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How do Export Pioneers Emerge and How are They Related to Product Creators?

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In this paper, we empirically examine how export pioneers emerge and how they are related to product creators/innovators, utilizing a rich plant-product level dataset from the Korean manufacturing sector for the period of 1990-1998. Our analysis covers the process from the appearance of product creators as well as product imitators to the emergence of export pioneers. We find, first, that product imitators are larger, more productive and older than product creators. Second, most export pioneers are nevertheless found to be product creators. This result is largely due to the fact that almost all export pioneers export the products in the same year as product creation. Third, there are similarities as well as differences between product creators and export pioneers. Plants that are more productive or larger are more likely to become product creators as well as export pioneers. However, previous exporting experience positively affects the probability of export pioneering only, while plants' engagement in R&D positively affects the probability of product creation only. We discuss possible explanations for our main empirical results as well as their policy implications.

Key Word: Export Pioneer, Product Innovation, Imitation
JEL Code: F14, F63, O47

I. Introduction

Many developing countries try to develop new export industries as a key element of their development strategy. Korea is not an exception. During the past few decades since the growth take-off in the 1960s, Korea has experienced the continuous diversification of her export product portfolio and has witnessed the appearance of new export industries. In order for a new export industry to appear, there should be an export pioneer: the first firm which exports a product for the first time in a country. A small but growing number of studies are paying attention to the role played by these entities in the economic development of a country. Most of these

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studies examined whether export pioneers generate positive spillover upon the entry of export followers. One issue which is at least as important as the issue of export spillover to understand the process of new export industry development is, however, how export pioneers are born. This is the main question addressed in this paper. There are, however, surprisingly few existing studies that seek to answer this question.

If a product is to be exported for the first time in an economy, it should exist in the first place via product innovation/creation. That is, if an export pioneer is to emerge, there should be a product creator, the first firm that produces a product for the first time in a country. Thus, one natural starting point for examining the process of the emergence of export pioneers would be the product creation stage.

In this paper, we examine empirically the overall dynamic process, from the birth of product creators to the emergence of export pioneers, utilizing a plant-product level micro-dataset for Korean manufacturing. Specifically, we try to identify plant characteristics which affect firm behaviors along the various stages of this process. We are particularly interested in asking what type of plants are more likely to become product creators or export pioneers and in examining how these two types of plants are related to each other.

Do we have any reason to expect that export pioneers and product creators are more or less the same firms? Standard theories of heterogeneous firms in international economics, such as that by Melitz (2003) and its various extensions (e.g., Arkolakis, 2010; Eckel and Neary, 2010), would predict that firms with higher productivity and hence a larger size are likely to be those that produce and export a certain product for the first time in the economy. Having higher productivity rates, these firms will face larger expected profits from product creation/innovation and export pioneering and, hence, would be more willing to incur the sunk cost of product development as well as the sunk cost of exporting before other firms with lower expected profits. Viewed in light of these theories, export pioneers and product creators are expected to be the same entities.

There are also reasons, however, for expecting that the characteristics of export pioneers and product creators may be different. After a firm creates a product, imitators or followers may start to produce the same product. Again, standard theories of heterogeneous firms would predict that product creators are more productive and, hence, larger than product imitators. That is, creators created a product before others because they are more productive. However, Wagner and Zahler (2015) shows that this is not the case. Using Chilean data, they analyze export market entry by export pioneers and export followers and find that export pioneers are smaller than export followers. With regard to this result, they argue that export pioneers that are good at exploration may be worse than export followers at exploitation or scaling up — producing the export-pioneered product on a larger production scale. One theoretical explanation provided by Wagner and Zahler (2015) for why export followers are larger (and more productive) than the export pioneer is as follows. In the face of uncertainty in the export profitability of a product, export pioneers appear randomly out of a plant productivity distribution. Once the export profitability of the product is revealed to be high due to the trial of the export pioneer, the most productive firms then react by self-selecting and entering the market for this product.[1] In our view,

[1]For a more detailed explanation, see Wagner and Zahler (2015).

arguments similar to those of Wagner and Zahler (2015) can be made with regard to the case of product creators and product imitators; product imitators are more productive and larger than product creators. Indeed, this is what we find in this paper. It should be noted that export pioneers can emerge not only from product creators but also from product imitators, at least conceptually. In view of the empirical findings and arguments by Wagner and Zahler (2015), it is possible for product imitators, which are more productive and larger than comparable product creators, to become export pioneers. Under this scenario, export pioneers may differ from product creators.

In this paper, we empirically examine how export pioneers emerge and how they are related to product creators/innovators, utilizing a rich plant-product level dataset from the Korean manufacturing sector for the period of 1990-1998. Our analysis covers the process from the appearance of product creators as well as product imitators to the emergence of export pioneers. We find, first, that product imitators are larger, more productive and older than product creators. Second, most export pioneers are nevertheless found to be product creators. This result largely stems from the fact that almost all export pioneers export the product in the same year as product creation. Third, there are similarities as well as differences between product creators and export pioneers. Plants that are more productive or larger are more likely to become product creators as well as export pioneers. However, previous exporting experience positively affects the probability of export pioneering only, while plants' engagement in R&D positively affects the probability of product creation only. We discuss possible explanations for our main empirical results as well as their policy implications.

There are several interesting findings in this paper. First, we find that imitators of created products are larger and more productive than the product creators, consistent with the findings of Wagner and Zahler (2015) but somewhat at odds with standard theories of heterogeneous firms. Second, we find that almost all export pioneers come from product creators, in spite of the above finding of product imitators being larger and more productive than product creators. This seemingly paradoxical result is largely due to the fact that almost all export-pioneer-product-creators are those which exported the created product in the same year as product creation, leaving no time for more productive imitators to become export pioneers. We provide an explanation for this finding in section 5. Third, we find that plants that are more productive or larger are more likely to become product creators and export pioneers. There are, however, some interesting differences in the characteristics between export pioneers and product creators. Previous exporting experience positively affects the probability of export pioneering only, while plants' engagement in R&D positively affects the probability of product creation only. We discuss how these results shed light on policy again in section 5.

Our paper is related to the existing literature in several ways. First, the paper is closely related to a small but growing body of literature on export discovery/pioneering. Hausmann and Rodrik (2003) argue that self-discovery of what one is good at producing, which corresponds to product creation in our paper, is key to the economic growth of developing countries; they show theoretically that there is too little self-discovery and too much imitation, as self-discovery is easily imitated. They provide some empirical evidence using trade data consistent with their theory. Several subsequent papers have examined whether there is spillover, either

technological or informational, from export pioneering. Iacovone and Javorcik (2010) present evidence from Mexico that export-pioneered products are quickly followed by other firms. Wagner and Zahler (2015) show, using detailed Chilean data, that the probability of export followers' entry into the export market increases if export pioneers survive more than one year of exporting. Other studies examine the issues of how export pioneers are born, as in our study. Freund and Pierola (2010) and Artopoulos, Friel, and Hallak (2013) document an important role of export pioneers in the emergence of a new export industry in Peru and Argentina, respectively. However, these studies rely on descriptive analysis or use case studies of ex-post successful export-pioneering episodes. In contrast, Hahn *et al*. (2018) examines empirically how export pioneers are born starting from the time of the first production of a product, utilizing a plant-product dataset for Indonesian manufacturing. Our paper utilizes a comprehensive dataset of manufacturing plants and products for Korean manufacturing, and provides systematic econometric evidence on the process from product creation to export pioneering as in Hahn *et al*. (2018). Our paper is most clearly differentiated from Hahn *et al*. (2018) in that our paper is focused on comparing the characteristics of product creators with those of export pioneers based on implications of existing theories. Second, our study is related to the earlier studies of firm-level exporting activity, such as those by Clerides, Lach, and Tybout (1998), Bernard and Jensen (2004), Eaton, Kortum, and Kramarz (2004; 2011), and Feenstra and Kee (2008), among others.[2] Again, our paper is differentiated from these studies in that it examines how a firm exports a product for the first time in the economy starting from the production of the product for the first time in the economy.

This paper is organized as follows. In the next section, we explain and describe our data. Section 3 provides our empirical evidence of the process from product creation to the appearance of product imitators. Section 4 discusses our empirical results on the emergence of export pioneers. Section 5 provides a further discussion of our main empirical results as well as their policy implications. The final section concludes the paper.

