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MMRC-F-69

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Dynamic Evidence from Japanese Firms

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February 2006

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* The METI database employed in this analysis was prepared and analyzed in cooperation with the Japan Center for Economic Research and the Research and Statistics Department, Ministry of Economy, Trade, and Industry (METI). The authors would like to thank Kyoji Fukao, Keiko Ito, Masahito Kobayashi, Yoshiaki Omori, Shujiro Urata, Ryuhei Wakasugi, seminar and conference participants at the Japan Society of International Economics, METI, Research Institute of Economy, Trade and Industry (RIETI) and Yokohama National University, an anonymous referee, and managing editor Harmen Lehment for their helpful comments. Kozo Kiyota gratefully acknowledges the financial support of a grant-in-aid (B-2: 14330012) from Ministry of Education, Culture, Sports, Science and Technology. The views expressed herein are those of the authors.
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Abstract

This paper examines the relationship between exports, foreign direct investment and firm productivity. Using longitudinal panel data on Japanese firms, it is found that the most productive firms engage in exports and foreign direct investment, medium productive firms engage in either exports or foreign direct investment, and the least productive firms focus only on the domestic market. Moreover, exports and foreign direct investment appear to improve firm productivity once the productivity convergence effect is controlled for. Firms that retain a presence in foreign markets, either by exports or foreign direct investment, show the highest productivity growth, which contributes to improvements in national productivity. (103 words)

JEL Classification Codes: F10 (International Trade, General), F20 (International Factor Movements and International Business, General), D21 (Firm Behavior)

Keywords: Multinational Enterprises, Panel Data, Firm Heterogeneity, Total Factor Productivity, Firm Survival

1. Introduction

With the growing importance of firm heterogeneity, often represented as productivity differences among firms, recent studies in international trade have begun to incorporate firm heterogeneity. The pioneering works of Bernard et al. (2003) and Melitz (2003), for example, theoretically clarify the relationship between exports and firm heterogeneity, represented as productivity, in a general equilibrium framework. Although based on different models, they both conclude that the higher the productivity of the firm, the more it is likely to be an exporter.

This central prediction is confirmed in empirical studies utilizing firm/plant level longitudinal panel data.[1] For instance, Bernard and Jensen examined the benefits of exports at the plant level in the United States (Bernard and Jensen 1999, 2004a, and 2004b). They found that exporters exhibited 4–18 percent higher productivity than nonexporters, and confirmed this before the firms actually engaged in exports, although the impact of exports on productivity was less clear.

Similar findings have been observed in other countries: for instance, Clerides et al. (1998) in Colombia, Mexico, and Morocco; Bernard and Wagner (2001) in Germany; Hallward-Driemeier et al. (2002) in Indonesia, Korea, Malaysia, the Philippines, and Thailand; Baldwin and Gu (2003) in Canada. The results of these studies are summarized in Table 1. On average, previous work confirms that exporters have 10–15 percent higher productivity than nonexporters. In fact, these differences are observed before firms become exporters: put simply, good firms become exporters. However, it is not always the case that a firm improves its performance after entering the export market.

=== Table 1 ===

In addition to exporting activities, foreign direct investment (FDI) has recently become an important issue in the discussion on globalization.[2] Helpman et al. (2004) extend Melitz's study to incorporate FDI into a trade and firm heterogeneity model. Representing firm heterogeneity with productivity differences, their model predicts that the least productive firms serve only the domestic market. On the other hand, relatively more

[1] The pioneering micro study on exports and productivity is Aw and Hwang (1995). Using cross-sectional firm-level data on the Taiwanese electronics industry in 1986, they found significant differences in productivity between exporters and non-exporters.

[2] See Lewis and Richardson (2001) for an extensive survey of the related literature, as well as a heuristic explanation for the benevolent effects of various channels of global commitment by firms, including FDI.

productive firms export, and the most productive firms engage in FDI. Empirical analysis based on European firm data in 1996 partly confirms the theoretical prediction that multinational enterprises (MNE) are substantially more productive than non-MNE exporters.

Similarly, productivity differences between MNEs and non-MNEs, or between foreign-owned firms and domestically owned firms have been extensively investigated in other countries: Globerman et al. (1994) in Canada; Doms and Jensen (1998) in the United States; Girma et al. (2002) in the United Kingdom; Hallward-Driemeier et al. (2002) in Indonesia, Korea, Malaysia, the Philippines, and Thailand; Kimura and Kiyota (2006) in Japan. All of these studies, with the exception of Globerman et al. (1994), confirm that foreign-owned firms present higher productivity than domestic firms in the static sense.

The scope of most of these analyses is, however, limited to the static aspect, and the dynamic aspects of FDI are not yet fully explored yet. That is, do good firms engage in FDI; does FDI improve firm's performance; or is it some combination of both? These questions have not yet been addressed. Furthermore, the relationship between exports and FDI at the firm level is still ambiguous. As Helpman et al. (2004) assume, the sunk costs of starting global commitment can differ for exports and FDI. Further analysis is then needed to clarify the relationship among trade, FDI and firm productivity.

In this paper, we investigate the dynamic aspects of FDI as well as exports. Questions addressed are whether or not good firms conduct exports/FDI, and whether or not exports/FDI improve firm productivity. The data used is firm-level longitudinal panel data of Japanese firms 1994–2000, which covers not only manufacturing firms but also nonmanufacturing firms, with approximately 22,000 observations each year.

The paper is organized as follows. Section 2 discusses the characteristics of the sample consisting of approximately 22,000 firms, and presents static differences between exporters and nonexporters and between firms that engage in FDI and those that do not. Section 3 examines the relationships among exports, FDI and productivity from a dynamic perspective. Section 4 extends the analysis to link exports, FDI and aggregate productivity. Section 5 concludes by providing the implications of the results for policy and future research.

2. Static Aspects of Exports, FDI and Firm Productivity

2.1. Data

We use the micro database of *Kigyou Katsudou Kihon Chousa Houkokusho* (*The Results of*

the Basic Survey of Japanese Business Structure and Activities) by the Research and Statistics Department, Ministry of Economy, Trade and Industry (METI). This survey was first conducted in the 1991 financial year (F/Y), then again in the 1994 F/Y and annually thereafter. The main purpose of the survey is to statistically capture an overall picture of Japanese corporate firms in light of their activity diversification, globalization, and strategies on R&D and information technology.

One of the strengths of this survey is that it is based on firms, rather than establishments. Since the manufacturing census does not cover nonmanufacturing establishments, including headquarters or sales branches, the aggregation of manufacturing plants does not always truly depict the 'firm' unless it is a single-plant firm. In that sense, our data captures the activity of firms more accurately than the manufacturing plant census.

A further strength is its coverage and reliability. The survey includes all firms with more than 50 employees and more than 30 million yen in capital, covering both manufacturing and nonmanufacturing firms.[3] One limitation is the lack of some financial information.

