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Changes in Variety, Price, and Quality of Chinese Export Products in Trade with Korea*

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This paper analyses the changes in the variety, price, and quality of Chinese export products, and their contributions to China's export growth into the Korean market, using HS 10-digit highly disaggregated Korean trade data between the years of 1992 and 2008. In this paper, empirical methodologies for estimating the price level and quality level of Chinese products are developed. Our results show that China's export growth is mainly explained by an increase in the intensive margin, and that the rise in the intensive margin is due to a decrease in price and an increase in quality of Chinese products. Even if an increase in product variety and a decrease in price have contributed to China's export growth, the improvement in product quality is the main factor affecting China's rapid export growth into the Korean market.

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1. INTRODUCTION

China's economic reforms in the late 1970s as well as the formal diplomatic relationship established with Korea in 1992 have strengthened the economic relationship between the two countries. The volume of trade has grown significantly since 1992, when China started to trade with Korea. The amount of bilateral trade increased from $6 billion to $170 billion between the years 1992 and 2008. In particular, China's exports to Korea have grown rapidly. From 1992 to 2008, the annual average growth rate of Korea's imports from China was 20.8%, while that of Korea's total imports from all over the world was only 11.0%. With the rapid import growth from China, China has become Korea's most important trading partner (Nicolas, 2009). In 1992, China's share in Korean total imports accounted for only 4.6%, but by 2008 the share had risen to 17.7%.

Moreover, China's trade structures have shown a significant change. The strongest rate of growth in China's exports to Korea is mainly in the manufacturing sectors. Manufacturing products, which accounted for only one third of China's total exports to Korea in 1992, rose drastically to 78.6% in 2008. That is, the trade structures between China and Korea show the increasing importance of manufactured products, with a decline in primary commodities. China's exports structure is highly correlated with its increasing ability to produce more technologically sophisticated products (Kim *et al*., 2004), and the increase of Korean firms' investment in China intensified vertical intra-industry trade between the two countries (Han and Lee, 2012).

This paper analyzes factors affecting China's rapid export growth to Korea, using highly disaggregated Korean import data between the years 1992 and 2008. We assume there is heterogeneity within products in order to distinguish between the characteristics of Chinese products and those of the rest of the world. We consider three major factors (i.e., product variety, price changes, and quality changes) as the potential forces behind China's dramatic export growth.

According to traditional trade theory, there is evidence that China's exports are higher in labor-intensive sectors (Leamer, 1995). New trade theory emphasizes the increase in exports in the new product category and considers product heterogeneity within industries, such as price and quality differences. Hummels and Klenow (2005) found that variations in the size of exports across countries are largely due to variations in the extensive margin. Broda and Weinstein (2006) reported that 30% of growth is the result of an expansion in the extensive margin. Amiti and Freund (2008) showed that since 1992 the export product category has increased by 40%; however, because the contribution of the extensive margin in China's export growth is less than 15%, almost all the export growth is due to the intensive margin. Most studies show that China's rapid export growth is mainly driven by the intensive margin (Kang and Ahn, 2010; Alvarez and Claro, 2006, 2007). In addition, some studies have demonstrated that the quality of Chinese export products has improved over time. Alvarez and Claro (2006) found that China's product quality in exports to Chile has increased, and that China's export growth is mainly explained by an increase in the quality of exports. Rodrik (2006) and Schott (2008) also showed that China's exports are more sophisticated than those of countries with similar incomes per capita. However, Branstetter and Lardy (2006) argued that after taking into account China's imports of high-value-added intermediate parts, China's export structure reflects the low costs of labor-intensive assembly.

Some studies have used export prices (unit values) as proxies for product quality (for example, Hallak, 2006; Schott, 2008; Krishna and Maloney, 2011). However, Hallak and Schott (2008) argued that unit values are an imperfect measure of product quality and suggested another method of estimating product quality. Our study differs from that of Hallak and Schott (2008) in measuring the product quality of a country in that we use a regression equation derived from demand function. Further contributions of this paper are that, in addition to measuring changes in variety, price, and quality of Chinese products, we analyze their relative contribution to China's

rapid export growth. The results show that the relative price of Chinese products compared to those of another country becomes lower over time, but the variety and product quality of Chinese products have increased over time. The results also show that quality improvement of Chinese export products is the main factor affecting China's export growth into the Korean market.

The rest of the paper is organized as follows. In section 2 we suggest a methodology for measuring the variety, price, and quality of Chinese export products. In section 3, we explain our data sources and show the estimated results for changes in variety, price, and quality using the methodologies suggested in section 2. In section 4, we explain the factors affecting China's export growth to Korea. Section 5 presents our concluding remarks.

