Does Exporting Promote New Product Introduction?:

An Empirical Analysis of Plant-Product Data on the Korean Manufacturing Sector

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Abstract

Utilizing previously unexplored plant-product data on Korean manufacturing sector, this paper examines whether and to what extent exporting promotes the introduction of new products. Firstly, to set the stage, this paper shows that new product introduction has played a large role in the growth of Korean manufacturing sector based on a simple decomposition analysis; new product introduction account for about half of the growth of aggregate manufacturing shipments during the eight-year period 1990-1998. Secondly, this paper shows that there are positive cross-sectional correlations at the plant level between exporting activity and the measure of creation of new products as well as other measures of product destruction, product adding and dropping, and product scope. The positive cross-sectional correlation between exporting and new product introduction might reflect causality running both ways: the self-selection of more "able" plants into export market and so-called the *creating-by-exporting* effect. Finally, based on the propensity score matching procedure, this paper provides some evidence that exporting has an effect of facilitating new product introduction by exporting plants. The evidence suggests, however, that not only exporting activity *per se* but also the absorptive capacity of plants matter in this process. It is also found that the number of products produced of a plant increases as a result of exporting activity. This seems to suggest that international knowledge spillovers associated with exporting activity is a positive plant "ability" shock which makes the plant more productive not only in producing that specific product that start to be exported but also in producing a wider range of other products. Furthermore, if international trade, or exporting in particular, has an effect of facilitating new product introduction, then the longer-term gains from trade or lowering trade costs might be much bigger than conventionally accepted.

I. Introduction

It is well understood that the continual process of creative destruction—introduction of new products and dropping of old products—is an integral part of economic growth.[1] In this respect, understanding the underlying mechanism of the new product introduction as well as its determinants is unarguably an important research and policy issue. Existing theoretical and empirical studies on trade and growth suggest, although there are some controversies remaining, that international trade or trade liberalization not only generates static gains but also promotes economic growth of developing countries. Main proposed channels include greater exposure to advanced foreign knowledge through exporting and increased access to new intermediate inputs through importing, both of which facilitates international knowledge spillovers and enhances the growth of productivity and income. Then, if new product introduction is a vital part of economic growth, one natural question that arises is whether introduction of new product in developing countries are related to openness to trade. Despite the prominent importance of understanding this issue, we have little empirical evidence to date.

Utilizing previously unexplored plant-product data on Korean manufacturing sector, this study aims to examine whether and to what extent exporting promotes the introduction of new products relying on propensity score matching technique. We are not aware of any previous studies that specifically address this issue. Although both exporting and importing could be important channels of international knowledge spillovers, we focus on exporting in this study

[1] As Schumpeter put it, "The fundamental impulse that keeps the capital engine in motion comes from the new consumers' goods, the new method of production and transportation, the new markets. … [The process] incessantly revolutionalizes from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact of capitalism." In fact, in many recent endogenous growth theories, the new product introduction is regarded as equivalent to the process of productivity improvement and economic growth.

for several reasons. Firstly, although new product introduction and exporting can be measured at plant level, the data on imports of intermediate inputs are not available at plant level in Korea's case. By narrowing down on the relationship between exporting and new product introduction, we can fully utilize the benefits provided by the micro-data and carry out a more focused analysis. Secondly, although existing literature provides somewhat mixed evidence on the existence of learning-by-exporting spillovers, several recent studies utilizing more refined empirical methodology to deal with self-selection problem, such as matched sampling techniques, tends to find evidence in favor of learning-by-exporting.[2] If the new knowledge gained through exporting improves firm's productivity or ability and/or shifts the within-firm relative profitability across products towards yet-to-be-introduced products, then it is plausible that firms that become exporters are more likely to introduce new products than those that produce for domestic market only. Finally, one well known study examining multi-product firms' product switching behavior in the U.S. documents that multi-product firms are more likely to export than single-product firms (Bernard, Redding and Schott 2006). Although this study does not explicitly deal with new product introduction, this fact might reflect the two-way causality between exporting and introduction of new products.

Examining the effect of exporting on new product introduction in the Korean case is particularly important in several respects. Above all, as well recognized, Korea is one of the few success countries that have continuously upgraded its product mix and narrowed the income gap with advanced countries by adopting an export-led or outer-oriented development strategy.[3] So, examining and clarifying whether and how exporting is related to new product introduction in the Korean case could provide valuable lessons on other developing countries that hope to

[2] See below for a brief discussion of the related literature.
[3] See Krueger (1997), for example.

catch-up with advanced countries.

This study is related to several strands of literature. Firstly, this study stems from the large empirical literature that scrutinizes the causal relationship between exporting and productivity. Most studies report that exporters are more productive than non-exporters before they start to export, suggesting that cross-sectional correlation between exporting and productivity partly reflects a self-selection effect. For example, Clerides, Lach and Tybout (1998) find very little evidence that previous exposure to exporting activities improves performance, using the plant-level panel data from Colombia, Mexico, and Morocco. Similar results are reported by Aw, Chung, and Roberts (2000) and Aw, Chen, and Roberts (2001) for Taiwan, Bernard and Jensen (1999b) for U.S. By contrast, the evidence on a learning effect is mixed. Earlier research such as Bernard and Jensen (1999b) find little evidence in favor of learning. They report that new entrants into the export market experience some productivity improvement at around the time of entry, they are skeptical about the existence of strong learning-by-exporting effect. However, several recent studies utilizing more refined empirical technique to deal with self-selection problem such as matched sampling techniques provide some empirical evidence in favor of learning-by-exporting. See Girma, Greenaway, and Kneller (2004) for UK, De Loecker (2007) for Slovenia, Albornoz and Ercolani (2007) for Argentina, and Hahn and Park (2009) for Korea.

Related previous studies on Korea include Aw, Chung, and Roberts (2000), Hahn (2004), and Hahn and Park (2009). Aw, Chung, and Roberts (2000), using plant-level panel data on Korean manufacturing for three years spaced at five-year intervals, does not find evidence in favor of either self-selection or learning-by-exporting. It differs from similar studies on other countries in that even the self-selection hypothesis is not supported. Aw, Chung, and Roberts (2000) argue that Korean government’s investment subsidies tied to exporting activity rendered plant productivity a less useful guide on the decision to export. By contrast, following the methodologies of Bernard and Jensen (1999a, 1999b), Hahn (2004) finds some supporting evidence for both selection and learning in Korean manufacturing sector, using annual plant-level panel data from 1990 to 1998. However, Hahn (2004) suffers from the same technical difficulties as Bernard and Jensen (1999a, 1999b) in that the uncontrolled self-selection problem in export market participation may have contaminated the result. Hahn and Park (2009) uses propensity score matching procedure to address the self-selection problem and finds strong and robust evidence in favor of learning-by-exporting. All of the above studies, however, did not examine whether and how exporting is related to new product introduction.