From this survey, we develop a longitudinal panel data set for the years 1994 to 2000, based on each firm's permanent number. We define FDI as having more than one affiliate in foreign countries.[4] Exporters are defined as firms whose sales are oriented towards foreign countries. Other firms are defined as domestic firms.[5] We remove firms from our sample where age (questionnaire-level year minus establishment year), total wages, tangible assets, value-added (sales less purchases) or the number of regular workers (including temporary workers) were not positive and those firms that reenter the market. The number of firms included amounts to over 22,000 each year. The panel data set therefore comprises an unbalanced panel.

2.2. Stylized Facts

Before turning to the dynamic aspects, we provide an overview of some basic statistics.

[3] Some non-manufacturing industries, such as in finance, insurance and software services, are not included. The industry is determined by the major sales products of the firm.

[4] In this survey, Japanese foreign affiliate is defined as an affiliate with 20 percent of the equity coming from the Japanese parent firm. Note that our analysis includes both new and continuing investment. The METI database can identify whether a firm has its first foreign affiliate, but cannot identify whether a firm has its first foreign affiliate in a given country.

[5] We did not distinguish between foreign-owned and non-foreign-owned firms in Japan. In Japan, inward FDI is still very small and foreign-owned firms are in the minority. In terms of the total number of firms in 2000, only 1.2 percent was foreign-owned (Kiyota and Urata, 2005).

Figure 1 reports the number of exporters and firms engaged in FDI in 1994 and 2000. Exporters are clearly in the minority. In 2000, of the roughly 22,000 firms included in the sample, only 20 percent (4,382 firms) reported exports. This is almost the same proportion as the United States (Bernard et al. 2003). Firms that engage in FDI are even less. Only 13 percent (2,765 firms) engaged in FDI. Of all Japanese firms, 76 percent neither export nor engage in FDI. Similar results are obtained for 1994.

=== Figure 1 ===

FDI appears to have a close relationship with exports. In 2000, of the 2,765 firms engaged in FDI, roughly two-thirds (1,988 firms) exported. On the other hand, exporters do not always engage in FDI. Of the 4,382 exporters, just 45 percent (1,638 firms) engaged in FDI. Firms that engage in FDI but not export are again in the minority, accounting for some 4 percent (777 firms) of our sample.

2.3. Do Firms That Engage in Exports and FDI Perform Better?

To make a comparison across firms and time, we employ deterministic (nonstochastic) methods to compute total factor productivity (TFP) indexes. This follows pioneering work by Caves et al. (1982), extended in Good et al. (1983). This index employs a hypothetical firm that has the arithmetic mean values of log output, log input, and input cost shares over the firms in each year. Each firm's outputs and inputs are then measured relative to this hypothetical firm and the hypothetical firms are chain-linked over time. Hence, the index measures the TFP of each firm in year t relative to the hypothetical firm in year 0 (the initial year). A detailed explanation of the methodology and the data is provided in the Appendix.

The advantage of the multilateral index is that we do not assume *any* specific production function. This is because the multilateral index only requires information on the quantity of output, as opposed to parametric methods that require the specification of a production function. This is particularly useful when we cannot directly observe the production function for each firm.[6]

Table 2 presents the export and FDI premia.[7] The premium is the productivity

[6] The multilateral index method is also employed by Aw et al. (2000, 2003). Olley and Pakes (1996) discuss alternative productivity measures that are consistent with a dynamic and stochastic model of industry development. Levinsohn and Petrin (2003) extend Olley and Pakes (1996) such that intermediate input demand functions play the same role as investment. However, due to the data availability (our data do not cover intermediate inputs except "purchases"), this method was not feasible.

[7] Export/FDI premia are measured as the coefficients for export and FDI dummies in a regression of the form:

difference between exporter and nonexporter firms in the same industry and the year with the same characteristics that engage in FDI. Two major findings are presented in this table. First, firms engaging in exports and FDI tend to have higher productivity. Columns (1) and (2) present differences between exporters and nonexporters, while columns (3) and (4) show the differences between firms that engage in FDI and those that do not. The differences are between 3.5–5.0 percent with statistical significance.

=== Table 2 ===

Second, there is a systematic relationship among exports, FDI, and productivity. The most productive firms engage in both exports and FDI, the second highest productive firms engage only in FDI, while the third group engages only in exports. Columns (5) and (6) present differences among firms that export only, firms that engage in FDI only and firms that engage in both exports and FDI. The largest differences are observed for firms that engage in both exports and FDI, presenting 6.4–7.9 percent higher productivity than firms that do not export or engage in FDI. The next largest coefficients are observed for firms that engage in FDI only, followed by firms that export, but do not engage in FDI. The lowest productive firms engage in neither exports nor FDI, and stay in the domestic market.

These findings support the theoretical predictions of Helpman et al. (2004). Their model predicted that low productivity firms stay in the domestic market, firms with higher productivity export, and highest productivity firms engage in FDI. However, we found yet another outcome: highest productivity firms export and engage in FDI at the same time.

3. Dynamic Aspects of Exports, FDI and Firm Productivity

3.1. Do Good Firms Become Exporters/Engage in FDI?

We now examine the pre- and postentry performance of Japanese firms entering foreign markets. We focus on two channels for firms to enter the foreign market: exports and FDI. This section investigates possible determinants of the decision to export and/or invest abroad, as suggested by Roberts and Tybout (1997).

$\ln\theta_{it} = \alpha + \beta Y_{it} + \gamma \text{Char.s}_{it} + \varepsilon_{it}$, where θ is TFP, Y is a dummy variable indicating export/FDI status that takes a value of one if the firm is an exporter/FDI and zero otherwise, Char.s is the vector of firm characteristics and ε is the error term. Firm characteristics include the natural log of the capital-labor ratio, firm age, the number of workers, R&D expenditure-sales ratio, TFP, foreign-owned dummy as well as year and industry dummies. A foreign-owned dummy takes the value of one if foreign ownership is larger than ten percent and zero otherwise. The coefficient β indicates the gap between exporters and non-exporters (between firms that engage in FDI and firms that do not). A fixed-effects model is employed for the estimation on the basis of the results of a Hausman specification test.

Suppose that firm i exports in year t if current and expected profits of exports are greater than costs. Costs are defined as market-entry fixed costs (sunk costs) for exports F_{it} plus variable costs. Denote current profit and current profit excluding fixed costs as π_{it} and $\tilde{\pi}_{it}$, respectively. Fixed costs are required only if the firm did not export in the previous year. Exporting and non-exporting firms are distinguished by a variable Y_{it} which takes a value of one if firm i exports in year t and zero otherwise.[8] For simplicity, assume that this fixed cost is the same across all firms and years ($F_{it} = F$). Thus the profit π_{it} is described as $\pi_{it} = \tilde{\pi}_{it} - F(1 - Y_{it-1})$.

