How Do Currency Fluctuations Affect Exports of China, Japan, and South Korea?[a]

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Abstract

This paper examines trades and trade relationships among China, Japan, and South Korea. It shows that China possesses a large comparative advantage in labor-intensive products, while Japan and Korea maintain large comparative advantages in capital-intensive products. Using quarterly data for the three countries from 1981 to 2002, the paper evaluates the effect caused by depreciation of Yen on the exports of China and South Korea. Our empirical results prove a positive impact of depreciation of Yen on China's export but a negative impact on Korea's export. This finding suggests that Japan is competing with South Korea in terms of exports, but not with China. The perceived threat of China may not exist, although it could be a catalyst for promoting economic development and international competitiveness of the three countries.

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1. Introduction

Over a long period of time, international trade has been regarded as major factor of economic development. Many researchers stated that international trade is an important “engine” that drives economic growth of nations and international competitiveness is the “fuel” that empowers that engine (e.g., Ezeala-Harrison, 1999).

The classical theory of international trade and its role in economic development are based on the principle of comparative advantage. The comparative advantage paradigm states that a country performs better when concentrating on the productions of those goods and services for which it possesses a comparative advantage over others and then trading these goods with other countries. By doing so, each country can produce its products more cheaply than others so that through trade all countries would benefit by obtaining goods more cheaply than they would have if they produce all goods themselves. Classical and neoclassical economics have concluded that trade is a vent for surplus, for it is trade that enables a country to overcome the limits set by the extent of the market against specialization and the division of labor.

In this tradition, classical and neoclassical economics vigorously support free and unrestricted trade among nations by asserting that trade opens up opportunities for people in all countries to improve their welfare. Through such free trade and exchange, over time international income redistributions take place as free product and factor mobility equalize prices and incomes across countries. This implies a more equitable distribution of the benefits of international progress and, therefore, a more even spread of economic development across the world. International trade is also advocated as a powerful engine of economic growth for countries. For example, international trade expands market demand across country borders and thus removes constraints that may limit a country’s ability to increase its production scale. In turn, this would enable a country to expand its output and create job opportunities within its borders, thus stimulating its economy.

There are two aspects to a country's international trade: exports and imports. Mainstream development economists recognize the superiority of a trade strategy of export promotion (EP) over that of import substitution industrialization (ISI). Previous empirical studies (Feder, 1982; Krueger, 1978; Lal and Rajapatirana, 1987) have illustrated that in contrast to the dismal performance of those countries that overdid the ISI strategy, developing countries that adopted an export-promoting strategy realized higher rates of increase in per capita income. They also have demonstrated superior performance in terms of increases in saving ratios, investment ratios, total factor productivity, employment, and real wages, as well as a declining incremental capital-output ratio, a more equitable distribution of income, and better adjustment to external shocks.

Why has export promotion had such a strong favorable impact on development? As for the effect on the balance of payments, one might think that there is little difference between earning a unit of foreign exchange through exports and saving a unit of foreign exchange through imports substitution. But the domestic resource cost of earning foreign exchange had been shown to be less than the domestic resource cost of saving foreign exchange at the margin (Meier, 1989). Moreover, export-promoting countries have become more creditworthy and their foreign exchange constraint have been relaxed (Krueger and Jones, 1990). Especially significant is the fact that an export-oriented industrialization strategy has resulted in not simply a once for all improvement in resource allocation according to the country's comparative advantage in international trade, but more importantly in the realization of dynamic benefits. While a reallocation of resource in conformity with comparative advantage can raise the income level, the dynamic gains have been most important in increasing the rate of growth in productivity (Melitz, 2003).

Export also increases capacity utilization of plant and realization of economies of scale (Amsden, 1985). It creates employment through export of labor-intensive products and generates a multiplier effect that gives rise to an increased demand for intermediate inputs and consumer consumption, and an increase in total factor productivity. Nishimizu and Robinson (1984) showed that export expansion, unlike import substitution, is positively correlated to changes in total factor productivity. Feder (1982) showed that marginal factor productivities in export-oriented industries are significantly higher than in the non-export-oriented industries.

Over the past two decades, especially since the normalization of the diplomatic relations between China and Korea in 1992, trades among China, Japan, and Korea have been active and significant. Table 1 presents the values of exports and imports among the three countries. It shows that from 1992 to 2003, China's export to Japan increased from \$11.68 billion to \$59.42 billion and its import from Japan increased from \$13.68 billion to \$74.15 billion. Japan is China's largest trading partner (Ministry of Commerce of the PRC, 2004). During the same period, Korea's export to China increased from \$2.65 billion to \$35.11 billion and its import from China increased from \$3.72 billion to \$21.91 billion. In 2003, China became the largest export destination for Korea, and Korea's trade surplus with China amounted to \$13.2 billion, representing about 80 percent of its total trade surplus (Nam, 2004). Still, Japan remains the largest source of Korea's imports. In 2003, import from Japan accounted for around 20 percent of Korea's total imports, followed by the USA (14%) and China (12.3%) (Nam, 2004).

Amid the fascination with expanding trade among the three countries, however, there are concerns in both Japan and Korea about the so-called China threat. For instance, some Koreans fear that China is creating a "black hole" by sucking in Korea's outward direct investment. This fear of hollowing-out has been amplified by the move of large conglomerates that have shifted their production bases to China and have set up R&D centers in China (Nam, 2004). In Japan, there is also a prevalent of "China threat," probably because of China's great successes in its market-oriented reforms and opening-up.

It is interesting to observe that in recent years many scholars and government organizations in the three countries are promoting a stronger economic cooperation by forming a CJKFTA (China-Japan-Korea free trade area) (e.g., Choeng, 2002; Lee, 1999; Luo, 1999). For example, Liu (2004) examines various issues related to CJKFTA, including the principles, organization structures, goals, and timetable. Ryou and Wang (2004) discuss the possibility of financial cooperation in East Asia by investigating the Chiang Mai Initiative and the Manila framework. They argue that China and Japan should provide leadership in forging a common political will for integration in East Asia. Using a multi-country CGE model, Ianchovichina and Walmsley (2005) find that China's accession to WTO increases the exports of Japan and the NIEs (Hong Kong, South Korea, Singapore and Taiwan), thanks to China's increasing demand in high quality textile and electronic inputs from those exporters, while negatively affects Indonesia, Malaysia, Philippines, Thailand, and Vietnam's exports, because these countries are competitors on textile and garment industries.

This paper examines trade relationships among China, Japan, and South Korea. It also investigates the effects of currency fluctuations on their exports of these countries. A better understanding of the trade structures and relationships will help to promote regional cooperation among the three countries.

2. Trade Patterns of Japan, China, and South Korea

First of all, we examine trade patterns of Japan, China, and South Korea and their trade relationships by focusing on their exports to the United States. The United States was chosen as the importing country because it is not only the biggest economy in the world but also a major trade partner of China, Japan, and South Korea. Moreover, the import structure of the United States illustrates that Japan is competing with South Korea but not with China. Figures 1-3 present the top 10 commodities exported to the United States in 2004 from China, Japan and South Korea. Figure 4 shows the top five categories of exports to the United States from these three countries between 1997 and 2004.

From the perspective of commodities exported in 2004, for China, automatic data processing machines accounted for 18.9 percent of total exports to the United States, the biggest portion of all commodities. The second largest composition of China's exports to the United States was toys and sporting goods (13.6%). Other major exports include footwear (8.8%), furniture & bedding accessories (8.4%), telecommunications equipments (9.3%), parts for office machines & ADP machines (7.1%), sound recorders and TV recorders (5.9%), household type electric & non-electric equipments (3.5%), articles of plastics (3.3%) and Trunks, Suitcases, Vanity Cases, and Briefcases (3.1%). For Japan and South Korea, however, motor vehicles are the most exported commodities to the United States, which took up 25 and 21.7 percent of their total exports, respectively. Also, South Korea's third largest export commodity - thermionic, cold cathode and photo cathode valves (8.7%) - is Japan's fifth largest export commodity (2.6%). Parts and accessories of motor vehicles, which China seldom exports, is Japan's second largest export commodity (6.9%) and South Korea's fourteenth largest exported commodity (1.4%). It is notable that Japan and South Korea share significant similarities in export structure trading with the Unites States, while China is different from these two countries.

Figure 4 shows trends in export structures in 1997-2004. For both Japan and South Korea, motor vehicles are increasing as the most exported commodity. For China, footwear and toys and sporting goods remained in the top three most exported commodity during the same period (exports of automatic data process machines became number one exported commodity in 2004). Also notice that, during 1997-2004, China exported mainly labor-intensive products, such as toys, furniture and clothes to the United States, while Japan and South Korea exported technology-intensive products, like motor vehicles, thermionic, cold cathode and photo cathode valves.

Moreover, enlarging the prospective of trading partner from the United States to the world, we calculate the revealed comparative advantage (RCA) of China, Japan and Korea to examine the degree of competitiveness of each good from these three countries on the world market. Country i's RCA on commodity m is defined as $RCA^i_{m,t} = \left(\frac{x^i_{m,t}}{\sum_m x^i_{m,t}} \right) / \left(\frac{\sum_i x^i_{m,t}}{\sum_i \sum_m x^i_{m,t}} \right)$

Where, $x^i_{m,t}$ is country i's total export of commodity m. So the numerator is country i's commodity m's export share of this country's total export. While denominator is world's commodity m's export share of world total export. The higher the RCA of a product, the more advantage a country has on exporting this particular good. In general, China has comparative advantage on low digit commodities such as textile and garment industry, food, and other agricultural products, while Japan excels at producing high-tech commodities, like telecommunication, photographic, optical goods, road vehicles, iron and steel, office machines, and electric machinery, etc. Korean industries, which are comparably competitive on the world market, are much closer to their Japanese counterparts, and more so over time.

Therefore, we conclude that Japan and South Korea are competing with each other in exports to the Unites States as well as to the world, while China is a complementary exporter to both of them.

Regarding China and Japan, there is a prevalent of "China threat" in Japan, probably because of China's great successes in its market-oriented reforms and opening-up. In the international trade arena, China's annual export increased from \$9.75 billion in 1978 to

$325.6 billion in 2002, and its annual imports increased from $10.89 billion to $295.2 billion, respectively (NBS, 2003, p. 654). The total international trade raised almost 30 folds in the past 25 years. In addition, China has run trade surplus every year since 1994. In 1997 and 1998, trade surplus reached the highest level of more than $40 billon. In 2002, China still had an annul trade surplus of $30.4 billion (NSB, 2003, p. 654).