2. MEASURES OF VARIETY, PRICE, AND QUALITY

2.1. Measure of Variety

The import penetration of country *c* relative to country *r* is expressed as the overall share *S*, which is the ratio of total imports from *c* and *r*:

$$S_t = \frac{M_{ct}}{M_{rt}} = \frac{\sum_{j \in N_{ct}} M_{cjt}}{\sum_{j \in N_{rt}} M_{rjt}}, \tag{1}$$

where M_{ct} denotes total imports from country *c* in time *t*, and M_{rt} represents total imports from the rest of the world *r*. N_{ct} and N_{rt} stand for the HS 10-digit product category with positive imports from *c* and *r* in period *t*.

Hummels and Klenow (2005) decomposed the overall share S_t into two components: the extensive margin and the intensive margin. For example, total imports from country *c* could be lower than those from country *r* either because import product categories from country *c* are fewer than those from

country *r*, or because import values from *c* are lower than imports from *r* within common categories. Analytically, the overall share in period *t* can be written as

$$S_t = \frac{\sum_{j \in N_{ct}} M_{rjt}}{\sum_{j \in N_{rt}} M_{rjt}} \cdot \frac{\sum_{j \in N_{ct}} M_{cjt}}{\sum_{j \in N_{ct}} M_{rjt}} = EM_t \cdot IM_t, \quad (2)$$

where $EM_t = \frac{\sum_{j \in N_{ct}} M_{rjt}}{\sum_{j \in N_{rt}} M_{rjt}}$, and $IM_t = \frac{\sum_{j \in N_{ct}} M_{cjt}}{\sum_{j \in N_{ct}} M_{rjt}}$.

The extensive margin (*EM*) measures country *r*'s exports to Korea in N_{ct} relative to country *r*'s exports to Korea in N_{rt}, that is, the ratio of total imports from *r* in categories of N_{ct} relative to total imports from *r*. The extensive margin is a weighted count of *c*'s categories relative to *r*'s categories, where weights are the import share of each category in total imports. If the share of each category is equal, then the extensive margin is simply the ratio of *c*'s category relative to *r*'s category. We use the extensive margin as a measure of country *c*'s export variety. The intensive margin (*IM*) compares imports from *c* and *r* within common product categories (i.e., N_{ct}).

2.2. Measure of Price Change

To measure changes in the price of China's export products, we use Hummels and Skiba's (2004) specification to test the Alchian-Allen effect. The prices of export products depend on transportation cost and exporter income. To measure changes in prices of China's export products, we add a dummy variable for China to the equation. We difference all variables with respect to the variable means over a given product *j*, which leaves us with variations across all countries for a given product *j*. Differencing in this

way removes commodity-specific variations in prices that may be unrelated to commodity characteristics.[1] The regression equation is as follows:[2]

$$\begin{aligned} \ln P_{jk} - \overline{\ln P_j} = \alpha_0 + \beta_1(\ln PCGDP_{jk} - \overline{\ln PCGDP_j}) \\ + \beta_2(\ln DIST_{jk} - \overline{\ln DIST_j}) + \beta_3 DC + (\varepsilon_{jk} - \overline{\varepsilon_j}), \end{aligned} \tag{3}$$

where P_{jk} is the unit value of imports from country k in product j. *PCGDP* is the per capita GDP of the exporter, and *DIST* is the distance between the exporter and Korea. All variables are converted in log terms. *DIST* is used as a proxy variable of transportation cost.[3] *DC* is the China dummy variable, which is 1 for China and 0 for other exporters. Positive *DC* means that China's export product is more expensive than those of other exporters. ε is the error term, which captures measurement error in prices.

The parameter β_1 is expected to be positive since richer countries specialize in high-priced products.[4] The parameter β_2 is expected to be positive due to the Alchian-Allen effect. The Alchian-Allen effect means that, when shipping abroad, firms tend to ship high quality goods because of transportation costs, which implies that a country farther from Korea exports higher priced goods. The dummy variable *DC* shows whether Chinese import prices differ from those of other countries after controlling for income per capita and distance. If β_3 is negative, we can conclude that China's products are cheaper than those of other countries on average. We use the estimated coefficients of *DC* as the price level of Chinese export products.

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[1] A low quality car might be much more expensive than high quality clothes. We can control this kind of price variation unrelated to commodity characteristics by using a mean-difference variable in the regression.

[2] All variables are measured for each year, and the regression is done year-by-year. For simplicity, we delete *t* (denoting time) in all variables in equations (3) and (7).

[3] It is geodesic distance between nation's capitals (Kilometers). The data are from Nicita and Olarreaga (2007).

[4] Schott (2001) and Hummels and Klenow (2005) showed that export prices are higher in high income exporters.

2.3. Measure of Quality Change

Although product prices reflect product quality, price differences for the same product also reflect several other features.[5] Product quality is unobservable in trade statistics, and we need some methodology for inferring quality measures. Alvarez and Claro (2006) developed a theoretical model to distinguish the impact of prices and unobserved variety and quality on import penetration under traditional assumptions of monopolistic competition. We develop a methodology measuring the product quality of Chinese exports, which is similar to those developed by Hallak (2006) and Alvarez and Claro (2006).

