Learning by Exporting: The Effects of Exporting on Firm Innovation in Korean Manufacturing Industries

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While a body of literature states that higher productivity or innovation leads firms to engage in exporting, previous empirical findings across many nations have also shown that exporting operation can precede productivity in the opposite direction and exporters perform better than non-exporters in several domains. We argue that exporters can often access diverse knowledge inputs not available in the domestic market, and this knowledge learning can spill back on the focal firm, thereby fostering increased innovation. In this paper, we examined the effects of exporting on the product, process, and organizational and marketing innovations of Korean manufacturing firms implementing probit regressions using the 2010 Korean Innovation Survey (KIS) data. We found that exporting is positively associated with innovation, especially product innovation. Moreover, the higher the level of exporting a manufacturing firm achieves, the more likely innovation activities are to be conducted in product, process, and organizational innovation areas. However, our data did not support our hypothesis regarding the relationship between export intensity and marketing innovation.

Key Words: Export, Manufacturing Firms, Product Innovation, Process Innovation, Organizational innovation, Marketing Innovation

I. Introduction

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With the rapid rate of globalization, the internationalization of enterprises has become a sweeping trend. It seems that every industry has become "global," and entrepreneurial firms are pushed to rapidly go after these opportunities. Yet only enterprises that have their own unique products or technological know-how can seek a breakthrough to maintain long-term development during fierce competition. Therefore, constant innovation is required to inject vigor into the enterprises in the process of internationalization.

Despite the importance of both globalization and the innovation processes and the increasing emphasis on their positive impact on economic growth, the interactions between the two phenomena are far from being clear. A variety of dissertations have focused on the effect of innovation on internationalization (Zhao & Li, 1997; Ozcelik & Taymar, 2004; Cassiman & Martinez-Ros, 2007). At the same time, a recent and quite active strand of literature—the learning-by-exporting theory—has emphasized the role of firm internationalization in enhancing firm-level productivity

Some recent papers have utilized firm-level data to examine this issue, focusing on exporting as a channel of technology diffusion or knowledge spillover. They stressed that firms can influence innovation through export participation (Melitz & Constantini, 2008). These studies pointed out that contact with foreign partners allows firms to tap into more diverse knowledge and take advantage of technological spillovers and organizational learning (Boermans & Roelfsema, 2012). Castellani & Zanfei (2007) explored the effects of exporting and FDI on productivity and innovation using data from 785 large Italian manufacturers and found that cross-border activities augment productivity given the level of innovation. Kafouros et al. (2008) also showed that internationalization enhances a firm's capacity to raise productivity through innovation.

Theory points to the existence of a learning-by-exporting effect. The current study provides empirical support for the theoretical literature by examining the repercussions of exporting on the subsequent innovation performance of South Korean manufacturing firms and aims to offer an overview of the learning effects in countries with a high level of exports as well as some implications about the stimulating measures on productivity enhancement for firms. We also expect that this study could be useful in policy making related to exporting and innovation assistance for governments, especially in Korea.

This paper is structured as follows. Section two gives a brief introduction of the literature reviews and hypothesis formulation. Section three covers the data and variables used in this

empirical analysis. Section four presents the empirical results and analysis. In the last section, the conclusion and limitations are outlined.

Ⅱ. Literature Review and Hypothesis Formulation

2.1 Learning by Exporting

The theoretical basis for the positive impact between exporting and performance lies in the economic models of the benefits arising from trade and openness. Trade exposes each country to the knowledge stocks of its trading partners. As this knowledge is transferred internationally, both embodied in the flow of traded goods and services and disembodied through technology transfer, the domestic productivity frontier shifts outwards and higher economic growth ensues. This is learning by exporting (Love & Ganotakis, 2013).

Previous literature has identified a number of potential channels through which exports might affect firms' innovative activities. First, adapting products and services to new markets makes new ideas and inputs for innovation. This can generate new production process innovation as well. Second, the financial and resource effect can emerge in the course of exporting. Exporting enables firms to use a wider range of resources available globally. Meanwhile, exporting extends the market over which margins can be earned; as many costs are largely fixed, such investments might be recouped over a large sales volume. This aids productivity and provides greater incentives to invest in R&D and innovation (Love & Ganotakis, 2013). Third, there are also incentive effects. Higher potential returns on future innovation outcomes due to larger markets and exporting firms might also benefit in terms of productivity and innovation because more intense competition in foreign markets forces firms to be more efficient in stimulating innovative activities to stay competitive.

Recent empirical evidence has offered some support for learning by exporting. Salomon & Shaver (2005) provided evidence on learning by exporting in terms of both increased product innovation and patent counts using a panel of Spanish manufacturing firms. Aw et al. (2007) examined the Taiwanese electronics industry and found that exporting significantly boosts productivity, especially if accompanied by investments in R&D and labor training. Girma et al. (2008) scrutinized the relationship between exports and R&D using British and Irish firm-level data and verified that exporting stimulates R&D for Irish firms, but not for British firms.

