



RIETI Discussion Paper Series 12-E-067

Estimating Trade Elasticities for World Capital Goods Exports

THORBECKE, Willem
RIETI



Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
<http://www.rieti.go.jp/en/>

October 2012

Estimating Trade Elasticities for World Capital Goods Exports

Willem THORBECKE*

Research Institute of Economy, Trade and Industry

Abstract: Capital goods exports exceed \$3 trillion and are volatile. This paper estimates trade elasticities for capital goods exports. For the UK and the U.S., exports depend on exchange rates. For Germany and France they do not. For Japan, exports to non-Asian countries depend on exchange rates and exports to Asian countries depend on Asia's exports to the rest of the world. For all countries, capital exports depend on GDP in the importing countries. These results imply that U.S. exports tumbled in 2009 because the dollar appreciated and global growth slowed. They also indicate that Japanese exports crashed because of the perfect storm of a yen appreciation, a global slowdown, and a collapse in Asia's exports.

JEL classification: F10, F40

Keywords: Exchange rate elasticities; Capital goods

RIETI Discussion Papers Series aims at widely disseminating research results in the form of professional papers, thereby stimulating lively discussion. The views expressed in the papers are solely those of the author(s), and do not represent those of the Research Institute of Economy, Trade and Industry.

Acknowledgements: I thank Masahisa Fujita, Takatoshi Ito, Minoru Kaneko, Atsuyuki Kato, Masayuki Morikawa, Atsushi Nakajima, Keiichiro Oda, and other colleagues for many helpful comments. Any errors are my own responsibility.

* Senior Fellow, Research Institute of Economy, Trade and Industry, 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8901 Japan; Tel.: + 81-3-3501-8248; Fax: +81-3-3501-8416; E-mail: willem-thorbecke@rieti.go.jp

1. Introduction

The value of capital and equipment goods exports exceeded \$3 trillion before the Global Financial Crisis (GFC). It fell 25 percent in 2009 but rebounded in 2010 and 2011. Over the last 20 years the majority of these exports has come from China, France, Germany, Japan, the United Kingdom, and the United States. More than 60 percent of these countries' capital goods exports in turn flow to developed economies. There is thus a lot of horizontal intra-industry trade between companies in the North in capital goods. Firms in developed economies often have specific needs for equipment goods that firms in other countries can meet better than firms in their own countries. For instance, a firm may prefer a Samsung Galaxy cell phone to an Apple iPhone or a Caterpillar digger to a Komatsu excavator.

Firms in the South also benefit from importing capital goods produced in the North. Apart from providing their workers with better tools, firms in developing countries are able to assimilate new technologies when they import sophisticated capital goods. This occurs because firms in developed countries that export these products sometimes provide firms in developing countries with detailed engineering instructions (Yoshitomi, 2003). It also occurs because firms in developing countries learn by engaging in reverse engineering of technologically-intensive imports.¹

Given the importance of capital goods exports in the world economy, it is desirable to obtain trade elasticities for these products. Previous work has focused on results for aggregate exports (e.g., Chinn, 2005, or Hooper *et al.*, 2000), industry-specific exports (e.g., Bahmani-Oskooee and Ardalani, 2006) or capital goods exports from individual countries (e.g., Thorbecke, 2008).

¹ Bhagwati (1998) describes how technical progress in emerging economies often begins as firms take imported products apart and reassemble them. After this, firms make marginal improvements in products and processes and finally begin innovating and inventing.

This paper employs panel data sets for exports from the six major exporters listed above and dynamic ordinary least squares estimation to obtain these elasticities. The results indicate that capital goods exports from the U.K and the U.S respond to exchange rate changes. This implies that the depreciation of the pound since the advent of the GFC has acted as a safety valve by stimulating exports. These findings also indicate that concerns among British policy makers about the harmful effects of a stronger pound are justified (see Hamilton, 2012). Finally, the results imply that U.S. monetary policy to lower the exchange rate, as Chinn (2012) advocates, would have a salutary effect on U.S. capital goods exports.

The evidence also indicates that exchange rate elasticities are essentially zero for Germany. There is a commonly held view that Germany has benefited from the euro because it has stimulated exports by keeping the exchange rate weaker than it would have been if Germany still had its own currency (see Subramanian, 2012, and Böll, 2012). The results presented here do not support this claim for equipment and capital goods which are the largest category of German exports.

For Japan, the evidence indicates that capital goods exports to Asia are closely related to regional supply chains. Japan ships parts and components and capital goods to supply chain countries where they are used to produce goods for re-export. Japanese capital goods exports to Asia thus depend on Asia's exports to the rest of the world. For shipments to non-Asian countries, Japan's exports are also sensitive to exchange rate changes.

The next section discusses the data and methodology employed in this paper. Section 3 presents the results. Section 4 investigates Japanese exports in more detail. Section 5 concludes.

2. Data and Methodology

Data on capital and equipment goods exports are obtained from the CEPIL-CHELEM database. These goods come from the following categories: aeronautics, agricultural equipment, arms, commercial vehicles, computer equipment, construction equipment, electrical apparatus, electrical equipment, precision instruments, ships, specialized machines, and telecommunications equipment.

