(Extended Abstract)

Do Chinese and Korean products compete in the Japanese market? An investigation of machinery exports

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Abstract

The purpose of this paper is to examine whether and to what extent Chinese and Korean products in the machinery industry compete with each other in the Japanese market. Empirical tests of panel data of 16 machinery products from 2000Q1 to 2012Q3 show that a decrease in unit prices of Chinese exports leads to an increase in Chinese exports to Japan and a decrease in Korean exports to Japan. In contrast, a decrease in unit prices of Korean exports leads to an increase in Korean exports to Japan but does not affect Chinese exports to Japan. In addition, panel VAR analyses indicate that a decrease in Chinese prices leads to a substantial decrease in Korean prices, but the opposite effect is very small. Overall, Korean exports and export unit prices are influenced by Chinese variables, but Chinese exports and export unit prices are rarely influenced by Korean variables.

I. Introduction

The purpose of this paper is to examine whether and to what extent Chinese machinery commodities are competing with Korean machinery commodities in the Japanese market. Specifically, this paper examines the cross-price elasticity in the export function of each country to determine whether the unit prices of one country affect exports of the other country. In addition, the impact of exchange rates on unit prices is also investigated to understand whether exchange rates affect export volumes through price changes.

The machinery industry[1] is the biggest export engine in both China and Korea. The share of the machinery industry in China's total exports to Japan is around 43% and that of Korea is around 31% as of 2011. As Figure 1 shows, the machinery share of China's exports has continually increased since 2000, and that of Korea has been between 40 and 50% from 2000 to 2010. This share in Korea declined to 33% in 2011 not because Korea's machinery exports to Japan decreased but because Korea's exports in some other sectors, such as food and chemicals, increased more rapidly due to the huge earthquake of March 11th of that year. Therefore, the machinery industry is still the most important sector in both China's and Korea's exports to Japan.

Meanwhile, as Table 1 shows, most of the machinery products exported from Korea to Japan are also exported from China. For example, in 2011 China exported 1190 items at the HS 9-digit level, while Korea exported 1018 items. Among them, 978 items were exported from both countries. Moreover, among the top 50 commodities on the list of Korean exports to Japan in the machinery industry, as Figure 2 shows, approximately 20 items are also on the Chinese list in the time period from 2000 to 2011. Those overlaps obviously imply the possibility of competition between the two countries in the Japanese machinery import market.

II. Methodology

1. Commodities included in econometric analyses

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1 In this paper, the machinery industry means the sectors whose HS codes range from 84 to 93. The trade data between China/Korea and Japan were obtained from the trade statistics of Japan Customs.

The machinery industry produces and exports more than a thousand commodities at the 9-digit level of the HS code both in China and Korea. However, because the export values of a number of commodities are very small relative to a small number of major exports, this paper confines its analysis to the major export commodities of the industry. For example, the biggest value of a commodity (HS code: 8517.12-000) exported from Korea to Japan in 2011 was 134 billion yen, while the smallest value was only 201 thousand yen. In fact, only 144 out of 1018 commodities exported from Korea to Japan in 2011 had export values bigger than 1 million yen.

Therefore, we selected the top 100 commodities on the 2011 list of Korean exports to Japan in the machinery industry with regard to their export values, and also the top 100 commodities on the Chinese list. Among them, 49 items were included in both lists. Then, the top 30 out of those 49 commodities were selected from the Korean list with regard to their export values. Because 16 out of those 30 commodities have been exported to Japan from both China and Korea since 2005, while the other 14 commodities were exported to Japan for a relatively short time period, those 16 commodities were finally chosen for econometric analyses. However, it should be noted that 3 out of the finally chosen 16 commodities were not exported from 2000 to 2004. Therefore, the sample size of the panel data analyzed in this paper is 740 ('16 times 50' minus '3 times 20,' that is, 16 commodities for 50 quarters from 2000Q1 to 2012Q2 minus 3 commodities for 20 quarters from 2000Q1 to 2004Q4). The 16 commodities analyzed in this paper are listed in Table 2. In addition, their values are illustrated in Figure 3.

2. Econometrics models

2.1. Export functions

This paper estimates the Chinese and the Korean export functions in which the dependent variable is machinery exports from either China or Korea to Japan. Explanatory variables include export unit prices, GDP of Japan, and total exports of Japan which are not linearly related to GDP of Japan.

