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Keywords: FDI, Trade duration, intermediate goods, agglomeration

JEL classification: F14

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Stability of Complementarity between Japanese FDI and Import of Intermediate Goods: Agglomeration Effects and Parent-Firm Heterogeneity[♣]

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Abstract

This paper examines the duration of intermediate goods imports and its determinants for Japanese affiliates in China. Our estimations, using a unique parent-affiliate-transaction matched panel dataset for a discrete-time hazard model over the 2000–2006 period, reveal that products with a higher upstreamness index, differentiated goods, and goods traded under processing trade are less likely to be substituted with local procurement. Firms located in more agglomerated regions with more foreign affiliates tend to shorten the duration of imports from the home country. For parent-firm characteristics, multinational enterprises that have many foreign affiliates or longer foreign production experience import intermediate goods for a longer duration.

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1. Introduction

When China symbolically joined the world trading system by becoming a member of the World Trade Organization in 2001, Japanese firms dramatically increased their foreign direct investment (FDI) flows to China, surpassing its largest trade and investment partner, the US, by 2005. Not only large but also small- and medium-sized enterprises (SMEs) set up their plants in China. As Table 1 shows, the share of SMEs (with less than 300 employees) has steadily increased over the past few decades. Especially, the share of firms with less than 1,000 employees account for 48% of the firms that began investing after 2001. The relocation of SMEs, which employ a majority of Japanese labor force, to foreign countries including China has revived concerns of the hollowing out of the local economy in Japan.

[Insert table 1 approximately here]

The hollowing-out effect of FDIs has long been debated in international trade literature, often centering on whether FDIs are substitutes for or complements of exports. Brainard (1993, 1997) argues that FDIs and exports are substitutes because of the trade-off between proximity and concentration. When the production function is characterized by increasing returns to scale, a firm can benefit from lower costs by concentrating all its production in one plant, but it incurs trade costs such as transportation costs or import tariffs to serve foreign markets through exports. On the other hand, by setting up a plant in each market, a firm can save on trade costs, but it loses cost reductions through scale effects. Thus, this trade-off determines if a firm exports or invests to serve its foreign demand.

Complementarity may arise in a vertical production relationship. When an assembler company relocates its plant to a foreign country, the company that has supplied parts and components to the assembler firm now starts to export to the assembler firm's foreign plant. The same can be said for operations within the same firm. Specifically, when a firm "unbundles" its production stages and relocates a stage to a foreign country, the parent firm exports inputs (typically, parts and components) to its affiliate plant abroad. The recent development of supply chains has brought this type of FDI to the fore.

However, there are concerns that the complementary relationship between FDIs and export may not last long. First, as mentioned above, recent FDI flows to China have been mainly driven by SMEs. Many of these SMEs are single-product firms. Thus, if it is difficult for SMEs to “unbundle” their production stages, exports from the parent SMEs to their foreign affiliates may not increase. Second, FDI flows to China tend to concentrate on coastal areas, which mean multinational enterprise (MNE) affiliates in China have formed agglomerations in some coastal regions. Agglomerations of foreign firms may attract domestic suppliers that seek transactions with MNE affiliates. Therefore, once an agglomeration of suppliers develops, MNE affiliates may reduce imports of intermediate goods from the home country. Third, as Berdelbos et al. (2001) and Kiyota et al. (2008) demonstrate, MNE affiliates tend to increase local procurement as they accumulate experience in the local market. These results imply that imports from the home country may gradually become substituted with the passage of time. In other words, the choice between imports from the home country or purchases from local suppliers may also change over time. Thus, the complementary relationship should be examined from a dynamic perspective.

Pioneering works on dynamic trade relationships can be traced to Besedes and Prusa (2006a, 2006b). Employing survival analysis to a study of the duration of US imports, they find that the median duration of exporting a product to the US is very short, typically two to four years. They further examine the extent to which product differentiation affects the duration of the US import-trade relationship. Applying the Cox proportional hazard model to conduct empirical estimations, they estimate the hazard rate to be at least 23% higher for homogeneous goods than for differentiated products. Obashi (2010a) examines whether the duration of intermediate goods trade is longer than that of the usual transactions of goods within East Asia because of the relation-specific nature of the international fragmentation of production. A series of survival analyses provides evidence that the stability of international production networks is a particularly prominent feature of East Asia. In addition, East Asian countries are more likely to engage in long-lasting trade relationships of intermediate goods with each other than with outsiders. Obashi (2010b) conducts another similar study to examine the stability of international production networks in East Asia using highly disaggregated product-line data for intra-East Asian machinery trade. The survival analysis finds that compared with trade in finished products, trade in parts and components is longer lasting and more stable among East Asian countries. Shao et al. (2012) focus on China's manufacturing exports at the six-digit harmonized system (HS) code product from 1995 to 2007 to isolate the factors that affect export duration. Their results show that export durations tend to be rather short-lived. Crucially, the duration is longer for differentiated products and parts and components, highlighting the stability of intermediate goods trade resulting from international production fragmentation, as indicated by Obashi (2010a, 2010b).

Building on previous literature, we incorporate the FDI-trade nexus, which helps us better understand the hollowing-out effect of FDIs. More specifically, we study what kinds of firms are more likely to continue to import intermediate goods from the home country and what kind of intermediate goods imported from the home country are less likely to be substituted by local procurement, which are questions that could not be addressed by the product-level trade data used in previous studies. Thus, we construct a parent-affiliate-transaction matched panel dataset to explore these issues.

This paper is structured as follows. Section 2 describes the data source and demonstrates several important stylized facts about the dynamics of intermediate goods trade. Section 3 presents the empirical specifications. Section 4 analyzes estimation results. The final section summarizes our concluding remarks.

