impact of FDI on home productivity, we conduct our analysis at the most detailed level possible. This means that instead of the firm, our unit of analysis is the production activities in a specific line of business. As mentioned earlier, in the case of VFDI, a certain part of the production process is relocated abroad, meaning that the production activities at home before and after the relocation of production differ. This, in turn, implies that investigations examining the impact of VFDI on productivity at the firm-level in fact miss a key element, namely that changes in productivity reflect changes in activities in addition to any learning effects. Therefore, in order to measure the learning effects only, it is necessary to focus on the productivity change only in those activities conducted at home both before and after the relocation of production. It is for this reason that in our analysis we employ not firm-level but activity-level data.

To examine the impact of FDI on home performance, it is necessary to address the issue of endogeneity between productivity and FDI. Previous studies have tended to adopt one of two approaches: instrumental variable methods and propensity score matching methods. Particularly when micro data are available, the latter, which requires a larger number of observations, is usually the preferred method. However, our data are highly disaggregated, and this high degree of disaggregation prevents us from using the type of matching methods typically employed in preceding studies such as the ones mentioned at the outset. The purpose of such matching methods is to overcome the endogeneity problem that firms that conduct FDI, by their very nature, tend to be more productive than non-FDI firms. (Nearest) matching methods usually choose non-FDI firms that not only have the closest probability of conducting FDI but that also operate in the same industry as the FDI firms that they are matched with. However, the high degree of disaggregation in our study means that the number of non-FDI firms engaged in the same industry/production process as FDI firms is small even though our dataset is one of the largest datasets available in Japan. Thus, the lack of a sufficient number of observations prevents us from obtaining a good matching. Instead, following Castellani et al. (2007) and Hijzen et al. (2008), we therefore specify a linear equation with a lagged dependent variable in order to control for fluctuations caused by elements not adequately measured by our productivity index. We estimate two kinds of equations at the activity-level: level equations and growth equations. The specifications are as follows:

$$TFP_{ij}(t) = \rho\, TFP_{ij}(t\text{-}1) + \beta_1\, Horizontal_{ij}(t\text{-}1) + \beta_2\, Vertical_{ij}(t\text{-}1) + \delta(t) + \eta_{ij} + \varepsilon_{ij}(t),$$

$$\Delta TFP_{ij}(t) = \lambda\, \Delta TFP_{ij}(t\text{-}1) + \gamma_1\, Horizontal_{ij}(t\text{-}1) + \gamma_2\, Vertical_{ij}(t\text{-}1) + \delta(t) + \eta_{ij} + \varepsilon_{ij}(t),$$

where $TFP_{ij}(t)$ and $\Delta TFP_{ij}(t)$ denote respectively the level and the first-difference of productivity in firm *i*'s activity *j* in year *t*. Productivity is measured using a total factor productivity index, the construction of which will be explained below. $Horizontal_{ij}$ and $Vertical_{ij}$ represent the magnitude of firm *i*'s horizontal and vertical FDI in activity *j*. We take the lagged dependent variable and the two FDI variables as predetermined. To control for any endogeneity of these predetermined variables, we employ the System GMM (general method of moments) proposed by Blundell and Bond (1998). We use the second and third lagged observations of the dependent variable and of the FDI variables as instruments. In both equations, the error term is modeled as a time fixed effect (δ), a firm activity fixed effect (η), and the usual disturbance (ε).

In order to pinpoint the impact of FDI on home productivity in the activity of interest, it is necessary to gauge the magnitude of HFDI and VFDI in these activities, which the variables $Horizontal_{ij}$ and $Vertical_{ij}$ do. These variables are constructed as follows. As outlined in Section 2.1, in the case of HFDI, overseas units engage in the same activity as units at home, while in the case of VFDI, activities abroad differ from those at home and often form an input-output relationship with home activities. Thus, firm *i*'s HFDI in activity *j*, i.e, $Horizontal_{ij}$, represents the scale of production abroad in the same activity that units at home are engaged in. On the other hand, firm *i*'s VFDI in activity *j*, $Vertical_{ij}$, represents the scale of production abroad in activities which form an input-output relationship with home activities. In practice, many firms have foreign affiliates in different countries. To give an example, suppose that an MNE with both upstream and downstream activities at home also has downstream activities in country 1 and country 2 as well as upstream activities in country 2. Table 1 shows a hypothetical example of such a distribution of production activities. In this example, both *A* and *C* are upstream activities, so *C* represents a horizontal investment for *A*. On the other hand, assuming the overseas downstream activities *D* and *E* form an input-output relationship with upstream activity *C* at home, *D* and *E* represent vertical investments for *A*. We measure the scale of firms' overseas activities using the number of employees, so in the case of our hypothetical firm here, *Horizontal* for *A* measures the employment in *C*, while *Vertical* for *A* measures the sum of the employment in *D* and *E*.

=== Table 1 ===

Furthermore, it is necessary to normalize the scale of the two FDI variables, *Horizontal* and *Vertical*. For the HFDI variable, we do so by dividing the scale of firm *i*'s overseas production in activity *j* by its worldwide production in that activity, i.e., by the sum of overseas and domestic production in activity *j*. In our example in Table 1, *Horizontal* for home activity *A* thus is overseas upstream activity *C* adjusted by the sum of *A* and *C*. On the other hand, as for *Vertical*, we divide by the magnitude of firm *i*'s production in the whole world including home. That is, in Table 1, the VFDI variable for upstream activity at home *A* is adjusted by the sum of *A*, *B*, *C*, *D*, and *E*.[2]

[2] The reason why we include the same activity as a home activity in the denominator of *Vertical* is to distinguish *platform type* VFDI (the vertical division of labor between the host and other host countries) from *pure* VFDI (the vertical division of labor between the home and the host country). For instance, in Table 1, if overseas downstream activities (*D* and *E*) purchase upstream products

As already mentioned, in this paper we use overseas' affiliates employment to gauge the scale of firms' overseas activities. Another measure that would potentially be more appropriate than employment is overseas affiliates' value added. However, many firms do not report the cost of intermediate inputs, which would be necessary to calculate value added. Consequently, we use the number of employees and define the two FDI variables as follows:

$$Horizontal_{ij} = \frac{\sum_{r \in R_O} L_{ij}^r}{\sum_{r \in R} L_{ij}^r}, \quad Vertical_{ij} = \frac{\sum_{r \in R_O} \sum_{k \in S_j} L_{ik}^r}{\sum_{j \in S} \sum_{r \in R} L_{ij}^r}$$

where L^r_{ij} represents the number of employees in firm i in activity j in country r; S denotes the set of all activities in the industry to which activity j belongs; and R is the set of all countries: $R \in$ {All countries including Japan}, $R_O \in$ {All countries except for Japan}. S_j denotes the set of activities with an input-output relationship with activity j. For example, if activity j is the manufacture of "electrical machinery, equipment and supplies," S_j is the manufacture of "electronic parts and devices." Details on the activities used in our analysis are provided in the next subsection.

