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Anatomy of Learning-from-Exporting: Role of Foreign Knowledge Acquisition*

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Abstract

The essence of learning-from-exporting can be thought of as a process in which exporters absorb international knowledge spillovers and feed it back to their innovation efforts. Learning-from-exporting is often difficult to observe because it is conditional on at least two efforts: information gathering from foreign markets and zealous R&D. We exploit unique survey data to explicitly analyze the contribution of these activities to exporters' innovation. We find that gathering information from foreign markets significantly raises exporters' probability of succeeding in technology upgrades or new product developments, along with their R&D activities. While learning about the latest foreign technology and competitor products is at the core of such knowledge acquisition, international marketing activities, such as gathering feedback from foreign customers or information on the taste and needs of foreign customers, is also associated with a significant contribution. The importance of foreign knowledge acquisition is also confirmed for exporters that do not serve high-income markets or those that supply intermediate goods. Although it is likely that the acquisition of foreign knowledge contributes to exporters' innovation strategies, such as where to allocate R&D resources, it does not seem to raise the marginal effectiveness of R&D.

Key Words: Learning-from-Exporting, Knowledge Acquisition

JEL Classification: F23, O3, M2

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1. Introduction

Firms that export not only enjoy additional demand in foreign countries but may also acquire seeds of innovation from foreign markets. Such seeds may provide information on advanced technology, novel products in foreign markets, or knowledge on foreign consumers' tastes, which helps the firms upgrade their technology or develop new, internationally competitive products. This phenomenon is often called "learning-from-exporting" and is most likely to result in exporters experiencing higher productivity growth compared with non-exporters. Learning-from-exporting is considered to provide an explanation for the export-oriented economic development witnessed in several countries at the level of exporting firms.

Learning-from-exporting is most likely conditional on at least two types of efforts by exporters: information-gathering activity in foreign markets and R&D. The essence of learning-from-exporting can be thought of as the absorption of foreign knowledge channeled by commodity trade, as claimed by Grossman and Helpman (1991). Therefore, it requires the act of gathering such knowledge from foreign markets through the marketing or reverse engineering of foreign products (Salomon, 2006). Furthermore, in order to reflect the acquired knowledge into successful innovation, exporters must be engaged in intensive R&D activities as a prerequisite. Empirical studies on learning-from-exporting, however, focused mostly on the relationship between a firm's export status and its ex-post productivity growth.[1] The problem with such an approach is that it implicitly assumes that exporters automatically realize that learning as a reward of exporting. As a result, results of previous studies are fairly mixed about the existence of the learning effect.[2]

In this study, we particularly focus on the role of the foreign knowledge acquisition in

[1]Some exceptions include Salomon and Shaver (2005), who evaluated the effect of exporting on patent applications of Spanish firms, and Aw, Roberts, and Winston (2007), who reported the effect of exporting on inducing R&D investments at Taiwanese firms.
[2]See Wagner (2007) for a brief survey.

exporters' innovation along the spirit of learning-from-exporting. To do so, we exploit a custom-made survey of Japan's small and medium enterprises (SMEs), which provides an in-depth report on their oversea information-gathering activity. We carry out the first study that explicitly analyzes the contribution from the absorption of foreign knowledge spillovers to exporters' innovation. Our study takes a step forward in clarifying the mechanism of "learning-from-exporting," which has been treated as a black box in most previous empirical studies. SMEs are well suited for observing learning-from-exporting in an established exporting country like Japan, where large enterprises often have long career as exporters and may have little room left for learning. Our study is related to Aw, Roberts and Winston (2007) who found that export participation and R&D are complementary to productivity of Taiwanese firms, and more closely with Cirscuolo, Haskel and Slaughter (2010) who reported that exporters use larger input of knowledge flow from internal and external sources than domestic firms. Our study is different from these studies in a way that we capture explicitly the role of knowledge acquisition within exporter's learning process and explore the types of foreign knowledge acquired as opposed to the source of such knowledge. We also incorporate in our analysis exports characteristics such as their destinations and type of product exported.

From our empirical analysis, we find that exporters' information-gathering activities play a significant role in increasing their chances of succeeding in innovation. While the ex-post R&D (R&D conducted after export entry) is an essential factor in shaping the probability of success, the presence of an information-gathering activity raises such chances by 13% to 16%, depending on the type of innovation. Among various types of foreign knowledge, information on the latest technology or products in foreign markets turns out to be the most important, implying that absorption of international technology spillovers is the essence of learning-from-exporting. However, information related to global marketing activity such as feedback from foreign customers

is also found to contribute to innovation. On the other hand, we do not find a significant effect of information gathering in raising the marginal contribution of ex-post R&D. This suggests that foreign knowledge is important to the corporate strategy for successful innovation such as allocation of R&D resources to the right area; however, it does not necessarily enhance the marginal productivity of R&D. The importance of foreign knowledge acquisition remains robust to types of innovation considered, and also whether exporters serve high income markets or not, as well as whether they supply final goods (consumer goods) or only intermediate goods.

The next section offers a concise review of previous studies on exports and innovation including empirical evaluation of learning-from-exporting. Section 3 formulates our hypothesis on the relationship between exporters' knowledge acquisition, R&D activities, and innovation. Section 4 explains our data and Section 5 introduces the empirical framework followed by the presentation of basic results in Section 6. Section 7 extends our empirical analysis by incorporating some exports characteristics that may be relevant to nature of learning. Finally Section 8 concludes our study.

2. Brief Review of Literature on Exporting and Innovation

It is now a stylized fact that exporters have, on average, several advantages over non-exporters, including higher productivity.[3] As for why such "exporter's premia" exists, previous studies more or less support the explanation that, given a large entry cost associated with exporting, only firms competitive enough to earn sales that cover such sunk costs begin exporting. Such "self-selection into exporting" is supported by empirical evidence, such as Bernard and Jensen (1999), who reported that future exporters are more productive than other firms three years

[3]See Bernard et al. (2007), Mayer and Ottaviano (2007), Wakasugi et al. (2008) for documentation of such "exporter's premia" in the U.S., European, and Japanese firms.

prior to their internationalization. On the other hand, a long-held belief is that exports foster a firm's development.[4] In particular, exports have been thought of as a channel through which advanced knowledge or technology in foreign countries is transferred internationally (Grossman and Helpman, 1991). Firms can also acquire valuable information for their corporate strategies such as foreign consumers' taste or needs. Feeding such knowledge acquired from foreign markets into their innovation efforts allows exporters to upgrade their technology or develop competitive new products, which can capture foreign markets. Such a mechanism is often referred to as "learning-from- exporting." Exporters are expected to realize higher productivity growth than non-exporters if such a learning process is successful.

Empirical studies that explored the existence of learning-from-exporting more or less focused on the difference in the ex-post evolution of productivity between firms that participated in exporting versus those that did not. A typical estimation related to such an approach is the following regression:

$$Y_{it+s} = \alpha + \beta Export_{it} + \gamma X_{it} + \eta_i + \varepsilon_{it}, \quad (1)$$

where the left-hand side is the productivity level of firm i at time t + s, the term $Export_{it}$ on the right-hand side is a binary variable taking the value 1 if it entered export markets at time t, and 0 otherwise. In some studies, this variable is replaced by export intensity, the ratio of export sales to total sales. X_{it} is a vector of control variables that includes other factors likely to influence a firm's future productivity, such as its size, skill intensity, and initial productivity level. The forth term is the firm's unobserved heterogeneity, which is often assumed to be time invariant, and the last term

[4]For previous view on the contribution of exports on a firm's growth, see for example, World Bank (1993).

is an i.i.d. error. Learning-from-exporting was inferred by observing the significance and size of the coefficient β . Studies, such as Van Biesebroeck (2005), Kimura and Kiyota (2006), and Park et al. (2010) estimated β by using the panel data method or the instrumental variables approach.

Other studies, such as Girma et al. (2004) and De Loecker (2007), employed the framework of policy evaluation, where β is estimated as a following difference-in-difference estimator revealing the treatment effect of export participation on treated:

$$\beta = E(Y_{t+s} - Y_t \left| Export_{it}^1 = 1) - E(Y_{t+s} - Y_t \right| Export_{it}^1 = 0), \quad (2)$$

where $Export_{it}^1$ indicates whether the treated group, expressed by number 1 in its shoulder, engaged in exports. Since the treatment itself is export participation, the second term of equation 2 is actually an unobservable counterfactual. Therefore, it has to be replaced with $E(Y_{t+s} - Y_t \left| Export_{it}^0 = 0)\right.$, the ex-post productivity change of non-exporters. To alleviate the selection bias caused by the self-selection of more productive firms into exports, studies often exploited propensity score matching, which builds a control group of non-exporters, similar to some extent with exporters with their probability to enter export markets.

So far, results of such studies are mixed: while Girma et al., (2004), Kimura and Kiyota (2006), Van Biesebroeck (2005), De Loecker (2007), and Park et al. (2010) found a positive and significant effect of exporting for firms in the U.K., Japan, Sub-Saharan African countries, Slovenia, and China, several other studies, such as Clerides et al. (1998), Bernard and Jensen (1999) and Mayer and Ottaviano (2008) reported the absence of such evidence for U.S. and Columbian firms.

