International Production Networks and Domestic Operations of Japanese Manufacturing Firms: Normal periods and the Global Financial Crisis

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Abstract

The paper investigates the features of production networks of Japanese manufacturing firms and their domestic operations and export/import activities in normal periods and during the Global Financial Crisis (GFC). Our previous empirical studies have shown that firms that expand their operations in East Asia are more likely to expand domestic operations, particularly domestic employment, than firms that do not in normal periods. This study further verifies that such tendency stands during the GFC. Moreover, this paper expands the scope of our series of studies by introducing labor productivity as one of the performance variables and also analyzing changes in the relative and absolute size of headquarters and manufacturing activities over time in order to seek a possible sign of de-industrialization.

Keywords: International production networks, Domestic operations, Japanese manufacturing firms, Global Financial Crisis, East Asia

JEL classification: D22, F23, L23

1. Introduction

        Foreign direst investment (FDI) in lower-income countries by multinational enterprises (MNEs) raises concerns about de-industrialization of investing countries. A popular argument claims that domestic employment and operations may shrink due to the relocation of economic activities that takes advantage of a large wage gap between developed and developing countries.   However, whether FDI makes domestic operations larger or smaller depends on the nature of international division of labor, to be verified as rigorous empirical studies.   As Ando and Kimura (2012a, 2012b) demonstrates, Japanese manufacturing firms that expand their operations in East Asia, compared with those that do not, tend to relatively expand domestic operations including domestic employment.   As the fragmentation theory suggests,[1] once a firm successfully establishes efficient division of labor between domestic headquarters/establishments and foreign affiliates in terms of production processes and tasks, the firm may substantially gain competitiveness, its production activities as a whole may grow, and thus domestic operations themselves can also expands.[2]

        This is, however, the episode of normal periods.   There is no guarantee that the same hopeful story would work with a serious economic crisis such as the Global Financial Crisis (GFC).[3]   Different from normal periods with largely stable economy, a

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[1] For theoretical framework for production sharing, see the fragmentation theory; Jones and Kierzkowski (1990) and Arndt and Kierzkowski (2001).

[2] The related literature includes Becker, Ekholm, Jackle, and Muendler (2005), Blomstrom, Fors, and Lipsey (1997), Federico and Minerva (2008), and Yamashita and Fukao (2010).   See Ando and Kimura (2012b) for the literature of related studies.

[3] Japanese firms are one of major players of the networks, and sales by Japanese manufacturing firms in East Asia indeed dropped (Table A.1).   Tables A.1 to A.3 in the Appendix are based on METI database "Survey of Overseas Business Activities of Japanese Companies". Although this database has an advantage in that foreign affiliates include both "affiliates abroad" with no less than 10 percent ownership by Japanese parent firms and "affiliates of affiliates abroad" with no less than 50 percent ownership by "affiliates abroad," except those in finance, insurance, or real estate. On the other hand, the effective return ratios are as low as around 60 percent since the survey is voluntary (i.e., non-compulsory) unlike the other METI database used in the remaining sections, and thus, strictly speaking, time-series values of total sales and purchases may not be compared.   However, if total sales and by-destination shares of sales by Japanese manufacturing affiliates in East Asia for 2009 are compared with those for 2007, the values certainly dropped at the GFC, and shares of sales to North America and Europe also declined as expected.   Tables A.2 and A.3 show by-destination sales ratios, by-origin purchases ratios, and intra-firm transaction ratios for Japanese manufacturing

deep and prolonged crisis may trigger a firm's substantial restructuring in the international division of labor and accelerate de-industrialization of developed countries. Ando and Kimura (2012c) employ the HS 9-digit-level export data of Japan and examine whether the GFC generates permanent changes in the Japanese export patterns.[4]   Although the value of Japanese exports in terms of the US dollars substantially dropped from October 2008 to January 2009, a steady recovery followed, and the value of exports came back to the original level in a year or so (Figure 1). There seems to exist, however, a permanent change in extensive margins of Japanese exports; the number of product-country pairs for exports to all countries in the world significantly dropped in the GFC, with a bottom in January 2009 (Figure 2).[5]   The number for exports to East Asian countries only also shows a significant drop of the number though the decline is less serious than the case of exports to all countries in the world.

== Figure 1 ==

==Figure 2 ==

This paper is based on our previous works and examines the implication of production networking of Japanese manufacturing firms on domestic operations both in normal periods and under the GFC.   First, the paper attempts to examine whether the strong results in normal periods, i.e., manufacturing firms that expand their operation in East Asia relatively enhance their domestic operations, particularly domestic employment, stand even in a crisis period such as the GFC.   The GFC was indeed a massive shock to the Japanese and Asian economies, and the external economic environment became substantially worse.   Whether production networking firms still present better performance than other firms is an empirical question.   We employy

firms from 1992 to 2001; unfortunately, the information on intra-firm transactions are not available after this.

[4] Other studies on the GFC using international trade data include Haddad and Shepherd (2011), Haddad, et al. (2010), and Ito (2011).

[5] The number of exported product-country pairs is expressed as an index based on the number in January 2007; the number of exported product-country pairs for all products exported to the world is 66,119.

comprehensive firm-level panel data and investigate changes in domestic operations in employment, establishments and affiliates at home, and international trade of firms that expand operations in East Asia compared with firms not expanding operations in East Asia.[6] Normal periods, 1998-2002 and 2002-2006 are used as references in order to extract special features of the GFC period of 2007-2009.

Second, the paper attempts to further investigate the patterns of possible shift of domestic activities in terms of domestic employment; not only domestic employment as a whole but also relative and absolute size of HQ services and manufacturing activities in terms of employment and employment engaged in the sector of manufacturing activities. Third, as one of domestic performance indices, labor productivity measured as value added divided by labor, is also examined.

The rest of this paper is organized as follows: section 2 provides data description of micro data employed in our paper and descriptively examines patterns of production networking by Japanese firms and their domestic operations. Then, section 3 quantitatively investigates those patterns, employing logit and ordinary least squares (OLS) regression analyses, and section 4 concludes.

2. Japanese investment in East Asia at the firm level: overview

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[6] Most of the previous studies use data only for MNEs, but there are some studies using data of non-MNEs. For instance, Hijzen, Inui, and Todo (2007) investigate the causal effect of becoming a multinational or establishing the first foreign affiliate during the sample period between 1995 and 2002, on home performance, by adopting propensity score matching techniques in combination with a difference-in-difference estimator. They find that Japanese outward FDI tends to strengthen the economic activities in terms of output and employment, but not productivity. Although this is probably one of the purest approaches to pick up causality from FDI to domestic operations, we do not apply such an analytical strategy for our benchmark case because the number of firms with the first FDI occupies just a minor portion of firms that conduct FDI (see Table 2 below). Our previous works (Ando and Kimura (2012b)) instead compare firms that conduct the first FDI with firms that remain domestic and also to compare MNEs that expand operations with MNEs that do not. A possible direction to make econometrics more rigorous would be to further control firm-specific time-invariant characteristics with time-lagged variables or to apply some technique such as propensity score matching to these two comparisons. This paper in the current version, however, basically applies the same approach as our previous studies and concentrates on a comparison between normal periods and a crisis period.

2.1 Data description

The analysis in sections 2 and 3 is based on the firm-level statistics, which is conducted by the Ministry of Economy, Trade, and Industry (METI), Government of Japan (the former name was the Ministry of International Trade and Industry (MITI)): *The Basic Survey of Business Structure and Activity*. This database provides detailed information on (parent) firms located in Japan as well as the number, industry, and regional location of their foreign affiliates with no less than 20 percent Japanese ownership. Note that the location of foreign affiliates is not identified on the country basis; the questionnaires from *the 1997F/Y Basic Survey* include only East Asia, North America, and Europe as regional categories.[7]

The samples in the survey cover firms with more than 50 workers, capital of more than 30 million yen, and establishments in mining, manufacturing, wholesale/retail trade, and restaurants. Our study employs this survey for the latest available years from *the 1999F/Y Basic Survey* (data for 1998F/Y) to *the 2010F/Y Basic Survey* (data for 2009F/Y).

2.2 Characteristics of Japanese firms investing in East Asia

This subsection investigates patterns of production networking by Japanese firms, with a particular emphasis on firms investing in East Asia. Table 1 presents the number of 1) all sized firms and 2) small and medium enterprises (SMEs) with affiliates in East Asia/North America/Europe and the number of affiliates in East Asia/North America/Europe by the industry of parent firms and by the industry of affiliates.[8] In 2007, 4,562 out of 29,080 firms located in Japan (in the data set) have affiliates abroad. Among them, 4,078 firms have affiliates in East Asia. That is, almost 90 percent of the Japanese firms going abroad have at least one affiliate in East Asia.

== Table 1 ==

Japanese manufacturing parent firms, particularly machinery parent firms, are active investors in East Asia; 70 percent of the Japanese firms with affiliates in East

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[7] "East Asia" includes all Asian countries east of Pakistan. Note that Japanese FDI to South Asia is mostly small in our sample period.

[8] SMEs are here defined as firms with regular workers of less than 300.

Asia are in the manufacturing sector and almost half of them are in machinery industries. Moreover, Japanese manufacturing affiliates, regardless of the industries of their parent firms, account for 59 percent of the total Japanese affiliates in the region, while 36 percent for North America and 34 percent for Europe.

A parent firm often conducts various types of operations at the same time and establishes foreign affiliates in order to conduct a subset of those activities.[9] Japanese manufacturing parent firms have 72 percent of their total affiliates in East Asia in the manufacturing sector. The corresponding portion is even higher for manufacturing SMEs; 83 percent of their affiliates in East Asia are manufacturing. Such investment patterns by SMEs reflect a typical strategy for firms involved in manufacturing activities, aimed at supplying intermediate goods for other firms and/or for their own affiliates and forming a critical mass of industrial clusters in the manufacturing sector. In contrast, the share of non-manufacturing affiliates in all affiliates in North America/Europe of Japanese manufacturing firms is high; more than half of their affiliates are non-manufacturing affiliates. It indicates that Japanese manufacturing investment in North America or Europe aims at selling their products or producing goods to be sold there, rather than being involved in dense vertical production chains as is the case in East Asia.

Table 2 in turn presents patterns of production networking by Japanese manufacturing firms for 2007-2009 under the GFC in the two-year balanced panel data. The table also presents globalizing patterns for 1998-2002 and 2002-2006 in the two-year balanced panel data as a comparison. Although the expansion of globalizing activities at the firm level may be measured in various ways, this paper regards an increase in the number of affiliates in East Asia as the indication of globalizing activities. As Ando and Kimura (2012a, 2012b) addresses, most Japanese firms expanding operations abroad enlarge their activities in East Asia particularly in the manufacturing sector. Therefore, the paper places a focus on their expanding activities in East Asia.

== Table 2 ==

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[9] The industrial classification is based on the largest activities in terms of the value of sales.

Interestingly, even under the GFC, six percent of manufacturing firms in the sample expand their operations in East Asia, which is much higher than the corresponding portion for firms in all industries. Although the portion is lower under the GFC than that in the normal periods (nine percent or 13 percent), and the portion of firms simply keeping operations in East Asia, 14 percent, is higher than that in the nominal periods, these figures suggest that manufacturing firms are still active in investment in East Asia during such a shorter period of two years at the crisis. Moreover, most SMEs that expand operations in East Asia under the crisis are manufacturing SMEs, though the portion of firms expanding operations is lower than the one for all sized manufacturing firms. Their active FDI certainly contributes to the development of vertical production chains in the region.

Tables 3 to 5 represent changes in domestic operations by the type of firms.[10] In the period 1998-2002 (one of normal periods in our analysis), 65 percent of the firms in the two-year-balanced panel dataset simply maintain or reduce domestic employment, and aggregate employment in the domestic market drops, mainly in the manufacturing sector (Table 3). Even in the manufacturing sector, however, the share of firms increasing domestic employment is relatively high for firms expanding operations in East Asia (34 percent), particularly those starting operations in East Asia (37 percent), compared with those retreating operations or remaining intact in East Asia (25 percent) and those without entry in the region (32 percent). The corresponding figures in the period 2002-2006 demonstrate more vividly features of globalizing firms; the portion of firms increasing domestic employment is 63 percent for those with expansion in East Asia, in contrast with 50 percent to 54 percent for firms in other categories. Moreover, the corresponding figures in the period under the crisis present common features as well: the portion of firms increasing domestic employment is 52 percent for those with expansion in East Asia, in contrast with around 40 percent for firms in other categories (Table 4). Furthermore, regardless of whether normal periods or crisis period, both of the shares of firms increasing employment engaged in HQ services and manufacturing activities are larger for manufacturing firms expanding operations in East Asia (Table 5).