2. Data Sources

To estimate the stability of intermediate goods trade for affiliates in the East Asian production network and the roles played by agglomeration and parent-firm characteristics, this study focuses on intermediate goods trade between Japanese affiliates in China and their parent companies. To do this, we construct a unique parent-affiliate-transaction panel data, covering 1,007 Japanese affiliates in China from 2000 to 2006. This dataset is compiled from a number of sources—Japanese affiliates are drawn from China's Annual Survey of Industrial Firms (CASIF) and from the Overseas Japanese Companies Data from Toyo Keizai; firm-level trade data come from China Customs; and parent-firm information is from the Tokyo Shoko Research (TSR) database. This section describes how the dataset was constructed.

CASIF is conducted by the National Bureau of Statistics (NBS) and consists of the whole population of state-owned enterprises (SOEs) and non-state firms with sales above RMB 5 million, the so-called "scale-above" enterprises. It covered 162,885 firms in 2000 to 301,961 firms in 2006, with the surveyed firms accounting for nearly 88% of value-added in the manufacturing sector per year, on average. This dataset provides rich information in three parts: basic information such as company name, establishment date, industry code, and type of ownership; financial information related to financial statements; and production information such as sales, output, intermediate goods, and innovation activities. In the dataset, each firm reports its ownership type, viz., SOEs, private firms (POEs), and foreign-owned enterprises (FOEs).[1] Unfortunately, nationality information for FOEs is unavailable, preventing us from differentiating Japanese affiliates from those of other countries.

The second data source is the Toyo Keizai's Overseas Japanese Companies Data (Kaigai

[1] FOEs include Hong Kong, Macao, and Taiwan-owned firms (HMTs) and other foreign-owned firms.

Shinshutsu Kigyo Soran). Toyo Keizai's survey on outward FDIs primarily covers foreign subsidiaries with a 20% or higher Japanese ownership in principle and covers all industries. Crucially, Japanese foreign affiliates in China covered in this survey have information on their Chinese name and address, enabling us to link it to the CASIF database and thereby access the dataset of Japanese affiliates.

Using the aforementioned compiled dataset, we link to two more data sources. One is China Customs data. It contains detailed information on each transaction, including the eight-digit HS code of trading products, product unit, quantity, unit value of each eight-digit HS product, total value, type of ownership, origin, destination, and type of trade. As firm identification numbers are different in CASIF and Customs data, we use affiliates' Chinese names to match the two datasets for information on Japanese affiliates' imports of intermediate goods.

To consider the parent-firm characteristics, we use the TSR database. The TSR Data Bank is one of the largest databases compiled by a private company and records both listed and non-listed companies in Japan. It gives several facts on each firm, including the year of establishment, the paid-up capital, and the current number of employees. Almost all the firms are classified at the four-digit standard industrial classification (SIC) level.

3. Empirical Specification and Data Overview

3.1 Empirical Specification

The semi-parametric Cox proportional hazards model has been widely used (see Besedes and Prusa (2006a, 2006b), Brenton *et al*. (2010), and Obashi (2010a, 2010b)) to investigate the relationship between the duration of intermediate goods imports and its determinants. However, a recent study by Hess and Persson (2012) argues that the Cox model is inappropriate for analyzing the duration of a trade relationship. For example, given that trade duration refers to the number of years such a relationship continues, we observe many trade durations are of equal length. Hess and Persson (2012) argue that the many tided trade duration cause asymptotic bias in the estimated coefficients. Hess and Persson (2012) propose using a discrete-time hazard model instead of the continuous-time Cox proportional hazard model.

The estimation procedure in a discrete-time hazard model is as follows: let T_i be a continuous, non-negative random variable measuring the survival of intermediate goods imported from the parent country by affiliates of Japanese MNEs in China. In the discrete-time framework, the probability that an affiliate terminates its imports of intermediate goods in a given time interval k, conditional on its survival up to the beginning of the interval and explanatory variables, or the hazard rate, is

$$h_{ik} = P(T_i < t_{k+1} \mid T_i \geq t_k, X_{ik}) = F(X'_{ik}\beta + \gamma_k) \tag{1}$$

where X_{ik} is a vector of time-varying covariates while γ_k is a function of time that allows the hazard rate to vary across periods. As the underlying baseline hazard is unknown in practice, we incoporate γ_k into the model as a set of dummy variables, to identify the duration (the period dummy variables). $F(.)$ is an appropriate distribution function such that $0 \leq h_{ik} \leq 1$ for all i, k. The subscript i denotes a separate spell of intermediate goods imports. Introducing a binary variable, y_{ik}, equaling one if the spell i is observed to stop imports of intermediate goods during the k_{th} interval, Hess and Persson (2012) derive the log-likelihood for the observed data as follows:

$$\ln L = \sum_{i=1}^{n} \sum_{k=1}^{k_i} [y_{ik} \ln(h_{ik}) + (1 - y_{ik}) \ln(1 - h_{ik})] \tag{2}$$

It is similar to a standard log-likelihood function for a binary panel regression model. Assuming the functional form for the hazard rate to be normal, logistic, or extreme-value minimum distribution, it will lead to a probit, logit, or cloglog (complimentary log-log) model, respectively. The cloglog model with period-specific intercepts represents the exact grouped-duration analog of the Cox proportional hazard model (Hess and Persson, 2012).