II. Data, Definition, and Some Basic Facts

A. *Data*

This study utilizes two datasets. The first dataset consists of plant-level census data from the *Mining and Manufacturing Census* published by Statistics Korea. During the sample period, the dataset covers all plants with five or more employees in the mining and manufacturing industries. We use data on the manufacturing industries. It is an unbalanced panel dataset with about 70,000 to 100,000 plants for each year from 1990 to 1998.[3] For each year, the value of production, shipments,

[2]Because there is a considerable body of literature on this topic, we will not provide a comprehensive survey of the literature here. For this literature, see Wagner (2007) and Bernard *et al*. (2011).

[3]It appears that the plant-product dataset used in this study exists for the 2000s and 2010s inside Statistics Korea. I have asked Statistics Korea many times to allow me to access the datasets for 2000s and 2010s. However, the replies from Statistics Korea have always been that due to changes in internal regulations which took place during the 2000s, they cannot release information on exports (and R&D) either at the plant level or at the product

and tangible fixed assets as well as the number of production and non-production workers are available. The second dataset is an unpublished plant-product dataset by Statistics Korea for the same period, which provides information on the value of total and export shipments for each plant-product observation. We can calculate the value of the domestic shipments of a plant-product by subtracting export shipments from total shipments. The two datasets can be merged using the plant identification number. The plant-product dataset covers approximately 70 to 80 percent of plants in the plant dataset depending on the year. The plant identification code and product code are consistent over time within the sample period.[4]

B. *Definitions*

The plant-product dataset has an eight-digit product code, which we use to identify a *product*. The total number of distinct products with a positive value of shipments increases from 2,531 in 1990 to 3,351 in 1997 and then decreases to 3,299 in 1998. A product can be produced by multiple plants. For example, a mid-sized passenger car can be produced by both Hyundai and Kia. Each plant-product is a *product variety* such that the Sonata is one product variety and the K7 is another product variety of the same product, i.e., a mid-sized passenger car. The total number of product variety instances in our dataset increases from 74,932 in 1990 to 100,812 in 1996, after which it decreases to 86,215 in 1998.

We define *product creation* or *creation* as the production of a certain product for the first time in the economy. The *product creator* or *creator* is the plant which creates a product. Given that a product can be created by more than one plant, there can be multiple product creators of one *created product*. To use these definitions in our analysis, we need to provide an operational definition of a created product. A created product is a product which did not exist in our dataset during the period of 1990-1991 and that began to be produced by some plant(s) during the period of 1992-1998. For example, if a product is produced in 1992 for the first time in an economy, it is considered to be a product created in 1992. After a product is created in a certain year, other plants may also begin to produce that product eventually, a situation defined with the terms *product imitation* or *imitation*. A *product imitator* or an *imitator* defines the plant which begins imitative production of the product after 1992. Accordingly, a product imitator may have produced the imitated product for the first time from the viewpoint of the plant but not from the viewpoint of the economy. *Export pioneering* is defined as the exporting of a certain product for the first time in an economy. The terms *export pioneer* and *export-pioneered product* can be defined analogously. Operationally, in this case an export-pioneered product is a product which did not exist in the export market in 1990-1991 and began to be exported by some plant(s) during the years 1992-1998. As with the created product,

level. Without this information, a study like this would not be feasible. In fact, I do have access to plant-product data up to 2002. However, I was not able to use the information for the period from 1999 to 2002 due to a major industrial classification change. Given that the first five digits of the eight-digit product code are industry classification code, the product classification scheme also changed with the change in the industrial classification scheme. This is why I confined my analysis to the period of 1990-1998, during which the product codes are consistent over time.

[4]For a more detailed description of the datasets, see Hahn (2012). The author obtained the datasets from Statistics Korea when the author was a researcher at the Korea Development Institute. I am grateful to Statistics Korea for allowing access to these datasets.

there can be multiple export pioneers of one export-pioneered product.

C. *Basic Facts*

Table 1 shows the number of created and export-pioneered products for each year from 1992 to 1998. The total number of created products during that period is 980. The number of created products per year varies considerably over the years, with a low of 44 in 1996 and a high of 225 in 1997. The total number of export-pioneered products during the same period is 1,283. The corresponding yearly figures show a low of 88 in 1996 and a high of 281 in 1992. The numbers of export-pioneered products tend to be higher than those of created products, as the export-pioneered products can arise from those products which are not created products, i.e., those products that already existed during the period 1990-1991, and also because the number of such non-created products tends to be large relative to the number of created products.

The industries for which the numbers of created or export-pioneered products are largest are the communication equipment, machinery and equipment, and chemical industries. However, the number of created or export-pioneered products may be large simply because the number of product categories in these industries would be large. Accordingly, in the second and fourth columns of Table 2, we also show the number of created or export-pioneered products as the share of the total number of product categories in the corresponding industry. Then, we find that office and computing machinery, communication equipment, and apparel are the industries for which the shares of created products are largest.[5] The industries for which the shares of export-pioneered products are the largest are office and computing machinery, communication equipment, and apparel. Thus, Table 2 is broadly consistent with the perception that the growth of the Korean manufacturing sector in the 1990s was driven by active product innovation and export pioneering in computing machinery and communication equipment.

TABLE 1—NUMBER OF CREATED AND EXPORT-PIONEERED PRODUCTS

Year	Number of products	
	Created	Export-pioneered
1992	178	281
1993	180	245
1994	76	125
1995	84	121
1996	44	88
1997	225	211
1998	193	212
Total	980	1,283

Source: Author's own calculation.

[5]Tobacco is the industry for which the shares of created or export-pioneered products are among the largest, but we do not want to emphasize this because there are only four product categories in this industry. A similar point can be made for the recycling industry.

TABLE 2—INDUSTRY DISTRIBUTION OF CREATED AND EXPORT-PIONEERED PRODUCTS

KSIC 2-digit code	Name	Created products		Export-pioneered products		Industry total products
		No. of products	Share of industry products	No. of products	Share of industry products	No.
		A	=(A/Y)*100	B	=(B/Y)*100	Y
15	Food and beverage	58	15.3	123	32.5	378
16	Tobacco	2	50.0	3	75.0	4
17	Textiles	45	16.7	60	22.3	269
18	Apparel	64	41.3	58	37.4	155
19	Leather and footwear	5	7.9	10	15.9	63
20	Wood and wood products	5	6.0	23	27.7	83
21	Pulp and paper	28	27.2	34	33.0	103
22	Publishing and printing	5	10.9	7	15.2	46
23	Petroleum	4	11.8	6	17.6	34
24	Chemical	93	20.6	127	28.2	451
25	Rubber and plastics	11	8.1	16	11.9	135
26	Non-metallic mineral	32	18.6	49	28.5	172
27	Basic metal	41	16.5	63	25.4	248
28	Fabricated metal	42	16.3	54	20.9	258
29	Machinery and equipment	135	19.4	220	31.7	695
30	Office and computing machinery	60	60.0	57	57.0	100
31	Electrical machinery	56	31.1	62	34.4	180
32	Communication equipment	178	54.9	160	49.4	324
33	Precision instruments	35	22.3	43	27.4	157
34	Automobile	22	30.6	23	31.9	72
35	Other transport equipment	25	27.5	32	35.2	91
36	Furniture	34	13.7	51	20.5	249
37	Recycling	0	0.0	2	66.7	3
Total	All manufacturing	980	23.0	1,283	30.0	4,270

Source: Author's own calculation.

