Extended Abstract

The impacts of exchange rates on the machinery exports from China, Japan and Korea to the US

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Abstract

This research analyzes the panel data of ten-digit level machinery commodities which are exported from China, Japan and South Korea to the US from 2002Q1 to 2012Q4 to determine the impacts of exchange rates on the quantity and price of the exports of the three Asian countries involved. The TSLS estimation results show that a depreciation of the yen by 1% in a quarter leads to 0.47% increase in the Japanese quantity and 0.48% decrease in the Japanese price, resulting in a very slight change in the value of Japan's exports in the same quarter. Even though it pushes up the Chinese quantity more than it pushes down the Chinese price, its impact on the Chinese export value is negligibly small. In contrast, a 1% depreciation of the yen in a quarter increases the Korean quantity by 0.85% and decreases the Korean price by 0.7% resulting in 0.15% increase in the Korean export value in the same quarter. In addition, it increases the Korean export value in the following quarter by 0.19%. Those results imply that a weakening yen does not necessarily hurt the exports of China and Korea regarding the overall export value. However, it should be noted that the present research does not analyze how the changes in export prices will have a long-run effect on the exports of the three Asian countries through their impacts on the earnings of the exporters of the three countries.

JEL Classification: C33, F14, F17

Keywords: Panel data, Simultaneous equations, Cross price elasticity, Machinery exports, Exchange rates

I. Introduction

The purpose of this research is to examine the impacts of exchange rates on the machinery exports from China, Japan and South Korea to the US.

The recent aggressive monetary policy of the Japanese government led to a sharp depreciation of the Japanese yen, and provoked concerns in neighboring countries that are competing with Japan in the global market. Their major concern is that cheaper Japanese products might crowd out the products of Japan's competitors in the global market. However, since the three Asian countries are tightly connected to each other in their production network, a lower value of yen could also reduce prices of Chinese and Korean products by reducing prices of Japanese equipment or intermediate goods that are needed in the production of other Asian countries. Besides, lower prices of Japanese products will put pressure on Chinese and Korean exporters to lower down their prices, too, not to lose their market shares. Therefore, the overall impacts of a weakening yen on the exports of its Asian competitors are not unambiguous and should be investigated by empirical studies.

Against that background, this research analyzes the panel data of ten-digit level machinery commodities which are exported from China, Japan and South Korea to the US from 2002Q1 to 2012Q4 to determine the impacts of exchange rates on the quantity and price of the exports of the three Asian countries involved. The machinery sector (HS code from 84 to 93) occupies 54, 80 and 68 percent of the total exports to the US from China, Japan and South Korea respectively in 2012. In the same year, China, Japan and South Korea exported respectively 3333, 3014, and 2337 out of 6245 machinery commodities to the US. The fact that 2128 commodities among their machinery exports overlapped highlights the competition of the three Asian countries in the US market.

Using the panel data obtained from the US trade online, the demand and supply equations of the three exporting countries are simultaneously estimated by the TSLS with fixed effects. Then, using the estimated parameter values, the effects of exchange rates on export prices, export quantities and export values are simulated.

The simulation results indicate that a depreciation of any currency of the three countries increases the quantities of their exports while it decreases the prices. Therefore, the overall effect on the export value depends on relative size of price and quantity changes.

For example, a depreciation of the yen by 1% in a quarter leads to 0.47% increase in the Japanese quantity and 0.48% decrease in the Japanese price, resulting in a very slight change in the value of Japan's exports in the same quarter. Even though it pushes up the Chinese quantity more than it pushes down the Chinese price, its impact on the Chinese export value is negligibly small. In contrast, a 1% depreciation of the yen in a quarter increases the Korean quantity by 0.85% and decreases the Korean price by 0.7% resulting in 0.15% increase in the Korean export value in the same quarter. In addition, it increases the Korean export value in the following quarter by 0.19%.

Those results imply that a weakening yen does not necessarily hurt the exports of China and Korea regarding the overall export value. Instead, it increases the export quantities of the three Asian countries by reducing their export prices, and this finding is consistent with our observations for the first 5 months of this year. Even though the yen continually depreciated in the time period, the Japanese exports to the US decreased while the exports of China and South Korea to the US increased.

