Kyoto University,
Graduate School of Economics
Research Project Center Discussion Paper Series

Firm Heterogeneity and the Structure of Export and FDI:

Evidence from Japanese Manufacturing Industries

Ayumu Tanaka

Discussion Paper No. E-09-003

Research Project Center
Graduate School of Economics
Kyoto University
Yoshida-Hommachi, Sakyo-ku
Kyoto City, 606-8501, Japan

March 2010

Firm Heterogeneity and the Structure of Export and FDI
Evidence from Japanese Manufacturing Industries

Ayumu Tanaka[†]

March 31, 2010

Abstract

The percentage of exporters and multinational enterprises (MNEs) varies substantially across industries. We extend the firm heterogeneity model presented in Helpman et al. (2004) to derive testable predictions about the prevalence of these internationalized modes. The model indicates that intra-industry firm heterogeneity and R&D intensity play large roles in the inter-industry variation of the number of internationalized firms. We investigate whether these factors as well as import tariff affect the structure of export and foreign direct investment (FDI) using Japanese industry-level data. We obtain results that are consistent with the model. First, industries with larger productivity dispersion have a larger percentage of non-MNE exporters, a larger percentage of MNEs, and a larger percentage of the sum of exporters and MNEs. Second, MNEs are heavily concentrated in R&D intensive industries. In addition, we reveal that lower import tariffs raise the percentage of exporters and MNEs in line with Melitz (2003).

Keywords: Firm heterogeneity; Multinationals; Exports; Foreign direct investment
JEL Classification: F1, F23

[†]Kyoto University and Research Institute of Economy, Trade and Industry (RIETI). E-mail: ayumu21<at>gmail.com

1 Introduction

The percentage of exporters and multinational enterprises (MNEs) vary substantially across industries, and almost all industries have at least one exporter or MNE. Recent empirical research in international trade and foreign direct investment (FDI) provides firm-level evidence that firms that export or conduct FDI are relatively rare. However, the percentage of firms that export or conduct FDI within each industry category ranges rather widely. For example, according to Bernard et al. (2007), the number of firms exporting is nearly 40% in some U.S. manufacturing industries but less than 10% in others.

In this paper we use the firm heterogeneity model presented in Helpman et al. (2004) to derive the theoretical relationship between firm heterogeneity and the percentage of internationalized firms. The firm heterogeneity models of Helpman et al. (2004) assume that firms differ in productivity and must incur the fixed costs of exporting and FDI. They predict that only firms that are productive enough to cover the fixed cost of exporting can export. Since the fixed cost of FDI is larger than that of exporting, firms that conduct FDI must be more productive than firms that only export.

Based on the model of Helpman et al. (2004), we show that industries with a larger degree of productivity dispersion have a larger percentage of MNEs, a larger percentage of the sum of exporters and MNEs, and a larger relative percentage of MNEs over exporters, although the effect of an increase in the dispersion of productivity on the percentage of exporters can be either positive or negative. In addition, we show that R&D intensive industries have an advantage in conducting FDI. Our approach resembles Antràs and Helpman (2004, 2008) who focused on the prevalence of such organizational forms as foreign outsourcing and FDI; Helpman et al. (2004) focused on the relative magnitude of exports and FDI sales.

We also use Japanese industry-level data to examine the model's implications. Many previous empirical studies have confirmed that exporters are more productive than non-exporters (Bernard and Jensen, 1999) and that MNEs are more productive than firms that only export (Tomiura, 2007). Such firm-level evidence supports the standard firm heterogeneity models of Melitz (2003) and Helpman et al. (2004). Helpman et al. (2004) also provide empirical evidence at the industry level that industries with larger productivity dispersion have smaller relative export sales over FDI sales as predicted by their theoretical model. However, no evidence exists that confirms the large role of firm heterogeneity and R&D intensity in the variation of the percentage of internationalized firms across industries. The results support the predictions of our heterogeneous firm model that firm heterogeneity and R&D play key roles in the structure of international trade and FDI and additionally reveal that import tariffs matter. First, industries with a larger degree of productivity dispersion have more exporters, a larger percentage of MNEs, a larger relative percentage of MNEs over exporters, and a larger percentage of the sum of exporters and MNEs. Second, MNEs are concentrated heavily in R&D intensive industries. Third, we additionally test and confirm the reallocation effect that lower import tariffs raise the percentage of internationalized firms.

The remainder of this paper is divided into four sections. In Section 2, we briefly describe the Japanese manufacturing data used in this paper and show that the variation of the percentage of exporters and MNEs is systematic. In Section 3, we use a version of Helpman et al. (2004) to derive predictions about the prevalence of internationalized modes. In Section 4, we introduce our estimation approach. In Section 5, we present the results of our empirical analysis. The summary and conclusion are presented in the final section.