Specifically, the export function of each country has the following form:

$$Y_{it}^{j} = \xi_0 + \xi_1 p_{it}^{K} + \xi_2 p_{it}^{C} + \xi_3 . g_{it} + \xi_4 x_{it} + \varepsilon_{it} \quad \text{------ (1)}$$

where Y_{it}^{j} denotes the quantity of commodity i at time t exported from China to Japan if j is China or exported from Korea to Japan if j is Korea. Two price variables, p_{it}^{K} and p_{it}^{C}, are the unit price of Korean commodity i and the unit price of Chinese commodity i, respectively. The last two variables, g_{it} and x_{it}, are the real GDP of Japan and the real exports of Japan, respectively. Since the real exports of Japan may be linearly correlated to the real GDP of Japan, leading to the multi-linearity problem in the estimation of the export functions, only those parts of exports which are not linearly related to the GDP are used as x_{it}. More specifically, x_{it} is the residuals from the regression of the real exports of Japan on the real GDP of Japan.

2.2. Unit price functions

While the main purpose of equation (1) is to estimate the impact of unit prices on the Chinese and the Korean exports, this section estimates unit price functions to determine the factors which affect unit prices. In particular, this section examines whether the unit prices of one country affect the unit prices of the other country using the panel VAR. In addition, the bilateral real exchange rate between Japan and China (or Korea) is also included as an exogenous explanatory variable to examine whether unit prices are affected by exchange rates.

Specifically, the unit price function of each country has the following form:

$$p_{it}^{j} = \alpha_0 + \alpha_{1,1} p_{it-1}^{K} + \alpha_{1,2} p_{it-2}^{K} + \alpha_{2,1} p_{it-1}^{C} + \alpha_{2,2} p_{it-2}^{C} + \alpha_3 . er_{it}^{j} + \varepsilon_{it} \quad \text{------ (2)}$$

where the superscript, j, is either K (Korea) or C (China), as before, and er_{it}^{j} denotes the exchange rate of country j's currency against the Japanese yen. The lag length of the panel VAR is confined to 2 based on F-tests and the Akaike criterion.

3. Data Sources

The trade statistics of Japan Customs provide the value and the quantity of each item imported to Japan at the HS 9 digit-level. The data for the quantity of each item imported to Japan (Y_{it}^{j}) are directly obtained from the trade statistics of Japan Customs, and the data for unit prices (p_{it}^{K} and p_{it}^{C}) are obtained by dividing the value of each item by the quantity. The real GDP of Japan and nominal exchange rates are collected from the International Financial Statistics (IFS). Finally, the total exports of Japan are obtained from the Direction of Trade Statistics (DOTS).

III. Empirical Results

1. Panel unit root tests

Since the panel data set contains relatively longer time series (50 quarters, 2000Q1 to 2012Q2) compared to cross-sections (16 products), non-stationarity of each time series and cointegration among variables may generate statistical problems when the OLS is employed to estimate equations 1 and 2. Therefore, panel unit root tests are performed for each variable in equations 1 and 2.

As seen in Table 3, the results of the panel unit root test proposed by Levin, Lin and Chu (2002) indicate no unit root for all the variables except for exchange rates at 5 percent significance level. In contrast, a unit root is strongly detected in the Chinese (er_{it}^{C}) and in the Korean exchange rate (er_{it}^{K}). Accordingly, in the case of exchange rates, either levels or first differences are used in estimation, while only levels are used for all other variables.

2. Estimation of export functions

Table 4 shows the estimation results of equation (1) for each country. In the estimation of a fixed effects model, fixed effects are included only for cross-sections. The unit price of a commodity turns out to have similar effects on the exported quantity both in the Chinese and the Korean export function. If the unit price of a Korean commodity increases by 1%, the export quantity of the Korean commodity decreases by 0.64%. Similarly, if the unit price of a Chinese commodity increases by 1%, the export quantity of the Chinese commodity decreases by 0.59%.

Of interest is the difference in the cross-price elasticity estimates. If the Chinese unit price of a commodity increases by 1%, the Korean export of the commodity increases by 0.17%, implying Korean commodities are substitutes for Chinese commodities. In contrast, the impact of the Korean unit price of a commodity on the Chinese export of the commodity is statistically insignificant.