In addition, we construct two further variables by decomposing the variable *Vertical* as follows. If activity j is an upstream activity, then

$$Upstream_{ij} = \frac{\sum_{r \in R_O} \sum_{k \in S_j} L_{ik}^r}{\sum_{j \in S} \sum_{r \in R} L_{ij}^r},$$

and $Upstream_{ij} = 0$ otherwise. If activity j is a downstream activity, then

$$Downstream_{ij} = \frac{\sum_{r \in R_O} \sum_{k \in S_j} L_{ik}^r}{\sum_{j \in S} \sum_{r \in R} L_{ij}^r}.$$

and $Downstream_{ij} = 0$ otherwise. Returning to the example in Table 1, while the variable *Downstream* for home activity *A* refers to the sum of *D* and *E*, there are no further upstream activities for home activity *A*. Thus, we set *Upstream* to zero for the home activity, i.e., *A*, in the case of this example. Similarly, while *Upstream* for home activity *B* is *C*, there are no further downstream activities for *B*, thus, *Downstream* for

not only from the home activities (*A*) but also from country 2 (*C*), the use of indicator (D+E)/(A+D+E) as the VFDI variable for *A* overestimates the impact of overseas production (D+E) on the productivity of activity *A*. In this case, the more appropriate indicator for the VFDI variable for *A* is (D+E)/(A+C+D+E). Therefore, we normalize the VFDI variable by the sum of the scale of all activities in the world.

B is defined as zero. Therefore, using *Upstream* and *Downstream* in place of *Vertical*, we distinguish between the impact of the relocation of an upstream activity and a downstream activity.

Finally, two more points should be noted. First, our variables representing FDI are continuous, while most previous studies use binary variables, i.e., variables that take unity if a firm conducts FDI and zero otherwise.[3] Since most other studies use propensity score matching methods, their FDI variables are restricted binary variables. However, since we use the GMM approach here, this enables us to use continuous variables. Given that it takes time for overseas affiliates to ramp up production after the initial investment, using continuous variables has the advantage that we can measure the incremental spillovers from the division of labor through FDI. Using continuous variables representing affiliates' activities enables us to take this kind of time lag into consideration. However, employing continuous variables, we cannot clearly distinguish between the impacts of two separate investments if these occur in short succession and production is still being ramped up in the first affiliate when investment in the second takes place. Therefore, the variables representing firms' overseas production activities measure these not for individual affiliates but for *all* affiliates in one particular region.

Second, a possible concern is the double counting of learning effects. Let us return to the example presented in Table 1. In our methodology, for home upstream activity *A*, the proxy for the scale of HFDI is foreign upstream activity *C*. At the same time, for home downstream activity *B*, foreign upstream activity *C* is regarded as the proxy for the scale of VFDI. That is, the effect of relocating production shows up in both *Horizontal* and *Vertical* if an MNE has both downstream and upstream activities at home (i.e., the MNE is an integrated MNE). Such double counting produces noise in the coefficients for both *Horizontal* and *Vertical*. However, since there are few integrated MNEs,[4] the influence of such double counting on our estimates is likely to be trivial.

3.2. Data Issues

[3] One preceding study using continuous variables is Hijzen et al. (2008).

[4] The share of integrated MNEs in all Japanese MNEs in our dataset is around 10 percent. That is, most firms investing abroad engage only in one type of activity overseas.

Our primary data sources are the linked longitudinal data sets of the *Census of Manufactures* and the *Basic Survey of Overseas Business and Activities* for the period 1985-2003.[5] The *Census of Manufactures* provides data on establishments located in Japan (including, e.g., their location, number of employees, tangible assets, and value of shipments). The *Basic Survey of Overseas Business and Activities*, on the other hand, provides data on Japanese overseas affiliates for the period from 1985 and 2003. Finally, information on the parent firms of establishments/affiliates, such as their number of employees, we obtain from the *Basic Survey of Japanese Business Structure and Activities*. In our analysis, we exclude establishments with fewer than 9 employees, because such establishments do not provide information on capital, which is indispensible for calculating our productivity measure, total factor productivity (TFP). Information on capital data is also not available for 2001 and 2002 for establishments with less than 29 employees. Therefore, our linked panel data set covers the years from 1985 to 2000 and 2003.

We calculate the TFP index following Caves et al. (1982, 1983) and Good et al. (1983). The TFP index at the activity-level is calculated as:

$$TFP_{ijt} = \left(\ln Q_{ijt} - \overline{\ln Q_t}\right) - \sum_{f=1}^{F} \frac{1}{2}\left(s_{ijft} + \overline{s_{ft}}\right)\left(\ln X_{ijft} + \overline{\ln X_{ft}}\right)$$
$$+ \sum_{s=1}^{t}\left(\overline{\ln Q_s} - \overline{\ln Q_{s-t}}\right) - \sum_{s=1}^{t}\sum_{f=1}^{F}\frac{1}{2}\left(\overline{s_{fs}} + \overline{s_{fs-1}}\right)\left(\overline{\ln X_{fs}} - \overline{\ln X_{fs-1}}\right) \quad ,$$

where Q_{ijt} denotes the gross output of firm *i*'s activity *j* in year *t*, s_{ijft} stands for the cost share of input *f* for firm's activity *j* in year *t*, and X_{ijft} is the input of factor *f* in firm's activity *j* in year *t*. Variables with an upper bar denote the industry average of that variable. We define a hypothetical (representative) firm for each year and industry. Its input and output are calculated as the geometric means of the input and output of all establishments in the industry. The first two terms on the right-hand side of the equation denote the cross-sectional TFP index based on the Theil-Tornqvist specification for each firm and year relative to the hypothetical establishment. Since the cross-sectional TFP indexes for *t* and *t*-1 are not comparable, we adjust the cross-sectional TFP index with the TFP growth rate of the hypothetical firm, which is what the third and fourth terms in the equation represent. For more details on the construction of these variables, see Appendix B.