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[10] Most of firms categorized in the type of firm "no entry in East Asia" are purely domestic firms (Table 2). Although there are some firms that have at least one affiliate abroad other than in East Asia, most Japanese MNEs have at least one affiliate in East Asia.

This may indicate that globalizing manufacturing firms intensify both HQ services and manufacturing activities in terms of the absolute size of employment.

== Table 3 ==

== Table 4==

== Table 5==

The average growth rates of domestic employment at the firm level for manufacturing firms is also higher for those expanding operations in East Asia as a whole (12.6 percent in the period 2002-2006), particularly for those starting operations in East Asia (16.1 percent), compared with those without entry in East Asia (5.2 percent), those with shrinkage (1.4 percent), and those intact (4.5 percent).   As a result, an aggregate change in domestic employment is positive even for manufacturing firms in the period 2002-2006, while it is negative in the period 1998-2002.   Even at the crisis, the average growth rates are positive only for firms expanding operations (2.8 percent), though the aggregate change is negative.

Moreover, the share of firms increasing domestic employment is much higher for SMEs expanding operations in East Asia than that for those not expanding activities in East Asia; for manufacturing SMEs, the ratios in the period 1998-2002 are 45 percent for those expanding operations in East Asia (67 percent in the period 2002-2006) while 33 percent for those with no entry (51 percent), 32 percent for those shrinking (54 percent), and 30 percent for those remaining (58 percent).   Furthermore, manufacturing SMEs expanding operations in East Asia have much higher average growth rates of domestic employment and indeed contribute to net domestic job creation at the aggregate level.   Again, common features can be observed even under the crisis for manufacturing SMEs expanding operations in East Asia, particularly for those starting operations in East Asia.

Besides, firms expanding operations in East Asia increase in the number of domestic establishments and domestic affiliates, rather than diminishing domestic operations; firms expanding operations in East Asia have much higher shares than those not expanding operations in terms of the portion of firms increasing the number of

domestic establishments in periods 2002-2006 and 2007-2009 as well as the portion of firms increasing the number of domestic affiliates in all three periods. All of the above-mentioned features indicate that intensified activities of Japanese firms through FDI in East Asia might be complements of domestic operations, rather than substitutes, and reduce direct negative impacts on employment, establishments, and affiliates at home, particularly in more recent period.

As Table A.4 shows, firms with operations in East Asia in the analytical periods are relatively large at size of the firm, capital-intensive, R&D-intensive, and HQ services-intensive and have large foreign sales ratio and labor productivity, compared with those without operations in the region. However, among those with operations, figures for these variables are not necessarily the largest for those expanding operations in East Asia. Firms expanding operations in East Asia seem to have larger R&D activities and higher labor productivity than those having operations in East Asia without expansion.

3. International production networking and domestic operations at the firm level

While the last section observes robust correlation between expanding corporate activities abroad and domestic operations, this section rather formally analyzes the relationship with econometric. Given the fact that most Japanese firms expanding operations abroad activate their operations in East Asia, this section investigates how these firms with expanding activities in East Asia reorganize domestic operations and export/import activities compared with other types of firms, employing logit/OLS regression analyses. As the types of firms for a comparison, firms simply keeping operations in East Asia and firms shrinking operations in East Asia are distinguished from firms not having operations in East Asia and are separately examined.

3.1 Empirical method and data

A typical relationship between conducting FDI and making adjustments in domestic operations can be illustrated as Figure 3. What we would like to detect is the causal relationship of the "decision of international production networking" with "adjustments of domestic operations." However, the former is not directly observable.

Therefore, we use "the establishment of a foreign affiliate" as an instrumental variable for "the decision of international production networking." There is a time lag between "the decision of international production networking" and "the establishment of a foreign affiliate"; it typically takes a few years. Also, "adjustments of domestics operations" take time, at least over a few years or more. Therefore, Ando and Kimura (2012b) conduct four-year one-shot cross-section regressions for 1998-2002 and 2002-2006. For the GFC, due to the data availability at this moment, we can have just two-year changes: changes from 2007 (basically April 2007 to March 2008), which is the year just before the GFC occurs, to 2009 (April 2009 to March 2010) as the one at the crisis. This is probably too short to see the whole consequences, and thus we would like to expand the duration when the data are available.[11]

== Figure 3 ==

The basic equations for our logit/OLS estimation analyses are as follows:

$$Y_{t_0}^t = \alpha + \beta_{1a}X_{a\,t_0}^t + \beta_2 S_{t_0} + \beta_3 KL_{t_0} + \beta_4 EX_{t_0} + \beta_5 RD_{t_0} + \beta_6 AD_{t_0} + \beta_7 FC_{t_0} + \varepsilon \qquad (1),$$

$$Y_{t_0}^t = \alpha + \beta_{1a}X_{a\,t_0}^t + \beta_{1b}X_{b\,t_0}^t + \beta_{1c}X_{c\,t_0}^t + \beta_2 S_{t_0} + \beta_3 KL_{t_0} + \beta_4 EX_{t_0} + \beta_5 RD_{t_0} + \beta_6 AD_{t_0} + \beta_7 FC_{t_0} + \varepsilon \qquad (1)',$$

where $Y_{t_0}^t$ expresses a change in domestic operations or a change in export/import activities with East Asia from base year t_0 to the targeted year t. As for benchmark indices of domestic operations, 0/1 binary variables are used for a change in domestic employment, in the number of domestic establishments, and in the number of domestic affiliates; $Y_{t_0}^t$ is one if a firm does increases domestic employment/the number of domestic establishments/the number of affiliates and is zero otherwise. Another variable for a change in domestic employment, $Y_{t_0}^t$, a growth rate of domestic employment, is also used. As for export/import activities with East Asia, a change in

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[11] In one interpretation, "the decision of international production networking" may influence both "the establishment of a foreign affiliate" and "adjustments of domestic operations." If so, we may have an endogeneity problem. Possible extension in econometrics would be to address this issue by using a two-stage least square method with regressing "the establishment of a foreign affiliate" at the first stage or employing GMM.

the ratio of exports to/imports from East Asia in total sales/purchases is applied; $Y_{t_0}^t$ is a difference obtained by subtracting the ratio for the base year from the ratio for the targeted year.

$X_{a\,t_0}^t$ is an instrument for a firm's production-networking decision and a binary variable for expanding corporate activities in East Asia; $X_{a\,t_0}^t$ is one if a firm increases in the number of affiliates in East Asia from the base year to the targeted year and is zero otherwise. Similarly to $X_{a\,t_0}^t$, $X_{b\,t_0}^t$ and $X_{c\,t_0}^t$ are instruments for a firm's production-networking decision and binary variables for simply keeping corporate activities and shrinking corporate activities in East Asia, respectively. Regarding domestic operations, if a firm increases in domestic employment/ the number of domestic establishments/the number of domestic affiliates with their globalizing activities, or their activities in East Asia are complements of domestic operations, the coefficient for $X_{a\,t_0}^t$ is going to be positive. In the case of transactions with East Asia, if a firm expanding operations in East Asia relatively intensifies transactions with that region, the coefficient for $X_{a\,t_0}^t$ is expected to be positive. In particular, if FDI and exports are complements rather than substitutes, the coefficient is expected to be positive. The coefficients for $X_{b\,t_0}^t$ and $X_{c\,t_0}^t$ are expected to smaller than the coefficient for $X_{a\,t_0}^t$ if activities in East Asia are complements of domestic operations, and/or the international production networking firms are likely to adjust/expand domestic operations more successfully.

Other independent variables are included as conventional control variables for the base year: the size of firm in terms of the number of regular workers in Japan (natural log) (S_{t_0}), the capital-labor ratio in terms of tangible assets per regular workers (natural log) (KL_{t_0}), the foreign sales ratio (in total sales) (EX_{t_0}), an in-house R&D expenditure ratio (in total sales) (RD_{t_0}), the advertisement expenditure ratio (in total sales) (AD_{t_0}), and the foreign capital ratio (FC_{t_0}); these are all for domestic (parent) firms.[12] Note that to control industry characteristics, industry dummies are also included as identified.[13]

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[12] The foreign capital ratio of a firm is denoted from zero to 1000: 10 times percentage of the ratio of foreign capital to total capital of a firm.

[13] The GFC primarily started from the drops of demand in the US and Europe. Thus, to see their effects, the paper included dummies for exports to North America and Europe examined their effects for the analysis of the GFC. However, their coefficients were insignificant, and the results of other major variables did not change. The paper,

As discussed in section 2, the reorganization of domestic operations may be different according to the size of the firm.   The variable of firm size is included to control such differences if at all.   Capital-labor ratio, foreign sales, R&D expenditure, and advertisement expenditure are variables representing firm specific intangible assets. As a firm expanding operations abroad would have superior technology (or more capital-intensive technology), the coefficient for tangible assets per worker is expected to be positive.   A firm's relatively large foreign sales would indicate that the firm is exposed to the global market and internationally competitive and may be significantly involved in production sharing activities.   Therefore, the coefficient for the variable of foreign sales is expected to be positive, particularly for relatively strengthened export/import activities with East Asia.   The expenditure to R&D and advertisement activities would imply a firm's intangible assets and technological competitiveness, and thus, the coefficient for these variables is expected to be positive.   A variable for foreign capital is included to examine whether any significant difference exists between purely domestic firms and firms with (higher) foreign capital in Japan.

For each of dependent variables mentioned above, logit estimation analysis is conducted when they are binary variables measuring changes in domestic operations, while OLS estimation analysis is conducted when they are a growth rate of domestic employment or a change in exports to/imports from East Asia as a share of total sales/purchases.   To see whether there are significant features for machinery firms that are the major players in the production networks in East Asia, we also conduct same analysis for machinery firms in addition to manufacturing firms as a whole.

In addition to the above analyses, we also investigate other performance indices of domestic operations; domestic employment engaged in sectors of HQ services and manufacturing activities and labor productivity. Although Ando and Kimura (2012a and 2012b) already demonstrate that international production networking firms tend to expand domestic employment, they do not reveal how they reorganize/change domestic operations in terms of employment; for instance, whether HQ services are intensified instead of shrinking domestic manufacturing activities or not and whether domestic manufacturing activities are also expanded or not.

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thus, does not show the results of the analysis including dummies for exports to North America and Europe at the GFC.

Therefore, this paper attempts to investigate a change in the sector of HQ services (manufacturing activities) in terms of the relative and absolute size of employment in the corresponding sector, using equations (1) and (1)'.[14] As for the absolute size of employment, 0/1 binary variables are used for a change in employment engaged in the sector of HQ services/the manufacturing activities sector; $Y_{t_0}^t$ is one if a firm increases employment in these sectors and is zero otherwise. As for the relative size of the HQ services sector, a change in the ratio of employment engaged in the HQ services sector in total domestic employment is applied; $Y_{t_0}^t$ is a difference obtained by subtracting the ratio for the base year from the ratio for the targeted year.

Labor productivity is calculated as the value added per worker. The value-added is obtained as the sum of the operating profit [sales minus (cost of sales and operating costs)], rent, wage, depreciation, and paid tax, basically following previous studies such as Ito and Lechevalier (2009) and Morikawa (2010). To obtain real labor productivity, we employ industry-level GDP deflators available from the National Accounts (Economic and Social Research Institute, Cabinet Office), again following Morikawa (2010)[15]. The equation for the analysis of labor productivity is as follows:

$$Y_t = \alpha + \beta_0 Y_{t_0} + \beta_{1a} X_{a\,t_0}^t + \beta_{1b} X_{b\,t_0}^t + \beta_{1c} X_{c\,t_0}^t + \beta_2 S_{t_0} + \beta_3 KL_{t_0} + \beta_4 EX_{t_0} + \beta_5 RD_{t_0} + \beta_6 AD_{t_0} + \beta_7 FC_{t_0} + \varepsilon\,(2),$$

where Y_t and Y_{t_0} express real labor productivity in the targeted year t and base year t_0. Other independent variables are the same in equations (1) or (1)'. The coefficients for $X_{i\,t_0}^t$ (i=a, b, c) are expected to be positive if the firm improves labor productivity when it expands/simply keeps/shrinks operations in East Asia, and are negative if the firm worsen labor productivity.

3.2 Empirical results

Tables 6 to 7 report results of logit regression analyses and OLS regression analyses under the GFC in the period 2007-2009 in terms of domestic employment,

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[14] The sector of HQ services is composed of investigation/planning department, an information processing section, the R&D division, an international-operations section, other sections (general affairs, accounting, personnel affairs, etc.) in the dataset.
[15] See Table A.4 for the average of real labor productivity by the type of firms.

establishments, affiliates, and trade, based on the equations (1) and (1)' for manufacturing firms and machinery firms. Similarly, Tables 8 to 9 present corresponding results, based on the equation (1)' in the period (a) 1998-2002 and (b) 2002-2006 for manufacturing firms and machinery firms.[16] As Tables 3 and 4 suggest, to control the size of firm must be crucial for our analysis, particularly of domestic employment. For manufacturing firms in normal periods, the coefficient for the size of firm is negative and statistically significant in equations for domestic employment while it is positive and mostly statistically significant in equations for domestic establishments and domestic affiliates. It indicates that Japanese manufacturing firms with larger employment size at home are more likely to diminish domestic operations in terms of domestic employment, though they tend to expand domestic operations in terms of domestic establishments and domestic affiliates. Under the crisis, on the other hand, Japanese manufacturing firms with larger employment size at home are more likely to increase domestic employment. In other words, Japanese manufacturing SMEs are more likely to be exposed to the negative effects of the crisis in terms of employment, unlike to the case of normal periods.

