Quantitative Evaluation of Determinants of Export and FDI: Firm-Level Evidence from Japan *

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March, 2009

Abstract

This paper examines determinants of the export and FDI decision, using firm-level data for Japan. Contributions of this paper are twofold. First, this paper employs a mixed logit model to incorporate unobserved characteristics of firms. Second, special attention is paid to quantitative evaluation of effects of the covariates. We find that the impact of productivity on the export and FDI decision is positive and statistically significant but economically negligible in size, despite the theoretical prediction of recent heterogeneous-firm trade models. The impact of the firm size and information spillovers from experienced neighboring firms in the same industry are also positive but small in size. Quantitatively, the dominant determinants of the export and FDI decision are firms' status on internationalization in the previous year and unobserved firm characteristics. The evidence suggests that there may be some kind of inefficiency in the selection process of exporters and FDI firms.

Keywords: export; foreign direct investment; productivity; mixed logit; Japan

JEL classifications: F10; F21

*This research was conducted as part of the project on "International Trade and Firms" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The author would like to thank RIETI for providing us with the opportunity to conduct this research and the Ministry of Economy, Trade and Industry (METI) for providing the valuable data sets. The author is also grateful to Richard Baldwin, Banri Ito, Toshiyuki Matsuura, Hitoshi Sato, Ryuhei Wakasugi, and seminar participants at the World Trade Institute and La Trobe University for helpful comments. The opinions expressed and arguments employed in this paper are the sole responsibility of the author and do not necessarily reflect those of RIETI, METI, or any institution the author is related to.

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1 Introduction

Recent empirical studies on international trade at the firm level have found that firms engaging in export or foreign direct investment (FDI) are generally more productive and larger than firms serving only the domestic market (Clerides, Lach and Tybout, 1998; Bernard and Jensen, 1999, 2004; Head and Ries, 2003; and Tomiura, 2007, among many others). This finding is consistent with theoretical predictions of heterogeneous-firm trade models, most notably those of Melitz (2003) and Helpman, Melitz, and Yeaple (2004), in which only productive firms can pay costs associated with export and FDI and hence can serve foreign markets. The consistency between theory and empirics has deepened our understanding on firms' internationalization.

However, there are still several unsolved questions in the literature. In particular, it is found that a number of firms that are as productive as those engaging in export or FDI do not engage in either of the international activities. Figure 1 shows the distribution of the log of total factor productivity (TFP) of four types of Japanese firm:[1] those serving only the domestic market ("domestic firms"), those engaging in export but not in FDI ("pure exporters"), those engaging in FDI but not in export ("pure FDI firms"), and those engaging in both ("export and FDI firms"). On average, firms serving only the domestic market are less productive than exporters and FDI firms, but the distribution of the four types of firm overlaps with each other to a great extent. In other words, many firms do not serve foreign markets although they are as productive as many exporters and FDI firms. Mayer and Ottaviano (2007, Figure 4) show that this is also the case for Belgian firms. This evidence suggests that there should be other key determinants of firm-level internationalization besides productivity. Thus, this study reexamines determinants of the export and FDI decision, incorporating unobserved firm characteristics and paying special attention to the quantitative size of the impact of each determinant in addition to its statistical significance.

For this purpose, we use firm-level data from Japan and estimate a mixed logit model, or a multinomial logit model with random intercepts and random coefficients, in which firms choose whether export or not and whether conduct FDI or not simultaneously. More precisely, we assume three types of firm: domestic firms, pure exporters, and firms engaging

[1] The figure is taken from Wakasugi et al. (2008) and is based on firm-level data for Japanese firm described below.

in FDI (FDI firms). The existing studies such as Bernard and Jensen (1999), Bernard and Wagner (2001), and Bernard and Jensen (2004) mostly focus on binary choices, i.e., whether exporting or not, or performing FDI or not. This is the case for the most existing studies using Japanese firm-level data, such as Kiyota and Urata (2005), Kimura and Kiyota (2006), and Ito (2007). Exceptions are Head and Ries (2003) and Tomiura (2007) who consider multiple choices, but they do not employ formal multiple-choice regression models. The use of the mixed logit model enables us to take account of simultaneous decisions on export and FDI theoretically examined in Helpman, Melitz, and Yeaple (2004). In addition, we incorporate random intercepts and random coefficients on the previous firm status in the export and FDI decision to control for unobserved firm heterogeneity and to correct for biases due to endogeneity.

In addition to standard covariates that determine the export and FDI decision, such as the productivity level and the firm size, this study examines the impact of credit constraints.[2] Firms under credit constraints, even if they are sufficiently productive, may not be able to engage in export or FDI, since they cannot finance initial costs required for the international activities. Muûls (2008) examines the same issue using a bankruptcy risk measure provided by a credit insurance company, Coface, as a measure of the degree of credit constraints and finds that credit constraints indeed affect the export decision of Belgian firms. This paper uses the ratio of long-term debts to total assets to proxy for the extent of credit constraints faced by each firm.

We also examines effects of intra-region and intra-industry spillovers. Export and FDI are often costly due to lack of information on foreign markets. If neighboring firms in the same industry have experiences in foreign markets, spillovers of information on foreign markets from these firms may stimulate internationalization of other firms. Aitken, Hanson, and Harrison (1997) first investigate whether spillovers from other firms promote export, using firm-level data from Mexico. They find evidence of spillovers from multinational enterprises but not from exporting firms. Greenaway, Sousa, and Wakelin (2004) using U. K. data obtain similar results. By contrast, Bernard and Jensen (2004) using U.S. data and Barrios, Görg, and Strobl (2003) using Spanish data find positive spillover effects. We revisit this issue, estimating spillover effects by the impact of the *number* of exporters or

[2]Manova (2008) uses cross-country data and finds that equity market liberalization increases exports more in credit-constrained sectors than other sectors, concluding that credit constraints are an important determinant of international trade flows.

FDI firms in the same region and the same industry, not by the impact of the *share* of exporters or FDI firms used in the existing studies.