2 A first glance at the data

There is tremendous variation in the percentage of exporters and MNEs across industries, as Bernard et al. (2007) and Tomiura (2007) have shown. In addition, this section reveals that this variation is systematic. First, the percentage of exporters is higher in industries with a larger dispersion of sales. Second, the percentage of MNEs is also higher in industries with a larger dispersion of sales. Third, relative to all active firms, MNEs is heavily concentrated in R&D intensive industries. Finally, the percentages of exporters and MNEs are higher in less protected industries. This section unveils these patterns in the Japanese manufacturing industry-level data. The facts in this section motivate the theoretical model and more rigorous empirical analysis in the following sections.

This study uses the industry-level data for the period 1997-2005 constructed from the confidential firm-level data collected by the Ministry of Economy, Trade, and Industry (METI). METI conducts annual surveys called *the Basic Survey of Japanese Business Structure and Activities*, which covers all firms with 50 employees or more and capital of 30 million yen or more. We focus on firms whose main line of business is manufacturing and exclude those whose main line of business is weapons and the munitions industry because Japanese law prohibits the export of such products. 57

manufacturing industries remain. Table 4 provides three-digit METI industry codes and descriptions. In this section we use the data averaged over nine years: 1997-2005.

Figure 1 illustrates that the percentage of exporters in all active firms is higher in industries with a larger dispersion of logarithm of sales in a cross section of 57 manufacturing industries. The X-axis measures the standard deviation of the logarithm of sales, and the Y-axis measures the percentage of non-MNE exporters. Fig. 2 plots the percentage of MNEs across industries. The X-axis again measures the standard deviation of the logarithm of sales. Fig. 2 reveals that industries with a larger dispersion of sales have higher percentages of MNEs. Fig. 3 shows how the percentage of MNEs varies with the ratio of R&D expenditures to sales and demonstrates the third strong pattern: the percentage of MNEs is higher in R&D intensive industries. Finally, Fig. 4 shows the percentage of exporters and MNEs is higher in industries with a lower import tariff.

3 Model

To explain why the percentage of exporters and MNEs systematically varies, we use a framework based on Helpman et al. (2004) and establish the relationship between intra-industry firm heterogeneity and the percentage of exporters and MNEs. We specify the model, which is a simplified version of Helpman et al. (2004), and extend it to generate predictions about the percentage of exporters and MNEs.

3.1 Set-up

J countries are indexed by j and S industries are indexed by s. A continuum of heterogeneous firms produces differentiated goods in each country and sector. The preferences are identical everywhere and given by a Cobb-Douglas aggregate over industry-specific CES consumption indice C_{js}:

$$u_j = \prod_s C_{js}^{\theta_s},\ C_{js} = \left[\int_{\omega\in\Omega_{js}} x_{js}(\omega)^{\alpha}\, d\omega\right]^{\frac{1}{\alpha}},\ 0 < \alpha < 1 \qquad (1)$$

where $x_{js}(\omega)$ is the quantity of good consumed, Ω_{js} is the set of goods available in industry s in country j, and tha parameter α determines the elasticity of substitution across products, which is $\sigma = 1/(1-\alpha) > 1$. Parameter θ_s indicates the total expenditure share of each industry and satisfies $\sum_s \theta_s = 1$. Then country j's demand for product in industry s is

$$x_{js}(\omega) = \frac{p_{js}(\omega)^{-\sigma}\theta_s Y_j}{p_{js}^{1-\sigma}} \tag{2}$$

where Y_j is gross national expenditure in country j, $p_{js}(\omega)$ is the price of good ω in industry s in country j, and P_{js} is the price index in industry s in country j, given by

$$P_{js} = \left[\int_{\omega\in\Omega_{js}} p_{js}(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}} \tag{3}$$

Next we temporarily consider particular industry s and drop index s. Each firm is capable of producing a single good using a single input called labor, whose price in country j is w_j. Firms are heterogeneous in terms of their productivity φ. The empirical distribution of φ in each country $F(\varphi)$ is assumed to be Pareto with shape parameter k, i.e.:

$$F(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^k,\ \varphi \geq b \geq 0 \tag{4}$$

where b is a minimum value in an industry's productivity distribution. We assume that $k > \sigma + 1$, which ensures that the distribution of productivity draws have finite variances. k is an inverse measure of variance, since the variance of Pareto distribution is given by

$$V(\varphi) = \frac{b^2 k}{(k-1)^2(k-2)}, \text{ for } k > 2$$

The smaller parameter k is, the larger the variance of productivity is. The Pareto assumption is consistent with the evidence (see Helpman et al. 2004; Wakasugi et al. 2008). Note that we assume that productivity distributions differ among industries.

