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ON THE MEASURMENT OF EXPORT VARIETY: EVIDENCE FROM KOREA AND TAIWAN

KICHUN KANG*

This paper sheds some light on measure of export variety and features the geographical spread of a country's export varieties to the worldwide countries. First this paper constructs measures of export variety that are consistent with an underlying constant-elasticity of substitution (CES) aggregator function to compare export varieties from a country to its many destination countries. Second this paper shows how exports to different destination markets shows a distinct pattern with greatest variety to the wealthier and larger markets, following by exports of those products to other countries.

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I. INTRODUCTION

The endogenous growth models by Romer (1990) and Grossman and Helpman (1991) feature the creation of new products and their effect on economic growth. Several empirical papers[1] have provided significant

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* Korea Institute for Industrial Economics & Trade, 206-9 Cheongyangni-dong Dongdaemun-gu Seoul Korea 130-742. Phone: 82-19-9410-0529. Email: kichunkang@hotmail.com. I am particularly grateful to Professor Robert Feenstra for his guidance and comments. I would like to thank Professor Peter Lindert, Katheryn Russ, Joaquim Silvestre, and Deborah Swenson for helpful comments and discussions. I am indebted to two anonymous referees for the suggestions. All errors are my responsibility.

[1] Feenstra et al (1999) show that changes in relative variety have a positive and significant effect on total factor productivity, using the sectoral data for Korea and Taiwan. Funke and Ruhwedel (2001a, 2001b) find that a country's export variety is a significant determinant of its per capita

evidence of the growth on the export variety over countries, and analyzed the relationship between export variety, productivity and economic growth. It has been evident that new products and export varieties have played an important role in export and economic growth.

There have been some studies that investigate the determinants of the growth of export variety. Bernard, Jensen, and Schott (2003) find strong evidence that new plants choose to enter the export market as trade costs fall, using the data on US manufacturing plants. Kehoe and Ruhl (2003) shows that the substantial growth of exporting goods they had not been previously trading is attributed to the trade liberalization. Hummels and Klenow (2002) show that larger and rich countries that tend to be more liberalized in trade have larger set of goods in both export and import. Evenett and Venables (2002) identify the "geographic spread of export" in 23 developing countries by tracking down a country's exports to many partners at two different points. They notice the disappearance of numerous zero matrixes in bilateral trade by the use of product line at 3-digit level of trade data. They show that the experience effects, spillovers from markets that are already supplied to a new market, are significant and the strength of the effects depends on the proximity to the supply frontier. The force driving the spillover effect might be learning effect: fixed investment cost would decrease. Even if those are the most important determinants of the growth of the export variety, I present empirical evidence on the determinants of the expansion of export variety, focusing on the impact of destination income because of data un-availability in variable exporting cost and identification difficulties in the fixed entry cost.

One of the major contributions to export variety literatures is to build a new and more sophisticated measurement that compares export varieties from a country to its trading partners. The crude measure of the export variety, the number of exporting goods, has some drawbacks, so some empirical[2] studies have provided significant evidences of the growth on

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GDP and export performance for the OECD and the East Asian countries. Feenstra and Kee (2003) show how export variety affects productivity, using a cross-section of advanced and developing countries.

[2] Feenstra, Yang, and Hamilton (1999), Feenstra, Yang, Madani, and Liang (1999), Funke and Ruhwedel (2001a and 2001b), Hummels and Klenow (2002), Kehoe and Ruhl (2002), Feenstra and Kee (2003), Broda and Weinstein (2003)

the export variety over countries by the method benefited from the seminal work of Feenstra (1994).[3] The ratio of a country's export to a particular partner divided by its total exports is decomposed into two portions: the 'extensive' margin and 'intensive' margin. The 'extensive' margin is an index representing measure of export variety and the 'intensive' margin is an index defined as the total export to a particular trading partner relative to the total export in the same set to all partners. The suggested measurement in section 4 provides us with the clear-cut pattern of the growth of the extensive and intensive margins in Korea and Taiwan's exports over the period, 1980 to 1996. The exports from Korea and Taiwan to the world have shown the increasing extensive and decreasing intensive margin with some variations. In sections 5 I report estimates of the effect of destination income on the extensive margin. Korea and Taiwan tend to export more or fast to high income economies. The responsiveness of the extensive margin to the destination income has decreased over time for both Korea and Taiwan, and the coefficients for Korea are higher than for Taiwan. Over the time the importance of destination income has fallen, which implies that the other factors such as a fall in trade and fixed entry costs may have been driving the increase in the extensive margin. Taiwan has exported more varieties to its trading partners relative to Korea, which may have been attributed to more firms with higher productivity and lower exporting costs according to the model's implication in Section 2.

In summary, the plan of this paper is as follows. Section 2 develops a simple comparative static model to explain the mechanism that generates the expansion of export varieties. In order to provide evidence, Section 3 builds a new measurement of export variety. The empirical measurement results are presented in Sections 4 and 5. Section 6 concludes this paper.

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[3] Feenstra (1994) derives the exact price index from the CES unit cost function, allowing for the new product varieties and taste or quality change. The introduction of new or upgraded product varieties lowers the exact price index. Broda and Weinstein (2003) extends this to all US imports.

II. THE MODEL

2.1 Closed Economy

In order to illustrate what factors determine the expansion of export variety, I modify the monopolistic competition model put forward by Melitz (2003).[4] This paper first introduces a model for a closed economy and incorporates an open economy into the model. The preference in every country is given by a CES function for each period t.

$$U_t = \left[\sum_{i \in \tilde{I}_t} (q_{i,t})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where $\tilde{I}_t$ represents the available set of goods (domestic goods or plus imported goods for the open economy). The goods are substitutes, and an elasticity of substitution between any two goods $\sigma > 1$ and constant over time and across countries. The aggregate CES price is then

$$P_t = \left[\sum_{i \in \tilde{I}_t} (p_{i,t})^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{2}$$

There are many monopolistically competitive firms with their own productivity, a_i, each producing a different variety. Labor is the only input and is a linear function of output and the wage is normalized to one. Each firm requires the labor to produce output of $q_{i,t}$:

$$l_{i,t} = f_t + \frac{q_{i,t}}{a_i}$$

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[4] The early monopolistic competition model by Krugman (1979, 1980) with consumers' love of variety and homogeneous firms, producing differentiated products, stylizes the extensive margin. The models by Melitz (2003), Yeaple (2002) and Bernard et al (2003) feature the heterogeneous firms with different productivities to explain the reason why some firms are exporters and others are non-exporters.

where f_t is fixed labor cost and $1/a_i$ is constant marginal labor cost for production.