There should be no disagreement that Japan has a larger scale of export and a more advanced export structure than China. But, with the development of China's industrial economy, difference of trade patterns between China and Japan is diminishing overtime, shown in Figure 5. This phenomenon might lead to the argument that China is becoming stronger, even to extent to be able to compete with Japan.

When it comes to considering whether or not China is competing with Japan, two points must be taken into account. First, Japan is exporting high-class products (comparatively higher quality and more expensive), while China's exports belong to much lower class. Take television as an example, the price difference between an ordinary television made in China and a high definition television made in Japan can be as much as one digit. Second, China relies more on semi-manufactured goods and accessories compared to Japan. Government statistical data show that China's exports contain more than 50 percent imported components, and this ratio is higher for high-tech products. In other words, China's competitiveness is limited in those industries that require less technology.

It may even be reasonable to say that China and Japan are more compensative to each other than to any other countries. Japan is the largest trade target country of China and China is the second largest trade target country of Japan. The total trade amount between these two countries exceeded $100 billions in 2002. Total exports of Japan to China were more than $0.5 billion. It is also noticeable that Japan has maintained a trade surplus towards China all these years.

In fact, it is interesting to speculate how depreciation of Yen would affect China's economy. On one hand, depreciation of Yen may enhance Japanese products' competitiveness. Therefore, depreciation of Yen may adversely impact China's export. But this negative impact could be very limited because China's export is labor-intensive but Japan's export is technology-intensive. These two countries are barely competing with each other in the international market. Consequently, even though depreciation of Yen enhances Japan's price competitiveness in the international market, the extension of Japan scrambling China's export demand is still very limited.

On the other hand, depreciation of Yen may also have positive impact on China's economy. Depreciation of Yen causes prices of imported productions to decrease and eases the burden of China's foreign loan repayments. In the first instance, depreciation of Yen will lower the prices of enginery products and semi-finished products that China needs from Japan, which will help China to reduce its production costs. In 2000, for example, China's imports from Japan were fairly concentrated. Semiconductors and other electronic components accounted for 7.9 percent of the total imports, steel 7.0 percent, organic compound 5.6 percent, and plastic 4.7 percent (International Trade Statistics Yearbook compiled by the United Nations). Take China's high-tech intermediate goods import as an example, goods imported from Japan and Korea account for over 20 and 13 percent, respectively in 2004, and this share was much higher for Japan in earlier years, shown in Figure 6. Among China's total exports of high tech intermediate goods, the percentages of China's direct or indirect inputs imported from Japan are 54.98, 80.19 and 87.54 percent in 1980's, 1990's and after 2000 period, respectively.[1]

In the second instance, with depreciation of Yen, China's debts, mostly government loans calculated in Yen, will be reduced when transferred into US dollars from Japanese Yen, easing the burden of repaying foreign principal and interest.

Furthermore, intuitively, even if depreciation of Yen to RMB doesn't reduce the demand of China's import from other countries, prices of exports from China into Japan will go up, which should negatively affect China's export to Japan. But after examining export structure of China to Japan (Figure 7), we found that commodities exported from China concentrate on natural resource and low-end manufactured goods especially in early periods, and it is well known that these goods have low income elasticity. As a result, it is expected that depreciation of Yen will not deteriorate China's export to Japan too much. Combining both the negative and positive impacts, depreciation of Yen probably will not work against China's export.

The trade relationship between South Korea and Japan, however, seems quite different from that between China and Japan. As Figures 2 and 3 shows, for both Japan and South Korea in 2001, motor vehicles are the most exported commodities to the United States, accounting for 25 percent and 18 percent of their total exports, respectively. Among their top 10 exported commodity categories, six are the same: motor vehicles, automatic data process machines, thermionic-cold cathode-photocathode valves, parts for office machine and ADP machines, sound records and TV recorders, and telecommunication equipments. Hence, export structures of Japan and South Korea are largely similar, making them trade competitors.

There is an interesting phenomenon that illustrates the competitive relationship between Japan and South Korea. South Korea exports very few automobiles to Japan, and vice verse. In consequence, few Korean cars run on streets in Japan, and vice verse. However, both Japan and South Korea export their automobiles to other Asian countries and the rest of the world.

Because South Korea is competing with Japan in the international market, South Korea's exports change with the fluctuation of Yen. For instance, export of South Korea automobiles tends to climax when Yen appreciates. The other way round, when Yen depreciates, export of South Korean automobiles tends to stagnate. More generally, we conclude that the exports of South Korea are better off when Yen appreciates and worse off when Yen depreciates.

3. Estimation and Results

Based on the above discussion, we expect that depreciation of Yen has no negative impact on China's export performance while depreciation of Yen negatively affects the export of Korea.

To test our hypotheses, we build a relationship between net export and exchange rate by employing the concept of *export intensity* (EI), which is defined as a ratio of the volume of net exports to the total volume of goods and services transacted within the economy (GDP) during a given time period:

$$EI = \frac{X_h}{Y_h} \tag{1}$$

where X_h is the net exports and Y_h is GDP of the home country.

Previous studies have illustrated *EI* as a function of growth rate of real exchange rate of domestic currency to foreign currency and GDP ratio between two nations (domestic GDP divided by foreign GDP):

$$EI = f\left(E, \frac{Y_f}{Y_h}\right) \tag{2}$$

Where Y_h, and Y_f are home country and foreign country's GDP, respectively.

Previous studies, however, have also shown a lag and J-curve effect of changes of exchange rate on international trade. According to the J-curve theory, it is observed that a country's current account worsens immediately after real currency depreciation and begins to improve only some months later (e.g., Krugman and Obstfeld, 2000).

In the models we specify below, to study how depreciation of Yen relative to RMB and WON affects China's and South Korea's exports, respectively we take lag value of exchange rate change to take into account of the J-curve effect. Moreover lagging exchange rate may give us the advantage of dealing with potential endogenous problem[2].

Specifically, we have the following regression model:

$$\frac{X_{it}}{Y_{it}} = \alpha_i + \beta_i \hat{e}^i_{jt-4} + \gamma_i \frac{Y_{jt}}{Y_{it}} \frac{P_{it}}{P_{jt}} + \varepsilon_{it} \text{ for } i = cn, sk \text{ ; } j = jp$$

Where X_{it} is country i's exports to the rest of the world at year t. $\hat{e}^i_{jt-1}$ is change rate of real exchange rate of country i against Japanese Yen. Y_{it} , and Y_{jt} are country i and Japan's nominal GDP at year t. P_{it} and P_{jt} are price index of country i and Japan, respectively. So $\frac{Y_{jt}}{Y_{it}} \frac{P_{it}}{P_{jt}}$ is supposed to pick up the effect of relative country size. ε_{it} is white noise.

If our above arguments are valid, China and Japan are complementary trade partners, and the positive change rate of RMB relative to Yen, i.e. RMB depreciates against Yen, should have negative effect on China's export. We expect that increasing Japan's real GDP will attract more China's exports to Japan. Due to their competitive relationship, for South Korea's export regression, the expected signs of β , which is the coefficient of Won relative to Yen, should be positive. We expect the growth rate of Won relative to RMB to be negative, for the same reason as for China-Japan in terms of the relationship between GDP and export.

Data sets used in this research come from the following resources. First, all of the data sets are from 1981 to 2002. We bought quarterly exports and imports data (1981 to 2002) from the Department Customs of People's Republic of China. Quarterly data of China's CPI was obtained from the website of Census Bureau of China (www.stats.gov.cn). Quarterly CPI data sets of Japan, South Korea and the United States were downloaded from Noruiel Roubini's Global Macroeconomic and Financial Policy website (Stern School of Business, New York University, www.stern.nyu.edu/globalmacro). All of the quarterly exchange rates were found in the government website of Federal Reserve System (www.federalreserve.gov). From United Nations Conference on Trade and Development (http://www.unctad.org), we also obtained quarterly Japan's and South Korea's exports and imports data as well as the United State's imports data from China, Japan and South Korea.

The export intensity variables use the quarterly data from the 3rd quarter of 1982 to the 4th quarter of 2001 (derived by dividing the quarterly total exports of China and South Korea by quarterly real GDP of China and South Korea, respectively). The growth rates of the real exchange rate were also calculated from the 3rd quarter of 1982 to the 4th quarter of 2001. The growth rate of the real exchange rate variables is lagged for four quarters. The GDP ratio variables are derived by dividing the quarterly real GDP of Japan, respectively by the quarterly real GDP of China and South Korea (all of the real GDP are in 1995 prices).

Results from ordinary least squared regression are consistent with our predication, appreciation of Yen relative to RMB (increase in our measure) didn't have statistically significant positive effect on China's export performance. But we should keep in mind that all of the exports variables are quarterly data starting from the 1st quarter of 1985 and continuing through the 4th quarter of 2001. Serial correlation is the most common potential problem in a time series model. From the Durbin-Watson (DW) statistics of the two OLS regressions, we find that both of them have the problem of serial correlation. In detail, the DW-statistics of regressions, which are 0.9448 and 0.3763, respectively, indicate that there is a positive serial correlation. This implies that the coefficients estimated by OLS regressions are biased. In this case, we use the CORC method to rerun regressions in order to correct serial correlations.[3] The results of CORC regressions satisfy our purposes. All of the DW-statistics of CORC regressions indicate that there are no serial correlations.

Table 2 presents results of OLS and CORC. Obviously, positive signs of coefficients of GDP ratios illuminate that increases in the GDP of Japan has a positive impact on export intensity in both China and South Korea. In other words, China and South Korea exports will increase if real GDP increases in Japan, holding all other indicators constant. Based on the regressions, the lag of growth rate of real exchange rate of RMB against Yen has a negative impact on export intensity of China, while lag of growth rate of real exchange rate of Won against Yen has a positive impact on South Korea's export intensity. This is to say, holding China's and South Korea's GDP constant, a depreciation of Yen leads to an increase of China's total exports and decrease of South Korea's total exports. This finding affirms our original hypotheses. In turns, it shows that China and Japan are complementary trade partners while South Korea and Japan are competitors.

After examining one country's total exports to the whole world, let's focus on China, South Korea and Japan's exports to the Unites States, because the United States is a major trade partner of China, South Korea, and Japan. Practically all the values of exports depend on many variables. Among those variables, real GDP of the importing country and exchange rate of currencies of exporting countries against importing country are our main concerns. Based on previous discussion and hypotheses, China and Japan are considered complementary or non-competing trade partners. We expect that depreciation of Yen against US dollar will not negatively affect exports of China to the United States. Since South Korea is a substitute trade partner of Japan, we expect that depreciation of Yen against the US dollar will deteriorate South Korea's exports to the United States. Also, depreciation of Yen against USD will raise Japan's trade competitiveness, thus increasing its exports to the United States.