Figure 1 shows the value of capital and equipment goods exports from the six major exporters. For every year between 1988 and 2010 the majority of the world's capital goods exports came from these countries. The figure shows that the U.S. was the largest exporter until 2003, but was then overtaken by Germany and China. The figure also shows that exports fell the most for the U.S. after the Global Financial Crisis in 2008. Logarithmically U.S. capital goods exports fell by 46 percent between 2008 and 2009. The second largest percentage drop was for Japan. Its exports fell 33 percent between 2008 and 2009.

Table 1 shows where exports from the major exporters go. The data are for 2010, but the results are similar for other years. France, Germany, and the U.K. are most dependent on the Eurozone. For France, 39 percent of capital goods exports go to the Eurozone; for Germany, 33 percent go to the Eurozone; and for the U.K. 38 percent go to the Eurozone. China and the U.S. are more dependent on NAFTA countries. China sends 29 percent of capital goods exports to NAFTA countries and the U.S. sends 26 percent of these exports to Mexico and Canada. Japan, being upstream in regional supply chains, sends 46 percent of its capital goods exports to East Asia. Kamada and Takagawa (2005) note that demand by other Asian countries for imported capital goods in turn depends on their ability to export. Table 1 shows that East Asia ex-Japan exports 25 percent of its capital goods to NAFTA countries and only 15 percent to the Eurozone.

Thus Japan is less dependent on demand for capital goods in the Eurozone, either directly or indirectly through the effect of European demand on exports in downstream Asian countries.

To estimate trade elasticities, the workhorse imperfect substitutes model of Goldstein and Khan (1985), is employed. In this framework, exports can be modeled as a function of the real exchange rate and real income:

$$ex_t = \alpha_{10} + \alpha_{11} rer_t + \alpha_{12} rgdp_t^* + \varepsilon_t \quad (1)$$

where ex_t represents the log of real exports, rer_t represents the log of the real exchange rate, and $rgdp_t^*$ represents the log of foreign real income.

For each of the six exporting countries, panel data sets are constructed over the 1988-2010 sample period including all of the countries that imported substantial quantities of capital goods. It is desirable to exclude minor importers of capital goods because these countries can have very large percentage changes in imports from year to year due to idiosyncratic factors such as an individual firm's decisions rather than due to macroeconomic factors such as those in equation (1). This is a major problem for China. Figure 1 indicates that at the beginning of the sample period China's total exports of capital goods were very small. When dividing these small aggregate exports among several importing countries, the quantities received by individual countries were often minuscule. Thus many of the changes in China's exports to these countries could be due to factors other than the real exchange rate and income in the importing country. Table 2 lists the primary importing countries for each of the six exporting countries.

Data on the value of capital and equipment goods exports are obtained from the CEPII-CHELEM database and are measured in U.S. dollars. They are deflated using the capital goods

import price index from the U.S. Bureau of Labor Statistics (BLS). As a robustness check they are also deflated using the capital goods export price index obtained from the BLS.

Data on the real exchange rate between the exporting and importing countries and real income are obtained from the CEPII-CHELEM database. As Bénassy-Quéré, Fontagné, and Lahrèche-Révil (2001) discuss, the real exchange rate variable measures the units of consumer goods in the exporting country needed to buy a unit of consumer goods in country j . An increase in the exchange rate represents an appreciation of the exporter's currency. Real income is measured in 2005 dollars. These data are described in detail at www.cepii.fr.

In principle, a producer price index (PPI) deflated real exchange rate would be preferable for explaining capital goods exports.² Data on the PPI are available from the IMF International Financial Statistics database. Unfortunately, data on the PPI are not available for all of the leading exporters over the sample period. For France, these data are not available for the first 8 years and for China they are not available for the first 12 years. For the other four leading exporters, PPI-deflated bilateral exchange rates are constructed with the countries listed in Table 2. However, even in these cases there are gaps in the data. For example, PPI data for Germany are only available starting in the fourth year of the sample period and PPI data for Taiwan are not available. The data that are available are used to construct PPI-deflated bilateral real exchange rates. These exchange rates are used in one specification to test the robustness of the findings.

Table 3 presents the results for a battery of panel unit root tests for the levels and first differences of real capital goods exports, the CEPII real exchange rate, and real income.³ The results indicate that, apart from the data for China, in most cases the variables are integrated of order 1 (I(1)). For all of the countries except the U.S., the sample period extends from 1988 to

² I am indebted to Dr. Masayuki Morikawa for this suggestion.

³ These tests include the Im, Pesaran, and Shin test, the ADF Fisher Chi-square test, the Phillips-Perron Fisher Chi-square test, and the Levin, Lin, and Chu test. These tests are discussed by Barbieri (2005).

2010. For the U.S., the sample extends to 2008. Because of the almost 50 percent drop in capital goods exports from the U.S. in 2009, real capital goods exports from the U.S. are not I(1) when 2009 is included in the sample. Thus in the case of the U.S., more emphasis should be placed in the results reported below when the sample is truncated at 2008. However, the results for the U.S. are very similar whether the sample only extends to 2008 or whether the whole sample period is used.