The vector $\boldsymbol{X}$ for the hazard function (1) consists of three dimensions: affiliate and product characteristics, regional characteristics (agglomeration), and parent-firm characteristics. For affiliate characteristics, *Initial-value* is the initial size of the transaction, namely, the logarithm of intermediate-goods import value in the first year. It is expected to be associated with a negative coefficient, because a larger initial import is more difficult to be replaced with local procurement in the short term. Affiliate size (*Alabor*) is measured by the logarithm of the number of workers. A large affiliate generally needs a range of intermediate goods and some of them have to be imported, suggesting a longer duration. Thus, a negative coefficient is expected to be associated with this variable. The terms *Awage* and *KL-ratio* refer to the logarithm of the total wage bill per worker and the capital-to-labor ratio, respectively. The exporter dummy (*Export*) takes one if an affiliate engages in export. Most Japanese affiliates undertake process exports in China, suggesting they need to import intermediate goods, and this translates into a longer trade duration. Home dummy (*Home*) equals one if an affiliate shows a positive value for intermediate goods imported from Japan. As Japan is one of the world's leading countries in technology, their intermediate goods are difficult to be replaced with local supplies, meaning that trade with the home country should have a longer duration than that with other countries.

For product characteristics, we include two product dummies—one is *Diff*, which takes the value one if the products are categorized as differentiated goods, and zero otherwise. The definition of differentiated goods is as per Rauch's (1999) commodity classification. He classifies products traded on an organized exchange as "homogeneous goods" and products that are not sold on exchanges but whose benchmark prices exist, as "reference priced." We regard all other products as differentiated goods and expect them to be more likely to survive because differentiated goods boast more complex technologies and thus are less easily substitutable by local supplies. The other variable for product characteristics is the upstreamness index (*Upstream*). The concept of an upstreamness index was proposed by Antràs *et al*. (2012) and measures how far an industry is from final consumption. An industry whose output is used mostly as intermediate input for other industries is considered to be relatively upstream.[2] Since these products are required by other relatively upstream industries, they embody a higher degree of technological content. Again, it is less likely to be substituted with local procurement, leading to a longer trade duration.

Variables capturing regional characteristics are key variables for us. We consider three regional agglomeration variables. A narrowly defined agglomeration is the number of Japanese affiliates in the same industry in the same region or in the same province (*Agg-Jaffiliates*). Under conditions of high transportation costs, the products of Japanese affiliates, who are probably able to provide the same quality of intermediate goods, can replace the imported ones, leading to a negative influence on the duration of trade. Two more widely defined agglomeration variables are *Agg-foreign* and *Agg-local*, denoting the number of foreign affiliates (including Japanese affiliates) in the same industry in the same region or province, and the number of locals in the same industry in the same region or province. In a region with more foreign firms or local firms in the same industry or related industries, firms tend to exhibit a shorter life of imports of intermediate goods. We construct the agglomeration variables by industry and region or by industry and province. For regional

[2] For detailed definition of the upstreamness index, please see the supplemental appendix in Antràs *et al.* (2012).

characteristics, we divide regions in China into six groups, namely the Bohai economic zone, the Yangtze River Delta, the Pearl River Delta, the Central region, the Western region, and the Northwest region.

As for the effect of parent-firm characteristics on the duration of affiliates' intermediate goods imports, we include the size dummy of parent firm (*Plarge*) that equals one if the parent firm has 1,000 employees or more.[3] And to examine MNEs' own production networks, we also control the number of foreign affiliates in the world or in China that belong to the same parent firm (*Pnetwork* and *Pnetwork-China*) or the years of experience in forging production for each MNE (*Exper* and *Exper-China*). Table 2 summarizes variable definitions and basic statistics.

[Insert table 2 approximately here]

3.2 Data Overview

Before starting our econometric analysis, we provide a brief overview of the sample firms and their imports of intermediate goods. Table 3 illustrates the firm distribution across industries. Japan's FDI is very diversified given its investments in various industries, with a higher proportion concentrated in technology-intensive industries, mainly communication equipment, machinery, and electrical machinery, which together account for about 24.4% in terms of firm numbers (246 out of 1,007). Moreover, transportation equipment, machinery, and chemical firms also account for about 10% each (113, 126, and 100 out of 1,007). The paper and paper products industry has the lowest proportion, accounting for only 1.09% in terms of firm numbers.

[3] The legal definition of SMEs in Japan comprises those firms whose employees are 300 or more or whose paid-in capital is more than 3,000 million yen. However, we define large firms as those firms with more than 1,000 employees following the definition used in some labor statistics, such as the Census of Wage Structure by the Ministry of Health, Labor, and Welfare of Japan. The other reason is that the share of firms with fewer than 300 employees is quite limited. As shown in Table 1, it is little more than 20%. These results do not change even if we use a different threshold for the parent firms' number of employees, namely 300 or 500.

[Insert Table 3 approximately here]

As the survival analysis of intermediate goods imports is based at the firm-product level, the right two columns of Table 3 display the industrial distribution of observations. Among the 104,003 observations, 53,365 are related to communication equipment and the machinery and electrical machinery industries, accounting for 60.14% of the total, which is much higher than the corresponding proportion (34%) of firm numbers. It suggests a considerable difference in the range of intermediate goods a firm needs across industries.

Owing to the specific operational features across industries, the share of imported intermediate goods from home (*Home-IG*) in production cost also varies considerably. As indicated in Table 4, the apparel, communication equipment, basic metals, and precision instruments industries saw a higher ratio of home-IG. Conversely, the paper and paper products industry saw the lowest home-IG ratio of only 3.01% because its production process requires mainly raw materials rather than intermediate goods. Although many Japanese affiliates in China belong to the communication equipment industry and import a large variety of intermediate goods, as shown in Table 3, the share of intermediate goods in production costs is low, reaching an average of 6.59%.