After a firm observes a productivity draw from distribution $F(\varphi)$, a firm bears the fixed costs of domestic production rf^D if it chooses to enter the market. These are costs of setting up production facilities including a research institute in home country. r is an indusrty-specific measure of R&D intensity and $r > 1$. A firm in R&D intensive industry must incur larger fixed cost due to R&D expenditure.

In serving foreign markets, a firm faces a proximity-concentration trade-off. If the firm chooses to export, it bears additional fixed costs f^X per foreign market, faces domestic wage w_h, and incurs iceberg transport cost $\tau_i > 1$. On the other hand, if it chooses to serve a foreign market by FDI, it bears additional fixed costs f^I in every foreign market. In this case, the firm may avoid transport cost and face local labor cost w_i. These fixed costs are industry-specific.

A firm from country h that sells its product will face marginal costs of

$$c(\varphi) = \begin{cases} \frac{zw_h}{\varphi} \text{ if it sells in home country } h \\ \frac{z\tau_i w_h}{\varphi} \text{ if it exports to a foreign country } i \\ \frac{zw_i}{\varphi} \text{ if it produces in a foreign country } i \end{cases} \tag{5}$$

where z is a industry-specific inverse measure of R&D intensity i.e., $z'(r) < 0$, and $z \in (0,1)$. We assume that R&D reduces marginal costs.

A firm facing demand curve (1) will optimally charge a price of $p(\varphi) = c(\varphi)/\alpha$. The profit from the domestic market is

$$\pi^D = (zw_h)^{1-\sigma} A_h \varphi^{\sigma-1} - rf^D \tag{6}$$

where $A_h = (1-\alpha)\alpha^{\sigma-1}\theta Y_h P_h^{\sigma-1}$ is the mark-up adjusted demand level in an industry and in country i. We regard $\varphi^{\sigma-1}$ as a productivity index, since $\sigma > 1$.

Setting $\pi^D = 0$, we define the entry cutoff for domestic production as

$$\varphi^D = \left(\frac{rf^D}{(zw_h)^{1-\sigma} A_h} \right)^{\frac{1}{\sigma-1}} \tag{7}$$

Firms with productivity below this cutoff ($\varphi < \varphi^D$) do not enter the industry, but firms with productivity above this cutoff ($\varphi \geq \varphi^D$) do enter and sell their products in their home countries.

Similarly, the additional profit from exports to country i is

$$\pi^X = (z\tau_i w_h)^{1-\sigma} A_i \varphi^{\sigma-1} - f^X \tag{8}$$

and the additional profit from FDI in country i is

$$\pi^I = (zw_i)^{1-\sigma} A_i \varphi^{\sigma-1} - f^I \tag{9}$$

Setting $\pi^X = 0$, we define the export cutoff:

$$\varphi^X = \left[\frac{f^X}{(z\tau_i w_h)^{1-\sigma} A_i} \right]^{\frac{1}{\sigma-1}} \tag{10}$$

We also define the FDI cutoff as

$$\varphi^I = \left[\frac{f^I - f^X}{A_i z^{1-\sigma} \left[w_i^{1-\sigma} - (\tau_i w_h)^{1-\sigma} \right]} \right]^{\frac{1}{\sigma-1}} \tag{11}$$

where setting $\pi^X = \pi^I$. Following Helpman et al. (2004), we assume $\left(\frac{w_i}{w_h}\right)^{\sigma-1} f^I > \tau_i^{\sigma-1} f^X > r f^D$, which ensure $\varphi^D < \varphi^X < \varphi^I$ if $A_h = A_i$. The optimal strategy of internationalization depends on each firm's productivity. First, firms with productivity levels between entry cutoff and export cutoff ($\varphi \in (\varphi^D, \varphi^X)$) only supply their products to domestic markets and neither export nor conduct FDI. These firms are "purely domestic." Second, firms with productivity levels between the export cutoff and FDI cutoff ($\varphi \in (\varphi^X, \varphi^I)$) are "exporters," who supply their products to domestic markets and export them to foreign markets. Firms with productivity levels above the FDI cutoff ($\varphi > \varphi^I$) are "MNEs," who invest in a foreign country. Therefore, exporters are more productive than purely domestic firms, and MNEs, in turn, are more productive than exporters.