Secondly, this study is related to the growing literature that assesses the effect of trade or trade liberalization on domestic product variety.[4] There are macroeconomic theoretical studies that suggest that trade may contribute to expansion of domestic varieties and growth, in addition to static efficiency gain (Romer 1990, Grossman and Helpman 1991). In these models, trade expands the set of available input varieties, which reduces the R&D cost of creating new domestic varieties.[5] Some empirical implications from these theories have been empirically tested by Feenstra *et al.* (1999). Using the data of Korea and Taiwan, they showed that changes in *domestic product variety* have a positive and significant effect on total factor productivity. Based on the implications of these endogenous growth models as well as more recent theories of heterogenous-firm theories of trade, such as Melitz (2003), Baldwin and Forslid (2008), Bernard,

[4] We do not review in detail the large literature examining the effect of trade or trade liberalization on productivity, import prices, and welfare. Also, we do not review in detail the general literature examining the gains from trade through the import of new varieties. For the latter literature, Krugman (1979) is a pioneering theoretical paper suggesting that expansion of available varieties is a new channel of realizing gains from trade. Later, Feenstra (1994) and Broada and Weinstein (2006) developed new methodologies that enabled the empirical examination of the implications from monopolistic competition theories of trade, such as Krugman (1979). Empirical literature along this line includes Feenstra (1994), Broda and Weinstein (2006), Arkolakis, Demidova, Klenow, and Rodriguez-Clare (2008), Feenstra *et al.* (1999), Goldberg, and Khandelwal, Pavcnik, and Topalova (2008).

[5] In these models, growth is viewed as a process of continuous expansion of domestic varieties. Though a closed economy model, Stokey (1988) views growth as a continuous process of creating new products and dropping of old products and constructs an endogenous growth model with learning-by-doing.

Redding, and Schott (2006b), Goldberg *et al.* (2008) examined empirically whether increased imported variety induced by trade liberalization has generated “domestic-variety-creation” effect. They find evidence that the increase in imported variety following trade reform in India in the early 1990s contributed to the expansion of domestic product variety. Bernard, Redding, and Schott (2006a) examines the product switching behavior of multi-product firms using a firm-product data for the U.S., and shows that multi-product firms are more likely to add or drop a product and export. However, neither Goldberg *et al.* (2008) nor Bernard, Redding, and Schott (2006a) explicitly analyzed the introduction of products that are *new from the view point of the aggregate economy*; they focused on the product scope decision of firms from the view point of individual firms. As mentioned earlier, if creative destruction process— creation of new products and destruction of old products—is an integral part of economic growth, we think that the research question raised in this paper is unique.

Main elements of this paper are as follows. To set the stage, this study first documents some basic facts about new product introduction in Korean manufacturing sector. Here, we are mainly interested in examining, for example, how pervasive new product introduction is, how much of the aggregate manufacturing shipment growth is accounted for by new product introduction, and how new products are distributed across different types of plants. Next, we examine cross-sectional correlation between plant’s exporting status and measures of new product introduction as well as other plant’s performance characteristics, such as shipment, employment, productivity, etc. It has been widely documented that exporting plants (or firms) have many desirable performance characteristics compared with non-exporting plants. The issue is whether exporting plants also have better track record of introducing new products.

Then, we turn to our main analysis. Here, we use the propensity score matching procedure explained in Becker and Ichino (2002) to analyze whether plants that started exporting introduces more new products than plants that produce for domestic market only. Even if we observe a positive cross-sectional correlation between exporting and measures of new product introduction, it does not necessarily mean that exporting promotes new product introduction. That is, the causality might run both ways. Simple mean difference test on differences in measures of new product introduction between exporters and non-exporters might suffer from selection bias problem if plants that are more capable of introducing new products tend to enter export market. Propensity score matching is one way of addressing this selection bias issue.

In this study, we distinguish between new product from the viewpoint of an aggregate economy and a new product from the viewpoint of a plant. Here, it should be noted that a new product from the view point of a plant may or may not be a new product from the view point of an aggregate economy. We cannot tell exactly why and how important this distinction is *ex ante*, although new product introduction and product switching behavior may not be driven by the same causes. Nevertheless, we think that distinguishing between the two in our analysis is a worthwhile effort given the importance of new product introduction in the process of economic growth.

This paper is organized as follows. The next section explains the plant-product data. Section 3 discusses some basic facts on new product introduction in Korean manufacturing sector. Section 4 examines the cross-sectional correlation between exporting status and our measures of new product introduction. Section 5 analyzes the effect of exporting on new product introduction using propensity score matching procedure. Final section concludes with a summary.

II. Data

This study utilizes two data sets. The first one is the unpublished plant-level census data underlying the *Survey of Mining and Manufacturing* in Korea, which has been previously used by the author. The data set covers all plants with five or more employees in 580 manufacturing industries at KSIC (Korean Standard Industrial Classification) five-digit level. It is an unbalanced panel data with about 69,000 to 97,000 plants for each year from 1990 to 1998. For each year, the amount of exports as well as other variables related to production structure of plants, such as production, shipments, the number of production and non-production workers and the tangible fixed investment, are available. The exports in this data set include direct exports and shipments to other exporters and wholesalers, but do not include shipments for further manufacture.

The second data set is plant-product data set for the same period. For most plants covered in the plant-level census data, this dataset contains information on the value of shipments of each product produced by plants. It also has information on plant identification number that will be used to link this data set to the plant-level census data, as well as KSIC five-digit level industry code to which each plant belong. The product data is recorded in eight-digit product code which is made by combining the five-digit KSIC code to which the product belongs and the three-digit code based on the Statistics Office's internal product classification scheme. Each plant is assigned to a five-digit industry based on the industry matched with the product whose output share is the largest.

III. New Product Introduction: Some Basic Facts

How important is the creative destruction process—introduction of new products and destruction of old products—in understanding the growth of manufacturing sector in Korea? To answer this question, we start by examining some of the main features of out plant-product data. As shown in the first column of Table 1, the aggregate manufacturing shipment more than tripled between 1990 and 2000. Although the increase in aggregate shipment was accompanied by both the increase in the number of plants and the increase in average shipment per plant, the latter played a much bigger role, which more than doubled during the same period. The remaining columns of Table 1 show that virtually all of the increase in average shipment per plant came from the expansion of average shipment per product, rather than from the increase in average number of products per plant. While the average shipment per product more than doubled, the average number of products per plant hardly changed during the same period.