[5] For details on the construction of our dataset, see Appendix A.

This paper focuses on the seven activities in the electrical machinery and electronics manufacturing industry with the largest outward FDI stock. Five of these are categorized as downstream activities, while the other two are upstream activities. The classification into upstream and downstream activities is based on the input-output relationships among them, which are determined on the basis of the Input-Output Tables published by the Ministry of Internal Affairs and Communications. We do so by first defining upstream activities as activities in which the share of manufacturers' intermediate demand in total domestic demand is greater than 90 percent. This is the case for the manufacture of "electronic parts and devices" and "semiconductors." Next, the five remaining activities are defined as downstream activities. They include "office machinery," "household electronic equipment," "industrial electrical apparatus," "electronic data processing machines," and "communication equipment."

Using this classification, Table 2 shows the distribution of firms, for the year 2000, in terms of the combination of their activities at home and abroad. The figure 113 in the right-most column, for example, indicates that there are 113 firms that are engaged in upstream activities at home and also abroad. The figures in parentheses show the distribution when we focus only on whether firms have activities in East Asia (i.e., ignoring activities in other parts of the world). The table allows two observations. First, there are more firms that engage in *similar* activities at home and abroad (i.e., downstream/downstream or upstream/upstream) than firms that engage in *different* types of activities at home and abroad (i.e., downstream/upstream or upstream/downstream). This suggests that there are more firms conducting HFDI than VFDI. Second, the pattern is very similar if the criterion is whether firms have activities located in East Asia, which is the area that has attracted the greatest number of Japanese overseas affiliates and accounts for the largest share of overseas employment by Japanese firms.

=== Table 2 ===

It is generally presumed that Japanese FDI in the electrical machinery and electronics industry, especially when it is directed at East Asia, is motivated by the exploitation of factor cost differences. This means that we would expect firms to move labor-intensive downstream activities overseas, while they keep capital-intensive upstream activities in Japan. However, in practice, the vertical division of labor in Japanese MNEs may be more complicated than this. The upper half of Table 3 shows the share of imports from Japan in overseas affiliates' total procurements. As can be seen, the share of imports from Japan tends to be higher for upstream than for downstream affiliates, and in one case (semiconductors) substantially so. Next, the lower half of the table shows the share of exports to Japan in overseas affiliates' total sales. The figures indicate that upstream affiliates, particularly those in the ASEAN countries and China, tend to export more of their output to Japan than downstream affiliates. In the case of semiconductor manufacturing affiliates in ASEAN and China, more than 60 percent of their products are exported to Japan. Since around 90 percent of affiliates' exports to Japan are intra-firm trade,[6] such upstream products are likely to be further assembled in home activities, and the assembled products then are potentially again exported abroad. This pattern reflects the complex nature of production systems in the electrical machinery and electronics industry. For example, the manufacturing process of semiconductors can be decomposed into two types of processes, capital-intensive processes such as lithography and etching and labor-intensive processes such as packaging and inspection. A large share of the latter labor-intensive processes is conducted in China, and the completed semiconductor products are then imported back to Japan to be used for the further assembly of electronics products. Due to this complex division of labor in the electrical machinery and electronics industry, we may find that VFDI may have an impact on productivity not only in upstream activities but also in downstream activities.

=== Table 3 ===

[6]According to Kiyota et al. (2008), the average intra-firm trade ratio for Japanese multinationals in the electrical machinery and electronics industry exceeds 90 percent.

4. Empirical Results

We can now begin the empirical analysis.[7] The system GMM regression results are reported in Table 4. Introducing only the first-lagged dependent variable in the level equation, we can see that the results are not consistent with the assumption of the System GMM: the AR(2) test and Hansen's *J* test are rejected. Based on the rejection of the AR(2) test, we introduce both the second- and third-lagged dependent variables as independent variables in the level equation. The results are as follows. First, the coefficients on *Horizontal* are insignificant in the level equation, while in the growth equation, the coefficients are positive and significant. These results may be evidence of weak spillover effects from host countries to activities at home. Second, the coefficients on *Vertical* are significantly positive in both the level and growth equations. We may say that, while the positive coefficient in the level equation suggests that VFDI raises productivity through the vertical division of labor, that in the growth equation suggests that VFDI generates learning-by-doing effects. This difference in the productivity impact of HFDI and VFDI is consistent with our theoretical discussion in Section 2.

In addition, we decomposed the variable *Vertical* into *Upstream* and *Downstream*, corresponding to the relocation abroad of upstream and downstream activities, respectively. We find that the coefficients for both *Upstream* and *Downstream* are significant and positive. This is a somewhat surprising result. We had expected a significant positive effect on home productivity of the relocation of downstream activities, which typically consist of labor-intensive assembly processes, and the significant coefficient on *Downstream* confirms the presence of such an effect. On the other hand, the significant result for *Upstream* is somewhat unexpected, but is likely to reflect the complex nature of production systems in the electrical machinery and electronics industry described earlier: certain upstream activities (such as inspection and packaging) also tend to be labor intensive and their relocation raises productivity in activities that remain at home.

=== Table 4 ===

[7] For basic statistics of the variables we used, see Table A1 in the Appendix.