Assume that preferences are represented by a two-tier utility function that incorporates love of variety. The upper tier is Cobb-Douglas, with expenditure share s_j for each sector j. The lower tier utility function in product j, which consists of numerous differentiated varieties, has the following CES form:[6]

$$U_j = \left[\sum_{i=1}^{n} (q_{ij} x_{ij})^{\rho} \right]^{1/\rho}, \quad 0 < \rho < 1, \tag{4}$$

where U_j is a utility for product j, and product j is composed of many differentiated varieties of commodity i. q_{ij} represents a utility shifter that captures qualities of varieties of commodity i in product j, and x_{ij} is the quantity consumed per variety.

From the first order condition for utility maximization, demand for a variety i in product j can be derived as follows:

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[5] See Hallak and Schott (2008) for a discussion on how prices are an imperfect measure of product quality.

[6] In order to analyse quality changes, we have to think about quality differentiation of the product. Thus, we adopted the utility function suggested by Hallak (2006), which considers qualities of varieties.

$$x_{ij} = \frac{(p_{ij} / q_{ij})^{-\sigma}}{\sum_{i=1}^{n}(p_{ij} / q_{ij})^{1-\sigma}} s_j Y, \quad (5)$$

where $\sigma = 1/(1-\rho) > 1$ is the elasticity of substitution between varieties, s_j is product j's share of total expenditure, and Y is consumer's total expenditure.

From equation (5), we can calculate trade flows of product j between countries. Assume that country k produces N_{jk} different varieties of product j, and that the varieties of country k are the same in terms of both quality and price. In this case, total import quantity of product j from country k can be obtained by multiplying x_{jk} by the number of varieties N_{jk} as follows:

$$x_{jk} = N_{jk} \frac{(p_{jk} / q_{jk})^{-\sigma}}{\sum_{i=1}^{n}(p_{ijk} / q_{ijk})^{1-\sigma}} s_j Y, \quad (6)$$

where x_{jk} is total import quantity from country k. Equation (6) tells that total import quantity is negatively related with the price of the variety of the exporter, but is positively related with the number of varieties of exporters, product quality of exporters, share of expenditures in product j, and total expenditures of the importer.

A country with a large economy will produce more variety than a small country. Thus, the number of varieties N_{jk} is positively related to the economy size of the exporters. Since volume of trade depends on distance between the two countries as in the gravity model, we added a distance variable in the regression equation. As in the regression equation of (3), we difference all variables with respect to the variable means over a given product j. If China exports more than other countries after controlling for the price of the product, economy size, and distance, we can assume that the quality of the Chinese product is better than those of other countries. This can be measured with the China dummy variable. From the above discussion, the regression equation for estimating the quality of China's

export is as follows:[7)]

$$\ln(x_{jk}) - \overline{\ln(x_{jk})} = \alpha_0 + \beta_1(\ln P_{jk} - \overline{\ln P_j}) + \beta_2(\ln GDP_{jk} - \overline{\ln GDP_j}) + \beta_3(\ln DIST_{jk} - \overline{\ln DIST_j}) + \beta_4 DC + (\varepsilon_{jk} - \overline{\varepsilon_j}), \quad (7)$$

where x_{jk} is the import quantity of product j from country k, and GDP is the GDP of the exporter. The parameter β_1 is price elasticity, the sign of which is expected to be negative. Because large countries produce more varied products, the expected sign of β_2 is positive. Higher transportation costs reduce import quantity, and thus the expected sign of β_3 is negative. The variable DC is a dummy variable that is 1 for China and 0 for all other countries. Positive β_4 means that the product quality of China's export is higher than those of other countries.

3. CHANGES IN VARIETY, PRICE, AND QUALITY OF CHINESE PRODUCTS

3.1. Data Sources

Trade data were obtained from Korea's Customs Office, classified at the HS 10-digit level, which is the most disaggregated classification. We consider 96 countries that export to Korea in a data period covering the years from 1992 to 2008.[8)] Quality changes are more important in differentiated products than in homogeneous products. Thus, our analysis focuses on the manufacturing sectors, where product differentiation and quality changes are more prevalent than in primary sectors.

[7)] We do not consider the variables s_j and Y of equation (6) in the regression equation (7) since the importer is Korea only in this study.

[8)] China established the formal diplomatic relationship with Korea in 1992, and so trade data between China and Korea are available from 1992. We selected 96 countries whose trade data are available during the period. The list of countries is in the appendix.

There are measurement errors in highly disaggregated data. To mitigate the impact of these errors, we screen the raw data. First, all imports under 1,000 dollars are dropped. Second, we remove observations with extreme unit values 100 times above or below the product mean during the period. After filtering, the total number of observations in our data is 1,093,022, representing 88% of the observations in the full sample. The number of HS 10-digit manufacturing products in Korean trade was 7,036 categories in 1992 and 7,571 categories in 2008. In this paper, we refer to a product as a 10-digit level category. For each product we have data of product code (HS), country code, import value (US dollar), and shipment weight (kg). We use shipment weight as a measure of quantity, and thus the unit value of a product is calculated as the import value divided by weight.