A fundamental problem with such an approach is that it fails to incorporate whether exporters engaged in the necessary activities to translate their contacts with foreign markets into

innovation activities such as R&D. Learning-from-exporting is far from an unconditional consequence of exporting, but requires extensive efforts to be realized. As Salomon (2006) described, the essence of learning-from-exporting is gathering information concerning foreign consumers' tastes or foreign competitors' products and strategies, as well as wide knowledge on world markets and the technology frontier, allowing firms to respond rapidly to changes in a globalized economy. It is also difficult to expect a successful innovation outcome without intensive R&D activities. Exporters can make the best of externally acquired knowledge only if substantial innovation activity exists into which such knowledge can be fed. Exporter's chance to succeed in innovation should, thus, depend particularly on these two activities, which are possibly complementary.

Recently, some studies have focused on how exports motivate innovation activities. Their basic idea is that it pays more for exporting firms to engage in those efforts than non-exporters, since they can realize larger gains in sales, in contrast to the case where such gains are constrained within a domestic market. For example, Ederington and McCalman (2008) argued that exporters introduce a new technology that lowers production costs faster than non-exporters do, since they enjoy an increase in foreign demand in addition to increased domestic demand, whereas non-exporters are rewarded only the latter. Verhoogen (2008) claimed that an improved access to the markets of high-income countries encourages exporters to upgrade their product quality to export higher value-added products. He used this reasoning to explain the increase in the propensity of ISO9000 acquisition and export intensity by Mexican firms following the large devaluation of the peso in 1994. Although these studies provide a clearer link between exporters' advantages and their innovation efforts, such efforts are mainly exporters' investment decisions motivated by their higher expected profit compared with non-exporters, and are not motivated by any acquisition of foreign knowledge. Thanks to their more intensive innovation efforts, exporters realize higher

productivity or productivity growth compared with non-exporters. However, such a relationship between exports, R&D, and productivity growth can be understood as self-selection of firms with higher expected profits into R&D activities rather than a description of learning-from-exporting. To our knowledge, Aw, Roberts, and Xu (forthcoming) is the only study that incorporates the aspects of learning-from- exporting. In their framework, export participation itself contributes to future productivity, which indirectly induces R&D by increasing its expected return.

3. Analytical Framework

In this paper, we emphasize the role of the acquisition of foreign knowledge in exporters' innovation. Salomon and Shaver (2005) pointed out that productivity, especially total factor productivity, may be problematic as a measure of innovation, as it is affected by many other factors such as demand shocks and the market structure. We, therefore, observe the direct innovation outcome instead of changes in productivity to infer learning-from-exporting. Knowledge of the world's latest technology or global market trends should be an important input for exporters' innovation, along with their R&D efforts. Such knowledge is not only valuable for its technological contents, but it also contributes to exporters' fundamental strategies such as the types of products they should engage in global competition and the R&D activities that they should carry out. Knowledge of the latest foreign technology can indicate the technology that is obsolete and the type of new technology that exporters should concentrate their resources to develop in order for them to compete globally. Information on consumer tastes in world markets provides hints on the modifications or quality upgrades, which they need to make to their products to enable them to penetrate foreign markets. Such relationship between information acquisition from foreign markets and innovation activities is similar to the idea of "user-led innovation," as pointed out by Von

Hippel (1978), where cutting-edge products are developed by the initiative of the end users, instead of the suppliers.

As our conceptual framework, we consider the following innovation production function which describes firm i's probability to succeed in innovation as function of its stock of R&D experience and its knowledge acquired from foreign markets.

$$\Pr(IN_{it} = 1) = f(R_{it}, E_{it}) \qquad (3)^5$$

The stock of R&D experience denoted as R_{it} can be thought of internally or domestically accumulated production knowledge. We assume that it is accumulated in a following way, similar to the manner often assumed for capital stock:

$$R_{it} = r_{it} + (1-\delta)R_{it-1}, \qquad (4)$$

where r_{it} is the R&D expenditure in this period and δ is the depreciation rate. We assume for simplicity that externally acquired knowledge E_{it} depreciate fully every period, considering the nature of world trend changing so fast. The innovation production function can then be rewritten as follow:

$$\Pr(IN_{it} = 1) = f(r_{it}, R_{it-1}, E_{it}), \qquad (5)$$

that is, innovation depends on current R&D expenditure, stock of R&D in previous period and

[5] This production function is conceptually close to the production evolution function assumed by Aw, Roberts and Xu (forthcoming) where future productivity is a function of current R&D and export participation. We replace export participation with actual foreign knowledge acquisition.

currently acquired information on foreign markets. We apply this framework to the innovation realized by the exporter who entered export market in beginning of period t. We proxy r_{it} with a binary variable indicating whether the exporter conducted R&D after the entry (ex-post R&D), R_{it-1} with a binary variable indicating if the exporter conducted R&D before export entry (ex-ante R&D) and finally E_{it} with a binary variable indicating if the exporter engaged in effort to gather information from foreign markets as they engaged in exports. From this framework, we draw our first hypothesis.

Hypothesis 1: $\partial f / \partial E_{it} > 0$ *.That is, all else being equal, the exporters that engaged in knowledge-gathering activity in foreign markets have a higher probability of succeeding in innovation than other exporters.*

This hypothesis is coupled with our natural hypothesis on the contribution of R&D.

Hypothesis 2: $\partial f / \partial r_{it} > 0$ *or* $\partial f / \partial R_{it-1} > 0$. *That is, all else being equal, the exporters that engaged in R&D activities have a higher probability of succeeding in innovation than other exporters.*

It is however not so clear if it is the ex-ante or ex-post R&D that is more essential to exporters' success in innovation. Studies that focused on the effect of exports in increasing the expected return of innovation investments do not offer any guidance on this point. As in Constantini and Melitz (2008) or Lileeva and Trefler (forthcoming), forward-looking firms engage in such investments either before or after export participation, or even simultaneously. Therefore, if their frameworks completely describe exporters' R&D, there should not be a systematic difference between ex-ante and ex-post R&D in their contribution to their innovation outcome. From our perception of learning-from-exporting process however, ex-post R&D is expected to play a more essential role in exporters' innovation.

Furthermore, if exporters are well acquainted with foreign consumer tastes or obtained

feedback from foreign consumers on previous products, they may have a greater chance to develop successful products with the same level of ex-post R&D effort. Such a function of foreign knowledge in enhancing the effectiveness of R&D can be summarized as our third hypothesis.

Hypothesis 3: $\partial^2 f / \partial r_{it} \partial E_{it} > 0$ *. That is, the absorption of foreign knowledge raises the contribution of ex-post R&D in increasing an exporter's probability of succeeding in innovation.*

On the other hand, ex-ante R&D can define an exporter's ability to absorb foreign knowledge. Cohen and Levinthal (1989) argued that the R&D activity is not only an input to innovation but also a building block to a firm's ability to learn from an external source. This is confirmed, for example, by Hu et al. (2005), who show that the contribution of technology transfer to the productivity of Chinese firms is conditional on its stock of knowledge, i.e., accumulated R&D investments. Our conjecture is expressed as our final hypothesis:

Hypothesis 4: $\partial^2 f / \partial E_{it} \partial R_{it-1} > 0$ *. That is, the ex-ante R&D raises the contribution of absorption of foreign knowledge in increasing an exporter's probability of succeeding in innovation.*

Note that we will be comparing the innovation performance among exporters, unlike previous studies that seek a difference between exporters and non-exporters. We are interested in identifying the case in which exporters are more likely to attain innovation as a result of exports, thereby showing that learning-from-exporting depends on specific factors surrounding the act of exporting.

4. Description of the Data

Needless to say, the absorption of foreign knowledge is unobservable from typical

corporate data. We have developed a custom-made survey, together with the Small and Medium Enterprises Agency of the Ministry of Economy, Trade and Industry (METI)[6] to capture this process, as well as other important features of the internationalization of Japanese SMEs. Our survey population includes 18,000 firms, taken from the Census of Manufacturing and the Census of Commerce, which cover manufacturing and nonmanufacturing firms of all sizes. Eighty percent of the population is from the Census of Manufacturing. Since we were interested in the internationalization of SMEs, all firms known to have export activity in the past were included in the population. The rest of the population was selected randomly. We acquired 3,383 responses from firms corresponding to the definition of SMEs (number of employees less than 300)[7]. We focused on 1,755 observations from SMEs that export. As we narrowed down these samples to those providing consistent response to all of our variables of interest, we ended up with 1,093 observations.[8]

The novel feature of this survey which is the information on firms' information-gathering activity in foreign markets, allows us to infer their foreign knowledge acquisition. The survey specifically asks whether firms have engaged in gathering the following information from foreign markets before or after they started exporting: (1) feedbacks on own product or service, (2) taste and needs of foreign markets, (3) information related to the latest technology or products in foreign markets, and (4) other types of information.[9] While the first two types of information are related to exporters' global marketing activity, the acquisition of the third type of information can be

[6]"Survey on Internationalization and Corporate Activity" (Kokusai-ka to Kigyo Katsudo ni kansuru Anketo Chosa) conducted by the Mitsubishi UFJ Research and Consulting Co. (December 2009)
[7]While the definition of SMEs is always ad hoc to some extent, we use the definition from the Small and Medium Enterprise Basic Law for the manufacturing industry. Since manufacturing firms constitute 76.5% of the effective responses, this seems a fair choice.
[8] For example, we dropped the observations of SMEs reporting information gathering but not reporting the type of information gathered.
[9]While the information gathered after exporting may be more relevant in the context of learning-from-exporting, it is not as clear whether it is adequate to exclude pre-export information gathering, which is most likely motivated by exporting. The estimation results are unaltered even if we restrict the sample to ex-post information gathering.

considered as the absorption of international knowledge spillovers.