Each monopolistically competitive firm maximizes its own profit, following that marginal revenue is equal to marginal cost. Y_t is aggregate expenditure or income in each country.

$$p_{i,t} = \frac{w_t}{\rho a_i} \qquad \text{where} \qquad \rho = \left(\frac{\sigma}{\sigma - 1} \right)$$

The revenue and profit are given by:

$$r_{i,t} = Y_t (P_t \rho a_i)^{\sigma - 1}, \qquad \pi_{i,t} = \frac{Y_t}{\sigma} (P_t \rho a_i)^{\sigma - 1} - f_t \tag{3}$$

Heterogeneous firms provide their own horizontally differentiated goods with the domestic market if the productivities are above a cutoff level due to the fixed cost. An entering firm with less than the cutoff level of productivity immediately exits the domestic market.[5] Let a_t^* be the lowest productivity level of producing firms, which yields $\pi_{i,t}(a_t^*) = 0$. Re-arranging the zero profit condition gives:

$$a_t^* = \frac{1}{P_t \rho} \left(\frac{f_t \sigma}{Y_t} \right)^{\frac{1}{\sigma - 1}} \tag{4}$$

An entering firm with $a_i > a_t^*$ produces. Even if the firms' productivities do not change over time, the cutoff productivity for zero profit decreases due to an increase in domestic income or decrease in fixed production cost over time. Thus more firms produce for their domestic market.

[5] As in Melitz (2003), this paper considers steady state equilibria in which each firm's productivity does not change over time. Thus an entering firm would immediately exit if the profit were negative.

2.2 Open Economy

Many papers identify substantial magnitude of fixed export market entry cost, important enough to generate large hysteresis effects associated with foreign markets and imply that the fixed cost could be on decrease. As a result this paper assumes that the entry fixed cost depends on the export market and may as well fall over the time.[6] In order for firms to enter into international markets they have to pay a fixed entry cost which does not vary with export volume and per-unit cost. The per-unit cost, τ_t^c is modeled by the formation of Samuelson's iceberg assumption. This paper is trying to identify market entry and the expansion of the extensive margins in many destination countries, $c \in (1,.....,C)$. The profit $(\pi_{i,t})$ from domestic market and exports to all destinations is

$$\pi_{i,t} = \pi_{i,t}^d + \sum_{c=1}^{C} \pi_{i,t}^c$$

The prices in domestic and destination market are

$$p_{i,t}^d = \frac{1}{\rho a_i} \quad \text{and} \quad p_{i,t}^c = \frac{\tau_t^c}{\rho a_i} \quad \text{where} \quad c \in (1,.....,C)$$

The firm's profit can be also divided by

$$\pi_{i,t}^d = \frac{Y_t^d \left(P_t^d \rho a_i\right)^{\sigma-1}}{\sigma} - f_t^d \quad \text{and} \quad \pi_{i,t}^c = \frac{Y_t^c (\tau_t^c)^{1-\sigma} \left(P_t^c \rho a_i\right)^{\sigma-1}}{\sigma} - f_t^c \quad (5)$$

A firm produces for its domestic market and exports to destination

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[6] Bernard and Jesen (2001), Bernard and Wagner (2001), Das, Robert, and Tybout (2001), and Robert and Tybout (1997a). Particularly in Robert and Tybout (1997b), interviews with managers making export decision confirm that firms in differentiated product market face significant fixed costs. A firm must find and inform foreign buyers and learn about the foreign market. It must research the foreign regulatory environment and adapts its product to ensure conformity to foreign standards such as testing, packaging, and labeling requirements. An exporting firm must also set up new distribution channels and conform to the shipping rule specified by the foreign customs agency (Ghironi and Metliz, 2003).

countries if and only if the profits are non-negative. Heterogeneous firms provide their own horizontally differentiated goods with the international markets if the productivities are above a cutoff level. The additional exporting cost involves higher productivity level of threshold.[7] Since this paper is examining a country's export variety to all trading partners with different income, fixed and trade costs, the required cutoff productivities across destinations are not equal. Let a_t^{c*} be the lowest productivity level of exporting firms for foreign country $c \in (1,.....,C)$ in period t, which yields: $\pi_t^c(a_t^{c*}) = 0$.

$$a_t^{c*} = \frac{\tau_t^c}{P_t^c \rho}\left(\frac{f_t^c \sigma}{Y_t^c}\right)^{\frac{1}{\sigma-1}} \quad \text{where} \quad c \in (1,.....,C) \tag{6}$$

The assumption that $\tau_t^c \left(f_t^c\right)^{\frac{1}{\sigma-1}} > \left(f^d\right)^{\frac{1}{\sigma-1}}$ leads us to the stylized fact that the cut-off level (a_t^{c*}) for exporting firms is greater than that for domestic supplying firms (a_t^*) : $a_t^{c*} > a_t^*$ where $c \in (1,.....,C)$. Because of the additional entry and per-unit trade costs, the firms with higher productivities can provide their products with international markets. The firms with productivity levels between a_t^* and the export cutoff level only provide for their domestic market. The fixed entry and per-unit trade costs explain the self-selection of firms into the export market. The firms with higher productivity can provide their products with international markets.

The variety produced by a firm with high productivity is first exported. The required cutoff-productivity for exporting firms ($a_{t+1}^{c*} < a_t^{c*}$) decreases as destination income increases and exporting costs decreases. The favorable conditions induce some domestic supplying firms with $a_i < a_t^{c*}$ to enter into the market in the next period. However, this paper will explore the effect of destination income on the export extensive margin for each year because of the data un-availability in other variables.