Data for PPP-adjusted GDP and PPP GDP per capita of each country were obtained from the World Development Indicators of the World Bank. Data for distance between Korea and the trading partners were obtained from the database of Nicita and Olarreaga (2007).

3.2. Changes in Variety

Table 1 shows China's export margin relative to the rest of world in Korea's total manufacturing imports. China's export share relative to the rest of world has increased continuously throughout the study period accompanied by a continuous increase in both the extensive margin and the intensive margin. The overall share increased from 4.0% in 1992 to 43.7% in 2008 with an annual growth rate of 16.1%. In 1992, the extensive margin was 52.3% and the intensive margin was 7.6%, which indicates that only 52.3% of Korea's imported products were subject to direct competition with Chinese products, and that the value of imports from China was only 7.6% of the rest of world's within common product categories. However, in 2008, China's export product category overlapped with the rest of world, standing at about 91.0%, and China's share increased to 48.0% in overlapped product categories. The annual growth rate of the extensive margin is 3.5% while

Table 1 China's Export Margin Relative to the Rest of the World (1992-2008)

Year	Extensive Margin	Intensive Margin	Share (%)
1992	52.3	7.6	4.0
1993	53.3	7.9	4.2
1994	66.2	7.8	5.1
1995	71.1	9.2	6.5
1996	68.5	9.8	6.7
1997	73.2	11.6	8.5
1998	74.6	11.6	8.7
1999	80.5	11.3	9.1
2000	83.9	12.3	10.3
2001	85.4	15.5	13.2
2002	87.0	18.0	15.6
2003	87.7	20.9	18.3
2004	88.6	24.5	21.7
2005	91.5	28.5	26.0
2006	89.3	35.1	31.3
2007	90.2	43.9	39.6
2008	91.0	48.0	43.7
Average Annual Growth Rate	3.5	12.2	16.1

Note: Extensive margin and intensive margin are calculated by equation (2), and the share is the ratio of total imports from China relative to that from the rest of the world.
Sources: Korea Custom Office, Korean Trade Data, 2010.

the intensive margin grew 12.2% annually, indicating that the increase in the intensive margin is the major source of China's penetration into the Korean market during the period between 1992 and 2008. However, the share of extensive margin is still larger than that of intensive margin in Chinese trade with Korea.

The results show that China's export growth comes more from the

intensive margin than the extensive margin. The factors affecting the rise in the intensive margin can be decomposed into the changes in price and quality of China's export products. In other words, the increase in quantity penetration is due to lower price or improvements in quality of the products produced in China.

3.3. Changes in Price

We analyze the relative price level of Chinese products compared to those of other countries after controlling for income per capita and distance using equation (3). The regression of equation (3) was done year-by-year to measure price changes to China's products. Import price of a product in equation (3) is the unit value of a product calculated by import value divided by weight.

Table 2 shows the regression results for equation (3). For convenience, we report the estimated coefficients only, without *t*-values, since all estimated coefficients are significant at the 1% level. The coefficients for the variable *PCGDP* are positive, which implies that higher income countries export higher priced products. The coefficient of this variable ranges from 0.25-0.28 for all years, which means that if the income level of a country is 10% higher than that of another country, then the price of their export product will be 2.5-2.8% higher than that of the other country. The coefficient of *DIST* is positive, which implies that the Alchian-Allen effect is proved in our data.[9] That is, more distant countries export higher priced exports than countries that are near.

We are particularly interested in the regression coefficient of the China dummy variable. If the coefficient is negative, we conclude that China's products are cheaper in a given year than those of other countries. In table 2, the coefficient of *DC* is negative and it becomes smaller over time. It means

[9] Hummels and Skiba's (2004) study, which proved the Alchian-Allen effect, shows that the coefficient of freight cost has a positive effect on export price. We used the distance between the two countries as a proxy for freight cost.

Table 2 Changes in China's Relative Export Prices

Year	ln(*PCGDP*)	ln(*DIST*)	*DC*	R^2	*N*
1992	0.262	0.193	–0.179	0.178	21,640
1993	0.252	0.130	–0.376	0.177	24,937
1994	0.278	0.121	–0.351	0.186	31,825
1995	0.279	0.123	–0.362	0.179	37,511
1996	0.257	0.181	–0.343	0.168	42,193
1997	0.247	0.151	–0.457	0.163	46,372
1998	0.267	0.199	–0.385	0.181	35,600
1999	0.254	0.161	–0.513	0.173	46,062
2000	0.243	0.134	–0.607	0.164	53,821
2001	0.232	0.167	–0.596	0.158	56,509
2002	0.233	0.199	–0.595	0.165	61,491
2003	0.248	0.193	–0.646	0.176	66,638
2004	0.262	0.199	–0.634	0.182	68,783
2005	0.266	0.205	–0.630	0.186	70,990
2006	0.261	0.210	–0.637	0.187	69,881
2007	0.277	0.219	–0.614	0.191	67,102
2008	0.287	0.189	–0.628	0.184	66,671

Notes: The numbers in the second to fourth columns are the coefficients of explanatory variables estimated from equation (3). All coefficients are significant at the 1% level. *N* is the number of observations. The regression method is OLS.

that the price of Chinese products is lower than that of the other countries, and that Chinese product prices have declined relative to countries with similar income per capita over the study period. This result is consistent with that of Schott (2008), who showed that during the 1990s, Chinese products on average sold for a discount relative to products of countries with similar GDP per capita in the United States.