As for the outcome of learning-from-exporting, the survey asked whether firms realized the following innovations *as a result of* internationalization[10] : (1) improvement of technology or product quality, (2) development of new product or service, and (3) acquisition of intellectual property (such as patent or new design for practical use). Therefore, by design, the question excludes possible reverse causality from innovation to export participation. Unless we assume that an SME's manager does not know how his innovation was realized—pretty unlikely, especially in the case of small enterprises—we are extracting the successful episodes of learning-from-exporting.[11]

Regarding the R&D activities related to the above innovation, firms were asked whether they engaged in the R&D activities before exporting, after exporting, or both. This allowed us to evaluate the relative importance of ex-ante versus ex-post R&D to exporters' innovation, which itself is an important issue. The survey also collected wide range of valuable information that allows us to infer the destinations or types of products exported, what kind of factors encouraged the manager's decision to engage in exports. The appendix explains in detail the information used in this paper. Finally, the Survey also provides a firm's basic information such as its employment size and the ratio of college graduates in the employee population, which we will use to control exporters' firm-level heterogeneity.

[10] While about one-third of our sample of exporters also conduct FDI, we interpret internationalization as primarily indicating export participation drawing on the theoretical prediction by Helpman et al.(2004) where FDI is more selective mode of internationalization requiring higher entry cost than exports. The basic estimation results are unaltered even if we exclude those samples.

[11] In case of large enterprises, managers responding to our survey may not be well acquainted with their episodes of innovation, especially if they do not belong in R&D. However, information is better shared within small firms, where managers usually engage in multiple tasks and there is a higher probability that more senior executives with a broader perspective not subject to sectionalism answered our survey. This was an additional benefit of targeting small enterprises for this type of survey.

5. Empirical Framework

(1) Empirical Issues

We basically regresses the linearized version of innovation function expressed in equation (5). This can be expressed in the following Probit function.

$$\begin{aligned}\Pr(IN_i = 1) &= \Phi(r_i, R_i, E_i, X_i) \\ &= \Phi(\alpha_0 + \alpha_1 r_i + \alpha_2 R_i + \alpha_3 E_i + \alpha_4 r_i \bullet E_i + \alpha_5 R_i \bullet E_i + \beta' X_i)\end{aligned} \tag{6}$$

The left-hand side is the binary variable, indicating 1 if exporter i realizes a specific type of innovation as a result of exporting and 0 otherwise. We focus on the improvement of technology or product quality, which we call "process innovation" and the development of new product or service, which we refer to as "product innovation." The first to third terms on the right-hand side of the first line are binary variables, indicating whether the exporter conducted ex-ante and ex-post R&D activities and whether it gathered information from foreign markets. The third term will be further disintegrated into four binary variables, indicating whether the exporter gathered the specific type of information listed in the previous section. This allows us to observe the type of information in the foreign markets that is relevant for a specific type of innovation. The fourth term, X_i, is a vector of variables that controls exporters' heterogeneity likely to be relevant for innovation. This vector includes employment size, intended to represent the firm size, and economy of scale, the ratio of college graduates over total employees, as a proxy for skill intensity and industry level dummies that capture industry-specific innovation environment.[12] Our hypothesis in Section 3 is tested by observing whether estimated coefficients $\alpha_2, \alpha_3, \alpha_4, \alpha_5$ turn out to be positive and significant.

[12]However, these variables collected in the survey are all in value at the time of survey, which does not necessarily correspond to exporters' condition at the time of innovation.

As a drawback to many customized surveys, our data are one-shot; therefore, panel data techniques cannot be applied to remove a firm's unobserved heterogeneity, which may simultaneously influence its R&D, information-gathering decision, and success in innovation. We alleviate this problem by including in X_i, another novel information collected by the survey. The survey specifically asked whether the following factors applied as the motive of a manager in his decision to participate in the export market: (1) confidence in the competitiveness of one's own products, (2) overseas reallocation of a domestic customer's production plant, (3) decrease in domestic sales, and (4) successful episode of competitors. We include a dummy variable for each of these factors, indicating whether it is applicable. Previous studies often described the unobserved heterogeneity that governs a firm's export participation and innovation as a manager's type or ability. These variables allow us to control the degree of a manager's spontaneity or "aggressiveness" toward internationalization and the potential competitiveness of exporters' products. Managers who decide to go global on the basis of the strong confidence on their product are likely to have aggressive global business strategy and may be more zealous toward learning from foreign markets. On the other hand, if managers are responding only to changes in domestic business conditions, such as the reallocation of their domestic clients abroad, they may not be as eager to invest resources in learning. It is indeed found later that some of these variables do significantly define chance of innovation success. We, therefore, believe that we contain, to some extent, the endogeneity problem that has been plaguing studies on exports and innovation.

(2) First Look

Before running a Probit estimation, it is always helpful to carry out preliminary observations to infer what our data can tell us. Table 1 lists the summary statistics of our variables of interest created from the 1093 samples, which contain effective answers for all our variables.

From the construction of our variables, we can infer that the probability of exporters realizing process innovation as a result of exporting is about 32%. This figure is 28% for product innovation and lower for the case of acquiring intellectual property (IP). This alone shows that learning-from-exporting is hardly an unconditional benefit of exporting. Turning to exporters' efforts, about 33% of the exporters engaged in R&D before exporting and about 52% of them engaged in R&D after exporting. Note that a majority of exporters engaged in some type of information gathering from foreign markets. However, about half or more of the exporters engaged in gathering feedback or information on foreign consumers' tastes, much fewer gathered information on the latest technology or products.

Table 1 about here

Figure 1 compares the probability of achieving three types of innovations mentioned above between exporters that gathered information from foreign markets and those that did not. It can be clearly seen that information gathering is associated with almost twice as higher probability of success for each type of innovation. The difference is starkest in the case of the acquisition of IP, where the exporters that engaged in information gathering were about six times more likely to succeed.

Figure 1 about here

Finally, Table 2 lists the correlation between our variables of interest. Note that the probability of succeeding in process innovation is highly correlated with that of product innovation, suggesting that the exporters that succeed in technology upgrades are likely to succeed in new

product development as well. Ex-ante and ex-post R&D are also substantially correlated, whereas various types of information gathering from foreign markets are less correlated with either ex-ante or ex-post R&D which relieves us from the concern that significant contribution by information gathering may be representing the effect of R&D.

Table 2 about here

6. Empirical Results

(1) Process Innovation

Table 3 reports a series of estimation results with the success of process innovation as dependent variables. In our first specification, we only include ex-ante and ex-post R&D. Note that while the contribution of ex-ante R&D is insignificant, ex-post R&D contributes significantly to increasing the chance of success by 28%. The strong significance of ex-post R&D and lack of significance by ex-ante R&D is consistent across specifications. Our results, thus, not only confirm the important role of R&D in the realization of learning-from-exporting but also reveal an apparent difference between the contribution of R&D conducted before and that conducted after firms begin exporting. Together, they confirm the mechanism whereby exporters provide feedback on what they obtained from foreign markets related to innovation activity.

When we add the binary variable indicating exporters' information gathering in line 2, its contribution is highly significant. The act of information gathering is associated with a 16% greater probability of success. Furthermore, as we disaggregate such information gathering into four types of information in line 3, we find that gathering information on the latest technology and products in foreign markets is associated with the largest contribution. Gathering feedback from foreign

customers also contributes significantly to process innovation. These results support our hypothesis 1 that foreign knowledge acquisition plays an essential role in increasing the success of technology or quality upgrading. Furthermore, such knowledge acquisition is not only about the absorption of international technology spillovers, it is also important marketing information provided by foreign customers. It is, therefore, likely that a part of exporters' innovation is actually directed by foreign customers in the spirit of "user-led innovation."

Next, we observe whether possible complementarity between the foreign information acquisition and R&D activities exists in raising the chance of successful process innovation by including interaction terms. The result in line 4 indicates that neither the interaction term between ex-post R&D and information gathering nor the interaction between ex-ante R&D and information gathering is significant, therefore providing no support to our hypothesis 3 nor 4. While the foreign knowledge acquisition makes an important contribution alongside ex-post R&D in the realization of learning-from-exporting, it does not seem to enhance the marginal productivity of ex-post R&D. In a same token, ex-ante R&D does not seem to enhance the contribution of foreign knowledge acquisition. This result is somewhat in line with Aw, Roberts, and Xu (forthcoming), who reported that export participation increases the marginal return of R&D in the absence of either activity but not so when both activities take place.

Table 3 about here

(2) New Product Development (Product Innovation)

Table 4 presents the estimation results for the probability of product innovation as a dependent variable. Similar to the case of process innovation, we find throughout our specifications that ex-post R&D contributes significantly to the success of leaning-from-exporting, whereas

ex-ante R&D remains insignificant. Ex-post R&D is associated with a 28% higher probability of product innovation. As seen from line 2, information gathering is also associated with a significant contribution of 13%. When disaggregated across types of information in line 3, the acquisition of the latest technology and products in foreign markets is the only type of information gathering that is significantly associated with a 20% higher probability of success. It is, therefore, likely that Japan's small exporters make good use of their knowledge of foreign technology and foreign products in their new product development efforts, although they do not seem to incorporate the tastes of foreign customers. Finally, from line 4, we see that once again, information gathering and ex-ante or ex-post R&D are not complement to product innovation when either activity already takes place.