== Table 6 ==

== Table 7 ==

== Table 8 ==

== Table 9 ==

The coefficient for capita-labor ratio is statistically significant with a positive value in the analysis in most cases. In addition, the coefficient tends to be larger for machinery firms than for manufacturing firms in many cases. These results suggest that Japanese manufacturing firms with capital-intensive technology, particularly machinery firms with capital-intensive technology, tend to expand domestic operations.

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[16] See Tables A.5 and A.6 in the Appendix for the results based on equation (1) in the period 1998-2002 and 2002-2006.

Machinery firm are active investors in East Asia as well as one of important players in developing international production/distribution networks in the region.

Moreover, the coefficient for in-house R&D ratio is positive with statistical significance mostly for domestic employment, regardless of whether the binary variable or the growth rate, and export activities with East Asia in some cases, in normal periods. It implies that R&D intensive manufacturing firms are more likely to expand domestic operations in terms of employment at home, probably because they succeed in reorganize competitive activities and strengthen their competitiveness. Under the crisis, however, no statistically significant results for in-house R&D activities are obtained in all cases except export activities that are relatively intensified with East Asia. It suggests that R&D intensive manufacturing firms tend to be able to strengthen their competitiveness in normal periods, sometimes with strengthening export activities with East Asia, and even at the crisis, those R&D intensive manufacturing relatively intensify export activities with East Asia though they do not necessarily expand domestic operations.

Furthermore, the coefficient for advertisement expenditure is positive with statistical significance for domestic establishment and domestic affiliates in most cases for manufacturing firms, regardless of whether in normal periods or at the crisis. It suggests that manufacturing firms with intangible assets and technological competitiveness are more likely to expand domestic operations in terms of domestic affiliates and domestic establishments.

Given the size of firm and other controls, our results provide several interesting insights. First, most importantly, the expansion of operations in East Asia is positively associated with an increase in domestic employment and their growth rates with statistical significance for manufacturing firms. The coefficient is much larger for those expanding operations than other types of firms, and such a tendency is stronger for machinery firms than manufacturing firms as a whole. These suggest that manufacturing firms expanding operations in East Asia, particularly machinery firms, are likely to increase their domestic employment, compared with those not, according to the further development of production networks. Moreover, their growth rates of domestic employment for manufacturing firms expanding operations are likely to be higher than those for other manufacturing firms by as much as 4.5 percent to 6.7 percent during the four years in normal periods and around 4 percent during the two years at the

crisis.

Second, there is a positive and statistically significant relationship between the expansion of manufacturing operations in East Asia and an increase in the number of domestic establishments and the number of domestic affiliates for most equations, regardless of whether in the normal period or under the crisis. These suggest that manufacturing firms, particularly machinery firms, tend to expand domestic corporate operations in terms of the number of domestic establishments and domestic affiliates when they expand operations in the region.

Third, Japanese manufacturing firms with shrinking operations in East Asia tend to decrease domestic employment, while they tend to increase in the number of domestic affiliates under the GFC, unlike the cases in normal periods; both coefficients for domestic employment and domestic affiliates are insignificant for firms with shrinking operations in East Asia in normal periods. These results may reflect the fact that the GFC partially worked as a trigger of reshuffling geographical distribution of activities by Japanese firms.

Fourth, both export and import activities with East Asia are relatively intensified by production networking firms in the region, and such a tendency is likely to be stronger for machinery firms than manufacturing firms as a whole. The relationship between the expansion of manufacturing operations in East Asia and the relative intensification of transactions with East Asia is positively associated with statistical significance, particularly for machinery firms. Moreover, even when the coefficients are positive and statistically significant for firms simply keeping operations and/or shrinking operations in East Asia, they are smaller than the coefficients for firms expanding operations in the region. It suggests that these types of firms tend to intensify transactions with East Asia compared with firms not having operations in the region, but their tendency is weaker than the one for firms expanding operations in East Asia. All of these results indicate that firms expanding operations in East Asia intensify their transactions with East Asia even under the crises compared to other manufacturing firms, which is particularly true in the case of machinery firms.

Fifth, firms expanding operations in East Asia are likely to intensify HQ services, and such a trend is strengthening, while they are likely to intensify manufacturing activities in normal periods, but such a trend is weakening and manufacturing activities are relatively shrinking. The expansion of operations in East

15

Asia is associated with the intensifying HQ services in terms of absolute size, regardless of whether under the crisis or not, and is associated with the relative expansion of HQ services under the crisis.   In other words, production-networking firms tend to strengthen its HQ services, and such a trend is becoming stronger.   On the other hand, the expansion of operations in East Asia is statistically significant and positively correlated with the expansion of manufacturing activities in the absolute term in both normal periods, but is no longer statistically significant under the crisis.   Moreover, the expansion of operations in East Asia is negatively correlated with the relative expansion of manufacturing activities in the latter normal period and under the crisis.   These indicate that production-networking firms tend to strengthen its manufacturing activities, but such a trend is weakening and manufacturing activities are relatively shrinking. Furthermore, the shrinking operations in East Asia are negatively correlated with the intensifying manufacturing activities in the absolute term.   All of these findings may suggest the tendency toward de-industrialization.

== Table 10 ==

Sixth, firms expanding operations in East Asia do not necessarily worsen labor probability, while firms shrinking operations in East Asia tend to deteriorate labor probability, under the crisis (Table 11).

== Table 11 ==

In sum, although the total domestic employment in manufacturing sectors declines at the aggregate level from the end of the 1990s to the beginning of the 2000s, production-networking manufacturing activities, particularly by machinery firms, tend to partially offset job destruction and sometimes even contribute to net job creation in the domestic market at the firm level.   Moreover, under the economic crisis, such a tendency is revealed more strongly.   A rise in domestic employment by Japanese manufacturing firms expanding operations in East Asia would partially reflect a need to expand domestic production of key parts and components to be exported to East Asia, to strengthen R&D activities for new products, or to intensify a specialization in HQ services at home, as a result of active and effective fragmentation of production and

specialization.   The fragmentation with successful cost reduction would allow firms to expand employment engaged in production or services of these production blocks (PBs) though it may indeed decrease in employment at home in other PBs, which results in an expansion of employment at home in total.   Of course, there is another possible explanation for a relative rise in domestic employment by production-networking manufacturing firms that they succeed in differentiating products to be produced in the domestic market from those to be produced in East Asia.

4. Conclusion

Our study has investigated patterns of production networking by Japanese manufacturing firms and their adjustments of domestic operations under the GFC by using comprehensive firm-level panel data including both firms with and without operations abroad, and normal periods are used as references in order to extract special features of the GFC period.   In addition to changes in domestic (parent) employment, domestic establishments, and domestic affiliates, changes in transactions with East Asia are also examined.   Moreover, changes in sectors of HQ services and manufacturing activities in terms of employment as well as labor productivity are additionally investigated in order to seek a possible sign of de-industrialization.

Our logit/OLS estimation analyses demonstrate that given the size of firm and other controls, production-networking manufacturing firms with expanding operations in East Asia are likely to increase their domestic employment and rather tend to increase in the number, compared with other types of manufacturing firms even under the GFC. The paper also finds that those production-networking manufacturing firms are more likely to increase the number of domestic affiliates and establishments in addition to domestic employment.   Such a tendency is more vividly observed in the latter normal period and under the crisis, while Japanese manufacturing firms shrinking operations in East Asia tend to decrease domestic employment with an increase in the number of domestic affiliates under the crisis.   This may partially reflect the fact that the GFC partially worked as a trigger of reshuffling geographical distribution of activities by Japanese firms.   Moreover, production-networking manufacturing firms, particularly R&D intensive manufacturing firms tend to intensify export/import activities with the

region, regardless of whether normal periods or crisis period.   Furthermore, in terms of employment, production-networking manufacturing firms are likely to intensify HQ services, and such a trend is strengthening, while they are likely to intensify manufacturing activities in normal periods, but such a trend is weakening and manufacturing activities are relatively shrinking.   At the individual firm level, the fragmentation of production by Japanese manufacturing firms seems to generate additional jobs and operations at home by effectively utilizing the mechanics of production process-wise division of labor in East Asia.   At the same time, however, there exist an intensification of domestic operations to those are complementary to PBs abroad, with the tendency toward de-industrialization.

Our dataset does not unfortunately allow us to fully analyze the impacts of the GFC yet.   With data of additional years, we may investigate be able to follow reshuffling geographical distribution as well as impacts of the crisis.

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Figure 1 Japanese real exports
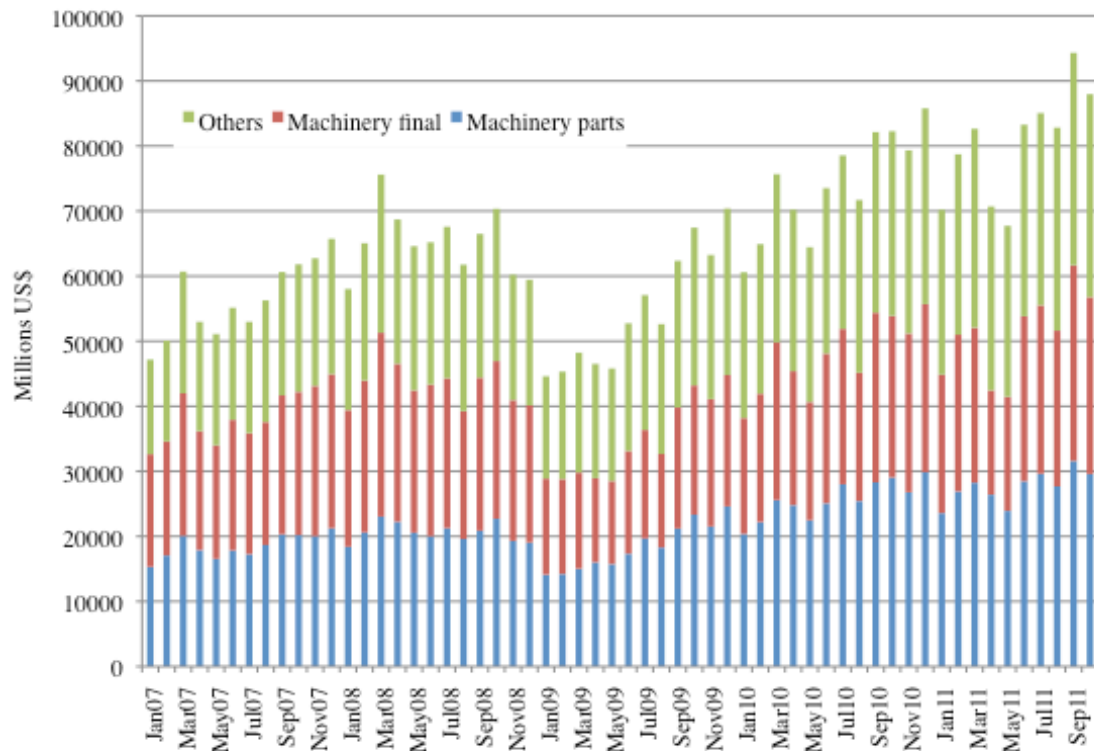
Figure 2 The number of exported product-country pairs, indexed to January 2007=1
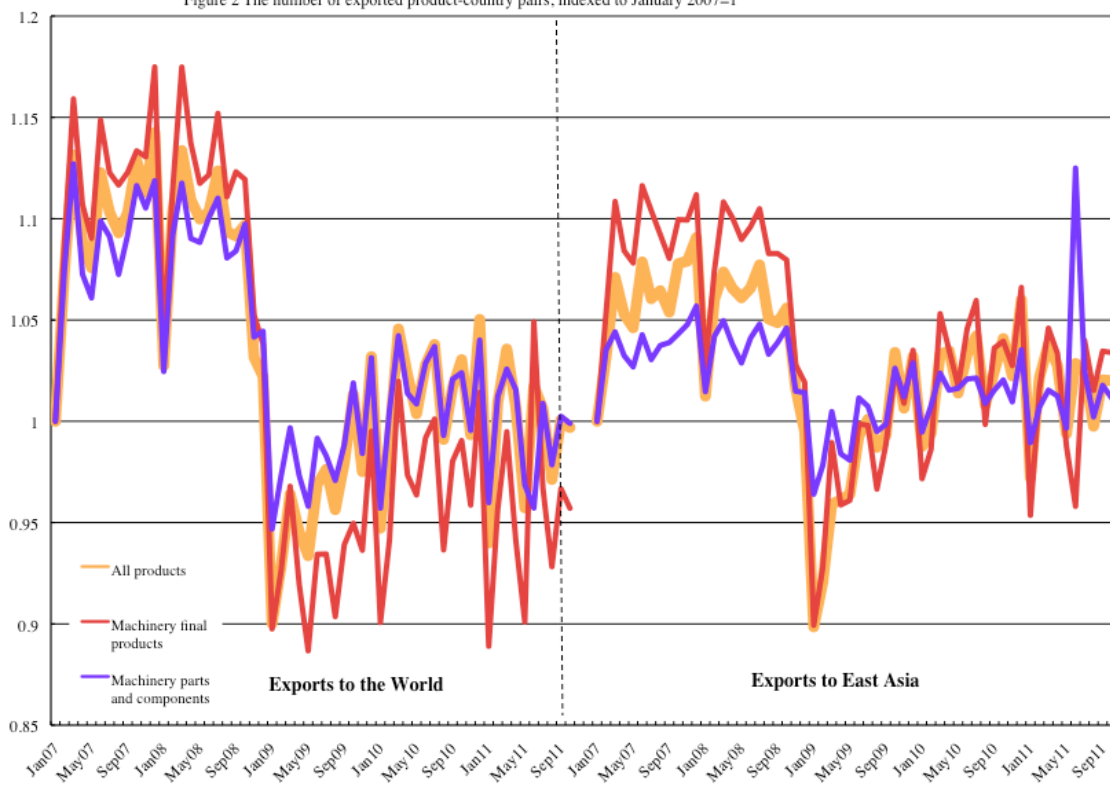
Source: Ando and Kimura (2012c).