In sum, we have found that within highly disaggregated product categories, income per capita differences are correlated with differences in product prices. The product prices of higher income countries are higher than those

of low income countries. In particular, the prices of Chinese products are lower compared to those of other countries, and they have dropped over time. The decreasing lower prices of Chinese products might have a positive effect on China's rapid export growth into the Korean market. In the next section, we will consider the quality changes in Chinese products as an additional source affecting China's export growth.

3.4. Changes in Quality

In addition to lower price, elements other than relative product prices have affected the rapid growth of China's exports into the Korean market. We use equation (7) to measure the quality of Chinese export products.

Table 3 shows the regression results for equation (7). The regression analysis is done year-by-year to measure changes in quality. The estimated coefficient of *GDP* is positive with values of 0.58-0.61, explaining that a 10% increase in *GDP* is associated with a 5.8-6.1% increase in quantity imported. That is, large countries export more. The coefficient of product price *P* is negative, which conforms to the demand theory that higher priced goods will be in less demand. The estimated coefficients show that a 10% increase in a product's price will decrease the quantity imported by 11.1-12.4%, meaning that the price elasticity is elastic. The coefficients of variable *DIST* are negative and explain that a country that is 10% farther away will export 4.9-6.7% less. The results conform to the gravity model that explains that volume of trade between countries is positively related to the economy size of trading partners and negatively related to the distance between the two countries.

The coefficient of the China dummy variable *DC* was negative until 2003 and became positive in 2004. If a country can export more quantity compared to its product price, GDP, and distance, it might be because of the higher quality of its product. Thus, we can interpret the coefficient of this dummy variable as a quality factor. The negative coefficients of dummy variable *DC* show that China's product quality is lower than that of other

Table 3 Changes in China's Relative Export Qualities

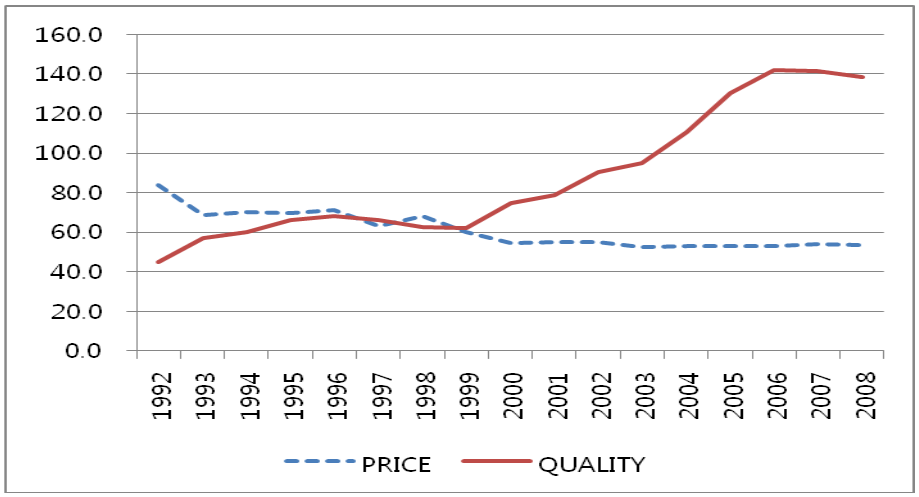
Year	ln(*GDP*)	ln(*P*)	ln(*DIST*)	*DC*	R^2	*N*
1992	0.583	–1.240	–0.614	–0.796	0.438	21,645
1993	0.569	–1.231	–0.576	–0.564	0.422	24,965
1994	0.607	–1.232	–0.526	–0.510	0.417	31,862
1995	0.626	–1.210	–0.505	–0.411	0.411	37,513
1996	0.639	–1.199	–0.490	–0.386	0.422	42,196
1997	0.630	–1.215	–0.517	–0.412	0.436	46,383
1998	0.562	–1.212	–0.509	–0.471	0.443	35,602
1999	0.588	–1.223	–0.574	–0.478	0.452	46,063
2000	0.609	–1.186	–0.569	–0.289	0.450	53,823
2001	0.588	–1.168	–0.579	–0.239	0.453	56,522
2002	0.582	–1.157	–0.594	–0.101	0.454	61,503
2003	0.600	–1.148	–0.647	–0.051	0.458	66,667
2004	0.599	–1.132	–0.662	0.100	0.455	68,813
2005	0.608	–1.133	–0.666	0.265	0.460	71,259
2006	0.594	–1.123	–0.660	0.350	0.476	70,192
2007	0.610	–1.137	–0.653	0.348	0.481	67,389
2008	0.610	–1.114	–0.679	0.324	0.466	66,704

Notes: The numbers in the second to fifth columns are the coefficients of explanatory variables estimated from equation (7). All coefficients are significant at the 1% level. *N* is the number of observations. The regression method is OLS.

countries. Table 3 shows that the coefficient of *DC* has increased over time, which explains that the quality of China's export product has improved over time.