We, thus, obtained quite consistent results on the importance of foreign knowledge acquisition, especially information related to foreign technology or products, and the contribution of ex-post R&D for two types of innovations by exporters. Note also that the motive of manager to participate in exports is strongly significant in case of product innovation. Exporters that entered foreign markets based on confidence on their products are more than 10% likely to achieve product innovation than those that did not.

Table 4 about here

7. Additional Analysis

In this section, we present additional analysis to infer the robustness of our results and to explore whether the essence of learning-from-exporting may differ because of certain important characteristics of exports.

(1) Acquisition of Intellectual Property

While technology upgrades and new product development are important innovations, their definition is not standardized across firms. It is often difficult to distinguish new products or new technology from modifications and improvements to existing products or technology, thus leaving fair room for a manager's subjection. It is, therefore, adequate to confirm the effect of exporters' foreign knowledge acquisition and R&D on more clearly defined indices of innovation. We observe exporters' acquisition of intellectual property (IP), which should require substantially intense research and must result from a novel feature that is approved by criteria of patent office.

From table 5, we observe results fairly similar to those obtained for process and product innovation. Ex-post R&D contributes significantly whereas ex-ante R&D does not. Information gathering is associated with a higher chance of success. Similar to prior analysis, information on the latest technology and products are the most important types of information to gather, but other types of information, such as feedback from foreign customers, are also useful. This suggests that the IP acquired by Japan's small exporters is not limited to pure technical novelty but includes specific product features motivated by requests from foreign customers.

Table 5 about here

(2) Exports Destination and Learning-from-exporting

Previous literature often treated exports comprehensively when assessing their impact on innovation. However, De Loecker (2007) and Park et al. (forthcoming) distinguished exports by destination, reporting that productivity gains are only associated with exports to high-income countries. They interpret this as the evidence of exporters learning from more sophisticated markets than from home. Since our dataset contains information on export destination, we conducted a

similar exercise to infer whether the importance of the foreign knowledge acquisition in learning-from-exporting is altered depending on where the firms export.

We proxy exports to high-income countries by those directed to North American and European countries. We separate our sample of exporters between those that export to such countries and those that do not. Table 6 lists the estimation results in the case of process innovation for both groups. For brevity, we only list the first three estimations for each group. We find that the significant contribution of ex-post R&D and information gathering is preserved for both groups, even the highlighted importance of information on foreign technology and products. Such a result is similarly observed for product innovation (not reported).

Table 6 about here

Why does information on technology and products from markets that are not necessarily more sophisticated than the home market matter? One possibility is that Japanese exporters may be benefiting from the information on foreign competitors' products that is not necessarily related to cutting-edge technology but provides hints for product features that appeal to foreign consumers. This type of "learning-from-competitor" can be especially important in markets that are highly heterogeneous compared with Japan. Another possibility is that export destinations are not an essential factor related to customer sophistication. Many of Japan's SMEs supply parts and components to production plants—often that of large Japanese enterprises—in Asia, which are then assembled and exported to high-income countries. Thus, supplying to Asia may allow exporters to acquire useful information about the technology or the quality required in high-income markets from set makers operating such production plants.

(3) Final Goods Exports Versus Intermediate Goods Exports

Would the nature of learning-from-exporting differ depending on the type of goods exported? In particular, is the knowledge from foreign markets also important for exporters that are not supplying final goods? Although the trade of intermediate goods comprises more than half the total trade flow,[13] no previous study has explored the difference in exporters' innovation process associated with the export of final goods and intermediate goods. Our survey specifically collects information on the type of goods exported, which allows us to distinguish between final goods (consumer related product) and intermediate goods. Using this information, we split our sample between those that export any final goods and those that do not, i.e., intermediate goods exporters.

Table 7 reports the estimation results for process innovation. We find that most of the qualitative results in the previous section are preserved in both groups, such as the significance of ex-post R&D versus the insignificance of ex-ante R&D, and the important contribution of information gathering related to foreign technology and products that correspond to the absorption of international knowledge spillovers. However, to our surprise, gathering feedback from foreign customers seems to contribute significantly to process innovation only for exporters *not* supplying final goods. Although the marked importance of feedback from foreign customers for exporters supplying intermediate goods instead of final goods exporters is counterintuitive, intermediate goods are likely to include more relation-specific features than the final goods. That is, they are often custom-made or tailored to buyers' requests, which sometimes become a source of contractual friction (Grossman and Helpman, 2002). It can, therefore, be more beneficial for intermediate goods exporters to retrieve feedback from customers to adjust technology content or product quality to the level that adequately meets their customers' requests. It is even likely that some seeds of technology upgrades are provided by customer feedback. The example of "user-led innovation"

[13]According to the recent estimation by Miroudots et al. (2009), intermediate trade comprises 56% of goods and 73% of service trade flow during 1995–2005.

by Von Hippel (1978) has been mostly reported for industrial products, which in our case roughly corresponds to intermediate goods.

Table 7 about here

We now compare the results in the case of product innovation in Table 8. Again, we observe a significant contribution of ex-post R&D, which is more pronounced in the case of final goods exporters. Gathering information on foreign technology and products is important for both types of exporters of similar magnitude. However, unlike the results for the joint sample in the previous section, we find that the acquisition of knowledge on foreign customers' tastes and needs is significantly associated with a higher chance of product innovation by final goods exporters. Therefore, exporters that directly supply foreign consumers seem to incorporate knowledge from their global marketing activities into their new product development.

Table 8 about here

8. Conclusion

Learning-from-exporting is often difficult to observe, because it is conditional on at least two types of efforts: absorption of foreign knowledge and zealous innovation efforts. To connect their access to foreign markets with successful innovation, exporters must gather valuable information from foreign markets and feed them back to their innovation process. We exploit unique survey data that captures such an information gathering to explicitly analyze the contribution of these two types of efforts for successful innovation. Unlike previous studies that

inferred the existence of learning-from-exporting by observing changes in productivity, we observe the following three types of innovations, which are highly relevant to a firm's competitiveness and are reported to have been achieved as a consequence of exporting: technology or quality upgrading, development of new products, and acquisition of IP.

We find a significant and substantial contribution from the gathering of foreign knowledge to exporters' success in innovation alongside their ex-post R&D. In particular, the acquisition of knowledge on the latest foreign technology and competitors' products, which may be regarded as absorption of international technology spillovers, turns out to be the core of such knowledge acquisition. However, the information acquired through international marketing activities, such as feedback from foreign customers or information on the tastes and needs of foreign consumers, is also important, especially for product innovation of a final goods exporter. The contribution of foreign knowledge acquisition remains significant regardless of export destination and type of goods—final goods or intermediate goods—exported. On the other hand, foreign knowledge acquisition does not seem to increase the marginal effectiveness of ex-post R&D. It is, therefore, likely that foreign knowledge contributes to exporters' innovation strategies, such as where to direct ex-post R&D, but does not necessarily reduce the cost of R&D or increase the returns from R&D efforts. We also saw that ex-ante R&D does not increase the marginal effectiveness of foreign knowledge acquisition. Therefore while foreign knowledge acquisition and (ex-post) R&D are both important components of learning-from-exporting, they are not necessarily complementary.

Our analysis provides explanation to the difficulty faced by previous studies that did not incorporate foreign knowledge acquisition into their assessment of learning-from-exporting. It also offers rich policy implications on the development of firms through internationalization, especially for SMEs: firms have to invest in knowledge acquisition and R&D activities to develop through

exporting. Since these activities require substantial costs, only the most initially productive exporters may actually be able to learn from exporting. There may be, therefore, room for policy measures that facilitate information gathering and ex-post R&D activities of small exporters. While export promotion is often concentrated on the facilitation of export entry, our study stresses the importance of a supporting scheme after export entry, an area much less stressed in previous policy discussions.

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References

Aw, Bee Yan., Mark J. Roberts and Daniel Yi Xu "R&D Investment, Exporting and Productivity Dynamics," *American Economic Review*, forthcoming.

Aw, Bee Y.an, Mark J. Roberts and Tor Winston (2007) "Export Market Participation, Investments in R&D and Worker Training, and the Evolution of Firm Productivity," *The World Economy*, Vol. 30 (1), pp. 83-104.

Bernard, Andrew B. and Bradford Jensen (1999) "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics*, Vol. 47 (1), pp. 1-25.

Bernard, Andrew B., Bradford Jensen, Stephen J. Redding and Peter K. Schott (2007) "Firms in International Trade," *Journal of Economic Perspective*, Vol. 21 (3), pp. 105-130.

Clerides, Sofronis K., Saul Lach and James Tybout (1998) "Is Learning from Exporting Important? Micro Dynamic Evidence from Columbia, Mexico and Morocco," *The Quarterly Journal of Economics*, Vol. 113 (3), pp. 903-947.

Cohen, Wesley M. and Daniel A. Levinthal (1989) "Innovation and Learning: The Two Faces of R&D," *The Economic Journal*, Vol. 99, pp. 569-596.