Table 3 also shows that the Chinese and Korean exports positively respond to the economic activity of Japan. The income elasticity in the Chinese export function is 18.7, and it is 4.6 in the Korean export function. The income elasticity in the Korean export function, 4.6, is close to the income elasticity in Korea's total export to Japan reported in Baak (2013). Baak (2013) estimates four bilateral export functions for Korea (from Korea to China, the Euro Area, Japan, and the US), and reports that the income elasticity is the highest in the export function of Korea to Japan.

In addition, the estimation results indicate that the Chinese and the Korean exports depend on the total exports of Japan. Baak (2013) reports that Korean exports are positively related to the total exports of importing countries only in the case of Korean exports to China and Japan. According to Baak (2013), the total exports of the Euro Area and the US are not positively related to Korean exports to the Euro Area and the US. Baak (2013) conjectures that it may be due to the production network in East Asia. The findings of the present paper are consistent with the findings of Baak (2013), even though the former uses commodity level data and the latter uses country level data.

3. Estimation of unit price functions

Table 5, which reports the estimation results of equation (2), has two columns under each country since either the level or the first difference of exchange rates is used to estimate equations (2). The first column under each country reports the results when the level is used, while the second column reports the results when the first difference is used. The estimation results of other variables than the exchange rate are affected only marginally by the choice between the level and the first difference of exchange rates. Therefore, the discussions with regard to the estimated coefficient values of other variables than the exchange rate will be based only on the numbers reported in the first columns for simplicity.

The results reported in Table 5 show that the relationship between the current unit prices and lagged unit prices is very similar in the Chinese and the Korean functions. For example, the coefficient of one-lagged unit prices is 0.415 in Korea and 0.506 in China, while the coefficient of two-lagged unit prices is 0.280 in Korea and 0.276 in China.

However, the cross-effects of unit prices are different in the functions of the two countries. While Chinese unit prices in the previous quarter have positive and significant impact (0.155) on the current Korean unit prices, Korean unit prices in the previous quarter do not have a significant impact on the current Chinese unit prices. Even though Korean unit prices two quarters before have a positive impact on the current Chinese unit prices (0.033), the size of the coefficient is quite small. Overall, the estimation results strongly indicate that Korean unit prices increase or decrease following Chinese unit prices, but Chinese unit prices do not.

Table 5 also shows the impact of exchange rates on unit prices. When the level is used (the first column) the coefficient of exchange rates in the Chinese VAR is very small and strongly insignificant. On the other hand, the coefficient of exchange rates in the Korean VAR is a substantial negative number (-0.113), and it is marginally significant (p-value=0.127), implying that depreciation of the Korean won decreases Korean unit prices.

In contrast, when the first difference is used, the coefficient of exchange rates in the Chinese VAR is negative and substantial. Moreover, it is significant at the five percent significance level. On the other hand, the coefficient of exchange rates in the Korean VAR is insignificant (p-value=0.330) although it is negative and substantial.

These findings indicate that Chinese unit prices decrease when the depreciation rate of renminbi increases. Korean unit prices seem to decrease when the Korean won depreciate or when the depreciation rate increases. However, the evidence of that connection is statistically weak.

IV. Conclusion

This paper estimated export functions and unit price functions of China and Korea to determine whether and to what extent the machinery products of the two countries compete in the Japanese market.

The estimation results using 740 panel observations of 16 machinery products from 2000Q1 to 2012Q2 indicate that Korean exports decrease if Chinese unit prices decline, but that Chinese exports are not affected by changes in Korean unit prices.

In addition, while decreases in Chinese unit prices lead to decreases in Korean unit prices, the opposite effect is very small or insignificant. Overall, Korean exports and export unit prices are influenced by Chinese variables, but Chinese exports and export unit prices are rarely influenced by Korean variables.

Table 1. Number of machinery commodities exported to Japan from China and Korea

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Korea & China	925	944	974	989	987	1047	1035	1034	1006	975	977	978
Korea	1050	1068	1069	1079	1093	1104	1074	1069	1046	1024	1013	1018
China	1085	1115	1151	1173	1173	1237	1233	1202	1190	1177	1188	1190