3.2 Prevalence of internationalized modes

In this section we consider the relationship between the inter-industry variation of the percentage of internationalized firms and productivity dispersion. Helpman et al. (2004) derived the relationship between the relative magnitude of exports and local FDI sales and productivity dispersion and predicted that industries with higher dispersion levels of firm productivity have lower ratios of exports to FDI sales. They tested this prediction using American data with European firm-level data. Their results support the theoretical model's predicted link between intra-industry firm-level heterogeneity and relative export sales. However, except their own study, little evidence supports their prediction at the industry level.

Our approach is slightly different from Helpman et al. (2004) and more closely resembles Antras and Helpman (2004, 2008). We establish the relationship between the inter-industry variation of the percentage of internationalized firms and intra-industry productivity dispersion. While Helpman et al. (2004) focused on the relative magnitude of export sales, we focused on the percentage of each internationalization mode of firms for two reasons. First, we do not have the data of FDI local sales per country, which is necessary to construct the relative magnitude of export sales. Second, we can easily derive richer predictions than Helpman et al. (2004) by deriving predictions not only about the relative percentage of exports over FDI but also about the percentage of MNEs and exporters and MNEs. Given the Pareto assumption (2), the number of purely domestic firms in all active firms can be written

$$\delta^D = \frac{F(\varphi^X) - F(\varphi^D)}{1 - F(\varphi^D)} = 1 - \left(\frac{\varphi^D}{\varphi^X}\right)^k \tag{12}$$

where we exclude exit firms. Hence, the percentage of the sum of exporters and MNEs is

$$\delta^N = \frac{1 - F(\varphi^X)}{1 - F(\varphi^D)} = \left(\frac{\varphi^D}{\varphi^X}\right)^k \tag{13}$$

Since $\varphi^D < \varphi^X$, an increase in this percentage is driven by a decrease in k, which is generated by an increase in the dispersion of productivity. Next, the percentage of MNEs is

$$\delta^I = \frac{1 - F(\varphi^I)}{1 - F(\varphi^D)} = \left(\frac{\varphi^D}{\varphi^I}\right)^k \tag{14}$$

Since $\varphi^D < \varphi^I$, a decrease in k increases the percentage of MNEs. Similarly, the percentage of exporters equals

$$\delta^X = \frac{F(\varphi^I) - F(\varphi^X)}{1 - F(\varphi^D)} = \left(\frac{\varphi^D}{\varphi^X}\right)^k - \left(\frac{\varphi^D}{\varphi^I}\right)^k \tag{15}$$

The first term means the percentage of internationalized firms (exporters and MNEs), and the second term means the percentage of MNEs. Both increase when k decreases. Therefore, the effect of the increase in the productivity dispersion on the percentage of exporters is ambiguous. However, we can derive the effect of an increase in productivity dispersion on MNEs per exporters. This relative percentage of MNEs over exporters is

$$\delta^{IX} = \frac{\delta^I}{\delta^X} = \frac{1}{\left(\frac{\varphi^I}{\varphi^X}\right)^k - 1} \tag{16}$$

This relative percentage increases when k decreases.

In addition, we examine the change of R&D intensity, which is relevant in the next section's empirical analysis. From (10), (11), and $z'(r) < 0$,

$$\frac{\partial \varphi^X}{\partial r} < 0 \quad \text{and} \quad \frac{\partial \varphi^I}{\partial r} < 0. \tag{17}$$

Therefore, we get

$$\frac{\partial \delta^I}{\partial r} > 0 \quad \text{and} \quad \frac{\partial \delta^N}{\partial r} > 0. \tag{18}$$

4 Empirical specifications

Our aim is to empirically analyze the effect of our measure of firm-size dispersion, R&D intensity, and other variables on the following: (i) the percentage of exporters, (ii) the percentage of MNEs, (iii) the relative percentage of MNEs over exporters, and (iv) the percentage of the sum of exporters and MNEs. We clarify the effect of the productivity dispersion on the percentage of exporters in our empirical analysis, although the model predicts that the effect can be either positive or negative.

We estimate the following reduced-form specification:

$$\begin{aligned}\delta_{srt} &= \mu + \chi_{sr} + \lambda_r \cdot year_t + \beta_1 \ln DISPERSE_{st} \\ &\quad +\beta_2 \ln RDINT_{st} + \beta_3 \ln SKINT_{st} + \beta_4 \ln KAPINT_{st} \\ &\quad +\beta_5 \ln ADINT_{st} + \epsilon_{srt}\end{aligned} \tag{19}$$

where μ is constant, $\delta_{srt} \in (\delta^X, \delta^I, \delta^{IX}, \delta^N)$, and s, r, and t are indexes of industries, regions, and years, respectively. For each firm in our sample, we observe its value of export sales per region (Asia, North America, and Europe) and its number of foreign affiliates per region. Using these data, for each region we can identify each firm as one of three types: "purely domestic," "Non-MNE exporter," or "MNE." We approximate δ^{IX} as MNEs / (non-MNE exporters +1) because some pairs of industries and regions have no exporters. $DISPERSE_{st}$ is our measure of the extent of productivity dispersion across firms within industry s in year t. We use the standard deviation of the logarithm of firm sales across all firms within an industry as a measure of the dispersion of firm productivity, following Helpman et al. (2004) and Yeaple (2006). $RDINT_{st}$ is the ratio of R&D expenditures to sales (R&D intensity).

