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Abstract

In this paper, we investigate empirically how firms' choices of globalization mode differ according to their productivity and Tobin's *q* using firm-level data of Japanese firms. Our findings support predictions by Helpman, Melitz, and Yeaple (2004) and by Chen, Horstmann, and Markusen (2008). That is, we find that firms with higher productivity tend to choose more foreign direct investment (FDI) and less exporting. We also find that firms with higher Tobin's *q* tend to choose more FDI and less foreign outsourcing of production. The difference in productivity is relatively less important for the choice between FDI and foreign outsourcing, and the difference in Tobin's *q* is relatively less important for the choice between exporting and FDI. Because the indexes of globalization activities have a strong negatively skewed distribution, our results indicate that quantile regression would be appropriate to analyze the relationship between firm characteristics and choice of globalization mode.

Keywords: FDI, foreign outsourcing, export, Tobin's *q*, and quantile regression.
JEL classification: F10; F23; D22; L22

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1 Introduction

The relationship between a firm's productivity and the manner in which it accesses foreign markets has been investigated both theoretically and empirically.[1] Melitz (2003) presents a model in which the most productive firms export goods to foreign markets, whereas less productive firms supply goods to their domestic markets only. Helpman, Melitz, and Yeaple (2004) extend the framework of Melitz (2003) to incorporate the possibility that firms serve foreign markets through foreign direct investment (FDI). They predict that only the most productive firms find it profitable to serve foreign markets via FDI and that medium-productivity firms serve foreign markets by exporting. As in Melitz (2003), lower-productivity firms serve their domestic markets only.

The sorting of firms into multinationals, exporters, and domestic producers according to their productivity has been well documented by numerous empirical studies. First, the superior performance of exporting firms relative to domestic producers has been confirmed by Bernard and Jensen (1995, 1999) and Bernard et al. (2007) for the US; by Clerides, Lach, and Tybout (1998) for Colombia, Mexico, and Morocco; by Aw, Chung, and Roberts (2000) for South Korea and Taiwan; and by Mayer and Ottaviano (2007) for European countries. Moreover, the productivity advantage of firms that engage in FDI relative to exporters that do not engage in FDI has been documented by Helpman, Melitz, and Yeaple (2004) for the US; by Head and Ries (2003), Kimura and Kiyota (2006), and Wakasugi et al. (2008) for Japan; and by Girma, Kneller, and Pisu (2005) for the UK.

However, when a firm offshores its production of intermediate inputs, it can choose either FDI or outsourcing. By introducing intra-sectoral firm heterogeneity into an incomplete contracting model developed by Antràs (2003), Antràs and Helpman (2004) theoretically show that high-productivity firms engage in FDI and that medium-productivity firms choose foreign outsourcing. They also show that low-productivity firms acquire intermediate inputs within their domestic economies. That productivity ordering emerges in sectors that are intensive in headquarter services.

Tomiura (2007) tests the predictions of Antràs and Helpman (2004) using a firm-level dataset that covers all manufacturing industries in Japan. He provides rare and direct evidence that supports their predictions. That is, he finds that firms that engage only in foreign outsourcing tend to be less productive than firms that engage in FDI. More precisely, he finds that the average productivity of firms that serve only their domestic markets is much lower than that of firms with access to foreign markets. Multinationals (firms that engage in FDI) are on average more productive than exporters (firms that export to foreign markets but engage in neither FDI nor foreign outsourcing) and outsourcers (firms that outsource abroad but neither export nor conduct FDI). The average productivity of exporters is lowest among globalized firms (firms that have access to foreign markets). Moreover, firms that undertake multiple modes of foreign market access tend to be far more productive than other types of firms.

[1] Helpman (2006), Greenaway and Kneller (2007), and Wagner (2007) provide surveys of the literature.

The models of Antràs and Helpman (2004) and Antràs (2003) are based on the property rights approach (Grossman and Hart, 1986; Hart and Moore, 1990), which emphasizes the ownership of physical assets. The owner of residual rights over an asset retains full control of the asset in the event of a failed relationship or negotiation. Another approach focuses on knowledge-based assets (Markusen, 1984, 2002; Horstmann and Markusen, 1987; Markusen and Venables, 1998, 2000). This approach emphasizes the jointness property of knowledge-based assets. The jointness property leads to the problem of non-excludability if relationships or negotiations fail. That is, knowledge capital is easily absorbed by the local manager or licensee.

Chen, Horstmann, and Markusen (2008) have recently proposed a model that combines the two approaches to explain how the relative importance of knowledge capital over physical capital affects a firm's choice between FDI and foreign outsourcing. They show that firms with higher physical capital intensity tend to engage in outsourcing, whereas firms with higher knowledge capital intensity tend to engage in FDI. Based on the theoretical analysis, Chen, Horstmann, and Markusen (2008) provide an interesting testable hypothesis that firms with higher Tobin's q would more likely establish foreign subsidiaries. As is well known, Tobin's q is the ratio of a firm's market value to the replacement value of its book equity. Because the firm's market value reflects knowledge-based assets as well as physical assets and because the book value of capital largely reflects physical assets only, a firm with higher knowledge capital intensity will have a higher Tobin's q. Consequently, their result implies that firms with high Tobin's q are more likely to engage in FDI, whereas those with low Tobin's q are more likely to engage in foreign outsourcing.

