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Exchange Rates and Intra- and Inter-Firm Trade in Japan*

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Abstract

This study examines the effects of exchange rate changes on intra- and inter-firm trade using a rich, firm-level dataset of the Japanese manufacturing sector during the period 2009-2015. We estimate trade between overseas affiliates of Japanese manufacturing firms and their parent firms and other firms in Japan by applying the Poisson pseudo maximum likelihood method to firm level export and import data. Our results reveal that export from Japanese-affiliated overseas firms to Japan is not sensitive to exchange rate changes. This applies for both intra- and inter-firm transactions. On the other hand, exchange rate changes affect the import behavior of overseas affiliates from their parent firms and other firms in Japan. Appreciation in the value of the yen increases exports from the parent firms to their overseas affiliates, while decreasing exports from other firms in Japan to those overseas affiliates.

Keywords: Exchange Rate Changes, Intra- and Inter-Firm Trade, Invoice Currency, Supply Chain Networks
JEL Classification Code: F14, F31, L11

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1. Introduction

Exchange rates have been examined by businesspeople, economists, and policy makers for a long period of time. In particular, the effects of exchange rate changes on trade have been discussed in many countries[1]. Japan is not an exception. Exchange rate policy has been a major issue in economic policies since the 1970s and an appreciation of the Japanese yen is thought to trigger structural changes in the Japanese manufacturing sectors[2]. The Plaza accord in 1985 encouraged Japanese manufacturing firms to shift their factories to other Asian countries. More recently, many Japanese multinational enterprises (MNEs) have formed sophisticated supply chain networks covering Northeast and Southeast Asia, to mitigate exchange rate shocks and make their production processes more efficient[3]. This trend has led to discussion about the resilience of the Japanese MNEs against dramatic appreciation of the yen. Some observers insisted that a skyrocketing appreciation of the yen during the recent global financial crisis seriously harmed the Japanese export sectors. Conversely, other observers stated that their supply chain networks absorbed the shocks of this appreciation of the yen to some extent, so the damage was less serious than when the yen dramatically appreciated in the mid-1990s[4].

Many studies empirically examine this issue. For example, Thorbecke and Kato (2012) focus on Japan's consumption exports and find that an appreciation of the yen statistically significantly reduces those exports. On the other hand, Kato (2015) shows that Japan's exports of the medium skill and technology intensive manufacturing products are not statistically significantly affected by bilateral exchange rate changes or

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[1] For example, Ilhan, O. (2006).

[2] Belke and Volz (2018).

[3] Ando and Kimura (2005).

[4] Morikawa (2012).

competitors' exchange rate changes. Notably, these products are the largest components of Japan's exports. More recently, The Bank of Japan (BOJ) reports that the impact of exchange rate changes on real export has declined because "exports of the Japanese firms have shifted to higher value-added goods and thus, they are less likely to get involved in price competition to maintain their market shares[5]."

This study also provides additional statistical evidence for this issue. We use firm-level data and examine the effects of exchange rate changes on intra-firm trade as well as inter-firm trade. Trade data of overseas affiliates of the Japanese manufacturing firms allow us to divide their trade with Japan into two forms; trade with their parent firms (intra-firm trade) and other firms in Japan (inter-firm trade). This is because intra-firm trade has gained importance as the global value chains of Japanese MNEs have developed[6]. In addition, Japanese MNEs possibly use different strategies (e.g., in terms of their selection of the invoice currency between intra- and inter-firm trade) to reduce transaction costs and exchange rate risks[7]. They may use the yen as a major invoice currency in intra-firm trade while they possibly use the trading partner's local currency or US dollars (USD) in inter-firm trade.

Until now, few studies have examined the effects of exchange rate changes on trade at the firm-level[8]. Moreover, few studies empirically analyze the relations between intra-firm trade and exchange rate changes. This is partly because trade data availability at the firm-level is poor. Firm survey data rarely separate intra and inter-firm trade unlike the data which we use. For Japan, Ando and Kimura (2013) investigate how the Japanese

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[5] The Bank of Japan (2018).

[6] Lanz and Miroudot (2011).

[7] Ito et al. (2019).

[8] For example, Berman et al. (2012), Guillou (2008), and Kato (2016).

manufacturing MNEs adjust to exchange rate changes and find that intra-firm exports are more responsive to exchange rate changes. Song (2015) examines the responsiveness of Korean MNEs to changes in external environments. This study focuses on the relationships between firm-level trade and exchange rate changes in the framework of supply chain networks, which differentiates this study from preceding studies. This analysis has implications for the further development of theoretical models. Specifically, it is advocated that a risk management process should be incorporated in a heterogeneous firm model to account for exchange rate fluctuations. This will enable more reliable trade policies to be devised.