[Insert Table 4 approximately here]

Table 5 shows the regional distribution of Japanese affiliates in China. Two things are noteworthy. First, almost all Japanese affiliates are located in the coastal areas—the Bohai economic zone, the Yangtze River Delta, and the Pearl River Delta area. These areas explain 95% of the regional distribution of Japanese affiliates in China. Second, of these coastal areas, the Yangtze River Delta area accounts for 50% of the Japanese affiliates. Moreover, 25% of the affiliates in China are located in Shanghai. These facts suggest that Japanese affiliates in China form a dense agglomeration in these areas.

[Insert Table 5 approximately here]

Table 6 compares product and affiliate characteristics by parent-firm size. As for product characteristics, while large firms show higher values for *Diff* and *Initial-value*, *Home*, *Upstream*, and *Process* are larger for SMEs, suggesting that SMEs in China import more "upstream" intermediate goods from Japan and engage more actively in process trading. Looking at affiliate characteristics, those owned by large firms are, on average, larger in terms of the number of employees, paying higher wages and having a higher K-L ratio. In contrast, affiliates owned by SMEs tend to be more active in export activities.

[Insert Table 6 approximately here]

4. Empirical Results

4.1 Baseline Model

What determines the duration of imported intermediate goods for Japan-owned enterprises in China? Based on product-level data of the eight-digit HS code, the results of estimations using the discrete-time hazard rate of a probit model are reported in Table 7. Column (1) shows benchmark models comprising product and affiliate characteristics. The estimates in columns (2)–(4) are results obtained by including both product and affiliate characteristics along with industry- or (and) province-fixed effects.

[Insert Table 7 approximately here]

As for the influence of product characteristics, some interesting findings are contained in the various estimations. The coefficient on the logarithm of import value of the initial period of each spell (*Initial-value*) is negative and significant in all specifications, suggesting that the larger the initial trade value, the longer is the duration of intermediate goods imports. This result is consistent with findings by Besedes and Prusa (2006a, 2006b) and Obashi (2010a, 2010b). Crucially, we find a significantly negative coefficient of the variable *Home*, indicating that if intermediate goods are imported from Japan, the trade relationship survives longer than in the case of imports from other countries. Japan is at the forefront of technology and possesses outstanding capability in producing many key components and parts. Thus, intermediate goods imported from Japan are not easily substitutable through local procurement and decay slower on the hazard rate.

The coefficient of *Diff* is negative and significant in all specifications. It means the traded goods' characteristics matter to the trade duration. The differentiated products (*Diff*) dominate other product types in their survival rates to last a longer period for Japanese affiliates. Moreover, as the estimated coefficient of *Upstream* is negative and significant in all specifications, it suggests that if an industry is located upstream across industries, i.e., selling a disproportionate share of their output to relatively upstream industries, its hazard rate is lower and has a longer duration of trade. The fragmentation of production across national boundaries is a distinctive feature in the Asian production network (Athukorala and Yamashita, 2006). Thus, production in developing countries entails the sourcing of inputs and components from multiple suppliers, particularly from home countries. That an industry's output is required by other relatively upstream industries implies a higher degree of technological content embodied in products, thereby making its replacement through local procurement difficult. The above findings are consistent with existing product-level studies, e.g., Besedes and Prusa (2006a, 2006b) and Obashi (2010a, 2010b). Another interesting phenomenon found is that if imported goods are used for process trading (*Process*), they experience a lower hazard rate; that is, they survive for longer. This result can be attributed to the specific export-promoting measure adopted by the Chinese government that allows firms undertaking process trade to enjoy zero tariffs on imported inputs. It induces exporters to continue importing intermediate goods for assembly exports.

Turning to affiliates' characteristics, which are not examined in extant literature, *Export* is negatively related to hazard rate. Why does an affiliate that is an exporter tend to import persistently more intermediate goods rather than its domestic market-oriented counterparts do? One possible reason is that exporters may need more imported intermediate goods given global production networks, whereas domestic, market-oriented Japanese affiliates may mainly use raw materials and inputs acquired from local suppliers. In particular, as discussed above, process exporters can waive the tariff and commodity tax on imports of intermediate goods, thereby showing a higher survival rate.

On the other hand, the variables *Alabor*, *Awage*, and *KL-ratio* show a significantly positive coefficient, suggesting that larger affiliates, which pay higher wages to employees and are more capital intensive, tend to show a shorter duration of imports of intermediate goods. Large and capital-intensive Japanese affiliates tend to establish local production networks and purchase inputs from local (China-owned or foreign-owned) suppliers, thereby experiencing a shorter duration of intermediate goods imports.

In columns (5) and (6), we employ various techniques of our discrete-time survival model to conduct our estimations. The estimates in columns (5), (6), and (7) are obtained using the cloglog model, the random-effect probit model, and the random-effect logit model. All estimates are very similar, suggesting the robustness of baseline results.

4.2 How Does Agglomeration Affect the Duration of Intermediate Goods Trade?

As mentioned earlier, the agglomeration of suppliers may affect the procurement pattern of Japanese affiliates because they can purchase intermediate goods locally if local suppliers, either local firms or other foreign affiliates, can supply qualified commodities. How does regional agglomeration affect the duration of intermediate goods trade? Table 8 reports the results by including various measures of the agglomeration variable and excluding the province fixed effect.