The issue then is identifying the relationship between a firm's productivity and Tobin's q. One can expect that many factors will affect Tobin's q of a firm. Productivity would be one such factor. As Dwyer (2001) argues, however, in theory, there may or may not be a positive relationship between productivity and Tobin's q. In the presence of ex ante uncertainty with respect to the outcome of investments (in physical capital, R&D, and so on), since firms with successful investments will have high productivity and a high market value relative to the replacement cost of their assets, the model predicts a positive relationship between productivity and Tobin's q (Jovanovic, 1982; Hopenhayn, 1992: Melitz, 2003). In contrast, if productivity differentials are embodied in physical capital, the relationship between productivity and Tobin's q is not necessarily positive for every firm can use the capital embodied higher productivity (Cooley, Greenwood, and Yorukoglu, 1997). In the literature of corporate finance, some studies empirically analyze the relationship between firm productivity and Tobin's q and show that in reality, a positive relationship exists between them even after controlling various other factors that also affect the firm's market value (Palia and Lichtenberg, 1999; Dwyer, 2001; Balasubramanyan and Mohan, 2010).[2]

[2]Palia and Lichtenberg (1999) find a significantly positive relationship between total factor productivity (TFP) and Tobin's q. Dwyer (2001) also finds a significantly positive effect of a firm's plant-level productivity on Tobin's q. Balasubramanyan and Mohan (2010) find a significantly positive effect of sectoral TFP growth on Tobin's q of the

Another issue is that the relative importance of knowledge capital to physical capital discussed in Chen, Horstmann, and Markusen (2008) may simply be captured by calculating the ratio of intangible to tangible assets. In general, intangible assets include patents, copyrights, trademarks, trade names, goodwill, and other items that lack physical substance but provide long-term benefits to the company. It may be interesting to examine whether the effects of Tobin's q on the choice of globalization mode differ from effects of the intensity of intangible assets. In this paper, we use the stock of patent applications as a direct measure of intangible assets.

The main purpose of this paper is to investigate empirically whether the predictions of Chen, Horstmann, and Markusen (2008) and those of Helpman, Melitz, and Yeaple (2004) are supported by the data. We use firm-level data for Japanese firms covering the period 1994–1999. Our dataset includes information on sales, employment, capital, R&D expenditure, direct exports, and costs of domestic and foreign outsourcing of the companies headquartered in Japan, and sales of their foreign affiliates. Data regarding corporate balance sheets and patent applications are also included. We then construct new indexes of a firm's choice of globalization mode by calculating the ratio of a mode of globalization activity (export, FDI, or foreign outsourcing) to the domestic sales of headquarter companies. The size of FDI is measured by sales of foreign affiliates. We also construct indexes to measure the relative choice of globalization modes by taking the ratio of the volume of direct export by the headquarter company to FDI (i.e., sales of foreign affiliates) and the ratio of costs of foreign outsourcing to FDI. We use labor productivity, defined by value-added per worker, which is among the most frequently used measures in the literature, to measure productivity. Among various approaches to measuring Tobin's q, we employ a simple approximation version proposed by DaDalt, Donaldson, and Garner (2003). We also calculate the ratio of intangible to tangible assets, capital intensity (capital-labor ratio), and R&D intensity (the ratio of R&D stock to labor). Then, we regress indexes of the firm's choice of globalization mode on these variables.

The main findings of this paper are as follows. We first run the random-effect instrumental-variable panel estimation to address the issue of endogeneity bias in labor productivity and Tobin's q. The estimation results indicate that both labor productivity and Tobin's q have significantly positive effects on the ratio of FDI to domestic sales and on the ratio of exports to domestic sales, but effects on the ratio of foreign outsourcing to domestic sales are insignificant.

We next focus on our indexes of globalization activities, which have a strong negatively skewed distribution and include outliers. Traditional estimation techniques such as the linear regression model may not be appropriate because they provide information only on the effects of the regressors at the conditional mean of the dependent variable. Alternatively, it may be important to estimate the relationship between the dependent variable and the independent variables at different points in the conditional distribution of the dependent variable. To address this issue, we employ *quantile*

benchmark firm in the sector.

regression. In contrast to traditional estimation techniques, quantile regression can provide estimates of parameters at different quantiles of the dependent variable. Thus, it incorporates heterogeneity among firms and allows outliers in the sample.[3]

The quantile regression estimation indicates that labor productivity has a significantly negative effect on the ratio of exporting to FDI at higher quantiles; however, it has no significant effect on the ratio of foreign outsourcing to FDI at any quantile. This result suggests that firms with higher labor productivity tend to choose more FDI and less exporting and that the difference in labor productivity does not matter for the choice between FDI and outsourcing. The former is consistent with the prediction by Helpman, Melitz, and Yeaple (2004). On the other hand, Tobin's q has a significantly negative effect on the ratio of foreign outsourcing to FDI, whereas it has an insignificant effect on the ratio of exporting to FDI. Thus, firms with higher Tobin's q tend to choose more FDI and less foreign outsourcing, whereas the difference in Tobin's q is not important for the choice between FDI and exporting. The former is consistent with the prediction by Chen, Horstmann, and Markusen (2008). Moreover, we find that a higher intensity of intangible assets measured by the ratio of patent stock to fixed capital favors FDI over foreign outsourcing and exporting. This result confirms that the effects of Tobin's q on the choice of globalization mode are not the same as those of the ratio of intangible to tangible assets. Finally, our estimation result also indicates that firms with higher physical capital intensity tend to engage in more FDI and less foreign outsourcing. This result supports the prediction by Antràs (2003).

The remainder of the paper is organized as follows. Section 2 describes the data employed in this paper and explains variables used in our analysis. Section 3 provides empirical results and discusses implications arising from those results. Section 4 concludes.