To show how the exchange rate of the US dollar to other currencies and how the US economy affects exports to the United States from China, Japan and South Korea, we specify the following models:

$$X_{it}^{us} = f\left(Y_{us}, e_{it}^{us}, e_{jt}^{us}\right) \qquad \text{for } i, j = cn, jp, sk$$

where X_{it}^{us} and Y_{us} are country i's real export to the United State at year t and real GDP of the United States, which we use to capture the income of the United State, after adjusting for US CPI. e_{it}^{us} is country i's real exchange rate relative to USD.

In order to achieve stationarity in our data, we take logarithm to reduce the probability of correlations.[4] Therefore, our model can be formulated into:

$$\ln X_{it}^{us} = \alpha_i + \sum_j \beta_j \ln e_{jt}^{us} + \gamma_i \ln Y_{us,t} + \varepsilon_{it} \qquad \text{for } i, j = cn, jp, sk$$

Theoretically, when a country's economy is doing well, it will import more from other countries to improve the living standard of its people. As a result, an increase in US GDP will cause an increase of exports to the Unites States from all three countries. This means that the expected signs of all three γ_i are positive. Depreciation of the domestic country's currency and complementary trade partner countries will not negatively impact domestic exports. On the contrary, depreciation of currencies of substitutive trade partners will help boost exports of substitutive trade partners so that exports of domestic country will be deteriorated. This makes us believe that most expected signs of exchange rate will be non-negative, except in either Japan or Korea export regression we expect coefficient on exchange rate of the other country's currency against US dollar to be negative.

Table 3 presents the results of OLS and CORC regressions on the three time series models. Satisfactorily, most coefficients have the expected signs. For China export regression, the results prove our hypothesis that both depreciation of Yen and RMB against Dollar lead to an increase in the level of China's exports to the United States by showing that every percentage increase in real exchange rate of Yen against USD (Yen depreciation) would result in an 5.58% increase of exports to the US from China, respectively. When a real depreciation of RMB against USD exists, imports of the United States from China will also go up, though not statistically significant.

For Korea export, the signs of real exchange rate of Yen relative to USD in both OLS and CORC regressions are negative, indicating that depreciation of Yen decreases imports of the United States from South Korea. This is because Japan is competing with South Korea for exports to the United States. Depreciation of Yen makes Yen cheaper relative to USD, holding the exchange rate of the Won against USD constant. In this case, the United States is willing to import more similar products from Japan instead of from South Korea. As a result, South Korea's total export to the United States decreases if exchange rate of the Won against the USD remains the same.

In our Japan model, the positive sign of RMB relative to US dollar bears out again that China and Japan are not competitors in export. Depreciation of the RMB against USD actually increases the exports of Japan to the United States. On the contrary, the coefficient of the log of the exchange rate of the Won against USD has a negative sign, suggesting signal that depreciation of Won against USD leads to a drop in exports from Japan to the United States. This is also consistent with the result of the Korea model that depreciation of Yen against USD decreases the exports of South Korea to the United States because they are substitute trade partners.

Coefficients of exchange rate of Won and RMB from the Korea model have unexpected signs, and they are both negative. The value of coefficient on Won means that a one percent increase of the exchange rate of Won against USD will decrease China's exports to the US by 0.44 percent. The value of coefficient on RMB tells that a one percent increase of the exchange rate of RMB against USD will decrease Korea's exports to the US by 0.003 percent. From China's regression, one percent depreciation of Won against USD decreases China's export to the US by 0.133 percent. These results show a possible trade competition between China and South Korea. However, the latter two coefficients are not statistically significant, or the trade competition between China and South Korea is minimal.

Furthermore we study exchange rate's effect on the 4-digit level data of export in electrical and electronics products from China, Japan and Korea on US market. On one hand, because China imports lots of intermediate goods from Japan for the final high-tech goods productions, we expect when Japanese Yen depreciates against USD, holding others constant (that is equivalent to Yen depreciates over RMB), China will exports more final high-tech goods to the US market. On the other hand, at this disaggregated commodities level, competition between China and Japan over the US market becomes stronger, so there should be a negative effect of Yen's depreciation on China's exports. Exchange rate change also has impact on the foreign direct investment (FDI), which in turn may affect trade. Depreciation of domestic currency may enhance that country's product competitiveness. Therefore, it becomes more profitable for foreign companies to relocate plants in such a country. The DFI comes in two forms. One is horizontal, in which plants in two or more countries produce the same output, using similar producers. The usual motivation for such FDI is to avoid trade barriers, which tends to substitute trade. The other form is vertical. In order to take advantage of cost gaps, the vertical FDI build manufacturing plants in separate countries specializing in different procedures for a common end product, such as putting labor intensive production in low wage countries and capital intensive production in industrialized countries. The horizontal FDI, more prevalent between the industrialized and developing countries, tends to create trade. So the aggregate effect of FDI on trade can be ambiguous. Many recent studies have examined the interactions between financial flows and trade empirically (Albuquerque et al. 2005, Lane and Milesi-Ferretti, 2004 and 2005, Rose and Spiegel, 2004, Swenson, 2004). Most of them find that larger inflows of FDI lead to higher volume of trade as well as other benefits such as increased rates of total factor productivity growth and higher output growth rates. Annual data on bilateral trade flows are from the UN Commodity Trade Statistics Database (UN Comtrade) and we use HS 1996 four-digit commodities goods from year 1996 to 2004. Annual FDI inflow data from 1996 to 2004 are from the World Bank's world development indicators.

Since for each country, there are 18 kinds of final 'high-tech' commodities (see appendix), and this is a study of exports in products from 1996 to 2004, there are 162 observations within each country in total. This Panel data setting allows us to use fixed effect to control product specific effect.

$$\ln x_{mt}^{us} = \alpha + \gamma \ln X_{mt}^{w} + \sum_{i} \beta_i \ln e_{it-1} + \theta \ln I_{mt-1} + v_m + \varepsilon_{mt}$$

Where x_{mt}^{us} is either China, Japan, or Korea's real export of final good m to US at time t, and X_{mt}^{w} is world's real export of final good m to US at time t, which captures good m demanded by the United States. In order to capture substitution effect, e_{it-1}, one-period lag value of RMB, Yen and Won relative to USD, is also included. I_{mt-1} is lag FDI inflows for China, Korea and Japan. All of above variables are adjusted by US GDP deflators from the Bureau of Economic Analysis (U.S Department of Commerce). v_m is latent variable, which remains constant overtime. The results (shown in Table 4) are quite similar to aggregated level regression. Depreciation of both Yen and RMB increases China's final high-tech goods exports to the US market, while there is no empirical evidence that RMB's depreciation hurts Japan's high tech export to US. Surprisingly, depreciation of Korea Won has no significant negative effect on Japan's export to the US market, and vise versa. FDI does increase trade from all three countries, though significant effect only exists for Korea.

4. Conclusions

Since the normalization of diplomatic relations between China and Korea in 1992, the total export and import volume between the two countries has expanded dramatically, from $25.36 billion in 1992 to $133.57 billion 2004. In 2003, China became the largest export destination of Korea, and Korea's trade surplus with China reached $13.2 billion, representing about 80 percent of its total trade surplus. Still, Japan remains the largest import source for both China and Korea.

This paper has examined the trade relationships among China, Japan, and South Korea. We concluded that China possesses a large comparative advantage in labor-intensive products, such as toys, sporting goods, and footwear. Japan and Korea maintain large comparative advantages in capital-intensive products. In 2001, for example, motor vehicles were the largest export commodity for both Japan and Korea. There is little competition between Chinese and Japanese export products, while a relative high level of competition exists between Japanese and Korean export products. China and Japan are complementary trade partners, while Japan and Korea are trading competitors.

The paper has empirically evaluated the effect depreciation of Yen against RMB or Korea Won on the exports of China and South Korea. Based on regression results, we found that depreciation of Yen has a positive impact on China's export but has a negative impact on Korea's export. The same findings remain when we restrict our dependent variables to China's and Korea's commodities export or final high-tech goods export to the US market. The econometric tests confirm our hypotheses that Japan is competing with South Korea in exports, but not with China. This conclusion could be of some value to the Japanese government in its policy-making. Recently, the authorities of the Japanese government assume China as the biggest threat to Japan in the international market. Under this assumption, the Japanese government directly or indirectly supports a policy of depreciation of Yen against USD in order to beat China in exports. They even believe that by doing so Japan will make its economy better off and slow down China's fast development. However, according to our empirical results, Japan's policy will not yield the results they wanted. Also, our results clearly show that neither China is a threat to Japan, nor the other way around.

Certainly, the development of China's economy presents opportunities for Japan and Korea as well as challenges. From the perspective of market demand, China is a substitute for some of Japan and Korea's exports. But these negative impacts are limited under the precondition that China is a largely complementary trade partner of Japan as well as of Korea. From the perspective of supply, Japan and Korea import cheap semi-products from China, reducing costs of their domestic corporations, so that Japanese and Korean corporations could expand the scale of their production and distribution. As many studies have shown, China's rise has been a boon to both Japan and Korea's economies. Since the Asian financial crisis in 1997, Japan and Korea have benefited from the dynamics of the Chinese economy to recover their own economies by building complementarity with China. Looking ahead, the rising competitiveness of Chinese products in the international trade arena requires all three countries adopt a strategy to upgrade their own industries and develop niche markets. In this sense, the perceived "China threat" could be a catalyst for promoting East Asian nations' economic development and international competitiveness.