However, it should be noted that the present research does not analyze how the changes in export prices will have a long-run effect on the exports of the three Asian countries through their impacts on the earnings of the exporters of the three countries. According to the results, the Japanese export price declines only by 0.4 to 0.6% for the first two quarters after the yen depreciates by 1%, implying the earnings of the Japanese exporters measured in the yen will increase. In contrast, it is not certain whether and to what extent the decrease in the export prices due to depreciation of the yen will hurt the earnings of the exporters of China and South Korea since their cost structures are not known. If Chinese and Korean exporters could lower down their prices mainly due to lower import prices of Japanese equipment and intermediate goods which are used in their production processes, their earnings may not be hurt and accordingly their exports may not be discouraged. On the other hand, if Chinese and Korean exporters should reduce their prices mainly just not to lose their market share to cheaper Japanese products, lower profitability will discourage them to export.

In conclusion, the empirical results do not imply that the export quantities and values of China and South Korea will be reduced by depreciation of the yen. Instead, their export values increase slightly because export quantities increase more than export prices decrease. However, lower export prices of China and South Korea may hurt their earnings and accordingly may have a negative effect on their future exports in the long-run.

II. Estimation of Demand and Supply Equations

1. Commodities included in econometric analyses

The econometric analyses in this paper cover the quarterly data of 10 digit level machinery products exported from China, Japan and Korea to the US for the period 2002Q1–2012Q4. The monthly data obtained from the US Trade Online were used to produce quarterly data.

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2. Econometrics models

If machinery exports of the three Asian countries compete in the US market, the quantity and price variables of the three countries should be correlated. Therefore, the demand and supply equations of the two countries are simultaneously estimated by the TSLS. In addition, fixed effects for cross-sections are included in the panel TSLS model.

2.1.Demand Equations

We use quantity of exports as the dependent variable in a demand equation. Riedel (1988) uses price as the dependent variable in his estimation of the demand function for Hong Kong's export, while Muscatelli et al. (1992) and Abbot and De Vita (2002) use quantity in the estimation of the same function. Since to determine the sign of cross-price elasticity in a demand function is one of the main tasks in the present paper, we use quantity as the dependent variable and include prices as explanatory variables. The demand equation for each country's export to the US also includes as explanatory variables export unit prices and GDP of the US.

Specifically, the demand function for each country's exports has the following form:

$$q_{it}^{j} = \xi_0 + \xi_1 p_{it}^{C} + \xi_2 p_{it}^{J} + \xi_3 p_{it}^{K} + \xi_4 . g_t + \varepsilon_{it} \text{------ (1)}$$

where q_{it}^{j} denotes the quantity of commodity *i* at time *t* exported from country *j* to the US. Country *j* is China, Japan or Korea. Three price variables, p_{it}^{C}, p_{it}^{J} and p_{it}^{K}, are the unit price of Chinese, Japanese and Korean commodity *i* , respectively. The last variable, g_t is the real GDP of the US.

2.2.Supply Equations

While unit prices are explanatory variables in a demand equation in the previous section, they are used as the dependent variables in supply equations. Accordingly, export quantity of each country is employed as an explanatory variable along with lagged unit prices and exchange rates. Lagged unit prices are included because they may influence current unit prices. Besides, if one country's unit prices decline, it would put some pressure on its competitors to lower their prices, too.

The exchange rate between the US and an exporting country may have an impact on trade volume between the two countries through changing export prices. A lower currency value of an exporting country against the US dollar can raise the profit margin of exporters in terms of their domestic currency (yuan, yen, or won), and it would give them an incentive to decrease their export prices with the intention to increase their market share in the importing country.[1] In fact, a number of papers adopting reduced-form export equations report that exchange rates play undeniable roles in the trade of the countries involved in the present paper.[2] The present paper traces how exchange rates affect East Asian trades by incorporating exchange rate variables in a structural form supply equation.

[1] Alternatively, importers may demand exporters to lower export prices, since importers understand that the profit margin of exporters has increased due to a lower currency value of the exporting country.

[2] See, for example, Baak et al. (2007), Baak (2008), Huh and Zhu (2013), Thorbecke and Smith (2010), Thorbecke (2011), Thorbecke and Kato (2012), and Baek (2012) among others.

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

$$p_{it}^{j} = \alpha_0 + \alpha_1 q_{it}^{j} + \alpha_2 p_{it-1}^{C} + \alpha_3 p_{it-2}^{C} + \alpha_4 p_{it-1}^{K} + \alpha_5 p_{it-2}^{K} + \alpha_6 er_t^{j} + \varepsilon_{it} \text{ - (2)}$$

where the superscript, *j*, is one of the three exporting countries as before. The last explanatory variable, er_t^j, denote the exchange rate of country *j*'s currency against the US dollar.

3. Data Sources

The US Trade Online provides the value, price and quantity of each item imported to the US at the HS 10 digit-level. The real GDP of the US and nominal exchange rates are collected from the International Financial Statistics (IFS).