Table 1 Sectoral patterns of Japanese parent firms and their affiliates in East Asia, North America, and Europe for 2007

Industry of parent firm	Number of parent firms: all sized	(%)	Number of affiliates	(%)	Share: Manufacturing (machinery)		Share: Non-manufacturing (wholesales)		Number of parent firms: SMEs	(%)	Number of affiliates	(%)	Share: Manufacturing (machinery)		Share: Non-manufacturing (wholesales)	
(a-1) East Asia									**(a-2) East Asia**							
Manufacturing	2,849	70%	11,935	67%	72%	(30%)	28%	(16%)	1,403	88%	2,510	61%	83%	(26%)	17%	(11%)
-Machinery	1,289	32%	5,970	34%	68%	(54%)	32%	(20%)	585	37%	1,051	26%	82%	(57%)	18%	(12%)
Non-manufacturing	1,229	30%	5,831	33%	32%	(10%)	68%	(35%)	185	12%	1,581	39%	32%	(4%)	68%	(41%)
-Wholesales	171	4%	3,951	22%	38%	(13%)	62%	(47%)	108	7%	1,064	26%	34%	(4%)	66%	(56%)
Total	4,078	100%	17,766	100%	59%	(23%)	41%	(22%)	1,588	100%	4,091	100%	63%	(17%)	37%	(23%)
(b-1) North America									**(b-2) North America**							
Manufacturing	1,221	88%	3,811	66%	45%	(23%)	55%	(20%)	349	86%	393	57%	51%	(19%)	49%	(33%)
-Machinery	661	48%	2,456	43%	39%	(32%)	61%	(23%)	199	49%	223	32%	47%	(30%)	53%	(41%)
Non-manufacturing	163	12%	1,944	34%	16%	(4%)	84%	(31%)	57	14%	299	43%	10%	(2%)	90%	(37%)
-Wholesales	72	5%	4,479	78%	6%	(2%)	94%	(12%)	30	7%	142	21%	13%	(4%)	87%	(67%)
Total	1,384	100%	5,755	100%	36%	(17%)	64%	(23%)	406	100%	692	100%	33%	(12%)	67%	(35%)
(c-1) Europe									**(c-2) Europe**							
Manufacturing	720	88%	4,034	74%	41%	(17%)	59%	(29%)	134	85%	167	49%	47%	(15%)	53%	(37%)
-Machinery	401	49%	2,632	48%	34%	(24%)	66%	(37%)	70	45%	92	27%	35%	(24%)	65%	(51%)
Non-manufacturing	97	12%	1,401	26%	16%	(6%)	84%	(39%)	23	15%	175	51%	13%	(1%)	87%	(34%)
-Wholesales	41	5%	4,470	82%	4%	(2%)	96%	(11%)	11	7%	99	29%	15%	(1%)	85%	(55%)
Total	817	100%	5,435	100%	34%	(14%)	66%	(32%)	157	100%	342	100%	30%	(8%)	70%	(36%)

Data source: authors' calculation, based on METI database.

Notes: The figures for (a-1, b-1, c-1) are those of all sized parent firms and figures for (a-2, b-2, c-2) are of parent SMEs. The figures for "share" for manufacturing, machinery, non-manufacturing, and wholesales express the shares of manufacturing affiliates, machinery affiliates, non-manufacturing affiliates, and wholesales affiliates in total number of affiliates of all sized/SMEs firms in each sectoral category.

Table 2 Globalizing patterns of firms in the normal periods and at the Global Financial Crisis

| | Normal periods | | | | GFC | |
| | 1998-2002 | | 2002-2006 | | 2007-2009 | |
The type of firms	# of firms	Share	# of firms	Share	# of firms	Share
(a) Manufacturing firms						
No entry in East Asia	8,619	80%	8,017	77%	8,937	77%
- (Domestic)	8,368	78%	7,807	75%	8,699	74%
Expansion in East Asia (i+ii)	1,003	9%	1,314	13%	675	6%
- (i) Expansion in East Asia	539	5%	773	7%	458	4%
- (ii) Expansion in East Asia (with 1st FDI in the region)	464	4%	541	5%	217	2%
Steady in East Asia	764	7%	822	8%	1,646	14%
Shrinkage in East Asia (i + ii)	326	3%	313	3%	422	4%
- (i) Shrinkage in East Asia	177	2%	156	1%	307	3%
- (ii) Shrinkage in East Asia (withdrawal from the region)	149	1%	157	2%	115	1%
Total	10,712	100%	10,466	100%	11,680	100%
(b) Manufacturing SMEs						
No entry in East Asia	7,007	89%	6,777	85%	7,509	85%
- (Domestic)	6,885	87%	6,657	84%	7,357	83%
Expansion in East Asia (i+ii)	420	5%	544	7%	270	3%
- (i) Expansion in East Asia	125	2%	208	3%	122	1%
- (ii) Expansion in East Asia (with 1st FDI in the region)	295	4%	336	4%	148	2%
Steady in East Asia	373	5%	489	6%	917	10%
Shrinkage in East Asia (i + ii)	109	1%	146	2%	174	2%
- (i) Shrinkage in East Asia	29	0%	50	1%	97	1%
- (ii) Shrinkage in East Asia (withdrawal from the region)	80	1%	96	1%	77	1%
Total	7,909	100%	7,956	100%	8,870	100%

Source: authors' calculation, based on METI database and Ando and Kimura (2011).

Table 3 Changes in domestic operations in the period 1998-2002 and 2002-2006 by the type of firms, based on the two-year-balanced panel data

The type of firms	Domestic employment						Domestic establishments				Domestic affiliates			
	1998-2002			2002-2006			1998-2002		2002-2006		1998-2002		2002-2006	
	Share of firms increasing	Average growth rates at the firm level	Aggregate change	Share of firms increasing	Average growth rates at the firm level	Aggregate change	Share of firms increasing	Aggregate change	Share of firms increasing	Aggregate change	Share of firms increasing	Aggregate change	Share of firms increasing	Aggregate change
(a) Manufacturing firms														
No entry in East Asia	32%	-3.7%	-128,527	51%	5.2%	60,913	19%	393	20%	299	11%	-664	8%	-235
Expansion in East Asia (i+ii)	33%	-4.2%	-160,084	64%	12.6%	116,235	26%	-620	33%	108	27%	-240	28%	1,443
- (i) Expansion in East Asia	29%	-8.1%	-142,988	62%	10.1%	99,970	25%	-728	34%	73	29%	-685	32%	1,347
- (ii) Expansion in East Asia (with 1st FDI)	38%	0.2%	-17,096	67%	16.1%	16,265	28%	108	33%	35	26%	445	23%	96
Steady in East Asia	25%	-9.3%	-69,561	54%	4.5%	13,861	25%	-283	25%	-117	19%	-389	16%	-193
Shrinkage in East Asia (i + ii)	25%	-10.1%	-113,890	50%	1.4%	-40,715	27%	-145	23%	-159	19%	-1,499	16%	-513
- (i) Shrinkage in East Asia	23%	-10.2%	-104,182	48%	2.2%	-35,154	28%	-282	24%	-7	23%	-1,392	16%	-369
- (ii) Shrinkage in East Asia (withdrawal)	29%	-9.7%	-9,708	52%	0.7%	-5,561	26%	137	23%	-152	15%	-107	16%	-144
Total	32%	-4.3%	-472,062	53%	6.0%	150,294	21%	-655	22%	131	13%	-2,792	12%	502
(b) Manufacturing SMEs														
No entry in East Asia	33%	-2.7%	-38,565	52%	6.0%	40,767	17%	103	19%	433	9%	-599	7%	-153
Expansion in East Asia (i+ii)	45%	2.1%	344	67%	16.9%	12,769	25%	97	26%	56	20%	35	19%	32
- (i) Expansion in East Asia	46%	0.5%	-92	63%	12.5%	4,461	22%	-21	27%	1	21%	-10	19%	5
- (ii) Expansion in East Asia (with 1st FDI)	44%	2.7%	436	70%	19.6%	8,308	27%	118	26%	55	20%	45	19%	27
Steady in East Asia	30%	-7.2%	-5,588	58%	5.8%	3,060	21%	-66	23%	-4	14%	-22	15%	-22
Shrinkage in East Asia (i + ii)	32%	-2.2%	-1,512	55%	5.2%	820	27%	-11	18%	-26	21%	9	10%	-53
- (i) Shrinkage in East Asia	28%	-10.9%	-665	56%	13.6%	899	41%	-21	18%	-9	34%	5	14%	-15
- (ii) Shrinkage in East Asia (withdrawal)	34%	-5.7%	-847	54%	0.9%	-79	23%	10	18%	-17	16%	4	7%	-38
Total	34%	-2.6%	-44,586	54%	6.7%	57,416	18%	123	20%	459	10%	-577	8%	-196

Source: authors' calculation, based on METI database and Ando and Kimura (2011).

Table 4 Changes in domestic operations in the period 2007-2009 by the type of firms, based on the two-year-balanced panel data

The type of firms	Dom. Employment			Dom. establishments		Dom. affiliates	
	Share of firms increasing	Average growth rates at the firm level	Aggregate change	Share of firms increasing	Aggregate change	Share of firms increasing	Aggregate change
(a) Manufacturing firms							
No entry in East Asia	41%	-0.5%	-3,500	12%	-79	5%	-257
Expansion in East Asia (i+ii)	52%	2.8%	-9,579	24%	-218	23%	302
- (i) Expansion in East Asia	53%	2.5%	-10,996	24%	-263	22%	87
- (ii) Expansion in East Asia (with 1st FDI)	50%	3.3%	1,417	23%	45	23%	215
Steady in East Asia	43%	-1.4%	-1,773	16%	-169	9%	-410
Shrinkage in East Asia (i + ii)	40%	-3.9%	-5,576	19%	-535	13%	-521
- (i) Shrinkage in East Asia	42%	-2.9%	-2,487	20%	-491	14%	-548
- (ii) Shrinkage in East Asia (withdrawal)	33%	-6.5%	-3,089	16%	-44	8%	27
Total	42%	-0.6%	-20,428	14%	-1,001	7%	-886
(b) Manufacturing SMEs							
No entry in East Asia	39%	-0.7%	-8233	11%	-105	5%	-158
Expansion in East Asia (i+ii)	43%	1.3%	425	18%	18	16%	11
- (i) Expansion in East Asia	40%	-0.9%	-117	15%	-14	13%	-12
- (ii) Expansion in East Asia (with 1st FDI)	45%	3.0%	542	21%	32	18%	23
Steady in East Asia	38%	-2.1%	-3380	11%	-65	6%	-138
Shrinkage in East Asia (i + ii)	34%	-5.2%	-1762	13%	-32	11%	65
- (i) Shrinkage in East Asia	36%	-3.7%	-792	11%	-27	14%	-2
- (ii) Shrinkage in East Asia (withdrawal)	32%	-6.7%	-970	13%	-5	8%	67
Total	39%	-0.9%	-12,950	11%	-184	5%	-220

Source: authors' calculation, based on METI database.