Figure 1 shows the relative price level and the relative quality level of Chinese products, calculated from the coefficients of the variable *DC* from equations (3) and (7). Since the dependent variable is a log variable, the exponential value of the coefficient of *DC* denotes China's price level compared to other countries. For example, in table 2, the coefficient of *DC* is –0.179 for 1992, which means China's price level is 83.6% (=exp(–0.179)) of other countries. In 2008, China's price level compared to other countries

Figure 1 Changes in Relative Prices and Relative Qualities of Chinese Export Products



Note: The relative price level and relative quality level are calculated as exponential values of the coefficient of DC in equations (3) and (7).

decreased to 53.4% (=exp(–0.628)). With the same methodology, we can calculate the quality level of Chinese export products using the estimated coefficient of *DC* in table 3. The quality level of Chinese products was 45.1% of other countries in 1992, but it increased to 138.3% of other countries in 2008. We can see from figure 1 that quality of Chinese exports has improved during the period, while its relative price compared to other countries has been declining over time.

4. CONTRIBUTIONS OF VARIETY, PRICE, AND QUALITY CHANGES TO CHINA'S EXPORT GROWTH

As shown in table 1, the import share from China has increased significantly since 1992, and its annual growth rate is 16.1%. China's rapid export growth was due to changes in variety, price, and quality. The variety of Chinese export products measured by the extensive margin has increased

from 52.3 to 91.0 with an annual growth rate of 3.5% as shown in table 1. The intensive margin has increased with annual growth rate of 12.2%. Factors affecting increases in intensive margin can be decomposed into changes in price and quality. As seen in figure 1, the price level has decreased and the quality level has increased during the period. Average annual growth rates of price and quality are –2.8% and 7.3%, respectively. From these results, we can say that three factors, which are increase in variety, decrease in price, and increase in quality, have contributed to China's rapid export growth to the Korean market during the period of 1992-2008.

To examine the contributions of variety, price, and quality to China's export growth into the Korean market, we used regression analysis with the following equation:

$$\log(SH_{jt}) = \alpha_0 + \beta_1 \log(EM_{jt}) + \beta_2 \log(PR_{jt}) + \beta_3 \log(QL_{jt}) + \varepsilon_{jt}, \qquad (8)$$

where *SH* is import share from China, *EM* is extensive margin, *PR* is price level, and *QL* is quality level. *j* and *t* denote sector and time, respectively.

The values of *SH*, *EM*, *PR*, and *QL* in tables 1 to 3 are estimated from all products together, and so we have only one summary index for each year. In this case, the number of observations is only 17 and the degree of freedom is not enough to conduct regression analysis. To increase the degree of freedom, we measured these values by the Standard International Trade Classification (SITC) 2-digit level. There are 35 SITC 2-digit sectors in manufacturing. Thus, the number of observation increases to 595 (35 sectors·17years).

Table 4 shows the regression results and the contribution of each factor to China's export growth into the Korean market. In table 4, regression (1) uses values estimated from total products, and regression (2) uses values estimated by the SITC 2-digit level. In regression (2) of table 4, which used SITC 2-digit level data, the coefficients of the variety and quality are positive, and that of price is negative, which implies that increases in variety and quality have positive effects on export share, while increase in price has a

Table 4 Contributions of Variety, Price, and Quality Changes to China's Export Growth

	Regression (1)	Regression (2)	Contribution of Factors (%)		
	Total	SITC 2-digit Level	Factor	Total	SITC 2-digit Level
Intercept	–2.14 (0.89)	–2.40*** (14.92)			
log(*EM*)	1.16* (1.89)	0.80*** (12.56)	Variety	26.4%	23.7%
log(*PR*)	0.16 (0.21)	–0.34*** (3.40)	Price	–2.9%	8.0%
log(*QL*)	1.63*** (7.44)	1.11*** (25.26)	Quality	76.5%	68.2%
R^2	0.962	0.879		100.0%	100.0%
N	17	595			

Notes: Regression (1) uses year-average data for all products and regression (2) uses year-average by 35 SITC 2-digit data. In regression (2), industry fixed effects are considered, but not reported here. The values in parentheses are *t*-values, and * and *** denote significance at the 10% and 1% levels, respectively. Contribution of factors is measured as percentage of fitted value considering the observed average growth in extensive margin (3.52%), price change (–2.77%), and quality change (7.25%). The regression method is OLS.

negative effect on export share. In regression (2), the coefficient of ln(*EM*) shows that a 10% increase in varieties is associated with an 8.0% increase in overall share. The coefficient of ln(*PR*) is estimated to be –0.34, meaning that a 10% increase in price is associated with a 3.4% decrease in overall share. Finally, the coefficient of quality is estimated to be 1.11, meaning a 10% increase in product quality is associated with an 11.1% increase in overall share. The results of regression (1) are similar to those of regression (2), except that the coefficient of ln(*PR*) is positive but insignificant. The coefficient of quality is the largest among the three factors, which suggests that quality changes have the biggest effect on export share.