χ_{sr} is a fixed effect of the pair of industry s and region r, λ is an indicator variable for region r, and $year_t$ is an indicator variable for year t. Since cutoffs are functions of trade costs[*1], wages, and market sizes, these variables also affect the percentages of internationalized firms that we estimate. Since these factors are specific to country or a country and industry pair, proxying them is difficult because we do not have the number of internationalized firms per country. We, therefore, added the fixed effects of an industry and region pair and the interaction of region dummies with year dummies to the estimation equations.

[*1] While we have import tariff data, we do not have any data on variable trade costs faced by Japanese firms when they export their goods.

Finally, we included capital intensity ($KAPINT_{st}$), the number of skilled workers per total employment (skill intensity, $SKINT_{st}$), and the ratio of advertisement expenditures to sales (advertisement intensity, $ADINT_{st}$) in regression to the control for the omitted industry characteristics. All of these variables were constructed from the METI survey. The descriptive statistics for all variables are shown in Table 1.

In this section, we also empirically examine the effect of a decline in import tariffs applied to foreign goods on the percentage of exporters and MNEs. Although our partial equilibrium model does not capture the link between import tariffs and the percentages, Melitz (2003) showed that a decline in variable trade costs forces low-productivity firms to exit and results in increases in the average productivity in an industry. If this so-called reallocation effect exists, as Bernard et al. (2006) empirically show, lower import tariffs encourage more low-productivity firms to exit and increase the percentage of exporters and MNEs. We estimate the following equation:

$$\begin{aligned} \delta_{srt} &= \mu + \chi_{sr} + \lambda_r \cdot year_t + \gamma_1 \ln TARIFF_{st-1} \\ &\quad + \gamma_2 \ln RDINT_{st} + \gamma_3 \ln SKINT_{st} + \gamma_4 \ln KAPINT_{st} \\ &\quad + \gamma_5 \ln ADINT_{st} + \epsilon_{srt} \end{aligned} \tag{20}$$

$TARIFF_{st-1}$, which is an import-weighted average tariff applied to the import of foreign goods in industry s in year $t-1$ in Japan, is taken from Nicita and Olarreaga (2007)[*2] where the data are described in more detail. This variable is lagged by one year to avoid reverse causality.

5 Results

We first discuss the results shown in Table 2 where we estimated the coefficients by the random effect model. The dependent variables in columns (1), (2), (3), and (4) are the following percentages: non-MNE exporters, MNEs, MNEs per non-MNE exporters, and the sum of exporters and MNEs, respectively. Since , the coefficient estimates in column (4) equal the sum of the coefficients in columns (1) and (2). First, the coefficients on the log of dispersion are positive in all four columns and statistically significant in all columns except column (3). Although the coefficient in column (3) is not significant, the estimated sign is consistent with the theoretical implications derived in Section 3 that predicted that industries with a higher level of productivity dispersion have larger percentages of internationalized firms. In an

[*2]We make a concordance to match the 3-digit ISIC industries to the METI code industries.

unreported regression of restricted sample which excludes Asia, we obtain an estimation resultus that the log of dispersion has a significantly positive effect on the relative percentage of non-MNE exporters over MNEs. Since these estimated signs show that industries with higher dispersion of productivity have a larger percentages of MNEs, MNEs over non-MNE exporters, and exporters and MNEs, all the results support the theoretical predictions. The positive coefficient of dispersion in column (2) provides evidence that industries with larger dispersion of productivity have a larger percentage of non-MNE exporters.

Second, the coefficients on R&D intensity are positive and significant in columns (2) and (4). This implies that R&D plays an important role in doing FDI, as predicted by the theory.

Third, such control variables as skill intensity and advertisement intensity are significant in some columns. In particular, the skill intensity coefficients are positive in columns (2)-(4) and significant in columns (2) and (4). This indicates that MNEs need more skilled workers in their home countries and is consistent with earlier findings by Head and Ries (2002).