The remainder of the paper is structured as follows. In the next section, we describe the methodology that we use and detail our data. Section 3 discusses our empirical results and the last section gives a concluding remark.

2. Methodology and Data

This section describes our empirical model and data. We apply a gravity model to data of overseas affiliates of the Japanese manufacturing firms and estimate the effects of exchange rate changes on both intra- and inter-firm trade, following many existing studies on trade[9]. The gravity model describes how bilateral trade is positively correlated with the magnitude of the market sizes of two countries and negatively correlated with the distance between them[10]. In our model, we include bilateral exchange rates to examine the impacts of exchange rate changes on trade between overseas affiliates of Japanese manufacturing firms. In addition, the model includes several characteristics of overseas

[9] For example, Urata and Okabe (2014).

[10] Urata and Kato (2017).

affiliates as control variables because affiliate characteristics vary considerably and this can be expected to have a significant impact on their trade behavior. We examine trade between overseas affiliates of the Japanese firms and their parent firms as well as between overseas affiliates and non-parent Japanese firms to compare intra- and inter-firm trade. We also examine export and import separately to identify the effects of exchange rate changes on selling and procurement behavior. Our estimation models are, therefore, represented as follows:

$$\text{export}_t = \beta_0 + \beta_1 lnM_{it} + \beta_2 lnM_{jt} + \beta_3 lnDistance_{ij} + \beta_4 lnEXR_{ijt} + \sum_{h=1}^{n} \delta_h X_{ht} + \lambda lnEXR_{ijt} \cdot F + \theta lnEXR_{ijt} \cdot LP_t + u_t \quad (1),$$

$$\text{export}_t = \beta_0 + \beta_1 lnM_{it} + \beta_2 lnM'_{jt} + \beta_3 lnDistance_{ij} + \beta_4 lnEXR_{ijt} + \sum_{h=1}^{n} \delta_h X_{ht} + \lambda lnEXR_{ijt} \cdot F + \theta lnEXR_{ijt} \cdot LP_t + u_t \quad (1)'$$

$$\text{import}_t = \gamma_0 + \gamma_1 lnM_{it} + \gamma_2 lnM_{jt} + \gamma_3 lnDistance_{ij} + \gamma_4 lnEXR_{ijt} + \sum_{h=1}^{n} \rho_h X_{ht} + \lambda lnEXR_{ijt} \cdot F + \vartheta lnEXR_{ijt} \cdot LS_t + v_t \quad (2),$$

$$\text{import}_t = \gamma_0 + \gamma_1 lnM_{it} + \gamma_2 lnM'_{jt} + \gamma_3 lnDistance_{ij} + \gamma_4 lnEXR_{ijt} + \sum_{h=1}^{n} \rho_h X_{ht} + \lambda lnEXR_{ijt} \cdot F + \vartheta lnEXR_{ijt} \cdot LS_t + v_t \quad (2)',$$

where EXR is the exchange rate index. An increase of this index means an appreciation of the yen and vice versa. Subscripts i and j denote the country where the overseas affiliates are located and Japan, respectively. In many gravity models, the respective GDP of the bilaterally trading countries are used as a proxy for the market size. However, in

this study, M_i represents the total sales of overseas affiliates. This is because overseas affiliates of the Japanese firms are thought to have various roles in the supply chain networks. Some of them sell their products to local customers while some re-export their products to other countries. Their markets are, therefore, not always restricted to where they are located. M_j and M_j' represent total sales of the parent firms in the intra-firm regression and Japan's GDP specific to the corresponding industry in the inter-firm trade regression, respectively. X represents the set of control variables including the age, size and status dummy variable of overseas affiliates. The status dummy is 1 if the affiliate is a first-generation subsidiary and zero otherwise[11]. Industry dummies are also included to control for industry specific factors. In addition, we examine if the effects of exchange rate changes vary between the stages of supply chains using interaction terms between EXR and other variables. Namely, F is the finished goods dummy and LP and LS denote local procurement / total procurement and local sales / total sales, respectively. A low LP/LS means that the overseas affiliate is in the intermediate process in the network. The interaction term between EXR and F is reflects the difference in exchange rate pass-through between finished and intermediate products.