In order to further investigate the effect of FDI on home productivity, we focus on Japanese overseas activities in East Asian countries (ASIA).[8] The FDI variables for East Asia are defined as follows:

$$Horizontal_{ij} = \frac{\sum_{r \in ASIA} L_{ij}^{r}}{\sum_{r \in R^{Asia}} L_{ij}^{r}}, \ Vertical_{ij} = \frac{\sum_{r \in ASIA} \sum_{k \in S_j} L_{ik}^{r}}{\sum_{j \in S} \sum_{r \in R^{Asia}} L_{ij}^{r}},$$

where R^{Asia} is a set consisting of East Asian countries and Japan. While in the previous analysis, these variables were based on MNEs' overseas employment worldwide, here they are restricted to overseas employment in East Asia only.

Focusing on FDI in East Asia is useful for two reasons. First, as shown in Table 2, East Asia is by far the most important region for overseas production by Japanese firms; concentrating on East Asia only thus allows us to examine whether there are any qualitative differences in the impact of FDI in this region. Second, focusing on FDI in East Asia helps to control for differences in skill levels across host countries. For example, the skill level of workers in OECD countries tends to be higher than that of workers in East Asian countries. Restricting the two FDI variables to East Asian countries thus enables us to avoid the aggregation of employees with different skill levels.

Since the above two variables include only employment in East Asian countries, to control for the different [???] impacts of MNEs' activities in developed countries (Developed) and developing countries excluding East Asian countries (Other) on home productivity,[9] we also prepared the following two variables:

$$FDI_{Developed,ij} = \frac{\sum_{r \in Developed} \sum_{j \in S} L_{ij}^{r}}{\sum_{j \in S} \sum_{r \in R} L_{ij}^{r}}, \ FDI_{Other,ij} = \frac{\sum_{r \in Other} \sum_{j \in S} L_{ij}^{r}}{\sum_{j \in S} \sum_{r \in R} L_{ij}^{r}}.$$

The numerator for these variables is the number of employees at Japanese affiliates in the developed countries and in all other countries apart from the East Asian countries, respectively, while the denominator is the same as for *Vertical.*

The regression results are reported in Tables 5.[10] The table shows, first, that the

8 In this paper, East Asia includes South Korea, Taiwan, Hong Kong, Singapore, Malaysia, the Philippines, Thailand, Indonesia, and China.

9 Developed countries here consist of the United States, Canada, the Western European countries, Australia, and New Zealand. And other developing countries are rest of countries except for East Asia.

10 Basic statistics are again presented in Table A1 in the Appendix.

coefficient on *Horizontal* is insignificant in all specifications. This result is consistent with the fact that we would expect any impact of HFDI on home productivity to be the result from knowledge spillovers from the host country. Such knowledge spillovers are less likely from East Asian countries, which have a lower knowledge base than developed countries. Second, although the results for the VFDI-related variables are qualitatively unchanged from those in Table 5, the size of the coefficients is considerably greater. This result is consistent with the general argument that the larger the differences in factor prices between home and host countries, the larger are the benefits from VFDI. Third, as in Table 5, the coefficients on both *Upstream* (*t*-1) and *Upstream* (*t*-1) are positive and significant.

=== Table 5 ===

Finally, in order to check the validity of using activity-level data, we also run the same regressions using firm-level data.[11] The equations that are estimated are:

$$TFP_i(t) = \rho\, TFP_i(t\text{-}1) + \beta_1\, Horizontal_i(t\text{-}1) + \beta_2\, Vertical_i(t\text{-}1) + \delta(t) + \eta_i + \varepsilon_i(t),$$

$$\Delta TFP_i(t) = \lambda\, \Delta TFP_i(t\text{-}1) + \gamma_1\, Horizontal_i(t\text{-}1) + \gamma_2\, Vertical_i(t\text{-}1) + \delta(t) + \eta_i + \varepsilon_i(t),$$

where $TFP_i(t)$ and $\Delta TFP_i(t)$ denote the level and the first-difference of productivity in firm *i* in year *t*, respectively. $Horizontal_i$ and $Vertical_i$ are calculated as:

$$Horizontal_i = \frac{\sum_{r \in R_O} L^r_{ih}}{\sum_{r \in R} L^r_{ih}}, \quad Vertical_i = \frac{\sum_{r \in R_O} \sum_{k \in S_h} L^r_{ik}}{\sum_{h \in S} \sum_{r \in R} L^r_{ih}},$$

where L^r_{ih} represents firm *i*'s employment in activity *h* in country *r*. Activity *h* is the activity with the largest sales share in all of firm *i*'s activities. As is shown in Table 6, the coefficients for *Horizontal* and *Vertical* become insignificant. Similarly, the coefficients on *Upstream* and *Downstream* now are also insignificant with the exception of that on *Downstream* in the growth equation. In sum, the results of the firm-level estimation are strikingly different from the activity-level estimations,

[11] The firm-level data were constructed by aggregating the activity-level data for each firm. Thus, our observations do not include the cost of headquarter services.

confirming our hypothesis that the inconclusive results of preceding studies on the relationship between FDI and productivity at home owe to data problems. As we argue in Section 1, VFDI may change the activities that firms are engaged in at home and the inconclusive results on the effect of FDI on home productivity may be a result of the noise caused by such changes in home activities. Thus, activity-level data is more appropriate to compare productivity before and after the relocation.

=== Table 6 ===

5. Concluding Remarks

Focusing on Japanese electrical machinery and electronics firms, the purpose of this study was to examine the impact of HFDI and VFDI on productivity at home separately by using activity- rather than firm-level data. The difference between these two types of FDI lies in the way they firms' activities at home change as a result. Although there are a substantial number of studies that have sought to compare the productivity impact of HFDI and VFDI, their results have been inconclusive. In particular with regard to the productivity impact of VFDI, the evidence tends to be weak. A likely reason for this is that all of these studies have used firm-level data. Yet, in the case of VFDI, firms' domestic activities may change significantly as a result, so that simply comparing the performance of the firm before and after the investment will lead to inconclusive conclusions. Therefore, it is important to address the impact of foreign investment in downstream (or upstream) activities on those activities that remain at home.