As explained above, when a product is created, it can be created by multiple plants. Figure 1 show the distribution of 980 created products according to the number of product creators. The greatest number of products created by a single plant is 208, which accounts for nearly 21 percent of all created products in this case. The number of created products decreases as the number of simultaneous creators increases. For example, there are 117 products which were created by two

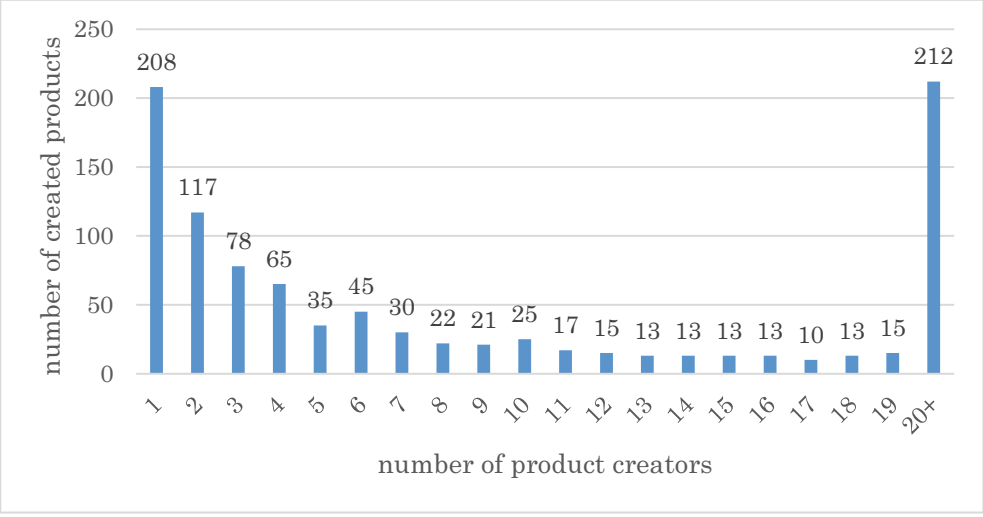


FIGURE 1. DISTRIBUTION OF CREATED PRODUCTS ACCORDING TO THE NUMBER OF PRODUCT CREATORS

plants in the same year. However, 212 created products have more than 20 creators.

When product creators produce created products, do they produce them for the domestic market only, for both the domestic and export markets, or for the export market only? In other words, what does the distribution of created products according to the initial shipment destination look like? We attempt to answer this question from the two standpoints of created "products" and created "product varieties." Table 3 shows that there are 19,690 created product varieties for 980 created products.[6] In terms of product varieties, most (about 84 percent) created product varieties are produced for the domestic market only in the year they were initially produced. Some of the plants which produce these created product varieties may become export pioneers in the future, but they are not export pioneers at least during the first year of production. What captures our attention in Table 3 is that the remaining 3,245 created product varieties (16 percent) are exported during the very first year of production. Among them, 2,512 created product varieties (about 13 percentage points) are produced for both the domestic and export market, while the remaining 733 created product varieties are exported, bypassing the domestic market, in the first year of production. Given our definition of export pioneers, these 3,245 plants are export pioneers. This implies that these plants became both a product creator and an export pioneer in the same year. In other words, for these created product varieties, the export pioneers are the product creators themselves. Moreover, these created product varieties did not require any time lag between product creation and export pioneering. In terms of products, approximately 65 percent of the created products are exported by some plants in the year the product was created.[7] This feature of the data has an import implication which we will discuss in section 5.

[6]As explained above, more than one plant can create the same product in the same year; therefore, the total number of created product varieties exceeds the total number of created products.

[7]The share of exported products in the first year of production is much larger than the share of exported product varieties because, due to plant heterogeneity, only a subset of plants will export the same created product.

TABLE 3—SHIPMENTS DESTINATION OF CREATED PRODUCT VARIETIES AND CREATED PRODUCTS

Destination	Created product varieties		Created products	
	Number	(share)	Number	(share)
Domestic only	16,445	(83.52)	341	(34.8)
Domestic and export	2,512	(12.76)	632	(64.49)
Export only	733	(3.72)	7	(0.71)
Total	19,690	(100.0)	980	(100.0)

Source: Author's own calculation.

III. From Product Creation to Imitation

After products or product varieties are created, they go through a selection process; some of them survive and others cease to be produced over time. For some created products, product imitators appear. Export pioneers will emerge from the pool of product creators and product imitators. In this section, we examine the dynamic process from the appearance of product creators to the appearance of product imitators. In the next section, we will examine how export pioneers emerge. In doing so, we are mainly interested in identifying plant-level determinants of plants' behaviors at various stages of this dynamic process, which helps us to understand how export pioneers are related to product creators.

A. *Who will become product creators?*

What types of plants are likely to become product creators? To answer this question, we estimate the following probit model.

$$\begin{aligned}&\Pr(Product\ Creator_{ijt} = 1 \mid X_{ijt-1})\\ &= \Psi(\beta_1 \ln TFP_{ijt-1} + \beta_2 \ln Worker_{ijt-1} + \beta_3 Exporter_{ijt-1} + \beta_4 Innovator_{ijt-1} +\\ &\quad \beta_5 \ln Age_{ijt-1} + \beta_6 Multi_{ijt-1} + \beta_7 \ln KI_{ijt-1} + \beta_8 \ln SI_{ijt-1} + \gamma_1 XRatio_{jt-1} +\\ &\quad \gamma_2 HHI_{jt-1} + \gamma_2 R\&DInt_{jt-1} + u_j + u_t)\end{aligned}$$

$Product\ Creator_{ijt}$ is an indicator variable which equals 1 if plant i in industry j creates a product variety in year t, equaling 0 otherwise. $\ln TFP$ is plant total factor productivity (log)[8], $\ln Worker$ is the number of workers (log), $Exporter$ is an dummy variable which equals one if a plant has a positive export shipments and zero otherwise, Innovator is a dummy variable which equals one if a plant has a positive R&D expenditure and zero otherwise, $\ln Age$ represents the age of the plant, $Multi$ is a dummy variable which equals one if a plant is a multiproduct plant and zero otherwise, $\ln KI$ is the capital intensity of the plant (=tangible fixed

[8]We estimated plant total factor productivity using the methodology of Levinsohn and Petrin (2003) according to the two-digit KSIC industry.

assets/workers, log), and $\ln SI$ is a proxy for skill intensity (=non-production workers/total workers, log). We additionally include time-varying industry characteristics as controls, in this case the industry exports-shipments ratio (*XRatio*), the Herfindahl-Hirschman index (*HHI*), and the industry R&D intensity (*R&DInt* = R&D/shipments). All independent variables are lagged by one year to address the endogeneity issue. We also introduce industry and year fixed effects. The sample includes all plant-year observations from 1992 to 1998 in five-digit industries for which there are product creators. However, we dropped observations of product creators after product creation so as to mitigate the problem of reverse causality.

Table 4 shows that plants that are productive, large, or engaged in R&D are more likely to become a product creator, which is not at all surprising. If product creation requires innovation activity and if there are financial market imperfections, large, productive, R&D-engaged plants are likely to be in a better position to introduce a product for the first time in the economy. There is no evidence, however, that previous

TABLE 4—WHO WILL BECOME PRODUCT CREATORS?

Explanatory variable	[1]	[2]
lpln*TFP*	0.0022***	0.0021***
	(0.0008)	(0.0008)
ln*Worker*	0.0029***	0.0033***
	(0.0004)	(0.0004)
Exporter	-0.0001	0.0003
	(0.0010)	(0.0010)
Innovator	0.0023**	0.0046***
	(0.0011)	(0.0012)
ln*Age*	-0.0003	-0.0006
	(0.0004)	(0.0005)
Multiprp	0.0143***	0.0119***
	(0.0008)	(0.0008)
ln*KI*	0.0001	-0.0014***
	(0.0004)	(0.0004)
ln*SI*	0.0018***	0.0001
	(0.0007)	(0.0007)
XRatio	-0.0039	-0.0044
	(0.0041)	(0.0030)
HHI	0.0271***	0.0713***
	(0.0056)	(0.0042)
R&D Intensity	0.0476**	0.2242***
	(0.0231)	(0.0209)
Industry Dummy	KSIC 5 dgt	KSIC 3dgt
Year Dummy	Yes	Yes
No. Obs.	226,796	235,558
Log likelihood	-26,359.75	-31,637.07
Pseudo R^2	0.2333	0.1283

Note: Estimated marginal effects. The numbers in parenthesis are robust standard errors. ***, **, and * indicates that the estimated coefficient is significant at the 1, 5, and 10 percent level, respectively.

Source: Author's own calculation.

exporting experience helps plants to create products, as suggested by the insignificant *Exporter* variable. With regard to the industry characteristics, *HHI* and *R&DInt* are estimated to be significantly positive, indicating that product creation is more likely in industries which are more concentrated or are technologically sophisticated.

Table 3 indicates that some product varieties are created and exported in the same year. This implies that the characteristics of *some* export pioneers are identical to those of the product creators, shown in Table 4. However, this does not warrant us to infer, based on Table 4, that export pioneers are also more likely to be large, productive plants engaged in R&D given that export pioneers can emerge not only from product creators but also from product imitators. We postpone examining what types of plants become export pioneers out of a pool of product creators and imitators until the next section.