To preview the results, we find that the productivity level positively affects the probability of engaging in export and FDI. This finding is consistent with the theoretical predictions of recent trade models with heterogeneous firms and the empirical findings of many existing studies mentioned above. However, our numerical experiments suggest that the impact of productivity is negligible in size: When a hypothetical firm with the average characteristics of domestic firms, which we call the average domestic firm, raises its productivity by 50 percent, or one standard deviation, the probability of engaging in export or FDI increases by only 0.01–0.06 percentage points (not 1–6 percentage points). In fact, this limited role of productivity in the export and FDI decision has been found in the existing studies such as Bernard and Wagner (2001) and Bernard and Jensen (2004). This evidence has been undervalued in the literature but should be paid more attention to.

This study also finds a negative impact of the debt-asset ratio on the probability of engaging in export and FDI and a positive impact of the number of employees and the number of exporters/FDI firms in the same region and industry. This evidence suggests that credit constraints prevents firms from being internationalized, whereas the firm size and spillovers within the same region and industry promotes firms' internationalization. However, as in the case of productivity, the size of these effects is numerically very small.

By contrast, the impact of firms' status in the previous year is quite large. The predicted probability that the average domestic firm remains domestic in the next year is 99 percent, and the probability does not change much even when the firm's characteristics such as the level of productivity and employment improve so much that the characteristics are better than the average of exporters and FDI firms. Although the positive effect of firms' previous status has been found in existing studies, this study highlights the extremely large degree of stickiness of the export and FDI behavior by performing a number of numerical exercises.

Another major determinant of export and FDI is unobserved firm characteristics. If unobserved characteristics, measured by random intercepts in equations for the export and FDI decision, change by one standard deviation, the probability of engaging in export and FDI in the next year changes by more than 5 percentage points. Compared with the change in the probability due to the change in productivity, 0.01–0.06 percentage points as mentioned earlier, this change is substantial.

Contributions of this study are as follows. First, we employ a mixed logit model to account for time-invariant unobserved heterogeneity among firms, to alleviate the Independence from the Irrelevant Alternatives assumption imposed in standard multinomial logit models, and to correct for biases due to possible correlation between the error term and the dummy variables for the previous status. Second, we provide quantitative evaluation of the impacts of potential determinants of the export and FDI decision. Such quantitative evaluation has been mostly ignored or undervalued in existing studies. By so doing, we find a quantitatively minor role of productivity in the export and FDI decision. Third, the use of the mixed logit model enables us to highlight the important role of unobserved firm characteristics in the export and FDI decision.

The rest of the paper is organized as follows. The next section explains the empirical methodology employed, whereas Section 3 presents the description of data and summary statistics. Section 4 shows empirical results, and Section 5 concludes.

2 Empirical Methodology

We assume that in each period firms determines whether they engage in export and/or FDI. There are three types of firm: those serving only the domestic market (domestic firms), those engaging in export but not in FDI (exporters), those engaging in FDI (FDI firms).[3] Firms choose one of the three statuses based on expected profits, or revenues less costs. Following Helpman, Melitz, and Yeaple (2004), we assume that revenues depend on firms' productivity measured by their TFP. We also assume that revenues may be determined by firms' size, measured by the amount of employment, due to possible increasing returns to scale. As Melitz (2003) and Helpman, Melitz, and Yeaple (2004) suggest, costs of export and FDI include initial fixed costs for, for example, researching foreign markets and constructing sales networks. Therefore, costs of export (or FDI) are lower for firms that already engaged in export (FDI) than otherwise. In addition, those initial costs of export and FDI depend on each firm's level of information on foreign markets, which depends on the extent of the firm's internationalization, measured by the foreign ownership ratio. Initial costs of export and FDI are also affected by spillovers of information on foreign markets from experienced firms in the same region and industry. Therefore, costs of export (FDI) depend on the number of firms in the same region-industry engaging in export (FDI).

[3] As an experiment, we distinguished between firms engaging in FDI but not in export and firms engaging in both. However, the main conclusions remained the same.

Based on those arguments, we assume that expected profits of firm i in year t from state j, which is either serving only the domestic market (D), engaging in export but not in FDI (E), or engaging in FDI (F), are given by

$$\pi_{ijt} = X_{i(t-1)}\beta_j + Z_{ij(t-1)}\delta + D_{i(t-1)}\gamma_j + \epsilon_{ijt}. \tag{1}$$

$X_{i(t-1)}$ is a vector of variables for firm characteristics in the previous year such as the level of productivity and employment, and $Z_{ij(t-1)}$ denotes the characteristics of state j for firm i. In particular, to examine impacts of information spillovers from other internationalized firms, Z includes a variable that is equal to the number of firms of state j in the same region-industry as firm i when $j = E, F$ and zero when $j = D$. $D_{i(t-1)} = (d_{iE(t-1)}, d_{iF(t-1)})$ represents dummy variables indicating that firm i engages in export and FDI, respectively, in year $t-1$ to take account for impacts of initial costs on the export and FDI decision.

Assuming that ε_{ijt} are *iid* distributed type 1 extreme value leads to a logit model. In addition, to take advantage of the panel structure of our data, we incorporate random effects to the profit function (1):

$$\epsilon_{ijt} = \alpha_{ij} + \varepsilon_{ijt}$$

where α_{ij} are firm-choice specific random effects. By incorporating random effects, we can control for unobserved firm heterogeneity. In addition, by assuming correlation between random effects, we can relax the Independence from Irrelevant Alternatives (IIA) assumption imposed in standard multinomial logit models. Under the IIA assumption, exclusion of one choice from the choice set should not change the estimated coefficients of other choices. However, since the structure of the three choices in our model is unclear, we are not sure whether the IIA assumption is satisfied. Therefore, incorporating random effects in our estimation leads to more reliable estimation results.

An additional problem of the logit estimation based on equation (1) is that the inclusion of the lagged status of the firm ($D_{i(t-1)}$) as a regressor leads to correlation between the error term and the lagged status. Following Johannesson and Lundin (2001), we correct for possible biases due to this correlation by allowing random variation in the coefficient on the lagged status.