III. Empirical Results

1. Estimation of Demand Equations

As shown in Table 1, the real GDP of the US has a positive impact on each country's export quantity. In addition, each country's export prices have a substantial and significant negative coefficient confirming a downward-sloping demand curve.

Regarding the cross-price elasticity, Korean prices have an insignificant coefficient in the demand equation for Chinese products and a significantly negative but very small coefficient in the demand equation for Japanese products, implying Korean products are not substitutes for those of other two countries. Japanese prices have significantly negative but small coefficients in the demand function for the products of China and Korea, also implying Japanese products are not substitutes for those of other two countries. In contrast, Chinese prices have a significantly positive coefficient in the demand function for Korean products, implying lower Chinese prices can reduce demand for Korean products. They have a very small and insignificant coefficient in the demand function for Japanese products.

2. Estimation of Supply Equations

Table 1 also reports the estimation results of the supply equation. The coefficient of the quantity variable turns out to be positive only in the supply equation of China, therefore, an upward-sloping supply curve is not found in the other two countries. Of interest is that the dependent variable (that is current price variables) in all three supply equations are positively related to price variables of previous quarters regardless of nationalities. In other words, if the current price of one country rises, it will raise the future prices (one and two quarters ahead) of all the three countries.

Meanwhile, the coefficient of the exchange rate of one country against the US dollar is estimated to be significant and negative in each supply equation, indicating that depreciation of an exporting country's currency lowers the export prices of the country. Since the exchange rate is a significant variable in each supply equation, and the current export price of one country is affected by previous quarters' export prices of its competitors, a change in the exchange rate of one country can influence not only the exports (quantity and price) of the country but the exports of the other two countries.

3. Simulation of the effects of exchange rate changes

As the last task in the paper, this section performs simulation experiments to illustrate how changes in the currency values of the three exporting countries affect the quantities and prices of the products exported by them. In the framework adopted in the paper, a change in the currency value of a country (e.g. country A) alters its current and future export quantities and prices by shifting its current and future export supply curve. It changes not only current quantities and prices but also future variables because lagged prices are related to current prices in the supply equation.

A change in country A's currency value also influences current and future quantities and prices of the exports of its competitor (e.g. country B) through two channels, by affecting current demand for country B's products and/or by affecting country B's future supply. First, a change in the price of a commodity exported by country A, caused by a change in A's currency value, may shift the demand for the same commodity exported by country B. Second, it can shift the future supply of country B because the lagged prices of country A are related to current supply of country B in country B's supply equation. The overall effect of a change in a currency value can be computed by the estimated coefficient values of the three countries' supply and demand equations. The competition of the three countries will be better illustrated by examining how one country's export volume is affected by not only its own currency value but also the currency values of its competitors.

Hence, the six demand and supply equations are arranged in a matrix format in the following way using the estimated coefficient values.[3]

$$Y_t = A_0 Y_t + A_1 Y_{t-1} + A_2 Y_{t-2} + B X_t$$

where $Y_t = \begin{bmatrix} p_{it}^C \\ p_{it}^J \\ p_{it}^K \\ q_{it}^C \\ q_{it}^J \\ q_{it}^K \end{bmatrix}$ and $X_t = \begin{bmatrix} g_t \\ er_t^C \\ er_t^J \\ er_t^K \end{bmatrix}$.

Y_{t-1} and Y_{t-2} are one and two lagged values of Y_t, respectively. A_0, A_1 and A_2 are 6 by 6 matrices of coefficients and B is 6 by 4 matrix of coefficients. Constants are omitted because their values do not affect the simulation results at all.

After some necessary processes, Y_{t+k} $(k = 0,1, \dots)$ can be expressed as a function of the exogenous variables, X_t. Figures 1 through 3 illustrate how the export volumes of the three countries respond to a one-time 1% depreciation of the currency value of each exporting country.

The simulation results indicate that a depreciation of any currency of the three countries increases the quantities of their exports while it decreases the prices. Therefore, the overall effect on the export value depends on relative size of price and quantity changes.

For example, a depreciation of the yen by 1% in a quarter leads to 0.47% increase in the Japanese quantity and 0.48% decrease in the Japanese price, resulting in a very slight change in the value of Japan's exports in the same quarter. Even though it pushes up the Chinese quantity more than it pushes down the Chinese price, its impact on the Chinese export value is negligibly small. In contrast, a 1% depreciation of the yen in a quarter increases the Korean quantity by 0.85% and decreases the Korean price by 0.7% resulting in 0.15% increase in the Korean export value in the same quarter. In addition,

[3] The estimated coefficient values in the second columns in Tables 4 and 5 are used for this simulation.