Denote the discount rate of future revenue as δ. Assume that in year t, firms choose an infinite sequence of values $(Y_{it}, Y_{it+1}, ...)$ that maximizes the expected value of revenue. Denote the maximized revenue as:

$$V_{it}(\Omega_{it}) = \max_{Y_{it}} E_t\left(\sum_{\tau=t}^{\infty} \delta^{\tau-t} \tilde{\pi}_{i\tau} \mid \Omega_{it}\right), \tag{1}$$

where Ω_{it} is the firm-specific information set. Using Bellman's equation, firm i's decision to export is represented as Y_{it} that satisfies:

$$V_{it}(\Omega_{it}) = \max_{Y_{it}} E_t\left(\tilde{\pi}_{it}(Y_{it}, Y_{it-1}, ...) + \delta E[V_{it+1}(\Omega_{it+1} \mid Y_{it}, Y_{it-1}, ...)]\right). \tag{2}$$

In the dynamic framework, the firm exports if the present value of current and future revenues of exporting is larger than the total costs (fixed plus variable). Denote the current profit and discounted increase in the value of the firm in the future if the firm exports in year t as:

$$\pi_{it}^{*} = \tilde{\pi}_{it} + \delta\left(E_t[V_{it+1}(\bullet) \mid Y_{it} = 1] - E_t[V_{it+1}(\bullet) \mid Y_{it} = 0]\right), \tag{3}$$

where $E[V_{it+1}(\bullet)]$ is the expected value of maximized payoff conditioned by Y_{it}. The decision to export by firm i is represented as:

$$Y_{it} = \begin{cases} 1 & \text{if } \pi_{it}^{*} > F(1 - Y_{it-1}); \\ 0 & \text{otherwise.} \end{cases} \tag{4}$$

In the empirical analysis, we specify the regression equation as follows:

$$Y_{it} = \begin{cases} 1 \text{if } \beta_0 + \sum_{k=1}^{K} \beta_k Z_{ikt-1} - F(1 - Y_{it-1}) + \mu_{it} > 0; \\ 0 \text{otherwise,} \end{cases} \tag{5}$$

where Z_{ikt-1} indicates firm-specific variables that may affect the probability of exporting in

[8] In our dataset, exports include sales by establishments abroad but exclude those by affiliates abroad.

period t; μ_{it} represents the error term.

There are several estimation strategies for this dynamic binary-choice model with unobserved heterogeneity, such as a probit model with random model (Roberts and Tybout 1997, and Bernard and Wagner 2001) or a linear probability model with fixed effects (Bernard and Jensen 1999, and Bernard and Wagner 2001). A linear probability model requires instruments such as two-period lags of the right-hand-side variables (Bernard and Wagner 2001). Since our sample period is not long enough to use such instruments, we employ the probit model with random effects of the form:

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k Z_{ikt-1} + FY_{it-1} + \mu_{it}. \qquad (6)$$

We introduce two-digit industry dummies for some of the regressions to control for industry characteristics including comparative advantage and market conditions.[9] Additional firm characteristics Z_{it-1} include the capital-labor ratio, firm age, the number of workers, the R&D expenditure-sales ratio, TFP, a foreign ownership dummy as well as year and industry dummies.[10] In order to avoid problems with possible simultaneity, we lag all explanatory variables by one year.[11]

We also assume that the initial conditions Y_{i0} are exogenous. If there are permanent unobserved firm-specific characteristics in the error term, the coefficient of the initial status Y_{i0} will be biased. In order to fix this problem, however, we need appropriate instruments such that the error term in estimating the initial status equation is to be freely correlated with the error term μ_{it}.[12] However, as was pointed out by Bernard and Wagner (2001), such instrument is difficult to find. Given the lack of the appropriate instrument, following Bernard and Wagner (2001), we estimate equation (6), assuming that the initial conditions are exogenously determined. Summary statistics and the correlation matrix of variables are provided in Table A1.

We also apply this analytical framework for the decision to engage in FDI. As for the

[9] Foreign market conditions could also affect the decision to export and/or conduct FDI. However, because of difficulties in obtaining relevant data, we do not introduce foreign market variables in addition to the industry dummies.

[10] These firm characteristics are similar to those used in estimating export/FDI premia in Section 2.3.

[11] For more details, see Bernard and Jensen (1999 p.12 and footnote 19).

[12] Note that the dependent variable is not a continuous but a discrete variable. In case of a continuous dependent variable, the Blundell and Bond (1998) GMM estimator may fix this type of problem as was shown in Görg, Hanley, and Strobl (2005), since it does not require the information on initial conditions. For more detail about the initial conditions problem, see Hsiao (2003).

FDI analysis, variable Y_{it} takes a value of one if a firm engages in FDI and zero otherwise. In this paper, the firm that engages in FDI is defined as the firm with one or more affiliates abroad.

Table 3 presents the regression results of equation (6) with random effects probit estimation. Columns (1) through (3) present the results for exports while columns (4) through (6) indicate the results for FDI. For exports, three features stand out. First, good firms become exporters. The coefficients of TFP are significantly positive in all equations. This implies that the higher the firm's productivity, the higher the probability of firms entering the export market. Second, sunk costs, as reflected by the coefficients for lagged export dummies, also appear to be an important factor when a firm decides to enter the export market. This finding is consistent with Roberts and Tybout (1997) and Bernard and Jensen (1999). Third, the probability of exports increases with a firm's size, research intensity, and age. Foreign ownership is another significant factor in the decision to export.

=== Table 3 ===

Similar results are observed for the decision to engage in FDI, with the exception of the ownership structure: foreign-owned firms are not more likely to invest abroad. Sunk costs for FDI, as reflected by the coefficients of the lagged FDI dummies, do not seem to be very different from the coefficients for exports. However, once the sample firms are separated by employment size, as presented in Table A2, we find that the sunk cost for FDI is slightly higher than that for exports for small-scale firms (less than 500 workers). This partly supports the assumptions in Helpman et al. (2004).

3.2. Do Exports and FDI Contribute to Productivity Growth?

We next examine the reverse effect: whether or not exports and FDI contribute to productivity growth. To test the effects of exports and FDI on productivity growth, following Bernard and Jensen (1999), we run a simple regression of changes in TFP (θ_{it}) on the initial export/FDI status (Y_{it}) and additional firm characteristics (Char.s_{it}):

$$\begin{aligned} \%\Delta\theta_{it} &= \ln\theta_{it} - \ln\theta_{it-1} \\ &= \alpha + \beta Y_{it-1} + \gamma \text{Char.s}_{it-1} + \varepsilon_{it}. \end{aligned} \tag{7}$$

The coefficient, β, represents the gap in the annual average growth rate of TFP performance between exporters/firms that invest abroad and other firms. Additional firm characteristics for the initial year are the same as those in Section 3.1.