B. *Survival of Created Product Varieties and Created Products*

After products or product varieties are created, they go through a selection process of survival. Figure 2 shows the production duration of 2,275 product varieties and 178 products created in 1992. What is most noteworthy in Figure 2 is that approximately half of the created product varieties are produced for only one year and then disappear. After three years, about 67 percent of the created product varieties stop being produced. Only about 20 percent of the created product varieties survive longer than five years. In terms of created products, the figure shows a pattern which is quite different, understandably, from the previous one. Although some created products completely disappear from the economy within the first several years, most (about 84 percent) of the created products survive for more than five years. The difference in survival patterns between created products and the created product varieties indicates that there is some selection among the plants which created the same product, which is most likely more important than selection

[2,275 product varieties created in 1992]

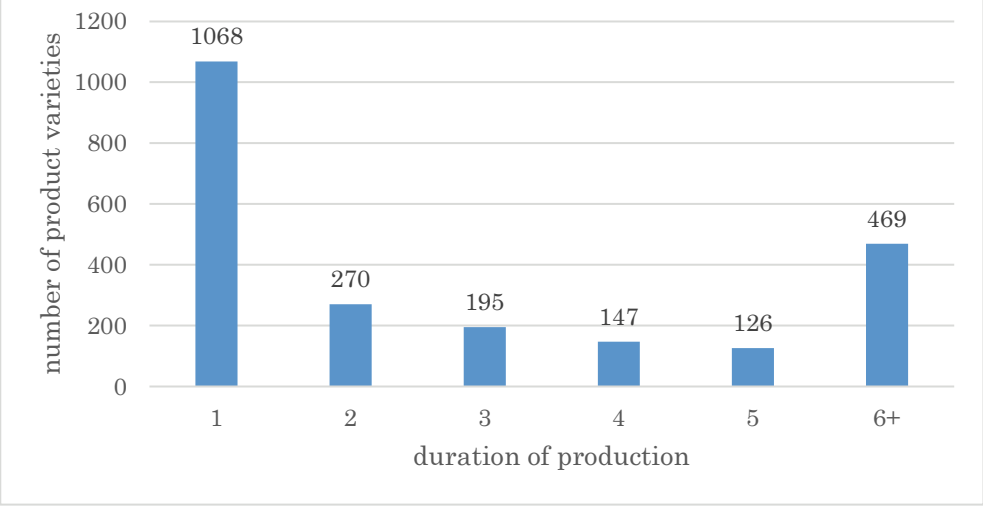


FIGURE 2. PRODUCTION DURATION OF CREATED PRODUCT VARIETIES AND PRODUCTS

[178 products created in 1992]

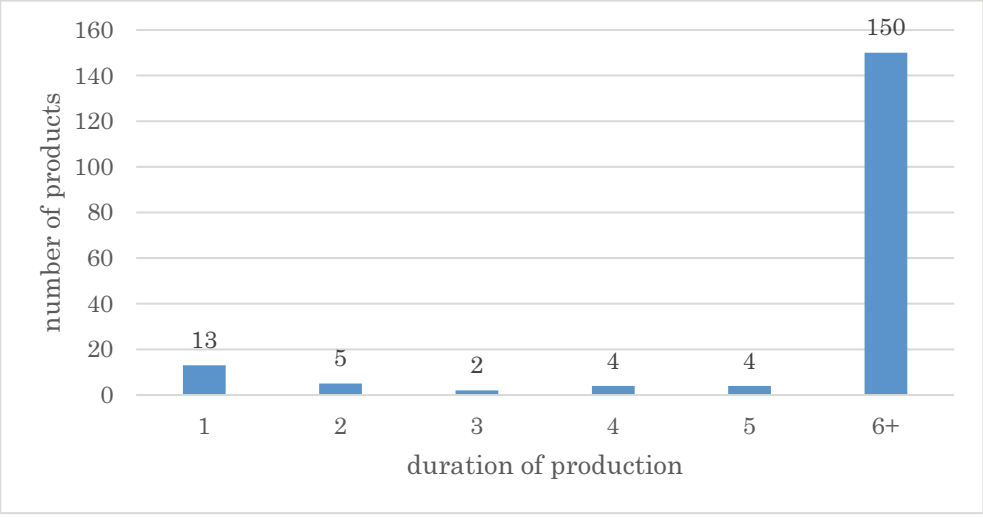


FIGURE 2. PRODUCTION DURATION OF CREATED PRODUCT VARIETIES AND PRODUCTS (CONT'D)

Source: Author's own calculation.

among products. For each product possibly created by multiple plants, a strong force of selection is working among plants, but most created products continue to be produced by a small number of survivors even after five years. Motivated by this observation, we further explored the plant-level characteristics determining the probability of survival for more than one year for the created product varieties by estimating a probit model with the same explanatory variables presented in Table 4 using the full sample of created product varieties, which we do not report here. We find that product varieties created by large, old, exporting plants are more likely to survive for more than one year.

C. *When does the first imitator appear and how many imitators are there?*

Export pioneers may emerge not only out of product variety creators but also out of product variety imitators. Thus, we examine here when the first imitator appears after the appearance of a product variety creator. Table 5 shows the distribution of 980 created products according to the creation year and the first imitation year. The first imitator appears very quickly. For nearly 75 percent of created products, the first imitator appears merely one year after product creation. In the case of cohorts of products created in 1992 and 1993, approximately 90 percent those products are imitated within five years. The fact that most created products are imitated within a short period of time suggests that export pioneers can emerge out of product imitators as well as product creators if the product creators do not export the created product varieties immediately. Specifically, plants which created the 16,455 product varieties produced for the domestic market only in the first year of production, as shown in Table 3, may lose their chance of becoming export pioneers due to the quick appearance of imitators.

TABLE 5—WHEN DOES THE FIRST IMITATOR APPEAR?

Created in	Imitated first in							
	1993	1994	1995	1996	1997	1998	Not followed	Total
1992	132	11	12	3	2	2	16	178
1993		136	17	6	0	6	15	180
1994			54	9	4	3	6	76
1995				59	8	3	14	84
1996					36	3	5	44
1997						171	54	225
1998							193	193
Total	132	147	83	77	50	188	303	980

Source: Author's own calculation.

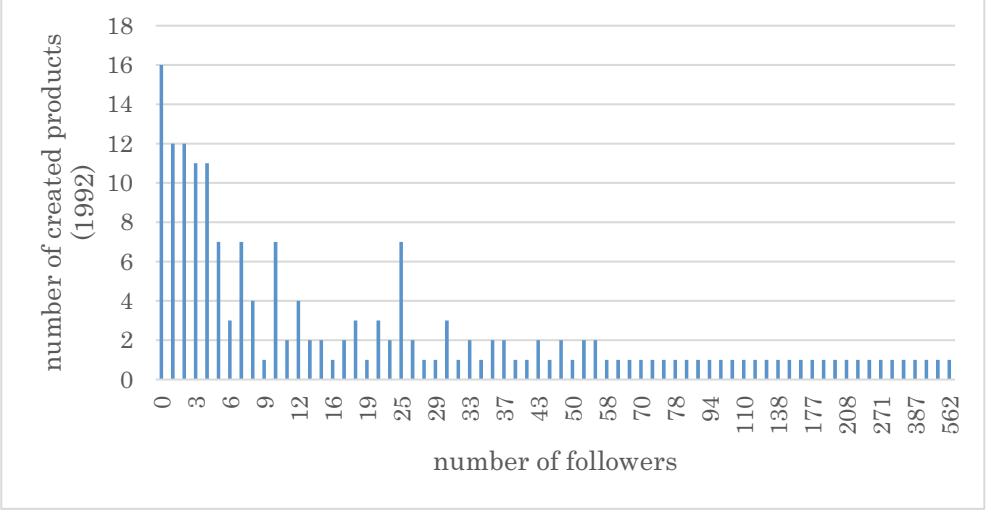


FIGURE 3. DISTRIBUTION OF 178 PRODUCTS CREATED IN 1992 ACCORDING TO THE NUMBER OF IMITATORS

Source: Author's own calculation.

After the creation of products, increasing numbers of imitators, if any, may appear over time and a new industry will be formed. One may wonder how many followers appear. Among the 178 products created in 1992, close to 30 percent of them have five or fewer imitators while about 42 percent have ten or fewer imitators. It is interesting, however, to note that there are more than one hundred imitators for a small subset of created products.