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[7] The empirical findings by Bernard and Jensen (1999), Aw *et al*. (2000) show that exporters are more productive than non-exporters. Bernard et al (2003), Yeaple (2002) as well as Melitz (2003) suggest the theoretical model to account for the fact that the plants that export appear to be more productive. They argue that exporting does not itself improve productivity.

It has been painstaking to collect tariff rates in each destination at such a disaggregated data level. Furthermore, the papers about the fixed entry cost only identify that by the exit and entry in response to a change in some exogenous variables such as exchange rate, proximity to already supplied destination, so there is no tangible variable for the fixed entry cost.[8]

III. MEASURING EXPORT VARIETY (EXTENSIVE MARGIN)

The simplest way to measure the variety of export is to count the number of items at a trade classification. This count measurement is unweighted, so I construct a more sophisticated measurement by adapting Feenstra measure (1994, 2003) in order to compares export varieties from a country to its many destination countries, $c \in (1,...,C)$ over the time, instead of comparing varieties imported from different exporting countries in previous studies.[9] The suggested method in this paper allows us to identify the expansion of a country's export variety to all of its destinations and compare the level of export variety across destinations. Let P_t^c is an aggregate CES function of the prices of all varieties from an exporting country to its destination country c.

$$P_t^c = \left[\sum_{i \in I^c} b_i \left(p_{i,t}^c \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{7}$$

where I^c is the set of exporting varieties from a country to its destination country c where b_i denotes a taste or quality parameter for good i.

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[8] But this does not underestimate this paper if we consider the biggest contribution of this paper as the suggestion of more sophisticated method to measure export variety and the model is derived to explain the fact that the correlation between export variety and importer income has been dropping over time even with the increasing export variety.

[9] The Feenstra measure and others derived from this have so far applied in the empirical studies. The consistent references, conceptually, the worldwide exports from all countries to all (Hummels and Klenow, 2002), from all countries to the US (Feenstra and Kee, 2003), and from all countries to the investigating country (Kehoe and Ruhl, 2003) should be modified to find the path-dependent extensive margins in an exporting country. Thus the distinguished point in this paper is that the weight is a country's own exports, not importance in world exports.

The ratio of the CES functions over two destination countries l and k equals to the product of the Sato (1976)-Vartia (1976) price index of goods that are common, $I = \left(I_t^l \cap I_t^k\right) \neq \acute{O}$, multiplied by the terms reflecting the export share of unique goods[10]. The exact price index with variety change is equal to the conventional price index times additional adjustment.

$$\frac{P_t^l}{P_t^k} = \prod_{i \in I} \left(\frac{p_{i,t}^l}{p_{i,t}^k} \right)^{W_i(I)} \left(\frac{\lambda_t^l(I)}{\lambda_t^k(I)} \right)^{\frac{1}{\sigma - 1}}, \quad l,k = 1,...C \tag{8}$$

where the weights $W_i(I)$ are constructed from the export shares in two countries

$$W_i(I) = \left(\frac{s_{i,t}^l(I) - s_{i,t}^k(I)}{\ln s_{i,t}^l(I) - \ln s_{i,t}^k(I)} \right) / \sum_{i \in I} \left(\frac{s_{i,t}^l(I) - s_{i,t}^k(I)}{\ln s_{i,t}^l(I) - \ln s_{i,t}^k(I)} \right)$$

$$s_{i,t}^c(I) = p_{i,t}^c q_{i,t}^c / \sum_{i \in I} p_{i,t}^c q_{i,t}^c, \quad \text{for} \quad c = l,k$$

$$\lambda_t^c(I) = \frac{\sum_{i \in I} p_{i,t}^c q_{i,t}^c}{\sum_{i \in I_t^c} p_{i,t}^c q_{i,t}^c} = 1 - \frac{\sum_{i \in I_t^c, i \notin I} p_{i,t}^c q_{i,t}^c}{\sum_{i \in I_t^c} p_{i,t}^c q_{i,t}^c}, \text{ for } \quad c = l,k \tag{9}$$

$\lambda_t^c(I)$ in equation (9) is the fraction of export value in the varieties that are available in both comparing countries relative to export value in the varieties available in the country. Comparing aggregate export prices for country l relative to country k needs an additional adjustment for the size of each set of exporting goods in addition to a weighted average of the price ratios in both countries.

To see the expansion of the extensive margins from a country to all

[10] In index number theory the price index is evaluated, using data on prices and quantities for the same varieties in the two periods or two cross-sections. Feenstra (1994) shows that since the conventional price ignores new and disappearing, or different varieties, so there is a bias in the conventional price index.

destination countries, the paper uses the total export from the country to all destination countries as a consistent comparison. Let $I_t^* = U_{c=1}^{C} I_t^c$ be the union set of varieties exported by a country to all its destination countries, $c = 1,...,C$. We have that $\lambda_t^l(I_t^l) = 1$ and the extensive margin to country l is

$$\lambda_t^*(I_t^l) = \frac{\sum_{i \in I_t^l} p_{i,t}^* q_{i,t}^*}{\sum_{i \in I_t^*} p_{i,t}^* q_{i,t}^*} = 1 - \frac{\sum_{i \in I_t^*, i \notin I_t^l} p_{i,t}^* q_{i,t}^*}{\sum_{i \in I_t^*} p_{i,t}^* q_{i,t}^*} \tag{10}$$

The extensive margin to country l is the total export of a country that occur in the set in which the country exports to country l relative to the total export to all destinations. The crude measure of export variety, the number of exporting goods, can be used only when the export quantities in each variety are equal. The extensive margin $\left(\lambda_t^*\right)$ is the ratio of the number of exporting goods to the number of all exporting goods $\left(N^l / N^*\right)$. My measure of the extensive margin can be understood as a weighted count.[11]

$$\lambda_t^*(I_t^l) = \frac{\sum_{i \in I_t^l}^{N^l} p_{i,t}^* q_{i,t}^*}{\sum_{i \in I_t^*}^{N^\bullet} p_{i,t}^* q_{i,t}^*} \neq \frac{N^l p_{i,t}^* q_{i,t}^*}{N^* p_{i,t}^* q_{i,t}^*} = \frac{N^l}{N^*} : \quad (0 < \lambda_t^*(I_t^l) < 1) \tag{11}$$