//Insert Table 1 about here//

The distribution of plants according to the number of products produced is highly skewed and fairly stable over time. For every year during the period 1990-2000, more than three-fourth of the plants are single product plants. Plants that produce two products account for about fourteen percent of the plants and plants that produce three products about five percent. So, plants that produce three or less products account for more than 95 percent of the plants. Although there are some plants that produce more than 10 products, plants producing five or more products account for less than two percent of plants.

//Insert Table 2 about here//

At first glance, the above discussion might give one the impression that changes at product intensive margin, the growth of shipment per product, were much more important than changes at product extensive margin, creation and destruction products, in accounting for aggregate manufacturing shipment growth. As we will discuss below, however, the fairly stable product count distribution of plants masks a large amount of product creation and product destruction.

Table 3 shows the shares of product created and product destroyed, respectively, during four- and eight-year time interval in the Korean manufacturing sector. Here, a product created during a certain time interval is defined as the product which did not exist in the beginning year but made its appearance in the end year with positive shipments. A product destroyed is defined symmetrically. A continuing product is the product that existed in both years with positive shipments. The table shows that both product creation and product destruction explain a significant share of total number of products and total manufacturing shipments. During the eight-year period from 1990 to 1998, new products or products created accounts for 40.9 percent of number of products that existed in 1998. In terms of shipments, new products account for somewhat smaller share, 28.7 percent, of manufacturing shipments in 1998, suggesting that the average size of shipment for new products are smaller than continuing products. Comparing the two four-year sub-periods, we find that introduction of new products was more active during the period 1990-1994 than during the period 1994-1998. The product destruction also explains a large share of total number of products and manufacturing aggregate shipments. During the same eight-year period, products destroyed accounts for 22.9 percent of total number of products and 14.6 percent of manufacturing shipments in the beginning year, which is 1990. Thus, although product destruction rate is somewhat smaller than product creation rate, leading to the expansion of the range of products produced, the rapid growth of the Korean manufacturing sector was accompanied by large amounts of product creation and product destruction. Although the expansion of the product range is consistent with the implications of variety-based models of growth, such as Grossman and Helpman (1991), the co-existence of product creation and destruction in the growth process of Korean manufacturing sector suggests that models which feature both introduction of new products and dropping of old products, such an Stokey (1988), are a more realistic description of the real world's growth process.

//Insert Table 3 about here//

Then, how much of the aggregate manufacturing shipment growth can be accounted for product creation and product destruction? To answer this question, we perform a simple decomposition exercise as follows. Let Y_t denote aggregate manufacturing shipments at year t. Then, the aggregate change in manufacturing shipment between year t and year $t+\tau$ can be decomposed into the contributions from continuing plants (CP), entering plants (NP), and exiting plants (XP).

$$\Delta Y_t = \sum_{j\in CP}\Delta Y_{jt} + \sum_{j\in NP}\Delta Y_{jt} + \sum_{j\in XP}\Delta Y_{jt},$$

where j is an index for plants. Each plant produces a set of products, such that $Y_{jt} = \sum_i Y_{ijt}$, where i is an index for products. The set of products produced by continuing plants in year t or $t+\tau$ can be broken down into continuing products (C), new products (N), and products destroyed (X). Here, new products and destroyed products are defined from the viewpoint of the aggregate manufacturing sector, not from the viewpoint of individual plants. The products produced by entering plants are either continuing products or new products, and the products produced by exiting plants are either continuing products or destroyed products. That is,

$$\Delta Y_t = \sum_{j\in CP}(\sum_{i\in C}\Delta Y_{ijt} + \sum_{i\in N}\Delta Y_{ijt} + \sum_{i\in X}\Delta Y_{ijt}) + \sum_{j\in NP}(\sum_{i\in C}\Delta Y_{ijt} + \sum_{i\in N}\Delta Y_{ijt}) + \sum_{j\in XP}(\sum_{i\in C}\Delta Y_{ijt} + \sum_{i\in X}\Delta Y_{ijt}).$$

Rearranging,

$$\Delta Y_t = \sum_{i\in C}(\sum_{j\in CP}\Delta Y_{ijt} + \sum_{j\in NP}\Delta Y_{ijt} + \sum_{j\in XP}\Delta Y_{ijt}) + \sum_{i\in N}(\sum_{j\in CP}\Delta Y_{ijt} + \sum_{j\in NP}\Delta Y_{ijt}) + \sum_{i\in X}(\sum_{j\in CP}\Delta Y_{ijt} + \sum_{j\in XP}\Delta Y_{ijt}).$$

The above equation decomposes the change in aggregate manufacturing shipment into three components: contributions from continuing products, new products, and destroyed products. Each component can be further broken down into contributions from each plant type. Thus, the decomposition exercise can tell us, for example, how much of the aggregate change in manufacturing shipments is due to new products and, furthermore, how much of the (contribution from) new products are accounted for by continuing plants and entering plants, respectively.

Table 4 shows the decomposition results. During the period from 1990 to 1998, the aggregate manufacturing shipments increased by 145 percent. Although the growth of continuing products explains much (about 60 percent) of this growth, the role of new products is also very large; new products account for about half of the growth of aggregate manufacturing shipments during the eight-year period. Net product creation effect is also large: it accounts for almost 40 percent of aggregate manufacturing shipments growth. The results for the two four-year sub-periods are more or less similar—new products and net creation of products account for substantial portions of the aggregate shipments growth. Since new products are defined as new from the viewpoint of the aggregate manufacturing sector, not from the viewpoint of plants, these numbers seem very large. This fact provides a strong motivation for exploring the underlying determinants of new product introduction, which is tackled in subsequent sections of this paper.

//Insert Table 4 about here//

Then what are the respective roles of continuing and entering plants in new product creation? Table 5 shows the decomposition results that are same as above but further broken down into each plant types. During the period 1990-1998, continuing plants contributed to 28.4 percent of the aggregate manufacturing shipments growth through new product creation, while entering plants 20.2 percent; the contribution of entering plants is as much as four-fifth of the contribution of continuing plants. Thus, new product creation is not a monopoly of continuing plants; entering and surviving plants are about as equally, although not more, important as continuing plants during the time span of eight years. If the time span becomes longer, then the contribution of entering and surviving plants is likely to become larger. In terms of net product creation, entering and exiting plants play a role that is roughly comparable to that of continuing plants.

//Insert Table 5 about here//

Then, how pervasive is new product introduction? Is it dominated by some small fraction of plants? To see this, we classify continuing plants during a time interval into four mutually exclusive and exhaustive groups: none, destruction only, creation only, creation and destruction. Creation only is the plants that created at least one product from the viewpoint of the aggregate economy, while destruction only is the plants that destroyed at least one product during a time interval. For comparison, we classify continuing plants alternatively into none, drop only, add only, and add and drop, as in Bernard, Redding, and Schott (2006a).[6] Here, add is the plants that added at least one product from the viewpoint of the plant, while drop is the plants that dropped at least one product during a time interval. So, a plant classified as creation also added at least one product, but not vice versa. Table 6 shows the share of each group of plants for the period 1990-1998 and for the two four-year sub-periods.