Table 4 presents the regression results of equation (7) with the fixed-effects model.[13] Coefficients indicate the gap of annual average TFP growth rate between exporters/FDI firms and others. Columns (1) through (3) indicate the results without controlling for the initial TFP level, while columns (4) through (6) are the results controlling for the initial TFP level. We control for the initial productivity level since the higher productivity, the lower the subsequent growth if the productivity convergence effect over time holds.[14]

=== Table 4 ===

The results of columns (1) through (3) do not strongly support the hypothesis that exports and/or FDI improve productivity. However, once we control for the initial TFP level, a totally different story emerges. From columns (4) through (6), we can clearly see the positive impact of exports and FDI on productivity growth. Exporters have 2.4 percent higher growth than nonexporters. Firms that engage in FDI have 1.8 percent higher growth than those that do not engage in FDI. Firms that engage in both exports and FDI display the highest productivity growth.

The coefficients of initial TFP level are significantly negative.[15] These results suggest that a productivity convergence effect exists: firms with higher productivity tend to have lower growth in subsequent years, and vice versa. Since we use annual panel data, macro business cycles as well as annual idiosyncratic shocks at the firm level are leveled out over time. Without controlling for the initial TFP level, the regression could generate an omitted variable bias, which previous studies could not fully distinguish from the gains from trade. However, once we control for the initial TFP level, or productivity convergence effect, we can confirm the gains from trade: both exports and FDI improve firm productivity.

[13] We select a fixed-effects model based on the results of a Hausman specification test.

[14] The productivity convergence model assumes that productivity in firm i evolves according to: $\ln\theta_{it} = \gamma_i + \lambda \ln D_{it} + \lambda \ln\theta_{it-1} + \ln\varepsilon_{it}$, where γ_i is the asymptotic rate of productivity growth of firm i, D_{it} represents the catch-up variable, and ε_{it} stands for the firm-specific productivity shock. The catch-up variable, D_{it}, is defined as a function of the productivity of firm i, θ_{it-1}, relative to the most productive firm, θ^*_{it-1}: $\ln D_{it} = -\ln(\theta_{it-1}/\theta^*_{it-1}) = -\ln(\hat{\theta}_{it-1})$, where $\hat{\theta}_{it-1} = \theta_{it-1}/\theta^*_{it-1}$. This formation leads to the productivity convergence equation: $\ln\hat{\theta}_{it} - \ln\hat{\theta}_{it-1} = \alpha_i + \beta \ln\hat{\theta}_{it-1} + \mu_{it}$ with negative β. See Bernard and Jones (1996), Wolff (1991) and Pascual and Westermann (2002) for the analysis of TFP convergence.

[15] Note that the dependent variable is percentage growth. The coefficients are one hundred times larger than those from traditional convergence regressions.

4. Alternative Aspects of the Gains from Exports and FDI

4.1. Is 'Survival' in Foreign Markets Important?

To statistically test the importance of surviving in foreign markets, we run a similar regression to equation (7), including the following three dummy variables:

$$\begin{aligned}\%\Delta\theta_{it} &= \ln\theta_{it} - \ln\theta_{it-1} \\ &= \alpha + \beta_1 \text{Start}_{it} + \beta_2 \text{Both}_{it} + \beta_3 \text{Stop}_{it} + \gamma \text{Char.s}_{it-1} + \varepsilon_{it},\end{aligned} \tag{8}$$

where $\text{Start}_{it} = 1$ if $(Y_{it-1} = 0) * (Y_{it} = 1)$

$\text{Both}_{it} = 1$ if $(Y_{it-1} = 1) * (Y_{it} = 1)$

$\text{Stop}_{it} = 1$ if $(Y_{it-1} = 1) * (Y_{it} = 0)$

Additional firm characteristics are the same as those in Section 3.2, controlling for the productivity convergence effect. If the continuation of exports and FDI, or the 'survival' in the foreign market is important for the productivity growth of the firm, the coefficients β_2 should be positive and larger than β_1 and β_3.

Table 5 presents the regression results. All coefficients for "Start," "Both," and "Stop" exhibit positive and statistically significant signs for both exports and FDI. The coefficients "Both" are larger than those of "Start," and the coefficients of "Stop" are the smallest. These imply that firms that continue to export and/or conduct FDI have the highest growth, while firms that just enter foreign market via exports and/or conduct FDI show relatively modest growth. Firms that exit from foreign markets display relatively low TFP growth, though their growth is still higher than that of firms which never entered foreign markets. To continue to export and engage in FDI, or survive in the foreign market, is therefore important for the productivity growth of a firm.

=== Table 5 ===

In Table 4, we confirmed that the interaction term between exports and FDI is an important factor for analyzing TFP growth. A recent study by Kiyota and Urata (2005) found that firms do not make a choice between exporting and undertaking FDI, but exporters do make a decision on whether or not to undertake FDI. In order to control for the simultaneous effects of exports and FDI, we introduce an interaction term between exports and FDI as follows:

$$\begin{aligned}\%\Delta\theta_{it} &= \ln\theta_{it} - \ln\theta_{it-1} \\ &= \alpha + \beta_1 \text{ExpStart}_{it} + \beta_2^0 \text{ExpBoth}_{it} + \beta_2^1 \text{ExpBoth\_FDIStart}_{it} \\ &\quad + \beta_2^2 \text{ExpBoth\_FDIBoth}_{it} + \beta_2^3 \text{ExpBoth\_FDIStop}_{it} + \beta_3 \text{ExpStop}_{it} \\ &\quad + \gamma \text{Char.s}_{it-1} + \varepsilon_{it},\end{aligned} \tag{9}$$

where ExpStart_{it}, ExpBoth_{it}, and ExpStop_{it} are the same as equation (8) for exports but ExpBoth_{it} is now decomposed into four parts. $\text{ExpBoth\_FDIStart}_{it}$ is a dummy variable that takes a value of one if exporters between years $t-1$ and t commence FDI in year t, $\text{ExpBoth\_FDIBoth}_{it}$ is a dummy variable that takes a value of one if exporters between years $t-1$ and t commence FDI in the same period, and $\text{ExpBoth\_FDIStop}_{it}$ is a dummy variable that takes a value of one if exporters between year $t-1$ and t quit FDI in year t.

Column (3) in Table 5 indicates the estimation results of equation (9). The coefficient of ExpBoth_{it} has a positive and significant sign, implying that the continuation of exports contributes to productivity growth. The coefficient of $\text{ExpBoth\_FDIBoth}_{it}$ also has a positive sign, but it is not significant. On the other hand, the coefficients of $\text{ExpBoth\_FDIStart}_{it}$ and $\text{ExpBoth\_FDIStop}_{it}$ are negative, but not significant.