The term will be less than one if there are goods that are not exported to country l. For example, if Korea or Taiwan exports all exporting goods to the US, the extensive margin will be one. This will be less than one if

[11] A disadvantage is that a destination country may have a large extensive margin (1) even if a sourcing county exports small number of export varieties to the destination, but does a lot to the worldwide destination (2) if the value of a variety increases with no change in the number of export varieties (I thank to an anonymous referee for (2)). As shown in Section 6, discarding small trade flows, using cutoff and sample, affects the size of extensive margins but did not affect the correlation between income and extensive margin. On the other side of the coin, an advantage is that it prevents a variety from appearing important only because a sourcing country exports that product a lot only to the destination.

there are goods that are not found in the complete set of varieties. The corresponding intensive margin to country l is the total export to country l relative to the total export in the same set to all destinations.

$$\frac{\sum_{i\in I_t^l} p_{i,t}^l q_{i,t}^l}{\sum_{i\in I_t^l} p_{i,t}^* q_{i,t}^*} \tag{12}$$

The ratio of export to a country to total exports to all destinations is the product of the two margins. The above measure decomposes country l's share of total exports into the extensive margin and intensive margins.

$$\frac{\sum_{i\in I_t^l} p_{i,t}^l q_{i,t}^l}{\sum_{i\in I_t^*} p_{i,t}^* q_{i,t}^*} = \frac{\sum_{i\in I_t^l} p_{i,t}^* q_{i,t}^*}{\sum_{i\in I_t^*} p_{i,t}^* q_{i,t}^*} \frac{\sum_{i\in I_t^l} p_{i,t}^l q_{i,t}^l}{\sum_{i\in I_t^l} p_{i,t}^* q_{i,t}^*} \tag{13}$$

IV. EXTENSIVE AND INTENSIVE MARGIN

This paper focuses on Korea and Taiwan since their exports have dramatically increased over the last decades. The data on the international trade flows is the World Trade Flows (WTF) with 4-digit categories compiled by Feenstra (2000), covering the period 1980 to 1997 for approximately 230 countries.[12] The criteria for the choices are driven by the data availability. 127 importing countries for Korea and 63 importing countries for Taiwan are chosen over the period 1980-1996. I have calculated export varieties of Korea and Taiwan for the years 1980 to 1996.[13]

The results are given in Table 1 and Appendix.

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[12] There are two possible data sets: OECD's International Trade by Commodity Statistics (ITCS) and the data set compiled by Robert Feenstra (2000). The World Trade Analyzer (WTA) assembled by Statistics Canada is reported by Feenstra (2000) according to the Standard International Trade Classification, Revision 2 with some modifications.

[13] Because of the limitation about pages and consistent comparison between Korea and Taiwan, 45 destination countries are chosen. The other destinations are provided in the version of working paper.

[Table 1] Extensive and Intensive Margin

		Extensive Margin		Intensive Margin	
Country		Average	Average(same destinations)	Average	Average(same destinations)
KOREA	Mean Value In 1980-1983	0.3617	0.5011	0.0099	0.0160
	Mean Value In 1993-1996	0.5378	0.7090	0.0078	0.0134
	% Change in Mean Value	57.24	49.64	-59.34	-11.42
	Annual Growth Rate (%)	4.87	2.79	-3.19	-1.09
TAIWAN	Mean Value In 1980-1983	0.7207	0.7185	0.0151	0.0151
	Mean Value In 1993-1996	0.8589	0.8572	0.0138	0.0137
	% Change in Mean Value	25.12	25.33	-21.50	-22.25
	Annual Growth Rate (%)	2.06	2.08	-1.58	-1.63

The first impression is that the exports from Korea and Taiwan to the world-wide countries have shown the increasing extensive margins with some variations. According to Table 1, the mean value of Korea's (Taiwan's) extensive margins during the two periods 1980-1983 and 1993-1996 has increased by 57.2% (25.1%) and 4.8 % (2.0%) annually. Taiwan tends to export a greater variety to almost all comparing destinations (60 countries). Table 1 also shows that the intensive margins in Korea and Taiwan's exports have been decreasing over the sample period.[14] The mean value in Korea (Taiwan) over the world has decreased by 59.3% (22.2%) and by 3.1 % (1.6%) annually.

V. EXTENSIVE MARGIN AND INCOME

This section features the correlation between the extensive margin and destination income. This paper then regresses the natural log of the extensive margin on the log of GDP or GDP per capita in each year, t.

[14] For the graphs of the intensive margins, contact to the author.

$$\log(EM_{c,t}) = \alpha_t + \beta_t \log(Income_{c,t}) + \varepsilon_t, \quad c = 1,.....,C \tag{14}$$

where $Income_{c,t}$ represents importing county c's GDP or GDP per capita. The estimating equation shows the responsiveness of the extensive margin to GDP and GDP per capita in each year. β represents the elasticity of the extensive margin with respect to destination income. Table 2 presents the correlation between destination income and the extensive margin. The interesting finding is that the extensive margin is highly correlated with destination income, and the correlation has been dropping over time. The extensive margins of the two countries are more correlated with GDP per capita than GDP. A destination country with 100% more GDP had 43.9 % more extensive margin from Korea in 1980 but did 24.8% more in 1996. Taiwan exported 6.3% more extensive margin in 1980 but did 4.2 % more in 1996 to a destination with 100% more per capita GDP. A destination country with 100% more GDP per capita had 51.9% more extensive margin from Korea in 1980 but did 22.7% more in 1996. Taiwan exported 12% more extensive margin in 1980 but did 3.5 % more in 1996 to a destination with 100% more GDP per capita. Korea and Taiwan have exported more varieties to high income destinations. But the importance of destination income has fallen over the time.[15] According to the implication of the model in section 2, the other factors such as declining fixed and trade costs may have been playing intensified role in the tremendously increasing export varieties.