Data source: Trade Statistics of Japan Customs

Table 2. The 16 machinery commodities analyzed in the paper

	CODE	NAME
1	8431.49-020	Parts suitable for use solely or principally with the machinery of headings 84.25 to 84.30 - Of machinery of heading 84.26, 84.29 or 84.30 - Other -- Other
2	8466.93-000	Parts and accessories suitable for use solely or principally with the machines of headings 84.56 to 84.65, including work or tool holders, self-opening dieheads, dividing heads and other special attachments for machine-tools; tool holders for any type of tool for working in the hand - Other -- For machines of heading 84.56 to 84.61
3	8471.30-000	Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included - Portable automatic data processing machines, weighing not more than 10 kg, consisting of at least a central processing unit, a keyboard and a display
4	8471.41-000	Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included - Other automatic data processing machines -- Comprising in the same housing at least a central processing unit and an input and output unit, whether or not combined
5	8479.89-000	Machines and mechanical appliances having individual functions, not specified or included elsewhere in this Chapter - Other machines and mechanical appliances -- Other
6	8480.71-000	Moulding boxes for metal foundry; mould bases; moulding patterns; moulds for metal (other than ingot moulds), metal carbides, glass, mineral materials, rubber or plastics - Moulds for rubber or plastics -- Injection or compression types

7	8481.90-000	Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or the like, including pressure-reducing valves and thermostatically controlled valves - Parts
8	8483.40-090	Transmission shafts (including cam shafts and crank shafts) and cranks; bearing housings and plain shaft bearings; gears and gearing; ball or roller screws; gear boxes and other speed changers, including torque converters; flywheels and pulleys, including pulley blocks; clutches and shaft couplings (including universal joints) - Gears and gearing, other than toothed wheels, chain sprockets and other transmission elements presented separately; ball or roller screws; gear boxes and other speed changers, including torque converters -- Other
9	8529.90-111	Parts suitable for use solely or principally with the apparatus of heading 85.25 to 85.28 - Other -- Display modules --- Incorporating liquid crystal devices (LCD) ---- Of display diagonal of less than 59cm
10	8529.90-113	Parts suitable for use solely or principally with the apparatus of heading 85.25 to 85.28 - Other -- Display modules --- Incorporating liquid crystal devices (LCD) ---- Of display diagonal of 76cm or more
11	8529.90-900	Parts suitable for use solely or principally with the apparatus of heading 85.25 to 85.28 - Other --Other
12	8534.00-000	Printed circuits
13	8708.29-000	Parts and accessories of the motor vehicles of headings 87.01 to 87.05 - Other parts and accessories of bodies (including cabs) -- Other
14	8708.70-090	Parts and accessories of the motor vehicles of headings 87.01 to 87.05 - Road wheels and parts and accessories thereof - Other
15	8708.99-090	Parts and accessories of the motor vehicles of headings 87.01 to 87.05 - Other parts and accessories -- Other --- Other
16	9013.80-000	Liquid crystal devices not constituting articles provided for more specifically in other headings; lasers, other than laser diodes; other optical appliances and instruments, not specified or included elsewhere in this Chapter - Other devices, appliances and instruments

Table 3. Panel unit root test results

variable	p-value	variable	p-value
Y_{it}^{C}	0.000	g_{it}	0.001
Y_{it}^{K}	0.009	x_{it}	0.000
p_{it}^{C}	0.000	er_{it}^{C}	0.639
p_{it}^{K}	0.004	er_{it}^{K}	0.999

Notes: (1) This table shows the results of the Levin, Lin and Chu (   ) test. In the test, the null hypothesis assumes a common unit root process.

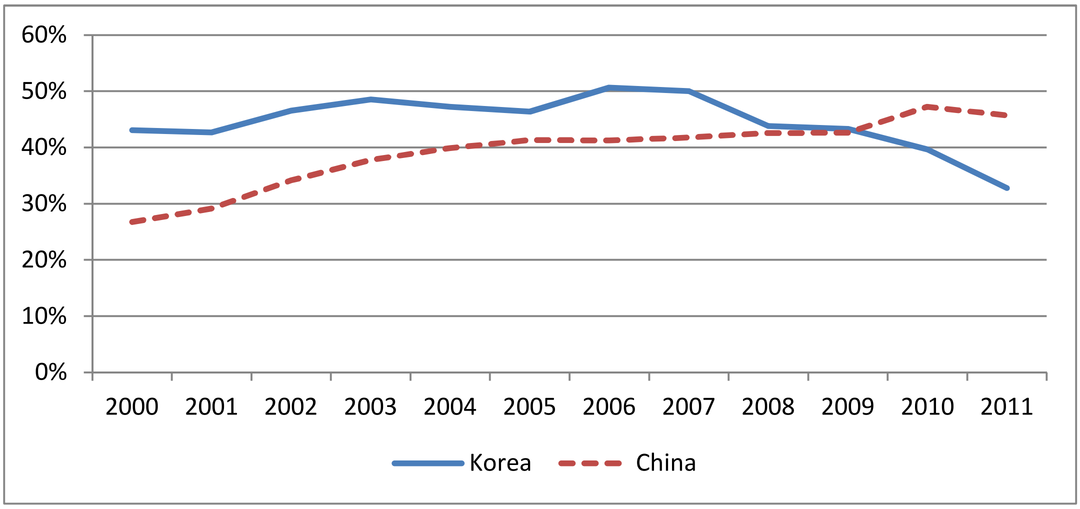
Table 4. Estimation of Korean and Chinese export functions