2 Data and Variables

2.1 Data

Our data are primarily collected from three datasets for Japanese companies: the Basic Survey of Japanese Business Structure and Activities (*Kigyo Katsudo Kihon Chosa*, hereafter KKKC), the Basic Survey of Overseas Business Activities (*Kaigai Jigyo Katsudo Kihon Chosa*, hereafter KJKKC), and the NEEDS' Company Financial Reports (NEEDS). The first two surveys are annual surveys implemented by the Ministry of Economy, Trade and Industry (METI) and include data on business

[3]Quantile regression was introduced by Koenker and Bassett (1978). Buchinsky (1998) provides a survey and Koenker and Hallock (2001) provide a nontechnical introduction of quantile regression. For technical details, see Koenker (2005) and Hao and Naiman (2007). Wagner (2006) applies quantile regression to the analysis of export behavior of German manufacturing plants and shows that the effects of plant characteristics, such as size, branch plant status, and R&D intensity, on export activities vary along the conditional size distribution of the export/sales ratio. Kosteas (2008) and Trofimenko (2008) also apply quantile regression to related issues.

activities of companies headquartered in Japan and their affiliates, such as sales, employment, capital, R&D expenditure, and direct exports of the headquarters, and sales of their foreign affiliates. The KKKC also includes information on outsourcing — i.e., the number of domestic and foreign firms to which a headquarter company contracted out its manufacturing or processing tasks and the cost involved in contracting out business activities during 1994–1999. Data on corporate balance sheets are obtained from NEEDS, which covers about 4,000 publicly traded firms in Japanese stock market. All publicly traded firms are identified by two codes — a Nikkei company code defined by Nikkei Inc. and a security code defined by the Japanese Securities Identification Code Committee. Since firm codes in the KKKC and KJKKC surveys differ from those in NEEDS, we use the Nikkei company code to link the three datasets. By matching the full names and addresses of companies among the three datasets we identify approximately 1,100 headquarter companies for each year during the period 1994–1999.

Besides the data discussed above, we collect data on patent applications by companies headquartered in Japan made to the Japanese Patent Office during 1990–1999 from the database released by the Institute of Intellectual Property (IIP).[4]

2.2 Indexes of globalization activities

Table 1 shows the globalization activities of our sampled companies. We identify FDI firms, outsourcing firms, and export firms by acquiring information on foreign affiliates' sales reported in the KJKKC survey in year t and on the costs of foreign outsourcing and export reported in the KKKC survey in year t. Among these headquarter companies, about two-thirds reported implementing at least one globalization activity from 1994 to 1999. The share of the companies involved in globalization activities in our sample is overwhelming, contrary to the findings in Tomiura (2007) that about 90% of the firms are "domestic" for Japanese companies. This may be because the publicly traded companies are usually sizable and competitive compared with firms that are not publicly traded. Therefore, publicly traded companies may have greater ability to enter international markets. Among our sampled companies, over 52% undertake FDI (including companies that also engage in export and/or foreign outsourcing). About 65% of our sampled firms export and 16% outsource. Compared with the number of firms engaged in FDI and exporting, the number of foreign outsourcing firms is quite limited.

In the literature (e.g., Bernard et al., 2009; Tomiura, 2007), globalization activities are usually categorized by using dummies that equal one when the firm engages in a particular activity and zero otherwise. The KKKC and KJKKC survey datasets allow us to recognize the extent to which Japnese companies are involved in globalization activities. That is, we can measure the ratio of sales by foreign affiliates (I), which capture the size of FDI, to domestic sales by headquarter companies (D), which

[4]See Goto and Motohashi (2007) for details of the IIP dataset.

is denoted by RID. Similarly, the ratio of export by headquarter companies (X) to domestic sales (RXD) and the ratio of costs of foreign outsourcing (O) to domestic sales (ROD) can be computed. Using this information, we construct new indexes for FDI, export, and foreign outsourcing: RID, RXD, and ROD. These new indexes can capture the relative importance of a particular type of globalization activity (i.e., FDI, export, or foreign outsourcing) for a firm in relation to the size of its domestic activity. Table 2 presents the percentiles, mean, and standard deviation for the three indexes. The statistics of the percentiles and mean suggest that the distributions of the indexes have a strong negative skew. There are some outliers among firms that engage in globalization activities, reflecting that some leading MNEs mainly produce abroad rather than domestically.

We also construct indexes to measure the relative choice of globalization modes. RXI is the ratio of export sales to foreign affiliate sales, and ROI is the ratio of outsourcing costs to foreign affiliate sales. The former measures the relative choice of exporting over FDI, and the latter measures the relative choice of foreign outsourcing over FDI.[5] Descriptive statistics for these indexes are summarized in Table 2.

2.3 Labor productivity, Tobin's q, and patent stock

In this subsection, we explain important independent variables in our estimation. We begin with labor productivity. Following Tomiura (2007), labor productivity ($LnLP$) is measured in logarithms as

$$LnLP = \log\left[(Sales - COGS)/L\right],$$

where L and $Sales$ denote the number of regular employees and total sales, respectively, and $COGS$ refers to the cost of goods sold. Tomiura (2007) argues that this measure is preferable to gross output per worker because deducting costs from sales is important, especially when the manufacturing process involves outsourcing

Tobin's q is measured as the ratio of the firm's market value to its tangible assets. Corporate finance scholars have developed complex estimations of Tobin's q which rely on estimated market value of the firm (Abel and Blanchard, 1986; Perfect and Wiles, 1994). As indicated by DaDalt, Donaldson, and Garner (2003), these approaches to Tobin's q produce more precise estimations but are computationally costly. Moreover, these approaches may be subject to a larger selection bias. They suggest that a simple approach is preferable unless extreme precision of the q estimates is paramount and sample selection bias is unlikely to be significant. We attempt to use a simpler approximation

[5]We measure the size of FDI by sales of foreign affiliates. The sales data include local sales, exports to the source country (Japan), and exports to third countries. Thus, when we consider the choice between FDI and foreign outsourcing, factors not directly related to the choice between FDI and outsourcing may be included. Note that using sales of foreign affiliates as a measure of FDI, our analysis is not inconsistent with the model in Chen, Horstmann, and Markusen (2008), who consider only the case in which production occurs in the foreign country and a firm in the home country chooses either FDI or outsourcing for production. They do not specify whether the possible FDI is horizontal or vertical.

version as discussed in DaDalt, Donaldson, and Garner (2003), who propose the following simple approximation of Tobin's q:

$$\text{Tobin's } q = \frac{MVE + PS + LTDEBT + CL + BVINV - CA}{TA},$$

where MVE is the year-end value of common stock and PS is the liquidation value of preferred stock. $LTDEBT$, CL, $BVINV$, CA, and TA denote the book values of long-term debt, current liabilities, inventory, current assets, and total assets, respectively. We exclude PS in our measure for Tobin's q because the data are unavailable.