During the eight-year time span, the fraction of plants did some creation or destruction of

[6] It should be noted, however, that Bernard, Redding, and Schott (2006a) uses firm-product data while this paper

products is large: as much as 45 percent of plants were involved in some creation or destruction activity. The fraction of plants that created at least one product is also large, which is about 40 percent of all continuing plants. Creation only accounts for about 26 percent of plants, which is about twice as large as the set of plants that both create and destroy at least one product, which is 12 percent. When weighted by the beginning-year shipments, product creation is even more frequent; about 60 percent of all continuing plants created at least one product during the eight-year time span. This suggests that large plants are more likely to create new products. In particular, plants that both create and destroy products tend to be large plants as suggested by their much larger shipment-weighted share.

//Insert Table 6 about here.//

The bottom panel of Table 6 shows that plants' product switching—add or drop—is even more frequent, as expected. During the eight-year period, about 80 percent of plants changed their product mix. Consistent with Bernard, Redding, and Schott (2006a), plants frequently both add and drop products; they account for 68 percent and 77 percent of the total number and shipments of continuing plants, respectively. This pattern is somewhat in contrast with the product creation and destruction behavior; the share of plants that both create and destroy products is much smaller than the share of plants that both add and drop. This suggests that the underlying factors that determine plants' product creation and destruction behavior might be different from the factors that determine plants' product switching behavior. Based on the frequent behavior of simultaneous adding and dropping of products, Benard, Redding, and Schott (2006a) suggest that the class of explanations for the product switching that are consistent with the data should emphasize the interactions of firm and product attributes. For

uses plant-product data.

example, the accumulation of R&D knowledge or the substitution of one management team for another, may have uneven effects across products, resulting in an addition of those products whose relative profitability has risen and a dropping of those products whose relative profitability has fallen. The product switching behavior observed in Korean manufacturing plants are very similar to those observed by Bernard, Redding, and Schott (2006a), in the sense that both adding and dropping dominate product switching behavior. However, the much less frequent simultaneous creation and destruction suggests that firm (or plant) attributes might be as important in explaining product creation and destruction as firm-product attributes. In as much as plants' exporting status is a plant characteristic, focusing on exporting as a possible determinant of new product introduction as in this paper is not incompatible with the patterns of product creation and destruction documented above.

IV. Exporting and New Product Introduction: Cross-sectional Correlations

Is exporting related to creation of new product? Is it also related to product switching—adding and dropping of products? To answer these questions, we examine whether there is a positive cross-sectional correlation between plant's exporting status and measures of new product introduction as well as measures of product switching. We estimate average difference in various performance measures between exporters and non-exporters using the following regression equation.

$$Y_i = \alpha + \beta \cdot EXPORT_i + \gamma \cdot INDUSTRY_i + \delta \cdot REGION_i + \lambda \cdot SIZE_i + \varepsilon_i,$$

where $EXPORT$ is a dummy variable for exporters, and $INDUSTRY$, $REGION$, and $SIZE$ are dummy variables for five-digit KSIC (Korea Standard Industrial Classification) industry, dummy variables for provincial-level plant location, and log of plant size proxied by employment, respectively. Y is a measure of plant performance of interest. Exporters in a particular year are defined as those plants with positive exports, while non-exporters are those with zero exports. The coefficient on $EXPORT$ is the estimated exporter premium.

It is a well-established fact that exporters are better than non-exporters by various performance standards. That is, exporters are larger, more productive, more capital- and skill-intensive, and pay higher wages than non-exporters. As a starting point, we check whether similar results are found for Korean manufacturing sector. Table 7 confirms that exporters have many of the desirable characteristics.[7]

//Insert Table 7 about here//

As a plant performance characteristic, we also consider measures of new product introduction (product creation), product destruction, product adding and dropping, and product scope. As a measure of new product introduction, we use the cumulative count of creation of new products, CCC henceforth. This is a measure of track record of a plant on new product introduction, which is intended to capture the innovativeness of a plant. Since the dataset covers the period 1990-1998, CCC in 1990 is assumed to be zero for every plant. CCC for year t is the sum of the count number of new products introduced each year between 1990 and year t. Similarly, our measure of product destruction is the cumulative count of destruction of products (CDC) between 1990 and year t.[8] The measures for product adding and dropping are also the cumulative count of product adding (CEC) and dropping (CXC) of a plant. An added product in

[7] Hahn (2004) already documents in more detail that exporters are "better" than non-exporters in most performance characteristics. The results for other years are qualitatively similar to Table 7 and are not reported separately.

[8] Mechanically speaking, CDC of a plant is the cumulative number of products for which the plant was the last one to drop the product. What plant is most likely to be the last one to drop a product does not seem clear *ex ante*. Although the most able plant can profitably hold on to a product while others have to abandon it, it seems also possible that the most able plant can leave a product early that is becoming obsolete. The aim of this paper is not to provide a theory of product creation, but to provide empirical facts that will be the basis of such a theory.

year t is defined as a product that was not produced in year t-1 but that began to be produced in year t, and a dropped product is defined likewise, as in Bernard, Redding, and Schott (2006a). Our measure for the plant's produce scope (PRNOPP) is the number of eight-digit products.

Table 8 shows the cross-section regression results using the above equation for selected years during the period 1990-1998. As expected, we find a strong tendency that CCC, as well as CDC, of exporting plants is significantly higher than that of non-exporting plants, whether or not industry and region dummy variables are included. When we include plant size as a control variable, the coefficient on export dummy variable becomes smaller but still remains significant for the year 1994 or after.[9] So, the regression results suggest that exporters not only create new products but also destroy old products more frequently than non-exporters. What is interesting is that exporter premium is generally estimated to be higher for CCC than for CDC, which suggests that exporters are better than non-exporters in terms of net-creation of products.

//Insert Table 8 about here//

Table 8 also shows that both cumulative count of product adding and product dropping are also higher for exporters. The coefficient for exporting dummy variable remains positive and significant even after controlling for industry and region dummy variables as well as plant size. Finally, the bottom rows of Table 8 show that exporters produce larger number of products than non-exporters. This finding is consistent with the finding by Bernard, Redding, and Schott (2006a) that multi-product firms are more likely to be exporters.[10] In sum, the results suggest

[9] In year 1998, the coefficient on export dummy loses its significance, though still positive, when plant size as well as industry and region dummy variables are all included. We conjecture that this might be due to the large amount of plant closing of non-exporters that do not have a good track record of new product introduction, with huge depreciation of domestic currency during the financial crisis See Table 1 in Hahn(2004).