Accordingly, we obtain the following mixed logit model for estimation:

$$Pr[y_{it} = j] = \frac{\exp(\alpha_{ij} + X_{i(t-1)}\beta_j + Z_{ij(t-1)}\delta + D_{i(t-1)}\gamma_{ij})}{\sum_{k=D,E,F} \exp\left(\alpha_{ij} + X_{i(t-1)}\beta_k + Z_{ik(t-1)}\delta + D_{i(t-1)}\gamma_{ij}\right)}, \tag{2}$$

where we assume that the parameters for $j = D$ are zeros for identification purposes. We allow for correlation between αs and γs.

In equation (2), we assume that the coefficients do not vary in size across firms. However, the coefficients for firms serving only the domestic market in the previous year are likely to be different from those for firms serving foreign markets through export or FDI. Suppose, for example, that a domestic firm increases its productivity while an exporter lowers it by the same degree. Then, the increase in the probability that the domestic firm exports in the next year is likely to be larger than the decrease in the probability that the exporter remains an exporter, since the exporter has paid initial costs of exporting. We have incorporated in equation (2) the effect of initial costs of internationalization by including the dummy variables for the previous status. However, it is still possible that the coefficient on the covariates is different in size between pervious domestic and internationalized firms. To take into account of this possibility, we add interaction terms between the covariates and the dummy variable for internationalized firms in the previous year. Based on the argument above, we would expect that the coefficient on the interaction terms with the productivity level, the firm size, and the number of internationalized firms in the same region and industry is negative, whereas the coefficient on the interaction term with the debt-to-asset ratio is positive.

3 Data

3.1 Description of the data

For the estimation in this paper, we employ a firm-level data set for Japanese firms based on the *Kigyo Katsudo Kihon Chosa* (KKKC, Basic Survey of Enterprise Activities). This survey is a census for all firms with 50 employees or more and capital of 30 million yen or more conducted annually by the Ministry of Economy, Trade and Industry (METI). The participation in the survey is compulsory. In particular, we use data for the period 1997-2005, since data for this period contain information on exports in a consistent manner.[4]

The KKKC data include information on exports and the number of affiliates in foreign countries. We define that firms are engaging in export, if their reported exports are positive.[5] To identify firms engaging in FDI, we supplement information in the KKKC data by

[4]See Wakasugi et al.(2008) for details of the data set.

[5]This definition implies that when firms did not report the amount of exports, we define these firms as firms which do not engage in export.

another data set for Japanese firms' affiliates in foreign countries collected annually also by METI, *Kaigai Jigyo Katsudo Kihon Chosa* (KJKKC, Basic Survey of Overseas Enterprise Activities). The KJKKC survey collects data on foreign affiliates from their parent firms in Japan. Although the survey covers all parent firms, the response rate is usually around 60 percent since response is not compulsory in the case of KJKKC. We define as FDI firms those which report a positive number of foreign affiliates in the KKKC data or information on one or more foreign affiliates in the KJKKC data. Further, following the theoretical model of Helpman, Melitz, and Yeaple (2004), we exclude vertical FDI, i.e., FDI for exporting parts and components to the parent firm in the home country, from the definition of FDI. This is because export and horizontal FDI are complementary channels to serve foreign markets, but determinants of the decision on vertical FDI should be different from those of the decision on export and horizontal FDI. Therefore, we assume that Japanese firms engage in vertical FDI if all of their overseas subsidiaries export 75 percent or more of its total sales to Japan in the KJKKC data set and exclude those firms from the set of firms engaging in FDI.

Although the KKKC data include firms in the service sector, we exclude those and focus on firms in the manufacturing sector. We also drop firms whose information for estimation is not available. This leads to 92,659 firm-year observations.

The variables used for estimation are constructed as follows.[6] TFP is given by

$$\ln TFP = \ln Y - \beta_L \ln L - \beta_K \ln K,$$

where Y, L, and K are real value added, the number of workers, and the amount of capital stocks, respectively. Since the KKKC data do not have information on the composition of workers according to the level of human capital or information on work hours, we cannot adjust the amount of labor by the level of human capital or work hours. β_L and β_K are estimated by the method developed by Olley and Pakes (1996) and are 0.7822 and 0.1754, respectively. The foreign ownership ratio is reported in the KKKC survey. The debt-to-asset ratio is the ratio of long-term debts to total assets. The variables to examine spillover effects include the number of firms engaging in export (FDI) in the same region and the same industry. "Regions" are defined by prefectures. There are 47 prefectures in Japan, and the average area of a prefecture is about 8,000 square kilometers. "Industries" are classified by the SNA Industry Classification at the two-digit level. The total number of

[6]The details of the procedures for the variable construction are explained in the Appendix.

industries in the manufacturing sector is 20.

3.2 Summary statistics

Table 1 shows the mean and the standard deviation of each variable by type of firm. This table indicates that exporters and FDI firms are on average more productive and larger than exporters, and exporters are more productive and larger than domestic firms, as existing studies have found. We also find that exporters and FDI firms have a smaller debt-to-asset ratio than domestic firms. Looking at the middle rows, we find that exporters and FDI firms tend to agglomerate in the same region and industry.

Table 2 shows the share of firms in each status (domestic, exporting, or engaging in FDI) by status in the previous year. Column (1) indicates that 96 percent of previously domestic firms remain domestic, whereas 2.5 percent and 1.4 percent become exporters and FDI firms, respectively. Similarly, 84 percent of exporters remain exporting in the next year, and 94 percent of FDI firms engage in FDI in the next year. This evidence suggests that the current status is quite sticky, and that only a few firms change their status.

4 Econometric Results

4.1 Benchmark results

The results from the mixed logit model represented by equation (2) are shown in column (1) of Table 3. The first row indicates that the effect of the number of internationalized firms of the same status in the same prefecture and industry is positive and statistically significant at the one-percent level. This evidence suggests that firms' decision on internationalization is affected by spillovers of information on foreign markets from neighboring experienced firms.