Boermans & Roelfsema (2012) showed that exporting results in more R&D, higher sales from product innovation, and an increase in the number of international patents.

2.2 Bi-directional Impacts between Exporting and Innovation[2)]

When a firm starts exporting, it has to establish contacts with potential customers, set up logistic distribution channels, and modify its products to meet foreign tastes or country-specific regulations (Lopez, 2005). In principle, these activities are costly, and a firm faces sunk-costs when overcoming the entry barriers of international markets. Hence, the decision to export is not a random event but rather the result of the combination of sunk-costs and firm productivity. Over the last decade, many empirical studies have observed the positive impact of innovation on exporting. An early study by Vernon (1966) developed a product life cycle theory whereby product innovation should be indirectly linked to the decision of a firm to start exporting. Cassiman & Martinez-Ros (2007) examined a sample of Spanish firms and found that engaging in product innovation significantly increases the likelihood of initiating exporting activities. Similarly, Becker & Egger (2009) found that product innovation in German firms plays an important role in increasing the propensity to export.

The evidence discussed the far suggests that causality might run in a reverse direction—from firm innovation to the subsequent decision to export—which runs counter to the direction in our study. A recent work on the bi-directional effects between exporting and innovation by Damijan et al. (2010) found no empirical support for the hypothesis that either product or process innovations increase the probability of becoming an exporter; however, they did find evidence that exporting increases the probability of a firm becoming a process rather than product innovator and that exporting leads to productivity improvements.

Lacking a panel data set that could possibly observe both directions between innovation and exporting, in this paper, we only examine the learning-by-exporting effect. Regarding the details of innovation, we refer to the Oslo Manual (OECD, 2005), which classifies innovation into four different areas: product innovation, process innovation, organizational innovation, and marketing innovation. This study formulates hypotheses about the impact of exporting into these four areas to understand how exporting activities are able to foster each type of

2) The related research conducted in Korean context in the link between internationalization (via exporting and FDI) and innovation can be found in Hwang & Cho (2013), Lim (2012), Lee (2012), Shin & Kim (2012), Kang (2011), Lee et al. (2007), Yang & Min (2011) and Lee & Park (2007).

innovation.

2.3 Hypothesis Formulation

As previously mentioned, exporting firms have more opportunity to bring together market, technological information, new ideas, and inputs for innovation. The wider range of resources collected from the global market is incorporated into the firm's production function. Meanwhile, additional finances earned through exporting can be reinvested to help improve the quality of the product or increase the efficiency of production processes (Filippetti, Frenz, & Letto-Gillies, 2009; Greenaway & Kneller, 2007; Zahra, Ucbasaran, anfcad Newey, 2009). Liu & Buck (2007) showed a positive and significant effect of export sales on product innovation using a panel of sub-sector level data for Chinese high-tech industries. Another contribution by Salomon & Shaver (2005), using firm-level data, found evidence of learning by exporting when considering product innovation for Spanish manufacturing firms from 1990 to 1997. Massimiliano et al. (2009) analyzed the relationship between a firm's export status and its product innovation and found that the positive effect of export on product innovativeness is robust when controlling for many resources of the firm's observable heterogeneity. Thus, here we arrive at our first hypothesis:

Hypothesis 1: There is a positive e fect ofexporting on product innovation. The higher the export intensityis, the more significant this learning e fect is.

Overseas exporters might have to align production to help meet the myriad needs of foreign markets and reduce costs. One example of this realignment is the introduction of Internet product tracking to help new exporters transact over a greater geographic and cultural distance (Hanley & Monreal-Pérez, 2011). The predominance of such Internet-based operations for exporters was recently highlighted in a World Bank paper (Ferro, 2011). An increasing number of successful exporting manufacturing firms strive to enhance process technologies to meet variable needs of foreign customers. Clearly, exporting raises the bar for firms that might be forced into more imaginative and cost-efficient ways of producing and selling products overseas. Therefore, improving the process to enhance productivity becomes an inevitable and imperative task for exporting firms. As a result, we come to our second hypothesis:

Hypothesis 2: There is a positive effect of exporting on process innovation. The higher the export intensity is, the more significant this learning effect is.