[10] They also show the evidence that more productive firms are likely to become multi-product firms. Then, one might infer, based on their results, that more-productive multi-product firms tend to self-select themselves to become exporters, although Bernard, Redding, and Schott (2006a) do not explicitly discuss this story. Although our result is apparently consistent with this selection story, it does not preclude the possibility that exporting has an effect on the

that exporters are more likely to add and drop products than non-exporters, and have larger number of products. What is more interesting is that exporters are also more likely to create and destroy products and more likely to be net-creator of products than non-exporters.

The positive cross-sectional correlations between exporting and new product introduction, which is the main focus of this paper, might reflect causality running both ways. That is, given the existence of sunk cost of entry into the export market, more able (or productive) firms which already have good track record of introducing new products are likely to self-select themselves to enter the export market. Alternatively, there is, which we call, the *creating-by-exporting* effect. That is, if the new knowledge gained through exporting improves plant's productivity or ability and/or shifts the within-plant relative profitability across products towards yet-to-be-introduced products, then by becoming exporters, plants are able to introduce new products more frequently than those plants that produce for domestic market only. In the next section, we examine whether there is a creating-by-exporting effect.

V. The Effect of Exporting on New Product Introduction

V.1 Methodology: Propensity Score Matching

In this section, we use propensity score matching procedure as explained by Becker and Ichino (2002) to estimate the effect of exporting on new product introduction. To implement this procedure we first classify all plants in the dataset during the period 1990-1998 into five sub-groups: Always, Never, Starters, Stoppers, and Other.[11] "Always" is a group of plants that were exporters in the year that they first appear in the dataset and never changed their exporting

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product scope, which seems to be an still open question. The next section of this paper explores this possibility.

[11] We confine our analysis to only those plants that do not have a split in time series observations during the period from 1990 to 1998.

status. Similarly, “Never” is a group of plants that were non-exporters in the first year they appear in the data set and never switched to exporters. “Starters” includes all plants that were non-exporters in the first year that they appear, but switched to exporters in some later year and remained as exporters thereafter. “Stoppers” consists of all plants that were exporters in the first year that they appear, and then switched to non-exporters, never switching back to exporters thereafter. “Other” is a group of plants that changed their exporting status more than twice during the sample period.

To estimate the effect of exporting on new product introduction, one natural way to proceed might be compare the performance (new product introduction in this case) of “Starters” after the export market entry with “Never”. However, it is widely acknowledged that the decision to become an exporter is not a random event but a result of deliberate choice. Specifically, the participation decision in the export market is likely to be correlated with the data generating process for a plant’s productivity. In our case, if the participation decision in the export market is correlated with the data generating process for a plant’s new product introduction, the traditional simple mean difference test on new production introduction between Starters and Never would give a biased estimate of the effect of exporting on new product introduction. Propensity score matching is a way to reduce this bias by addressing problems associated with endogenous participation decision, by comparing the outcomes using treated (starters) and control (never) subjects that are as similar as possible.

In order to assess the effect of exporting on new product introduction, what we would like to ask is the question “what would have happened to the new product introduction of starters, had they not participated in the export market?”. However, we don’t have such counterfactual observations on the outcome variable available. The basic idea underlying propensity score matching is to reproduce the counterfactual outcome of the treated (starters) had they not been treated (exported), out of the control group (never). In order to do this, the crucial assumption is that the potential outcome in the absence of the treatment is independent of the participation status.

$$y_i^0 \perp d_i \mid X_i, \tag{1}$$

where y_i^0 is the potential outcome of plant i in the absence of treatment (denoted by superscript 0), d_i is the dummy indicating export market participation, and X_i is the vector of pre-treatment characteristics. Rosenbaum and Rubin (1983) shows that if the conditional independence assumption (1) is satisfied, it is also valid for $P(X_i)$, such that

$$y_i^0 \perp d_i \mid P(X_i). \tag{2}$$

Here, $P(X_i)$ is the propensity score, which is defined as the conditional probability of receiving a treatment (becoming an exporter) given pre-treatment characteristics as follows.

$$P(X_i) \equiv \Pr(d_i = 1 \mid X_i) = E(d_i \mid X_i) \tag{3}$$

The condition (2) may reduce the dimensionality problem involved when using condition (1). Based on the estimated propensity score for each treated and control units (plants in this case), we can match a set of control units to each treated unit. Let T be the set of treated units and C the set of control units, and y_i^T and y_j^C be the observed outcomes of the treated and control units, respectively. Denote the set of control units matched to the treated unit i by $C(i)$. Also let us denote the number of control units matched with $i \in T$ by N_i^C and the number of units in the treated group by N^T. Then, the propensity score matching estimator for the average treatment effect on the treated at s years after the export market entry is given by

$$ATT_s^* = \frac{1}{N^T} \sum_{i \in T} \left(y_{i,s}^T - \sum_{j \in C(i)} w_{ij} y_{j,s}^C \right), \tag{4}$$

where $w_{ij} = 1/N_i^C$ if $j \in C(i)$ and $w_{ij} = 0$ otherwise.

In this paper, we use propensity score matching procedure written in STATA language as explained in Becker and Ichino (2002). Specifically, we use nearest matching procedure which sets $C(i)$ as follows.[12, 13]

$$C(i) = \min_{j \in C} \| p_i - p_j \| \tag{5}$$

We use probit model to estimate the propensity score, given by (3). In our baseline specification, we consider plant TFP (log of total factor productivity) as well as plant size (log of worker) and capital intensity (log of capital per worker) as pre-exporting plant characteristics, following the convention in the literature, and also include year and ten industry dummy variables. Plant TFP is the value for one year before export market participation. The outcome variable of our main interest is the cumulative count of new products of plant, CCC. In addition to CCC, we also examine whether there is an effect of exporting on product destruction (CDC), as well as product adding(CEC) and dropping(CXC). We also examine whether exporting has any effect on the number of products produced per plant (PRNOPP) which starts to export. In the

[12] Nearest neighbor matching is invoked by using **attnd.ado** procedure in Becker and Ichino (2002). Please note that one control unit is matched to each treated unit in this case. So, equation (4) above is a general formula for nearest neighbor matching and radius matching which can match multiple control units to each treated unit. We use common support option. While imposing the common support condition may improve the quality of the matches, the sample may be considerably reduced. See Becker and Ichino (2002) for further discussion on this issue.

[13] For further details of the propensity score matching methodology, see Becker and Ichino (2002).

alternative specification of the probit model for each outcome variable, we include the value of the corresponding outcome variable one year before export market participation as an additional characteristic. We expect that the lagged outcome variable contains some information on the "ability" of plants which might not be adequately captured by plant total factor productivity.[14] The average effect of exporting on starters for each outcome variable is estimated for s = 0, 1, 2, 3.