4.2. Do Exports and FDI Contribute to Survival in the Domestic Market?

To address this question, we estimate Cox's proportional hazard model of the form:

$$h_{it} = h_{0it} \exp(\beta Y_{it} + \gamma Z_{it}), \tag{10}$$

where h_{it} is firm i's hazard rate and h_{0it} is a baseline hazard rate.[16] The hazard rate is defined as "the rate at which spells are completed after duration t, given that they last at least until t" (Greene 2003). Y_{it} represents the export/FDI status in year t, and Z_{it} is a vector of corporate characteristics in year t and other variables used in Section 3.1.

The advantage of this analysis is that it requires no prior assumption on the distribution of exit timing. Also, the hazard rate directly captures the probability that a firm will exit in the next short interval of time given that it survives until time t. The estimated coefficients are interpreted as the ratio of hazards for a one-unit change in the corresponding covariate (vector). For instance, suppose that we focus on the FDI status and $\beta = 0.09$. This

[16] The equation does not have an intercept because the baseline hazard cannot be explicitly specified (and is therefore not estimated). Since $h_{it} = h_{0it} \exp(\alpha + \beta Y_{it} + \gamma Z_{it}) = \{h_{0it} \exp(\alpha)\} \exp(\beta Y_{it} + \gamma Z_{it})$, it simply changes the baseline hazard from h_{0it} to $\{h_{0it} \exp(\alpha)\}$, both of which are not defined. Hence, any value works for α.

means that firms that engage in FDI face a hazard 10 percent greater than firms that do not since $\exp(0.09) \approx 1.10$. On the other hand, if $\beta = -0.11$, firms that engage in FDI face a hazard 10 percent lower than firms that do not ($\exp(-0.11) \approx 0.9$). If exports/FDI has a positive contribution on firm survival, the coefficient β must be significantly *negative*.

Table 6 presents the regression results of equation (10). Exports have positive impacts on firm survival. The hazard rates of exports are 0.82–0.93, meaning that exporters face a hazard rate 7–18 percent lower than nonexporters.

=== Table 6 ===

On the other hand, FDI has negative impacts on firm survival. The hazard rates of firms that engage in FDI is between 1.09–1.23, meaning that FDI firms face hazard rates 9–23 percent greater than non-FDI firms. An explanation may be that FDI imposes high financial or managerial burdens on some firms, particularly small- and medium-sized enterprises, such that the probability of exit is higher.[17]

5. Concluding Remarks

In this paper, we examine the relationship between exports, FDI and productivity using firm level longitudinal panel data for Japan between 1994 and 2000. Our major findings are as follows: firms that engage in exports and FDI are in the minority. Most firms that engage in FDI are exporters, while exporters do not always engage in FDI. The most productive firms are those that engage in FDI and export. Medium productive firms engage in either exports or FDI. The least productive firms neither export nor invest abroad.

These findings are consistent with theoretical predictions by Helpman et al. (2004). Their model suggests that low productivity firms stay in the domestic market, higher productivity firms export, and highest productivity firms engage in FDI. Our contribution is that there is an additional choice. The highest productivity firms export as well as engage in FDI. This may be caused by MNEs operating foreign affiliates in several countries, or by intra-firm trade between headquarters and foreign affiliates. Exports and FDI do not seem to be "substitutes." Rather, both work as "complements" in designing global operations of MNEs.

We also found that productivity was an important factor explaining the decision to engage in FDI as well as export. Moreover, both exports and FDI do improve firm

[17] Kimura and Fujii (2003) found that small firms could benefit from exports, but that conducting FDI aggravated rather than improved the performance.

productivity, once we control for the productivity convergence effect. The positive impact of exports and FDI on productivity growth has a potential policy implication: survival in foreign markets is likely to result in higher productivity growth for both the firm and the economy. Hence, the facilitation of exports or the enhancement of global commitment has some validity, though more discussion on implementation and sequencing is required. We should also keep in mind that FDI has a possible negative impact on firm survival.

Future research should include a more thorough investigation of the mechanics of interaction between global commitment and productivity. A clue may be found by examining the differential effects of the various types of global commitment. For instance, various types of international trade exist, including inter-industry, vertical and horizontal intra-industry, arm's-length/intra-firm, and so on. There are also different types of FDI possible, including horizontal, vertical, manufacturing/nonmanufacturing, etc. Although serious data limitations exist, more thorough analyses would provide useful feedback for existing theoretical insights.

Appendix: Construction of the Multilateral TFP Index

Methodology

The multilateral index measures the TFP of each firm in year t relative to that of a hypothetical firm in year 0 (the initial year). The hypothetical firm is the firm that has the arithmetic mean values of log output, log input, and input cost shares over firms in each year. Suppose that the TFP of this hypothetical firm is equal to one. The TFP index for firm i in year t relative to that of the hypothetical firm in the initial year is defined as

$$\ln \theta_{it} \approx \left(\ln Q_{it} - \overline{\ln Q_t}\right) + \sum_{\tau=2}^{t}\left(\overline{\ln Q_\tau} - \overline{\ln Q_{\tau-1}}\right) - \sum_{j=1}^{J}\frac{1}{2}\left(s_{ijt} + \bar{s}_{jt}\right)\left(\ln X_{ijt} - \overline{\ln X_{jt}}\right) - \sum_{\tau=2}^{t}\sum_{j=1}^{J}\frac{1}{2}\left(\bar{s}_{j\tau} + \bar{s}_{j\tau-1}\right)\left(\overline{\ln X_{j\tau}} - \overline{\ln X_{j\tau-1}}\right),$$

where $\ln Q_{it}$, $\ln X_{ijt}$, and s_{ijt} are the log output, log input of factor j, and the cost share of factor j for firm i, respectively. $\overline{\ln Q_t}$, $\overline{\ln X_{jt}}$, and $\bar{s}_{jt}$ are the values of the hypothetical firm in year t and are equal to the arithmetic means of corresponding variables over all firms in year t. The first term on the right hand side is the deviation of the firm's output from the output of the hypothetical firm in year t, and the second term is the cumulative change in the output the hypothetical firm between year t and year, $t = 0$. The same operations are applied to each input j, weighted by the average of the cost shares.

Data

Output is defined as value-added, while the inputs are capital and labor. The main advantage of value-added is its aggregation property. This is because it is difficult to aggregate firm level productivity to the whole economy level if we use gross output: value-added is directly comparable across industries. For other data and their manipulation, we adopt the methodology described in the Appendix in Nishimura et al. (2005).