The concept of organizational learning, first discussed by Cyert & March in 1963, refers to the process by which firms and other organizations learn by interacting with the environments. Entry in global markets could provide the firm a contact with new customers or competitors who could provide new information valuable to the firm. One of the key factors for successful foreign market entry through exporting is to have skilled workforces. Exporting firms often achieve this through two simultaneous ways: employing local specialists and technicians with a high level of skills and specialized know-how in adapting to foreign cultures and dispatching managers to local branches. The learning effect occurs when workers and managers gain experience in solving technical or organizational problems. With the increase of the managers' international experience, the liability of foreignness can be reduced, and parent firms can take advantage of more international social networks to boost exports. Furthermore, parent firms can recreate their organizational structure by absorbing the knowledge conveyed from a foreign market. Lyles & Salk (1996) highlighted the central role of top managers in the process of organizational restructuring and how absorptive capacity and ties with foreign partners affect knowledge transfer. In this process of overcoming the administrative heritage underlying central planning, contextual factors play a critical role for firms seeking to build dynamic capabilities and organizational routines to meet the demands of a market-oriented economy (Kriauciunas & Kale, 2006; Steensma et al., 2008). Therefore:

Hypothesis 3: There is a positive effect of exporting on organizational innovation. The higher the export intensity is, the more significant this learning effect is.

With the deepening of enterprise internationalization, the transition to localization reform and the introduction of international talents have become crucial for the enterprise that has strong capital to expand market share and strengthen competitiveness. Through the localization, firms change the promotion ways and customize services that adapt to local needs, such as by changing the product design or packaging, launching advertisements featuring a local star, and/or adopting different after-service regulations to comply with the local situation. Inversely, in this process, the introduction of a new culture and the influx of new ideas influence the

firms as well. The process could also change the ways of marketing in the domestic market due to knowledge sharing. Egan & Mody (1992) studied American importers of bicycles and footwear from East Asian countries in the mid-1980s and found that the links between developed country buyers and developing country suppliers acted as a channel for information about marketing and provided access to larger industry networks. From this discussion, we derive:

Hypothesis 4: There is a positive effect of exporting on marketing innovation. The higher the export intensity is, the more significant this learning effect is.

Klepper (1996) demonstrated that product innovation dominates the early stage of the product lifecycle whereas process innovation becomes important in the later stages, after production volumes have increased and the efficiency of production becomes increasingly important. This means that learning-by-exporting efforts in process innovation might take a long time before they become evident, which is probably why researchers cannot detect them. Andersson & Lööf (2009) pointed out that strong learning effects from exporting are unlikely to take place when exporting is a temporary activity and of minor importance for the firm's sales. Several studies have also shown that learning effects on process innovation take a longer time than product innovation. In the same way, organizational and marketing innovation occurs much later than product innovation as well because it requires larger investments and a more advanced integrating capability. Thus, they tend to take place in large enterprises due to the large resource base of both capital and labor. Considering the exporting characteristics of the Korean manufacturing firms and the sample distribution of our data, we could anticipate that:

Hypothesis 5: The learning-by-exporting effects on product innovation are the most significant among the four areas of innovations.

III. Data and Methodology

3.1 Data

The empirical analysis is based on the data from the Korea Innovation Survey (KIS) 2010, which focuses on Korean manufacturing firms. The survey is carried out by the Science & Technology Policy Institute (STEPI) every three years, which collects information about technological innovation, including sources and methods of innovation, innovation expenditures, and R&D workforce as well as general information such as the industry, sales, exports, and operating profits of Korean firms. The definition of each kind of innovation activity and the methodology of the survey rest on the revised edition of the Oslo Manual framed by the OECD. When a firm introduced at least one new or improved product, process, or organizational and marketing change during the 2007—2009 period, it was deemed to have carried out that specific sort of innovation. The definition of innovation activities is presented in Table 1.

The KIS 2010 database included 3925 observations that met the criteria for innovation activity. After excluding missing data, 3520 records were chosen for the sample. These firms belong to 20 different manufacturing industries, which are classified using the three-digit Korean Standard Industry Classification (KSIC) code. Table 2 shows the industry distribution of the sample. The data for each industry are evenly distributed in general.

Table 1: Definition of Innovation Activities

Product Innovation	Goods or services that are either new or significantly improved in their fundamental characteristics, or their technical specifications, in their incorporated software or other immaterial components, in their intended use, or user friendliness, and which lead to an increase in the firms' turnover
Process Innovation	A new or significantly improved production technology, new or significantly improved methods of supplying services and delivering products which importantly contribute to an increase in productivity
Organizational Innovation	The introduction of new methods or the significant improvement of existing methods, in terms of methods of working, organizing, and creating external cooperation networks. It contributes to the increase in the effectiveness and efficiency of firms' internal capabilities.
Marketing Innovation	The implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

Source: Korea Innovation Survey 2010, STEPI (Science & Technology Policy Institute)