V.2 The Results

Table 9 and Table 10 show our main estimation results. For each outcome variable, we report four estimation results: the baseline specification and the alternative specification explained above, each with and without the imposition of common support restriction. Before we examine the effect of exporting on new product introduction, we first check whether the dataset can reproduce the learning-by-exporting effect that was reported by Hahn and Park (2009). The top rows of the table show that exporting has a significant and positive effect on plant productivity, and that this result is little sensitive to the common support restriction.[15]

We find some evidence suggesting that exporting promotes the new product introduction. In the baseline specification, exporting has positive and significant effects on CCC even if we impose the common support restriction. Even when $CCC_{s=-1}$ is included as an additional conditioning variable, the estimated effects of exporting on new product introduction remain still positive, although they become less significant for some years. Imposition of common support restriction changes the results little qualitatively. Taken together, the results in Table 9 are consistent with

[14] Plant TFP is measured using multilateral-chained index number approach. See Appendix 1 for details.
[15] When the outcome variable is the plant total factor productivity(TFP), the baseline and the alternative specifications are the same since the plant TFP one year before export participation is already considered as a pre-existing characteristic in the baseline specification.

the story that exporting facilitates international knowledge spillovers and raises the expected profitability of yet-to-be-introduced products, promoting new product introduction.

//Insert Table 9 about here//

Then, does exporting also promote destruction of old products as well?[16] Suppose we find that exporting not only makes a plant to introduce new products more easily but also makes that plant more likely to be the last one to drop old products. Then, we might infer that knowledge spillovers related to exporting is a plant-level productivity shock, rather than plant-product specific productivity shock, which makes the plant more productive in producing all range of products which it currently produces or could produce in the future. The results shown at the bottom rows of Table 9 do not provide a very conclusive answer to this question. Although the effects of exporting on CDC were estimated to be significant and positive for all years in the baseline specification, they were not robust to the inclusion of $CDC_{s=-1}$ as an additional pre-exporting plant characteristic. This suggests that the significant and positive effects estimated from the baseline specification mostly reflect pre-exporting differences in CDC between starter and never, which is persistent over time. Nevertheless, it should be noted that the estimated ATT with CXC as the outcome variable remains still positive for all years, and even significant when $s = 2$.

The results do not allow us to draw out a definitive conclusion on whether exporting has an effect on product adding (CEC) and product dropping (CXC), either. As shown in Table 10, the effects of exporting on CEC and CXC are estimated to be positive and significant in the baseline specification. In the alternative specification, however, the effects are estimated to be negative

[16] Accurately speaking, we are asking whether exporting makes a plant more likely to be the last one to drop a certain product, since our measure of destruction of old products, CXC, is the cumulative number of products for which the plant has been the last one holding on to produce it but dropped it eventually.

and some of them are even significant. In contrast, we find a significantly positive effect of exporting on the number of products produced per plant (PRNOPP). The effects are robust to the changes in the specification as well as to the imposition of common support restriction. This result is consistent with our earlier story that knowledge spillovers related to exporting is a plant-level positive productivity shock which raises the profitability of all products that the plant is producing or can potentially produce. In other words, exporting raises the plant's general "ability" and makes the plant to produce a larger number of products.

//Insert Table 10 about here//

V.3 Sub-group Estimation Results

So far, the effect of exporting on new product introduction was assumed to be the same across all plants that start to export. However, there might be differential treatment effects depending on the characteristics of plants. To consider this possibility, we divided the sample into several sub-groups according to plant characteristics and estimated the ATT for each sub-group using the alternative specification. As plant characteristic, we consider export intensity and skill intensity. Export intensity of the plant is the export-production ratio, while skill intensity is the share of non-production workers in total workers, the sum of production and non-production workers. According to export intensity, we divided the sample into three sub-groups: low (smaller than 10 percent), medium (between 10 and 50 percent), and high (greater than 50 percent). With regard to skill intensity, the sample was also divided into three sub-groups: low (smaller than 10 percent), medium (between 10 and 40 percent), and high (greater than 40 percent). Table 11 shows the results.

We find that the estimated effects of exporting on new product introduction tend to be most significant for the group of high export intensity. This result is consistent with the story that export-related knowledge spillovers is not free but requires costly resources so that plants with higher export intensity are more likely to incur these costs. Alternatively, this result might indicate that the effect of exporting on new production is the strongest in comparative advantage industries. Table 11 also shows that the estimated effect of exporting on new product introduction is largest and most significant for the sub-group with high skill intensity. In as much as skill intensity can be regarded as a proxy for "absorptive capacity" of a plant, this result suggests that the absorptive capacity also matters for successfully introducing new products with the help of new knowledge gained through exporting activity.[17]

//Insert Table 11 about here.//

VI. Summary and Concluding Remarks

To the best of my knowledge, this is the first study examining the relation between exporting and new product introduction. Based on propensity score matching procedure, this paper provided some evidence that exporting has an effect of facilitating new product introduction by those plants that export. The evidence suggests, however, that not only exporting activity *per se* but also the absorptive capacity of plants matter in this process. This paper also shows that the number of products produced of a plant increases as a results of exporting activity. This seems to suggest that international knowledge spillovers associated with exporting activity is a positive plant "ability" shock which makes the plant more productive not only in producing that specific product that start to be exported but also in producing a wide range of other products.

There is a wide consensus that new product introduction is an integral feature of economic

[17] These sub-group estimation results are also consistent with the results in Hahn and Park (2008), which shows that

growth process, and we showed some evidence that the Korean manufacturing sector has been no exception in this regard. If international trade, or exporting in particular, has an effect of facilitating new product introduction, then the longer-term gains from opening up to trade or lowering trade costs might be much bigger than conventionally accepted. It might be interesting to see whether the similar results obtained in other countries and time periods under different contexts. There seem to be many other interesting related issues left untouched or carelessly tackled in this paper. Further studies seem necessary.

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the effect of exporting on TFP is larger and more significant for plants with higher export and skill intensity.

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<Table 1> Basic Statistics of the Plant-Product Data

Year	Manufacturing shipments (trillion won)	Number of plants	Shipments per plant (million won)	Total number of products*	Average number of products per plant*	Average shipment per product* (million won)
1990	166.4	54725	3041.4	74932	1.37	2221.2
1991	193.1	57680	3348.0	81455	1.41	2370.8
1992	215.0	58143	3697.6	80355	1.38	2675.5
1993	234.0	68397	3552.5	94313	1.38	2576.3
1994	281.9	69645	4048.0	93568	1.34	3013.0
1995	343.2	73582	4664.8	100172	1.36	3426.5
1996	378.9	75053	5048.2	100812	1.34	3758.3
1997	408.6	71505	5713.8	97065	1.36	4209.2
1998	407.7	62458	6527.0	86215	1.38	4728.4
1999	457.4	71144	6429.6	96912	1.36	4720.0
2000	536.1	76287	7027.2	102193	1.34	5245.8

Note: * In this table, the total number of products is the sum of the number of products produced across plants, so that it is larger than the total number of products from the viewpoint of the aggregate manufacturing sector because the same product can be produced by multiple plants.