[Insert Table 8 approximately here]

Using the number of local firms within an industry and region (*Agg-local-r*) or within an industry and province (*Agg-local-p*) as measures of agglomeration, estimates in columns (1) and (5) show that the agglomeration variable has a positive and significant coefficient. Similarly, using sales of local firms to calculate the degree of agglomeration, the estimated coefficients of these two variables (*Agg-local-sls-r* and *Agg-local-sls-p*) are also significantly positive, as shown in columns (2) and (6). Recognizing the importance of innovation, China has been implementing various policies to encourage innovative activity since the late 1990s, aimed at transforming the economy into a knowledge-based one and at catching up to developed countries in technological capability.[4] With this technological upgrading in China, local firms can gradually produce qualified parts and provide them to MNE affiliates, including Japanese affiliates, in China. Thus, in a region (province) with more local firms in terms of numbers or sales, Japanese affiliates exhibit a higher hazard rate to stop importing intermediate goods.

Correspondingly, the procurement of intermediate goods for Japanese affiliates can come from other foreign affiliates in China. Using the number of foreign firms to measure the degree of agglomeration (*Agg-foreign-r* and *Agg-foreign-p*), estimates in columns (3) and (7) show that within a province with more foreign affiliates, Japanese affiliates located there tend to have a shorter duration of importing intermediate goods. This is because foreign affiliates overall have superior technological capability, and Japanese affiliates might acquire needed intermediate goods from other affiliates, thereby reducing imports. Similarly, for Japanese affiliates located in a region with many other Japanese-owned enterprises (A*gg-JAffiliates-r* and *Agg-Jaffiliates-p*), their imports of intermediate goods have a shorter period, as shown in columns (4) and (8). This finding is reasonable, because they may prefer to acquire intermediate inputs from other Japanese affiliates if available.

[4] China's R&D intensity (R&D expenditure to GDP ratio) has tripled from 0.57% in 1996 to 1.70% in 2009.

4.3 Does the Duration of the Trade of Intermediate Goods Differ According to Parent-Firm Size and Their Production Network?

In Table 9, we examine the impact of parent-firm characteristics. In column (1), we include the variable of parent-firm size *Plarge*. However, its impact is ambiguous because its coefficient is positive but insignificant. This result suggests that there are no statistically significant differences between large firms and SMEs when observable affiliate, product, and regional characteristics are controlled. However, recall that product and affiliate characteristics differ according to parent-firm size, as discussed in Table 6. For example, since the variables *Home*, *Upstream*, and *Process* all have negative and significant coefficients and SMEs have a higher value for these three variables, the trade duration for SMEs tends to be longer than those for large firms. Similarly, as confirmed in Table 6, affiliates owned by large firms are larger in terms of the number of workers, and have higher wages and K-L ratios. Additionally, these variables have positive coefficients and therefore the trade in intermediate goods for these affiliates is more likely to be short-lived.

Turning to variables for MNE production networks or the experience of foreign production, more striking results emerge, which are presented from column (2) to column (5) in Table 9. MNE production network variables, both *Pnetwork* and *Pnestwork-China*, are associated with a significantly positive coefficient, as shown in columns (2) and (3). Large Japanese MNEs such as Toyota and Hitachi have numerous foreign affiliates in China and other Southeast Asian countries to specialize in producing parts or in assembly work, and support the production needs of each other. Their affiliates in China thus substitute imported intermediate goods by procuring from other affiliates belonging to the same parent firm. Alternatively, Japanese affiliates owned by SMEs generally find it difficult to access their own production networks and continue to import needed intermediate goods from abroad, thereby showing a longer duration.

[Insert Table 9 approximately here]

Another parent-firm characteristic that potentially affects their affiliates' hazard rates of intermediate goods imports is FDI experience. Variables *Exper* and *Exper-China* shown in columns (4) and (5) denote years of experience of foreign production and years of experience of production in China by a parent firm, respectively. We find that for parent firms with more FDI experience, their affiliates in China tend to exhibit a shorter period of importing intermediate goods; that is, there is a higher hazard rate. This is probably because MNEs learn more about local or foreign suppliers as their experience of foreign production increases. Firms that have longer years of foreign production experience are more likely to substitute imports of intermediate goods with local procurement.

In sum, parent-firm size itself does not affect the duration of imports of intermediate goods when observable characteristics are controlled. However, considering their imported product characteristics and their affiliate characteristics, SMEs engage in long-duration trade of intermediate goods. Furthermore, firms with their own large production networks and longer experience of foreign production induce decreases in imports of intermediate goods. Since SMEs usually have just a few foreign affiliates and their experience of foreign production is limited, their trade duration might be shorter than that of large firms. This fact implies the trade in intermediate goods from Japan to China will continue to increase considering the fact that recent FDI is mainly driven by SMEs.

5. Concluding Remarks

The concern regarding the hollowing out of the domestic economy by outward FDI flows has re-emerged in Japan, with both large and small firms relocating their plants to China since the late 1990s, in line with the development of global production fragmentation. This paper provides some facts for better debate on this issue and, from a dynamic perspective, analyzes the duration of intermediate goods trade when it is accompanied by an increase in FDIs, using a unique parent-firm-affiliate-product level dataset for the 2000–2006 period.

The paper examines determinants of the duration of intermediate goods imports for

Japanese affiliates in China by focusing on the roles of products, affiliates, or parent-firm characteristics and agglomerations. Estimates obtained from the discrete-time hazard model show that intermediate goods, such as differentiated goods and products that belong to upstream industries, survive a longer time, which is consistent with previous studies. Intermediate goods imported from Japan have a stronger impact on lowering the hazard rate, suggesting they contain sophisticated technologies and are thus less easily substitutable locally. Using various measures of agglomeration indicators, we consistently find a positive relationship between agglomeration and the hazard rate of intermediate goods imports. The association of the size of parent firms in terms of the number of employees with the duration is not statistically significant, whereas SME affiliates and the characteristics of traded products imply that SMEs tend to engage in longer trade relationships. Moreover, parent firms' foreign production networks and their longer foreign production experience are found to reduce the duration. These findings also suggest that SMEs, which have a small number of workers by definition and usually do not have foreign production networks, tend to continue importing intermediate goods from the home country.