D. *Characteristics of imitators vis-à-vis creators*

How do the characteristics of imitators compare with those of product creators? Are imitators larger, more productive, older, and/or more capital- or skill-intensive, for example, than product creators? Answering these questions may help us to understand the emergence of export pioneers, as export pioneers can appear out of imitators as well as creators. First, we constructed a sample of product creators and product imitators for all created product. For each creator and imitator, we kept

observations only for the year when product creators created products and product imitators imitated products. Using this sample, we ran the following simple regressions.

$$C_{ipt-1} = \gamma_0 + \gamma_1 Imitator_{ip} + u_p + u_t + \varepsilon_{ipt}$$

Imitator is a dummy variable which takes a value of one if plant i producing a created product p is a product imitator and zero if they are a product creator. The characteristics of plants are those for one year before the product creation or imitation. We included product and year fixed effects. Table 6 shows the estimated coefficients of the imitator dummy variable.

The table shows that there are some differences between creators and imitators in terms of plant characteristics one year before creation/imitation and that the characteristics of imitators relative to pioneers change as they start producing those products. For the year before creation/imitation, imitators are found to be significantly more productive and larger than creators, as shown in the first two rows of the table. These results may seem surprising and somewhat at odds with what would be predicted by standard theories of heterogeneous firms in international economics, as pioneered by Melitz (2003); firms that are more productive and hence larger are more likely to be the pioneers. However, this result parallels the findings of Wagner and Zahler (2015) with regard to export pioneers and export followers.

TABLE 6—CHARACTERISTICS OF IMITATORS IN COMPARISON WITH CREATORS

Dependent Variable	Plant characteristics at t-1	
	Coefficients	No. Obs.
lpln*TFP*	0.0693***	26,725
	(0.0159)	
ln*Worker*	0.0756***	26,797
	(0.03)	
Exporter	0.0132	26,797
	(0.0099)	
Innovator	0.0105	26,797
	(0.0087)	
ln*Age*	0.0423*	25,763
	(0.0222)	
Multiprp	-0.0196*	26,797
	(0.011)	
ln*KI*	0.1079***	26,785
	(0.0269)	
ln*SI*	0.0127	22,321
	(0.0143)	
Product fixed effect	Yes	
Year fixed effect	Yes	

Note: The numbers in parenthesis are robust standard errors. ***, **, and * indicates that the estimated coefficient is significant at the 1, 5, and 10 percent level, respectively.

Source: Author's own calculation.

They find using detailed Chilean Customs exports data that export pioneers export less than comparable followers for the same new export product for Chile. Their explanation for this finding is that firms that are good at exploration (creation) may have a comparative disadvantage at producing (scaling up) so that export followers that are good at scaling up export more than comparable pioneers. One theoretical explanation provided by Wagner and Zahler (2015) for why export followers are larger (and more productive) than export pioneer is as follows. In the face of uncertainty in the export profitability of a product, export pioneers appear randomly out of a plant productivity distribution. Once the export profitability of a product is revealed to be high due to the trial of the export pioneer, the most productive firms then react by self-selecting and entering the export market of this product.[9] Our results suggest that a mechanism similar to that provided for export market entry by Wagner and Zahler (2015) may also be working in product creation/imitation; plants that are good at exploring (creation) may be different from plant that are good at producing and scaling up (imitation).[10] Table 6 also shows that imitators tend to be older and have more capital-intensive production structures than creators. The former result suggests that plants that are good at exploration are likely to be younger plants. The latter result appears to be consistent with our explanation above that imitators are those that have a comparative advantage at scaling up.

IV. The Emergence of Export Pioneers

At this stage, we examine how export pioneers emerge. We start by documenting when export pioneers appear for created products.

A. *When do Export Pioneers Appear?*

We have shown in Table 1 that 980 products were created in various years during our sample period. Then, for each cohort of created products, when does the export pioneer appear? Table 7 shows the distribution of the created products according to the year of product creation and the year of export pioneering. First, most created products are exported for the first time in the economy, i.e., export-pioneered, during the sample period. Specifically, 792 created products (about 80 percent) were exported for the first time from the viewpoint of the economy during our seven-year sample period. Table 1 shows that there are 1,283 export-pioneered products which are either created or non-created products. Accordingly, we find that a majority (about 62 percent) of the export-pioneered products are those products which were created during our sample period. Second and more interestingly, one clear tendency is that when created products are first exported, they are exported during the same year they were created. For these products, there is no time lag between product creation and export pioneering. Specifically, 639 products (65 percent) out of 980

[9]For a more detailed explanation, see Wagner and Zahler (2015).

[10]Another reason for imitators being larger than creators may be that larger and older firms are more likely to perform process innovation rather than product innovation and that imitation requires the capability of process innovation. I am thankful to an anonymous referee for this interpretation.

TABLE 7—FOR CREATED PRODUCTS, WHEN DO EXPORT PIONEERS APPEAR?

Created in	First exported in								
	1992	1993	1994	1995	1996	1997	1998	Not exported	Total
1992	98	21	11	6	4	2	5	31	178
1993		111	16	6	6	8	3	30	180
1994			42	10	2	4	2	16	76
1995				52	11	4	2	15	84
1996					28	5	0	11	44
1997						158	25	42	225
1998							150	43	193
Total	98	132	69	74	51	181	187	188	980

Source: Author's own calculation.

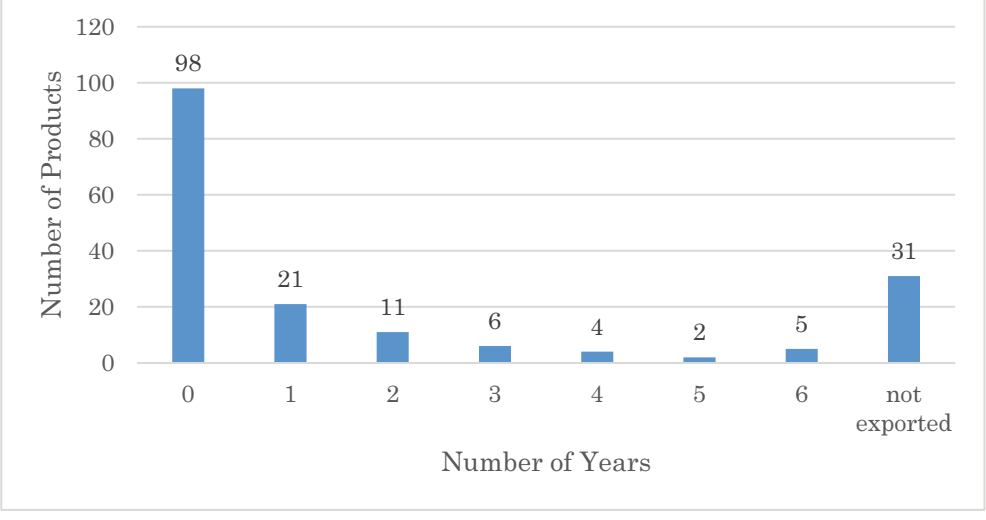


FIGURE 4. NUMBER OF YEARS FROM PRODUCT CREATION TO EXPORT PIONEERING FOR 178 PRODUCTS CREATED IN 1992

Source: Author's own calculation.

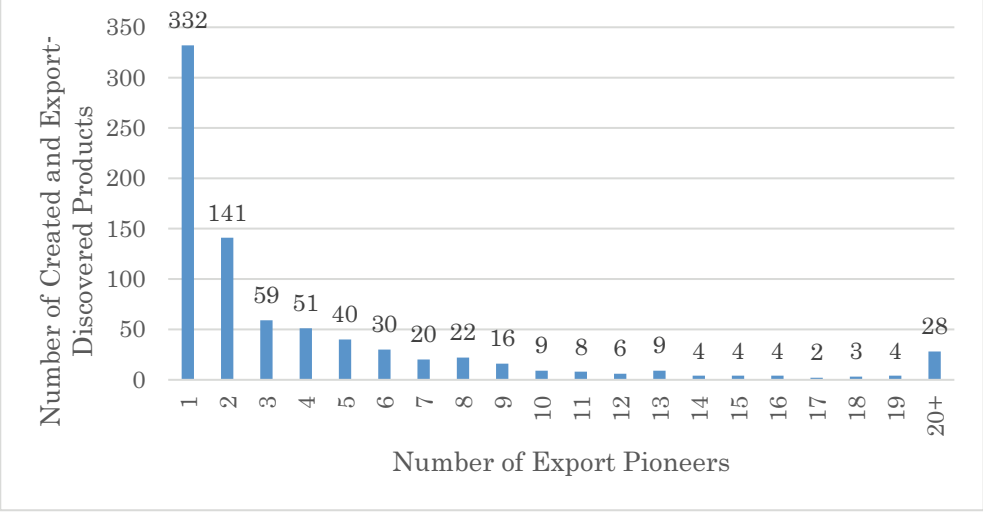
created products are exported the very year they were created.[11] There are some created products which are first exported with a time lag, but these are relatively few. Figure 3 shows the distribution of 178 products created in 1992 according to the number of years it takes from product creation to export pioneering. Here, 98 products are initially exported during the year of product creation. We see a clear tendency in that the number of emerging export pioneers decreases as the time lag between product creation and export pioneering increases. For those products for which product creation and export pioneering occurred during the same year, export pioneers are the same entity as the product creators. For those products for which export pioneering occurred with a time lag after product creation, we cannot tell whether product creators or product imitators became export pioneers.