<Table 2> Distribution of Plants According to the Number of Products Produced

Year	Plants with					
	One product(%)	two products(%)	Three products(%)	Four products(%)	Five or more products(%)	Total products(%)
1990	42463 (77.6)	7735 (14.1)	2704 (5.0)	1040 (1.9)	783 (1.4)	54725 (100)
1992	44436 (76.4)	8730 (15.0)	3017 (5.2)	1149 (2.0)	811 (1.4)	58143 (100)
1994	54495 (78.3)	9853 (14.2)	3294 (4.7)	1276 (1.8)	727 (1.0)	69645 (100)
1996	59200 (78.9)	10233 (13.6)	3397 (4.5)	1244 (1.7)	979 (1.3)	75053 (100)
1998	48237 (77.2)	9075 (14.5)	3021 (4.8)	1158 (1.9)	967 (1.6)	62458 (100)
2000	60350 (79.1)	10379 (13.6)	3315 (4.4)	1236 (1.6)	1007 (1.3)	76287 (100)

<Table 3> Product Creation and Destruction Rate: Number of Product and Shipments

Period	Destruction Rate* (percent)		Creation Rate* (percent)	
	Number of products	Shipments	Number of products	Shipments
90-98	23.0	14.6	40.9	28.7
90-94	15.3	7.4	31.5	21.0
94-98	12.6	10.7	17.1	14.7

Note: * The creation rate during a period is the share of created products in all products at the end year while the destruction rate during a period is the share of destroyed products in all products at the beginning year. The table shows both unweighted shares and weighted (by shipments) shares.

<Table 4> Decomposition of the Aggregate Manufacturing Growth: by Product Type

Period	Aggregate Shipments Growth A (A=b+c+d)	Continuing Product B	Product Created C	Product Destroyed D	Net Creation E (E=c+d)
90-94 (%)	69.4 (100.0)	41.3 (59.5)	35.5 (51.2)	-7.4 (-10.6)	28.1 (40.6)
94-98 (%)	44.6 (100.0)	34.0 (76.3)	21.2 (47.6)	-10.7 (-23.9)	10.5 (23.7)
90-98 (%)	144.9 (100.0)	89.2 (61.5)	70.3 (48.6)	-14.6 (-10.1)	55.7. (38.5)

Note: Growth rates are not annualized.

<Table 5> Decomposition of the Aggregate Growth: by Product and Plant Type

Period	Aggregate Shipments Growth	Continuing Product			
		Continuing Plant	Entering Plant	Exiting Plant	Sub Total
	a=e+h+k	b	c	c	E=b+c+d
90-94 (%)	69.4 (100)	29.8 (42.9)	27.9 (40.2)	-16.4 (-23.6)	41.3 (59.5)
94-98 (%)	44.6 (100)	30.2 (67.8)	22.4 (50.1)	-18.6 (-41.6)	34.0 (76.3)
90-98 (%)	144.9 (100)	59.5 (41.0)	55.3 (38.2)	-25.6 (-17.7)	89.2 (61.5)

Period	Product Creation			Product Destruction			Net Creation		
	Continuing Plant	Entering Plant	Sub Total	Continuing Plant	Exiting Plant	Sub Total	Continuing Plant	Entering& Exiting Plant	Sub Total
	f	G	h=f+g	i	j	k=i+j	l=f+i	m=g+j	N=h+k
90-94 (%)	25.5 (36.8)	10.0 (14.3)	35.5 (51.2)	-6.2 (-9.0)	-1.2 (-1.6)	-7.4 (-10.6)	19.3 (27.8)	8.8 (12.7)	28.1 (40.6)
94-98 (%)	17.2 (38.5)	4.0 (9.1)	21.2 (47.6)	-8.2 (-18.3)	-2.5 (-5.6)	-10.7 (-23.9)	9.0 (20.2)	1.5 (3.5)	10.5 (23.7)
90-98 (%)	41.1 (28.4)	29.2 (20.2)	70.3 (48.6)	-9.2 (-6.3)	-5.4 (-3.8)	-14.6 (-10.1)	31.9 (22.1)	23.8 (16.4)	55.7. (38.5)

Note: Growth rates are not annualized.

<Table 6> Product Creation and Destruction Activity by Plants

(unit: %)

Plant Activity	90-94	94-98	90-98
Creation and Destruction			
Unweighted			
None	65.1	83.5	54.8
(Number of plants)	(18060)	(23795)	(8307)
Destruction	5.2	3.5	6.7
(Number of plants)	(1441)	(999)	(1012)
Creation	23.7	6.5	26.4
(Number of plants)	(6558)	(1840)	(4003)
Creation & Destruction	6.0	6.5	12.1
(Number of plants)	(1663)	(1843)	(1837)
Total	100	100	100
(Number of plants)	(27722)	(28477)	(15159)
Weighted by Shipment			
None	42.1	67.5	33.7
Destruction	9.5	4.6	6.5
Creation	24.3	9.1	22.0
Creation & Destruction	24.1	18.8	37.8
Total	100	100	100
ADD & Drop			
Unweighted			
None	26.3	36.1	21.1
(Number of plants)	(7285)	(10273)	(3205)
Drop	5.4	5.9	5.2
(Number of plants)	(1499)	(1680)	(783)
Add	5.9	7.1	5.7
(Number of plants)	(1631)	(2018)	(863)
Add & Drop	62.4	50.9	68.0
(Number of plants)	(17307)	(14506)	(10308)
Total	100	100	100
(Number of plants)	(27722)	(28477)	(15159)
Weighted by Shipment			
None	13.0	18.9	10.2
Drop	7.2	8.5	5.6
Add	7.7	8.4	7.3
Add & Drop	72.1	64.2	76.9
Total	100	100	100

<Table 7> Exporter Premia

(unit: %)

	Estimated exporter premia		
	No control	Industry & region controlled	Industry , region & size controlled
1994			
Employment(person)	112.6	108.3	
Shipments(million won)	178.9	174.6	47.0
Production per worker(million won)	66.8	66.8	47.2
Value-added per worker(million won)	34.1	34.2	23.3
TFP	4.4	4.4	3.8
Capital per worker(million won)	56.0	51.4	34.5
Non-production worker/total employment(percent)	17.9	24.3	22.7
Average wage(million won)	12.8	15.2	9.7
Average production wage(million won)	8.9	11.9	8.3
Average non-production wage(million won)	22.6	23.0	8.7

Note: All co-efficient are significant at 1 percent level.