Figure 1. Top 10 commodities exported to US from China (year 2004)

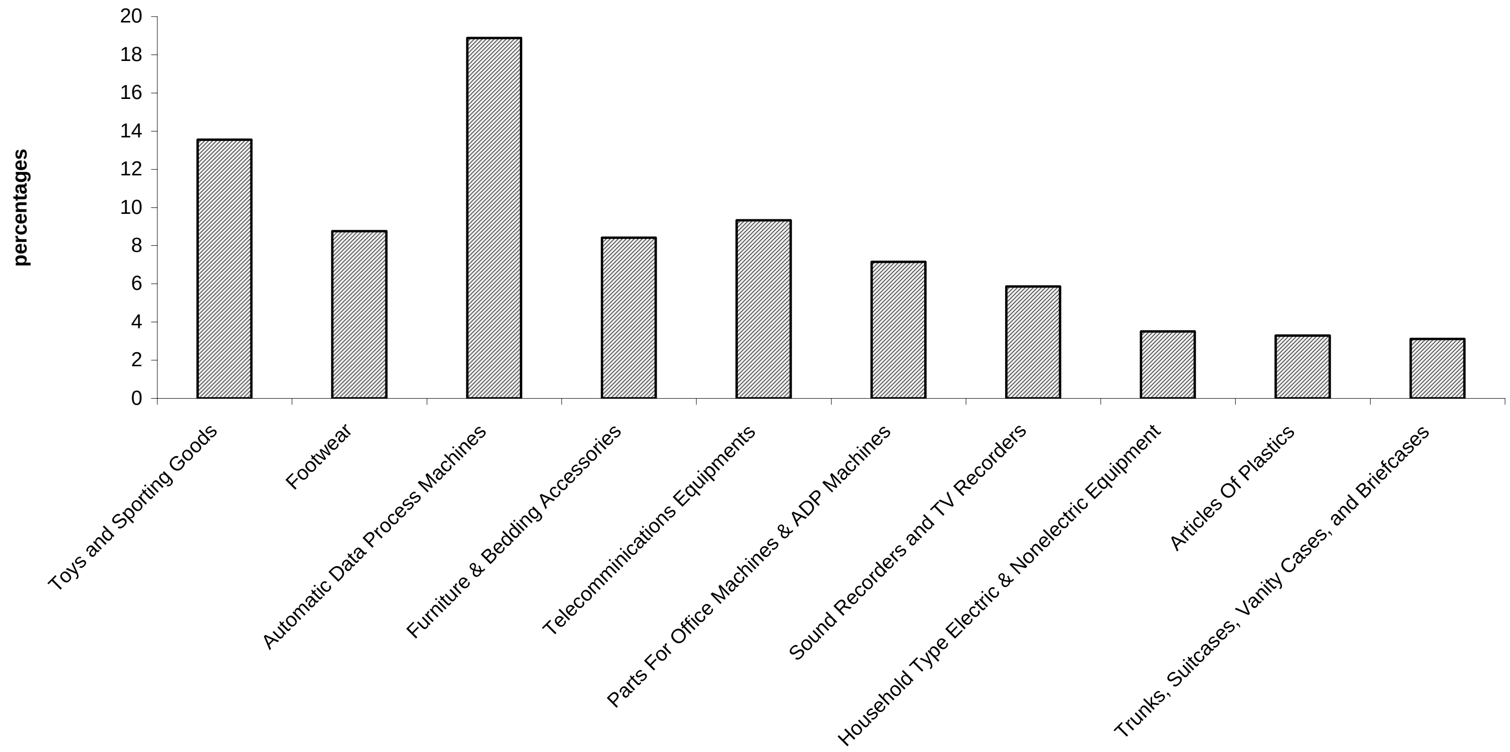


Figure 2. Top 10 Commodities Exported to US from Japan (year 2004)

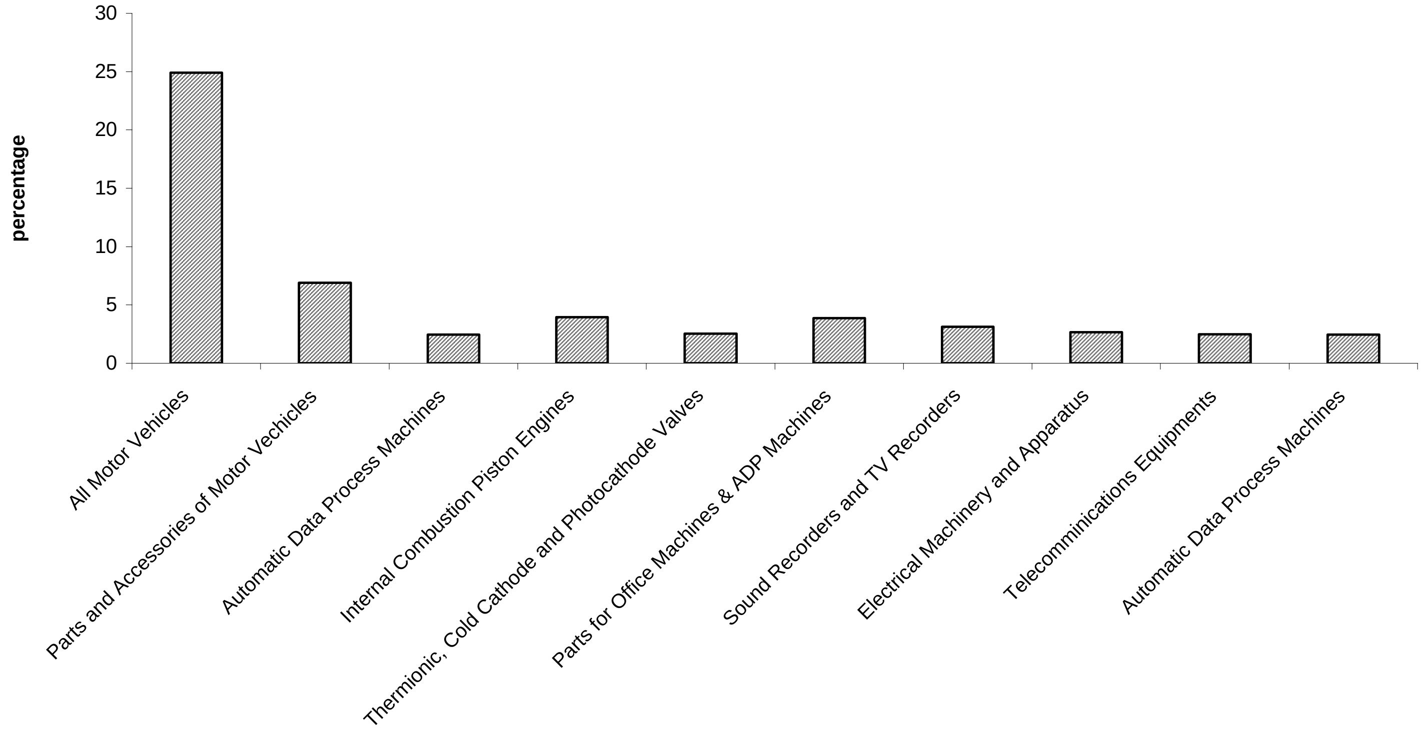


Figure 3. Top 10 commodities exported to US from Korea (year 2004)