		Korean Export to Japan	**Chinese Export to Japan**
Constant	Coefficient	-7.526	-71.190
	P-Value	0.146	0.000
Korean Price	Coefficient	-0.637	0.070
	P-Value	0.000	0.191
Chinese Price	Coefficient	0.171	-0.587
	P-Value	0.093	0.000
GDP of Japan	Coefficient	4.612	18.712
	P-Value	0.000	0.000
Export of Japan	Coefficient	1.103	4.011
	P-Value	0.082	0.000
R2		0.877	0.869
Adjusted R2		0.874	0.866

Table 5. Effects of exchange rate on unit price

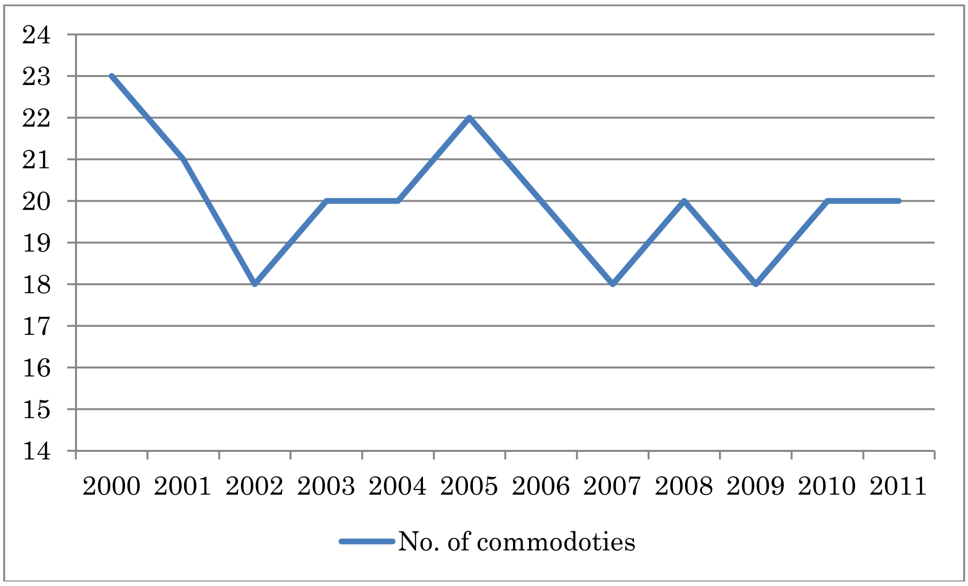
		Unit Price of Korean Exports		**Unit Price of Chinese Exports**	
Constant	Coefficient	0.449*	0.035*	0.146	-0.004
	P-Value	0.010	0.037	0.571	0.661
Korean Price (one lag)	Coefficient	0.445*	0.485*	0.020	0.029
	P-Value	0.000	0.000	0.301	0.130
Korean Price (two lags)	Coefficient	0.280*	0.343*	***0.033****	***0.047****
	P-Value	0.000	0.000	0.078	0.013
Chinese Price (one lag)	Coefficient	***0.155****	***0.214****	0.506*	0.589*
	P-Value	0.015	0.001	0.000	0.000
Chinese Price (two lags)	Coefficient	-0.088	-0.062	0.276*	0.334*
	P-Value	0.145	0.298	0.000	0.000
Won/Yen (level)	Coefficient	-0.113			
	P-Value	0.127			
Yuan/Yen (level)	Coefficient			0.005	
	P-Value			0.956	
Won/Yen (1^{st} diff.)	Coefficient		-0.208		
	P-Value		0.330		
Yuan/Yen (1^{st} diff.)	Coefficient				-0.427*
	P-Value				0.039
R2		0.963	0.961	0.990	0.990
Adjusted R2		0.962	0.960	0.990	0.989