Since other covariates are firm-specific but invariant to choices, the coefficient of each of these variables varies depending on the status chosen. First, the probability of engaging in export is positively affected by the level of TFP, the firm size measured by the number of workers, the foreign ownership ratio, and previous experiences in export and FDI. These results are qualitatively consistent with the existing theoretical and empirical studies. In addition, the debt-to-asset ratio has a negative and significant effect on the export decision. This finding suggests that credit-constrained firms are less likely to engage in export, since they cannot finance initial costs of export.

Second, the probability of engaging in FDI is also determined by the number of workers, the past experience in exporting and FDI, and the degree of debt. Again, these findings are mostly in line with those of existing studies. However, the TFP level has no significant impact on the FDI decision, despite the theoretical prediction of Melitz (2003) and Helpman, Melitz, and Yeaple (2004) that productivity is the major determinant of the FDI decision.

Next, we incorporate interaction terms between the covariates and the dummy for internationalized firms in order to account for possible differences in the size of the impact of covariates between domestic firms and internationalized firms, as we argues in Section 2. The results, presented in column (2) of Table 3, indicate that the interaction terms with the number of exporters/FDI firms in the same region and industry, the TFP level, and the amount of employment have a negative impact on the export and FDI decision, while the interaction term with the debt-to-asset ratio has a positive impact on the export decision. These results are consistent with our presumption that the impact of the covariates is smaller for already internationalized firm, although many of these effects are not statistically significant. Accordingly, the coefficient on the covariates is larger (in absolute terms) in column (2) than in column (1).

4.2 Numerical exercises

How much does the econometric model fit the data? Column (1) of Panel A of Table 4 show the share of domestic firms remaining domestic and engaging in export and FDI in the next year, taken from column (1) of Table 2. As we have seen before, 96.1 percent of domestic firms remained domestic in the next year, 2.5 percent became exporters, and 1.4 percent became FDI firms. Using the estimation results, we compute the probability that the hypothetical "average domestic firm," whose covariates are equal to the mean for domestic firms, remains domestic, becomes an exporter, and becomes an FDI firm and present the results in column (2) of Panel A of Table 4. The predicted probability that the average domestic firm remains domestic in the next year is 98.9 percent, whereas the probability that the firm engages in export and FDI in the next year is 0.73 and 0.36 percent, respectively. These results suggest that our econometric model explains the actual export and FDI decision reasonably well, although the prediction overvalues the probability of remaining domestic.[7]

[7]When we assume that the coefficients on the dummies for the previous status, γs in equation (2), are not stochastic but constant, the predicted probabilities are more close to the actual probabilities. The predicted probability that the average domestic firm becomes an exporter and an FDI firm is 2.34 and 1.22 percent,

Now, to see the quantitative size of impacts of the determinants of export and FDI, we use the results in column (2) of Table 3 and examine how the probability that the average domestic firm engages in export or FDI changes as the firm's characteristics, such as the level of productivity and employment, improve. Columns (3)–(7) of Panel A of Table 4 show the results assuming one or all of the covariates improves by one standard deviation. By so doing, the characteristics of the average domestic firm becomes better than the average exporter and FDI firm, according to Table 1. For example, when the log of TFP improves by one standard deviation, it becomes 2.266 ($= 1.765 + 0.501$), which is substantially larger than the average TFP for exporters (1.941) and FDI firms (1.999).

Overall, the numerical change in the probability of engaging in export and FDI due to the improvement in the average domestic firm's characteristics is small and often negligible. For example, column (4) of Panel A of Table 4 indicates that when the log of TFP improves by one standard deviation, or by 50 percent, the predicted probability that the average domestic firm becomes an exporter rises from 0.73 to 0.79 percent. Similarly, the predicted probability of conducting FDI increases by only 0.01 percentage points from 0.36 to 0.37 percent. The results from these numerical exercises suggest that although the positive impact of the productivity level on the export decision is statistically significant, it is negligible in size. The increase in the probability of internationalization is also negligible when the degree of credit constraints improves, or the debt-to-asset ratio declines (column [6]).

The spillover effect, measured by the effect of the number of exporters/FDI firms in the same region and industry (column [3]) and the effect of the firm size (column [5]) are larger in size than the effect of productivity and credit constraints. The results on the spillover effect suggest that relocating of the average domestic firm to a prefecture in which the number of internationalized firms in the same industry is 30–40 (one standard deviation) more leads to an increase in the probability of engaging in export and FDI by 0.3 and 0.1 percentage points, respectively. Also, a one-standard-deviation increase, or a 76-percent increase, in the number of workers improves the probability of engaging in export and FDI by about 0.2 percentage points. However, it should be emphasized that these impacts of spillovers and the firm size are still small.

The numerical impact of the covariates is small probably because we considered what

respectively, as compared with the actual probability, 2.51 and 1.37 percent. However, as we discussed in Section 2, assuming random coefficients on the dummies is necessary to correct for possible biases due to correlation between the error term and the dummies for the previous status. Moreover, our main results do not change using the alternative specification.

would happen one year after the change in the covariates. Therefore, we now examine long-run effects of the change in the covariates by computing the probability that the average domestic firm remain domestic, become an exporter, and become an FDI firm eight years after the change.[8] The results are presented in Panel B of Table 4. Comparing columns (1) and (2), we confirm that the long-run prediction of our econometric model is not very different from the actual probabilities. Columns (3)–(7) present the probability of the average domestic firm's being in each status eight years after the permanent change in one or all of the covariates by one standard deviation. For example, column (4) indicates that when the TFP level improves by 50 percent (i.e., by one standard deviation), the probability that the average domestic firm engages in export and FDI eight years after the improvement is 4.6 and 3.4 percent, respectively, as compared with 4.3 and 3.3 percent without such improvement. Therefore, the impact of the substantial productivity improvement on the export and FDI decision of the average domestic firm is negligible even in the long run. The long-run effect of credit constraints is also negligible.