In order to address this issue and overcome the shortcomings of previous research, the present study employed activity-level data, which makes it possible to compare the productivity in an activity before and after an overseas investment. The results we obtained are consistent with the theoretical predictions, namely, that VFDI significantly raises productivity in activities that remain at home, while HFDI has no clear impact on productivity. Furthermore, focusing on FDI in East Asia, which is the area that has attracted the largest number of Japanese affiliates, we found that the productivity improvements at home as a result of VFDI are even greater, which might be due to the large differences in factor prices between Japan and host countries. Although the relocation of production to East Asian countries, i.e., VFDI, has given rise to concerns over the "hollowing out" of domestic industry, our empirical results suggest that the active vertical division of labor with Japanese affiliates in East Asia helps to enhancing the productivity of, and hence sustain, those activities that remain at home.

These findings highlight a number of important issues and point to avenues for further research. First, it is important to take into account the complexity of FDI. Some recent studies have attempted to do so by developing theoretical models using a three-country rather than the traditional two-country framework (Ekholm et al., 2007; Grossman et al., 2006; Yeaple, 2003). In these models, VFDI is conceptually divided into pure VFDI and complex VFDI, where the former consists of the division of labor between the home country and one host country, while the latter involves more than one host country. While this paper does not distinguish between these two types of VFDI, doing so may help to further refine the analysis and produce interesting results. Second, although studies on the impact of FDI on productivity at the firm level have produced inconclusive results, it is important to continue examining firm-level effects. In the case of both HFDI and VFDI, the relocation of particular production activities results in a reallocation of labor resources within firms, and the speed with which firms are able to do so may be an important determinant of productivity improvements at the firm-level. The dataset employed for the analysis in this paper allows us to examine changes in employment across firm activities, and investigating the effects of the reallocation of labor resources within firms in response to the relocation of production through FDI represents an important research task for the future.

Appendix A. Data Sources

Our primary data source in this paper is a database we constructed using the *Census of Manufactures* (COM), the *Basic Survey of Japanese Business Structure and Activities* (BSJBSA), and the *Survey of Oversea Business Activity* (SOBA) by the Ministry of Economy, Trade and Industry (METI). In this appendix, we provide some basic information on these surveys and briefly explain the procedure of data construction.

A) Census of Manufacturers

The *Census of Manufactures* is a representative survey of economic activity and its origins date back to 1868, the year of the Meiji Restoration. The census is conducted on all establishments in calendar years ending with 0, 3, 5 and 8. For other years, the census covers establishments with 4 or more employees. The census uses two forms, one of which (Form A) is for establishments with 30 or more employees, and another, simpler one (Form B), which is for establishments with 29 or fewer employees. The total number of establishments covered in 2003 is 504,530, of which about 46,284 fall into the Form A category.

Major items in the census are shipments, inventories, book values of equipment and structures, employment, cost of materials, and energy usage. However, there are some limitations on the availability of information on book values of equipment and structures, and depreciation for smaller establishments, because establishments with 9 or fewer employees are not required to report these items and after 2000, such information for establishments with 29 or fewer employees is available only every 5 years.

Since the identification numbers for establishments are revised every 5 years, we linked the establishment data using matching tables provided by METI for the construction of our panel dataset.[12]

[12] The compilation of the panel dataset of the *Census of Manufactures* was conducted by a group of researchers as well as members of the Quantitative Analysis Database division at the Research Institute of Economy, Trade and Industry (RIETI), including Kazushige Shimpo (Keio University), Kazuyuki Motohashi (University of Tokyo), Toshiyuki Matsuura (Hitotsubashi University), Kyoji Fukao (Hitotsubashi University), Hyeog Ug Kwon (Nihon University), Mutsuharu Takahashi, and Tami Ohomori (RIETI). For details of the procedure, also see Motohashi (2002), Shimpo et al. (2004), Fukao et al. (2006) and Matsuura et al. (2007).

B) Basic Survey of Japanese Business Structure and Activities

The *Basic Survey of Japanese Business Structure and Activities* (BSJBSA) is a comprehensive firm-level survey conducted by the Ministry of Economy, Trade and Industry. The survey was first conducted in 1991 and then again in 1994, since when it has been conducted annually. The main purpose of the survey is to gain an overall picture of Japanese corporate firms' activities in terms of their diversification, globalization, and strategies on research and development as well as information technology. The strength of the survey is its coverage and the reliability of its information. The survey includes all firms with more than 50 employees and with capital of more than 30 million yen. The survey covers the mining, manufacturing, and service sectors, although some services industries, such as finance, insurance, and real estate, are not included. Another feature of this survey is that each firm has its own identification number (BSJBSA code) throughout. Therefore, it is easy for researchers to construct a panel dataset. The limitation of the survey is that information on financial and institutional features, such as whether firms belong to a *keiretsu*, are not available and small firms with fewer than 50 workers (or with capital of less than 30 million yen) are excluded.

For our analysis, we decided to extend our definition of a firm to include wholly-owned firms (subsidiaries). In Japan, manufacturing firms often relegate production activities to their subsidiaries. However, since the firm-level data in the BSJBSA is essentially on a non-consolidated basis, production activities by wholly- or majority-owned domestic affiliates are excluded from the measurement of MNEs' productivity.[13] This exclusion may result in significant measurement error. To avoid such measurement error, we extend our definition of the firm as described above. In practice, this means that we need to identify each firm's parent and, moreover, the parent's BSJBSA code. The BSJBSA reports the securities code of each firm's parent, and we obtained a converter table for the BSJBSA code and the securities code from METI for the period 1991-2000. Employing this converter table, we can identify the BSJBSA code of firms' parent even for the period 2001-2003 as long as the parent's securities code is available for the period 1991-2000.

[13] To provide an example, according to Sony's annual report, the domestic production of batteries, semiconductors, and video cameras is carried out by wholly-owned affiliates.

C) Survey of Overseas Business Activities

The *Survey of Overseas Business Activities* (SOBA) is an affiliate-level survey conducted by the Ministry of Economy, Trade and Industry. The aim of this survey is to obtain basic information on the activities of foreign affiliates of Japanese firms. The survey covers all Japanese foreign affiliates. The survey consists of two parts. One is the *Basic Survey*, which is more detailed and is carried out every 3 years. The other is the *Trend Survey*, which is less comprehensive and carried out between the *Basic Surveys*. A foreign affiliate of a Japanese firm is defined as an overseas subsidiary in which a Japanese firm holds 10 percent or more of the invested capital.