<Table 8> Exporter Premia: Product Creation and Destruction, etc..

(unit: product)

	Estimated exporter premia		
	No control	Industry & region controlled	Industry , region & size controlled
1991			
CCC	0.07***	0.05***	0.01
CDC	0.01***	0.00***	-0.00
CEC	0.14***	0.14***	-0.01
CXC	0.12***	0.13***	-0.02
PRNOPP	0.25***	0.33***	-0.02
1993			
CCC	0.11***	0.09***	0.01
CDC	0.04***	0.02***	-0.01
CEC	0.53***	0.54***	0.01
CXC	0.48***	0.47***	-0.01
PRNOPP	0.29***	0.36***	0.00
1995			
CCC	0.16***	0.15***	0.03***
CDC	0.09***	0.08***	0.02***
CEC	0.95***	0.95***	0.14***
CXC	0.97***	0.96***	0.14***
PRNOPP	0.29***	0.33***	0.02*
1997			
CCC	0.22***	0.17***	0.04***
CDC	0.13***	0.10***	0.02***
CEC	1.24***	1.18***	0.15***
CXC	1.24***	1.15***	0.13***
PRNOPP	0.30***	0.33***	0.03***

Note: Coefficients with asterisks are significant at 1%(***), 5%(**), and 10%(*) level.

<Table 9> The Effects of Exporting on Product Creation and Destruction

Outcome variable	Probit model specification	Common support restriction	Number of treated units	s=0	s=1	s=2	s=3
lnTFP		No	6806	0.057*** (0.008)	0.068*** (0.009)	0.076*** (0.011)	0.060*** (0.009)
		Yes	5797	0.056*** (0.008)	0.068*** (0.009)	0.076*** (0.011)	0.059*** (0.014)
CCC	Baseline	No	6806	0.068*** (0.011)	0.060*** (0.013)	0.574*** (0.068)	0.072*** (0.019)
		Yes	5797	0.067*** (0.011)	0.060*** (0.015)	0.571*** (0.085)	0.072*** (0.030)
	Alternative	No	6806	0.032** (0.014)	0.026* (0.015)	0.867*** (0.063)	0.012 (0.020)
		Yes	3506	0.052*** (0.017)	0.016 (0.024)	0.855*** (0.111)	0.005 (0.044)
CDC	Baseline	No	6806	0.039*** (0.009)	0.043*** (0.011)	0.504*** (0.060)	0.047*** (0.016)
		Yes	5797	0.038*** (0.009)	0.044*** (0.013)	0.499*** (0.081)	0.049* (0.028)
	Alternative	No	6806	0.001 (0.010)	0.014 (0.011)	0.823*** (0.044)	0.013 (0.011)
		Yes	3232	0.001 (0.014)	0.014 (0.018)	0.813*** (0.096)	0.014 (0.034)

Note: Numbers in parenthesis are standard errors. Coefficients with asterisks are significant at 1%(***), 5%(**), and 10%(*) level.

<Table 10> The Effects of Exporting on Product Adding, Dropping, and Product Scope

Outcome variable	Probit model specification	Common support restriction	Number of treat units	s=0	s=1	s=2	s=3
CEC	Baseline	No	6806	0.600*** (0.035)	0.543*** (0.048)	0.137*** (0.010)	0.719*** (0.082)
		Yes	5797	0.599*** (0.039)	0.539*** (0.056)	0.137*** (0.009)	0.711*** (0.130)
	Alternative	No	6806	-0.002 (0.045)	-0.433*** (0.057)	-0.007 (0.013)	-0.186*** (0.069)
		Yes	3506	-0.020 (0.070)	-0.490*** (0.114)	-0.008 (0.018)	-0.337 (0.229)
CXC	Baseline	No	6806	0.602*** (0.034)	0.498*** (0.044)	0.081*** (0.008)	0.644*** (0.079)
		Yes	5797	0.601*** (0.037)	0.493*** (0.054)	0.082*** (0.006)	0.636*** (0.121)
	Alternative	No	6806	-0.017 (0.042)	-0.501*** (0.043)	0.026*** (0.011)	-0.853*** (0.047)
		Yes	3232	-0.037 (0.070)	-0.550*** (0.109)	0.026*** (0.010)	-1.001*** (0.241)
PRNOPP	Baseline	No	6806	0.006 (0.019)	0.032 (0.025)	0.081*** (0.030)	0.120*** (0.035)
		Yes	5797	0.006 (0.021)	0.031 (0.030)	0.081** (0.040)	0.118** (0.056)
	Alternative	No	6806	0.061*** (0.020)	0.068*** (0.026)	0.162*** (0.030)	0.259*** (0.036)
		Yes	3587	0.064** (0.027)	0.065* (0.039)	0.158*** (0.049)	0.251*** (0.067)

Note: Numbers in parenthesis are standard errors. Coefficients with asterisks are significant at 1%(***), 5%(**), and 10%(*) level.

<Table 11> The Average Effects of Exporting: Sub-group Estimation Results

Firm Characteristics			s = 0	s = 1	s = 2	s = 3
Export Intensity	Low	ATT	0.043 (0.031)	-0.054 (0.041)	1.103*** (0.172)	-0.138** (0.068)
		No. Treated No. Controls	1565 1457	1565 548	1565 367	1565 247
	Medium	ATT	-0.038 (0.030)	-0.041 (0.044)	0.758*** (0.172)	0.016 (0.080)
		No. Treated No. Controls	1117 768	1117 386	1117 248	1117 157
	High	ATT	0.047* (0.028)	0.059* (0.036)	0.788*** (0.184)	0.160** (0.076)
		No. Treated No. Controls	813 553	813 300	813 184	813 119
Skill Intensity	Low	ATT	0.017 (0.036)	-0.034 (0.048)	0.409** (0.195)	-0.158 (0.098)
		No. Treated No. Controls	576 240	576 126	576 75	576 49
	Medium	ATT	0.019 (0.022)	-0.027 (0.027)	0.823*** (0.126)	-0.071 (0.051)
		No. Treated No. Controls	2128 1645	2128 884	2128 571	2128 370
	High	ATT	0.120*** (0.042)	0.181*** (0.052)	1.338*** (0.228)	0.080 (0.131)
		No. Treated No. Controls	802 615	802 303	802 179	802 116

Note: Numbers in parenthesis are standard errors. Coefficients with asterisks are significant at 1%(***), 5%(**), and 10%(*) level.