Table 2: Industry Distribution of KIS 2010 Manufacturing Firms

KSIC code	Industry	No. of firm	%
10	Manufacture of Food Products	206	5.85
11	Manufacture of Beverages	49	1.39
13	Manufacture of Textiles, Except Apparel	147	4.18
14	Manufacture of wearing apparel, Clothing Accessories and Fur Articles	130	3.69
15	Tanning and Dressing of Leather, Manufacture of Luggage and Footwear	81	2.30
16	Manufacture of Wood and of Products of Wood and Cork, Except Furniture	121	3.44
17	Manufacture of Pulp, Paper and Paper Products	151	4.29
18	Printing and Reproduction of Recorded Media	123	3.49
19	Manufacture of Coke, hard-coal and lignite fuel briquettes and Refined Petroleum Products	41	1.16
20	Manufacture of chemicals and chemical products except pharmaceuticals and medical chemicals	202	5.74
21	Manufacture of Pharmaceuticals, Medicinal Chemicals and Botanical Products	97	2.76
22	Manufacture of Rubber and Plastic Products	207	5.88
23	Manufacture of Other Non-metallic Mineral Products	201	5.71
24	Manufacture of Basic Metal Products	190	5.40
25	Manufacture of Fabricated Metal Products, except Machinery and Furniture	208	5.91
26	Manufacture of Electronic Components, Computer, Radio, Television and Clocks	203	5.77
27	Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks	158	4.49
28	Manufacture of Electrical equipment	208	5.91
29	Manufacture of Other Machinery and Equipment	244	6.93
30	Manufacture of Motor Vehicles, Trailers and Semitrailers	208	5.91
31	Manufacture of Other Transport Equipment	114	3.24
32	Manufacture of Furniture	122	3.47
33	Other manufacturing	109	3.10
total		3520	100

Source: Korea Innovation Survey 2010, STEPI (Science & Technology Policy Institute)

Table 3 shows the distribution of firms that conduct exporting and/or innovative activities from the large firms and SMEs perspective respectively. The sample is comprised of 1384 exporters (39.34% of the total) and 2329 innovators (66.19% of the total). Exporting firms that take part in innovative activities account for 34.82%. The positive correlations turn out to be

more apparent when considering the large firms and SMEs respectively. More than 70% of the large firms are exporters and 68% of them are innovators. For SMEs, exporters account for about 35% and more than 30% of them are innovators. Thus, we anticipate that our hypotheses may turn out to be significant.

Table 3: Distribution of Exporters and Innovators

	No Innovation & No Export	Export only	Innovation only	Innovation & Export	Total
All firms	1031 (29.29%)	159 (4.52%)	1104 (31.37%)	1225 (34.82%)	3520 (100%)
Large firms	25 (6.26%)	11 (2.76%)	92 (23.06%)	271 (67.92%)	399 (100%)
SMEs	1007 (32.26%)	148 (4.74%)	1012 (32.43%)	954 (30.57%)	3121 (100%)

Note: the table shows the number of firms in each category. Figure in parentheses are the share of each category in the total. Figures in parentheses are shares of the number of firms for each category.

3.2 Research Model and Operationalization of Variables

This paper aims to explore the impact of exporting on product innovation, process innovation, and organizational and marketing innovation. We also allow for a number of control variables—namely, age, foreign ownership, size, size2, profit margin, and government assistance—largely reflecting the resource base of the firm.

Three models are adopted in this paper. Model 1 uses only control variables to establish the benchmark. Model 2 uses the export dummy variable as the independent variable to explore the relationship between exporting status and innovative activities. Model 3 uses export intensity as the independent variable to confirm whether the higher level of exporting relates more strongly with innovation.

According to the data from KIS 2010, the dependent variables (product innovation, process innovation, organizational innovation, and marketing innovation) were estimated at binary levels, so we employed probit regression to test the hypotheses. STATA 12.0 was used to implement the probit regression in this study. We also utilized the marginal effect coefficients of the probit regression to assess how much the binary value 0 or 1 is affected by the

changes of the independent variables. Considering the endogeneity between innovation and export, export data in 2007 were used while innovations refer to the total innovative activities that took place from 2007 to 2009. As current innovations cannot influence past export performance, the causality effect between export and innovation could be minimized to some extent.

Dependent Variables

Innovation: Many papers have estimated innovations by sorting them as dummy variables (Damijan et al., 2010; Alfredo, 2010; Nauyen et al., 2008). Considering our data, the dependent variables (product innovation, process innovation, organizational innovation, and marketing innovation) are measured as binary values using 1 if the firm carried out the related innovative activities from 2007 to 2009 and 0 otherwise.

Independent Variables

Export: Export can be estimated using dichotomous values (i.e., 0 and 1). Some studies employed a dummy variable to indicate if the firm sells its main product abroad (Boermans & Roelfsema, 2012; Massimiliano & Giulia, 2009; Damijan et al., 2010; Salomon & Shaver, 2005; Love & Ganotakis, 2013). Following convention, we defined an exporter in 2007 as a firm reporting a positive amount of exports. Accordingly, non-exporters in 2007 are those firms with zero exports.

Export intensity, which presents the ratio of export sales in relation to total sales, has also been widely utilized to describe firms' export performance (Love & Ganotakis, 2013; Alfredo, 2010; Roper & Love, 2002; Cassiman & Martinez-Roz, 2003). Hence, we employed export intensity in 2007 as the independent variable in this paper to reflect the export performance.