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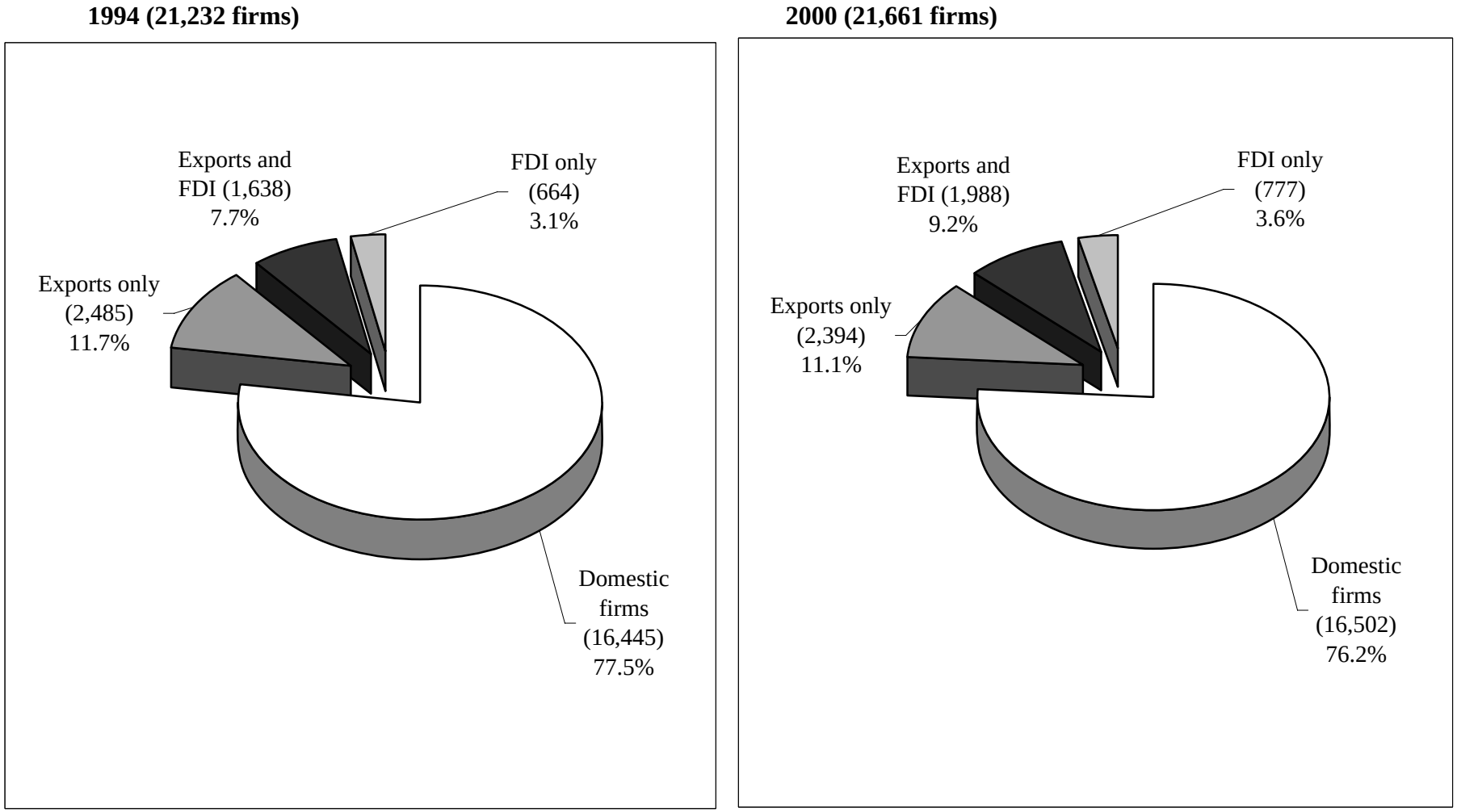
Figure 1: ***Exports and FDI of Japanese Firms, 1994 and 2000***



Source: METI database.

Table 1: ***Export, FDI and Productivity of Firm: Summary Results of Previous Studies***

Exports and productivity					
Authors	Roberts and Tybout (1997)	Clerides, Lach, and Tybout (1998)	Bernard and Jensen (1999)	Aw, Chung, and Roberts (2000)	Bernard and Jensen (2004a)
Country	Colombia	Colombia, Mexico, and Morocco	United States	Korea and Taiwan	United States
Unit	Plants	Firms and plants	Plants	Firms and plants	Plants
Period	1981-1989	1981-1991 (Colombia); 1986-1990 (Mexico); 1984-1991 (Morocco)	1984-1992	1981-1991 (Taiwan); 1983-1993 (Korea)	1983-1992
Industry	Manufacturing	Manufacturing (Table 7)	Manufacturing	Manufacturing	Manufacturing
Do exporters perform better?	Not examined	Yes	3.5-18.1% (Table 1)	3.9-31.1% (Table 2)	8-9% (p.9)
With control?	Not examined	Yes	Yes	No	No
Do good firms (plants) become exporters?	Yes	Yes	Yes	Yes for Taiwan	Yes
Do exports improve productivity?	Not examined	No	No	No for both countries	No
Authors	Bernard and Wagner (2001)	Baldwin and Gu (2003)	Bernard, Eaton, Jensen, and Kortum (2003)	Hallward-Driemeier, Iarossi, and Sokoloff (2002)	Bernard and Jensen (2004b)
Country	Germany	Canada	United States	Indonesia, Korea, Malaysia, Philippines, and Thailand	United States
Unit	Plants	Plants	Plants	Plants	Plants
Period	1978-1992	1974-1996	1992	1996-1998	1984-1992
Industry	Manufacturing	Manufacturing	Manufacturing	Manufacturing	Manufacturing
Do exporters perform better?	Not examined	4.0-15.0% (p.641)	15-33% (Table 2) [a]	Yes	11-12% (Table 3) [a]
With control?	Not examined	Yes	Yes	Yes	Yes
Do good firms (plants) become exporters?	Yes [a]	Yes	Not examined	Not examined	Yes (but not robust)
Do exports improve productivity?	Not examined	Yes	Not examined	Not examined	Not examined
FDI and productivity					
Authors	Globerman, Ries, and Vertinsky (1994)	Doms and Jensen (1998)	Girma, Thompson, and Wright (2002)	Hallward-Driemeier, Iarossi, and Sokoloff (2002)	Kimura and Kiyota (2006)
Country	Canada	United States	United Kingdom	Indonesia, Korea, Malaysia, Philippines, and Thailand	Japan
Unit	Plants	Plants	Firm	Plants	Firms
Period	1986	1987	1989-1994	1996-1998	1994-1997
Industry	Manufacturing	Manufacturing	Manufacturing	Manufacturing	All industry [b]
Do foreign-owned firms perform better than domestic firms?	Not significant difference (Table 2) [a]	2.3-2.4% (Table 7.4)	14% (Table 2)	Yes	67.2-101.8% (Table 3)
With control?	Yes	Yes	Yes	Yes	No

Notes: a) Labor productivity
b) Except some non-manufacturing industries such as agriculture, finance and insurance, software.