Next, Table 3 reports estimation results where we included import tariff rather than dispersion as an explanatory variables. The result reveals that import tariffs significantly decrease all percentages except the relative percentage of non-MNE exporters over MNEs in line with Melitz (2003). This suggests that government protection discourages low-productivity firms from exiting and lowers the percentage of exporters and MNEs.

6 Concluding remarks

In this paper, we examined the link between firm heterogeneity and the prevalence of exporting and FDI. In addition, we extend the standard heterogeneity model of Helpman et al. (2004) to explain the roles of R&D in export and FDI, while Helpman et al. (2004) model cannot capture it. In particular, we develop a model where R&D reduces marginal costs, while a firm which invests in R&D incurs larger fixed costs.

Our model yields two testable implications. First, industries with larger productivity dispersion have (i) a larger percentage of firms that conduct FDI, (ii) a larger relative percentage of MNEs over exporters, and (iii) a larger percentage of the sum of exporters and MNEs. Second, R&D intensive industries have an advantage in conducting FDI. The empirical results accord with both implications of the model and additionally revealed that (iv) the percentage of exporters is larger in industries with a larger degree of productivity dispersion and that (v) R&D intensity has positive effect on the fraction of non-MNE exporters as well as the fraction of MNEs.

In addition, we empirically examined whether highly protected industries have a smaller percentage of internationalized firms. The result confirms that lower import tariffs increase the percentage of exporters and MNEs. This suggests that government protection may discourage firms from supplying their products to foreign markets. Our results also shed light on the industry characteristics associated with export and FDI. In particular, we revealed that FDI is prevalent in skill intensive industries.

We conclude that within-industrial heterogeneity as well as R&D intensity and government trade policies play crucial roles in the structure of foreign trade and investment. Greater dispersion in productivity across firms within a single industry is associated with more FDI, as predicted in our model, and also with more exporting. In addition, R&D intensity is associated with a larger percentage of MNEs. Furthermore, lower import tariffs positively affect both the percentage of exporters and MNEs.

Acknowledgment

I thank Professor Taiji Furusawa, Professor Jota Ishikawa, Associate Professor Naoto Jinji, Professor Se-il Mun, Associate Professor Jee-Hyeong Park, Associate Professor Naomitsu Yashiro, Professor Ryuhei Wakasugi, and other participants in seminars at Kyoto and Hitotsubashi Universities for their helpful comments and suggestions.

References

[1] Antràs, Pol and Elhanan Helpman. (2004) "Global Sourcing." *Journal of Political Economy*, 112(3):552-580.

[2] Antràs, Pol and Elhanan Helpman (2008). "Contractual Frictions and Global Sourcing." In Helpman E, Martin D, Verdier T (eds), *The Organization of Firms in a Global Economy*, Harvard University Press, pp 9-54.

[3] Bernard, Andrew B. and J. Bradford Jensen. (1995) "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-87." *Brookings Papers on Economic Activity: Microeconomics*, 67-112.

[4] Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding and Peter K. Schott. (2007) "Firms in International Trade." *Journal of Economic Perspectives*, 21(3):105-130.

[5] Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott. (2006) "Trade Costs, Firms, and Productivity," *Journal of Monetary Economics*, 53(5): 917-937.

[6] Bernard, Andrew B., Stephen J. Redding, and Peter K. Schott. (2007) "Comparative Advantage and Heterogeneous Firms," *Review of Economic Studies*, 74(1): 31-66.

[7] Brainard, S. Lael. (1997) "An Empirical Assessment of the Proximity-Concentration Trade-off between Multinational Sales and Trade. *American Economic Review*, 87(4):520-544.

[8] Dixit, Avinash K. and Joseph E. Stiglitz. (1977) "Monopolistic Competition and Optimum Product Diversity." *American Economic Review*, 67:297-308.

[9] Head, Keith and John Ries. (2002) "Offshore production and skill upgrading by Japanese manufacturing firms," *Journal of International Economics*, 58: 81-105.

[10] Head, Keith and John Ries. (2003) "Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers. *Journal of the Japanese and International Economies*, 17:448-467.

[11] Helpman, Elhanan, Marc Melitz and Yona Rubinstein. (2008) "Estimating Trade Flows: Trading Partners And Trading Volumes. *Quarterly Journal of Economics*, 123 (2):441-487.

[12] Helpman, Elhanan, Marc J. Melitz and Stephen Ross Yeaple. (2004) "Export Versus FDI with Heterogeneous Firms. *American Economic Review*, 94(1):300-316.

[13] Kimura, Fukunari and Kozo Kiyota. (2006) "Exports, FDI, and Productivity of Firm: Dynamic Evidence from Japanese Firms. *Review of World Economics*, 142(4):695-719.