Table 2 demonstrates that the mean and median values of Tobin's q are 1.29 and 1.18, respectively, both of which are very close to those reported in Hall, Jaffe, and Trajtenberg (2005) for the US firms and slightly below those in Fukuda et al. (1999) for Japanese firms in the period 1985–1996.

As a measure of intangible assets, we use patent stock, Pat. We construct a patent stock at period t from the data on patent applications by using the perpetual inventory method as follows:

$$Pat_t = I_t + (1 - \delta)Pat_{t-1}, \tag{1}$$

where Pat_t is the stock of patent applications at the end of period t, I_t is the number of patent applications during period t, and δ is the depreciation rate. Following convention in the literature, we resort to the traditional 15% depreciation rate (see Hall, Jaffe, and Trajtenberg (2005)). We use the number of patent applications in 1990 as the benchmark value for Pat. Since our data on patent applications begin from 1990 and our sample period begins in 1994, there are four years between the benchmark year and the first year of the sample period. Thus, the value of Pat in 1994 estimated by the perpetual inventory method is influenced little by the initial value of Pat in the benchmark year. We then compute the logarithm of the ratio of patent stock to tangible fixed capital, $LnPatK$, as a measure of the ratio of intangible to tangible assets.

Moreover, as shown in Helpman, Melitz, and Yeaple (2004), we control for capital intensity and R&D intensity. The former is measured by the logarithm of the ratio of tangible fixed capital to regular employees in the headquarter company, $LnKL$. The latter is measured by the logarithm of the ratio of R&D stock to employees, $LnRL$. R&D stock, RD, is computed in the same manner as patent stock. That is, in Eq. (1), Pat_t and Pat_{t-1} are replaced by RD_t and RD_{t-1}, respectively, and I_t is interpreted as the R&D expenditure in the period of t. In calculating R&D stock we also use $\delta = 0.15$. Similar to the case of patent stock, R&D expenditure in 1990 is used as the benchmark value, and R&D stock in 1994 is estimated by the perpetual inventory method.

Table 2 presents descriptive statistics for these independent variables.

3 Empirical Results

First, we investigate the effects of labor productivity and Tobin's q on the globalization indexes RID, RXD, and ROD. Then we examine the effects of labor productivity, Tobin's q, and the intensity of intangible assets on the relative choice of globalization modes, RXI and ROI. Following Helpman, Melitz, and Yealple (2004), we use a linearized version of regression equations and consider a specification that controls for the firm's capital intensity ($LnKL$) and R&D intensity ($LnRL$).

3.1 Initial results

Table 3 shows the initial results of random-effects panel estimation. To address the issue of endogeneity bias in the logarithm of labor productivity ($LnLP$) and Tobin's q ($TobinQ$) we also instrument the two variables by taking one lag of all dependent and independent variables. The random-effects IV panel estimates are shown in Table 4. The left panels of Tables 3 and 4 show the estimated results regarding the effects of logarithm of labor productivity and the right panels show the results with respect to the effects of Tobin's q.

Hausman tests for the estimated results obtained from random-effects panel estimations in Table 3 suggest that the exogeneity hypotheses between error terms and explanatory variables are statistically accepted in most cases.[6] Thus, random-effects panel estimations are appropriate compared with those of the fixed-effects panel model. After $LnLP$ or $TobinQ$ is instrumented, estimates for capital intensity $LnKL$ in Table 4 turn out to be insignificant in many cases. However, the effects of $LnLP$ or $TobinQ$ retain almost the same signs and significance as shown in Table 3.

In both tables, the coefficients of $LnLP$ are positive and statistically significant in each index, although the significance level is relatively weak for the cases of export (RXD) in Table 3 and foreign outsourcing (ROD) in Table 4. These results are consistent with Tomiura (2007): higher-productivity firms tend to engage in more globalization activities (FDI, exporting, or outsourcing).

Next we consider the effects of Tobin's q on the globalization indexes. The estimated coefficients of $TobinQ$ are positive and significant for the regressions of RID and RXD in Table 4, and they are strongly significant for RID in Table 3. However, in the regressions of ROD, the coefficient of $TobinQ$ is insignificant in both tables. This result suggests that an increase in Tobin's q does not necessarily induce a firm to expand its foreign outsourcing relative to its domestic sales.

Coefficients of $LnRL$ are positive and statistically significant in all cases in both Tables 3 and 4, indicating the positive effects of R&D intensity on globalization activities. In contrast, while the

[6] Although the Hausman test indicates that the null hypothesis is rejected for regressions of ROD, results estimated by the fixed-effects panel regressions are quite similar to those estimated by random-effects panel regressions. In cases of fixed-effects panel regressions, the estimated coefficient of ROD is statistically significant at 0.79 for $LnKL$, whereas for $TobinQ$, it is statistically insignificant at 0.14. All estimated results of fixed-effects panel estimates are available from the corresponding author upon request.

coefficients of $LnKL$ are significantly positive in the right panel of Table 3, they are insignificant in most cases in Table 4. This result suggests that firms with higher capital intensity do not necessarily engage in more globalization activities, irrespective of their mode. We discuss this issue in the next subsection.