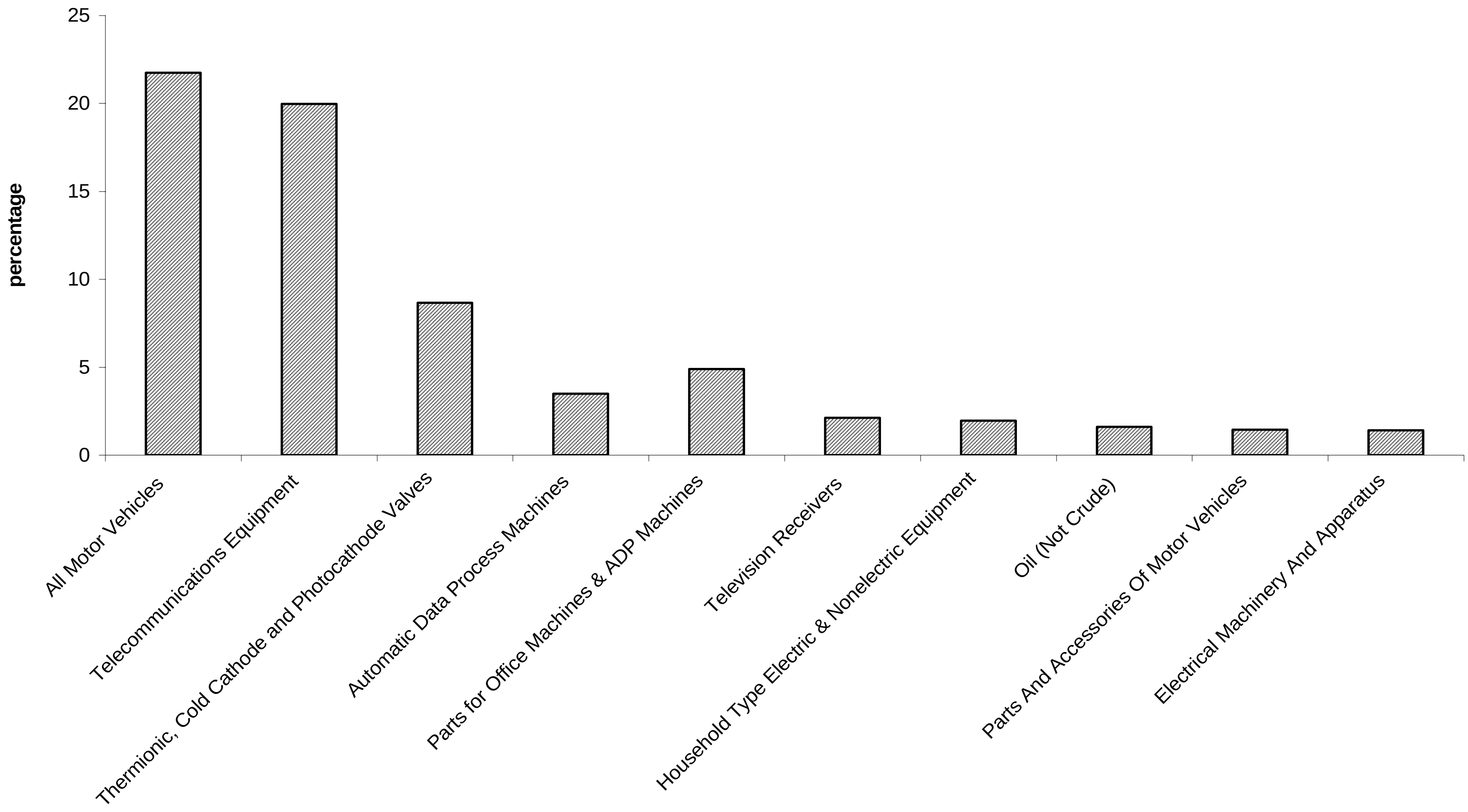
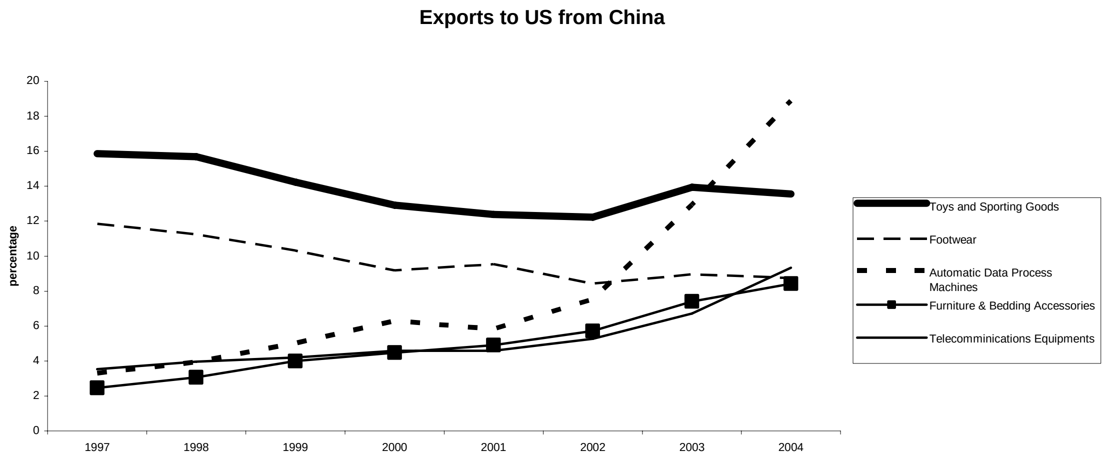
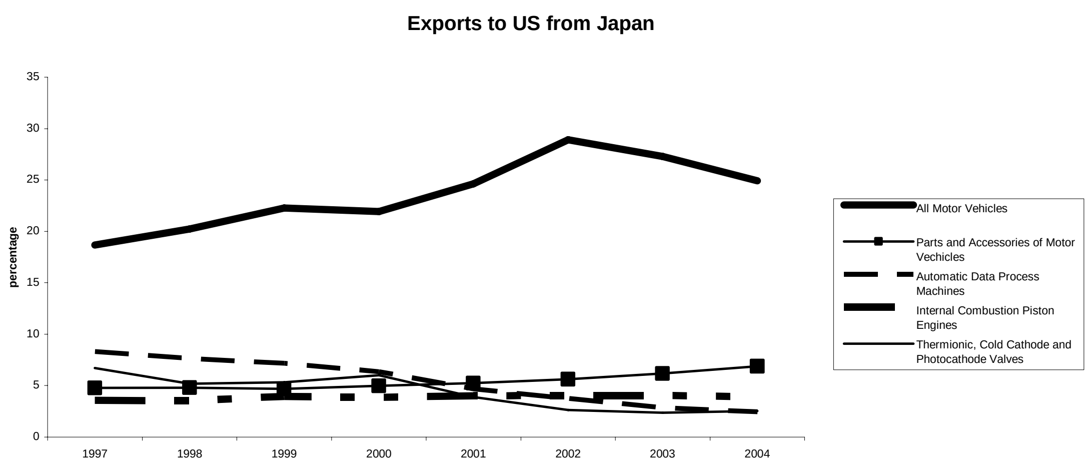
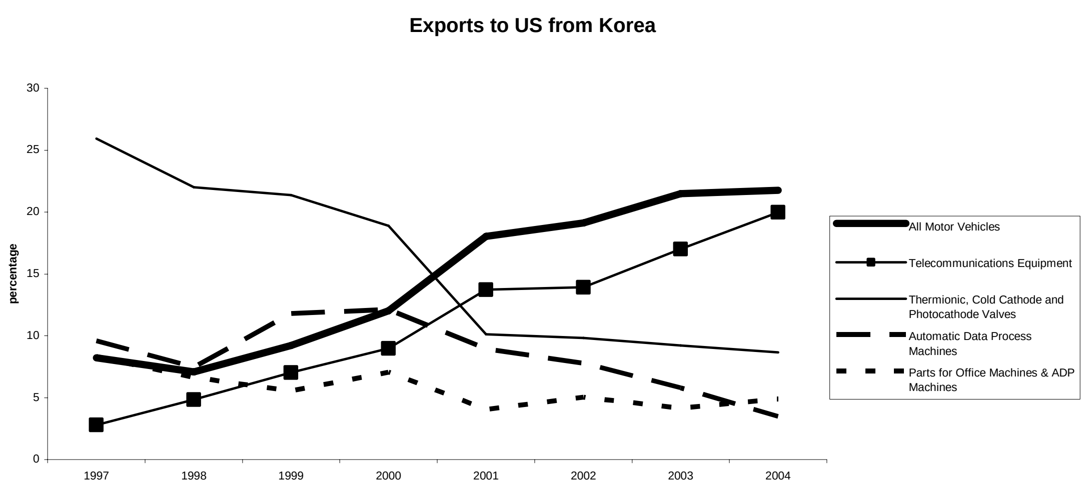


Figure 4. Top Five Export Commodities to the United States (1997-2004)







Source: The Office of Trade and Economic Analysis of the United States.