In the estimation, we apply the Poisson pseudo maximum likelihood method (PPML) developed by Santos and Silvana (2006). We start from the assumption that the appreciation of the yen increases imports to Japan and vice versa. We, therefore, expect the coefficient on EXR to be positive eq. (1) (export of overseas affiliates to Japan = import to Japan) and we expect the coefficient on EXR to be negative in eq. (2) (import

[11] The first-generation subsidiary is the firm that the parent firm has more than 50% of the voting rights. Our data includes the first-generation subsidiaries and the subsidiaries of subsidiaries.

of overseas affiliates from Japan = export of Japan). We expect that the market sizes are positively correlated with trade but negatively correlated with the distance in accordance with the standard understandings of a gravity model. For control variables, the size and status of overseas affiliates are expected to have positive coefficient estimates because large and first-generation subsidiaries are thought to have relatively stronger ties with their parent firms than smaller and/or second-generation subsidiaries. On the other hand, we expect that the age coefficient is negatively estimated because the longer overseas affiliates operate as a business, the more they are likely to become localized. The interaction term between the finished goods dummy and EXR is expected to have the same sign as that of EXR because finished goods seem to be more responsive to exchange rate changes. We expect that the interaction terms between local to total procurements (sales) and the exchange rates are positively (negatively) estimated because the higher weights of the local markets in their trade activities with Japan are usually thought to indicate that their products are more sensitive to the price changes between Japan and the local markets.

Our data of overseas affiliates of the Japanese manufacturing firms and their parent firms are obtained from the Basic Survey on Overseas Business Activities compiled by the Ministry of Economy, Trade and Industry (METI). This survey provides data of overseas affiliates and their parent firms separately. We, therefore, construct our database by matching the data sources according to their firm ID numbers. The period that we examine is 2009-2015 because of the availability of intra-firm trade data. Exchange rates are obtained from the United Nation Conference on Trade and Development (UNCTAD) statistics, and industrial GDPs in Japan are obtained from Japan's national accounts[12].

[12] https://www.esri.cao.go.jp/index-e.html

The data on the distance between countries are available in the CEPII database[13]. Export, import, and total sales in the data sources are nominal values. Among them, export and import are deflated by export and import deflators obtained from the BOJ statistics[14]. Total sales of overseas affiliates are deflated by the implicit GDP deflators. The implicit GDP deflators are calculated from the nominal and real GDP series in the UNCTAD statistics and the deflators are also used to construct the index of real exchange rates. A limitation of our methodology is that the METI data are compiled by the Japanese fiscal year (April-March) while the UNCTAD data are compiled by the calendar year (January-December). Nonetheless, this problem is unlikely to materially affect results because firms often use a fixed exchange rate during a contract period. It is, therefore, reasonable that there is a gap in timing between exchange rate changes and changes of trade behavior.

Table 1 shows the number of overseas affiliates of Japanese manufacturing firms by region. It is obvious that other Asian countries account for the lion's share of overseas affiliates of the Japanese manufacturing firms. This tendency has been strengthened in recent years, which indicates that Japanese manufacturing MNEs have further developed their supply chains in the Asian region. In Asia, 47% of overseas affiliates are located in mainland China while 30% of them are in ASEAN4 (Indonesia, Malaysia, the Philippines, and Thailand)[15].

Table 2 presents the shares of trade with Japan and the parent firms in total sales of the Japanese overseas affiliates. The table illustrates that imports from Japan and the parent firms have decreased during the period, 2009-2015 for both the finished and the

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[13] http://www.cepii.fr/%5C/anglaisgraph/bdd/chelem/internatrade/itpresent.htm

[14] http://www.boj.or.jp/en/statistics/index.htm/

[15] Author's own calculation using METI statistics.

intermediate products. By contrast, exports to Japan for them have increased. This possibly reflects the productivity growth of the local economies where overseas affiliates are located. That is, overseas affiliates of the Japanese manufacturing firms have shifted their procurement from Japan to local firms as the quality of their products has improved, while the parent firms also increased procurement from their overseas affiliates[16].

Table 3 presents overseas affiliates' share of export to (import from) their parent and other Japanese firms to their total sales (procurement) by industry. The table gives the weighted means as well as the arithmetic means, to consider the effects of non-sampling errors[17]. We weight the data by the number of employed workers. This reveals that the dependence on the parent firms varies considerably across industries. Export to the parent firms account for almost half of total sales of oversea affiliates in textile mill products, as well as in wood and paper products. Among others, rubber products, non-ferrous metals, fabricated metal products, general machinery, electrical machinery, equipment, and suppliers show relatively high dependence ratios (around 30%). On the other hand, the dependence ratios seem relatively low (under 15%) in petroleum and coal, iron and steel, and transportation equipment. The large difference in the dependence ratio between the arithmetic and the weighted means (27%) in food, beverages, tobacco, and prepared animal food possibly stems from non-sampling errors.