Control Variables

In this study, we controlled for five types of control variables—namely, age, foreign ownership, size, profit margin, and government assistance—to reflect the resource base of the firm.

Age: The firm's age in years was included in the estimation to allow for any knowledge acquisition related to years in business (Love et al., 2010; Love & Ganotakis, 2013).

Foreign ownership: We included a dummy variable to indicate if a foreign owner holds the largest single stake in the firm in order to allow for the possibility of knowledge flows within group networks (Boermans & Roelfsema, 2012).

Size: Size refers to the number of employees in 2007 and its square in order to allow for the possible scale benefits of exporting (Van Biesebroeck, 2005). Size squared was also used

to allow for a possible U-shape or inverted U-shape relationship between size and innovation (Love & Ganotakis, 2013).

Profit margin: Innovations always require large investments as the processes of innovative activities are costly. These enhancements can bring about larger profits in the near future. Circularly, firms are more likely to reinvest in innovations if they gain a decent profit from exporting. Therefore, we included profit margin, which refers to the ratio of net income out of total sales in 2007.

Government assistance: Korea is a highly innovative country with a relatively sound legal system. It actively encourages and assists enterprises to innovate, such as by operating some projects to provide technical and funding support, especially for SMEs because the largest barrier to their innovative activities is their shortage of capital. We argue that, for Korean firms, this might be a factor that we cannot ignore, especially because more than 80 percent of the firms in our sample are SMEs. In this paper, government assistance is measured by whether the firm benefits from government policy and support on innovation during the 2007-2009 period. Table 4 summarizes the description of the variables.

Table 4: Variables Description

Variables	Description
Dependent Variables	
Product Innovation	Dummy variable---whether a firm carried out product innovation during 2007-2009 (0/1)
Process Innovation	Dummy variable---whether a firm carried out process innovation during 2007-2009 (0/1)
Organizational innovation	Dummy variable---whether a firm carried out organizational innovation during 2007-2009 (0/1)
Marketing Innovation	Dummy variable---whether a firm carried out marketing innovation during 2007-2009 (0/1)
Independent Variable	
Export Dummy	Dummy variable---whether a firm participated in exporting activities in 2007 (0/1)
Export Intensity	Amount of export sales in relation to total sales in 2007 (%)
Control Variables	
Age	Firm age (years)
Foreign-own	Dummy variable---whether the firm is owned by foreign country (0/1)
Size	The employee in 2007 (number)
$Size^2$	The square of employee in 2007 (number)
Profit Margin	Net income in relation to total sales in 2007 (%)
Government assistance	Dummy variable---whether government provided assistance on innovation activities during 2007-2009 (0/1)

IV. Empirical Results and Analysis

4.1 Product Innovation

Table 5 summarizes the coefficients of the levels of product innovation. The table shows that, in Models 2 and 3, both exporting activity and export intensity have positive impacts on product innovation at the 1% significance level. These results are in line with our hypothesis suggesting that exporting boosts product innovation; the higher the exporting level is, the more significant the learning effects are. A chi-square test for the overall model fit with p-value showed that the addition of a variety of control variables significantly improved the fit of the model.

Table 5: Probit Regression: Product Innovation Levels

	Model 1	Model 2	Model 3
Export Dummy		0.6519***(0.0597)	
Export Intensity			0.6266***(0.1123)
Age	0.0130***(0.0024)	0.0081***(0.0025)	0.0118***(0.0024)
Foreign-own	0.2093 (0.1641)	0.0323 (0.1665)	0.1520 (0.1645)
Size	0.0015***(0.0002)	0.0011***(0.0002)	0.0013***(0.0002)
$Size^2$	-4.91e-08***(6.35e-09)	-3.83e-08***(6.47e-09)	-4.38e-08***(6.38e-09)
Profit Margin	-0.3424 (0.1409)	-0.3017 (0.3253)	-0.3298 (0.3210)
Government assistance	1.6933***(0.0646)	1.6002***(0.0663)	1.6638***(0.0651)
No. of firms	3520	3520	3520
Likelihood	-1682.2226	-1621.2210	-1666.21
LR chi^2	1311.93***	1433.94***	1343.96***
Pseudo R^2	0.2805	0.3066	0.2874

Note: *** p<0.01, ** p<0.05, * p<0.10; standard errors in parentheses.

In Models 1, 2 and 3, the control variables of age, size and size squared, and government assistance are all significant at the 5% to 1% levels, indicating that firms with a longer history get more help from the government and tend to introduce new innovative products to the market. Interestingly, the results indicated that both size (with positive coefficients) and

size squared (with negative coefficients) were significant at the 1% level. This result negates our intrinsic idea that bigger firms are more likely to conduct innovative activities. There is indeed an inverted U-shape relationship between firm size and product innovation, which could be explained by the bureaucratic and opportunism problem derived from the labor redundancy and autonomous groups in large firms that exceed a certain number of employees. Surprisingly, foreign ownership and profit margin showed no significance on product innovation, which is inconsistent with the previous theory of the technology spillover through contact with foreign resources. This might result from the production nature of Korean manufacturing firms. Another possible explanation for the insignificant results could be that the proportion of foreign-owned firms in the sample was relatively very low.