Figure 5. Competitive Degree of China, Japan and Korea in World market

5.1 China v.s. Japan 80's RCA

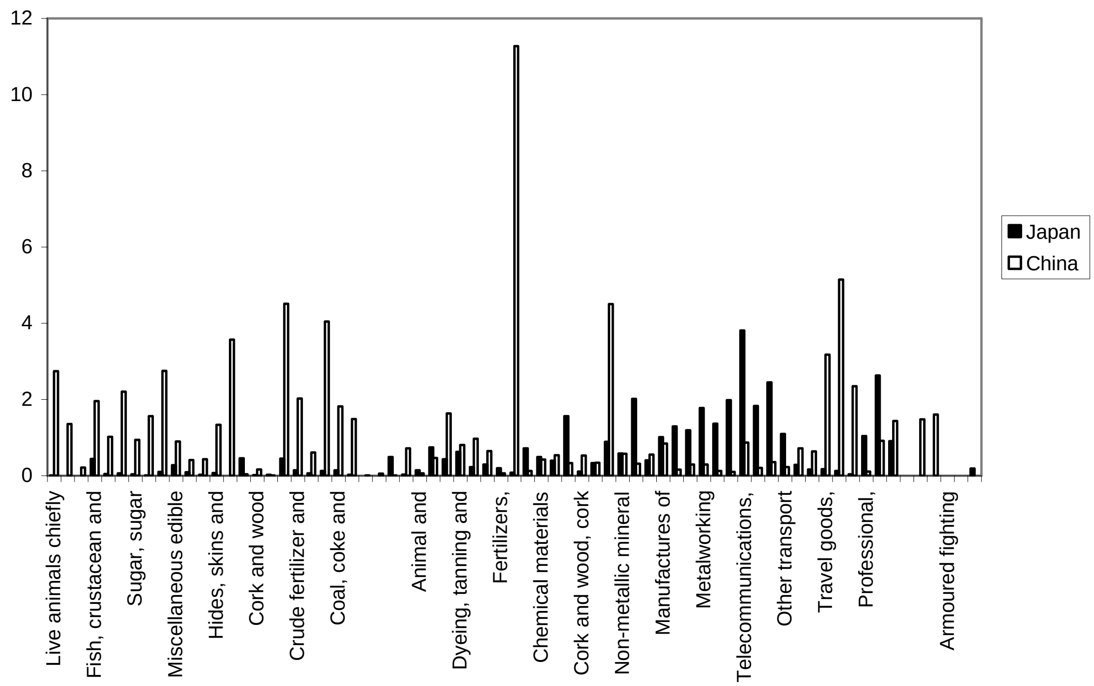


Figure 5.2 Japan v.s. Korea 80's RCA

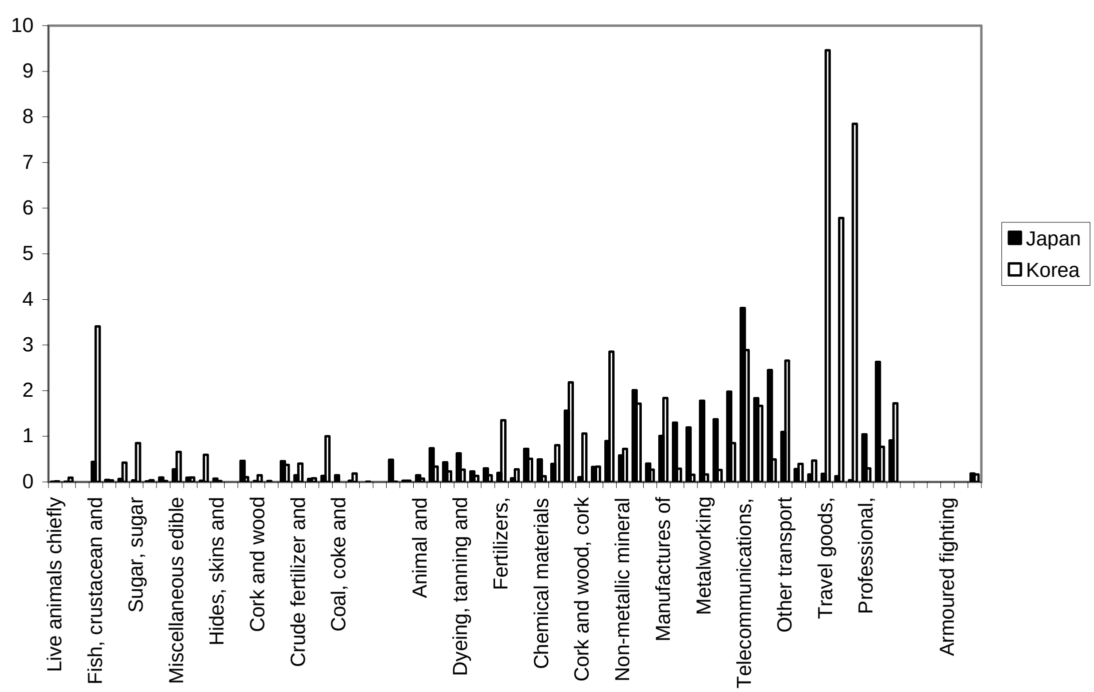


Figure 5.3 China v.s. Japan 90's RCA

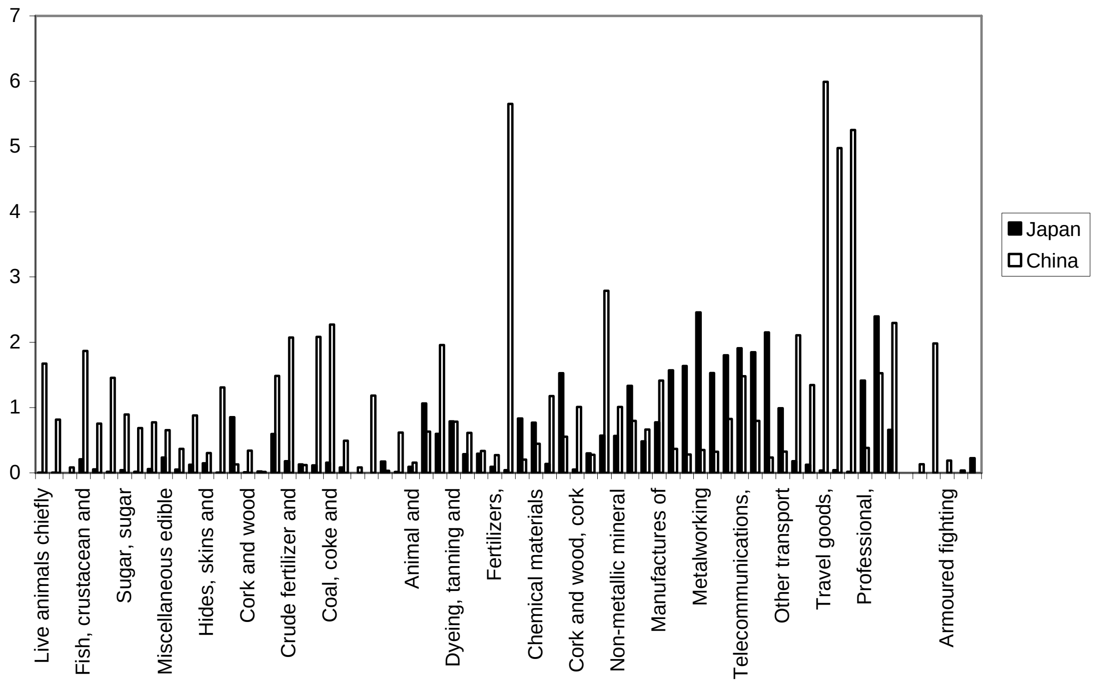


Figure 5.4 Japan v.s. Korea 90's RCA

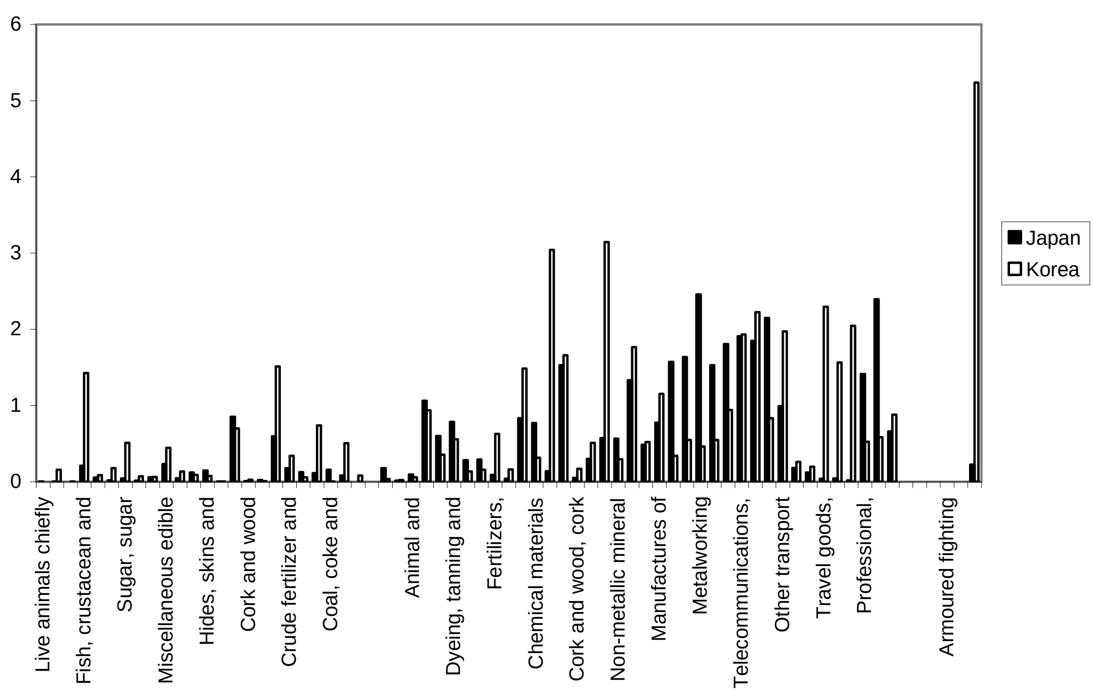
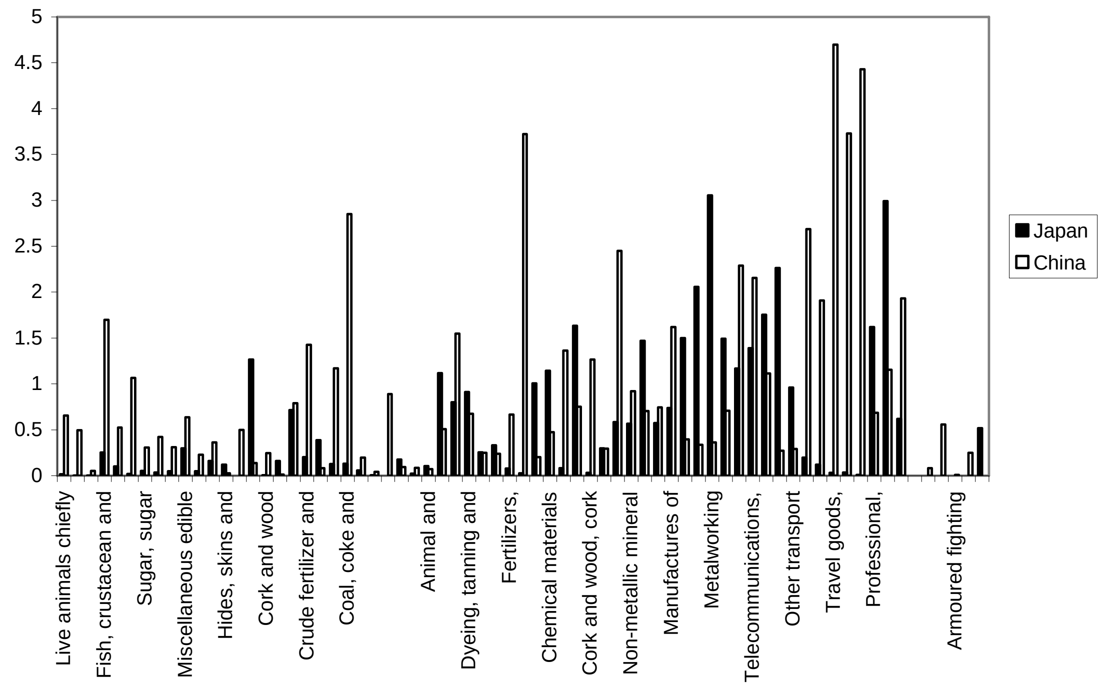
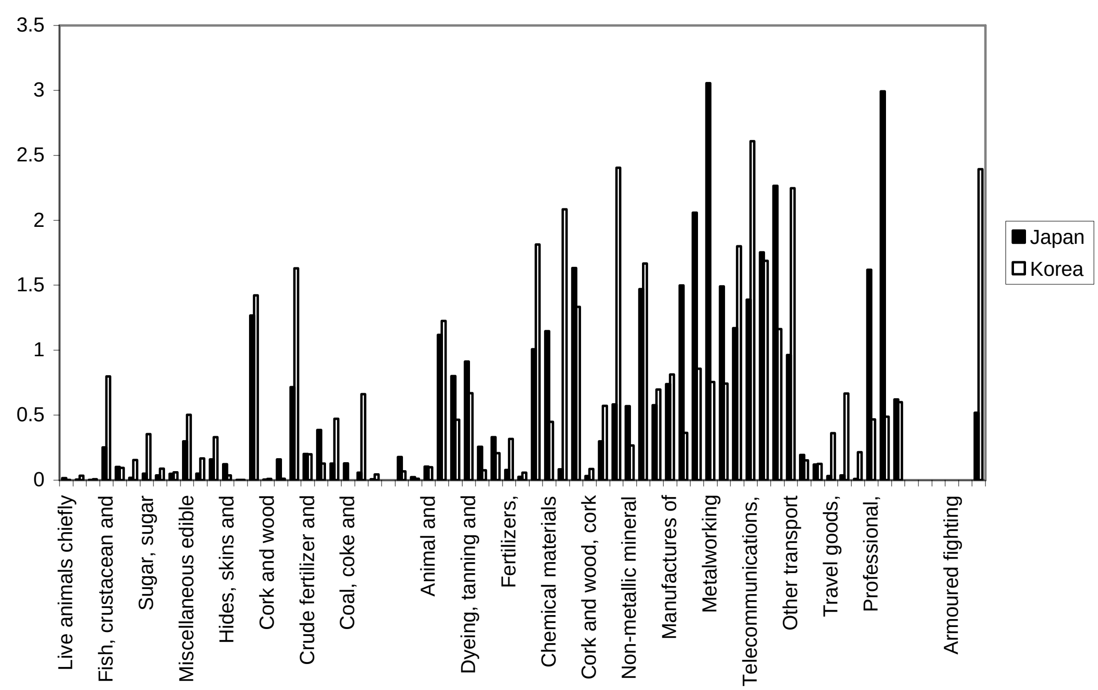