Dependency on import from the parent firms as a share of total procurement by overseas affiliates also varies across industries and the dispersion of the dependency ratios is smaller[18]. For the weighted means, the ratios are relatively high (over 15%) in iron and

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16 The Cabinet Office (2013)

17 The mean might be affected by omissions of data for large overseas affiliates.

18 The variances are 0.007 (export) and 0.002 (import), respectively.

steel, non-ferrous metal, and fabricated metal products but low (under 5%) in food, beverages, tobacco, and prepared animal food. There are gaps between the arithmetic and the weighted means in other industries such as rubber products, cerami, stone and clay products, general machinery, electrical machinery, equipment and supplies, and precision instruments and machinery.

3. Results

This section discusses the empirical results[19]. Tables 4 and 5 present the estimation results of equation 1 (examining exports) and equation 2 (examining imports), respectively. Table 4 shows that exports from overseas affiliates to their parent firms and non-parent firms in Japan are not affected by exchange rate changes because the estimated coefficients on EXR are statistically insignificant. Distance and the status dummy are statistically significant and have the expected signs (negative and positive, respectively) for intra-firm export. However, these variables are not statistically significant in inter-firm export. This indicates that the overseas affiliates play important roles as suppliers for the products to their parent firms if they are in countries which are geographically closer to Japan and the first-generation subsidiaries. The firm sizes and the firm ages are not statistically significant in all regressions. Among the market size variables, the coefficients on local sales are positive and statistically significant both in intra- and inter-firm export. The variables for industrial GDP in Japan in inter-firm export regressions are also statistically significantly positive (as would be expected in a gravity model) but the

[19] Some authors suggest that an earthquake dummy variable should be included for 2011 because the Great East Japan Earthquake is thought to have had heavy negative impacts on the supply chains of Japanese firms. We have re-rub the regression with that dummy and find similar results. Therefore, we rely on the results without that dummy in this study.

sales of the parent firms are statistically insignificant in both intra- and inter-firm export regressions. The interaction term between the finished product dummy and EXR is not statistically significant in intra-firm export regressions while the results are mixed in inter-firm export regressions. On the other hand, the interaction term between local procurement and EXR is negatively estimated at the 1% significance level in both intra- and inter-firm export to overseas affiliates. This suggests that an appreciation of yen decreases the volume of export to Japan (= import of Japan) if the local procurement rate is high, which contradicts our expectation.

Table 5, however, suggests that exchange rate changes affect the procurement behavior of overseas affiliates in terms of both intra- and inter-firm trade because the coefficients on EXR are statistically significantly at the 1% significance level in all regressions. An interesting finding is that the signs of the coefficients are different between intra- and inter-firm import of overseas affiliates. The results of intra-firm regressions indicate that an appreciation of the yen increases the imports of overseas affiliates from their parent firms (= increases exports from the parent firms to their overseas affiliates), which is contrary to our expectation. On the other hand, we obtained the expected signs of the coefficients on EXR in inter-firm import regressions. Distance is not statistically significant, even in intra-firm trade, which is contrary to the results identified for export behavior. The firm size is statistically significantly negatively estimated at the 1% significance level. This possibly implies that larger overseas affiliates have a more diverse range of suppliers and it is consistent with our analysis of the data above that showed the weighted means of the shares of import from the parent firms to total procurement are smaller than the arithmetic means in many industries. The coefficient on firm age is not statistically significant, which is the same result as for the

export regressions. Contrary to the export regressions, the status dummy is not statistically significant in intra-firm import regressions but is statistically significant in inter-firm import regressions. A possible interpretation of this result is that the first-generation overseas affiliates still rely on the relations with the domestic suppliers for the parent firms in their production activities to some extent. The coefficient on total sales are positive and significant in all regressions. The coefficients of Industrial GDPs in Japan are statistically significantly positive at the 10% significance level. However, in the regressions with the interaction term between EXR and local sales, the coefficients are not statistically significant. An insignificant estimate of the interaction term between the product dummy and EXR is reasonable because the dummy represents the characteristics of the products of overseas affiliates, not their imports.

These results indicate that exports and imports of overseas affiliates of Japanese manufacturing firms seem to be very different in terms of their responses to exchange rate changes. Differences may be explained by differences in exchange rate elasticities between exports and imports. Bussiere et al. (2017) illustrate that the estimated coefficients of exchange rates in regressions of Japan's imports are not always statistically significant while the estimated coefficients of exchange rates in regressions of Japan's exports are always statistically significant. In addition, differences in the invoice currencies that are used in export and import may explain these differences. Ito et al. (2019) report that overseas affiliates of Japanese manufacturing firms in Asia use the US dollar for exports to Japan while they use the yen for imports from Japan. Exchange rate changes between the yen and local currencies may not be directly related to export behavior of overseas affiliates to Japan because many of them are in Asia, not in the US, as Table 1 shows. Negative estimates of the interaction term between EXR and the local

procurement ratio are also controversial. This might reflect the increasingly frequency of the yen being used as an invoice currency.