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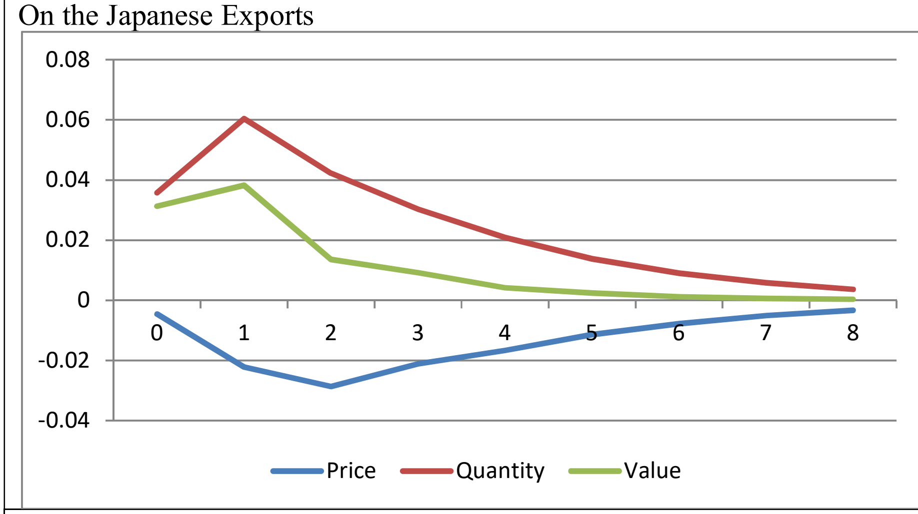
Table 1. Estimation Results

	China		Japan		Korea	
	Q_t^c	P_t^c	Q_t^j	P_t^j	Q_t^k	P_t^k
C	-14.448 0.000	0.812 0.042	-5.007 0.000	5.797 0.000	5.550 0.000	12.699 0.000
GDP^{us}	6.160 0.000		4.199 0.000		1.660 0.000	
Q_t^c		0.093 0.000				
Q_t^j				-0.127 0.000		
Q_t^k						-0.401 0.000
P_t^c	-0.812 0.000		0.005 0.768		0.054 0.023	
P_{t-1}^c		0.339 0.000		0.021 0.000		0.013 0.051
P_{t-2}^c		0.175 0.000				0.022 0.002
P_t^j	-0.061 0.000		-0.928 0.000		-0.045 0.045	
P_{t-1}^j		0.010 0.036		0.246 0.000		
P_{t-2}^j		0.010 0.029		0.134 0.000		
P_t^k	-0.016 0.177		-0.038 0.002		-1.177 0.000	
P_{t-1}^k		0.006 0.088		0.009 0.005		0.136 0.000
P_{t-2}^k						0.081 0.000
X_t^c		-0.283 0.001				-0.445 0.000
X_t^j				-0.416 0.000		-0.364 0.001
X_t^k						-0.523 0.000
Trend	0.023 0.000		-0.015 0.000		0.008 0.000	
R^2	0.957	0.936	0.960	0.952	0.907	0.935
$\bar{R}^2$	0.955	0.932	0.958	0.949	0.902	0.931