Another interesting finding is that the coefficients in Korea are higher than those in Taiwan over all the sample years. The extensive margin in Korea's export has depended more on the destination's income level rather than those in Taiwan. Taiwan's extensive margin might depend on the productivity and cost advantage relative to Korea's. Feenstra et al (1999) show that Taiwan exported relatively more high-priced intermediate inputs while Korea exported relatively more high-priced final goods may suggest higher per-unit trade cost of Korea. In addition, Levy (1991) suggests that the dense network of subcontracts and export

[15] The empirical findings are insensitive to different measure of income, GDP PPP and sample selection. The extensive margin is also highly correlated with GDP and when I shrink Korea's sample countries down to 60 destinations, the results are not sensitive.

traders in Taiwan has lowered the entry and exit costs, particularly for small firms. The comparison of the two countries and other papers findings intensify the loose connection of export variety and export costs.

[Table 2] Destination Income and Extensive Margin

	Korea			
	GDP	GDP per capita	GDP	GDP per capita
1980	0.439(0.048)*	0.519(0.069)*	0.063(0.027)**	0.128(0.041)*
1981	0.352(0.037)*	0.479(0.060)*	0.062(0.048)	0.141(0.068)*
1982	0.330(0.058)*	0.407(0.090)*	0.066(0.032)**	0.133(0.051)**
1983	0.378(0.035)*	0.405(0.064)*	0.075(0.017)*	0.152(0.040)*
1984	0.326(0.039)*	0.411(0.066)*	0.068(0.034)*	0.158(0.061)**
1985	0.313(0.075)*	0.432(0.101)*	0.056(0.042)	0.147(0.069)**
1986	0.306(0.045)*	0.335(0.064)*	0.033(0.060)	0.096(0.082)
1987	0.220(0.035)*	0.288(0.047)*	0.035(0.078)	0.117(0.104)
1988	0.259(0.033)*	0.309(0.045)*	0.050(0.003)	0.110(0.039)*
1989	0.256(0.024)*	0.302(0.038)*	0.049(0.021)**	0.105(0.027)*
1990	0.235(0.024)*	0.287(0.033)*	0.073(0.027)*	0.075(0.036)**
1991	0.234(0.030)*	0.276(0.042)*	0.051(0.014)*	0.051(0.019)*
1992	0.268(0.024)*	0.265(0.036)*	0.047(0.010)*	0.043(0.014)*
1993	0.266(0.025)*	0.239(0.039)*	0.042(0.005)*	0.040(0.009)*
1994	0.262(0.018)*	0.243(0.032)*	0.039(0.005)*	0.033(0.008)*
1995	0.276(0.020)*	0.245(0.033)*	0.045(0.007)*	0.035(0.011)*
1996	0.248(0.020)*	0.227(0.031)*	0.042(0.005)*	0.035(0.009)*

Data Source: WTF (Feenstra, 2000) and IMF, World Economic Outlook Database (2003,9)
Note: All variables are in natural logs. * significant at 1%, ** significant at 5%.

I examine the robustness of the calculation and estimation. The previous section measures the extensive margin for the goods, which are considered traded if and only if the value of export is above zero. To check the sensitivity of the results, we measure the extensive margin by a cut-off value of $50,000 that considers the likelihood of misclassified exports or economically unimportant level of exports (Evenett and Venable, 2002). $50,000 cut-off understates the extensive margin in Korea's export performance, as expected. The mean values in the extensive margin from 1980 to 1983 and 1993 to 1996 are 0.28 and 0.46, which are less than those measured by zero cut-off. It is natural because the destination countries with low extensive margin tend to have small value of import. Even if the cut-off did affect the level of extensive

margin, it has no effect on the increasing trend of the extensive margin as shown in Table 3. The extensive margin measured by $50,000 cut-off over the sample period is also highly correlated with destination income. The correlation between destination income and the extensive margin has been reduced over time. The extensive margin measured by cut-off makes it clear that the increase in income and fall in trade and fixed entry costs have been driving the increase in the extensive margin, and the importance of destination income has fallen over time.

[Table 3] Robustness to Cutoff and Sample

	CUTOFF	MANUFACTURING	HIGH INCOME	LOW INCOME
	Coefficient	Coefficient	Coefficient	Coefficient
1980	0.5226(0.073)*	0.5900(0.076)*	0.5656(0.105)*	0.7119(0.291)*
1981	0.5312(0.081)*	0.5070(0.059)*	0.4736(0.098)*	0.5317(0.202)*
1982	0.5655(0.106)*	0.4544(0.069)*	0.7629(0.238)*	0.2178(0.201)
1983	0.5447(0.079)*	0.4381(0.064)*	0.6043(0.130)*	0.2858(0.197)
1984	0.51677(0.074)*	0.4364(0.065)*	0.6129(0.138)*	0.2712(0.2057)
1985	0.5521(0.1070)*	0.5042(0.072)*	0.4699(0.154)*	0.3900(0.266)
1986	0.4858(0.059)*	0.3651(0.065)*	0.3180(0.109)*	0.2554(0.199)
1987	0.4533(0.059)*	0.3013(0.047)*	0.2524(0.097)*	0.4040(0.149)*
1988	0.4616(0.055)*	0.3297(0.046)*	0.2641(0.095)*	0.5428(0.165)*
1989	0.4148(0.047)*	0.3092(0.038)*	0.2458(0.070)*	0.4384(0.149)*
1990	0.3772(0.044)*	0.2900(0.033)*	0.2087(0.064)*	0.4196(0.128)*
1991	0.3749(0.048)*	0.2818(0.040)*	0.2466(0.073)*	0.1939(0.158)
1992	0.3502(0.049)*	0.2720(0.036)*	0.2675(0.089)*	0.3953(0.1153)*
1993	0.3507(0.043)*	0.2472(0.037)*	0.2584(0.084)*	0.2654(0.129)**
1994	0.3607(0.048)*	0.2507(0.030)*	0.2157(0.065)*	0.3053(0.097)*
1995	0.3636(0.054)*	0.2632(0.033)*	0.2285(0.069)*	0.3851(0.106)*
1996	0.2904(0.034)*	0.2675(0.033)*	0.2076(0.063)*	0.3760(0.101)*

Note: All variables are in natural logs. * significant at 1%, ** significant at 5%. The number of observations (countries) is from 112 to 117 for Korea.