The regression techniques we used above are the regressions for summarizing the average relationship between the globalization indexes and a set of regressors, such as $LnLP$ and $TobinQ$. However, it may be important to provide information about the relationship at different points in the conditional distribution of the globalization choice indexes, because they have a strong negatively skewed distribution. Quantile regression is a useful tool in addressing this issue.[7] Here, we use an algorithm known as least absolute deviations (LAD) to provide quantile estimates, where estimation is implemented by solving linear-programming problems.[8] Table 5 presents the estimated results obtained by quantile regression at the 95th percentile with industrial and year dummies. For purpose of comparison, the results estimated by ordinary least squares regression (OLS) with the same dummies for industries and years are also reported. Coefficients of $LnLP$ obtained both from OLS and quantile regression are positively significant at least at the 10% level for all instances of the globalization choice indexes except ROD, for which the significance level is 11%. On the other hand, coefficients of $TobinQ$ vary across regression techniques. Quantile regression coefficients reveal positive significance even for ROD, a result which differs considerably from the OLS regression. Our results suggest that the impact of Tobin's q on the globalization choice indexes may differ across quantiles, particularly for some outliers.

3.2 Effects of productivity and Tobin's q on globalization choice

In their theoretical and empirical analysis of a firm's choice between export and FDI for heterogeneous firms, Helpman, Melitz, and Yeaple (2004) show that the most productive firms choose to invest in foreign markets, whereas less productive firms choose to export. On the other hand, Chen, Horstmann and Markusen (2008), in their theoretical analysis, argue that FDI firms will have larger values of Tobin's q than outsourcing firms. Here we attempt to present a comprehensive view of the effects of Tobin's q and labor productivity on globalization choice for the firms that engage in at least one globalization activity, whether FDI, exporting, or outsourcing.

Tables 6 and 7 summarize OLS and quantile regressions of $LnLP$ and $TobinQ$ on globalization choices RXI (ratio of exporting to FDI) and ROI (ratio of foreign outsourcing to FDI).[9] We also apply the bootstrap simulation method to the same sample, where the estimates are obtained by

[7] See Koenker (2005) and Hao and Naiman (2007) for details on quantile regression estimation.

[8] See Cameron and Trivedi (2009) for the detailed STATA command for the quantile estimation.

[9] Our sample contains many zeroes, which may cause biases in the quantile regression. Moreover, we know from theoretical analyses, such as Melitz (2003) and Helpman, Melitz, and Yeaple (2004), that initiating export or FDI requires fixed costs and involves discontinuous choice, which is hence qualitatively different from changing the size of export or FDI after engaging in that mode. Thus, we concentrate on observations for which each of RXI and ROI is larger than zero.

bootstrapping 400 replications. The estimated results are shown in Table 9, which coincide fairly well with those in Tables 6 and 7.

For RXI, the estimated coefficients of $LnLP$ in Table 6 are negatively significant at higher quantiles, namely, the 50th and 75th percentiles. These results strongly support the theoretical and empirical results demonstrated by Helpman, Melitz, and Yeaple (2004). That is, an increase in labor productivity tends to motivate a firm to choose more FDI and less exporting. However, all coefficients of $LnLP$ fail the null hypothesis for ROI.

In Table 7, the coefficients of $TobinQ$ are significantly negative in the quantile regressions for ROI at the 25th and 75th percentiles, whereas we find no significant effects of $TobinQ$ on RXI. Thus, an increase in Tobin's q tends to motivate a firm to choose more FDI and less foreign outsourcing, but it does not affect the choice between exporting and FDI. This finding supports the prediction by Chen, Horstmann, and Markusen (2008) that firms which produce goods with higher knowledge capital intensity tend to choose FDI over foreign outsourcing.

In Tables 6 and 7, all coefficients of $LnKL$ are significantly negative in the quantile regressions for ROI. Thus, an increase in capital intensity leads a firm to choose more FDI and less foreign outsourcing. This result seems consistent with the finding of Tomiura (2007) and confirms the prediction by Antràs (2003). In contrast, the coefficients of $LnKL$ in the quantile regressions for RXI are significantly positive in most cases in both the tables. This suggests that an increase in capital intensity prompts a firm to choose more exporting and less FDI. This contradicts the result shown by Helpman, Melitz, and Yeaple (2004), who find that firms in more capital-intensive sectors tend to export less relative to FDI.[10] However, to our knowledge, there are no definitive theoretical predictions regarding the relationship between capital intensity and the choice between exporting and FDI.

Moreover, in Tables 6 and 7, all coefficients of $LnRL$ are significantly positive in the quantile regressions. This result indicates that an increase in R&D intensity causes a firm to export and outsource more relative to FDI. One might regard this result as inconsistent with conventional wisdom. However, Helpman, Melitz, and Yeaple (2004) also show that R&D intensity is not a useful predictor of exports versus FDI. Norbäck (2001) finds that firms with higher R&D intensity tend to export rather than engage in FDI if the costs of technology transfer are high, while the opposite is true if these costs are low. Theoretically, there is no definitive relationship between R&D intensity and the choice of globalization mode. Our empirical results suggest this issue should be investigated further theoretically and empirically.

3.3 Effects of the intensity of intangible assets on globalization choice

Finally, we analyze how the results for Tobin's q will change if we use the ratio of intangible to tangible assets. We repeat the estimations in the previous subsection by replacing $TobinQ$ with $LnPatK$, the

[10] Tomiura (2007) also finds that multinationals tend to be more capital intensive than exporters.

logarithm of the ratio of patent stock to tangible fixed capital. Table 8 shows the estimated results for regressions both of RXI and ROI on $LnPatK$. All quantile estimates of $LnPatK$ are significantly negative for the case of ROI, which coincides with the findings in Table 7 for the regression on Tobin's q. However, the estimated results also show significantly negative effects of $LnPatK$ on RXI, which are different from those of $TobinQ$ in Table 7. These results imply that headquarter companies with relatively higher intangible assets tend to favor FDI over exporting and outsourcing in their globalization decisions. Therefore, the effects of Tobin's q on firms' choices of globalization mode differ fairly from the effects of the intensity of intangible assets.