The different signs for the coefficients on EXR in intra- and inter-import regressions imply that intra- and inter-firm imports possibly have different roles in procurement activities of overseas affiliates of Japanese manufacturing firms. Imports from the parent firms are considered to be less replaceable for other products for their overseas affiliates[20]. In addition, the parent firms possibly use export to their overseas affiliates to manage risks of exchange rate fluctuations. This includes shifting their production to foreign countries, as well as temporary adjustment of the supply chains. For example, Japanese automobile producers have moved their production to North America as a response to the strong yen[21]. In this case, and if their major invoice currency is the yen, an appreciation of the yen possibly increases the volume of imports from the parent firms[22]. On the other hand, imports from other Japanese firms are possibly more replaceable using the products of local suppliers in the location of the overseas affiliate. If so, an appreciation of the yen encourages overseas affiliates to source more from local suppliers.

We also examine equations 1 and 2 for industry groups because the structure of the supply chains varies considerably across industries. We classify the 16 manufacturing industries into 4 industry groups (see Appendix) and estimate both export and import regressions. The four industry groups are light, heavy, machinery, and transportation

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[20] The Ministry of Economy, Trade and Industry (2005).

[21] Thorbecke (2017).

[22] Cost conversion from the local currency to the yen in the consolidated financial statements possibly contributes to this interesting finding. Even though the firms use the local currency or the US dollar as the invoice currency, they report exports in yen using the demeaned exchange rate in each fiscal year.

industries. The miscellaneous industry is excluded from these estimations.

Tables 6 and 7 present the results of those estimations. Table 6 illustrates that an appreciation of the yen decreases the exports of overseas affiliates to their parent firms in the heavy industry and to other firms in Japan in the transportation industry. The estimates of EXR are not statistically significant in other export regressions. The results of import regressions in Table 7 show that the estimates of EXR are still positive and statistically significant at the 1% significance level for imports from the parent firms in the machinery and the transportation industries. This result suggests that the machinery-related industries characterize intra-industry trade. A possible reason for this is that overseas affiliates in those industries heavily rely on imported parts and components from their parent firms. On the other hand, an appreciation of the yen reduces imports of overseas affiliates from their parent firms in the light industry and from other firms in Japan in the machinery industry, although the statistical evidence for these findings is relatively weak (at the 10% significance level). In other import regressions, the estimates of EXRs are statistically insignificant. These results suggest that the effects of exchange rate changes vary across industries.

4. Conclusion

In this study, we examine the effects of exchange rate changes on intra- and inter-firm trade using firm-level data of the Japanese manufacturing sectors. The trade data of overseas affiliates of Japanese manufacturing firms allow us to separately discuss their trade with their parent firms and other firms in Japan. Our estimation reveals that the effects of exchange rate changes on trade vary between export and import. Neither export of overseas affiliates to their parent firms or to other firms in Japan is responsive to

exchange rate changes, whereas imports from Japanese firms is very responsive to exchange rate changes. Specifically, the effects of exchange rate changes on imports from overseas affiliates' parent firms are just the opposite of those from other firms in Japan. Appreciation of the yen increases imports from parent firms and decreases imports from other firms in Japan. This indicates that the relations between exchange rate changes and trade performance have become more complicated as the supply chain networks have developed during the last decade. In addition, our findings suggest that exchange rate changes may have different impacts on firms' trade across different industries. However, this study doesn't identify what generate these differences based on theoretical models. Therefore, we should further develop both theoretical and empirical research on trade within supply chain networks, including considering the invoice currencies, the roles of overseas affiliates, and other factors at the firm level and the industry level, to further understand the recent trade structure and to devise more reasonable trade and industry policies.

Appendix: Industrial Classification

Textile Mill Products	Light
Wood and Paper Products	Light
Chemical Products	Heavy
Petroleum and Coal Products	Heavy
Rubber product	Light
Leather tanning and leather products	Light
Ceramics, stone and clay products	Heavy
Iron and Steel	Heavy
Non-ferrous metals and products	Heavy
Fabricated metal products	Heavy
General Machinery	Machinery
Electrical machinery, Equipment and Supplies	Machinery
Transportation Equipment	Transport
Precision instruments and machinery	Machinery
Miscellaneous manufacturing industries	No group
Food, beverages, tobacco and prepared animal foods	Light

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Table 1. Location of Overseas Affiliates of Japanese Manufacturing firms