[14] Krugman, Paul R. (1980) "Scale Economies, Product Differentiation, and the Pattern of Trade." *American Economic Review*, 70(5):950-959.

[15] Melitz, Marc J. (2003) "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6):1695-1725.

[16] Nicita, Alessandro and Marcelo Olarreaga. (2007) "Trade, Production, and Protection Database, 1976-2004," *The World Bank Economic Review*, 21(1): 165-171.

[17] Tomiura, Eiichi. (2007) "Foreign Outsourcing, Exporting, and FDI: A Productivity Comparison at the Firm Level," *Journal of International Economics*, 72: 113-127.

[18] Wakasugi, Ryuhei, Yasuyuki Todo, Hitoshi Sato, Shuichiro Nishioka, Toshiyuki Matsuura, Banri Ito, and Ayumu Tanaka. (2008) "Internationalization of Japanese Firms: New Findings Based on Firm-Level Data," *RIETI Discussion Paper*, 08-E-036.

[19] Yeaple, Stephen Ross. (2006) "Offshoring, Foreign Direct Investment, and the Structure of U.S. Trade," *Journal of the European Economic Association*, 4(2-3): 602-611.

Figure 1: Dispersion and Percentage of Non-MNE exporters

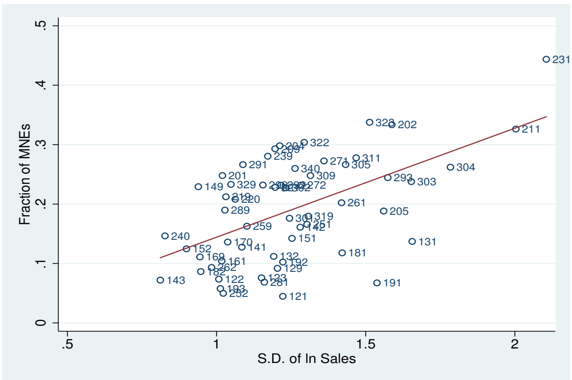

Figure 2: Dispersion and Percentage of MNEs

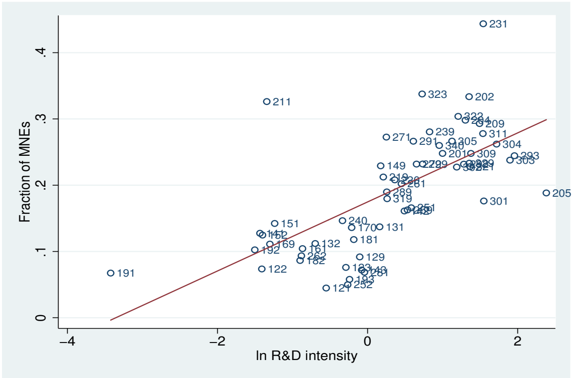

Figure 3: R&D intensity and Percentage of MNEs

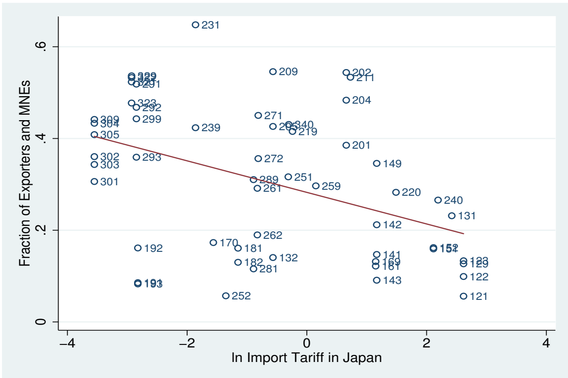

Figure 4: Import Tariff and Percentage of the sum of exporters and MNEs

Table 1: Descriptive Statistics

Variable	Mean	S. D.	N	Min	Max
Non-MNE exporters / All	0.143	0.100	513	0.000	0.417
MNEs / All	0.202	0.098	513	0.031	0.556
MNEs / Non-MNE exporters	1.851	1.438	513	0.375	12.500
Exporters and MNEs / All	0.345	0.180	513	0.047	0.889
ln S. D. of ln Sales	1.247	0.280	513	0.626	2.270
ln Capital intensity	2.859	0.761	513	0.968	5.511
ln R & D intensity	0.236	1.210	512	-5.688	2.484
ln Skill intensity	-2.205	1.076	505	-8.442	-1.066
ln Ad. Intensity	-5.397	1.111	513	-7.893	-2.755
ln Tariff	-0.780	2.046	492	-3.912	2.806