4 Conclusion

Using firm-level data for Japanese firms, this paper investigated empirically how firms' choice of globalization mode differs according to productivity and Tobin's q. We tested the predictions by Chen, Horstmann, and Markusen (2008) and Helpman, Melitz, and Yeaple (2004). Using quantile regression, we found that firms with higher productivity tend to choose more FDI and less exporting, which supports the prediction by Helpman, Melitz, and Yeaple (2004). The difference in productivity, however, has no significant effect on the choice between FDI and exporting. We also found that firms with higher Tobin's q tend to choose more FDI and less foreign outsourcing, which supports the prediction by Chen, Horstmann, and Markusen (2008). However, the choice between FDI and foreign outsourcing is not affected by the difference in Tobin's q. Moreover, the estimated result indicated that firms with higher intensity of intangible assets tend to choose more FDI relative to both exporting and outsourcing. Thus, we concluded that the effects of Tobin's q on the choice of globalization mode are not the same as those of the intensity of intangible assets.

Our results suggested that the quantile regression technique would be appropriate for analyzing the relationship between globalization mode and firms' characteristics, because the indexes of globalization activities have a strong negatively skewed distribution and include outliers. Estimated results from employing traditional estimation techniques that give information only at the conditional mean of the dependent variable may not be appropriate.

Our findings have important policy implications. Although existing empirical studies have primarily focused on the relationship between a firm's productivity and its choice of globalization mode, our findings illuminate the potential importance of Tobin's q on firms' globalization activities. In particular, we found that a difference in Tobin's q affects the choice between FDI and foreign outsourcing, whereas a difference in productivity is relatively less important for the choice between those two activities. Firms with lower Tobin's q are relatively more active in foreign outsourcing than in FDI. Thus, policies to facilitate foreign outsourcing will benefit the domestic economy, because foreign outsourcing contributes to improve the competitiveness of outsourcers by reducing their production

costs. Since relatively lower values of Tobin's q imply that these firms do not effectively utilize their capital, deregulation and expansion of supportive services to small and medium enterprises may be helpful. Providing information on regulation in foreign countries and helping to find potential partner companies of outsourcing may also enhance gains from foreign outsourcing by reducing fixed costs of outsourcing. On the other hand, firms with lower Tobin's q may be reluctant to enhance FDI because they have difficulty in financing costs of investment, as indicated by the low value of Tobin's q. Thus, policies to create a financing mechanism for FDI will help those firms and facilitate outward FDI.

There are a few caveats with respect to our analysis. First, we captured firms' globalization activities in the relative size, such as the ratio of exports to sales of foreign affiliates and the ratio of costs of foreign outsourcing to sales of foreign affiliates. This is because many globalized firms engage in more than one globalization mode. In theoretical models of Helpman, Melitz, and Yeaple (2004) and Chen, Horstmann, and Markusen (2008), by contrast, individual firms do not engage in multiple modes of globalization, although we observe multiple modes at the aggregated industry level. Second, we cannot fully explain our estimation results regarding the effects of capital intensity and R&D intensity on the choice of globalization mode. Further theoretical and empirical studies on this issue are required.

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Table 1: Globalization Choice of Japanese Companies

Year	No. of Firms	FDI Only	Export Only	Outsource Only	FDI+Export	FDI+Outsource	Export+Outsource	FDI+Export+Outsource
1994	1194	51	287	7	341	7	39	111
1995	1178	35	223	7	423	3	23	145
1996	1203	39	202	10	433	4	30	162
1997	1165	71	156	8	418	13	16	150
1998	1161	65	161	10	409	11	26	154
1999	1204	80	160	14	410	9	20	165

Note: The number of firms counts those matched by the three datasets: KKKC, KJKKC, and NEEDS for 1994–1999.

Table 2: Descriptive Statistics

	No. Obs.	Mean	Std.Dev.	Percentiles				
				10%	25%	50%	75%	90%
RID	7103	20.99	195.85	0.00	0.00	0.11	9.06	42.83
RXD	7103	30.38	530.55	0.00	0.00	1.40	12.23	39.71
ROD	7103	6.83	276.90	0.00	0.00	0.00	0.00	0.65
RXI	3707	32.44	719.43	0.00	0.27	0.84	2.16	7.13
ROI	3707	997.16	28608.99	0.00	0.00	0.00	0.02	19.52
$TobinQ$	7105	1.29	0.61	0.80	0.98	1.18	1.44	1.78
$LnPatK$	5691	-5.17	1.86	-7.76	-6.31	-4.86	-3.81	-3.02
$LnLP$	7084	2.25	0.72	1.36	1.81	2.26	2.71	3.13
$LnKL$	7104	2.48	0.82	1.54	2.02	2.48	2.95	3.45
$LnRL$	5691	-12.17	1.99	-14.68	-13.34	-11.92	-10.79	-9.94

Source: The authors' calculation from KKKC, KJKKC, NEEDS, and IIP for 1994–1999.