Year	N. America	L. America	Asia	Middle East	Europe	ROW
2009	1090	220	6154	9	786	140
	(13.0%)	(2.6%)	(73.3%)	(0.1%)	(9.4%)	(1.7%)
2010	1063	239	6189	10	762	149
	(12.6%)	(2.8%)	(73.6%)	(0.1%)	(9.1%)	(1.8%)
2011	1075	247	6404	10	795	153
	(12.4%)	(2.8%)	(73.7%)	(0.1%)	(9.2%)	(1.8%)
2012	1152	292	7962	15	851	153
	(11.1%)	(2.8%)	(76.4%)	(0.1%)	(8.2%)	(1.5%)
2013	1136	319	8110	18	813	149
	(10.8%)	(3.0%)	(76.9%)	(0.2%)	(7.7%)	(1.4%)
2014	1125	331	8167	19	804	146
	(10.6%)	(3.1%)	(77.1%)	(0.2%)	(7.6%)	(1.4%)
2015	1176	364	8528	21	848	143
	(10.6%)	(3.3%)	(77.0%)	(0.2%)	(7.7%)	(1.3%)

Source: The Basic Survey on Overseas Business Activities (METI).

Table 2. Trade of Overseas Affiliates of Japanese Manufacturing Firms by Year

	Finsihed				Intermediate			
	Export to		Import from		Export to		Import from	
	Japan	Parents	Japan	Parents	Japan	Parents	Japan	Parents
2009	0.28129	0.26090	0.20089	0.16277	0.20132	0.18054	0.25807	0.20692
2010	0.32901	0.32431	0.17606	0.14690	0.25422	0.24613	0.24676	0.20129
2011	0.33712	0.33904	0.17754	0.15573	0.25489	0.25010	0.23313	0.19242
2012	0.37837	0.37483	0.16939	0.14841	0.26818	0.26690	0.22382	0.19030
2013	0.37195	0.37971	0.17235	0.14824	0.25880	0.25693	0.20462	0.16988
2014	0.34457	0.34081	0.15852	0.14134	0.24677	0.24292	0.19981	0.16848
2015	0.36080	0.35338	0.15817	0.13911	0.26494	0.25924	0.18217	0.15581

Source: Author's own calculation.

Table 3. Trade of Overseas Affiliates of Japanese Manufacturing Firms by Industry

	Mean				Weighted Mean			
	Export to		Import from		Export to		Import from	
Industry Classification	**Parents**	**Others**	**Parents**	**Others**	**Parents**	**Others**	**Parents**	**Others**
Textile Mill Products	0.5471	0.0889	0.1415	0.0386	0.4906	0.0879	0.1149	0.0506
Wood and Pape Products	0.4972	0.0654	0.0872	0.0331	0.4985	0.0439	0.0710	0.0184
Chemical Products	0.1604	0.0186	0.1571	0.0319	0.1175	0.0165	0.1177	0.0355
Petroleum and Coal Products	0.0952	0.0003	0.0911	0.0213	0.0205	0.0001	0.1293	0.0270
Rubber product	0.3341	0.0144	0.1940	0.0240	0.3778	0.0107	0.0524	0.0131
Leather tanning and leather products	0.2880	0.0428	0.1114	0.0466	0.2089	0.0691	0.0819	0.0450
Cerami, stone and clay products	0.2758	0.0110	0.2228	0.0179	0.1886	0.0065	0.1162	0.0121
Iron and Steel	0.1387	0.0186	0.1706	0.0392	0.1068	0.0102	0.1729	0.0416
Non-ferrous metals and products	0.2858	0.0274	0.2057	0.0176	0.2949	0.0214	0.2135	0.0462
Fabricated metal products	0.2906	0.0253	0.1830	0.0511	0.3435	0.0287	0.1800	0.0437
General Machinery	0.2826	0.0225	0.2081	0.0262	0.3077	0.0223	0.1044	0.0184
Electrical machinery, Equipment and Supplies	0.3479	0.0230	0.1897	0.0565	0.4532	0.0214	0.1234	0.0465
Transportation Equipment	0.1310	0.0090	0.1600	0.0217	0.1371	0.0061	0.1335	0.0135
Precision instruments and machinery	0.2709	0.0206	0.1867	0.0482	0.2244	0.0112	0.0845	0.0524
Miscellaneous manufacturing industries	0.3258	0.0248	0.1823	0.0306	0.3564	0.0189	0.1573	0.0305
Food, beverages, tobacco and prepared animal food	0.3784	0.0553	0.0518	0.0122	0.1068	0.0181	0.0315	0.0049

Source: Author's own calculation.