[11]This result was discussed previously, as shown in Table 1.

B. *How many export pioneers are there?*

When a created product is first time exported, is this generally done by a single plant or by multiple plants? Figure 5 show the distribution of export-pioneered products according to the number of export pioneers. The upper figure shows the distribution for 792 "created and export-pioneered" products. However, according to our definition of an export-pioneered product, export-pioneered products can arise not only from created products but also from those products for which we do not

[792 Created and Export-Pioneered Products]



[1,283 Export-Pioneered Products]

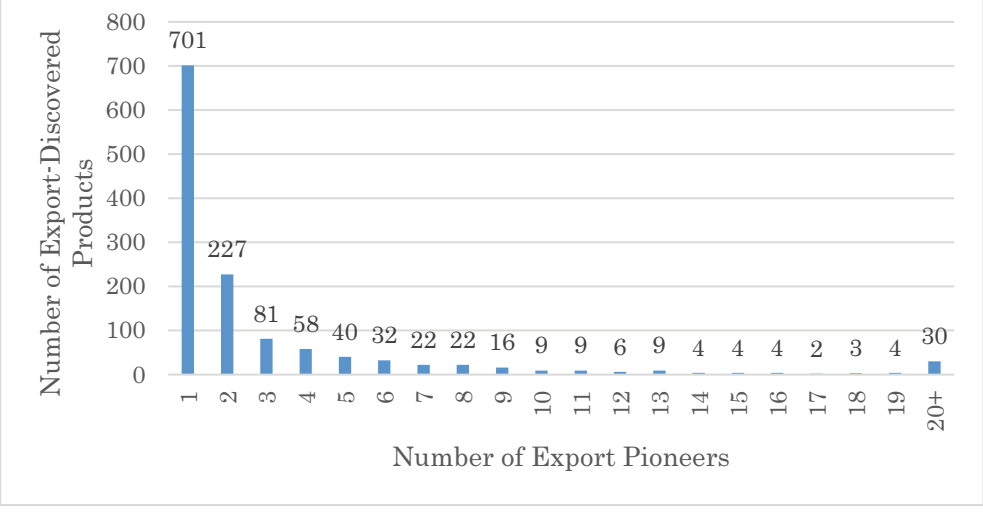


FIGURE 5. DISTRIBUTION OF EXPORT-PIONEERED PRODUCTS ACCORDING TO THE NUMBER OF EXPORT PIONEERS

Source: Author's own calculation.

have information about the creation year, i.e., non-created products. The number of export-pioneered products from among the non-created products is 491, meaning that the total number of export-pioneered products identified for our sample period is 1,283 (= 792+491). The lower figure shows the distribution for the 1,283 export-pioneered products according to the number of export pioneers (plants).

We find that roughly half of the export-pioneered products were pioneered by a single plant. The number of export-pioneered products tends to become small quickly as the number of export pioneers become larger. However, there are some products for which twenty or more plants simultaneously exported a product for the first time in the economy.

We have shown above that some created products are instantly exported while others are exported with some time lag. We have also shown that some created products are export-pioneered by a single plant while others are export-pioneered by multiple plants at the same time. One can therefore ask what factors determine how soon a created product is exported and what factors determine how many export pioneers simultaneously begin exporting a given created product. To address the former question first, we focus on several industry characteristics, specifically those factors presented in Table 4 of section 3. First, we constructed a sample of products created during the period of 1992-1995. Then, for each created product, we kept one observation for the year in which that product was exported for the first time in the economy. Using this sample, we estimated the probit model below.

$$\begin{aligned}&\Pr(Export\ Pioneered_p = 1 \mid X_{jt-1}) \\ &= \Psi(\gamma_1 XRatio_{jt-1} + \gamma_2 HHI_{jt-1} + \gamma_2 R\&DInt_{jt-1} + u_t)\end{aligned}$$

Here, $Export\ Pioneered_p$ takes a value of one if product p was first exported within n years after its creation and zero if it was first exported after n years. We set n equal to 0 or 2, which makes two separate dummy variables. The independent variables are the same industry characteristics used in Table 4, i.e., $XRatio$, HHI, and $R\&DInt$, which are measured at the five-digit industry level to which the product belongs.[12] We take the values of these industry characteristics one year prior to the product being export-pioneered. Because the calendar year for export-pioneering differs across products, we include year fixed effects.

Table 8 shows the estimated marginal effects. We find that the industry export ratio as well as the industry concentration ratio matter with regard to how soon a created product is first exported. We also find that a created product is more likely to be exported for the first time within two years, specifically when the industry export ratio is higher. To the extent that the industry export ratio captures the strength of the comparative advantage of the industry, this result suggests that when plants create a product in industries for which a country has a stronger comparative advantage, they are likely to bring it to the export market sooner. We also find that when a product is created in a more concentrated industry, it is less likely to be exported for the first time soon. One interpretation of this result could be that the incentive to export a created product early is weak in concentrated industries because

[12]The first five digits of the eight-digit product code make up the industry code to which the product belongs.

TABLE 8—WHEN DO EXPORT PIONEERS APPEAR AND HOW MANY APPEAR?

	Dependent variable		
	Export-discovered after creation within		No. export pioneers
	0 year	2 years	(2 years)
	Probit		OLS
Explanatory variable	[1]	[2]	[4]
Export ratio	0.4011***	0.2425***	0.4998**
	(0.0986)	(0.0897)	(0.2170)
HHI	-0.4481***	-0.4112***	-1.3595***
	(0.1048)	(0.0814)	(0.2285)
R&D Intensity	2.1320**	1.2418	2.1203**
	(0.9952)	(0.8066)	(0.8566)
Year Dummy	Yes	Yes	Yes
No. Obs.	498	498	381
Log pseudolikelihood	-311.52	-252.85	
Pseudo R^2	0.0668	0.0687	
R^2			0.0735

Note: The numbers in the first two columns are the estimated marginal effects from the probit model. The numbers in the third column are the estimated coefficients. The numbers in parenthesis are robust standard errors. ***, **, and * indicates that the estimated coefficient is significant at the 1, 5, and 10 percent level, respectively.

Source: Author's own calculation.

the competition pressure is weak. The industry R&D intensity variable is estimated to be positive but either only marginally significant or insignificant.

C. *Where do export pioneers come from?*

Thus far, we have provided various types of evidence about the process from product creation to the emergence of export pioneers. Conceptually, although we have already shown in Table 3 that approximately 65 percent of created products are instantly exported the year that they are created by some plant(s), export-pioneering plants or export pioneers can emerge not only from product creators but also from product imitators, with or without a time delay after product creation/imitation. Export pioneers can also emerge for products for which we cannot identify when they were produced for the first time in the economy. Here, we attempt to summarize how many export pioneers there are in our sample and where they come from. To do this, we count the total number of export pioneer plants and examine the corresponding distribution according to the plant type. There are five types of export pioneers: export pioneers that exported a created product in the same year as product creation (creator-pioneer without a delay), export pioneers that exported a created product with some time lag after product creation (creator-pioneer with a delay), export pioneers that exported an imitated product in the same year as product imitation (imitator-pioneer without a delay), export pioneers that exported an imitated product with some time lag after product imitation (imitator-pioneer with a delay), and finally export pioneers that exported a non-created product for the first time in the economy (pioneer of non-created product). Figure 6 shows the distribution.