Costanini, James A. and Marc J. Melitz (2008) "The Dynamics of Firm-level Adjustment to Trade Liberalization," in E. Helpman, D. Marin and T.Verdier edited *The Organization of firms in a global economy*, Harvard University Press, Cambridge

Criscuolo, Chiara, Jonathan H. Haskel and Matthew J. Slaughter (2010) "Global Engagement and the innovation activities of firms" *International Journal of Industrial Organization*, Vol.28, pp.191-202

De Loecker, Jan (2007) "Do Export generate higher Productivity? Evidence from Slovenia," *Journal of International Economics*, Vol. 73, pp. 69-98.

Ederington, Josh and Phillip McCalman (2008) "Endogenous Firm Heterogeneity and the Dynamics of

Trade Liberalization," *Journal of International Economics*, Vol. 74, pp. 422-440.

Girma, Sourafel, David Greenaway and Richard Kneller (2004) "Does exporting lead to better performance? A Microeconometric analysis of matched firms," *Review of International Economics*, Vol. 12, pp. 855-866.

Grossman, Gene and Elhanan Helpman (1991) "Trade, Knowledge Spillover and Growth," *European Economic Review*, Vol. 35, pp. 517-526.

Grossman, Gene and Elhanan Helpman (2002) "Integration Versus Outsourcing In Industry Equilibrium," *The Quarterly Journal of Economics*, Vol. 117 (1), pp. 85-120.

Helpman, Elhanan, Marc J. Melitz and Stephen R. Yeaple (2004) "Export versus FDI with Heterogeneous Firms," *The American Economic Review*, Vol. 94 (1), pp. 300-316.

Hu, Albert G., Gary H. Jefferson and Qian Jinchang (2005) "R&D and Technology Transfer: Firm-Level Evidence from Chinese Industry," *Review of Economics and Statistics*, Vol. 87 (4), pp. 780-786.

Kimura, Fukunari and Kozo Kiyota (2006) "Exports, FDI and productivity: Dynamic evidence from Japanese Firms," *Review of World Economics*, Vol. 142 (4), pp. 695-719.

Lileeva, Alla and Daniel Trefler "Improved access to foreign markets raises plant-level productivity…For some plants," *Quarterly Journal of Economics*, forthcoming.

Mayer, Thierry and Gianmarco I.P. Ottaviano (2007) *The Happy Few: The Internationalization of European Firms*, Brugel Blueprint Series.

Miroudot, Sebastien, Rainer Lanz and Alexandros Ragoussis (2009) "Trade in Intermediate Goods and Services," OECD Trade Policy Working Papers No.93

Park, Albert, Dean Yang, Xinzheng Shi and Yuan Jiang "Exporting and Firm Performance: Chinese Exporters and the Asian Financial Crisis," *Review of Economics and Statistics*, forthcoming.

Salomon, Robert M. (2006) *Learning from Exporting: New Insights, New Perspectives*, Edward Elgar Publishing.

Salomon, Robert and Myles J. Shaver (2005) “Learning by Exporting: New Insights from Examining Firm Innovation,” *Journal of Economics and Management Strategy*, Vol. 14 (2), pp. 431-460.

Van Biesebroeck, Johanne (2005) “Export raises productivity in Sub-Saharan African manufacturing plants,” *Journal of International Economics*, Vol. 67, pp. 373-391.

Verhoogen, Eric A. (2008) “Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector,” *Quarterly Journal of Economics*, Vol. 123 (2), pp. 489-530.

Von Hippel, Eric (1978) “Successful Industrial Products from Customer Ideas,” *Journal of Marketing*, Vol. 42 (1), pp. 39-49.

Wagner, Joachim (2007) “Exports and Productivity: A Survey of the Evidence from Firm-level Data,” *The World Economy*, Vol. 30 (1), pp. 60-82.

Wakasugi, Ryuhei, Yasuyuki Todo, Hitoshi Sato, Shuichiro Nishioka, Toshiyuki Matsuura, Banri Ito, Ayumu Tanaka (2008) “The Internationalization of Japanese Firms: New Findings Based on Firm-Level Data,” RIETI Discussion Paper Series 08-E -036.

World Bank (1993) *The East Asian Miracle: Economic Growth and Public Policy* Oxford university Press.

Appendix: Major Information Collected in “Survey on Internationalization and Corporate Activity” (Kokusai-ka to Kigyo Katsudo ni kansuru Anketo Chosa) (December 2009)

1. The Fruits of Internationalization

Firms were asked to indicate all of the following types of innovation they realized *as result of* internationalization.

(1) Improvement of Technology or Product quality (Process Innovation)

(2) Development of new product or service (Product Innovation)

(3) Acquisition of Intellectual Property

2. Ex-Ante and Ex-Post R&D and Information Gathering in Foreign Markets

Firms were asked to indicate all of the following activities they engaged before internationalization and after internationalization, in a separate manner.

(1) Introduction of advanced technology or production facilities

(2) Enhancement of production efficiency and cost reduction

(3) Increased efforts for development of new products

(4) Information Gathering from foreign markets

We regarded that the firm engaged in R&D if it indicated any of activities (1) to (3). We regarded that the firms engaged in Information Gathering if it indicated the activity (4) *and* indicated at least one type of information gathered from foreign markets in the next question.

3. Types of Information Gathered from Foreign Markets

Firms were asked to indicate all of the following types of information they gathered from foreign markets.

(1) Feedback on Own Products

(2) Taste and Needs of Foreign Consumers

(3) Latest Technology and Products in Foreign Markets

(4) Others types of Information (local business environment, etc.)

4. Factors that Motivated Manager's Decision to Start Exporting

Firms were asked to indicate all of the following factors that motivated the manager’s decision to enter export markets.

(1) Confidence on the Competitiveness of Own Products

(2) Oversea Reallocation of Domestic Customer's Production Plant

(3) Decrease in Domestic Sales

(4) Successful Episode of Competitors

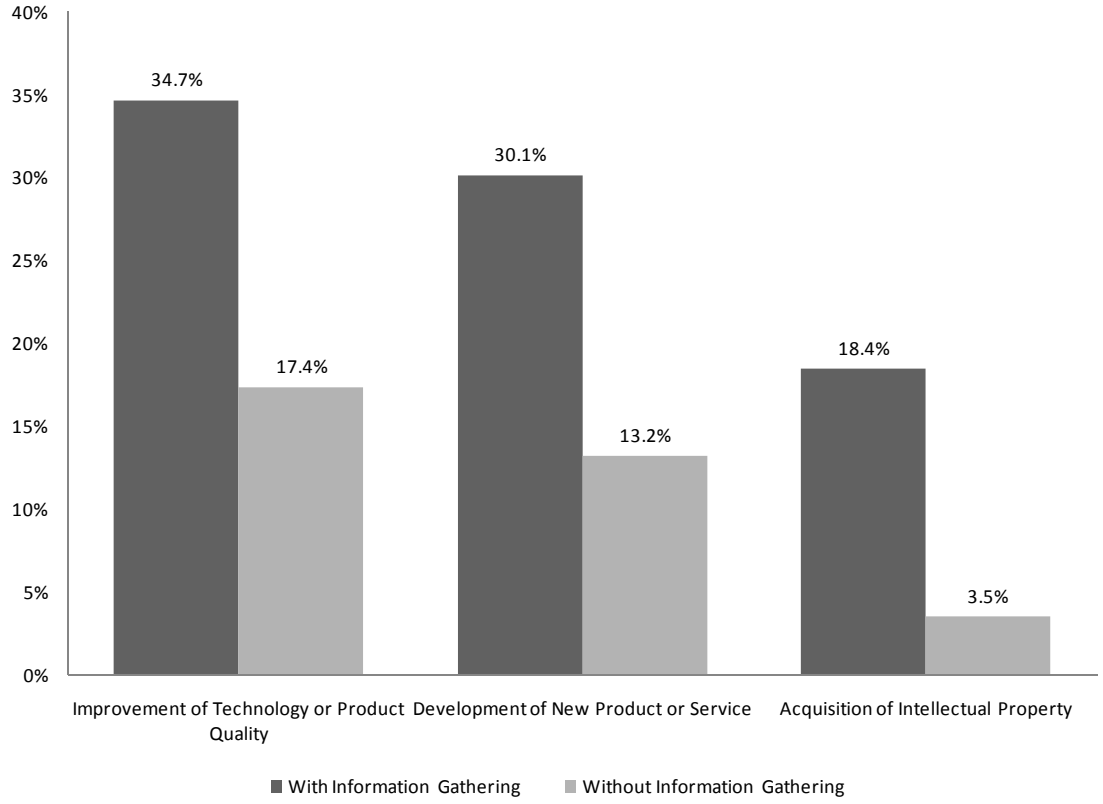
5. Exports destinations

Firms were asked to report their exports value by following areas: (1) Asian Region, (2) North American Region, (3) European Region and (4) Other Regions (Oceania, Africa, etc.). We regarded firms with positive exports to either (2) or (3) as exporters serving high income markets.