We measure the contributions of variety, price, and quality changes of Chinese products on China's export growth using the percentage of fitted values in the regression. We use the observed average growth of each explanatory variable obtained in tables 1 to 3, where the average growth of

the extensive margin is 3.52%, that of price is –2.77%, and that of quality is 7.25%. The right part of table 4 shows the contribution of each factor to China's export growth.[10] It indicates that the increase in variety has contributed to increase China's export share by 23.7-26.4%. The fall in Chinese product price explains –2.9% of export growth when measured at all industries, but explains 8.0% of export growth when measured at the SITC 2-digit level. The increase in quality of Chinese products explains 68.2-76.5% of export growth.

The results for the contribution of each factor show that the rapid increase in China's export share is mostly due to improvements in the quality of Chinese export products. The next factor contributing to China's export growth is increase in variety. The lower price of Chinese products has also contributed to export growth, but its effect is small. The main factors affecting China's export growth into the Korean market are improvements to the quality of Chinese export products as well as the rise in product varieties available from China.

5. CONCLUSIONS

China's trade with Korea has grown rapidly since 1992, when China started to trade with Korea. From 1992 to 2008, the annual average growth rate of Korea's imports from China was 20.8%, while that of Korea's total imports from all over the world was only 11.0%. In 1992, China's share in Korean total imports accounted for only 4.6%, and by 2008 the share had climbed to 17.7%. Now China has become Korea's most important trading partner.

This paper analyses the changes in variety, price, and quality of Chinese

[10] Contributions of factors are calculated as follows. If we put average growth of *EM* (3.52%), *PR*(–2.77%), and *QL*(7.25%) obtained from table 1-3 in equation (8), the average growth rate of SH is estimated as 15.47%. Thus, the contribution of variety can be 26.4% (=1.16·3.52/15.47), that of price is –2.9%(=0.16·(–2.77)/15.47), and that of quality is 76.5%(=1.63·7.25/15.47).

export products, and their contribution to China's export growth into the Korean market, using HS 10-digit highly disaggregated Korean trade data between the years 1992 and 2008. We also suggest an empirical model for estimating the price level and quality level of Chinese products.

The results show that China's strong export penetration relative to the rest of the world into the Korean market is mainly explained by an increase in the intensive margin. The annual growth rate of the intensive margin was 12.2%, while the extensive margin grew 3.5% annually during the period between 1992 and 2008. The factors affecting the rise in the intensive margin were decomposed into changes in price and quality. The results show that the price level of Chinese products is lower than that of other countries, and that the relative price of Chinese products to those of other countries lowered over time. However, the relative quality of Chinese products was lower than that of other countries until 2003, but became higher starting in 2004. Moreover, China's product quality has improved over time. The annual average growth rate of price was –2.77% and that of quality was 7.25% during the period of 1992 to 2008.

We measured the contributions of variety, price, and quality changes to China's export growth using the percentage of fitted values in the regression. The results show that the increase in variety has contributed to the growth of China's export share by 23.7-26.4%, the fall in Chinese product price explains –2.9% or 8.0% of export growth, and the increase in the quality of Chinese products explains 68.2-76.5% of export growth. These findings show that the rapid increase in China's export share is mostly due to improvements in the quality of Chinese export products. The next factor contributing to Chinese export growth is the increase in variety. The lower price of Chinese products has also contributed to export growth, but its effect is small.

Our analysis shows that quality improvements to Chinese export products is the main factor affecting China's export growth in the Korean market. However, it needs to think the limitation of this study in calculation of quality changes. The dummy variable may represent quality change as well

as other effects, and thus the estimated quality change measured with dummy variable may be overestimated. We have to refine the regression equation for estimating quality changes, and also have to develop the related econometric issues in future researches.