The effect of spillovers and the firm size is, again, larger. When relocating to a prefecture with more internationalized firms in the same industry by one standard deviation (30–40 firms), the average domestic firm raises the probability of engaging in export and FDI by 1.9 and 0.9 percentage points, respectively. When the number of workers becomes larger by one standard deviation, or 76 percent, the probability of engaging in export and FDI goes up by 0.9 and 2.2 percentage points, respectively. Thus, the spillover effect and the scale effect may not be "negligible" in the long run, although they are still small.

By contrast, our results suggest that the export and FDI decision heavily relies on the firm's status in the previous year. Panel B of Table 4 indicates that even after eight years, the average domestic firms's predicted probability of remaining domestic is 93 percent, and the probability is 83 percent even when all the firm characteristics improve by one standard deviation. In other words, currently domestic firms tend to be domestic in the long run, and the pattern is not much affected by improvements in observed firm characteristics.

To highlight the stickiness of firms' status on internationalization, we perform two numerical experiments. First, we examine how the probability that the hypothetical firm whose covariates are equal to the mean for domestic firms is in each status in the next year varies depending on the firm's current status. Column (1) of Table 5, which is the same as

[8] We consider a nine-year period, since our data set covers the nine-year period 1997–2005.

column (2) of Panel A of Table 4, indicates that if the firm is currently a domestic firm, the predicted probability of remaining domestic in the next year is 98.9 percent. However, in column (2), we find that if the firm is currently exporting, the firm's probability of becoming a domestic firm is only 5 percent, whereas its probability of remaining an exporter is 91 percent. Note that the differences between columns (1) and (2) solely stem from the difference in the current status. The same pattern can be seen in the case where the firm is currently an FDI firm (column [3]).

Second, we compute the probability that the "average exporter" whose covariates are equal to the mean for exporters and the "average FDI firm" defined similarly are in each status in the next year and further examine how the probability changes when one or all of the covariates deteriorates by one standard deviation. Panel A of Table 6 shows the results for the average exporter, whereas Panel B shows those for the average FDI firm. These results suggest that the probability that the average exporter remains to be an exporter changes only negligibly, even when all the covariates change (column [3]). Panel B presents similar stickiness of the current status in the case of FDI firms.

In addition to the current status of the firm, a major determinant of the export and FDI decision is unobserved characteristics of the firm represented by the random intercept in the export and the FDI decision equation (equation [2]). To see this, we perform numerical experiments again and compute the probability that the average domestic firm is in each status in the next year, assuming that the intercept in the export- or FDI-decision equation increases by one standard deviation. The results presented in Table 7 indicate that the probability of remaining domestic declined by more than 5 percentage points due to the change in the firm's unobserved characteristics. Compared with the very small changes in the probability, by less than 0.5 percentage points, due to the change in the observed characteristics (Panel A of Table 4), a 5 percentage-points change is substantial. Therefore, we conclude that firms' characteristics that are not captured by our covariates including the productivity level and the firm size affect firms' internationalization to a great extent in size.

4.3 Results from Alternative Specifications

To check the robustness of the benchmark results, we experiment with two alternative specifications. First, we have so far focused on horizontal FDI and excluded firms engaging only in vertical FDI from the set of FDI firms (See Section 3.1). However, since distinguishing

between horizontal and vertical FDI requires strong assumptions and detail data regarding vertical FDI, we now refrain from using such distinction. From a mixed logit estimation, we find that the significance level of the estimated coefficients are qualitatively the same as in the benchmark case. To highlight the size of the impact of the covariates, we present only the results from numerical exercises in Panel A of Table 8, similar to those in Panel A of Table 4. The results are quantitatively similar to the benchmark results in Table 4.

Second, we exclude the number of workers, a measure of the firm's size, from the covariates. This is because in the theory of Helpman, Melitz, and Yeaple (2004), firms' size becomes larger with their productivity level. If this is the case, the size variable may pick up effects of productivity in addition to effects of the size, and hence the coefficient on productivity may be underestimated. To check if this problem arises in our estimation, we exclude the size variable and highlight the impact of productivity on the export and FDI decision. The estimation results not presented here for brevity indicate that the coefficient on the TFP level is larger than before as predicted. Moreover, although TFP had no significant impact on the FDI decision when the log of employment is also included as a covariate, we now find that TFP has a positive and highly significant effect. However, when we compute probabilities that the average domestic firm engages in export or FDI assuming one or all of the covariates improves to the average level of internationalized firms, we find again that an increase in productivity or other covariates does not lead to a sizable increase in the probability of engaging in export and FDI (Panel B of Table 8). Thus, we conclude that the negligible effect of productivity found in the benchmark estimation is not underestimated.

In addition, we examine whether our conclusions come from the fact that our sample is consist of firms in various industries. For this purpose, we perform the same numerical experiments for each of 5 major industries serving foreign markets, i.e., the chemicals, the general machinery, the electrical machinery, the transportation equipment, and the precision machinery industry. In Table 9, column (1) indicates the actual probability that domestic firms are in each status in the next year, and column (2) the predicted probability of the average domestic firm in each industry. Columns (3) and (4) show the predicted probability when all the covariates improve by one standard deviation and when the intercept in the export equation deviates from the mean by one standard deviation. The results suggest that even in those foreign markets-oriented industries, the export and FDI decision is largely

determined by the status in the previous year and unobserved firm characteristics: The change in the predicted probability is more apparent in column (4) than in (3).