Figure 1. Share of machinery exports in the total exports of China and Korea to Japan



Data: Computed by the author using the data from the Trade Statistics of Japan Customs

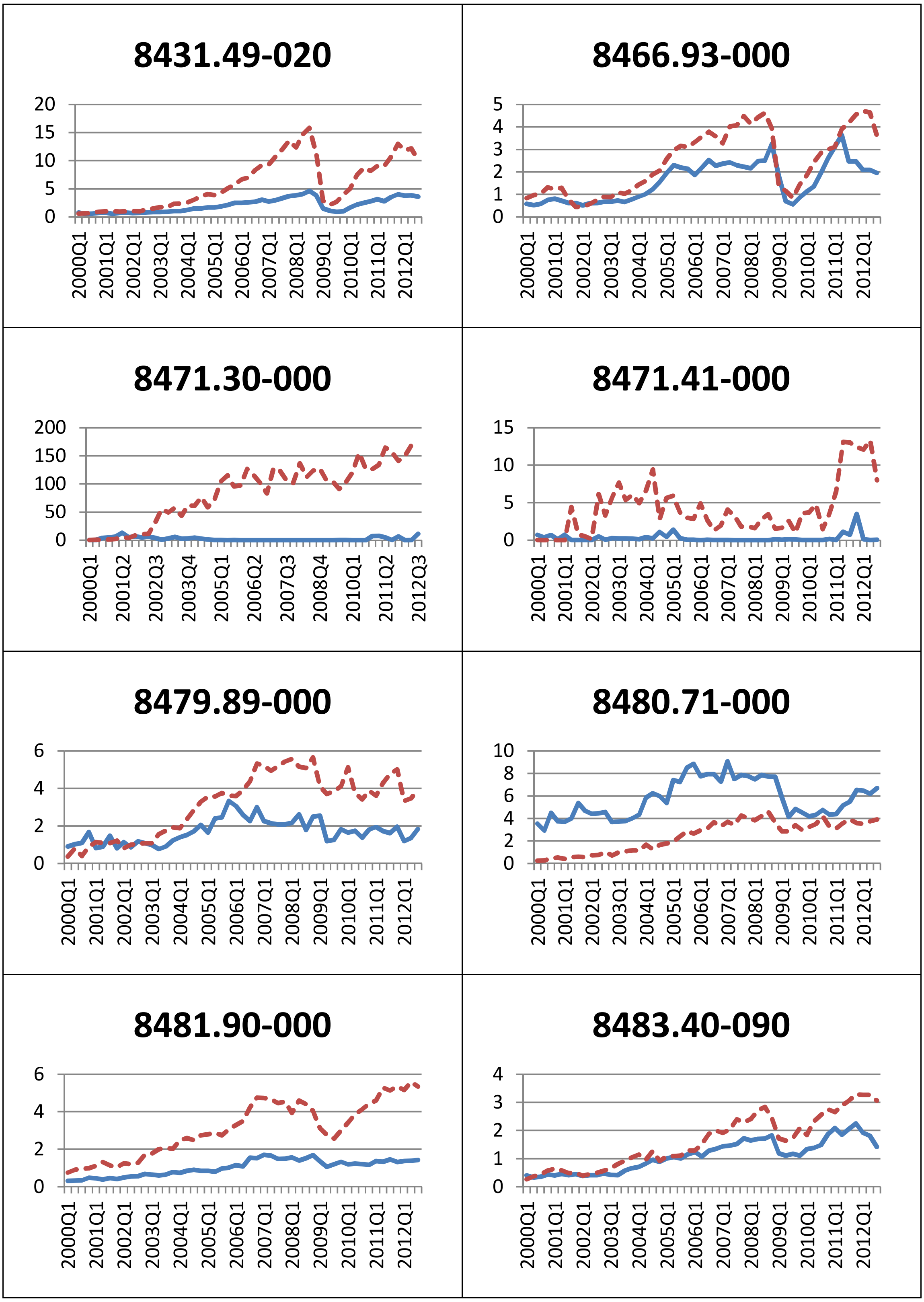
Figure 2. Number of commodities overlapped on the top 50 lists