Table 2: The share of internationalized firms (Japan, 1997-2005): Dispersion

Dep. Var.	(1) Non-MNE Exporters	(2) MNEs	(3) MNEs per Non-MNE Exporters	(4) Exporters and MNEs
ln Dispersion (Sales)	0.044*	0.084***	0.546	0.115***
	[0.027]	[0.026]	[0.350]	[0.028]
ln Capital intensity	-0.006	0.001	-0.056	-0.004
	[0.009]	[0.008]	[0.114]	[0.012]
ln R & D intensity	0.009***	0.015***	-0.048	0.019***
	[0.003]	[0.003]	[0.053]	[0.005]
ln Skill intensity	0.00	0.003***	0.026	0.003***
	[0.001]	[0.001]	[0.023]	[0.001]
ln Ad. Intensity	-0.002	-0.009***	-0.027	-0.011***
	[0.003]	[0.003]	[0.037]	[0.003]
Observations	1512	1512	1512	1512
Number of Clusters	171	171	171	171
R-squared	0.274	0.576	0.194	0.474
p-value				
BPL test	0.00	0.00	0.00	0.00

Notes: Coefficients are estimated by random effect model. Robust standard errors in brackets. *** Significant at 1%. ** Significant at 5%. * Significant at 10%. Dependent variables in column (1), (2), (3), and (4) are the share of nonmultinational exporters, the share of multinationals, multinationals per nonmultinational exporters, and the share of exporters and multinationals, respectively. The interaction of region dummies with year dummies and constant are suppressed.

Table 3: The share of internationalized firms (Japan, 1997-2005): Tariff

Dep. Var.	(1) Non-MNE Exporters	(2) MNEs	(3) MNEs per Non-MNE Exporters	(4) Exporters and MNEs
ln Capital intensity	0.000	0.012	0.034	0.010
	[0.008]	[0.007]	[0.083]	[0.012]
ln R & D intensity	0.010***	0.015***	-0.053	0.021***
	[0.004]	[0.003]	[0.056]	[0.005]
ln Skill intensity	0.001	0.003***	0.025	0.004***
	[0.001]	[0.001]	[0.023]	[0.001]
ln Ad. Intensity	0.001	-0.005**	0.003	-0.005
	[0.003]	[0.002]	[0.035]	[0.003]
ln Tariff	-0.011***	-0.011***	0.011	-0.023***
	[0.003]	[0.002]	[0.027]	[0.005]
Observations	1449	1449	1449	1449
Number of Clusters	165	165	165	165
R-squared	0.379	0.476	0.182	0.486
p-value				
BPL test	0.00	0.00	0.00	0.00

Notes: Coefficients are estimated by random effect model. Robust standard errors in brackets. *** Significant at 1%. ** Significant at 5%. * Significant at 10%. Dependent variables in column (1), (2), (3), and (4) are the share of nonmultinational exporters, the share of multinationals, multinationals per nonmultinational exporters, and the share of exporters and multinationals, respectively. The interaction of region dummies with year dummies and constant are suppressed.

Table 4: Industry Description and Classification

Code	Description	Code	Description
121	Meat and meat products	239	Other rubber products
122	Fish and fish products	240	Leather and fur
123	Grain mill products	251	Glass and glass products
129	Other food products	252	Cement, lime and plaster
131	Beverages and tobacco products	259	Other non-metallic mineral products
132	Prepared animal feeds	261	Basic iron and steel
141	Spinning	262	Casting of iron and steel
142	Weaving	271	Non-ferrous metals
143	Dyeing	272	Casting of non-ferrous metals
149	Other textiles	281	Structural metal products
151	Knitted and crocheted fabrics and articles	289	Other fabricated metal products
152	Other wearing apparel	291	Machinery for metallurgy
161	Sawmilling and planing of wood	292	Other special purpose machinery
169	Other products of wood	293	Office machinery
170	Furniture	299	Other general purpose machinery
181	Paper and paper products	301	Industrial electricity machinery
182	Corrugated paper and paperboard	302	Household electrical appliances
191	Publishing of newspapers	303	Communication equipment
192	Publishing	304	Applied electronic apparatus
193	Printing	305	Electronic components
201	Chemical fertilizer and inorganic chemistry	309	Other electrical equipment
202	Organic chemistry	311	Motor vehicles
204	Soap and detergents	319	Other transport equipment
205	Pharmaceuticals and medicinal chemicals	321	Medical equipment
209	Other chemical products	322	Optical instruments
211	Refined petroleum products	323	Watches and clocks
219	Other petroleum products	329	Other precision instruments
220	Plastic products	340	Other manufacturing
231	Rubber tyres and tubes		