Table 4. Estimation Results of Export Regressions

	Exports to Parent Firm				Exports to Other Japanese Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EXR	-0.216	-0.221	-0.135	-0.141	-0.571	-0.566	-0.158	-0.132
	(0.250)	(0.247)	(0.150)	(0.149)	(0.424)	(0.424)	(0.321)	(0.306)
Distance	-0.534***	-0.536***	-0.558***	-0.559***	-0.204	-0.197	-0.118	-0.105
	(0.198)	(0.198)	(0.135)	(0.134)	(0.190	(0.185)	(0.123)	(0.123)
Firm Size	0.160	0.160	0.075	0.075	-0.014	-0.007	-0.259	-0.012
	(0.137)	(0.138)	(0.074)	(0.074)	(0.071)	(0.069)	(0.065)	(0.065)
Firm Age	0.023	0.023	0.073	0.074	-0.141	-0.139	-0.110	-0.118
	(0.113)	(0.113)	(0.085)	(0.085)	(0.118)	(0.117)	(0.107)	(0.107)
1st Sub.	0.540***	0.540***	0.411***	0.411***	0.247	0.247	0.022	0.036
	(0.196)	(0.195)	(0.110)	(0.108)	(0.262)	(0.260)	(0.195)	(0.203)
A. Sales	0.788***	0.786***	0.810***	0.809***	0.880***	0.885***	0.864***	0.873***
	(0.129)	(0.128)	(0.073)	(0.073)	(0.146)	(0.146)	(0.139)	(0.132)
P. Sales	-0.016	-0.019	0.023	0.022	1.202***	1.222***	1.040***	1.110***
or GDP	(0.035)	(0.037)	(0.034)	(0.034)	(0.385)	(0.377)	(0.384)	(0.375)
$EXR \cdot F$		0.014		0.081		-0.044		-0.117***
		(0.027)		(0.021)		(0.046)		(0.034)
$EXR \cdot LP$			-0.626***	-0.626***			-0.426***	-0.426***
			(0.023)	(0.023)			(0.057)	(0.055)
Constant	3.297**	3.337**	4.849***	4.885***	-34.51***	-35.18***	-30.57**	-32.81***
	(1.671)	(1.701)	(0.967)	(0.969)	(11.87)	(11.64)	(12.25)	(11.82)
N. Obs.	35485	35485	32386	32386	24137	24137	23066	23066
$Pseudo\ \ R^2$	0.381	0.376	0.622	0.618	0.250	0.256	0.387	0.397

Note: ***, and ** represent 1% and 5% significance levels, respectively

Table 5. Estimation Results of Import Regressions

	Imports from Parent Firm				Import from Other Japanese Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EXR	0.369***	0.381***	0.410***	0.421***	-0.635***	-0.635***	-0.550**	-0.548**
	(0.131)	(0.126)	(0.119)	(0.113)	(0.184)	(0.191)	(0.224)	(0.230)
Distance	0.063	0.066	0.059	0.061	-0.160	-0.160	-0.153	-0.152
	(0.059)	(0.056)	(0.059)	(0.057)	(0.126)	(0.125)	(0.135)	(0.133)
Firm Size	-0.137***	-0.136***	-0.150***	-0.149***	0.077	0.077	0.073	0.074
	(0.033)	(0.032)	(0.031)	(0.030)	(0.054)	(0.054)	(0.056)	(0.056)
Firm Age	0.014	0.017	0.027	0.029	-0.017	-0.017	-0.014	-0.013
	(0.064)	(0.061)	(0.058)	(0.055)	(0.095)	(0.106)	(0.103)	(0.107)
1st Sub.	0.000	0.010	0.003	0.011	0.469***	0.469***	0.456*	0.457*
	(0.073)	(0.085)	(0.071)	(0.085)	(0.231)	(0.230)	(0.240)	(0.239)
A. Sales	1.006***	1.009***	1.012***	1.014***	0.901***	0.901***	0.910***	0.911***
	(0.032)	(0.030)	(0.031)	(0.030)	(0.033)	(0.037)	(0.033)	(0.036)
P. Sales	0.070***	0.073***	0.084***	0.086***	0.702*	0.702*	0.607	0.608
or GDP	(0.022)	(0.021)	(0.021)	(0.020)	(0.380)	(0.382)	(0.376)	(0.380)
$EXR \cdot F$		-0.014		-0.012		0.000		-0.004
		(0.033)		(0.037)		(0.032)		(0.033)
$EXR \cdot LP$			0.010	0.010			-0.027	-0.027
			(0.010)	(0.010)			(0.038)	(0.038)
Constant	-5.404***	-5.532***	-5.772***	-5.882***	-21.56*	-21.56*	-19.12	-19.17
	(1.125)	(0.991)	(1.044)	(0.907)	(12.38)	(12.49)	(12.24)	(12.41)
N. Obs.	33511	33511	31565	31565	22487	22487	21852	21852
$Pseudo\ \ R^2$	0.494	0.494	0.509	0.509	0.286	0.286	0.284	0.284