4.4 Summary and Discussion

This section summarizes the results above and relates them to previous findings in the literature. First, we confirm the findings of the existing empirical studies that the productivity level has a positive impact on the export and FDI decision.[9] However, the impact of productivity is negligible in size. This quantitatively limited role of productivity in the export and FDI decision is in fact not new in the empirical literature. For example, Bernard and Jensen (2004) find that the impact of TFP on the probability of exporting is statistically insignificant, when they apply the generalized method of moments (GMM) estimation of Arellano and Bond (1991) to a linear probability model. Using ordinary least squares (OLS) estimation, they find the impact positive and significant, but the impact is extremely small: The coefficient on the log of TFP is 0.017, and hence an increase in TFP by 100 percent raises the probability of exporting by only 1.7 percentage points.[10] Small or insignificant effects of labor productivity on the export decision are also found in Bernard and Wagner (2001) using German data. Their results and ours suggest that productivity probably affects firms' decision on internationalization but that the impact is quantitatively negligible. This evidence has been undervalued in the literature, but we should pay more attention to this, since this finding is inconsistent with the key prediction of heterogeneous-firm models of trade that productivity is the major determinant of the export and FDI decision.

Second, we find that the firm size positively affects the export and FDI decision, as previous studies have found. Moreover, the impact of the firm size is larger than that of productivity, although it is still small. The relatively large size of the scale effect is also well known in the literature. For example, Bernard and Jensen (2004) find that the coefficient on the log of employment is 0.132 and significantly different from zero in their GMM estimation, as compared with an insignificant coefficient on the log of TFP. Although the size of the scale effect in our estimation is not as large as the result of Bernard and Jensen (2004), our results are qualitatively consistent with their results. One possible reason for the relatively significant role of the firm size is that part of initial costs of export and FDI, for example,

[9] In the benchmark estimation presented in Table 3, we find that the impact of TFP on the FDI decision is insignificant. However, when we exclude the log of employment from the set of the covariates, the impact of TFP is highly significant, as mentioned in Section 4.2.

[10] Bernard and Jensen (2004) do not present summary statistics of the variables used for estimation. Therefore, the standard deviation of the log of TFP is unknown.

costs of constructing sales networks, is constant regardless of the amount of exports and the variety of goods exported. If this is the case, large firms selling a large amount/variety of goods in foreign markets can pay the initial costs more easily than small firms and hence can engage in export and FDI.

Third, effects of firms with experiences in foreign markets in the same region and industry are non-negligible in size in the long run. We interpret this evidence as showing that spillovers of information on foreign markets from experienced firms play an important role in firms' export and FDI decision. In other words, ignorance about foreign markets, which leads to large initial costs of export and FDI, is a barrier to internationalization of firms. This finding is consistent with evidence of spillovers found in previous studies such as Aitken, Hanson, and Harrison (1997), Barrios, Görg, and Strobl (2003), Greenaway, Sousa, and Wakelin (2004), and Bernard and Jensen (2004).

Fourth, we find that the debt-to-asset ratio has a negative impact on the export and FDI decision, concluding that credit constraints inhibit firms' internationalization. This is consistent with the finding of Muûls (2008). However, it should be emphasized that this impact is also negligible in size.

Fifth, we find that a dominant determinant of export and FDI is stickiness of the export and FDI status of each firm. Even when a firm serving only the domestic market improves its observed characteristics such as productivity substantially so that its characteristics are better than the average level of internationalized firms, the probability that the domestic firm engage in export or FDI does not increase much even in the long run. By contrast, if the average domestic firm happens to become an exporter or an FDI firm without any change in other observed firm characteristics, the firm can remain serving foreign markets with a probability of more than 90 percent. This finding is consistent with the findings of existing studies, although the stickiness of the export and FDI status found in this study is more substantial than that in other studies. For example, Bernard and Jensen (2004) find from their GMM estimation that experiences in exporting in the last two years raise the probability of exporting by only 51 percent. The stickiness of the export and FDI status may be generated by the importance of initial costs in the export and FDI decision. This conclusion is consistent with the theoretical assumption in trade models with heterogeneous firms such as those in Melitz (2003) and Helpman, Melitz, and Yeaple (2004).

Finally and most notably, the use of mixed logit models, which is the major contribution

of this study, enables us to find that firms' unobserved characteristics are another major determinant of the export and FDI decision. This finding is inconsistent with the theoretical prediction of the heterogeneous-firm models of Melitz (2003) and Helpman, Melitz, and Yeaple (2004) that productivity determines export and FDI behaviors.

These findings suggest that the selection process of internationalized firms may be inefficient. In other words, firms which are unproductive but are currently serving foreign markets through export or FDI are most likely to continue to serve foreign markets in the future, while firms which are productive but have no experience in foreign markets have a small chance to enter foreign markets. In the case of Japan, Peek and Rosengren (2005), Nishimura, Nakajima, and Kiyota (2005), and Caballero, Hoshi, and Kashyap (2008) find that unproductive firms, or zombies, remain in the market because of additional credit from large Japanese banks to avoid bankruptcy so that entries of new firms are discouraged and that productive firms are more likely to exit. Entry to foreign markets through export and FDI may be contaminated by similar inefficiency.

5 Conclusion

This paper examines determinants of the export and FDI decision, using firm-level data for Japan. Contributions of this paper are twofold. First, this paper employs a mixed logit model to incorporate unobserved characteristics of firms, to relax the Independence from Irrelevant Alternatives assumption imposed in standard multinomial logit models, and to correct for possible biases due to correlation between the error term and the dummy for the previous status. Second, special attention is paid to quantitative evaluation of effects of the covariates. We find that the impact of productivity on the export and FDI decision is positive and statistically significant but economically negligible in size, despite the theoretical prediction of recent heterogeneous-firm trade models such as those of Melitz (2003) and Helpman, Melitz, and Yeaple (2004). The impact of the firm size and information spillovers from experienced neighboring firms in the same industry are positive and larger than the impact of productivity, but it is still small in size. Quantitatively, the dominant determinants of the export and FDI decision are firms' status on internationalization in the previous year and unobserved firm characteristics. The evidence suggests that there may be some kind of inefficiency in the selection process of exporters and FDI firms. However, to investigate causes of the inefficiency is beyond the scope of this paper, and we would

expect further investigation to test the "internationalized zombie hypothesis."