Data: Computed by the author using the data from the Trade Statistics of Japan Customs

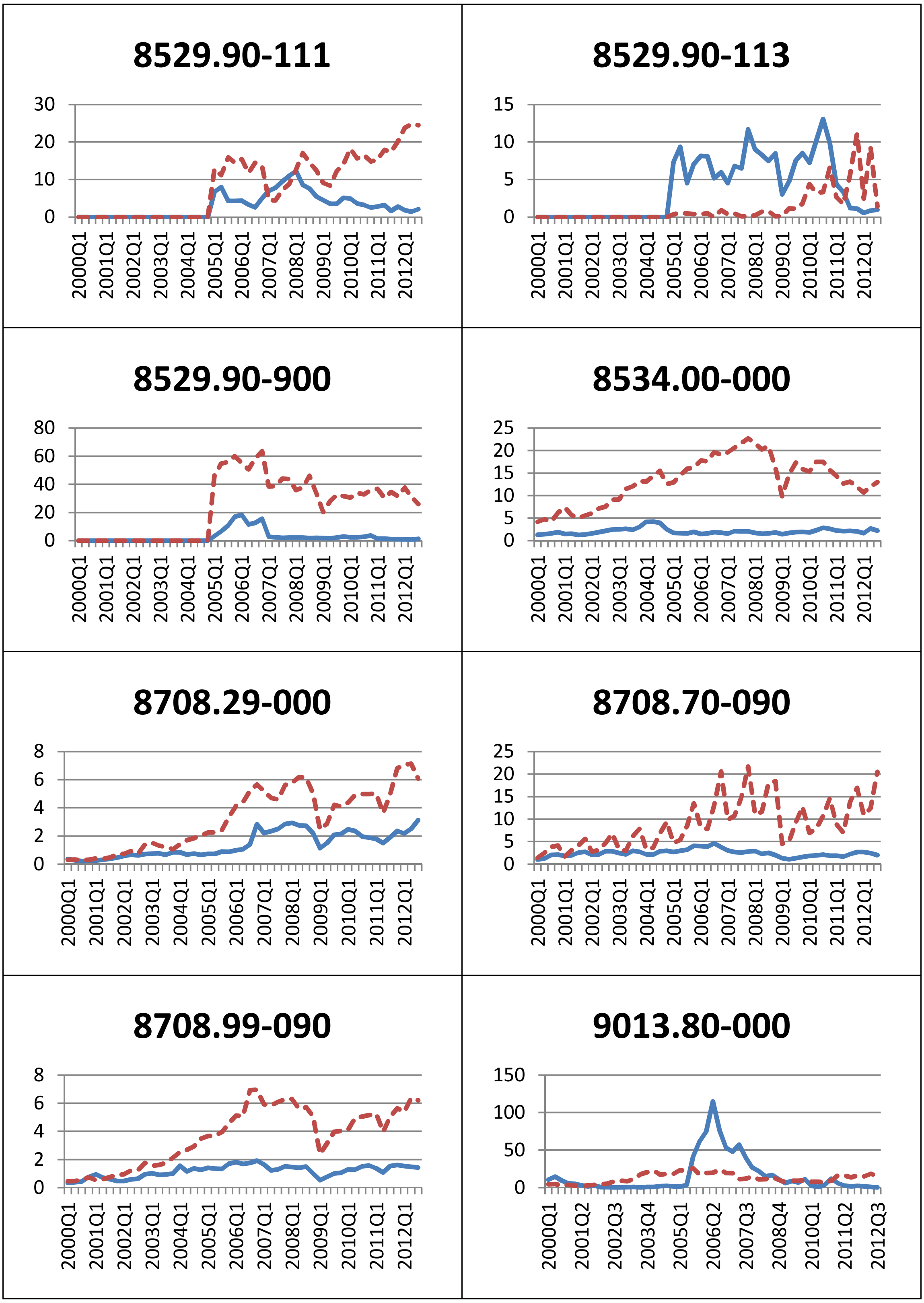
Note: The graph shows the number of commodities which are among the top 50 commodities both in China and Korea with regard to their export values.

Figure 3. 16 Values of commodities included in the analyses



The real and the dotted lines are the export values of Korean and Chinese commodities, respectively

Figure 3. 16 Values of commodities included in the analyses - continued



The real and the dotted lines are the export values of Korean and Chinese commodities, respectively