Table 2: ***Export and FDI Premia***

Dependent variable: TFP level	(1)	(2)	(3)	(4)	(5)	(6)
Export dummy	3.95	3.54				
	[7.05]	[6.37]				
FDI dummy			5.04	3.79		
			[7.79]	[5.89]		
FDI & Export dummy					8.00	6.43
					[9.38]	[7.57]
FDI only dummy					5.96	4.82
					[6.81]	[5.54]
Export only dummy					4.16	3.86
					[6.83]	[6.37]
Year dummy	No	Yes	No	Yes	No	Yes
Industry dummy	No	Yes	No	Yes	No	Yes
Firm characteristics	Yes	Yes	Yes	Yes	Yes	Yes
N	153,147	153,147	153,147	153,147	153,147	153,147
R^2	0.040	0.050	0.040	0.050	0.040	0.050

Notes: a) Fixed-effect model is used for estimation.
b) All differences are significant at 1% level and figures in brackets indicate t-statistics.

c) Estimated coefficients indicate the gap (%) of TFP level between exporters/firms engages in FDI and other firms

Source: METI Database

Table 3: ***Determinants of the Decision to Export and to Engage in FDI, 1994-2000***

Dependent variable:	All firms					
	Export dummy (t)			FDI dummy (t)		
	(1)	(2)	(3)	(4)	(5)	(6)
Export dummy	3.10***	3.01***	2.91***			0.62***
	[216.98]	[204.35]	[192.44]			[34.40]
FDI dummy			0.59***	3.05***	3.00***	2.82***
			[28.77]	[176.54]	[171.73]	[155.89]
TFP	0.18***	0.16***	0.13***	0.17***	0.14***	0.10***
	[14.64]	[12.52]	[10.43]	[12.82]	[10.16]	[6.60]
Number of workers	0.09***	0.13***	0.06***	0.22***	0.26***	0.24***
	[12.37]	[17.69]	[7.67]	[28.42]	[31.45]	[28.95]
Capital-labor ratio (millions of yen, 1994 prices)	0.02***	0.02***	0.01	0.07***	0.07***	0.07***
	[3.95]	[3.30]	[1.05]	[10.02]	[9.47]	[9.07]
R&D expenditure-sales ratio (%)	0.05***	0.04***	0.04***	0.03***	0.02***	0.01**
	[17.76]	[12.06]	[10.98]	[11.90]	[7.36]	[2.47]
Age	0.11***	0.09***	0.07***	0.12***	0.10***	0.05***
	[8.28]	[6.61]	[5.20]	[7.37]	[5.88]	[3.05]
Foreign ownership dummy	0.27***	0.24***	0.27***	-0.08	-0.09*	-0.21***
	[6.28]	[5.46]	[6.28]	[1.53]	[1.88]	[4.43]
Constant	-2.79***	-3.19***	-2.76***	-3.75***	-4.12***	-3.89***
	[51.88]	[40.34]	[34.14]	[58.30]	[46.37]	[43.86]
Year dummy	No	Yes	Yes	No	Yes	Yes
Industry dummy	No	Yes	Yes	No	Yes	Yes
N	121,825	121,825	121,825	121,825	121,825	121,825
AIC	0.323	0.312	0.305	0.244	0.240	0.230
Log-Likelihood	-19682.0	-18971.9	-18554.2	-14878.1	-14571.6	-13994.0

Notes: a) Random-effect probit model is used for estimation.
b) ***, **, and * indicate level of significance at 1%, 5%, and 10% and figures in brackets indicate z-statistics.

c) All independent variables are at period t-1. We take natural log for TFP, number of workers, capital-labor ratio and age.

Source: METI Database

Table 4: ***Effects of Exports and FDI on TFP Growth***

Dependent variable: annual average TFP growth (%)						
	All firms					
	Without controlling for "convergence" effect			With controlling for "convergence" effect		
	(1)	(2)	(3)	(4)	(5)	(6)
Export dummy	-0.20			2.41***		
	[0.24]			[3.86]		
FDI dummy		-0.69			1.83**	
		[0.74]			[2.57]	
FDI & Export dummy			-0.31			3.91***
			[0.25]			[4.14]
FDI only dummy			-2.19*			1.84*
			[1.74]			[1.91]
Export only dummy			-0.76			2.39***
			[0.86]			[3.52]
ln TFP (initial TFP level)				-87.87***	-87.86***	-87.88***
				[263.69]	[263.66]	[263.69]
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Initial TFP level	No	No	No	Yes	Yes	Yes
N	121,825	121,825	121,825	121,825	121,825	121,825
R^2	0.02	0.02	0.02	0.43	0.43	0.43

Notes: a) Fixed-effect model is used for estimation.
b) ***, **, and * indicate level of significance at 1%, 5%, and 10%, respectively. Figures in brackets indicate t-statistics.
c) Estimated coefficients indicate the gaps of the growth rate between exporters/firms that engage in FDI and other firms.

Source: METI Database

Table 5: ***Effects of Exports and FDI on TFP Growth: Extended Analysis***

Dependent variable: annual average TFP growth (%)			
	(1)	(2)	(3)
Exports, Start	2.19***		2.19***
	[2.67]		[2.67]
Exports, Both	3.89***		3.58***
	[4.74]		[4.01]
Exports, Both & FDI, Start			-0.02
			[0.02]
Exports, Both & FDI, Both			1.29
			[1.20]
Exports, Both & FDI, Stop			-1.61
			[1.08]
Exports, Stop	2.50***		2.48***
	[2.85]		[2.83]
FDI, Start		2.42**	
		[2.45]	
FDI, Both		4.38***	
		[4.60]	
FDI, Stop		0.44	
		[0.40]	
Year dummy	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes
Initial TFP level	Yes	Yes	Yes
N	121,825	121,825	121,825
R^2	0.43	0.43	0.43

For notes and sources, see Table 4.