6. Type of products exported

Firms were asked to report their export value by the following classification: (1)Consumer Goods, (2)Intermediate Goods, (3)Production Equipment, (4)Consumer Service, (5)Business Service. We regarded firms with positive exports of wither (1) or (4) as exporters supplying Final Goods. For simplicity, we referred in our paper all other types of products as “intermediate goods”

Figure 1. Probability of Success with and without Information Gathering from Foreign markets



Source: Authors' Calculation from "Survey on Internationalization and Corporate Activity" (Kokusai-ka to Kigyo Katsudo ni kansuru Anketo Chosa) Mitsubishi UFJ Research & Consulting

Table1. Summary Statistics

Variables	N	Mean	S.D.	Min	Max
(1) Improvement of Technology or Product Quality	1093	0.324	0.468	0	1
(2) Development of New Product or Service	1093	0.279	0.449	0	1
(3) Acquisition of Intellectual Property	1093	0.165	0.371	0	1
(4) Ex-Ante R&D	1093	0.327	0.469	0	1
(5) Ex-Post R&D	1093	0.518	0.500	0	1
(6) Information Gathering in Foreign Markets	1093	0.868	0.338	0	1
a) Feedback on Own Products	1093	0.517	0.500	0	1
b) Taste and Needs of Foreign Markets	1093	0.549	0.498	0	1
c) Latest Technology and Products in Foreign Markets	1093	0.253	0.435	0	1
d) Others	1093	0.539	0.499	0	1
(7) Factors Motivated Manager's Decision to Start Exporting					
a) Oversea Reallocation of Domestic Customer's Production Plant	1093	0.258	0.438	0	1
b) Confidence on the Competitiveness of Own Products	1093	0.435	0.496	0	1
c) Decrease in Domestic Sales	1093	0.223	0.417	0	1
d) Successful Episode of Competitors	1093	0.054	0.226	0	1
(8) Number of Employees (log value)	1093	3.310	1.288	0	5.70
(9) Skill Intensity (Ratio of College Graduates in Total Employee(%))	1093	32.63	27.07	0	100
Exports to High Income Countries	1087	0.494	0.500	0	1
Supply of Final or Consumption Goods	1027	0.403	0.491	0	1

Note: All variables are dummy variable taking 1 if true and 0 otherwise, except No. of employees and skill intensity.

Source: Author's calculation from "Survey on Internationalization and Corporate Activity" (Kokusai-ka to Kigyo Katsudo ni kansuru Anketo Chosa) Mitsubishi UFJ Research & Consulting

Table 2. Correlation among Main Variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	a)	b)	c)	d)	(7)	a)	b)	c)	d)	(8)	(9)
(1) Improvement of Technology or Product Quality	1																
(2) Development of New Product or Service	0.502	1															
(3) Acquisition of Intellectual Property	0.468	0.488	1														
(4) Ex-Ante R&D	0.218	0.119	0.096	1													
(5) Ex-Post R&D	0.351	0.282	0.182	0.504	1												
(6) Information Gathering in Foreign Markets	0.125	0.128	0.137	0.029	0.057	1											
a) Feedback on Own Products	0.160	0.116	0.143	0.103	0.141	0.403	1										
b) Taste and Needs of Foreign Markets	0.026	0.097	0.110	-0.023	-0.021	0.430	0.180	1									
c) Latest Technology and Products in Foreign Markets	0.168	0.247	0.155	0.097	0.120	0.227	0.172	0.131	1								
d) Others	0.174	0.097	0.129	0.073	0.165	0.421	0.127	0.091	0.104	1							
(7) Factors Motivated Manager's Decision to Start Exporting																	
a) Oversea Reallocation of Domestic Customer's Production Plant	0.106	-0.045	-0.042	0.058	0.075	-0.005	0.018	-0.117	0.007	0.1302		1					
b) Confidence on the Competitiveness of Own Products	0.047	0.149	0.108	0.014	0.031	0.157	0.221	0.177	0.159	-0.0278		-0.2354	1				
c) Decrease in Domestic Sales	0.000	0.054	-0.019	0.001	-0.002	0.118	0.043	0.159	0.067	0.0772		-0.0249	0.021	1			
d) Successful Episode of Competitors	-0.036	-0.022	-0.019	-0.002	-0.037	0.057	0.045	0.078	0.000	0.0179		-0.0761	-0.0057	0.0567	1		
(8) Number of Employees (log value)	0.170	0.062	0.078	0.128	0.216	0.081	0.126	0.039	0.056	0.117		0.153	0.112	-0.033	-0.052	1	
(9) Skill Intensity (Ratio of College Graduates in Total Employee(%))	-0.056	0.066	0.070	-0.084	-0.088	0.114	0.047	0.116	0.109	0.048		-0.021	-0.004	-0.020	0.015	-0.156	1

Source: Authors' Calculation from "Survey on Internationalization and Corporate Activity" (Kokusai-ka to Kigyo Katsudo ni kansuru Anketo Chosa) Mitsubishi UFJ Research & Consulting

Table 3. Probit Estimation Results

Dependent Variable: Process Innovation (Improvement of Technology or Product Quality)

	(1)	(2)	(3)	(4)
Ex-Ante R&D	0.1520	0.1570	0.1311	-0.2714
	(0.1033)	(0.1034)	(0.1041)	(0.3266)
	[0.0533]	[0.0547]	[0.0454]	[-0.0901]
Ex-Post R&D	0.8272**	0.8248**	0.7710**	1.5046**
	(0.1026)	(0.1026)	(0.1037)	(0.3608)
	[0.2781]	[0.2759]	[0.2575]	[0.4760]
Information Gathering in Foreign Markets		0.5428**		0.8433**
		(0.1422)		(0.2806)
		[0.1632]		[0.2293]
a) Feedback on Own Products			0.2305*	
			(0.0929)	
			[0.0786]	
b) Taste and Needs of Foreign Markets			0.0444	
			(0.0938)	
			[0.0152]	
c) Latest Technology and Products in Foreign Markets			0.3605**	
			(0.1030)	
			[0.1286]	
d) Others			0.3090**	
			(0.0906)	
			[0.1048]	
Ex-Ante R&D*Information Gathering in Foreign Markets				0.4619
				(0.3433)
				[0.1647]
Ex-Post R&D*Information Gathering in Foreign Markets				-0.7373
				(0.3775)
				[-0.2442]
Factors Motivated Manager's Decision to Start Exporting				
a) Oversea Reallocation of Domestic Customer's Production Plant	0.2023*	0.1896	0.1595	0.1976
	(0.1027)	(0.1039)	(0.1058)	(0.1044)
	[0.0716]	[0.0667]	[0.0557]	[0.0692]
b) Confidence on the Competitiveness of Own Products	0.1298	0.0722	0.0322	0.0822
	(0.0905)	(0.0917)	(0.0947)	(0.0920)
	[0.0451]	[0.0249]	[0.0110]	[0.0282]
c) Decrease in Domestic Sales	-0.0115	-0.0549	-0.1116	-0.0480
	(0.1021)	(0.1030)	(0.1067)	(0.1029)
	[-0.0040]	[-0.0187]	[-0.0375]	[-0.0163]
d) Successful Episode of Competitors	-0.0868	-0.1157	-0.1532	-0.1235
	(0.2000)	(0.1986)	(0.2030)	(0.1988)
	[-0.0294]	[-0.0386]	[-0.0504]	[-0.0409]
Number of Employees (log value)	0.0785*	0.0643	0.0540	0.0673
	(0.0374)	(0.0375)	(0.0380)	(0.0377)
	[0.0272]	[0.0221]	[0.0185]	[0.0230]
Skill Intensity (Ratio of College Graduates in Total Employee(%))	0.0006	-0.0002	-0.0007	-0.0003
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
	[0.0002]	[-0.0001]	[-0.0002]	[-0.0001]
Industry Dummy	yes	yes	yes	yes
Constant	-1.4986**	-1.8523**	-1.6000**	-2.1624**
	(0.2144)	(0.2396)	(0.2233)	(0.3341)
Pseudo R-sq	0.137	0.148	0.164	0.150
Log Likelihood	-589.9	-582.7	-571.4	-580.8
Chi-sq	183.4	193.5	226.7	181.7
Number of Observations	1083	1083	1083	1083

S.E. in parantheses, Marginal Effect in the bracket

*,** correspond to significant at 5% ,1%

Table 4. Probit Estimation Results

Dependent Variable: Development of New Product or Service (Product Innovation)