APPENDIX

Table A1 List of 96 Countries Used in this Study

No.	Nation	No.	Nation	No.	Nation	No.	Nation	No.	Nation
1	ALGERIA	21	ECUADOR	41	JAMAICA	61	NEW ZEALAND	81	SYRIA
2	ARGENTINA	22	EGYPT	42	JORDAN	62	OMAN	82	SWEDEN
3	AUSTRALIA	23	FINLAND	43	JAPAN	63	PAKISTAN	83	SWITZERL-AND
4	AUSTRIA	24	FIJI	44	KAZAKHST-AN	64	PANAMA	84	SWAZILAND
5	BELGIUM	25	FRANCE	45	KENYA	65	PERU	85	THAILAND
6	BANGLADE-SH	26	UNITED KINGDOM	46	KUWAIT	66	PHILIPPINES	86	TUNISIA
7	BULGARIA	27	GERMANY	47	LEBANON	67	POLAND	87	TURKEY
8	BAHRAIN	28	GHANA	48	LIBYA	68	PORTUGAL	88	UNITED ARAB EMIRATES
9	BRAZIL	29	GREECE	49	SRILANKA	69	PARAGUAY	89	URUGUAY
10	BURMA(MY ANMAR)	30	GUATEMALA	50	LITHUANIA	70	PUERTO RICO	90	UNITED STATES
11	CANADA	31	GUAM	51	MACAO	71	QATAR	91	UKRAINIAN
12	CHILE	32	HONG KONG	52	MOROCCO	72	ROMANIA	92	UZBEKIST-AN
13	CHINA	33	HONDURAS	53	MEXICO	73	RUSSIA	93	VIETNAM
14	CAMEROON	34	HUNGARY	54	MONGOLIA	74	SOUTH AFRICA	94	VENEZUE-LA
15	COLOMBIA	35	INDONESIA	55	MAURITIUS	75	SAUDI ARABIA	95	YEMEN
16	COSTARICA	36	INDIA	56	MALAYSIA	76	SUDAN	96	SLOVENIA
17	CYPRUS	37	IRELAND	57	NIGERIA	77	SINGAPORE		
18	CZECHO REPUBLIC	38	IRAN	58	NETHERLA-NDS	78	SLOVAKIA		
19	DENMARK	39	ISRAEL	59	NORWAY	79	EL SALVADOR		
20	DOMINICAN REPUBLIC	40	ITALY	60	NEPAL	80	SPAIN		

REFERENCES

Alvarez, Roberto and Sebastian Claro, "The China Phenomenon: Price, Quality or Variety," Working Papers Central Bank of Chile, 411, Central Bank of Chile, 2006.

_____, "On the Source of China's Export Growth," Working Paper No. 426, Central Bank of Chile, 2007.

Amiti, Mary and Caroline Freund, "The anatomy of China's Export Growth," World Bank Policy Research Working Paper, No. 4628, World Bank, 2008.

Branstetter, L. and N. Lardy, "China's Embrace of Globalization," NBER Working Paper, No. 12373, 2006.

Broda, C. and D. Weinstein, "Globalization and the Gains from Varieties," *Quarterly Journal of Economics*, 121(2), 2006, pp. 541-585.

Hallak, J. C., "Product Quality and the Direction of Trade," *Journal of International Economics*, 68(1), 2006, pp. 238-265.

Hallak, J. C. and P. Schott, "Estimating Cross-country Differences in Product Quality," NBER Working Papers, No. 13807, 2008.

Han, Kwangsuk and Jaeho Lee, "FDI and Vertical Intra-Industry Trade between Korea and China," *Korea and the World Economy*, 13(1), 2012, pp. 115-139.

Hummels, D. and P. Klenow, "The Variety and Quality of a Nation's Exports," *American Economic Review*, 95, 2005, pp. 704-723.

Hummels, D. and A. Skiba, "Shipping the Good Apples Out? An Empirical Confirmation of the Alchian-Allen Conjecture," *Journal of Political Economy*, 112(6), 2004, pp. 1384-1402.

Kang, Kichun and Byung Chul Ahn, "China's Penetration of the Korean Market: Stylized Facts and Welfare Effect," *China & World Economy*, 18(5), 2010, pp. 54-71.

Kim, Joon-Kyung, Yangseon Kim, and Chung H. Lee, "Trade and Investment between China and South Korea: Toward a Long-term Partnership," *The Journal of the Korean Economy*, 5(1), 2004, pp. 97-

124.

Krishna, Pravin and William F. Maloney, "Export Quality Dynamics," Policy Research Working Paper, No. 5701, The World Bank, 2011.

Leamer, E. E., "The Heckscher-Ohlin Model in Theory and Practice," *Princeton Studies in International Finance*, 77, 1995.

Nicita, A. and M. Olarreaga, "Trade, Production and Protection 1976-2004," *World Bank Economic Review*, 21(1), 2007, pp. 165-171.

Nicolas, Françoise, "The Changing Economic Relations between China and Korea: Patterns, Trends and Policy Implications," *The Journal of the Korean Economy*, 10(3), 2009, pp. 341-365.

Rodrik, Dani, "What's So Special About China's Exports?," *China & World Economy*, 14(5), 2006, pp. 1-19.

Schott, P. K., "Do Rich and Poor Countries Specialize in a Different Mix of Goods? Evidence from Product-level US Trade Data," NBER Working Paper, No. 8492, 2001.

_____, "The Relative Sophistication of Chinese Exports," *Economic Policy*, 23(1), 2008, pp. 5-49.