Table 3: Random-Effects Panel Estimates for Globalization Indexes

Variables	RID	RXD	ROD	RID	RXD	ROD
$LnLP$	15.04***	5.11	0.62***			
	(2.73)	(1.47)	(3.13)			
$TobinQ$				11.94***	3.43	0.13
				(2.36)	(1.26)	(0.90)
$LnKL$	10.53*	6.09*	0.27	14.87***	7.48**	0.40*
	(1.96)	(1.73)	(1.31)	(2.86)	(2.16)	(1.90)
$LnRL$	6.99***	4.2***	0.33***	6.59***	4.22***	0.34***
	(3.33)	(2.73)	(3.11)	(3.14)	(2.75)	(3.16)
No. of Obs.	5674	5674	5674	5690	5690	5690
Prob>chi^2	0.00	0.00	0.00	0.00	0.00	0.00
Hausman Test	0.52	0.59	0.00***	0.24	0.38	0.00***

Notes: (1) "***","**", and "*" denote 1%, 5%, and 10% significance level.

(2) The values in the parentheses are t-statistics.

(3) Constant terms are included in the estimations.

Table 4: Random-Effects Panel IV Estimates for Globalization Indexes

Variables	RID	RXD	ROD	RID	RXD	ROD
$LnLP$	22.15***	12.00*	1.14			
	(3.61)	(1.94)	(1.59)			
$TobinQ$				9.22*	8.93*	0.05
				(1.98)	(1.77)	(0.16)
$LnKL$	0.51	1.28	−0.06	5.83*	4.64	0.16
	(0.16)	(0.37)	(−0.24)	(1.96)	(1.45)	(0.68)
$LnRL$	4.59***	3.07**	0.23*	4.61***	3.04**	0.24*
	(3.42)	(2.17)	(1.91)	(3.41)	(2.16)	(1.94)
No. of Obs.	4602	4602	4602	4625	4625	4625
Prob>chi^2	0.00	0.00	0.00	0.00	0.00	0.00

Notes: (1) The first lags of dependent and independent variables are used as instruments for $LnLP$.

(2) "***","**", and "*" denote 1%, 5%, and 10% significance level.

(3) The values in the parentheses are t-statistics.

(4) Constant terms are included in the estimations.

Table 5: OLS and Quantile Estimates for Globalization Indexes

	RID		RXD		ROD		RID		RXD		ROD	
Variables	OLS	QR_{95}	OLS	QR_{95}	OLS	QR_{95}	OLS	QR_{95}	OLS	QR_{95}	OLS	QR_{95}
$LnLP$	30.02***	15.53***	19.28***	9.50***	0.93***	0.27						
	(3.03)	(4.47)	(3.70)	(3.97)	(3.86)	(1.63)						
$TobinQ$							7.73	25.09***	3.00	19.58***	0.11	0.23**
							(1.37)	(9.39)	(1.08)	(14.16)	(0.61)	(2.10)
$LnKL$	19.17*	7.09**	15.76**	5.01***	−0.37	−0.13	29.35**	9.26***	22.41***	6.06***	−0.09	−0.05
	(1.73)	(2.45)	(2.37)	(2.66)	(−1.57)	(−1.00)	(2.02)	(3.27)	(2.64)	(3.18)	(−0.42)	(−0.37)
$LnRL$	2.3	0.36	1.17	0.90	0.03	0.03	3.4	0.69	1.94*	2.19***	0.05	0.01
	(1.24)	(0.41)	(1.40)	(1.43)	(0.36)	(0.76)	(1.54)	(0.83)	(1.82)	(3.86)	(0.68)	(0.28)
No. of Obs.	5674	5674	5674	5674	5674	5674	5690	5690	5690	5690	5690	5690

Notes: (1) "***","**", and "*" denote 1%, 5%, and 10% significance level.

(2) The values in the parentheses are t-statistics.

(3) "OLS" refers to ordinary least squares regression and "QR_{95}" refers to quantile regression at 95th percentile.

(4) Constant terms and industrial and year dummies are included in the estimations.

(5) Quantile regression is based on least-absolute value model (LAV).

(6) R^2 of quantiel regression refers to pseudo R^2.

Table 6: OLS and Quantile Estimates of Productivity on Globalization Choices

	RXI				*ROI*			
Variables	OLS	QR_{25}	QR_{50}	QR_{75}	OLS	QR_{25}	QR_{50}	QR_{75}
$LnLP$	0.87	−0.02	−0.15***	−0.31***	500.5	0.25	0.15	−1.13
	(0.20)	(−0.74)	(−3.71)	(−2.68)	(1.01)	(1.31)	(0.15)	(−0.45)
$LnKL$	−1.61	0.07***	0.13***	0.46***	−1505.73	−1.55***	−5.24***	−15.96***
	(−1.01)	(3.77)	(3.31)	(3.78)	(−1.50)	(−5.90)	(−3.93)	(−4.54)
$LnRL$	1.34	0.04***	0.10***	0.32***	−81.14	0.56***	3.32***	4.05***
	(1.18)	(4.59)	(6.28)	(6.80)	(−0.27)	(4.67)	(5.77)	(2.64)
No. of Obs.	3034	3034	3034	3034	868	868	868	868
R^2	0.009	0.009	0.008	0.017	0.013	0.002	0.003	0.007

Notes: (1) "***","**", and "*" denote 1%, 5%, and 10% significance level.
(2) The values in the parentheses are t-statistics.
(3) "OLS" refers to ordinary least squares regression and "QR_X" refers to quantile regression at Xth percentile.
(4) Constant terms and industrial and year dummies are included in the estimations.
(5) Quantile regression is based on least-absolute value model (LAV).
(6) R^2 of quantiel regression refers to pseudo R^2.