Table 5 Changes in domestic operations for manufacturing firms: employment in HQ services and manufacturing activities

The type of firms	Share of firms increasing employment engaged in						Change in relative size of employment engaed in					
	HQ services			mfg activities			HQ services			mfg activities		
	1998-2002	2002-2006	2007-2009	1998-2002	2002-2006	2007-2009	1998-2002	2002-2006	2007-2009	1998-2002	2002-2006	2007-2009
Manufacturing firms: all sized firms												
No entry in East Asia	32%	44%	39%	32%	46%	40%	-1.1%	0.0%	0.1%	0.5%	-4.6%	0.2%
Expansion in East Asia	38%	57%	53%	32%	49%	43%	-1.0%	0.1%	0.8%	-1.6%	-5.0%	-1.4%
Steady in East Asia	35%	47%	45%	26%	47%	41%	-0.1%	-0.3%	-0.1%	-1.9%	-4.0%	0.0%
Shrinkage in East Asia	30%	43%	51%	26%	42%	37%	-1.0%	-0.3%	1.0%	-2.0%	-3.3%	-0.9%
Total	33%	46%	41%	32%	46%	40%	-1.0%	0.0%	0.2%	0.0%	-4.5%	0.0%
Manufacturing SMEs												
No entry in East Asia	32%	43%	37%	33%	47%	39%	-1.2%	-0.1%	0.1%	0.8%	-4.6%	0.3%
Expansion in East Asia	43%	56%	44%	39%	53%	36%	-1.5%	-0.1%	0.4%	-0.7%	-3.9%	-2.3%
Steady in East Asia	33%	44%	40%	31%	51%	36%	-0.2%	-0.2%	-0.2%	-1.4%	-4.4%	-0.2%
Shrinkage in East Asia	30%	41%	45%	34%	52%	32%	-2.4%	-1.8%	1.7%	-0.2%	-0.9%	-0.7%
Total	33%	44%	38%	34%	48%	38%	-1.1%	-0.1%	0.1%	0.6%	-4.5%	0.0%

Source: authors' calculation, based on METI database.

Figure 3 Typical sequence in international production networking

Decision of international production networking

Establishment of a foreign affiliate

Reach full operation

Foreign

Preparation period for FDI
(typically 2-3 years)

Expanding operation
(typically 2-3 years)

time

Domestic

Domestic adjustments on
    inputs (K, H, L)
    domestic establishments
    domestic affiliates
    exp./imp. patterns
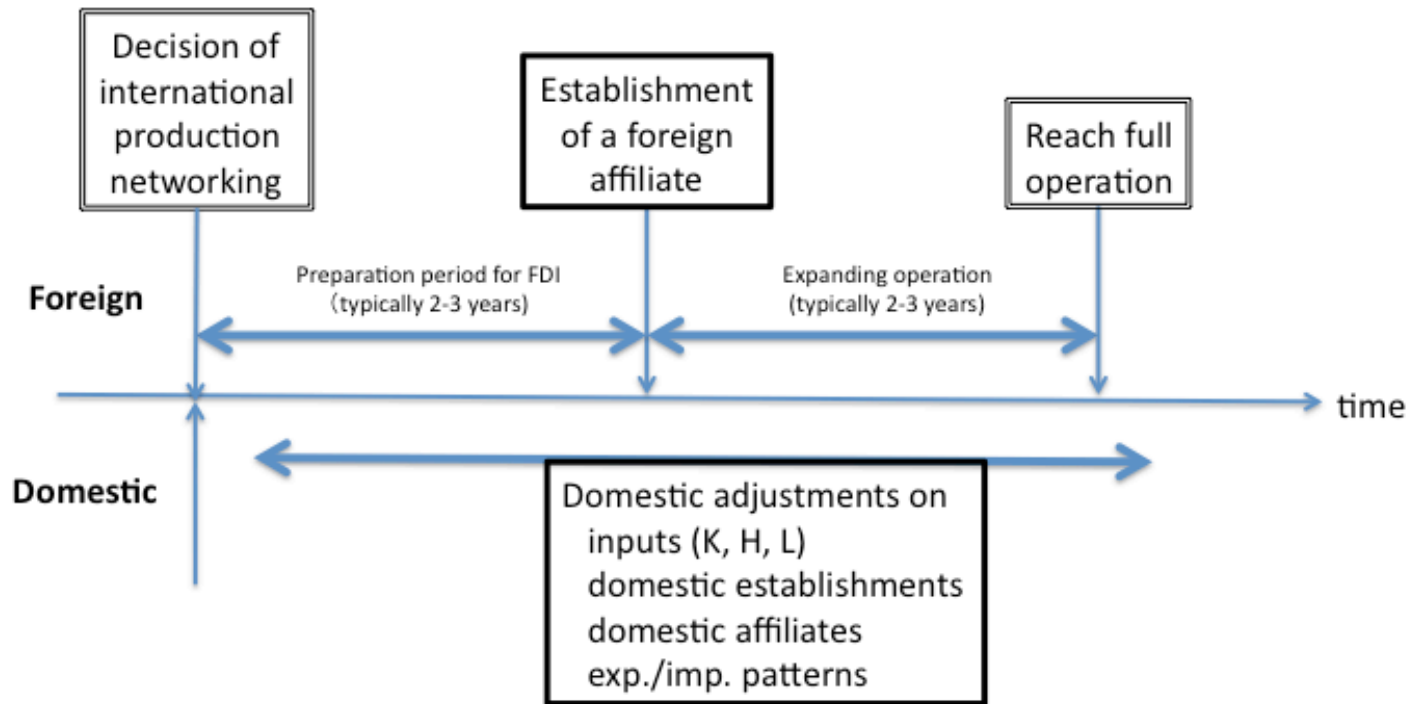
Source: Ando and Kimura (2012b)

Table 6 Production networking in East Asia and domestic operations for 2007-2009: manufacturing firms

Independent variables	(1) d. .employment [logit]	(2) d. employment [OLS]	(3) d. establishment [logit]	(4) d. affiliates [logit]	(5) exports to E.Asia [OLS]	(6) imports from E.Asia [OLS]
Constant	-1.301 ***	-0.096	-3.761 ***	-4.854 ***	0.000	-0.033
	(0.175)	(0.051)	(0.233)	(0.297)	(0.015)	(0.021)
Expansion in East Asia	0.320 ***	0.041 ***	0.229 **	0.990 ***	0.014 ***	0.019 ***
(incl. 1st FDI)	(0.090)	(0.010)	(0.110)	(0.120)	(0.003)	(0.005)
Firm size	0.127 ***	-0.001	0.374 ***	0.360 ***	0.002 ***	-0.004 ***
	(0.024)	(0.003)	(0.031)	(0.039)	(0.001)	(0.001)
Capital-labor ratio	0.119 ***	0.012 ***	0.009	0.260 ***	0.001	-0.002 *
	(0.022)	(0.002)	(0.030)	(0.046)	(0.001)	(0.001)
Foreign sales ratio	0.188	-0.009	0.124	-0.380	-0.038 ***	0.015 **
	(0.173)	(0.019)	(0.231)	(0.315)	(0.006)	(0.010)
In-house R&D ratio	1.135	-0.033	0.373	0.530	0.081 ***	0.100
	(0.900)	(0.097)	(1.142)	(1.539)	(0.030)	(0.051)
Advertisement ratio	0.992	-0.157	3.363 **	4.627 **	-0.047	0.041
	(1.439)	(0.159)	(1.652)	(2.034)	(0.048)	(0.083)
Foreign capital ratio	-0.002	0.000	0.000	0.003	0.000	0.000
	(0.002)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-6280.6		-3823	-2437		
Adj R2		0.0211			0.0132	0.0052
Number of observations	9509	9509	9509	9509	9509	9436
Constant	-1.361 ***	-0.033 *	-3.782 ***	-4.698 ***	0.004	-0.024
	(0.178)	(0.051)	(0.237)	(0.302)	(0.015)	(0.021)
Expansion in East Asia	0.284 ***	0.036 ***	0.231 **	1.172 ***	0.018 ***	0.025 ***
(incl. 1st FDI)	(0.094)	(0.010)	(0.117)	(0.131)	(0.003)	(0.005)
Steady in East Asia	-0.015	-0.006	0.078	0.352 ***	0.008 ***	0.012 ***
	(0.063)	(0.007)	(0.086)	(0.112)	(0.002)	(0.004)
Shrinkage in East Asia	-0.263 **	-0.033 ***	-0.174	0.396 **	0.007 *	0.025 ***
	(0.116)	(0.013)	(0.154)	(0.181)	(0.004)	(0.007)
Firm size	0.140 ***	0.000	0.377 ***	0.317 ***	0.001 *	-0.006 ***
	(0.025)	(0.003)	(0.032)	(0.041)	(0.001)	(0.001)
Capital-labor ratio	0.122 ***	0.012 ***	0.010	0.250 ***	0.000	-0.003 **
	(0.022)	(0.002)	(0.031)	(0.046)	(0.001)	(0.001)
Foreign sales ratio	0.242	-0.001	0.128	-0.571 *	-0.043 ***	0.005
	(0.178)	(0.020)	(0.237)	(0.323)	(0.006)	(0.010)
In-house R&D ratio	1.193	-0.024	0.360	0.337	0.076 ***	0.090 *
	(0.904)	(0.097)	(1.138)	(1.542)	(0.030)	(0.051)
Advertisement ratio	1.061	-0.149	3.411 **	4.491 **	-0.049	0.035
	(1.440)	(0.159)	(1.651)	(2.050)	(0.048)	(0.083)
Foreign capital ratio	-(0.002)	0.000	0.000	0.004	0.000	0.000
	(0.002)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-6278		-3821.6	-2431.2		
Adj R2		0.0216			0.0145	0.0071
Number of observations	9509	9509	9509	9509	9509	9436

Data source: Authors' calculation, based on METI database.

Notes: figures in parenthesis are standard deviation. *** indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Regressions are as follows:

(1) dependent variable: 1 if a firm increases in the number of domestic employments and 0 otherwise

(2) dependent variable: growth rate of the number of domestic employment

(3) dependent variable: 1 if a firm increases reduce the number of domestic establishments and 0 otherwise

(4) dependent variable: 1 if a firm increases the number of domestic affiliates and 0 otherwise

(5) dependent variable: a change in the ratio of expoprts to East Asia in total sales

(6) dependent variable: a change in the ratio of imports from East Asia in total purchases

Table 7 Production networking in East Asia and domestic operations for 2007-2009: machinery firms

	Dependent variable					
	(1)	(2)	(3)	(4)	(5)	(6)
	d. .employment	d. employment	d. establishment	d. affiliates	exports to E.Asia	imports from E.Asia
Independent variables	[logit]	[OLS]	[logit]	[logit]	[OLS]	[OLS]
Constant	-1.341 ***	-0.013	-3.282 ***	-5.480 ***	-0.013	0.032
	(0.206)	(0.023)	(0.275)	(0.389)	(0.009)	(0.013)
Expansion in East Asia	0.350 ***	0.042 ***	0.277 *	1.139 ***	0.020 ***	0.025 ***
	(0.126)	(0.014)	(0.157)	(0.174)	(0.006)	(0.008)
Firm size	0.166 ***	-0.004	0.275 ***	0.384 ***	0.004 **	-0.003
	(0.036)	(0.004)	(0.047)	(0.062)	(0.002)	(0.002)
Capital-labor ratio	0.084 **	0.014 ***	0.027	0.262 ***	0.001	-0.003
	(0.035)	(0.004)	(0.052)	(0.085)	(0.002)	(0.002)
Foreign sales ratio	0.202	0.007	0.581 **	-0.152	-0.055 ***	-0.010
	(0.204)	(0.023)	(0.262)	(0.370)	(0.009)	(0.013)
In-house R&D ratio	1.276	0.040	-0.089	1.203	0.130 ***	0.101
	(1.151)	(0.122)	(1.548)	(1.757)	(0.050)	(0.072)
Advertisement ratio	-0.758	-0.856	9.328	6.739	-0.306	0.205
	(5.843)	(0.649)	(7.063)	(9.530)	(0.267)	(0.381)
Foreign capital ratio	-0.004	0.000	-0.002	-0.001	0.000 **	0.000
	(0.003)	(0.000)	(0.004)	(0.005)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-2491.7		-1468.5	-845.31		
Adj R2		0.012			0.0174	0.0021
Number of observations	3747	3747	3747	3747	3747	3718
Constant	-1.436 **	-0.022	-3.259 ***	-5.354 ***	-0.009	0.039 ***
	(0.212)	(0.023)	(0.282)	(0.397)	(0.009)	(0.014)
Expansion in East Asia	0.291 **	0.036 **	0.339 **	1.505 ***	0.025 ***	0.031 ***
	(0.134)	(0.015)	(0.171)	(0.201)	(0.006)	(0.009)
Steady in East Asia	-0.019	0.000	0.162	0.662 ***	0.010 **	0.006
	(0.092)	(0.010)	(0.127)	(0.177)	(0.004)	(0.006)
Shrinkage in East Asia	-0.384 **	-0.039 **	0.006	0.586 **	0.012	0.023 **
	(0.167)	(0.018)	(0.217)	(0.279)	(0.007)	(0.011)
Firm size	0.187 ***	-0.003	0.265 ***	0.324 ***	0.003	-0.005 **
	(0.038)	(0.004)	(0.050)	(0.065)	(0.002)	(0.002)
Capital-labor ratio	0.088 **	0.014 ***	0.023	0.251 ***	0.000	-0.003
	(0.036)	(0.004)	(0.052)	(0.087)	(0.002)	(0.002)
Foreign sales ratio	0.271	0.014	0.521 **	-0.452	-0.061 ***	-0.016
	(0.211)	(0.023)	(0.270)	(0.383)	(0.010)	(0.014)
In-house R&D ratio	1.365	0.047	-0.202	0.717	0.122 **	0.092
	(1.164)	(0.122)	(1.554)	(1.803)	(0.050)	(0.072)
Advertisement ratio	-0.176	-0.795	9.611	6.857 ***	-0.313	0.175
	(5.860)	(0.650)	(7.078)	(9.480)	(0.267)	(0.382)
Foreign capital ratio	-0.004	0.000	-0.002	0.000	0.000 **	0.000
	(0.003)	(0.000)	(0.004)	(0.005)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-2489		-1467.6	-838.19		
Adj R2		0.0128			0.0187	0.003
Number of observations	3747	3747	3747	3747	3747	3718

Data source: Authors' calculation, based on METI database.