	(1)	(2)	(3)	(4)
Ex-Ante R&D	-0.0146	-0.0108	-0.0516	-0.2016
	(0.1068)	(0.1064)	(0.1076)	(0.3459)
	[-0.0047]	[-0.0034]	[-0.0162]	[-0.0625]
Ex-Post R&D	0.8937**	0.8917**	0.8568**	0.7857*
	(0.1080)	(0.1080)	(0.1094)	(0.3373)
	[0.2773]	[0.2747]	[0.2633]	[0.2437]
Information Gathering in Foreign Markets		0.4801**		0.3285
		(0.1527)		(0.2259)
		[0.1326]		[0.0953]
a) Feedback on Own Products			0.0970	
			(0.0949)	
			[0.0306]	
b) Taste and Needs of Foreign Markets			0.0934	
			(0.0946)	
			[0.0294]	
c) Latest Technology and Products in Foreign Markets			0.5784**	
			(0.0998)	
			[0.1973]	
d) Others			0.1121	
			(0.0929)	
			[0.0353]	
Ex-Ante R&D*Information Gathering in Foreign Markets				0.2105
				(0.3627)
				[0.0687]
Ex-Post R&D*Information Gathering in Foreign Markets				0.1187
				(0.3554)
				[0.0378]
Factors Motivated Manager's Decision to Start Exporting				
a) Oversea Reallocation of Domestic Customer's Production Plant	-0.0907	-0.1031	-0.1137	-0.1039
	(0.1059)	(0.1064)	(0.1086)	(0.1068)
	[-0.0285]	[-0.0321]	[-0.0352]	[-0.0324]
b) Confidence on the Competitiveness of Own Products	0.4066**	0.3621**	0.3046**	0.3613**
	(0.0915)	(0.0930)	(0.0957)	(0.0932)
	[0.1316]	[0.1162]	[0.0972]	[0.1162]
c) Decrease in Domestic Sales	0.1486	0.1126	0.0675	0.1118
	(0.1000)	(0.1009)	(0.1037)	(0.1009)
	[0.0487]	[0.0364]	[0.0216]	[0.0362]
d) Successful Episode of Competitors	-0.1599	-0.1874	-0.1906	-0.1877
	(0.2019)	(0.2005)	(0.1994)	(0.2012)
	[-0.0486]	[-0.0559]	[-0.0565]	[-0.0561]
Number of Employees (log value)	0.0432	0.0304	0.0269	0.0311
	(0.0389)	(0.0390)	(0.0389)	(0.0391)
	[0.0138]	[0.0096]	[0.0085]	[0.0099]
Skill Intensity (Ratio of College Graduates in Total Employee(%))	0.0044*	0.0039*	0.0032	0.0039*
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
	[0.0014]	[0.0012]	[0.0010]	[0.0012]
Industry Dummy	yes	yes	yes	yes
Constant	-1.4348**	-1.7496**	-1.4817**	-1.6163**
	(0.2236)	(0.2601)	(0.2312)	(0.3067)
Pseudo R-sq	0.116	0.124	0.148	0.125
Log Likelihood	-570.0	-564.9	-549.2	-564.5
Chi-sq	143.2	147.0	181.9	153.3
Number of Observations	1089	1089	1089	1089

S.E. in parantheses, Marginal Effect in the bracket

*,**correspond to significant at 5% ,1%

Table 5. Probit Estimation Results

Dependent Variable: Acquisition of IP

	(1)	(2)	(3)	(4)
Ex-Ante R&D	0.0595	0.0640	0.0220	-0.3319
	(0.1177)	(0.1183)	(0.1188)	(0.4669)
	[0.0137]	[0.0140]	[0.0048]	[-0.0671]
Ex-Post R&D	0.5615**	0.5612**	0.4974**	0.7858
	(0.1191)	(0.1204)	(0.1214)	(0.5206)
	[0.1266]	[0.1202]	[0.1076]	[0.1676]
Information Gathering in Foreign Markets		0.9307**		0.9245*
		(0.2132)		(0.3994)
		[0.1345]		[0.1335]
a) Feedback on Own Products			0.2483*	
			(0.1058)	
			[0.0539]	
b) Taste and Needs of Foreign Markets			0.1912	
			(0.1042)	
			[0.0413]	
c) Latest Technology and Products in Foreign Markets			0.3294**	
			(0.1091)	
			[0.0783]	
d) Others			0.3055**	
			(0.1036)	
			[0.0658]	
Ex-Ante R&D*Information Gathering in Foreign Markets				0.4153
				(0.4795)
				[0.0983]
Ex-Post R&D*Information Gathering in Foreign Markets				-0.2344
				(0.5347)
				[-0.0500]
Factors Motivated Manager's Decision to Start Exporting				
a) Oversea Reallocation of Domestic Customer's Production Plant	-0.1733	-0.2032	-0.2198	-0.2014
	(0.1178)	(0.1200)	(0.1221)	(0.1200)
	[-0.0377]	[-0.0415]	[-0.0452]	[-0.0411]
b) Confidence on the Competitiveness of Own Products	0.2097*	0.1372	0.0928	0.1401
	(0.0981)	(0.1007)	(0.1025)	(0.1001)
	[0.0484]	[0.0299]	[0.0204]	[0.0305]
c) Decrease in Domestic Sales	-0.0628	-0.1205	-0.1871	-0.1209
	(0.1176)	(0.1200)	(0.1222)	(0.1198)
	[-0.0140]	[-0.0251]	[-0.0385]	[-0.0251]
d) Successful Episode of Competitors	-0.0045	-0.0585	-0.0921	-0.0590
	(0.2226)	(0.2220)	(0.2278)	(0.2221)
	[-0.0010]	[-0.0123]	[-0.0192]	[-0.0123]
Number of Employees (log value)	0.0465	0.0294	0.0153	0.0307
	(0.0424)	(0.0429)	(0.0428)	(0.0430)
	[0.0106]	[0.0064]	[0.0033]	[0.0066]
Skill Intensity (Ratio of College Graduates in Total Employee(%))	0.0075**	0.0068**	0.0061**	0.0068**
	(0.0019)	(0.0020)	(0.0019)	(0.0020)
	[0.0017]	[0.0015]	[0.0013]	[0.0015]
Industry Dummy	yes	yes	yes	yes
Constant	-1.6286**	-2.3311**	-1.8058**	-2.3358**
	(0.2430)	(0.3030)	(0.2531)	(0.4493)
Pseudo R-sq	0.0833	0.106	0.118	0.107
Log Likelihood	-443.7	-432.8	-426.9	-432.5
Chi-sq	87.86	100.8	119.5	104.6
Number of Observations	1075	1075	1075	1075

S.E. in parantheses, Marginal Effect in the bracket

*,**,*** correspond to significance at 10%, 5%, 1%

Table 6. Probit Estimation Results

Dependent Variable: Process Innovation (Exports to High income countries)

	Firms Exporting to High Income Countries			Firms Not Exporting to High Income Countries		
	(1)	(2)	(3)	(1)	(2)	(3)
Ex-Ante R&D	0.2794	0.2685	0.2424	0.0341	0.0682	0.0323
	(0.1479)	(0.1481)	(0.1492)	(0.1548)	(0.1562)	(0.1563)
	[0.1016]	[0.0974]	[0.0873]	[0.0114]	[0.0226]	[0.0106]
Ex-Post R&D	0.7962**	0.7986**	0.7833**	0.9191**	0.9009**	0.8223**
	(0.1418)	(0.1418)	(0.1428)	(0.1619)	(0.1611)	(0.1656)
	[0.2776]	[0.2780]	[0.2712]	[0.2931]	[0.2850]	[0.2602]
Information Gathering in Foreign Markets		0.3226			0.6673**	
		(0.2235)			(0.1948)	
		[0.1067]			[0.1837]	
a) Feedback on Own Products			0.2366			0.1589
			(0.1323)			(0.1408)
			[0.0827]			[0.0520]
b) Taste and Needs of Foreign Markets			0.0639			0.0237
			(0.1420)			(0.1376)
			[0.0225]			[0.0078]
c) Latest Technology and Products in			0.3777**			0.4309**
Foreign Markets			(0.1414)			(0.1616)
			[0.1376]			[0.1501]
d) Others			0.2526			0.3748**
			(0.1310)			(0.1350)
			[0.0887]			[0.1205]
Factors Motivated Manager's Decision to Start Exporting						
a) Oversea Reallocation of Domestic	0.1822	0.1840	0.1647	0.3347*	0.2940*	0.2963*
Customer's Production Plant	(0.1611)	(0.1609)	(0.1665)	(0.1444)	(0.1485)	(0.1490)
	[0.0665]	[0.0670]	[0.0595]	[0.1147]	[0.0996]	[0.1000]
b) Confidence on the Competitiveness of	0.2546	0.2226	0.1557	-0.0627	-0.1414	-0.1598
Own Products	(0.1320)	(0.1344)	(0.1377)	(0.1418)	(0.1421)	(0.1472)
	[0.0899]	[0.0786]	[0.0547]	[-0.0207]	[-0.0458]	[-0.0513]
c) Decrease in Domestic Sales	0.1090	0.0774	-0.0006	-0.0669	-0.1146	-0.1567
	(0.1498)	(0.1509)	(0.1566)	(0.1495)	(0.1520)	(0.1567)
	[0.0394]	[0.0278]	[-0.0002]	[-0.0220]	[-0.0369]	[-0.0499]
d) Successful Episode of Competitors	0.1406	0.1257	0.0930	-0.3255	-0.3766	-0.3612
	(0.2767)	(0.2749)	(0.2835)	(0.2996)	(0.2976)	(0.3040)
	[0.0514]	[0.0458]	[0.0335]	[-0.0977]	[-0.1098]	[-0.1053]
Number of Employees (log value)	0.0280	0.0155	0.0023	0.1172*	0.1066	0.0927
	(0.0543)	(0.0549)	(0.0557)	(0.0580)	(0.0579)	(0.0582)
	[0.0100]	[0.0055]	[0.0008]	[0.0389]	[0.0350]	[0.0303]
Skill Intensity (Ratio of College	-0.0025	-0.0030	-0.0047	0.0023	0.0013	0.0017
Graduates in Total Employee(%))	(0.0027)	(0.0027)	(0.0027)	(0.0026)	(0.0026)	(0.0027)
	[-0.0009]	[-0.0011]	[-0.0016]	[0.0008]	[0.0004]	[0.0006]
Industry Dummy	yes	yes	yes	yes	yes	yes
Constant	-1.3118**	-1.5090**	-1.3858**	-1.6544**	-2.1011**	-1.7905**
	(0.2881)	(0.3253)	(0.2960)	(0.3562)	(0.3776)	(0.3863)
Pseudo R-sq	0.141	0.144	0.167	0.191	0.208	0.220
Log Likelihood	-287.3	-286.2	-278.7	-272.6	-266.9	-262.5
Chi-sq	90.46	92.93	115.0	124.8	139.1	153.1
Number of Observations	521	521	521	541	541	541