The SOBA provides, for example, the establishment year of a foreign affiliate, a breakdown of its sales and purchases, its employment, cost of labor, research and development expenditures, etc. For further information on the items in the SOBA, refer to the "Survey Form for Overseas Affiliates" and the "Guide for Completing the Survey."[14]

The micro data underlying the SOBA does not have any unique identification number for affiliates. We therefore linked the data using the information on affiliates' location, name, year of establishment, etc., to construct the panel data set.[15]

D) Linking the databases

The three datasets just described were linked as follows. First, we linked the activity-level data from the COM and firm-level data from the BSJBSA. Although both surveys are conducted by METI, each survey uses its own firm identification (ID) code and no matching table to match the COM and BSJBSA codes is available. We therefore match firms by referring to their names, telephone numbers, and other information such as addresses. Moreover, the firm ID numbers in the COM were drastically revised in 1997, meaning that we needed to match the firm ID number used before 1996 by referring to the list of name and addresses of firms. The result of linking the COM and the BSJBSA in this way is satisfactory: the number of manufacturing firms for which we manage to match the data from the two sources is

[14] Downloadable from the METI website at: http://www.meti.go.jp/english/statistics/tyo/kaigaizi/index.html.

[15] For details on the SOBA panel dataset, also see Kiyota et al. (2008).

more than 95 percent of the total number of manufacturing firms covered in the BSJBSA.[16]

Next, the SOBA is linked with the BSJBSA. First of all, since METI revises the parent firm code for the SOBA every year, we compiled a matching table for the parent firm codes and then constructed our panel dataset. Second, based on information such as firms' name, address, and number of employees, we matched firms in the BSJBSA and the SOBA. While the SOBA covers almost all Japanese firms with foreign affiliates, the coverage of the BSJBSA is restricted to firms with more than 50 employees or paid-in capital of more than 30 million yen. Therefore, we were not able to link all foreign affiliates in the SOBA with the BSJBSA.

16 Note that since the BSJBSA covers only firms with more than 50 employees and 30 million paid-in capital, establishments which belong to small firms cannot be linked with firm-level data. The number of matched firms is about 10 percent of the total number of firms in the COM.

Appendix B. Construction of Variables Used for the TFP Index

Output, intermediate input, labor input, and deflators

Real value added is defined as real gross output minus real intermediate input. 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 multiplied by the industry-level working hours from the System of National Accounts (Cabinet Office). All output and input deflators are obtained from the JIP Database 2006 (Fukao et al., 2006).

Capital stock

Following Fukao et al. (2006), as for the capital stock, we used the nominal book values of tangible assets by multiplying the ratio of the net stock with the book value of industry-level capital.[17] Net capital stocks by industry are from the JIP Database 2006, while the book values of capital by industry are obtained by aggregating the individual data from the *Census of Manufactures*.

Cost shares

To construct the TFP index, we need the shares of labor costs, intermediate input costs, and capital costs in total costs. 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. Capital costs are calculated by multiplying the real net capital stock with the user cost of capital, P_K. The latter is estimated as follows:

$$P_K = P_I\left(r_t + \delta - \dot{P}_I / P_I\right),$$

where P_I is the price of investment goods, r the interest rate, and δ the depreciation rate. Data on the price of investment goods and the depreciation rate are calculated

[17] Fukao, Kim and Kwon (2006) suggest that it is more appropriate to use the ratio of the net stock to the book value of capital by type of asset. In the COM, however, the book values of capital by type of asset are available only for those establishments that have more than 30 employees. Therefore, in order to include small establishments in our sample, rather than calculating the ratio of the net stock to the book value of capital by type of asset, we employed the methodology described above.

using the investment and capital stock matrices from the JIP Database 2006.[18] Interest rates (10-year-bond yields) are from the Bank of Japan.

[18] The JIP Database provides investment and capital stock matrices by 108 industries and 39 types of assets. We calculated the weighted averages of price indices for investment goods and the depreciation rates by industry.

Appendix C. Basic Statistics of our Dataset

Table A1. Basic Statistics

	N	Mean	Sd	p10	p90
Activity-level					
⊿TFP	32,897	0.024	0.243	-0.137	0.202
TFP	32,897	0.949	0.695	0.000	1.785
Horizontal	32,897	0.100	1.654	0.000	0.000
Vetical	32,897	0.030	0.663	0.000	0.000
Upstream	32,897	0.021	0.648	0.000	0.000
Downstream	32,897	0.009	0.143	0.000	0.000
Activity-level (East Asia estimation)					
$FDI_{Developed}$	32,897	0.085	1.285	0.000	0.000
FDI_{Other}	32,897	0.024	0.308	0.000	0.000
Horizontal	32,897	0.019	0.103	0.000	0.000
Vetical	32,897	0.007	0.107	0.000	0.000
Upstream	32,897	0.004	0.080	0.000	0.000
Downstream	32,897	0.003	0.072	0.000	0.000
Firm-level					
⊿TFP	29,322	0.029	0.249	-0.146	0.221
TFP	29,322	0.942	0.668	0.000	1.725
Horizontal	29,322	0.097	1.678	0.000	0.000
Vetical	29,322	0.013	0.316	0.000	0.000
Upstream	29,322	0.008	0.286	0.000	0.000
Downstream	29,322	0.005	0.134	0.000	0.000

Note: "East Asia estimation" refers to the variables used in Table 5. For details, see text.

Source: Authors' calculations based on the *Basic Survey of Overseas Business Activities and Census of Manufactures* (1985-2003).