Notes: see Table 6.

Table 8 Production networking in East Asia and domestic operations for 1998-2002 and 2002-2006: manufacturing firms

Independent variables	Dependent variable					
	(1) d. employment [logit]	(2) d. employment [OLS]	(3) d. establishment [logit]	(4) d. affiliates [logit]	(5) exports to E.Asia [OLS]	(6) imports from E.Asia [OLS]
a) Period: 1998-2002						
Constant	0.880 ***	0.199 ***	-2.932 ***	-3.925 ***	0.004	0.022 ***
	(0.215)	(0.029)	(0.238)	(0.272)	(0.004)	(0.009)
Expansion in East Asia	0.344 ***	0.043 ***	0.062	0.768 ***	0.021 ***	0.032 ***
(incl. 1st FDI)	(0.087)	(0.012)	(0.096)	(0.101)	(0.002)	(0.004)
Steady in East Asia	-0.088	-0.015	0.125	0.527 ***	0.006 ***	0.028 ***
	(0.097)	(0.013)	(0.101)	(0.112)	(0.002)	(0.004)
Shrinkage in East Asia	0.034	0.005	0.047	0.120	-0.001	0.028 **
	(0.151)	(0.020)	(0.151)	(0.175)	(0.003)	(0.006)
Firm size	-0.359 ***	-0.049 ***	0.247 ***	0.327 ***	0.000	-0.002 *
	(0.029)	(0.004)	(0.030)	(0.034)	(0.001)	(0.001)
Capital-labor ratio	0.117 ***	0.009 ***	0.092 ***	0.134 ***	0.000	-0.001
	(0.026)	(0.003)	(0.030)	(0.038)	(0.001)	(0.001)
Foreign sales ratio	0.080	-0.040	-0.238	-0.263	0.045 ***	0.039 ***
	(0.232)	(0.031)	(0.259)	(0.299)	(0.005)	(0.009)
In-house R&D ratio	2.339 **	0.272 *	2.626 **	2.104	0.049 *	-0.004
	(1.181)	(0.165)	(1.262)	(1.516)	(0.026)	(0.050)
Advertisement ratio	-0.221	0.227	2.294	4.887 ***	-0.047	-0.010
	(1.485)	(0.207)	(1.512)	(1.647)	(0.032)	(0.062)
Foreign capital ratio	0.000	0.000 **	0.000	-0.001 *	0.000 ***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-5398.5		-4438.3	-3275.1	0.051	0.0251
Adj R2		0.0337				
Number of observations	8834	8834	8834	8834	8526	8154
b) Period: 2002-2006						
Constant	0.553 ***	0.117 ***	-2.612 ***	-4.795 ***	-0.002	0.034 ***
	(0.175)	(0.026)	(0.203)	(0.254)	(0.003)	(0.008)
Expansion in East Asia	0.574 ***	0.066 ***	0.449 ***	0.932 ***	0.017 ***	0.037 ***
(incl. 1st FDI)	(0.081)	(0.012)	(0.087)	(0.102)	(0.002)	(0.004)
Steady in East Asia	0.049	-0.004	0.153	0.526 ***	0.011 ***	0.011 ***
	(0.089)	(0.013)	(0.102)	(0.123)	(0.002)	(0.004)
Shrinkage in East Asia	0.096	-0.008	0.058	0.184	0.004	0.015 **
	(0.135)	(0.020)	(0.155)	(0.191)	(0.003)	(0.006)
Firm size	-0.208 ***	-0.029 ***	0.222 ***	0.393 ***	0.001	-0.007 ***
	(0.029)	(0.004)	(0.032)	(0.039)	(0.001)	(0.001)
Capital-labor ratio	0.074 ***	0.019 ***	0.025	0.283 ***	0.000	0.001
	(0.028)	(0.004)	(0.033)	(0.047)	(0.001)	(0.001)
Foreign sales ratio	0.137	-0.031	-0.693 **	-0.259	-0.054	-0.004
	(0.242)	(0.035)	(0.286)	(0.330)	(0.006)	(0.011)
In-house R&D ratio	2.845 **	0.635 ***	1.112	2.081	0.110	-0.014
	(1.262)	(0.183)	(1.394)	(1.658)	(0.032)	(0.060)
Advertisement ratio	-0.534	0.000	4.147 ***	4.163 **	-0.057	-0.016
	(1.479)	(0.221)	(1.553)	(1.733)	(0.040)	(0.070)
Foreign capital ratio	0.004	0.000	-0.004	-0.004	0.000	0.001 ***
	(0.002)	(0.000)	(0.003)	(0.004)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-4857		-3874	-2549		
Adj R2		0.030			0.023	0.024
Number of observations	7281	7281	7281	7263	7003	6731

Data source: Authors' calculation, based on METI database.

Notes: see Table 6.

Table 9 Production networking in East Asia and domestic operations for 1998-2002 and 2002-2006: machinery firms

	Dependent variable					
	(1)	(2)	(3)	(4)	(5)	(6)
	d. employment	d. employment	d. establishment	d. affiliates	exports to E.Asia	imports from E.Asia
Independent variables	[logit]	[OLS]	[logit]	[logit]	[OLS]	[OLS]
a) Period: 1998-2002						
Constant	1.069 ***	0.215 ***	-2.709 ***	-4.362	-0.009	0.037 ***
	(0.265)	(0.034)	(0.284)	(0.354)	(0.007)	(0.012)
Expansion in East Asia	0.221 *	0.028 *	0.124	0.883 ***	0.022 ***	0.031 ***
(incl. 1st FDI)	(0.124)	(0.016)	(0.140)	(0.148)	(0.004)	(0.006)
Steady in East Asia	-0.028	-0.009	0.208	0.654 ***	0.002	0.032 ***
	(0.141)	(0.018)	(0.151)	(0.167)	(0.004)	(0.006)
Shrinkage in East Asia	0.131	0.032	0.214	-0.121	-0.008	0.019 *
	(0.223)	(0.028)	(0.228)	(0.293)	(0.006)	(0.010)
Firm size	-0.337 ***	-0.045 ***	0.244 ***	0.300 ***	0.001	-0.003
	(0.046)	(0.006)	(0.048)	(0.055)	(0.001)	(0.002)
Capital-labor ratio	0.193 ***	0.012 **	0.118 **	0.158 **	0.001	0.000
	(0.046)	(0.006)	(0.055)	(0.071)	(0.001)	(0.002)
Foreign sales ratio	-0.099	-0.060	-0.235	-0.106	0.054 ***	0.051 ***
	(0.284)	(0.037)	(0.319)	(0.360)	(0.008)	(0.013)
In-house R&D ratio	2.774 *	0.181	1.842	3.145	0.051	-0.053
	(1.559)	(0.210)	(1.716)	(1.968)	(0.046)	(0.074)
Advertisement ratio	0.600	0.651	20.075 ***	19.377 ***	-0.144	0.227
	(6.589)	(0.891)	(6.918)	(7.588)	(0.190)	(0.326)
Foreign capital ratio	0.001	0.000	0.000	-0.001	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-2024.2		-1587.8	-1177.5		
Adj R2		0.0334			0.0483	0.0289
Number of observations	3354	3354	3354	3354	3210	3083
b) Period: 2002-2006						
Constant	1.394 ***	0.253 ***	-2.186 ***	-4.955 ***	-0.002	0.051 ***
	(0.267)	(0.035)	(0.301)	(0.410)	(0.009)	(0.015)
Expansion in East Asia	0.596 ***	0.038 **	0.771 ***	1.052 ***	0.023 ***	0.056 ***
(incl. 1st FDI)	0.122	0.016	0.126	0.160	0.004	0.007
Steady in East Asia	-0.048	-0.027	0.314 **	0.353 *	0.013 ***	0.004
	0.129	0.018	0.148	0.203	0.004	0.007
Shrinkage in East Asia	0.063	-0.017	0.260	0.087	0.017 **	0.027 **
	0.195	0.028	0.225	0.313	0.007	0.011
Firm size	-0.271 ***	-0.027 ***	0.132 ***	0.334 ***	0.001	-0.009 ***
	(0.045)	(0.006)	(0.049)	(0.062)	(0.001)	(0.002)
Capital-labor ratio	0.082 *	0.017 ***	0.068	0.232 ***	0.002	0.003
	(0.046)	(0.006)	(0.056)	(0.087)	(0.002)	(0.003)
Foreign sales ratio	0.162	0.007	-0.673 **	0.049	-0.076 ***	-0.006
	(0.287)	(0.040)	(0.334)	(0.389)	(0.010)	(0.016)
In-house R&D ratio	2.081	0.404 *	0.391	4.219 *	0.115 **	-0.025
	(1.641)	(0.229)	(1.821)	(2.154)	(0.055)	(0.093)
Advertisement ratio	1.953	-1.016	23.630 ***	17.843 *	0.012	0.142
	(7.250)	(1.009)	(7.482)	(9.358)	(0.239)	(0.402)
Foreign capital ratio	-0.004	-0.001	-0.003	-0.007	0.000 **	0.001 ***
	(0.004)	(0.001)	(0.005)	(0.007)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-1836.8		-1466.1	-895.94		
Adj R2		0.0272			0.0309	0.0353
Number of observations	2807	2807	2807	2807	2673	2574

Data source: Authors' calculation, based on METI database.
Notes: see Table 6.

Table 10 Production networking in East Asia and domestic operations for 2007-2009: manufacturing firms

(excerpted, coefficients for dummies of globalizing patterns only)

Independent variables	Dependent variable			
	(1) HQ serivces: absolute size [logit]	(2) HQ serivces: relative size [OLS]	(3) Mfg activities absolute size [logit]	(4) Mfg activities relative size [OLS]
1998-2002				
Expansion in East Asia	0.230 ***	-0.004	0.230 ***	-0.008
Steady in East Asia	0.093	0.006	-0.118	-0.014 **
Shrinkage in East Asia	-0.093	-0.006	0.054	-0.006
2002-2006				
Expansion in East Asia	0.334 ***	0.000	0.220 ***	-0.014 **
Steady in East Asia	0.001	-0.004	-0.014	-0.003
Shrinkage in East Asia	-0.110	-0.003	-0.065	0.004
2007-2009				
Expansion in East Asia	0.174 *	0.006 *	0.002	-0.014 *
Steady in East Asia	-0.004	-0.004 **	0.017	-0.002
Shrinkage in East Asia	0.027	0.008 **	-0.313 ***	-0.014

Data source: Authors' calculation, based on METI database.

Notes: figures in parenthesis are standard deviation. *** indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Regressions are as follows:

(1) dependent variable: 1 if a firm increases in the number of domestic employment engaged in the sector of HQ serivces and 0 otherwise

(2) dependent variable: a change in the ratio of employment engaged in the sector of HQ services in total employment.

(3) dependent variable: 1 if a firm increases in the number of domestic employment engaged in manufacturing activities and 0 otherwise.