Figure 1. Effects of Depreciation of the Chinese Renminbi

On the Chinese Exports

On the Japanese Exports



On the Korean Exports

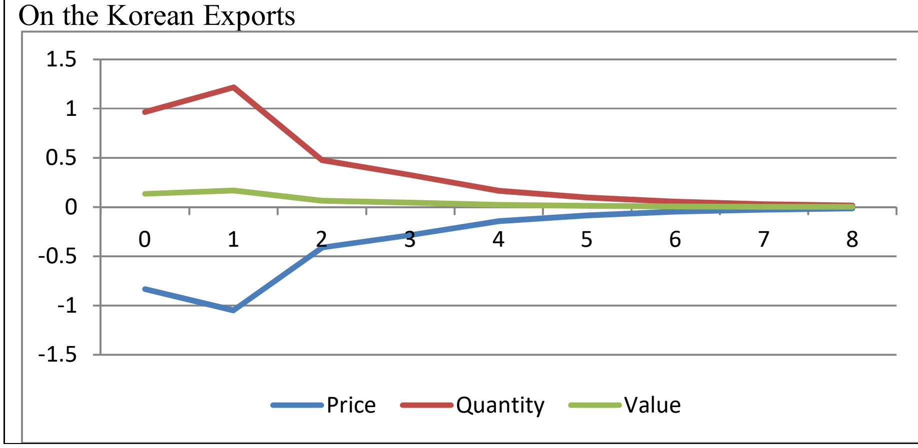
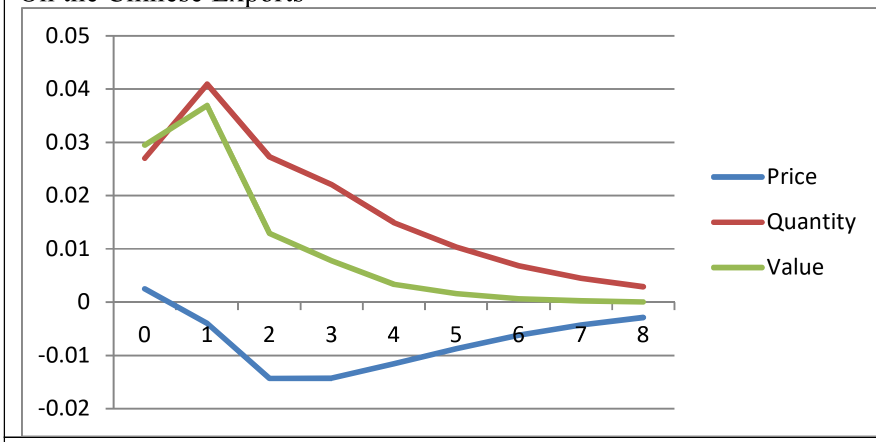
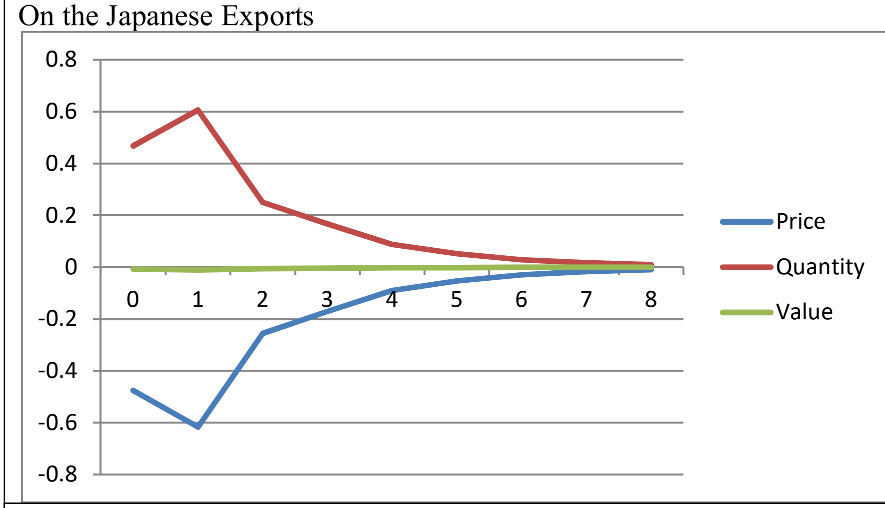


Figure 2. Effects of Depreciation of the Japanese Yen

On the Chinese Exports



On the Japanese Exports



On the Korean Exports

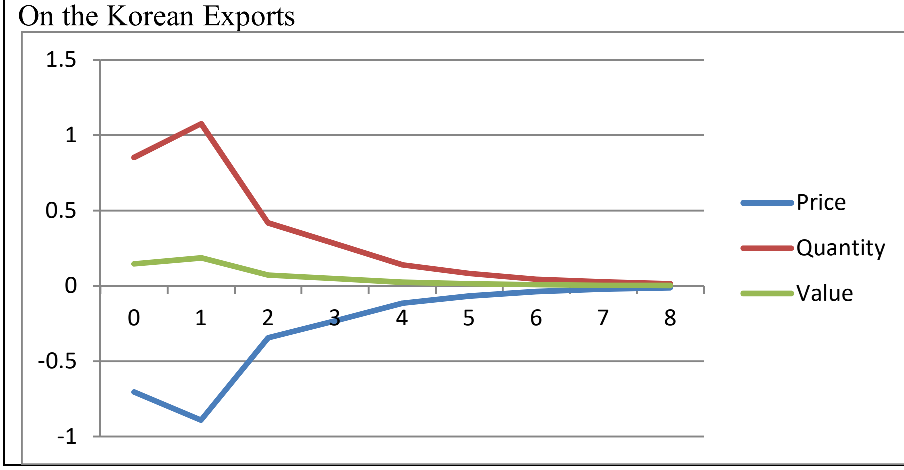


Figure 3. Effects of Depreciation of the Korean Won

On the Chinese Exports

On the Japanese Exports

On the Korean Exports