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Figure 1. The Impact of HFDI on the Average Cost of Home Activities

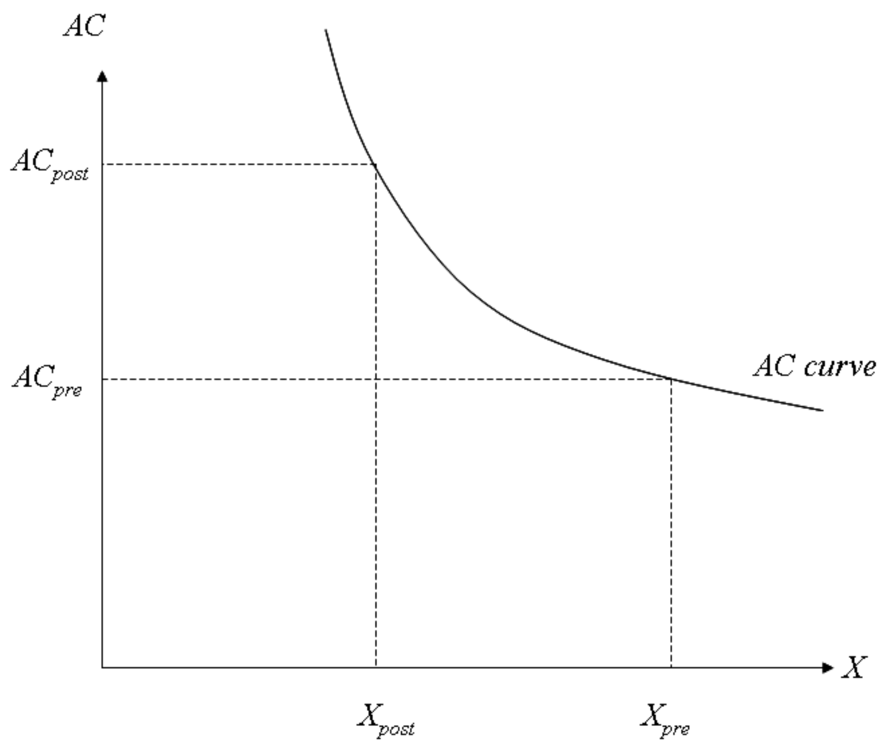

Figure 2. The Impact of HFDI on the Average Cost of Home Activities, with Spillovers

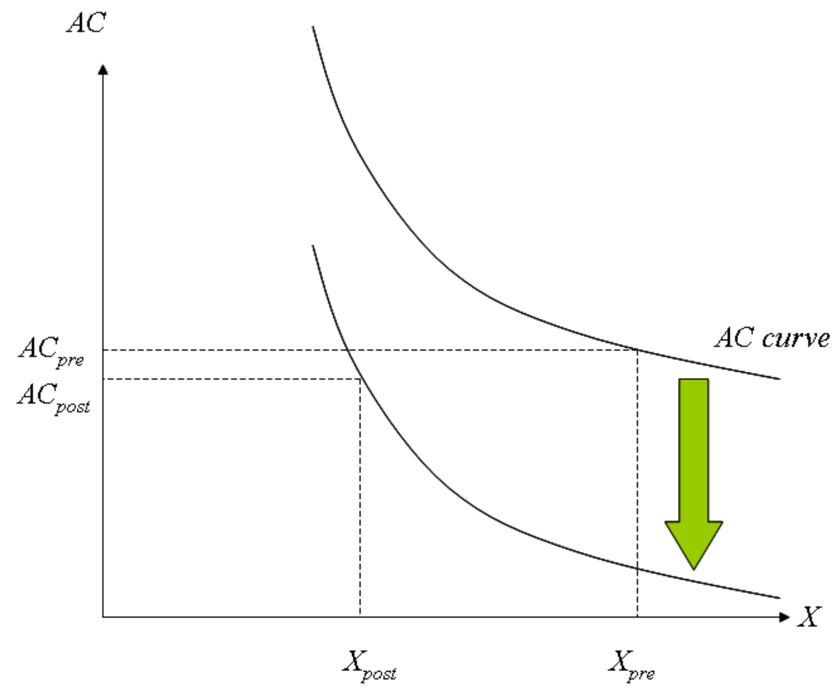

Figure 3. The Impact of VFDI on the Average Cost of Home Activities

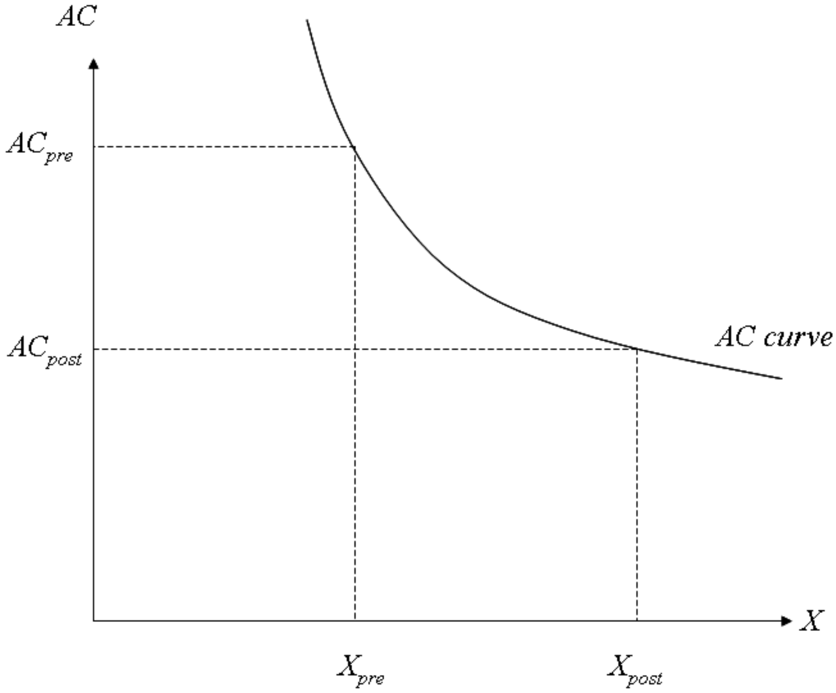

Table 1. Hypothetical Example of an MNE's Distribution of Production Activities

	Upstream	Downstream
Home	*A*	*B*
Country 1		*D*
Country 2	*C*	*E*

Table 2. Distribution of Firms in Terms of Their Activities at Home and Abroad

		No overseas activities	Abroad	
			Downstream	Upstream
Home	Downstream	1249 (1275)	174 (148)	113 (107)
	Upstream	723 (737)	81 (69)	124 (112)

Source: Authors' calculations based on the *Basic Survey of Overseas Business Activities* (2000).
Notes: The numbers in parentheses show the distribution if only overseas affiliates in East Asia are considered. "No overseas activities" means that these firms have no overseas affiliates (have no affiliates in East Asia).