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Table 1 Distribution of entry year of Japanese affiliates by parent-firm size

	Entry year			
# of employees	-1990	1991-1995	1996-2000	2001-
-299	14.1%	19.0%	18.1%	23.1%
300-499	6.7%	8.3%	8.1%	10.1%
500-999	11.3%	12.0%	12.0%	14.5%
1000-2999	23.2%	22.3%	22.0%	23.7%
3000-	44.7%	38.5%	39.7%	28.6%
Total	100%	100%	100%	100%

Source: Authors' calculation

Table 2 Variable definitions and basic statistics

Variable	N	Mean	Stan. Dev.	p25	p75	Definition
Product characteristics						
Initial-value	103995	7.80	2.56	6.06	9.58	Initital traded value in each span
Home	103995	0.73	0.44	0.00	1.00	Dummy variable for imported goods from home
Diff	103995	0.70	0.46	0.00	1.00	Dummy variable for differentiated goods (Rauch's classification)
Upstream	103995	2.52	0.65	2.14	2.95	
Process	103995	0.58	0.49	0.00	1.00	Dummy variable for imported goods under process trading
Affiliate characteristics						
Export	103995	0.94	0.24	1.00	1.00	Exported dummy
Alabor	103995	6.59	1.30	5.65	7.53	logged numher of employees for affiliates
Awage	103995	3.09	0.55	2.74	3.41	logged average wage for affiliates
KL-ratio	103995	4.78	1.10	4.06	5.53	Capital-Labor ratio
Regional characteristics						
Agg-local-r	103995	7.48	0.75	6.93	7.92	# of local firms by industry and region
Agg-local-p	103995	6.27	0.99	5.52	7.02	# of local firms by industry and province
Agg-local-sls-r	103995	18.67	0.91	18.04	19.47	logged local firms' sales by industry and region
Agg-local-sls-p	103995	17.38	1.30	16.59	18.33	logged local firms' sales by industry and province
Agg-foreign-r	103995	5.85	0.77	5.45	6.41	# of foreign firms by industry and region
Agg-foreign-p	103995	4.80	0.95	4.19	5.53	# of foreign firms by industry and province
Agg-Jaffiliates-r	103995	7.21	1.12	6.63	8.04	# of Japanese firms by industry and region
Agg-Jaffiliates-p	103995	6.39	1.17	5.77	7.26	# of Japanese firms by industry and province
Parent firm characteristics						
Plarge	103995	0.64	0.48	0.00	1.00	Dummy variable for parent firms with more than 1000 emp
Pnetwork	97314	41.61	56.49	7.00	48.00	# of foreign affiliates beloinging to the same parent firm
Pnetwork-China	97314	6.26	8.08	1.00	7.00	# of affiliates in China beloinging to the same parent firm
Exper	97258	30.22	13.01	21.00	40.00	experience year of foreign production at parent firm
Exper-China	93794	9.54	3.88	7.00	12.00	experience year of production in China at parent firm

Note: Numbers in parentheses are standard deviation. The means and standard deviation are calculated by pooling the 2000–2006 data.

Table 3 Industrial distribution of Japanese affiliates in China

Industry	# of firms	Percent	# of trade transaction tie	Percent
15. Food	50	4.97	963	0.93
17. Textiles	43	4.27	1,779	1.71
18. Apparel	61	6.06	5,352	5.15
21. Paper and paper products	11	1.09	389	0.37
24. Chemicals	100	9.93	5,142	4.94
25. rubber and plastics	87	8.64	3,895	3.75
26. Non-metallic mineral products	25	2.48	2,326	2.24
27. Basic metals	31	3.08	1,215	1.17
28. fabricated metal products	37	3.67	1,523	1.47
29. Machinery	126	12.51	9,186	8.83
31. Electrical machinery	121	12.02	17,730	17.05
32. Communication equipment	125	12.41	35,635	34.26
33. Precision instruments	49	4.87	7,008	6.74
34. Transportation equipment	113	11.22	9,916	9.53
36. Other Manufacturing	28	2.78	1,936	1.86
Total	1,007	100	103,995	100

Source: Authors' calculation

Table 4 Share of intermediate goods imported from Japan

Industry/year	2000	2001	2002	2003	2004	2005	2006	Average
Food	2.3%	4.8%	4.2%	3.2%	3.3%	3.8%	1.6%	3.3%
Textiles	3.1%	3.0%	4.6%	3.6%	3.4%	2.6%	2.7%	3.3%
Apparel	8.4%	12.1%	10.6%	12.2%	16.3%	11.7%	10.6%	11.7%
Paper and paper products	1.9%	4.7%	2.4%	4.6%	3.1%	2.3%	2.2%	3.0%
Chemicals	2.6%	3.5%	5.3%	5.7%	6.0%	5.0%	4.4%	4.6%
rubber and plastics	2.9%	3.7%	5.4%	6.4%	6.1%	3.5%	3.7%	4.5%
Non-metallic mineral products	2.4%	3.0%	3.6%	5.4%	4.0%	2.6%	2.7%	3.4%
Basic metals	2.8%	7.1%	6.7%	6.3%	7.1%	4.9%	5.1%	5.7%
fabricated metal products	4.0%	4.3%	5.1%	5.7%	5.7%	5.9%	4.8%	5.1%
Machinery	2.8%	4.2%	3.9%	4.7%	4.9%	3.3%	3.7%	3.9%
Electrical machinery	4.6%	5.3%	5.9%	6.4%	4.6%	3.9%	3.3%	4.9%
Communication equipment	5.4%	7.3%	7.2%	7.4%	7.7%	5.9%	5.3%	6.6%
Precision instruments	4.2%	7.3%	5.1%	6.0%	5.9%	4.6%	4.2%	5.3%
Transportation equipment	2.7%	4.1%	4.4%	5.2%	4.6%	4.1%	3.9%	4.2%
Other Manufacturing	1.7%	3.4%	3.8%	4.5%	3.7%	4.1%	3.7%	3.5%
All Manufacturing	3.9%	5.7%	5.7%	6.2%	6.2%	4.9%	4.4%	5.3%