Table 7: OLS and Quantile Estimates of Tobin's q on Globalization Choices

Variables	*RXI* OLS	*RXI* QR_{25}	*RXI* QR_{50}	*RXI* QR_{75}	*ROI* OLS	*ROI* QR_{25}	*ROI* QR_{50}	*ROI* QR_{75}
$TobinQ$	2.64	0.01	−0.01	0.00	−978.35	−0.40**	−1.47	−5.99**
	(1.40)	(0.73)	(−0.22)	(−0.05)	(−1.52)	(−2.21)	(−1.57)	(−2.00)
$LnKL$	−1.1	0.06***	0.05	0.30***	−1147.39	−1.40***	−5.57***	−16.07***
	(−0.52)	(3.26)	(1.30)	(2.66)	(−1.28)	(−5.41)	(−4.75)	(−4.70)
$LnRL$	1.38	0.04***	0.09***	0.29***	−44.45	0.44***	3.08***	3.71**
	(1.10)	(4.56)	(4.96)	(5.98)	(−0.15)	(3.48)	(5.76)	(2.35)
No. of Obs.	3042	3042	3042	3042	871	871	871	871
R^2	0.009	0.009	0.008	0.017	0.013	0.002	0.003	0.007

Notes: (1) "***","**", and "*" denote 1%, 5%, and 10% significance level.

(2) The values in the parentheses are t-statistics.

(3) "OLS" refers to ordinary least squares regression and "QR_X" refers to quantile regression at Xth percentile.

(4) Constant terms and industrial and year dummies are included in the estimations.

(5) Quantile regression is based on least-absolute value model (LAV).

(6) R^2 of quantile regression refers to pseudo R^2.

Table 8: OLS and Quantile Estimates of Stock of Patents on Globalization Choices

	RXI				*ROI*			
Variables	OLS	QR_{25}	QR_{50}	QR_{75}	OLS	QR_{25}	QR_{50}	QR_{75}
$LnPatK$	−1.05	−0.04***	−0.20***	−0.40***	−2307.33***	−1.81***	−4.43***	−16.87***
	(−0.35)	(−3.76)	(−11.60)	(−6.28)	(−2.07)	(−10.35)	(−10.92)	(−13.15)
$LnKL$	−0.96	0.06***	0.06**	0.36***	−1196.15	−1.80***	−5.79***	−26.90***
	(−0.46)	(3.78)	(2.38)	(3.58)	(−1.32)	(−5.50)	(−7.98)	(−12.84)
$LnRL$	2.01	0.06***	0.19***	0.50***	904.58**	0.92***	4.51***	6.34***
	(1.47)	(6.50)	(11.86)	(8.69)	(2.25)	(5.43)	(12.07)	(5.35)
No. of Obs.	3042	3042	3042	3042	871	871	871	871
R^2	0.025	0.002	0.004	0.007	0.009	0.009	0.009	0.018

Notes: (1) "***","**", and "*" denote 1%, 5%, and 10% significance level.
(2) The values in the parentheses are t-statistics.
(3) "OLS" refers to ordinary least squares regression and "QR_X" refers to quantile regression at Xth percentile.
(4) Constant terms and industrial and year dummies are included in the estimations.
(5) Quantile regression is based on least-absolute value model (LAV).
(6) R^2 of quantile regression refers to pseudo R^2.

Table 9: Bootstrap Quantile Estimates of Tobin's q on Globalization Choices

	RXI			ROI			RXI			ROI		
Variables	QR_{25}	QR_{50}	QR_{75}	QR_{25}	QR_{50}	QR_{75}	QR_{25}	QR_{50}	QR_{75}	rQR_{25}	QR_{50}	QR_{75}
$LnLP$	−0.02	−0.15***	−0.31**	0.25	0.15	−1.13						
	(−0.61)	(−2.60)	(−2.32)	(0.76)	(0.15)	(−0.26)						
$TobinQ$							0.01	−0.01	0.00	−0.40	−1.47	−5.99***
							(0.74)	(−0.23)	(−0.05)	(−1.15)	(−1.21)	(−1.98)
$LnKL$	0.07***	0.13**	0.46***	−1.55*	−5.24***	−15.96***	0.06**	0.05	0.30**	−1.40**	−5.57***	−16.07***
	(2.78)	(2.46)	(2.97)	(−1.99)	(−3.07)	(−3.68)	(2.57)	(1.07)	(2.05)	(−2.26)	(−3.20)	(−3.82)
$LnRL$	0.04***	0.10***	0.32***	0.56**	3.32***	4.05*	0.04***	0.09***	0.29***	0.44*	3.08***	3.71*
	(3.54)	(5.17)	(5.41)	(2.16)	(4.57)	(1.68)	(3.80)	(4.91)	(5.35)	(1.78)	(4.42)	(1.67)
No. of Obs.	3034	3034	3034	868	868	868	3042	3042	3042	871	871	871
R^2	0.009	0.008	0.017	0.002	0.003	0.007	0.009	0.008	0.017	0.002	0.003	0.007

Notes: (1) "***","**", and "*" denote 1%, 5%, and 10% significance level.

(2) The values in the parentheses are t-statistics.

(3) "QR_X" refers to quantile regression at Xth percentile.

(4) Constant terms and industrial and year dummies are included in the estimations.

(5) R^2 refers to pseudo R^2.

Table 10: Correlations of Variables

	$LnLP$	$TobinQ$	$LnPatK$	$LnKL$	$LnRL$	RID	RXD	ROD	RXI	ROI
$LnLP$	1.00									
$TobinQ$	0.18	1.00								
$LnPatK$	−0.17	0.15	1.00							
$LnKL$	0.35	−0.03	−0.26	1.00						
$LnRL$	−0.21	0.06	0.80	−0.32	1.00					
RID	0.06	0.04	0.05	0.05	0.05	1.00				
RXD	0.07	0.05	0.05	0.06	0.05	0.87	1.00			
ROD	−0.01	0.02	0.09	−0.08	0.09	0.09	0.10	1.00		
RXI	−0.02	0.01	0.01	−0.02	0.01	−0.01	0.01	0.00	1.00	
ROI	0.00	−0.01	0.00	−0.02	0.02	−0.01	−0.01	0.04	0.09	1.00