Table 3. Trade Between Japan and Overseas Affiliates

	N. America	Europe	ASEAN	NIES	China
A. Share of Imports from Japan in Total Procurements					
Downstream					
Office machines	44.7%	38.9%	37.9%	50.7%	24.0%
Household electric appliances	36.6%	44.0%	23.6%	32.1%	27.3%
Industrial electrical apparatus	32.9%	49.7%	47.1%	40.1%	49.0%
Electronic data processing machines	52.2%	42.4%	30.6%	47.5%	38.1%
Communication equipment	42.8%	36.9%	33.0%	27.0%	39.4%
Upstream					
Electronic parts and devices	50.7%	47.0%	39.8%	41.4%	46.9%
Semiconductors	63.9%	70.4%	84.5%	75.1%	90.9%
B. Share of Exports to Japan in Total Sales					
Downstream					
Office machines	2.5%	0.2%	24.6%	52.2%	32.2%
Household electric appliances	1.6%	12.2%	16.2%	22.8%	17.2%
Industrial electrical apparatus	3.5%	0.8%	34.3%	11.5%	23.6%
Electronic data processing machines	4.1%	1.4%	37.3%	25.5%	21.0%
Communication equipment	4.8%	6.2%	33.4%	23.9%	24.5%
Upstream					
Electronic parts and devices	7.3%	3.8%	28.6%	16.2%	37.5%
Semiconductors	16.4%	9.2%	50.7%	23.6%	54.8%

Source: Authors' calculations based on the *Basic Survey of Overseas Business Activities* (2000).

Table 4. Activity-level Results

	Level		Growth	
	(I)	(II)	(I)	(II)
Dependent Var. (*t*-1)	0.768	0.772	-0.158	-0.152
	[44.62]***	[46.16]***	[-9.38]***	[-9.08]***
Dependent Var. (*t*-2)	0.169	0.156		
	[8.60]***	[7.12]***		
Dependent Var. (*t*-3)	0.131	0.135		
	[7.63]***	[7.44]***		
Horizontal (*t*-1)	0.005	0.005	0.006	0.005
	[1.64]	[1.47]	[1.96]*	[1.67]*
Vetical (*t*-1)	0.005		0.004	
	[1.95]*		[1.77]*	
Upstream (*t*-1)		0.004		0.004
		[1.98]**		[2.01]**
Downstream (*t*-1)		0.023		0.029
		[3.49]***		[4.79]***
Time Fixed Effect	Yes	Yes	Yes	Yes
Activity Fixed Effect	Yes	Yes	Yes	Yes
Hansen *J* (p-value)	0.014	0.061	0.288	0.647
AR(2) (p-value)	0.533	0.369	0.322	0.418
No. of Observations	23,977	23,977	27,985	27,985
No. of Firms' Activities	3,242	3,242	3,682	3,682

Notes: z-values are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 5. Activity-level Results for East Asia

	Level		Growth	
	(I)	(II)	(I)	(II)
Dependent Var. (t-1)	0.770	0.773	-0.154	-0.148
	[46.53]***	[46.98]***	[-9.28]***	[-8.79]***
Dependent Var. (t-2)	0.162	0.162		
	[7.60]***	[7.47]***		
Dependent Var. (t-3)	0.120	0.117		
	[6.47]***	[6.43]***		
$FDI_{Developed}$ (t-1)	-0.004	-0.004	-0.003	-0.003
	[-1.32]	[-1.13]	[-1.31]	[-1.30]
FDI_{Other} (t-1)	0.039	0.036	0.042	0.040
	[1.81]*	[1.65]*	[3.37]***	[3.07]***
Horizontal (t-1)	-0.015	-0.019	0.004	0.003
	[-0.57]	[-0.70]	[0.16]	[0.12]
Vetical (t-1)	0.062		0.056	
	[4.06]***		[5.15]***	
Upstream (t-1)		0.076		0.067
		[4.07]***		[5.43]***
Downstream (t-1)		0.046		0.055
		[6.03]***		[6.00]***
Time Fixed Effect	Yes	Yes	Yes	Yes
Activity Fixed Effect	Yes	Yes	Yes	Yes
Hansen *J* (p-value)	0.102	0.218	0.495	0.667
AR(2) (p-value)	0.631	0.657	0.391	0.510
No. of Observations	23,977	23,977	27,985	27,985
No. of Firms' Activities	3,242	3,242	3,682	3,682

Notes: z-values are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 6. Firm-level Results

	Level		Growth	
	(I)	(II)	(I)	(II)
Dependent Var. (*t*-1)	0.768	0.771	-0.147	-0.145
	[45.30]***	[45.16]***	[-8.26]***	[-8.05]***
Dependent Var. (*t*-2)	0.158	0.159		
	[6.91]***	[6.85]***		
Dependent Var. (*t*-3)	0.156	0.154		
	[9.22]***	[9.21]***		
Horizontal (*t*-1)	0.003	0.002	0.004	0.003
	[0.87]	[0.85]	[1.07]	[0.92]
Vetical (*t*-1)	0.006		0.010	
	[0.61]		[0.99]	
Upstream (*t*-1)		0.006		0.009
		[0.50]		[0.80]
Downstream (*t*-1)		0.011		0.022
		[1.13]		[2.67]***
Time Fixed Effect	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
Hansen *J* (p-value)	0.177	0.910	0.347	0.960
AR(2) (p-value)	0.261	0.279	0.390	0.436
No. of Observations	23,744	23,744	26,417	26,417
No. of Firms' Activities	2,666	2,666	2,792	2,792

Notes: z-values are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.