Source: Authors' calculation

Table 5 Regional distribution of Japanese affiliates in China

1 Bohai economic zone	
11 Beijing	42
12 Tenjing	73
13 Hebei	17
21 Liaoning	76
37 Shandong	65
Subtotal	273
2 Yangtze River Delta	
31 Shang Hai	256
32 Jiangsu	171
33 Zhejiang	60
Subtotal	487
3 Perl River Delta	
35 Fujian	25
44 Guangdong	173
Subtotal	198
4 Central region	20
5 West region	24
6 North East region	5
Total	1007

Source: Authors' calculation

Table 6 Product and affiliate characteristics by parent-firm size

	Total	N=103995	SME	N=37077	Large firms	N=66918
	Mean	SD	Mean	SD	Mean	SD
Diff	0.70	0.46	0.69	0.46	0.71	0.46
Home	0.73	0.44	0.76	0.43	0.71	0.45
Initial-value	7.80	2.56	7.60	2.52	7.91	2.58
Upstream	2.52	0.65	2.54	0.64	2.51	0.66
Process	0.58	0.49	0.66	0.47	0.54	0.50

	Total	N=1007	SME	N=497	Large firms	N=510
	Mean	SD	Mean	SD	Mean	SD
Export	0.82	0.38	0.86	0.34	0.78	0.42
Export-home	0.69	0.46	0.75	0.43	0.63	0.48
Alabor	5.42	1.21	5.16	1.12	5.67	1.24
Awage	3.13	0.58	2.99	0.56	3.27	0.56
Aoutput	6.83	1.46	6.25	1.20	7.38	1.47
KL-ratio	5.05	1.16	4.72	1.13	5.38	1.10

Source: Authors' calculation

Table 7 Survival of intermediate goods imports for Japanese affiliates in China

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation method	Probit	Probit	Probit	Probit	cloglog	Random effect Probit	Random effect Logit
Initial-value	-0.0356***	-0.0363***	-0.0360***	-0.0367***	-0.0362***	-0.1167***	-0.1936***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0005)	(0.0022)	(0.0039)
Home	-0.0667***	-0.0649***	-0.0629***	-0.0632***	-0.0619***	-0.2031***	-0.3365***
	(0.0033)	(0.0033)	(0.0034)	(0.0034)	(0.0034)	(0.0112)	(0.0187)
Diff	-0.0274***	-0.0203***	-0.0269***	-0.0207***	-0.0176***	-0.0649***	-0.1090***
	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0106)	(0.0177)
Upstream	-0.0639***	-0.0677***	-0.0638***	-0.0673***	-0.0663***	-0.2171***	-0.3606***
	(0.0023)	(0.0024)	(0.0023)	(0.0024)	(0.0023)	(0.0080)	(0.0135)
Process	-0.0618***	-0.0612***	-0.0635***	-0.0615***	-0.0609***	-0.1962***	-0.3249***
	(0.0031)	(0.0031)	(0.0032)	(0.0032)	(0.0031)	(0.0104)	(0.0173)
Export	-0.0153**	-0.0003	-0.0162**	0.0008	0.0007	-0.0047	-0.0076
	(0.0063)	(0.0064)	(0.0065)	(0.0066)	(0.0062)	(0.0205)	(0.0341)
Alabor	-0.0014	0.0060***	-0.0003	0.0085***	0.0076***	0.0244***	0.0414***
	(0.0012)	(0.0014)	(0.0013)	(0.0015)	(0.0014)	(0.0046)	(0.0076)
Awage	0.0177***	0.0192***	0.0120***	0.0127***	0.0119***	0.0362***	0.0617***
	(0.0029)	(0.0030)	(0.0030)	(0.0031)	(0.0030)	(0.0096)	(0.0160)
KL-ratio	0.0276***	0.0230***	0.0295***	0.0237***	0.0227***	0.0760***	0.1254***
	(0.0015)	(0.0016)	(0.0016)	(0.0017)	(0.0017)	(0.0055)	(0.0091)
$ln\sigma$						-2.0093***	-1.0268***
						(0.1192)	(0.1251)
Observations	103,995	103,957	103,995	103,957	103,995	103,995	103,995
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes	Yes	Yes	Yes
Province FE	No	No	Yes	Yes	Yes	Yes	Yes
log LL	-64073	-63543	-63911	-63380	-63331	-63331	-63336
Pseudo P	0.0934	0.101	0.0957	0.103			

Note: Marginal effects at mean-level are presented in this table. Figures in parentheses are standard errors. *** represents statistically significant at the 1% level.