4.2 Process Innovation

Table 6 presents the coefficients and standard error of all variables at the process innovation levels. As we expected, regardless of whether the firm participated in exporting in 2007, the exporting volume compared to sales volumes in the same year played an important role in carrying out process innovation activities. Both affected the process innovation at the 1% level. The chi-square tests with p-value showed the overall fit of the models.

In Model 1, firm age proved to be significant to process innovation at the 10% level. The same was true of foreign ownership. Meanwhile, Models 2 and 3 failed to show any significance—at least, not at the 10% level. Thus, we cannot offer evidence to support that firm age and ownership are key determinants for process innovation in Korean manufacturing firms. In terms of size, size squared, and government assistance, the results concur with those in the case of product innovation for almost the same reasons. The firm's profit status (i.e., whether profitable or not) does not seem to be significant in Models 1, 2, or 3. This might stem from the financial burden of the higher level of innovation and the emphasis on product innovation rather than other forms of innovative activities, especially for manufacturing firms, in which creating more products is the priority. They are more likely to reinvest their profits to improve or develop new products rather than to improve production processes. In addition, as previously mentioned, firms can invest in process innovation in later stages of business after product innovation. As most firms in our sample were SMEs established just a few years earlier, they might focus mainly on product innovation.

Table 6: Probit Regression: Process Innovation Levels

	Model 1	Model 2	Model 3
Export Dummy		0.4614***(0.0531)	
Export Intensity			0.4331***(0.0976)
Age	0.0036*(0.0022)	0.0004 (0.0022)	0.0032 (0.0022)
Foreign-own	0.2387*(0.1414)	0.1273 (0.1419)	0.1978 (0.1415)
Size	0.0014***(0.0002)	0.0011***(0.0002)	0.0012***(0.0002)
$Size^2$	-4.40e-08***(7.23e-09)	-3.58e-08***(7.60e-09)	-4.01e-08***(7.36e-09)
Profit Margin	-0.2203 (0.3097)	-0.2241 (0.3128)	-0.2146 (0.3108)
Government assistance	1.2760***(0.0502)	1.1867***(0.0514)	1.2496***(0.0506)
No. of firms	3520	3520	3520
Likelihood	-1897.4900	-1859.7566	-1887.5957
LR chi^2	1082.77***	1158.24***	1102.56***
Pseudo R^2	0.2220	0.2375	0.2260

Note: *** p<0.01, ** p<0.05, * p<0.10; standard errors in parentheses.

4.3 Organizational Innovation

Table 7 displays the coefficients of the variables at the organizational innovation levels. The results are consistent with the cases of product and process innovation. Export participation and export intensity significantly influence organizational innovation at the 1% level. Case studies on Korean export firms have discussed the organizational restructuring during the contact with foreign firms and suppliers and how it conveyed a learning effect in the organization; our empirical analysis provides robust evidence to support such a theory.

In Model 1, age and foreign ownership affect organizational innovation at the 10% significance level, while in Model 2, the effects become insignificant. In Model 3, age is once again significant at the 10% level, showing a weak impact. However, foreign ownership remains insignificant, indicating that—for organizational innovation—foreign ownership might not be that important for Korean manufacturing firms, at least not at the 10% significance level. Size and size squared as well as government assistance showed the same significance with product and process innovation. We can thus conclude that more employees are not always better and that firms might face loopholes and obstacles in staff management. Profit margin affects the organizational innovation at the 5% level in all three models with negative

coefficients, representing that more profitable firms might not like to invest in organizational innovation. One possible reason might be that carrying out organizational innovation requires large capital and human resources.

Table 7: Probit Regression: Organizational innovation Levels

	Model 1	Model 2	Model 3
Export Dummy		0.4468***(0.0527)	
Export Intensity			0.2441***(0.0949)
Age	0.0034*(0.0021)	0.0001 (0.0021)	0.0032*(0.0021)
Foreign-own	0.2354*(0.1331)	0.1390 (0.1345)	0.2155 (0.1334)
Size	0.0013***(0.0001)	0.0011***(0.0001)	0.0013***(0.0001)
$Size^2$	-4.32e-08***(5.20e-09)	-3.69e-08***(5.30e-09)	-4.10e-08***(5.25e-09)
Profit Margin	-0.6768**(0.3377)	-0.6815**(0.3403)	-0.6638**(0.3372)
Government assistance	1.1629***(0.0487)	1.0741***(0.0499)	1.1458***(0.0491)
No. of firms	3520	3520	3520
Likelihood	-1831.1610	-1795.4461	-1827.8700
LR chi^2	1021.79***	1093.22***	1028.36***
Pseudo R^2	0.2181	0.2334	0.2195

Note: *** p<0.01, ** p<0.05, * p<0.10; standard errors in parentheses.