Table 11 Production networking in East Asia and labor productivity for 2007-2009

Independent variables	Dependent variable: real labor productivity			
	Manufacturing firms		Machinery firms	
	(1) [OLS]	(2) [OLS]	(3) [OLS]	(4) [OLS]
Constant	0.209 ***	0.196 ***	0.417	0.390 ***
	(0.037)	(0.037)	(0.049)	(0.050)
Initial real labor productivity	0.638 ***	0.637 ***	0.576 ***	0.574 ***
	(0.009)	(0.009)	(0.016)	(0.016)
Expansion in East Asia	-0.011	-0.022	-0.012	-0.043
(incl. 1st FDI)	(0.018)	(0.019)	(0.028)	(0.029)
Steady in East Asia		-0.017		-0.058 ***
		(0.012)		(0.020)
Shrinkage in East Asia		-0.045 **		-0.076 **
		(0.023)		(0.035)
Firm size	0.046 ***	0.049 ***	0.051 ***	0.059 ***
	(0.005)	(0.005)	(0.008)	(0.008)
Capital-labor ratio	0.052 ***	0.053 ***	0.018 **	0.020 **
	(0.005)	(0.005)	(0.008)	(0.008)
Foreign sales ratio	-0.251 ***	-0.235 ***	-0.219	-0.183 ***
	(0.035)	(0.035)	(0.044)	(0.046)
In-house R&D ratio	-0.075	-0.059	0.014	0.068
	(0.180)	(0.181)	(0.237)	(0.238)
Advertisement ratio	0.843 ***	0.855 ***	1.445	1.530
	(0.290)	(0.290)	(1.340)	(1.340)
Foreign capital ratio	0.000	0.000	0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Industry dummies	Yes	Yes	Yes	Yes
Adj R2	0.5693	0.5695	0.4443	0.4457
Number of observations	8974	8974	3542	3542

Data source: Authors' calculation, based on METI database.

Notes: figures in parenthesis are standard deviation. *** indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level.

Table A.1 Sales and Purchases by manufacturing firms in East Asia at the GFC

		Sales							Purchases						
			By-destination sales ratio (%)							By-origin purchases ratio (%)					
		Values (billion JPY)	Japan	Local	Third countries	East Asia	North America	Europe	Values (billion JPY)	Japan	Local	Third countries	East Asia	North America	Europe
Year: 2007															
East Asia	Manufacturing	36,255	20.3	54.7	25.1	16.6	2.9	2.8	21,224	29.6	54.6	15.9	13.8	0.7	0.6
	-Machinery	26,184	22.2	51.2	26.6	17.1	3.2	3.2	15,481	31.8	53.0	15.3	13.9	0.4	0.4
NIES4	Manufacturing	8,002	20.7	52.8	26.4	17.4	3.8	2.7	4,967	38.7	39.4	21.9	19.3	1.0	0.7
	-Machinery	4,611	27.6	42.6	29.8	18.4	5.5	3.2	3,159	44.0	33.7	22.3	20.9	1.0	0.2
ASEAN4	Manufacturing	13,965	19.0	50.5	30.5	19.9	2.8	3.9	8,463	22.5	63.1	14.4	12.0	0.8	0.5
	-Machinery	10,193	19.6	49.1	31.3	19.4	2.9	4.4	6,189	23.9	63.8	12.3	10.9	0.3	0.3
China	Manufacturing	11,854	23.8	57.8	18.4	11.8	2.8	1.9	6,697	32.5	54.0	13.6	12.5	0.2	0.3
	-Machinery	9,277	25.6	53.9	20.5	13.1	3.0	2.2	5,198	35.0	49.8	15.2	14.2	0.2	0.2
Year: 2009															
East Asia	Manufacturing	31,357	20.3	59.0	20.7	14.4	1.6	2.0	16,963	26.6	61.3	12.1	10.8	0.4	0.4
	-Machinery	22,472	20.2	57.8	22.0	14.8	1.8	2.2	12,142	28.1	59.7	12.2	11.3	0.2	0.2
NIES4	Manufacturing	5,750	22.4	50.5	27.1	18.5	1.4	1.2	3,278	38.4	45.7	15.9	14.7	0.5	0.5
	-Machinery	3,467	31.4	38.5	30.1	19.3	1.5	0.9	2,244	39.6	42.8	17.7	17.2	0.3	0.1
ASEAN4	Manufacturing	10,799	23.5	49.3	27.2	19.9	2.3	2.3	6,159	22.1	64.4	13.5	11.9	0.7	0.3
	-Machinery	7,333	18.1	52.1	29.8	21.1	2.9	2.6	3,966	26.1	60.1	13.8	12.6	0.4	0.2
China	Manufacturing	12,392	19.0	70.1	11.0	7.2	1.3	1.0	6,403	25.7	66.8	7.5	6.6	0.1	0.3
	-Machinery	9,544	20.7	67.6	11.7	7.6	1.3	1.1	4,972	25.8	66.7	7.5	6.7	0.1	0.2

Source: authors' calculation, based on METI database (Survey of Overseas Business Activities of Japanese Companies).

Notes: as by-destination sales and by-origin purchases are missing for some, their ratios are calculated as follows; shares are obtained by dividing corresponding values by the sum of sales to/purchases from Japan, local, and the third countries, not the total values of sales/purchases.

Table A.2 Sales and purchases by Japanese manufacturing affiliates in East Asia for 1992, 1995, 1998, and 2001

Year	Industry	Number of affiliates	%	Total sales/purchases (billion JPY)	%	By-destination sales/by-origin purchases ratio						Intra-firm transaction ratio (%)					
						Japan	Local	Third countries	East Asia	North America	Europe	Japan	Local	Third countries	East Asia	North America	Europe
(a) Sales																	
1992	Manufacturing	1,463	56.3	7,887	50.7	15.8	66.0	18.2	10.0	3.4	1.8	84.2	6.3	42.9	44.6	62.6	47.7
	-Machinery	715	27.5	5,202	33.4	16.8	66.2	17.0	9.4	4.0	1.8	90.5	7.8	57.7	53.9	76.6	65.0
1995	Manufacturing	2,966	64.5	12,300	50.0	18.8	58.4	22.8	13.3	3.6	1.8	83.2	15.8	45.4	49.1	57.0	60.7
	-Machinery	1,428	31.0	9,080	36.9	20.8	56.6	22.6	12.8	4.0	1.9	90.6	19.9	55.4	60.2	64.8	71.5
1998	Manufacturing	3,835	61.7	12,325	53.0	25.4	49.2	25.4	16.9	4.5	2.7	73.1	7.6	45.9	47.2	48.3	40.7
	-Machinery	1,809	29.1	8,485	36.5	44.1	38.6	17.3	15.4	1.1	0.4	80.6	15.6	48.7	47.5	50.8	63.7
2001	Manufacturing	4,247	62.5	20,382	56.6	25.9	46.1	28.0	18.6	4.9	2.6	77.4	10.9	46.1	44.0	58.1	43.8
	-Machinery	2,121	31.2	14,826	41.2	29.1	40.1	30.9	19.9	5.8	2.9	79.3	13.7	52.6	51.6	62.4	47.6
(b) Purchases																	
1992	Manufacturing	1,463	56.3	3,384	43.3	37.9	48.4	13.7	8.1	1.6	0.0	78.2	4.2	42.7	50.2	47.7	-
	-Machinery	715	27.5	2,466	31.5	46.2	43.4	10.3	8.3	1.3	0.0	84.4	2.0	62.6	58.8	80.8	-
1995	Manufacturing	2,966	64.5	6,914	47.5	40.3	40.3	19.4	14.4	1.4	0.7	76.5	15.1	40.8	44.9	32.6	50.7
	-Machinery	1,428	31.0	5,479	37.6	29.3	43.3	27.5	18.6	4.7	2.7	76.2	9.3	53.6	54.3	59.1	46.3
1998	Manufacturing	3,835	61.7	7,502	49.3	35.1	43.3	21.6	18.6	1.5	0.6	58.7	7.1	44.9	47.0	44.7	31.6
	-Machinery	1,809	29.1	5,764	37.9	36.8	41.3	21.8	20.3	1.0	0.4	61.9	6.7	49.3	50.0	51.6	21.8
2001	Manufacturing	4,247	62.5	13,781	51.5	35.8	43.3	21.0	18.6	1.0	0.6	66.0	9.5	42.0	42.6	43.1	19.2
	-Machinery	2,121	31.2	10,417	38.9	38.0	40.3	21.7	20.2	0.7	0.3	69.9	10.1	46.4	45.4	64.7	41.3

Data source: Ando and Kimura (2009).

Table A.3 Intra-firm and arm's length transactions by Japanese machinery affiliates in East Asia

		East Asia				NIES4				ASEAN4				China			
		1992	1995	1998	2001	1992	1995	1998	2001	1992	1995	1998	2001	1992	1995	1998	2001
Number of affiliates		715	1,428	1,809	2,121	343	559	609	644	286	505	666	791	54	318	422	552
(a) Sales																	
Values (billion JPY)		5,202	9,080	8,485	14,826	2,770	4,140	3,429	5,213	2,125	4,100	3,300	6,399	114	549	1,242	2,427
By-destination sales ratio (%)																	
(i)	**Japan**	**17**	**21**	**29**	**29**	**19**	**21**	**30**	**31**	**15**	**22**	**38**	**30**	**40**	**25**	**20**	**30**
	Intra-firm	15	19	22	23	18	19	23	20	13	20	30	27	40	24	15	25
	Arm's length	2	2	7	6	1	2	7	10	2	2	8	4	0	1	6	5
(ii)	**Local**	**66**	**57**	**43**	**40**	**64**	**54**	**45**	**44**	**66**	**57**	**27**	**31**	**46**	**46**	**51**	**45**
	Intra-firm	5	11	4	5	4	8	5	5	7	17	4	7	0	2	3	4
	Arm's length	61	45	39	35	60	47	41	40	59	40	23	23	46	44	48	41
(iii)	**Other East Asia**	**9**	**13**	**19**	**20**	**10**	**13**	**16**	**14**	**10**	**12**	**23**	**25**	**11**	**24**	**23**	**18**
	Intra-firm	5	8	10	10	3	7	5	7	7	7	13	12	11	22	19	15
	Arm's length	4	5	9	10	7	6	11	8	2	5	10	13	0	2	4	4
(i+ii+iii)	**East Asia (total)**	**92**	**90**	**91**	**89**	**93**	**88**	**92**	**89**	**91**	**90**	**88**	**86**	**97**	**95**	**94**	**93**
	Intra-firm	25	38	36	39	25	33	33	32	27	44	47	46	51	49	37	44
	Arm's length	67	52	55	50	68	55	59	58	64	47	41	40	46	47	58	49
(b) Purchases																	
Values (billion JPY)		2,466	5,479	5,764	10,417	1,140	2,298	2,556	3,733	1,204	2,666	2,090	4,560	54	352	816	1,626
By-origin purchases ratio (%)																	
(i)	**Japan**	**46**	**44**	**37**	**38**	**47**	**39**	**41**	**40**	**44**	**49**	**35**	**36**	**76**	**50**	**35**	**38**
	Intra-firm	39	36	23	27	39	32	27	32	39	41	23	23	71	42	17	24
	Arm's length	7	9	14	11	9	7	14	8	5	8	12	13	5	8	17	14
(ii)	**Local**	**43**	**39**	**41**	**40**	**42**	**43**	**41**	**38**	**45**	**34**	**38**	**41**	**21**	**27**	**42**	**43**
	Intra-firm	1	6	3	4	1	5	3	3	1	7	3	5	5	7	2	3
	Arm's length	43	33	39	36	41	38	38	34	44	28	35	35	16	19	40	40
(iii)	**Other East Asia**	**8**	**15**	**20**	**20**	**10**	**16**	**17**	**21**	**8**	**15**	**24**	**22**	**2**	**22**	**22**	**18**
	Intra-firm	5	7	10	9	9	9	9	11	2	4	9	8	2	17	19	12
	Arm's length	3	8	10	11	1	7	9	10	6	10	15	14	0	4	3	6
(i+ii+iii)	**East Asia (total)**	**98**	**98**	**98**	**99**	**99**	**97**	**99**	**99**	**97**	**98**	**98**	**98**	**98**	**99**	**99**	**99**
	Intra-firm	45	49	36	40	48	46	38	46	42	52	36	36	78	67	38	39
	Arm's length	53	49	63	59	51	52	61	53	56	47	62	62	20	32	60	60

Data source: Ando and Kimura (2009).