S.E. in parentheses, Marginal Effect in the bracket

*,** correspond to significance at 5%, 1%

Table 7. Probit Estimation Results

Dependent Variable: Process Innovation (Supply of Final or Consumption Goods)

	Firms Supplying Final or Consumption Goods			Firms Not Supplying Final or Consumption Goods		
	(1)	(2)	(3)	(1)	(2)	(3)
Ex-Ante R&D	-0.1410	-0.1301	-0.1095	0.2155	0.2010	0.1794
	(0.1906)	(0.1920)	(0.1942)	(0.1355)	(0.1363)	(0.1376)
	[-0.0429]	[-0.0397]	[-0.0331]	[0.0779]	[0.0720]	[0.0639]
Ex-Post R&D	1.2667**	1.2527**	1.1849**	0.6484**	0.6605**	0.6288**
	(0.1818)	(0.1833)	(0.1867)	(0.1379)	(0.1379)	(0.1402)
	[0.3853]	[0.3811]	[0.3583]	[0.2251]	[0.2270]	[0.2156]
Information Gathering in Foreign Markets		0.1489			0.7302**	
		(0.2494)			(0.1931)	
		[0.0445]			[0.2153]	
a) Feedback on Own Products			0.0725			0.2561*
			(0.1617)			(0.1249)
			[0.0223]			[0.0895]
b) Taste and Needs of Foreign Markets			0.3319			-0.1584
			(0.1796)			(0.1241)
			[0.0990]			[-0.0557]
c) Latest Technology and Products in			0.4855*			0.3707**
Foreign Markets			(0.1962)			(0.1352)
			[0.1624]			[0.1349]
d) Others			0.0464			0.4423**
			(0.1647)			(0.1202)
			[0.0143]			[0.1522]
Factors Motivated Manager's Decision to Start Exporting						
a) Oversea Reallocation of Domestic	0.1742	0.1827	0.2338	0.2255	0.2049	0.1484
Customer's Production Plant	(0.2131)	(0.2150)	(0.2176)	(0.1266)	(0.1291)	(0.1316)
	[0.0563]	[0.0592]	[0.0758]	[0.0818]	[0.0736]	[0.0529]
b) Confidence on the Competitiveness of	0.2275	0.2062	0.1354	0.0994	0.0397	-0.0006
Own Products	(0.1579)	(0.1626)	(0.1690)	(0.1218)	(0.1232)	(0.1257)
	[0.0708]	[0.0642]	[0.0417]	[0.0356]	[0.0140]	[-0.0002]
c) Decrease in Domestic Sales	-0.1024	-0.1185	-0.2624	0.0792	0.0474	0.0213
	(0.1784)	(0.1786)	(0.1878)	(0.1411)	(0.1428)	(0.1478)
	[-0.0313]	[-0.0361]	[-0.0768]	[0.0285]	[0.0168]	[0.0075]
d) Successful Episode of Competitors	-0.2589	-0.2700	-0.2492	0.0374	-0.0099	-0.0552
	(0.3242)	(0.3250)	(0.3321)	(0.2981)	(0.2943)	(0.3097)
	[-0.0738]	[-0.0766]	[-0.0704]	[0.0135]	[-0.0035]	[-0.0192]
Number of Employees (log value)	0.0963	0.0911	0.0835	0.0783	0.0638	0.0627
	(0.0621)	(0.0622)	(0.0642)	(0.0525)	(0.0522)	(0.0538)
	[0.0300]	[0.0283]	[0.0257]	[0.0279]	[0.0225]	[0.0221]
Skill Intensity (Ratio of College	-0.0004	-0.0007	-0.0012	0.0017	0.0008	0.0010
Graduates in Total Employee(%))	(0.0031)	(0.0031)	(0.0031)	(0.0023)	(0.0024)	(0.0024)
	[-0.0001]	[-0.0002]	[-0.0004]	[0.0006]	[0.0003]	[0.0003]
Industry Dummy	yes	yes	yes	yes	yes	yes
Constant	-1.7487**	-1.8340**	-1.9291**	-1.7068*	-2.0129**	-1.8056**
	(0.2903)	(0.3380)	(0.3282)	(0.7451)	(0.6408)	(0.6776)
Pseudo R-sq	0.200	0.201	0.226	0.124	0.142	0.160
Log Likelihood	-190.5	-190.4	-184.4	-339.0	-332.3	-325.1
Chi-sq	92.54	92.00	104.5	92.43	111.8	121.1
Number of Observations	395	395	395	603	603	603

S.E. in parentheses, Marginal Effect in the bracket

*,** correspond to significance at 5%, 1%

Table 8. Probit Estimation Results

Dependent Variable: Product Innovation (Supply of Final or Consumption Goods)

	Firms Supplying Final or Consumption Goods			Firms Not Supplying Final or Consumption Goods		
	(1)	(2)	(3)	(1)	(2)	(3)
Ex-Ante R&D	-0.1697	-0.1556	-0.1566	-0.0363	-0.0481	-0.1052
	(0.1982)	(0.1992)	(0.2015)	(0.1489)	(0.1485)	(0.1476)
	[-0.0520]	[-0.0476]	[-0.0470]	[-0.0112]	[-0.0145]	[-0.0312]
Ex-Post R&D	1.1563**	1.1425**	1.0945**	0.8450**	0.8543**	0.8605**
	(0.1863)	(0.1872)	(0.1961)	(0.1534)	(0.1536)	(0.1533)
	[0.3573]	[0.3522]	[0.3325]	[0.2517]	[0.2502]	[0.2494]
Information Gathering in Foreign Markets		0.2982			0.6843**	
		(0.2607)			(0.2341)	
		[0.0861]			[0.1669]	
a) Feedback on Own Products			0.0386			0.1612
			(0.1588)			(0.1339)
			[0.0119]			[0.0483]
b) Taste and Needs of Foreign Markets			0.4485*			-0.1691
			(0.1744)			(0.1326)
			[0.1321]			[-0.0509]
c) Latest Technology and Products in			0.5766**			0.7357**
Foreign Markets			(0.1823)			(0.1377)
			[0.1948]			[0.2437]
d) Others			0.0378			0.0813
			(0.1596)			(0.1310)
			[0.0116]			[0.0244]
Factors Motivated Manager's Decision to Start Exporting						
a) Oversea Reallocation of Domestic	-0.2382	-0.2265	-0.1707	-0.1553	-0.1816	-0.2267
Customer's Production Plant	(0.2094)	(0.2107)	(0.2092)	(0.1338)	(0.1358)	(0.1396)
	[-0.0708]	[-0.0673]	[-0.0504]	[-0.0470]	[-0.0537]	[-0.0659]
b) Confidence on the Competitiveness of	0.4329**	0.3888*	0.3007	0.4361**	0.3969**	0.3445*
Own Products	(0.1531)	(0.1558)	(0.1627)	(0.1301)	(0.1322)	(0.1343)
	[0.1361]	[0.1219]	[0.0926]	[0.1381]	[0.1235]	[0.1059]
c) Decrease in Domestic Sales	0.1672	0.1395	0.0045	0.2927*	0.2640	0.2601
	(0.1734)	(0.1742)	(0.1799)	(0.1425)	(0.1449)	(0.1480)
	[0.0541]	[0.0448]	[0.0014]	[0.0957]	[0.0846]	[0.0826]
d) Successful Episode of Competitors	-0.4852	-0.5063	-0.4635	0.0744	0.0292	0.0211
	(0.3630)	(0.3649)	(0.3723)	(0.2967)	(0.2936)	(0.3079)
	[-0.1287]	[-0.1326]	[-0.1206]	[0.0235]	[0.0090]	[0.0064]
Number of Employees (log value)	0.0272	0.0167	0.0101	0.0327	0.0208	0.0337
	(0.0613)	(0.0614)	(0.0615)	(0.0573)	(0.0572)	(0.0582)
	[0.0086]	[0.0052]	[0.0031]	[0.0101]	[0.0063]	[0.0102]
Skill Intensity (Ratio of College	0.0029	0.0027	0.0029	0.0059*	0.0052*	0.0041
Graduates in Total Employee(%))	(0.0028)	(0.0028)	(0.0029)	(0.0026)	(0.0026)	(0.0026)
	[0.0009]	[0.0008]	[0.0009]	[0.0018]	[0.0016]	[0.0012]
Industry Dummy	yes	yes	yes	yes	yes	yes
Constant	-1.5398**	-1.7167**	-1.7824**	-0.9380	-1.2094	-0.9151
	(0.3063)	(0.3822)	(0.3552)	(0.7327)	(0.6519)	(0.7290)
Pseudo R-sq	0.157	0.159	0.195	0.129	0.143	0.176
Log Likelihood	-197.6	-196.9	-188.5	-296.9	-292.0	-280.8
Chi-sq	67.31	65.94	80.11	87.63	94.63	112.7
Number of Observations	394	394	394	587	587	587

S.E. in parentheses, Marginal effect in the bracket

*,** correspond to significance at 5%, 1%