Figure 5.5 China v.s. Japan 2000's RCA



Figuere 5.6 Japan v.s. Korea 2000's RCA



Data Source: UN Comtrade

Figure 6 China's High Tech Intermediate Good Imports

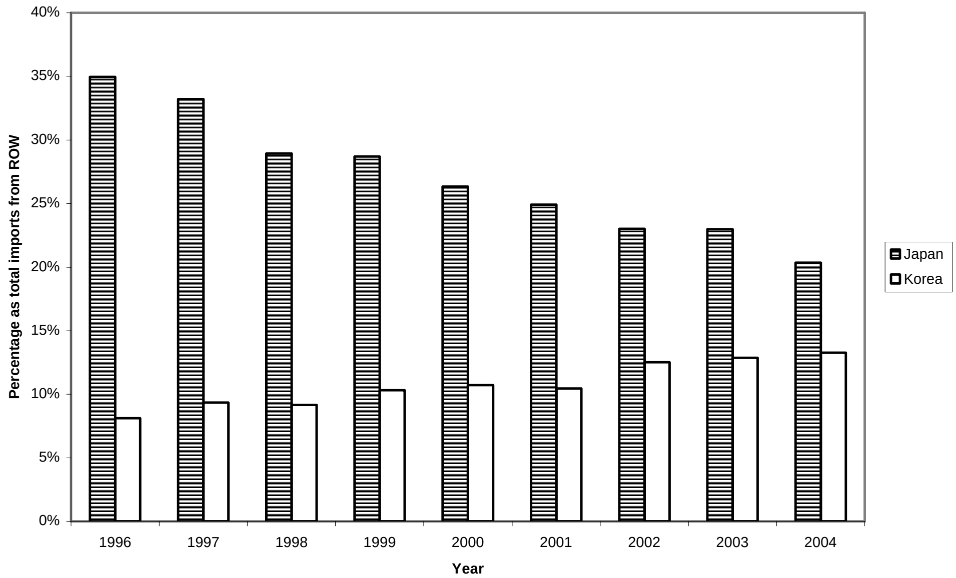


Figure 7.1 China exports to Japan 1984

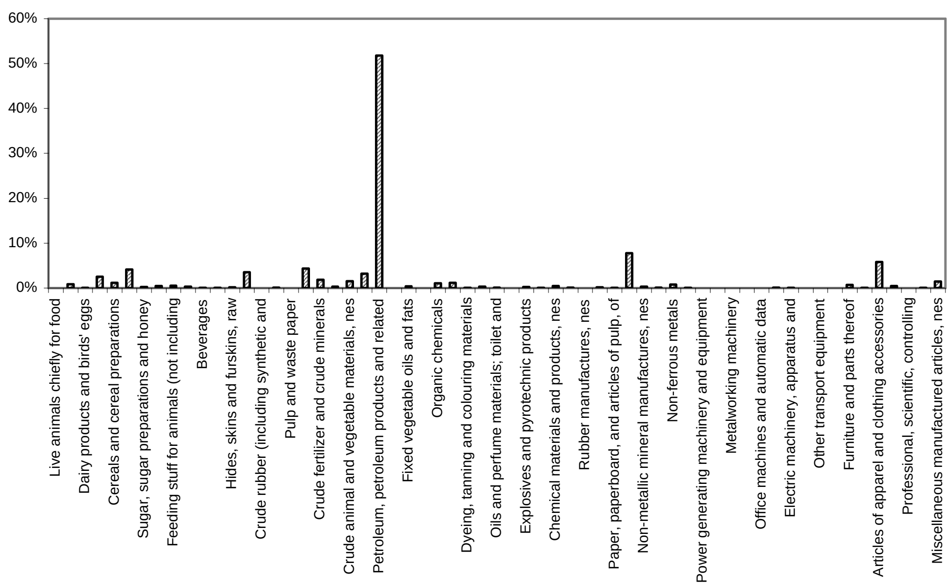


Figure 7.2 China's export to Japan 1994

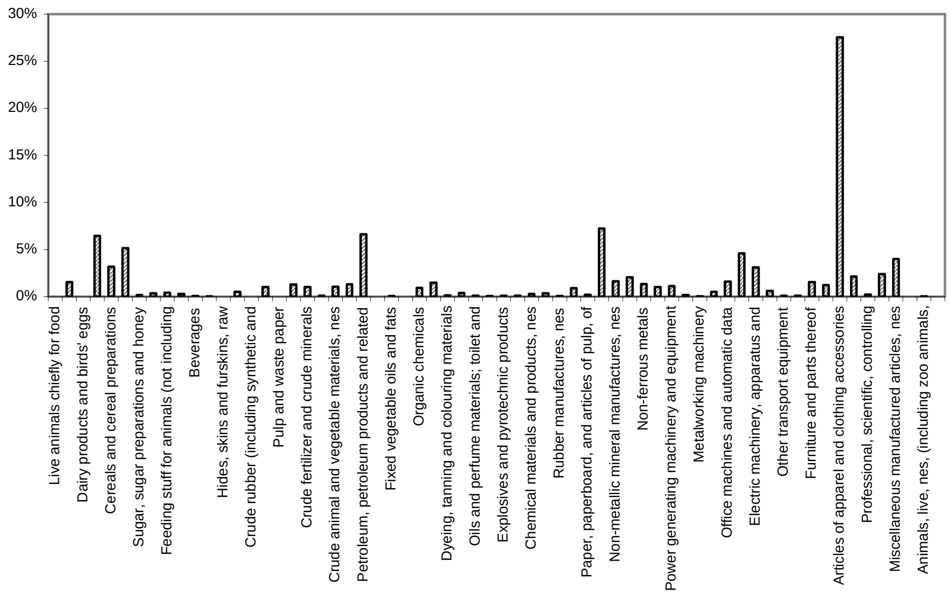
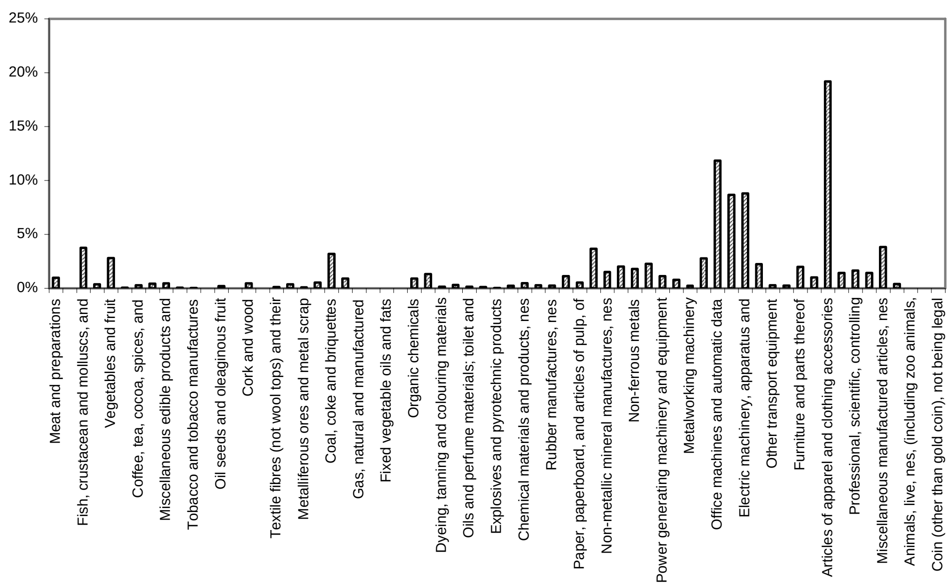


Figure 7.3 China's exports to Japan 2004



Data Source: UN Comtrade

Table 1. Trade among China, Japan, and Korea (in US$100million)

Year	China-Japan		Korea-China		Korea-Japan	
	Export	Import	Export	Import	Export	Import
1992	116.8	136.8	26.5	37.2	116.0	194.6
1993	157.8	232.9	51.5	39.3	115.6	200.2
1994	215.8	263.3	62.0	54.6	135.2	253.9
1995	284.7	290.0	91.4	74.0	170.5	326.1
1996	308.9	291.8	113.8	85.4	157.7	314.5
1997	318.4	289.9	135.7	101.2	147.7	279.1
1998	296.6	282.8	119.4	64.8	122.4	168.4
1999	324.1	337.6	136.8	88.7	158.6	241.4
2000	416.7	415.0	184.5	128.0	204.7	318.3
2001	449.6	428.0	181.9	133.0	165.1	266.3
2002	484.4	534.7	237.5	174.0	151.4	298.6
2003	594.2	741.5	351.1	219.1	172.8	363.1

Data sources: Korea International Trade Association (2004), http://www.kita.org, Ministry of Commerce of the PRC (2004), http://www.mofcom.gov.cn, and National Bureau of Statistics of China (1996, 2000).

Notes: Different sources provide different figures on exports and imports between countries. In this table, we use Chinese data for China-Japan and employ Korean data for Korea-China and Korea-Japan.

Table 2. Estimated Results of Models of Export Intensity

Variable	Export intensity of China OLS	Export intensity of China CORC	Export intensity of South Korea OLS	Export intensity of South Korea CORC
Constant	0.0013 (4.369)***	0.0015 (2.559)**	0.1156 (5.472)***	0.1997 (7.174)***
$LagGRE_{RMB/Yen}$	0.0003 (0.210)	-0.0020 (-1.763)*		
GDP_{JP}/GDP_{CN}	0.0004 (11.059)***	0.00003 (5.190)***		
$LagGRE_{Won/Yen}$			0.0801 (0.993)	0.0659 (1.926)*
GDP_{JP}/GDP_{SK}			0.0037 (5.283)***	0.0025 (5.126)***
Observations	78	77	78	77
R-squared adjusted	0.6097	0.2704	0.2518	0.2584
Durbin-Watson Statistics	0.9448	2.4219	0.3763	2.347

The table presents the OLS and CORC estimates of the export intensity models with t-statistics reported in parentheses

Table 3. Esimated Results of Export to U.S Market

	export of China		export of South Korea		export of Japan	
Method	OLS	CORC	OLS	CORC	OLS	CORC
GDP_{US}	0.737 (1.3)	0.710 (1.107)	5.856 (12.742)***	4.969 (6.091)***	1.348 (4.574)***	1.218 (2.539)***
Lag Real exchange rate of RMB/USD	0.155 (1.82)*	0.154 (1.610)	-0.560 (-0.811)	-0.003 (-0.026)	0.141 (3.185)***	0.107 (1.556)
Lag Real exchange rate of Yen/USD	5.574 (9.226)***	5.577 (8.195)***	-2.294 (-4.681)***	-2.107 (-2.461)***	-0.345 (-1.097)	-0.184 (-0.364)
Lag Real Exchange rate of Won/USD	-0.138 (1.328)	-0.133 (-1.119)	-0.660 (-7.813)***	-0.444 (-3.324)***	-0.180 (-3.323)***	-0.147 (-1.779)*
Constant	-22.653 (7.597)***	-22.467 (-6.652)***	-29.874 (-12.35)***	-24.346 (-5.618)***	-0.368 (-0.237)	-0.089 (-0.035)
Number of observations	68	67	68	67	68	67
Adjusted R-squared	0.986	0.982	0.915	0.665	0.900	0.688
Durbin-Watson Statistics	1.745	1.873	0.825	1.722	0.915	1.863

The table presents the OLS and CORC estimates of the export models with t-statistics reported in parentheses