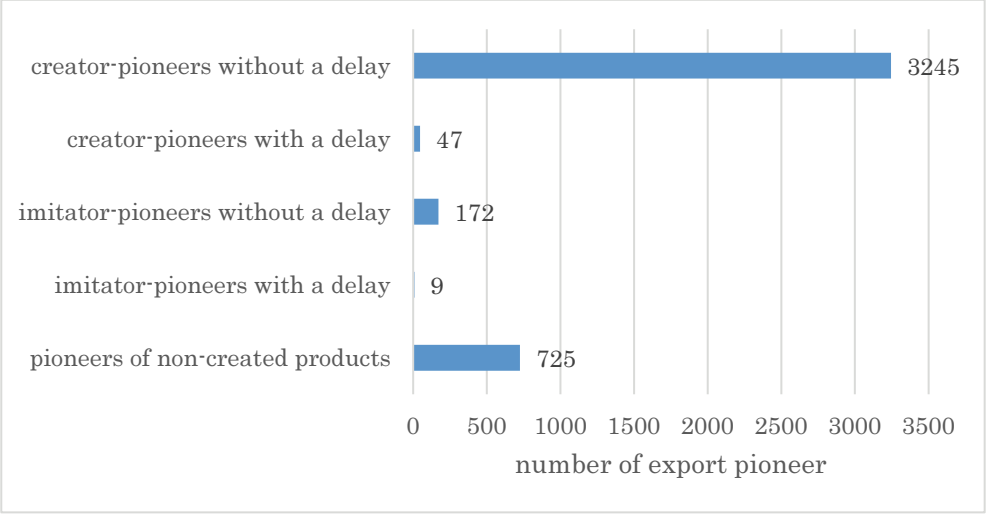


FIGURE 6. WHERE DO EXPORT PIONEERS COME FROM?

Source: Author's own calculation.

There are 4,198 export pioneer plants in total identified in our sample according to our definition. This number is greater than the total number of export-pioneered products, 1,283, in Table 1, as it is possible for multiple plants simultaneously to become export pioneers of the same product. What is most interesting and surprising in Figure 6 is that a predominant portion of export pioneers, approximately 77 percent of them (3,245 plants), are *creator-pioneers without a delay*.[13] There are only 47 plants that are creator-pioneers with a delay. Thus, there is a clear tendency for most product creators that become export pioneer ex post to have brought the created products to the export market instantly. Another interesting and surprising finding is that there are only a few export pioneers born from product imitators; there are only 172 imitator-pioneers without a delay and nine imitator-pioneers with a delay. In short, first, most export pioneers come from product creators, not from product imitators, and, second, most export pioneers created and exported the product in the same year. We consider this result as one of our main empirical findings. We postpone until the next section a discussion of our conjecture of the cause behind these findings, as well as their implications.

D. *Who will become export pioneers?*

As the final step in our empirical analyses, we examine the types of plants that are likely to become export pioneers. One of the key questions raised in this paper is how export pioneers are related to product creators. To address this question, we attempted to clarify the process from product creation to the emergence of export pioneers. To do so, we started by asking what types of plants are more likely to become product creators and found that plants that are productive, large, or engaged

[13]Hahn *et al*. (2018) finds a similar result for Indonesia.

in R&D are more likely to become a product creator. We also found from Figure 6 that a predominant portion of export pioneers come from product creators such that export pioneer plants are almost a subset of product creator plants. The question therefore arises as to what types of plants are likely to become export pioneers. To answer this question, we estimate the following probit model.

$$\begin{aligned}&\Pr(\textit{Export Pioneer}_{ijt} = 1 \mid X_{ijt-1})\\ &= \Psi(\beta_1 \ln TFP_{ijt-1} + \beta_2 \ln Worker_{ijt-1} + \beta_3 Exporter_{ijt-1} + \beta_4 Innovator_{ijt-1} +\\ &\quad \beta_5 \ln Age_{ijt-1} + \beta_6 Multi_{ijt-1} + \beta_7 \ln KI_{ijt-1} + \beta_8 \ln SI_{ijt-1} + \gamma_1 XRatio_{jt-1} +\\ &\quad \gamma_2 HHI_{jt-1} + \gamma_2 R\&DInt_{jt-1} + u_j + u_t)\end{aligned}$$

$\textit{Export Pioneer}_{ijt}$ is an indicator variable which equals 1 if plant i in industry j export-pioneers a product variety in year t, equaling 0 otherwise. All independent variables are the same ones shown in Table 3 and are lagged by one year to address the endogeneity issue. We also introduce industry and year fixed effects. The estimated marginal effects are shown in Table 9.

We find that plants that are more productive or larger in size are more likely to become an export pioneer.[14] This result is consistent with what is implied by the results of Melitz (2003) and the various extensions of their findings. According to these theories, more productive and hence larger firms are likely to be the first to enter the export market. We also find that plants which have previous exporting experience are more likely to be export pioneers. If there exist plant-specific sunk costs of export market entry, as in Melitz (2003), such as setting up distribution channels or establishing buyer-supplier relationships, which plants with previous exporting experience have already paid and do not have to pay again, it is expected that existing exporters will realize higher ex-ante export profitability of a created product compared to those that do not have previous exporting experience.

Then, how do the plant-level determinants of becoming export pioneers compare with those of becoming product creators? There are some similarities as well as differences, which are likely to be important to understand the connection between export pioneers and product creators. Plant productivity and plant size positively affect both the probability of becoming an export pioneer and the probability of becoming a product creator. The fact that there are some similarities between the two sets of determinants would not be surprising given our finding from Figure 6 that most export pioneers are creator-pioneers without a delay.

More interesting are the differences in the plant-level determinants between Table 4 and Table 9. First, the *exporter* dummy variable, which was not significant in Table 4, is significantly positive in Table 9. The presence of plant fixed sunk costs of entry into the export market may explain this result because plants which have previous exporting experience and hence, have paid the sunk cost do not have to pay the cost again when they attempt to export a new created product. Second, the *innovator*

[14]Table 8 shows results with industry fixed effects at the five-digit or three-digit industry level in columns 1 and 2. The two results are somewhat different, but we assign more weight to the results with five-digit level industry fixed effects given that three-digit industries are considered to be overly broad for our purposes.

TABLE 9—WHO WILL BECOME EXPORT PIONEERS?

Explanatory variable	[1]	[2]
lpln*TFP*	0.0012***	0.0008
	(0.0005)	(0.0005)
ln*Worker*	0.0040***	0.0035***
	(0.0003)	(0.0002)
Exporter	0.0168***	0.0168***
	(0.0006)	(0.0006)
Innovator	0.0007	0.0016***
	(0.0006)	(0.0006)
ln*Age*	-0.0002	-0.0001
	(0.0003)	(0.0003)
Multiprp	0.0031***	0.0031***
	(0.0005)	(0.0005)
ln*KI*	0.0007***	0.0003
	(0.0002)	(0.0002)
ln*SI*	0.0014	0.0011***
	(0.0004)	(0.0004)
XRatio	0.0027	0.0015
	(0.0025)	(0.0018)
HHI	-0.0011	0.0143***
	(0.0033)	(0.0024)
R&D intensity	0.0123	0.0409***
	(0.0148)	(0.0121)
Industry Dummy	KSIC 5 dgt	KSIC 3dgt
Year Dummy	Yes	Yes
No. Obs.	201,546	215,718
Log pseudolikelihood	-9,860.23	-10,962.58
Pseudo R^2	0.2693	0.1980

Note: Estimated marginal effects. The numbers in parenthesis are robust standard errors. ***, **, and * indicates that the estimated coefficient is significant at the 1, 5, and 10 percent level, respectively.

Source: Author's own calculation.

dummy variable, which was significantly positive in determining the probability of becoming a product creator, is not significant, although it is positive, in determining the probability of becoming an export pioneer. We discuss the policy implications of these differences in the next section.

As the final analysis of this paper, we examined the determinants of the probability of a plant becoming a *creator-pioneer without a delay*. To do this, we constructed a sample of product creators and kept observations only for the year of product creation. Then, we used the same explanatory variables presented in Table 9 with values for one year before product creation and estimated the probability, $\Pr(\textit{Creator-pioneer without a delay}_i)$. $\textit{Creator-pioneer without a delay}_i$ takes a value of one if a plant becomes a creator-pioneer without a delay in the next year and zero if it becomes a product creator which does not export the created product in the year of product creation. The estimated marginal effects are shown in Table 10. The result in Table 10 is similar to the result in Table 9 in that plant productivity,

TABLE 10—WHO WILL BECOME CREATOR-PIONEERS WITHOUT A DELAY?