Table 8 Agglomeration and duration of intermediate goods imports

	(1)	(2)	(3)	(4)
Initial-value	-0.0362***	-0.0362***	-0.0362***	-0.0362***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Home	-0.0644***	-0.0636***	-0.0650***	-0.0657***
	(0.0033)	(0.0034)	(0.0033)	(0.0033)
Diff	-0.0203***	-0.0201***	-0.0202***	-0.0203***
	(0.0033)	(0.0033)	(0.0033)	(0.0033)
Upstream	-0.0677***	-0.0677***	-0.0676***	-0.0675***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
Process	-0.0617***	-0.0616***	-0.0613***	-0.0614***
	(0.0031)	(0.0031)	(0.0031)	(0.0031)
Export	-0.0017	-0.0019	-0.0032	-0.0039
	(0.0064)	(0.0064)	(0.0065)	(0.0065)
Alabor	0.0063***	0.0058***	0.0062***	0.0059***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Awage	0.0169***	0.0167***	0.0169***	0.0173***
	(0.0030)	(0.0030)	(0.0030)	(0.0030)
KL-ratio	0.0231***	0.0234***	0.0228***	0.0226***
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
Agg-local-r	0.0113***			
	(0.0028)			
Agg-local-sls-r		0.0112***		
		(0.0023)		
Agg-foreign-r			0.0118***	
			(0.0028)	
Agg-Jaffiliates-r				0.0132***
				(0.0025)
Observations	103,957	103,957	103,957	103,957
Period FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Province FE	No	No	No	No
log LL	-63535	-63531	-63534	-63529
Pseudo P	0.101	0.101	0.101	0.101

Note: Marginal effects at mean-level are presented in this table. Figures in parentheses are standard errors. *** represent statistically significant at the 1% level.

Table 8 Agglomeration and duration of intermediate goods imports, cont.

	(5)	(6)	(7)	(8)
Initial-value	-0.0363***	-0.0363***	-0.0363***	-0.0363***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Home	-0.0642***	-0.0623***	-0.0638***	-0.0649***
	(0.0034)	(0.0034)	(0.0034)	(0.0033)
Diff	-0.0202***	-0.0199***	-0.0201***	-0.0203***
	(0.0033)	(0.0033)	(0.0033)	(0.0033)
Upstream	-0.0677***	-0.0678***	-0.0678***	-0.0677***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
Process	-0.0617***	-0.0626***	-0.0621***	-0.0611***
	(0.0032)	(0.0032)	(0.0032)	(0.0032)
Export	-0.0010	-0.0023	-0.0024	-0.0001
	(0.0065)	(0.0064)	(0.0065)	(0.0065)
Alabor	0.0060***	0.0056***	0.0060***	0.0061***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Awage	0.0188***	0.0174***	0.0180***	0.0194***
	(0.0030)	(0.0030)	(0.0030)	(0.0030)
KL-ratio	0.0233***	0.0242***	0.0234***	0.0230***
	(0.0016)	(0.0017)	(0.0016)	(0.0016)
Agg-local-p	0.0027			
	(0.0017)			
Agg-local-sls-p		0.0070***		
		(0.0013)		
Agg-foreign-p			0.0066***	
			(0.0018)	
Agg-Jaffiliates-p				-0.0007
				(0.0019)
Observations	103,957	103,957	103,957	103,957
Period FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Province FE	No	No	No	No
log LL	-63542	-63529	-63537	-63543
Pseudo P	0.101	0.101	0.101	0.101

Note: Marginal effects at mean-level are presented in this table. Figures in parentheses are standard errors. *** represent statistically significant at the 1% level.

Table 9 Impact of the parent-firm characteristics

	(1)	(2)	(3)	(4)	(5)
Initial-value	-0.0368***	-0.0365***	-0.0363***	-0.0365***	-0.0366***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Home	-0.0635***	-0.0606***	-0.0591***	-0.0612***	-0.0594***
	(0.0035)	(0.0036)	(0.0036)	(0.0036)	(0.0036)
Diff	-0.0209***	-0.0203***	-0.0202***	-0.0202***	-0.0194***
	(0.0033)	(0.0034)	(0.0034)	(0.0034)	(0.0035)
Upstream	-0.0673***	-0.0667***	-0.0664***	-0.0668***	-0.0664***
	(0.0024)	(0.0025)	(0.0025)	(0.0025)	(0.0025)
Process	-0.0614***	-0.0617***	-0.0615***	-0.0617***	-0.0596***
	(0.0032)	(0.0033)	(0.0033)	(0.0033)	(0.0034)
Export	0.0015	-0.0004	0.0009	-0.0010	0.0047
	(0.0066)	(0.0069)	(0.0068)	(0.0069)	(0.0072)
Alabor	0.0077***	0.0101***	0.0087***	0.0105***	0.0053***
	(0.0015)	(0.0016)	(0.0016)	(0.0016)	(0.0017)
Awage	0.0125***	0.0087***	0.0091***	0.0078**	0.0034
	(0.0032)	(0.0033)	(0.0033)	(0.0033)	(0.0034)
KL-ratio	0.0227***	0.0228***	0.0232***	0.0228***	0.0236***
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0019)
Agg-local-r	-0.0075**	-0.0113***	-0.0133***	-0.0133***	-0.0223***
	(0.0036)	(0.0038)	(0.0038)	(0.0038)	(0.0040)
Plarge	0.0055	0.0001	-0.0038	-0.0001	0.0085**
	(0.0035)	(0.0040)	(0.0043)	(0.0039)	(0.0038)
Pnetwork		0.0002***			
		(0.0000)			
Pnetwork-China			0.0010***		
			(0.0002)		
Exper				0.0016***	
				(0.0002)	
Exper-China					0.0044***
					(0.0005)
Observations	103,957	97,276	97,220	97,276	93,762
Period FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
log LL	-63376	-59272	-59236	-59263	-57294
Pseudo P	0.103	0.104	0.104	0.104	0.104

Note: Marginal effects at mean-level are presented in this table. Figures in parentheses are standard errors. *** and ** represent statistically significant at the 1% and 5% levels, respectively.