Table 4 Estimated Results of High Tech Final Goods Exported to U.S Market

Variable	Export of China (FE)	Export of Korea (FE)	Export of Japan (FE)
World exports to US	1.2073 (4.70)***	0.6248 (1.92)*	0.5072 (3.22)***
Real exchange rate of RMB/USD	6.5626 (5.10)***	2.6324 (1.78)*	-2.5525 (-1.04)
Real exchange rate of Yen/USD	1.6173 (1.66)*	1.0488 (0.95)	-0.1390 (-0.12)
Real exchange rate of Won/USD	0.3831 (0.54)	-1.9303 (-1.75)*	-0.5267 (-0.31)
FDI inflow	0.9505 (1.01)	0.1901 (2.01)**	0.0388 (0.37)
Constant	-49.5562 (-2.83)***	1.5847 (0.30)	14.3620 (1.37)
Number of groups	18	18	18
Number of observations	162	162	160
R-squared: Within	0.5504	0.0994	0.0920
: Between	0.6128	0.8538	0.5949
: Overall	0.6021	0.7518	0.5541

The table presents panel data regression fixed effect of the export models with t-statistics reported in parentheses

*** 1% level significant ** 5% level significant * 10% level significant

HS Code	Product name and description
	Intermediate Goods
8501	Name: Electric motors and generators, except generating sets Description: Electric motors and generators (excluding generating sets).
8502	Name: Electric generating sets and rotary converters Description: Electric generating sets and rotary converters.
8503	Name: Parts for electric motors and generators Description: Parts suitable for use solely or principally with the machines of heading No. 85.01 or 85.02.
8504	Name: Electric transformers, static converters and rectifiers Description: Electrical transformers, static converters (for example, rectifiers) and inductors.
8505	Name: Electro and permanent magnets, equipment using magnets Description: Electro-magnets; permanent magnets and articles intended to become permanent magnets after magnetisation; electro-magnetic or permanent magnet chucks, clamps and similar holding devices; electromagnetic couplings, clutches and brakes.
8506	Name: Primary cells and primary batteries Description: Primary cells and primary batteries.
8507	Name: Electric accumulators Description: Electric accumulators, including separators therefor, whether or not rectangular (including square).
8511	Name: Ignition/starter equipment, internal combustion engine Description: Electrical ignition or starting equipment of a kind used for sparkignition or compression-ignition internal combustion engines (for example, ignition magnetos, magneto-dynamos, ignition coils, sparking plugs and glow plugs.
8529	Name: Parts for radio, tv transmission, receive equipment Description: Parts suitable for use solely or principally with the apparatus of headings Nos. 85.25 to 85.28.
8532	Name: Electrical capacitors, fixed, variable or adjustable Description: Electrical capacitors, fixed, variable or adjustable (pre-set).
8533	Name: Electrical resistors and rheostats except for heating Description: Electrical resistors (including rheostats and potentiometers), other than heating resistors.
8534	Name: Electronic printed circuits Description: Printed circuits.
8535	Name: Electrical apparatus for voltage over 1 kV Description: Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (for example, switches, fuses, lightning arresters, voltage limiters, surge suppressors, plugs, junction boxes).

HS Code	Product name and description
8536	Name: Electrical switches, connectors, etc, for < 1kV Description: Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (for example, switches, relays, fuses, surge suppressors, plugs, sockets, lamp-holders, junction boxes).
8537	Name: Electrical power, etc, control and distribution boards Description: Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading No.85.35 or 85.36, for electric control or the distribution of electricity, including those incorporating instruments or apparatus.
8538	Name: Parts for electrical switches, protectors, connectors Description: Parts suitable for use solely or principally with the apparatus of heading No. 85.35, 85.36 or 85.37.
8539	Name: Electric filament, discharge lamps Description: Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; arc-lamps.
8540	Name: Thermionic and cold cathode valves and tubes Description: Thermionic, cold cathode or photo-cathode valves and tubes (for example, vacuum or vapour or gas filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes).
8541	Name: Diodes, transistors, semi-conductors, etc Description: Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes.
8542	Name: Electronic integrated circuits and microassemblies Description: Electronic integrated circuits and microassemblies.
8543	Name: Electrical machinery and apparatus, nes Description: Electrical machines and apparatus, having individual functions, not specified or included elsewhere in this Chapter.
8544	Name: Insulated wire and cable, optical fibre cable Description: Insulated (including enamelled or anodised) wire, cable (including co-axial cable) mand other insulated electric conductors, whether or not fitted with connectors; optical fibre cables, made up of individually
8545	Name: Carbon electrodes, brushes and electrical items Description: Carbon electrodes, carbon brushes, lamp carbons, battery carbons and other articles of graphite or other carbon, with or without metal, of a kind used for electrical purposes.
8546	Name: Electrical insulators of any material Description: Electrical insulators of any material.

HS Code	Product name and description
8547	Name: Insulating fittings for electrical equipment Description: Insulating fittings for electrical machines, appliances or equipment, being fittings wholly of insulating material apart from any minor components of metal (for example, threaded sockets).
8548	Name: Electrical parts of machinery and apparatus Description: Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, spent primary batteries and spent electric accumulators; electrical parts of machinery or apparatus.
	Final Goods
8508	Name: Hand tools incorporating electric motors Description: Electro-mechanical tools for working in the hand, with self-contained electric motor.
8509	Name: Domestic appliances, incorporating electric motor Description: Electro-mechanical domestic appliances, with self-contained electric motor.
8510	Name: Shavers and hair clippers, electric Description: Shavers, hair clippers and hair-removing appliances, with self-contained electric motor.
8512	Name: Electric lighting, signal equipment, car electrics Description: Electrical lighting or signalling equipment (excluding articles of heading No. 85.39), windscreen wipers, defrosters and demisters, of a kind used for cycles or motor vehicles.
8513	Name: Portable battery, magneto electric lamps Description: Portable electric lamps designed to function by their own source of energy (for example, dry batteries, accumulators, magnetos), other than lighting equipment of heading No. 85.12.
8514	Name: Industrial, laboratory electric furnaces, ovens, etc Description: Industrial or laboratory electric (including induction or dielectric) furnaces and ovens; other industrial or laboratory induction or dielectric heating equipment.
8515	Name: Electric solder, weld, braze,hot metal spray equipment Description: Electric (including electrically heated gas), laser or other light or photon beam, ultrasonic, electron beam, magnetic pulse or plasma arc soldering, brazing or welding machines and apparatus, whether or not capable of cutting.
8516	Name: Electric equipment with heating element, domestic etc. Description: Electric instantaneous or storage water heaters and immersion heaters; electric space heating apparatus and soil heating apparatus; electrothermic hair-dressing apparatus (for example, hair dryers, hair curlers, curling tong heaters).
8521	Name: Video recording and reproducing apparatus

	Description: Video recording or reproducing apparatus, whether or not incorporating a video tuner.

HS Code	Product name and description
8522	Name: Parts, accessories of audio, video recording equipment Description: Parts and accessories suitable for use solely or principally with the apparatus of headings Nos. 85.19 to 85.21.
8523	Name: Prepared unrecorded sound recording media (non-photo) Description: Prepared unrecorded media for sound recording or similar recording of other phenomena, other than products of Chapter 37.
8524	Name: Sound recordings other than photographic equipment Description: Records, tapes and other recorded media for sound or other similarly recorded phenomena, including matrices and masters for the production of records, but excluding products of Chapter 37.
8525	Name: Radio and TV transmitters, television cameras Description: Transmission apparatusfor radio-telephony, radio- telegraphy, radio-broadcasting or television, whether or not incorporating reception apparatus or sound recording or reproducing apparatus; television cameras; still image video cameras.
8526	Name: Radar, radio navigation and remote control apparatus Description: Radar apparatus, radio navigational aid apparatus and radio remote control apparatus.
8527	Name: Radio, radio-telephony receivers Description: Reception apparatus for radio-telephony, radio-telegraphy or radio-broadcasting, whether or not combined, in the same housing, with sound recording or reproducing apparatus or a clock.
8528	Name: Television receivers, video monitors, projectors Description: Reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus; video monitors and video projectors.
8530	Name: Electrical signalling and traffic control equipment Description: Electrical signalling, safety or traffic control equipment for railways, tramways, roads, inland waterways, parking facilities, port installations or airfields (other than those of heading No. 86.08).
8531	Name: Electric sound or visual signal equipment Description: Electric sound or visual signalling apparatus (for example, bells, sirens, indicator panels, burglar or fire alarms), other than those of heading No. 85.12 or 85.30.

[1] Use percentage of average value within 80's, 90's and 2000 to 2004

[2] Someone may argue that there are some trade or monetary policies or other variables we didn't include in our model, which results that our exchange rate variable is correlated with the regression error term. OLS will not nor generate consistent estimation. In Cochrance-Orcutt procedure, the algorithm will converge to a local

maximum instead of global maximum. The resulting GLS estimate need not be a consistent estimate. Lagged value is suggested by Durbin (1960), because it is believed to be uncorrelated with the error term.

[3] In this paper, we use Feasible Generalized Least Squares (FGLS) to estimate $\overline{\sigma}^2$ by adopting the Cochrane and Orcutt (1949) estimator (CORC). But we need to be careful about our model assumption, since OLS only requires $E(x_i e_i) = 0$, which is a quite weak assumption. When $E(e_i \mid x_i) = 0$, according to Gauss-Markov theorem, the best (minimum-variance) unbiased linear estimator is GLS, though if $E(e_i \mid x_i) \neq 0$, our estimation will be inconsistent.

[4] All these models are time serial models, which contains the value of a variable in time t in the series is dependent on the value of that variable in time t-1 (or some higher lag), such as real GDP and exports. This creates the problem of non-stationarity. Stationarity occurs in a time series when the mean value of the series remains constant over the time series. A stricter definition of stationarity also requires that the variance remain homogenous for the series. Sometimes this can be achieved by taking the logarithm of the data. There are still other reasons for preferring the $\log(Y)$ regression to the Y regression. First, it may be the case that $E(\log(y_i) \mid \log(x_i))$ is roughly linear in $\log(x_i)$ over the support of x_i, while the regression $E(y_i \mid x_i)$ is non-linear (which we believe to be true in our case), and linear models are easier to report and interpret. Second, and this may be the most important reason, if the distribution of y_i is highly skewed, the conditional mean $E(y_i \mid x_i)$ may not be a useful measure of central tendency, and estimates will be undesirably influenced by extreme observations ("outliers"). In this case, the conditional mean $E(\log(y_i) \mid \log(x_i))$ may be a better measure of central tendency, and hence more interesting to estimate and report. Because many time series (most economic indicators, for instance, GDP) tend to rise, simple application of regression methods to time series encounters spurious correlations and even multicollinearity.

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