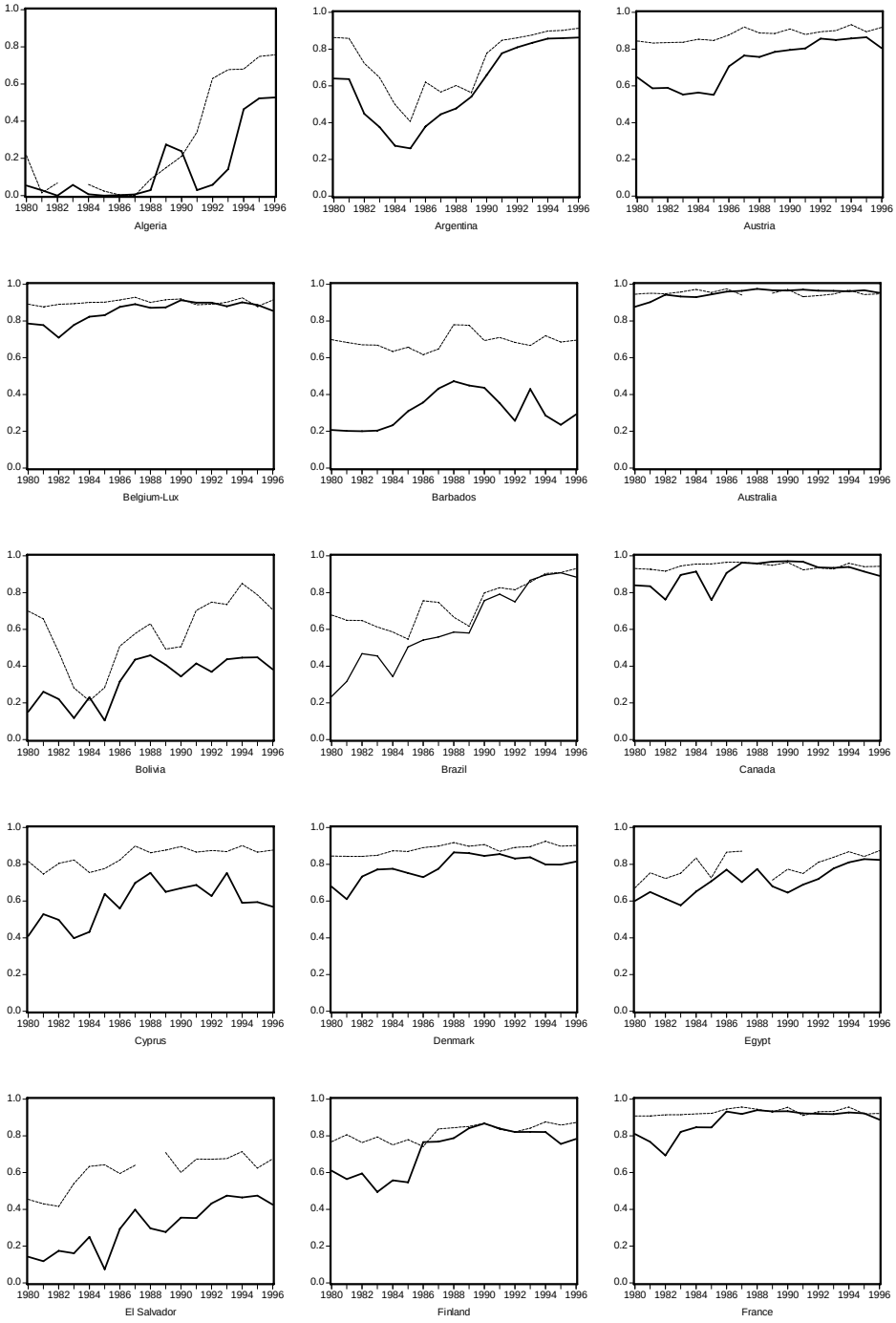
As another robustness check, the paper considers the sensitivity of the goods included in the sample. We can restrict the sample of the goods with Standard Industrial Trade Classification categories 5 to 8, which can be thought of as manufactured goods. The sub-sample overstates the extensive margin. The mean values in the extensive margin from 1980 to 1983 and 1993 to 1996 are 0.36 and 0.56, which are higher than those measured by the sample of all the categories. Even if the sub-sample of categories did affect the level of extensive margin, it has no effect on the