4.4 Marketing Innovation

Compared with the cases of product, process, and organizational innovation, the results of marketing innovation were somewhat different. Whether the firm exports remains significant for marketing innovation at the 1% level, but the volume of exports in relation to total sales volume appears to be insignificant. One reason for this might be that Korean manufacturing firms' exported goods are mainly mass-produced products so that firms usually apply a standardization strategy as opposed to localization. Therefore, contact with foreign markets cannot bring about the vigor necessary to activate marketing innovation in Korean manufacturing firms.

Table 8 shows similar results. Firm age has a significant impact on marketing innovation at the 1% level. Consistent with the theory, business experience is crucial for the creation of diverse marketing methods. Foreign ownership has an insignificant impact on marketing innovation—probably due to the sample size of foreign-owned firms. Profit margin has an

insignificant effect as well. The reasons might be the same as organizational innovation because these two kinds of innovative activities are relatively costly and require highly competent (i.e., more knowledge-intensive) people. Size and size squared as well as government assistance showed similar results. We can conclude that, for Korean manufacturing firms, size and government assistance are key factors in the performance of all innovative activities.

Table 8: Probit Regression: Marketing Innovation Levels

	Model 1	Model 2	Model 3
Export Dummy		0.3486***(0.0529)	
Export Intensity			0.0854 (0.0929)
Age	0.0090***(0.0019)	0.0062***(0.0020)	0.0088***(0.0019)
Foreign-own	0.1794 (0.1285)	0.0841 (0.1293)	0.1705 (0.1287)
Size	0.0003***(0.0001)	0.0002***(0.0001)	0.0002***(0.0001)
$Size^2$	-7.08e-09**(3.07e-09)	-4.80e-09 (3.39e-09)	-6.76e-09**(3.11e-09)
Profit Margin	-0.0722 (0.3347)	-0.0380 (0.3351)	-0.0626 (0.3344)
Government assistance	0.9862***(0.0487)	0.9074***(0.0502)	0.9791***(0.0493)
No. of firms	3520	3520	3520
Likelihood	-1800.3298	-1778.7561	-1799.9086
LR chi^2	589.50***	632.65***	590.34
Pseudo R^2	0.1407	0.1510	0.1409

Note: *** p<0.01, ** p<0.05, * p<0.10; standard errors in parentheses.

Table 9 shows the marginal effects of variables at the levels of each innovation. Since the marginal effects coefficients are for discrete change of dummy variables from 0 to 1, and for non-dummy variables, they only show the marginal change with all variables held at their mean, we only take the export dummy into our account. We can see from the table that when a firm participates in exporting, there is 20.60% probability for the firm to carry out product innovative activities, 18.17% higher probability to conduct process innovation. The marginal effect of export dummy for organizational innovation is 0.1707, which means that if a firm taped into exporting, it has 17.07% higher probability to innovate in organization and an 11.39% higher chance of being included in the firms that devote a significant share of their resources to marketing innovation than none-exporters.

Table 9: Marginal Effects

	Product Innovation	Process innovation	Organizational Innovation	Marketing Innovation
Export Dummy	0.2060*** (0.0178)	0.1817*** (0.0205)	0.1707*** (0.0200)	0.1139*** (0.0175)
Export Intensity	0.2102*** (0.0378)	0.1726*** (0.0389)	0.0930*** (0.0361)	0.0275 (0.0299)

Note: *** p<0.01, ** p<0.05, * p<0.10

As the coefficients of marginal effects could not simply be compared to determine the significance of influence, we utilized a t-test. Table 10 displays the t-statistics of the export dummy and export intensity in each regression. From the coefficients with p-value, we can make a general comparison about the significance of the four different areas of innovation from the sample to the whole population. The coefficients of the export dummy were 12.79 for product innovation, 10.58 for process innovation, 10.28 for organizational innovation, and 6.60 for marketing innovation. The coefficient of export intensity for product innovation was 6.61 and indicated that exports affect product innovation more significantly than process (5.59), organizational innovation (3.98), and marketing innovation (0.76), suggesting that there is no significant evidence to reject our fifth hypothesis. Hence, we can conclude that, for Korean manufacturing firms, the learning effects from exports turn out to be the most apparent on product innovation, which complies with the theory about the comparison between product and process innovation.