Explanatory variable	[1]	[2]
lpln*TFP*	0.0137**	0.0108*
	(0.0060)	(0.0056)
ln*Worker*	0.0313***	0.0275***
	(0.0034)	(0.0033)
Exporter	0.3026***	0.3094***
	(0.0061)	(0.0056)
Innovator	0.0122	0.0114
	(0.0095)	(0.0092)
ln*Age*	-0.0022	-0.0024
	(0.0043)	(0.0042)
Multiprp	-0.0436***	-0.0494***
	(0.0076)	(0.0073)
ln*KI*	0.0007	0.0024
	(0.0033)	(0.0031)
ln*SI*	0.0057	-0.0007
	(0.0056)	(0.0054)
XRatio	0.1330***	0.1839***
	(0.0346)	(0.0253)
HHI	-0.1409***	-0.0806**
	(0.0499)	(0.0346)
R&D intensity	-0.1558	-0.6886
	(0.2614)	(0.2225)
Industry Dummy	KSIC 5 dgt	KSIC 3dgt
Year Dummy	Yes	Yes
No. Obs.	10,181	10,706
Log pseudolikelihood	-3,648.59	-3,920.18
Pseudo R^2	0.3532	0.3274

Note: Estimated marginal effects. The numbers in parenthesis are robust standard errors. ***, **, and * indicates that the estimated coefficient is significant at the 1, 5, and 10 percent level, respectively.

Source: Author's own calculation.

plant size, and the exporter dummy are positively and significantly estimated. This is somewhat expected given that most export pioneers are creator-pioneers without a delay. Conditional on plants being would-be product creators, those which bring the created product to the export market instantly are likely to be experienced exporters.

V. Further Discussions and Implications for Policy

In this section, we discuss further some of our main empirical findings. Then, we discuss policy implications drawn out from our paper's results. In section 4, we showed by Figure 6 two results: first, most export pioneers come from product creators, not from product imitators, and, second, most export pioneers created and exported the product in the same year. These two results are closely related because if *all* export pioneers created and exported the product in the same year, there cannot

be any imitators which become export pioneers because imitators of a created product, by our definition, can only appear at least one year after the product has already been exported. Accordingly, the result which needs an explanation the most is that finding that most export pioneers create and export the product in the same year. Although a formal theory would be needed to explain this result rigorously, we leave this task to future researchers. Instead, we give some conjectures, based on our intuition, for the causes of this result.

When a firm (or a plant) creates a product and if it intends to export the product, it has in principle the choice between exporting it immediately and exporting it sometime later. Suppose that there exists a fixed cost of export pioneering. Then, the decision to export this product will be determined by comparing the fixed cost with the expected future export profit from this product. Suppose also that there is learning associated with production experience of the created product in the domestic market such that the marginal cost of production decreases as the length of domestic production increases. If we rule out the possibility of imitation, the product creator will choose the optimal timing for exporting the product. Exporting the product earlier will give the firm an export profit stream from earlier on, but the amount of the expected profit will be smaller due to the unexploited learning potential. In contrast, if the firm decides to export the product sometime later, it can earn larger current flows of export profits but their present value may become smaller due to the discount. Now suppose that there is a positive probability of the entry of imitators. Imitators, if they succeed in product imitation, also have the choice of entering the export market as well either earlier or later. If the imitators decide to enter the export market as well sometime later, the expected export market profits of the product creator will be reduced. Thus, the possibility of the future entry of imitators not only into the domestic market but also into the export market will tilt the incentive of the product creator toward exporting the created product earlier so that it can enjoy first-mover advantage at least temporarily. As we have shown in Table 5, the first imitator appears very quickly; for about 75 percent of created products, the first imitator appears only one year after product creation. Moreover, this and other subsequent imitators may also decide to enter the export market as export followers. Then, if the creator is to enjoy the first-mover advantage in the export market, it must export the created product not long after product creation. This could be one possible explanation of the prevalence of creator-pioneers without a delay.

Another possible reason for the prevalence of creator-pioneers without a delay may be related to the "experimentation and learning" motive of new exporters, as in Albornoz *et al*. (2012). Motivated by the empirical findings by Eaton *et al*. (2008) and Besedes and Prusa (2006) that there is a prevalence of short-lived trade relationships in the trade data, Albornoz *et al*. (2012) builds a theoretical model of sequential exporting. In that model, when firms are uncertain about their export profitability and if the export profitability is correlated across time and destination markets, firms may use their initial export experience to draw out information about export profitability in other markets. This experimentation and learning motive of initial exports can explain why firms initiate initial exports in spite of the high probability of failure. If the initial exporting is driven by experimentation or testing motive, firms may decide to test earlier rather than later when they have a new product which can potentially be exported.

At this point, we discuss some policy implications from the empirical findings of our paper. We have shown that most export pioneers nearly form a subset of product creators. We have also shown that there are two differences between plant-level determinants of product creation (Table 4) and plant-level determinants of export pioneering (Table 9). That is, while previous exporting experience positively affects the probability of becoming an export pioneer, it does not have any significant effect on the probability of becoming a product creator. In contrast, while the innovator dummy variable does not have any significant effect on the probability of becoming an export pioneer, it affects positively the probability of becoming a product creator. We focus our discussion on possible policies to promote the emergence of export pioneers.[15]

To the extent that most export pioneers are product creators, promoting product creators would certainly help export pioneers to emerge. However, this is not likely to be enough. As we have shown, previous exporting experience also helps product creators to become export pioneers. In this regard, for an effective policy of promoting export pioneers, policies to support product creation/innovation need to be complemented by policies to increase the number of exporters by, for example, supporting would-be first-time exporters. In a similar vein, increasing the number of exporters is not likely to be very effective for inducing more export pioneers to emerge because, as we have shown, if a plant is to become an export pioneer, it has to be a product creator in the first place. Increasing the number of exporters may be desirable given the existence of the various plausible benefits from firms' exporting activities which free markets cannot be expected to deliver. In sum, the empirical evidence presented here suggests that a possible export-pioneer promotion program must include both the promotion of product creation/innovation and factors that increase the number of exporters that are linked together somehow.[16]

VI. Summary and Concluding Remarks

In this paper, we empirically examined how export pioneers emerge and how they are related to product creators/innovators, utilizing a rich plant-product level dataset from the Korean manufacturing sector for the period of 1990-1998. In so doing, we examined the process from the appearance of product creators to the emergence of export pioneers and attempted to identify plant-level determinants during the various decisions of plants during this process. The main empirical findings of our paper are as follows. First, most export pioneers are product creators which export the created

[15]Although a growing number of studies document positive externalities from export pioneers to followers, I am not aware of any countries, including Korea, with a separate policy package targeted the promotion of export pioneers. For example, existing export promotion programs in Korea, such as information provision, marketing assistance and access to finance at favorable terms, do not differentiate between export pioneers and export followers. Nevertheless, it may be worthwhile to discuss a conceptual policy framework for promoting export pioneers equipped with the evidence provided by our paper.

[16]Another way of promoting export pioneers may be to introduce a policy targeting directly would-be export pioneers, those which export a product for the first time in the economy. I do not devote much space to discussing this type of policy, not because such a policy lacks rationale but because I did not discuss in detail the rationale for such a policy in this paper. See Hahn (2019) and Wagner and Zahler (2015) for evidence of positive spillover generated by export pioneers for Korea and Chile, respectively.

product in the same year of product creation. Second, plants that are more productive or larger are more likely to become product creators and export pioneers. Previous exporting experience positively affects the probability of export pioneering only, while plants' engagement in R&D positively affects the probability of product creation only. We discussed possible explanations for our main empirical results as well as their policy implications.

There are several limitations of this paper. First, although we provided a couple of possible explanations for the prevalence of export pioneers which export the created product in the same year of creation, a formal theoretical explanation may be warranted, which we leave for a future study. Second, due to data availability issues, our analysis was confined only to Korea and our sample period was limited to 1990-1998. It may be interesting to examine whether similar results can be found for a more recent period for Korea or for a broader set of countries. Finally, it may be worthwhile to examine the dynamics of export pioneers themselves after they are born. We leave this also as a future study.

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