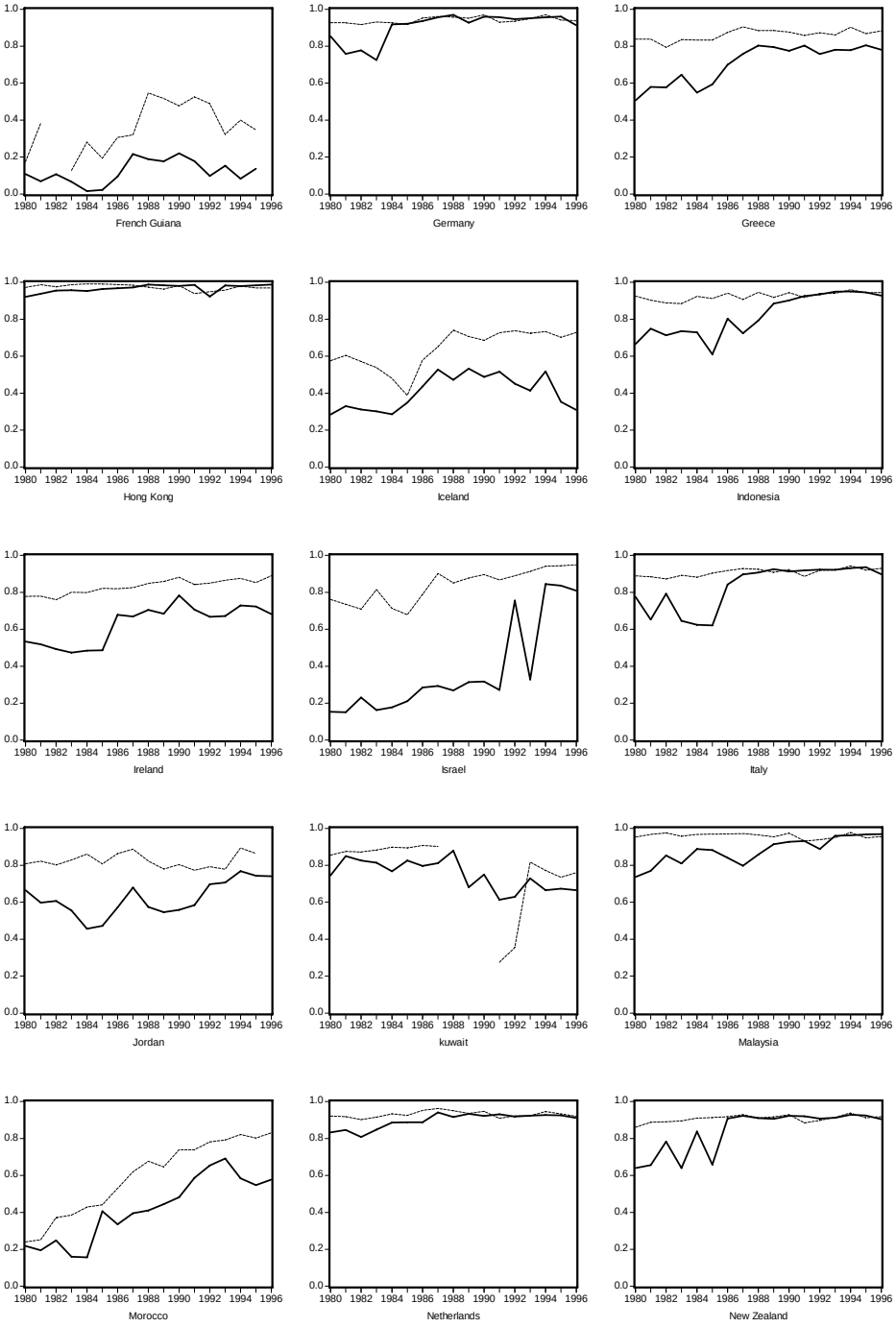
increasing trend of the extensive margin. Finally we can split the sample of destinations into the top and bottom halves of the average per capita GDP from 1980 to 1996. The estimating results indicate that the increase in income has been the force behind the increase in extensive margins, and the importance of destination income has fallen over time.