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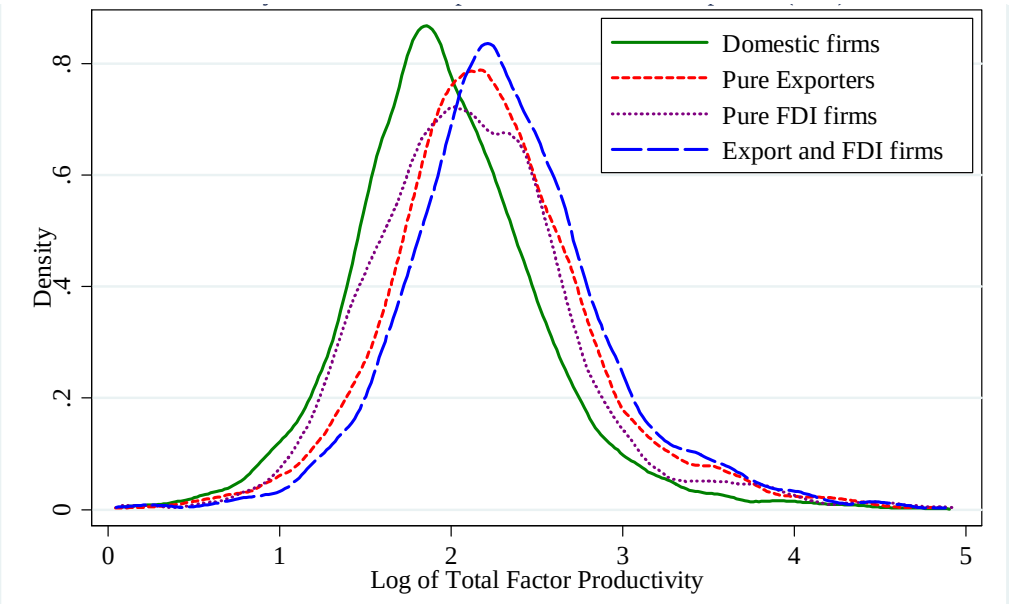
Figure 1. Distribution of TFP among Japanese Firms



Notes: This figure is taken from Figure 5 for Wakasugi et al. (2008), showing the distribution of the log of the TFP level of Japanese manufacturing firms in 2005.

Table 1. Mean and Standard Deviation (in Parentheses) of Variables by Status of Firms

Variables	Domestic firms	Exporters	FDI firms	All firms
Log of TFP	1.765 (0.501)	1.941 (0.512)	1.999 (0.522)	1.836 (0.517)
Log of employment	4.975 (0.755)	5.298 (0.938)	6.059 (1.225)	5.230 (0.985)
Foreign ownership (%)	0.581 (6.452)	4.880 (18.731)	2.923 (9.960)	1.665 (10.048)
Debt-to-asset ratio	0.269 (0.238)	0.225 (0.185)	0.219 (0.162)	0.253 (0.219)
Number of exporters in the same prefecture and industry	0.022 (0.042)	0.053 (0.066)	0.054 (0.065)	0.032 (0.053)
Number of FDI firms in the same prefecture and industry	0.015 (0.027)	0.032 (0.040)	0.035 (0.040)	0.021 (0.033)
Number of firms	61,209	13,691	17,759	92,659
Share in total (%)	66.06	14.78	19.17	100

Notes: This table shows the mean and the standard deviation (in parentheses) of each variable by type of firm. Observations are based on firms that are in operation in the next year during the period 1997-2004 and are classified according to the status in the next year.

Table 2. Share of Firms in Each Status by Previous Status

	(1)	(2)	(3)
	Previous status		
Current status	Domestic firm	Exporter	FDI firm
Domestic firm	0.9612	0.0904	0.0251
Exporter	0.0251	0.8379	0.0343
FDI firm	0.0137	0.0717	0.9405
Number of observations	61,209	13,691	17,759

Notes: Domestic firms are defined as firms serving only the domestic market. Exporters are firms engaging in export but not in FDI, whereas FDI firms are firms engaging in FDI.

Table 3. Benchmark Results from the Random-Effects Multinomial Logit Model

Variables		(1)		(2)	
Number of exporters/FDI firms in the same prefecture and industry		5.185 (0.432)**		9.031 (0.636)**	
		Export	*FDI*	*Export*	*FDI*
Intercept:	Mean	-6.483	-9.229	-7.073	-9.805
		(0.202)**	(0.232)**	(0.301)**	(0.373)**
	Standard deviation	3.114	3.130	1.858	1.847
		(0.277)**	(0.358)**	(0.081)**	(0.104)**
Dummy for exporters:	Mean	7.559	5.215	8.653	6.306
		(0.113)**	(0.153)**	(0.415)**	(0.485)**
	S. D.	9.478	8.209	3.061	2.879
		(0.562)**	(0.839)**	(0.090)**	(0.143)**
Dummy for FDI firms:	Mean	5.587	10.262	6.640	3.544
		(0.239)**	(0.215)**	(0.456)**	(0.138)**
	S. D.	11.902	12.813	3.466	12.557
		(1.122)**	(1.033)**	(0.159)**	(0.976)**
Log of TFP		0.083	0.068	0.148	0.084
		(0.047)+	(0.053)	(0.066)*	(0.082)
Log of employment		0.259	0.636	0.307	0.705
		(0.029)**	(0.031)**	(0.046)**	(0.053)**
Debt-to-asset ratio		-0.538	-0.341	-0.596	-0.309
		(0.122)**	(0.144)*	(0.172)**	(0.214)
Foreign ownership (%)		0.009	-0.005	0.012	-0.002
		(0.002)**	(0.003)+	(0.003)**	(0.006)
Interaction with a dummy for internationalized firms					
Number of exporters/FDI firms in the same prefecture and industry				-7.506 (0.901)**	
		Export	*FDI*	*Export*	*FDI*
Log of TFP				-0.164	-0.108
				(0.097)+	(0.112)
Log of employment				-0.100	-0.134
				(0.066)	(0.072)+
Debt-to-asset ratio				0.183	-0.005
				(0.272)	(0.315)
Foreign ownership (%)				-0.004	-0.005
				(0.005)	(0.007)
		92659		92659	
		-22148.61		-22105.88	

Notes: +, *, and ** signify the statistical significance at the 10, 5, and 1 percent level, respectively.