Table 10: T-statistics Comparison

	Product Innovation	Process innovation	Organizational Innovation	Marketing Innovation
Export Dummy	12.79***	10.58***	10.28***	6.60***
Export Intensity	6.61***	5.59***	3.98***	0.76

Note: *** p<0.01, ** p<0.05, * p<0.10

V. Conclusion and Limitations

This paper examined the impacts of exports on product, process, and organizational and marketing innovations of Korean manufacturing firms comprehensively and made a direct comparison about the degree of the learning effects, which distinguishes this paper from previous research. Overall, the results indicate that exporting raises innovation, which fits into the learning-by-exporting theory. We found clear and robust empirical evidence to show that both export participation and export intensity have a significantly positive association with product, process, and organization, especially with product innovation at the 1% significance level. Only when it comes to marketing innovation is export intensity not significant, at least not at the 10% level.

This research is one of the rare studies to have investigated the link between exporting and innovation using a dataset provided by STEPI. The findings can contribute to a better understanding of the association between exporting and innovation. Based on the hypothesis formulation and empirical results, we can state that Korean manufacturing companies were able to gather information in foreign markets and industries via exporting and bring it back to the home country to improve product quality and specifications as well as process-related logistics and enterprise resource-planning systems. International experience acquired through exporting activities seems to have facilitated changes in organizational structures' fit within intense competition in foreign markets. The relatively insignificant results of the impact of exporting on marketing innovation might be explained as follows. Korean manufacturing firms' main exporting commodities, such as wireless communication equipment, semiconductors, automotive goods, machinery, and cosmetics, are mass-produced products. This leads to a single model of standard producing, resulting in less sensitivity to the efficiency of the marketing method applied to foreign local markets. Thus, the effect of marketing knowledge feedback overseas is not that apparent. Moreover, most firms in our sample were SMEs, which do not have enough capital to conduct high-level innovative activities like marketing innovation. This paper also highlighted the consistently significant effect of government assistance on all the areas of innovative activities, which provides a meaningful implication for policy making related to exporting and innovations.

This paper can provide practical implications for Korean companies internationalizing via exporting and government institutions aiming to promote more internationalizing activities

among companies. First, exporting can be an effective vehicle for fostering innovation in companies. Increased competition in foreign markets and the collection of technological and market information can be a relevant source of the higher level of innovation. Second, Korean companies need to open their doors to the employment of foreign staffs as top managers in foreign offices in order to obtain diverse ideas from them, especially to promote more effective marketing activities embedded in different cultural elements. Third, at the government level, more policies could be implemented to stimulate exporting and innovative activities and to reduce export barriers and cost, such as by offering tax incentives and information programs and setting up refunds.

In terms of the theoretical contribution, this paper still has some limitations. First, this study relied on cross-sectional data, which might ignore the time effect. This concern has to be resolved by using a panel data set generated by the data provider. Second, the methodology of this study did not consider the self-selection of exporting activity (see Haidar (2012) for more on that). Matching export propensity scores—namely, classifying firms according to their propensity to export and then matching the exporting and non-exporting firms in order to compare their likelihood to innovate—might lead to a more accurate result. Finally, the bi-directional impact between exporting and innovation has to be investigated further to develop a more in-depth understanding of the relationship between these two variables. Our ongoing research will attempt to address these limitations.

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Learning by Exporting: The Effects of Exporting on Firm Innovation in Korean Manufacturing Industries - Xiaochen Wu·Jaeho Lee

수출이 기업 혁신에 미치는 효과

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요약

수출과 혁신의 관계를 다룬 문헌들 중 혁신이나 높은 생산성이 수출을 선행한다는 연구들이 있는 반면, 또다른 연구들은 수출이 혁신으로 이어진다고 주장하며, 또한 여러 실증분석에 따르면 수출을 하는 국가가 수출을 하지 않는 국가보다 더 높은 생산성을 지니고 여러 분야에서 더 좋은 성과를 거두고 있음을 보여주고 있다. 그렇지만 미시적 차원인 기업 측면에서 수출이 기업 혁신성을 향상시키는 실증적 증거는 드물다. 수출 기업은 국내 시장에서 얻지 못하는 다양한 지식을 획득할 수 있고 그러한 지식들이 본사로 유입되어 결국은 새로운 혁신 성과를 형성한다. 본 논문은 이러한 이론에 근거하여 KIS 2010 데이터를 활용하고 프로빗 회귀분석을 통하여 수출이 한국 제조업 기업의 제품 혁신, 공정 혁신, 조직 혁신 및 마케팅 혁신에 미치는 효과를 살펴보고자 한다. 실증분석 결과를 따르면 수출은 혁신에 긍정적 영향을 미친다. 특히 제품 혁신에 미치는 영향이 더 현저하다. 그리고 수출 집중도가 높을수록, 기업의 제품 혁신, 공정 혁신 및 조직 혁신 활동이 더 많이 전개된다. 그렇지만, 수출 집중도와 마케팅 혁신과의 관계에 대한 가설은 채택되지 못하였다.

주제어: 수출, 제조업, 제품 혁신, 공정 혁신, 조직 혁신, 마케팅 혁신