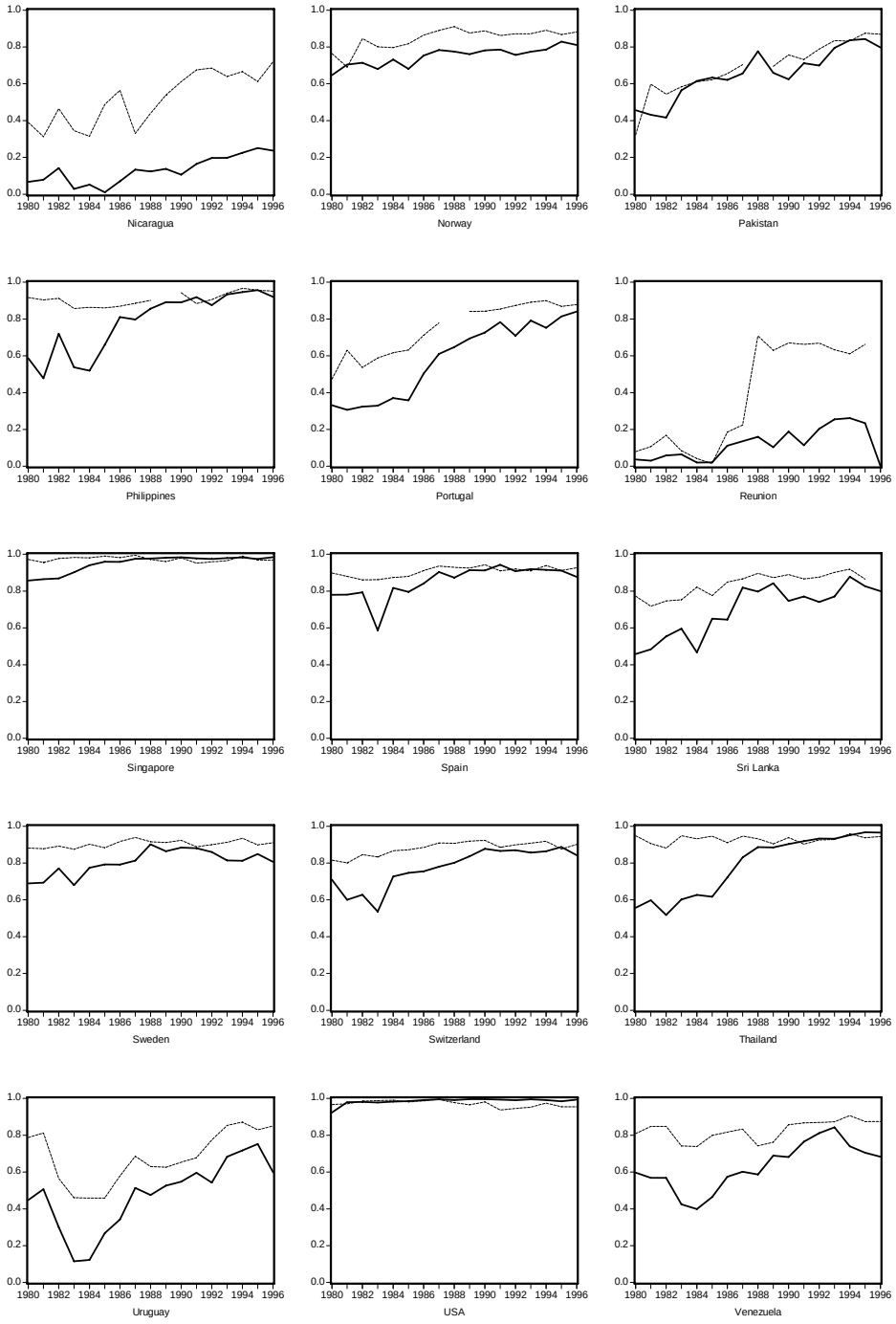
V. CONCLUSION AND FUTURE RESEARCH

It has been evident that new products and export varieties have played an important role in export and economic growth. Thus this paper develops a model with monopolistic competition to explain the mechanism that generates the expansion of export varieties. To provide evidence this paper builds a more sophisticated method to measure export varieties, which weights varieties by their importance in a country's own export. The measure strongly suggests that the exports from Korea and Taiwan to the world have shown the increasing extensive and decreasing intensive margin with some variations over the sample period, 1980-1996. Korea and Taiwan have exported more varieties to rich countries. Another interesting finding is that the correlation between export variety and importer income has been dropping over time. This would loosely be attributed to declining trade costs, so more is needed in the future research.

Appendix. **The Extensive Margin** (dash line- Korea and dot line- Taiwan)




French Guiana
Germany
Greece
Hong Kong
Iceland
Indonesia
Ireland
Israel
Italy
Jordan
kuwait
Malaysia
Morocco
Netherlands
New Zealand


Nicaragua
Norway
Pakistan
Philippines
Portugal
Reunion
Singapore
Spain
Sri Lanka
Sweden
Switzerland
Thailand
Uruguay
USA
Venezuela

References

Aw, B. Y., S. Chung, S. and M. Robert (2000), Productivity and Turnover in the Export Market: Micro-Level Evidence from the Republic of Korea and Taiwan, *World Bank Economic Review*, Vol. 14, 65-90.

Bernard, A. B., B. Jensen and P. Schott (2003), Falling Trade Costs, Heterogenous Firms, and Industry Dynamics, NBER Working Paper 9639.

Biesebroeck, J. V. (2004), Exporting Raises Productivity in Sub-Saharan African Manufacturing Plants, *Journal of International Economics*, Forthcoming.

Broda, C. and D. Weinstein (2003), Globalization and the Gain from Variety, NBER Working Paper, 10314.

Evenett, S. J. and A. Venables (2002), Export Growth in Developing Countries: Market Entry and Bilateral Trade Flows, Mimeo.

Feenstra, R. (1994), New Product Varieties and the Measurement of International Price, *American Economic Review*, Vol. 84, 157-177

Feenstra, R. (2000), World Trade Flows, 1980-1997, Center For International Data, UC Davis.

Feenstra, R. (2004), Advanced International Trade: Theory and Evidence, Princeton University Press.

Feenstra, R. and L. Kee (2003), Export Variety and Country Productivity, The World Bank, Policy Research Working Paper Series 3412

Feenstra, R. and A. Rose (2000), Putting Things in Order: Patterns of Trade Dynamics and Product Cycles, *The Review of Economics and Statistics*, Vol. 82, No. 3, 369-382.

Feenstra, R., T. Yang, and G. Hamilton (1999), Business Groups and Product Variety in Trade: Evidence from South Korea, Taiwan and Japan, *Journal of International Economics*, Vol. 48, No. 1, 71-100.

Feenstra, R., D. Madani, T. Yang and C. Liang (1999), Testing Endogenous Growth in South Korea and Taiwan, *Journal of Development Economics*, Vol. 60, 317-341.

Funke, M. and R. Ruhwedel (2001a), Export Variety and Export Performance: Empirical Evidence from East Asia, *Journal of Asian Economics*, Vol. 12, 493-505.

Funke, M. and R. Ruhwedel (2001b), Product Variety and Economic Growth: Empirical Evidence for the OECD Countries, IMF Staff Papers, Vol. 48, No. 2.

Ghironi, F. and M. Melitz (2003), International Trade and Macroeconomic Dynamics with Heterogenous Firms, NBER Working Paper, 10540.

Hallward-Driemeier, M. and G. Iarossi and K. Sokoloff (2002), Exports and Manufacturing Productivity in East Asia: A Comparative Analysis with Firm-level Data, NBER Working Paper, 8894.

Hummels, D. and P. Klenow (2004), The Variety and Quality of a Nation's Exports, NBER Working Paper, 8712.

Kang, K. (2004a), The Path of Export Variety (Extensive Margin): Theory and Evidence, Ph.D. Dissertation, University of California, Davis.

Kang, K. (2004b), Export Variety and Terms of Trade: Theory and Evidence, Ph.D. Dissertation, University of California, Davis.

Kehoe, T. and K. Ruhl (2003), "How Importance is the New Goods Margin in International Trade?, " Federal Reserve Bank of Minneapolis Staff Report, 324.

Krugman, P. (1979), Increasing Returns, Monopolistic Competition, and International Trade, *Journal of International Economics*, Vol. 9, 469-479.

Krugman, P. (1980), Scale Economics, Product Differentiation, and the Pattern of Trade, *American Economic Review*, Vol. 70, 950-959.

Melitz, M. J. (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica*, forthcoming.

Melitz, M. and G. Ottaviano (2003), Market Size, Trade, and Productivity, Mimeo, University of Harvard.

Redding, S. and A. Venables (2004), Geography and Export Performance: External market Access and Internal Supply Capacity, in (eds) Baldwin, R and L.A., Winters (2004), Challenges to Globalization: Analyzing the Economics, CEPR-NBER conference volume, NBER and Chicago University Press.

Robert, M. and J. Tybout (1997a), The Decision to Export in Colunbia: An Empirical Model of Entry with Sunk Costs, *American Economic Review*, Vol 87, 545-564.

Robert, M. and J. Tybout (1997b), What makes Export Booms? The World Bank.

Ruhl, K. (2003), Solving the Elasticity Puzzle in International Economics, Mimeo, University of Minnesota.