Note: ***, **, and * represent 1%, 5%, and 10% significance levels, respectively

Table 6. Estimation Results of Industrial Export Regressions

	Export to Parent Firm				Exports to Other Japanese Firms			
	Light	Heavy	Machineary	Transport	Light	Heavy	Machineary	Transport
EXR	-0.203	-0.550**	-0.262	-0.066	-0.200	0.527	-0.558	-2.084***
	(0.202)	(0.255)	(0.233)	(0.432)	(0.717)	(0.837)	(0.652)	(0.505)
Distance	0.143	0.007	-0.749***	-0.619***	0.204	0.103	-0.345	-0.708***
	(0.159)	(0.142)	(0.275)	(0.194)	(0.300)	(0.231)	(0.283)	(0.212)
Firm Size	-0.027	0.284**	0.148	0.611***	-0.092	-0.299*	0.241	-0.072
	(0.081)	(0.140)	(0.149)	(0.187)	(0.148)	(0.179)	(0.155)	(0.112)
Firm Age	0.062	-0.086	0.084	-0.066	0.088	-0.105	-0.001	0.161
	(0.087)	(0.150)	(0.124)	(0.132)	(0.139)	(0.141)	(0.161)	(0.169)
1st Sub.	0.082	0.782*	0.468**	0.613	1.894***	1.209	-0.106	0.505
	(0.295)	(0.428)	(0.218)	(0.379)	(0.545)	(0.746)	(0.226)	(0.719)
A. Sales	0.514***	0.638***	0.927***	0.376*	0.587***	1.434***	0.635***	0.791***
	(0.098)	(0.108)	(0.142)	(0.213)	(0.182)	(0.388)	(0.096)	(0.196)
P. Sales	0.032	-0.038	-0.020	-0.123	-0.064	-0.152**	-0.113	0.122
or GDP	(0.041)	(0.082)	(0.035)	(0.152)	(0.117)	(0.064)	(0.082)	(0.078)
Constant	1.726**	1.990	5.420**	6.301**	-1.146	-8.223	5.158	10.50***
	(0.825)	(1.306)	(2.184)	(2.947)	(3.746)	(7.736)	(3.511)	(3.105)
N. Obs.	4174	9343	11042	6835	2845	6654	7175	4685
$Pseudo\ R^2$	0.146	0.163	0.482	0.097	0.081	0.356	0.031	0.026

Note: ***, **, and * represent 1%, 5%, and 10% significance levels, respectively

Table 7. Estimation Results of Industrial Import Regressions

	Import from Parent Firm				Import from Other Japanese Firms			
	Light	Heavy	Machineary	Transport	Light	Heavy	Machineary	Transport
EXR	-1.094*	0.176	0.366**	0.541**	-0.706	-0.481	-0.627*	-0.364
	(0.651)	(0.276)	(0.181)	(0.244)	(0.887)	(0.499)	(0.336)	(0.395)
Distance	0.295	-0.048	0.119*	0.151	0.135	-0.502***	0.093	-0.223
	(0.185)	(0.103)	(0.071)	(0.096)	(0.214)	(0.160)	(0.078)	(0.355)
Firm Size	0.025	-0.081*	-0.169**	-0.049	0.129	0.082	0.041	0.089
	(0.078)	(0.044)	(0.070)	(0.052)	(0.181)	(0.067)	(0.074)	(0.134)
Firm Age	-0.319**	-0.349***	0.009	0.147	-0.143	0.198	-0.151*	0.116
	(0.129)	(0.090)	(0.076)	(0.102)	(0.160)	(0.211)	(0.084)	(0.332)
1st Sub.	0.290	0.299**	-0.197	0.046	-0.476	0.656**	0.255	0.802
	(0.429)	(0.124)	(0.164)	(0.183)	(0.385)	(0.325)	(0.328)	(0.613)
A. Sales	0.770***	0.871***	1.165***	0.825***	0.792***	1.031***	0.945***	0.959***
	(0.094)	(0.064)	(0.068)	(0.035)	(0.131)	(0.108)	(0.055)	(0.147)
P. Sales	-0.005	0.174***	0.023	0.170***	-0.212***	-0.148***	0.026	-0.164*
or GDP	(0.045)	(0.051)	(0.028)	(0.046)	(0.075)	(0.041)	(0.068)	(0.087)
Constant	2.245	-1.578	-4.773***	-6.058***	2.648	2.989	-0.871	0.305
	(2.109)	(1.281)	(1.093)	(2.039)	(3.856)	(2.337)	(1.487)	(2.509)
N. Obs.	3243	9119	10165	7067	2341	6314	6578	4607
$Pseudo\ R^2$	0.209	0.365	0.639	0.395	0.060	0.388	0.375	0.188

Note: ***, **, and * represent 1%, 5%, and 10% significance levels, respectively