Table 6: ***Determinants of Firm Survival in Domestic Market***

	(1)	(2)	(3)	(4)	(5)
Export dummy	-0.20***	-0.07*			-0.12***
	[5.41]	[1.78]			[2.94]
FDI dummy			0.09*	0.16***	0.21***
			[1.85]	[3.18]	[4.00]
TFP	-0.20***	-0.19***	-0.22***	-0.20***	-0.19***
	[10.04]	[9.07]	[11.07]	[9.62]	[9.27]
Number of workers	-0.64***	-0.65***	-0.66***	-0.66***	-0.66***
	[35.85]	[35.45]	[36.25]	[35.84]	[35.63]
Capital-labor ratio (millions of yen, 1994 prices)	-0.13***	-0.09***	-0.14***	-0.10***	-0.09***
	[14.19]	[9.73]	[14.52]	[10.00]	[9.95]
R&D expenditure-sales ratio (%)	-0.01	0.00	-0.03**	0.00	0.00
	[1.19]	[0.53]	[2.49]	[0.00]	[0.36]
Age	-0.75***	-0.72***	-0.76***	-0.73***	-0.73***
	[38.20]	[29.60]	[38.35]	[29.66]	[29.62]
Foreign ownership dummy	0.56***	0.48***	0.50***	0.46***	0.50***
	[5.80]	[4.96]	[5.19]	[4.76]	[5.09]
Year dummy	No	Yes	No	Yes	Yes
Industry dummy	No	Yes	No	Yes	Yes
Hazard rate					
Exports	0.82	0.93			0.89
FDI			1.09	1.17	1.23
N	118,415	118,415	118,415	118,415	118,415
AIC	0.907	0.871	0.871	0.907	0.871
Log-Likelihood	-53690.1	-51514.2	-51506.5	-53703.7	-51510.9

Notes: a) Cox's proportional hazard model is used for estimation.
b) ***, **, and * indicate level of significance at 1%, 5%, and 10%, respectively. Figures in brackets indicate z-statistics.

Source: METI Database

Table A1: ***Summary Statistics and Correlation Matrix***

	Summary statistics			Correlation matrix										
Variable	*N*	Mean	S.D.	FDID	EXPD	FDIEXPD	FDIonlyD	EXPonlyD	L	KL	RDS	Age	FOD	TFP
FDI dummy	153,147	0.12	0.32	1.000										
Export dummy	153,147	0.20	0.40	0.470	1.000									
FDI & Export dummy	153,147	0.09	0.28	0.829	0.608	1.000								
FDI only dummy	153,147	0.03	0.18	0.511	-0.095	-0.058	1.000							
Export only dummy	153,147	0.12	0.32	-0.134	0.722	-0.111	-0.068	1.000						
L	153,147	5.17	0.99	0.367	0.231	0.328	0.151	0.003	1.000					
Capital-labor ratio (millions of yen, 1994 prices) (KL)	153,147	1.65	1.31	0.140	0.103	0.117	0.070	0.027	0.101	1.000				
R&D expenditure-sales ratio (%) (RDS)	153,147	0.51	1.81	0.206	0.268	0.229	0.017	0.136	0.198	0.087	1.000			
Age	153,147	3.47	0.57	0.153	0.137	0.145	0.051	0.046	0.129	0.300	0.056	1.000		
Foreign ownership dummy (FOD)	153,147	0.02	0.15	0.103	0.164	0.104	0.023	0.114	0.159	0.030	0.123	-0.030	1.000	
Total factor productivity (TFP, natural log)	153,147	-0.01	0.62	0.148	0.193	0.144	0.043	0.116	0.065	-0.118	0.096	-0.014	0.139	1.000
Variable	*N*	Mean	S.D.	FDID	EXPD	TFP	L	KL	RDS	AGE	FOD			
FDI dummy (t-1)	131,486	0.12	0.32	1.000										
Export dummy (t-1)	131,486	0.20	0.40	0.467	1.000									
TFP (t-1)	131,486	-0.02	0.60	0.148	0.191	1.000								
L (t-1)	131,486	5.17	0.98	0.370	0.236	0.066	1.000							
Capital-labor ratio (millions of yen, 1994 prices) (KL) (t-1)	131,486	1.65	1.28	0.141	0.103	-0.096	0.108	1.000						
R&D expenditure-sales ratio (%) (RDS) (t-1)	131,486	0.57	1.86	0.220	0.287	0.105	0.207	0.094	1.000					
Age (t-1)	131,486	3.47	0.56	0.151	0.135	-0.010	0.129	0.292	0.062	1.000				
Foreign ownership dummy (FOD) (t-1)	131,486	0.02	0.14	0.093	0.162	0.133	0.152	0.030	0.132	-0.030	1.000			

Note: For the definition of variables, see main text.

Source: METI database.

Table A2: ***Determinants of the Decision to Export and to Engage in FDI, by Employment Scale***

Dependent variable:	less than 100 workers		100-500 workers		500-1000 workers		more than 1000 workers	
	Export dummy (t)	FDI dummy (t)	Export dummy (t)	FDI dummy (t)	Export dummy (t)	FDI dummy (t)	Export dummy (t)	FDI dummy (t)
	(a1)	(a2)	(a3)	(a4)	(a5)	(a6)	(a7)	(a8)
Export dummy	3.07***		2.97***		3.04***		3.04***	
	[109.12]		[150.50]		[60.39]		[53.65]	
FDI dummy		3.12***		3.00***		2.86***		2.91***
		[77.49]		[126.69]		[61.67]		[55.52]
TFP	0.18***	0.15***	0.16***	0.13***	0.14***	0.13***	0.06	0.16***
	[7.50]	[4.87]	[9.07]	[6.89]	[3.30]	[3.28]	[1.32]	[3.54]
Number of workers	0.08	0.31***	0.14***	0.27***	0.09	0.22***	0.00	0.26***
	[1.41]	[4.11]	[6.95]	[11.91]	[0.96]	[2.62]	[0.12]	[6.39]
Capital-labor ratio (millions of yen, 1994 prices)	0.01	0.05***	0.03***	0.07***	0.05*	0.12***	0.05*	0.15***
	[1.15]	[3.41]	[3.01]	[6.36]	[1.83]	[4.82]	[1.82]	[5.17]
R&D expenditure-sales ratio (%)	0.03***	0.03***	0.04***	0.02***	0.06***	0.04***	0.06***	0.03***
	[3.88]	[3.15]	[9.20]	[4.84]	[4.63]	[3.35]	[5.06]	[2.99]
Age	0.08***	0.04	0.09***	0.08***	0.19***	0.25***	0.09	0.21***
	[3.26]	[1.11]	[4.77]	[3.69]	[3.64]	[4.83]	[1.59]	[3.76]
Foreign ownership dummy	0.41***	-0.22	0.30***	0.04	0.16	-0.22*	0.14	-0.14
	[3.95]	[1.31]	[4.68]	[0.51]	[1.15]	[1.66]	[1.53]	[1.49]
Constant	-2.96***	-4.03***	-3.15***	-4.15***	-3.35***	-4.21***	-2.23***	-4.53***
	[9.76]	[10.52]	[22.70]	[25.71]	[5.29]	[7.19]	[6.51]	[12.49]
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	39,837	39,837	64,397	64,397	9,675	9,675	7,916	7,916
AIC	0.268	0.153	0.330	0.252	0.343	0.402	0.349	0.378
Log-Likelihood	-5299.8	-3022.2	-10601.8	-8086.9	-1623.1	-1908.4	-1348.6	-1462.5

Note: See Table 3.
Source: METI Database