Table 4. Predicted Probability That the Average Domestic Firms' Being in Each Status in the Next Year

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Predicted probability					
			If the average domestic firm's *X* increases by one standard deviation where *X* is				
	Actual probability	Average domestic firm	No. of exporters/ FDI firms in the same region and industry	Log of TFP	Log of labor	Debt-to-asset ratio	All covariates
Panel A: Status in the next year							
Domestic firms	0.9612	0.9891	0.9848	0.9884	0.9847	0.9877	0.9749
Exporters	0.0251	0.0073	0.0106	0.0079	0.0092	0.0084	0.0165
FDI firms	0.0137	0.0036	0.0045	0.0037	0.0061	0.0039	0.0086
Panel B: Status after 8 years							
Domestic firms	0.8579	0.9255	0.8977	0.9210	0.8941	0.9158	0.8310
Exporters	0.0699	0.0427	0.0613	0.0457	0.0518	0.0496	0.0906
FDI firms	0.0722	0.0325	0.0417	0.0340	0.0549	0.0353	0.0785

Notes: Domestic firms are defined as firms serving only the domestic market. Exporters are firms engaging in export but not in FDI, whereas FDI firms are firms engaging in FDI. The average domestic firm is defined as a hypothetical firm whose covariates are equal to their mean for domestic firms.

Table 5. Predicted Probability That a Firm with Domestic Firms' Average Covariates Is in Each Status in the Next Year

	(1)	(2)	(3)
	Current status		
Status in the next year	Domestic firm	Exporter	FDI firm
Domestic firm	0.9891	0.0526	0.0086
Exporter	0.0073	0.9079	0.0199
FDI firm	0.0036	0.0395	0.9715

Notes: Domestic firms are defined as firms serving only the domestic market. Exporters are firms engaging in export but not in FDI, whereas FDI firms are firms engaging in FDI.

Table 6. Predicted Probability of Average Exporter/FDI Firm's Being in Each Status in the Next Year

	(1)	(2)	(3)
		Predicted probability	
	Actual probability	Average exporter/ FDI firm	If all the covariates of the average exporter/FDI firm increase by one standard deviation
Panel A: Average exporter's status in the next year			
Domestic firms	0.0904	0.0450	0.0640
Exporters	0.8379	0.9142	0.9054
FDI firms	0.0717	0.0408	0.0306
Panel B: Average FDI firm's status in the next year			
Domestic firms	0.0251	0.0046	0.0100
Exporters	0.0343	0.0144	0.0209
FDI firms	0.9405	0.9810	0.9690

Notes: The average exporter (FDI firm) is defined as a hypothetical firm whose covariates equal to their mean among exporters (FDI firms).

Table 7. Predicted Probability of the Average Domestic Firm Being in Each Status in the Next Year When Unobserved Characteristics Change

Status in the next year	(1) Benchmark	(2) The intercept in the export equation increases	(3) The intercept in the FDI equation increases
Domestic firms	0.9891	0.9338	0.9345
Exporters	0.0073	0.0444	0.0440
FDI firms	0.0036	0.0218	0.0215

Table 8. Predicted Probability from Alternative Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Predicted probability					
			If the average domestic firm's *X* increases by one standard deviation where *X* is				
	Actual probability	Average domestic firm	No. of exporters/ FDI firms in the same region and industry	Log of TFP	Log of labor	Debt-to-asset ratio	All covariates
Panel A: Using an alternative definition of FDI							
Domestic firms	0.9612	0.9895	0.9853	0.9890	0.9854	0.9884	0.9767
Exporters	0.0251	0.0063	0.0092	0.0067	0.0079	0.0073	0.0143
FDI firms	0.0137	0.0042	0.0055	0.0043	0.0067	0.0043	0.0090
Panel B: Excluding log of labor from the set of covariates							
Domestic firms	0.9612	0.9891	0.9848	0.9879	-	0.9872	0.9803
Exporters	0.0251	0.0077	0.0111	0.0084	-	0.0090	0.0143
FDI firms	0.0137	0.0032	0.0041	0.0037	-	0.0037	0.0054

Notes: The average domestic firm is defined as a hypothetical firm whose covariates equal to their mean among domestic firms.

Table 9. Probability of the Average Domestic Firm's Being in Each Status in the Next Year: Results for Selected Industries

	(1)	(2)	(3)	(4)
			Simulate probability	
	Actual probability	Average domestic firm	If all the covariates of the average domestic firm improve by one standard deviation	If the intercept of the export equation increases by one standard deviation
Chemicals (N = 6665)				
Domestic firms	0.9336	0.9790	0.9567	0.9082
Exporters	0.0473	0.0198	0.0359	0.0866
FDI firms	0.0191	0.0012	0.0074	0.0053
General machinery (N = 11286)				
Domestic firms	0.9273	0.9720	0.9408	0.8123
Exporters	0.0539	0.0181	0.0355	0.1210
FDI firms	0.0188	0.0100	0.0237	0.0667
Electrical machinery (N = 13758)				
Domestic firms	0.9469	0.9851	0.9695	0.8999
Exporters	0.0399	0.0121	0.0257	0.0811
FDI firms	0.0132	0.0028	0.0048	0.0190
Transportation equipment (N = 8140)				
Domestic firms	0.9551	0.9837	0.9662	0.9065
Exporters	0.0221	0.0061	0.0105	0.0351
FDI firms	0.0227	0.0102	0.0233	0.0583
Precision machinery (N = 2495)				
Domestic firms	0.9182	0.9778	0.9614	0.8989
Exporters	0.0611	0.0218	0.0330	0.0993
FDI firms	0.0207	0.0004	0.0057	0.0018

Notes: The average domestic firm is defined as a hypothetical firm whose covariates equal to their mean among domestic firms in the industry. N represents the number of observations in the mixed logit estimation for the industry.