Table A.4 Characteristics of manufacturing firms by the type of firms

	Manufacturing firms: all sized firms						Manufacturing SMEs					
	1998		2002		2007		1998		2002		2007	
The type of firms	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Firm size (log)												
No entry in East Asia	5.030	0.756	4.967	0.743	5.003	0.748	4.756	0.437	4.723	0.464	4.753	0.461
Expansion in East Asia	6.202	1.333	6.138	1.297	6.338	1.389	5.006	0.451	4.956	0.471	5.043	0.440
Steady in East Asia	5.874	1.052	5.561	0.932	5.690	1.016	5.019	0.448	4.938	0.457	4.961	0.453
Shrinkage in East Asia	6.452	1.451	5.985	1.335	6.267	1.343	4.936	0.429	4.898	0.496	5.030	0.466
Total	5.230	0.971	5.191	0.967	5.223	0.964	4.782	0.444	4.755	0.471	4.789	0.467
Capital-labor ratio (log)												
No entry in East Asia	1.848	1.164	1.864	1.115	1.827	1.174	1.816	1.167	1.855	1.079	1.830	1.121
Expansion in East Asia	2.221	0.770	2.341	0.836	2.267	0.957	1.957	0.787	2.078	0.873	1.842	1.031
Steady in East Asia	2.129	0.793	2.118	0.812	2.153	0.794	1.941	0.755	2.016	0.804	2.022	0.801
Shrinkage in East Asia	2.317	0.949	2.267	0.953	2.332	0.812	1.962	0.889	1.993	0.942	2.095	0.757
Total	1.913	1.116	1.956	1.071	1.917	1.117	1.830	1.133	1.883	1.051	1.856	1.085
Foreign sales ratio												
No entry in East Asia	0.020	0.085	0.019	0.079	0.023	0.089	0.017	0.081	0.018	0.077	0.022	0.087
Expansion in East Asia	0.110	0.166	0.113	0.170	0.137	0.196	0.079	0.156	0.087	0.149	0.090	0.162
Steady in East Asia	0.100	0.167	0.092	0.148	0.112	0.172	0.083	0.162	0.079	0.137	0.101	0.164
Shrinkage in East Asia	0.118	0.175	0.110	0.172	0.155	0.221	0.063	0.117	0.078	0.129	0.108	0.209
Total	0.036	0.111	0.039	0.111	0.047	0.127	0.024	0.093	0.027	0.092	0.034	0.108
In-house R&D ratio												
No entry in East Asia	0.005	0.015	0.005	0.016	0.004	0.015	0.005	0.013	0.004	0.016	0.004	0.016
Expansion in East Asia	0.022	0.028	0.023	0.030	0.022	0.030	0.012	0.022	0.013	0.024	0.010	0.020
Steady in East Asia	0.018	0.026	0.017	0.026	0.016	0.040	0.011	0.024	0.012	0.023	0.013	0.045
Shrinkage in East Asia	0.025	0.032	0.019	0.027	0.022	0.032	0.009	0.022	0.009	0.018	0.011	0.024
Total	0.010	0.022	0.010	0.023	0.009	0.025	0.006	0.018	0.007	0.019	0.007	0.022
Advertisement ratio												
No entry in East Asia	0.007	0.019	0.007	0.020	0.006	0.018	0.006	0.017	0.006	0.019	0.006	0.018
Expansion in East Asia	0.006	0.015	0.006	0.015	0.005	0.014	0.003	0.010	0.004	0.009	0.004	0.012
Steady in East Asia	0.006	0.017	0.005	0.014	0.004	0.014	0.004	0.009	0.004	0.009	0.004	0.015
Shrinkage in East Asia	0.009	0.022	0.006	0.014	0.007	0.016	0.006	0.024	0.004	0.007	0.004	0.011
Total	0.006	0.015	0.005	0.016	0.004	0.015	0.005	0.013	0.004	0.015	0.004	0.015
The relative size of HQ serivces (in terms of employment)												
No entry in East Asia	0.155	0.120	0.134	0.108	0.132	0.112	0.160	0.122	0.137	0.108	0.135	0.111
Expansion in East Asia	0.165	0.126	0.157	0.132	0.152	0.129	0.180	0.129	0.174	0.146	0.162	0.125
Steady in East Asia	0.162	0.123	0.158	0.126	0.158	0.129	0.164	0.125	0.162	0.127	0.170	0.137
Shrinkage in East Asia	0.148	0.118	0.158	0.120	0.166	0.149	0.162	0.129	0.174	0.124	0.167	0.145
Total	0.156	0.121	0.139	0.114	0.138	0.118	0.161	0.123	0.141	0.113	0.140	0.116
Average real labor productivity												
No entry in East Asia	7.6	4.3	6.8	4.4	9.0	8.1	7.0	3.6	6.6	4.1	8.7	8.1
Expansion in East Asia	8.9	4.6	8.8	5.3	13.2	10.7	7.4	4.3	7.1	3.8	10.2	9.9
Steady in East Asia	8.5	6.0	7.3	4.1	11.0	9.9	7.3	3.9	6.7	3.9	9.5	6.6
Shrinkage in East Asia	9.2	4.7	8.8	7.2	12.0	8.0	7.0	3.4	6.6	3.9	9.0	5.5
Total	7.6	4.3	7.1	4.6	9.6	8.6	7.0	3.7	6.6	4.1	8.8	8.0

Source: authors' calculation, based on METI database.

Table A.5 Production networking in East Asia and domestic operations for 1998-2002 and 2002-2006: manufacturing firms

	Dependent variable					
	(1)	(2)	(3)	(4)	(5)	(6)
	d. .employment	d. employment	d. establishment	d. affiliates	exports to E.Asia	imports from E.Asia
Independent variables	[logit]	[OLS]	[logit]	[logit]	[OLS]	[OLS]
a) Period: 1998-2002						
Constant	0.890 ***	0.201 ***	-2.962 ***	-4.023 ***	0.004	0.016 *
	(0.213)	(0.029)	(0.235)	(0.267)	(0.004)	(0.009)
Expansion in East Asia	0.356 ***	0.045 ***	0.033	0.642 ***	0.020 ***	0.026 ***
(incl. 1st FDI)	(0.084)	(0.012)	(0.091)	(0.095)	(0.002)	(0.003)
Firm size	-0.362 ***	-0.050 ***	0.254 ***	0.356 ***	0.000	0.000
	(0.028)	(0.004)	(0.028)	(0.033)	(0.001)	(0.001)
Capital-labor ratio	0.116 ***	0.009 ***	0.094 ***	0.142 ***	0.0000	0.000
	(0.026)	(0.003)	(0.030)	(0.038)	(0.001)	(0.001)
Foreign sales ratio	0.057	-0.045	-0.190	-0.087	0.047 ***	0.050 ***
	(0.229)	(0.031)	(0.255)	(0.293)	(0.005)	(0.009)
In-house R&D ratio	2.316 **	0.267	2.683 **	2.299	0.051 **	0.014
	(1.179)	(0.164)	(1.259)	(1.508)	(0.026)	(0.050)
Advertisement ratio	-0.219	0.226 ***	2.320	4.964 ***	-0.046	-0.004
	(1.486)	(0.207)	(1.510)	(1.640)	(0.032)	(0.062)
Foreign capital ratio	0.00040	0.00009 **	-0.00005	-0.00081 *	0.00001 **	0.00001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-5399		-4439	-3286		
Adj R2		0.034			0.050	0.019
Number of observations	8834	8834	8834	8834	8526	8154
b) Period: 2002-2006						
Constant	0.531 ***	0.119 ***	-2.638 ***	-4.861 ***	-0.004	0.030 ***
	(0.173)	(0.026)	(0.201)	(0.094)	(0.004)	(0.008)
Expansion in East Asia	0.554 ***	0.067 **	0.412 ***	0.796 ***	0.015 ***	0.033 ***
(incl. 1st FDI)	(0.078)	(0.011)	(0.082)	(0.094)	(0.002)	(0.004)
Firm size	-0.203 ***	-0.029 ***	0.230 ***	0.418 ***	0.001 *	-0.006 ***
	(0.028)	(0.004)	(0.031)	(0.038)	(0.001)	(0.001)
Capital-labor ratio	0.075 ***	0.019 ***	0.028	0.288 ***	0.000	0.002
	(0.028)	(0.004)	(0.033)	(0.047)	(0.001)	(0.001)
Foreign sales ratio	0.171	-0.033	-0.635 **	-0.100	-0.049 ***	0.002
	(0.239)	(0.035)	(0.282)	(0.326)	(0.006)	(0.011)
In-house R&D ratio	2.864 **	0.633 ***	1.181	2.302	0.115 ***	-0.007
	(1.262)	(0.183)	(1.392)	(1.655)	(0.032)	(0.060)
Advertisement ratio	-0.529	0.000	4.152 ***	4.160 **	-0.057	-0.016
	(1.479)	(0.221)	(1.553)	(1.725)	(0.040)	(0.070)
Foreign capital ratio	0.00355	-0.00002	-0.00438	-0.005	0.00017 ***	0.00049 ***
	(0.002)	(0.000)	(0.003)	(0.004)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-4857		-3875	-2549		
Adj R2		0.030			0.020	0.024
Number of observations	7281	7281	7281	7263	7003	6731

Source: Ando and Kimura (2011).

Notes: see Table 6.

Table A.6 Production networking in East Asia and domestic operations for 1998-2002 and 2002-2006: machinery firms

Independent variables	(1) d. .employment [logit]	(2) d. employment [OLS]	(3) d. establishment [logit]	(4) d. affiliates [logit]	(5) exports to E.Asia [OLS]	(6) imports from E.Asia [OLS]
a) Period: 1998-2002						
Constant	0.488 **	0.154 ***	-3.022 ***	-4.238 ***	0.001	0.007
	(0.224)	(0.028)	(0.240)	(0.285)	(0.006)	(0.010)
Expansion in East Asia	0.222 *	0.026 *	0.065	0.726 ***	0.023 ***	0.022 ***
(incl. 1st FDI)	(0.118)	(0.016)	(0.130)	(0.135)	(0.003)	(0.006)
Firm size	-0.316 ***	-0.042 ***	0.230 ***	0.314 ***	0.001	0.000
	(0.043)	(0.005)	(0.044)	(0.051)	(0.001)	(0.002)
Capital-labor ratio	0.205 **	0.015 ***	0.108 **	0.160 **	0.0007	0.000
	(0.043)	(0.005)	(0.052)	(0.067)	(0.001)	(0.002)
Foreign sales ratio	-0.187	-0.074 **	0.012 **	0.080	0.057 ***	0.064 ***
	(0.276)	(0.036)	(0.304)	(0.347)	(0.008)	(0.013)
In-house R&D ratio	2.499	0.114	2.454	3.457 *	0.053	-0.009
	(1.532)	(0.208)	(1.676)	(1.921)	(0.045)	(0.074)
Advertisement ratio	0.886	0.503	24.838 ***	17.850 **	-0.095	0.374
	(6.451)	(0.878)	(6.935)	(7.389)	(0.186)	(0.322)
Foreign capital ratio	0.00057	0.00006	-0.00001	-0.00065	0.00001	0.00000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Log likelihood	-2063		-1614	-1199		
Adj R2		0.022			0.046	0.018
Number of observations	3382	3382	3382	3382	3237	3106
b) Period: 2002-2006						
Constant	1.307 ***	0.168 ***	-2.338 ***	-4.821 ***	-0.007	0.042 ***
	(0.221)	(0.031)	(0.252)	(0.337)	(0.007)	(0.012)
Expansion in East Asia	0.627 ***	0.051 ***	0.663 ***	0.960 ***	0.018 ***	0.051 ***
(incl. 1st FDI)	(0.114)	(0.015)	(0.117)	(0.142)	(0.004)	(0.006)
Firm size	-0.245 ***	-0.026 ***	0.149 ***	0.332 ***	0.002	-0.008
	(0.042)	(0.006)	(0.047)	(0.059)	(0.001)	(0.002)
Capital-labor ratio	0.150 ***	0.025 ***	0.063	0.232 ***	0.002	0.002
	(0.044)	(0.006)	(0.055)	(0.085)	(0.001)	(0.002)
Foreign sales ratio	-0.038	-0.026	-0.522	0.186	-0.065 ***	0.003
	(0.275)	(0.039)	(0.324)	(0.377)	(0.010)	(0.016)
In-house R&D ratio	0.298	0.188	0.696	4.396 **	0.134 **	-0.004
	(1.602)	(0.228)	(1.791)	(2.116)	(0.055)	(0.092)
Advertisement ratio	-1.708	-1.440	24.309 ***	18.730 **	0.086	0.157
	(7.019)	(1.002)	(7.376)	(9.166)	(0.236)	(0.398)
Foreign capital ratio	-0.00299	-0.00064	-0.00349	-0.00709 **	0.00023 *	0.00094 ***
	(0.004)	(0.001)	(0.005)	(0.007)	(0.000)	(0.000)
Log likelihood	-1870		-1469	-898		
Adj R2		0.012			0.025	0.033
Number of observations	2807	2807	2807	2807	2673	2574

Source: Ando and Kimura (2011).

Notes: see Table 6.