Since Table 3 indicates that most of the variables are I(1), Kao residual cointegration tests are performed for the variables.⁴ The results in Table 4 indicate that the null hypothesis of no cointegration can be rejected for all of the countries except China and Japan. Similar results, available on requests, are found when the PPI-deflated real exchange rate is employed instead of the CEPII real exchange rate. Panel dynamic ordinary least squares (DOLS) estimation, a technique for estimating cointegrating relations, is thus employed.

DOLS involves regressing the left hand side variable on a constant, the right hand side variables, and lags and leads of the first difference of the right hand side variables. The export equations have the form:

$$\begin{aligned}
 ex_{j,t} = & \beta_0 + \beta_1 rer_{j,t} + \beta_2 rgdp_{j,t}^* + \sum_{k=-p}^p \alpha_{1,k} \Delta rer_{j,t-k} + \sum_{k=-p}^p \alpha_{2,k} \Delta rgdp_{j,t-k}^* & (2) \\
 & + \mu_j + \mu_t + u_{j,t}, \\
 & t = 1, \dots, T; \quad j = 1, \dots, N.
 \end{aligned}$$

Here $ex_{j,t}$ represents real capital goods exports from one of the major exporting countries to importing country j , $rer_{j,t}$ represents the bilateral real exchange rate between the exporting country and country j , $rgdp_{j,t}^*$ equals real income in country j , μ_j is a country j

⁴ This test is discussed in Kao (1999).

fixed effect., and μ_t is a time fixed effect. The data set extends from 1988 to 2010. Because one lead and lag of the first differences is used in the DOLS equation, the actual sample period for the estimation extends from 1990 to 2009. One model is also estimated over the 1990 to 2008 period to see whether the results are robust to excluding the Great Trade Collapse in 2009 that is evident in Figure 1.

3. Results

Table 5 presents the results of estimating equation (2) over the 1990-2009 sample period. The countries in Table 5 are ordered by their exchange rate elasticities, with the most responsive country (China) in column (1) and the least responsive country (Germany) in column (6).

In column (1) for China the exchange rate elasticity is significant at the 10 percent level and the income elasticity at the 5 percent level. The results indicate that a 10 percent appreciation of the renminbi would reduce exports by 7.8 percent. The results also indicate that a 10 percent increase in income in the rest of the world would increase exports by 8.3%. However, as discussed above, China's capital goods exports do not appear to be I(1), there does not appear to be a cointegrating relationship between the variables, and China's exports to individual countries were minuscule for much of the sample period. Thus the findings for China should be interpreted with caution.

In column (2) for the U.K. both the exchange rate elasticity and the income elasticity are significant at the one percent level. The results indicate that a 10 percent increase in the pound would reduce exports by 5.4 percent. The results also indicate that a 10 percent increase in income in the rest of the world would increase exports by 8.1%.

In column (3) for the U.S. the exchange rate elasticity and the income elasticity are again both significant at the one percent level. The results indicate that a 10 percent increase in the dollar would reduce exports by 4.8 percent. The results also indicate that a 10 percent increase in income in the rest of the world would increase exports by 7.2%.

Column (3) of Table 6 reports the results for the U.S. when the sample period is truncated in 2008. These may be more appropriate for the U.S. since in this case the evidence indicates the presence of unit roots when the sample period ends in 2008. The results in Table 6 show that the exchange rate and income elasticities for the U.S. are again both significant at the one percent level. The results imply that a 10 percent increase in the dollar would reduce exports by 4.9 percent. The results also imply that a 10 percent increase in income in the rest of the world would increase exports by 7.6%. The findings are thus very similar whether the sample ends in 2008 or not.

Interestingly, the trade elasticities obtained for the U.S. up until 2008 can explain the large drop in U.S. exports in 2009. The U.S. dollar appreciated significantly in 2009 and income in importing countries tumbled. If equation (2) is estimated for the U.S. up to 2008 and then actual changes in exchange rates and income for 2009 are used to forecast changes in U.S. capital and equipment goods exports to the 16 importing countries in 2009, the predicted drop in total exports is 42 percent. These exports actually fell by 46 percent in 2009. The model thus provides a good out-of-sample forecast for the fall in U.S. exports during the crisis. Thus one reason why U.S. capital goods exports in Figure 1 fell so much more than capital goods from the other countries during the Great Trade Collapse is that the price elasticity of U.S. exports is relatively high and the dollar appreciated significantly against most other currencies at this time.

In column (4) for Japan the income elasticity and the exchange rate elasticity are both significant at the one percent level. The results indicate that a 10 percent appreciation of the yen would reduce exports by 2.7 percent. The results also indicate that a 10 percent increase in income in the rest of the world would increase Japanese capital goods exports by 12.2 percent. Since Table 4 indicated that the null hypothesis of no cointegration could not be rejected for Japan, the next section explores other specifications for Japanese capital goods exports.

Columns (5) and (6) report the results for France and Germany, respectively. In both cases the exchange rate elasticity is not statistically different from zero. In the case of France, the coefficient equals -0.19 and in the case of Germany it equals -0.02. The income coefficients, on the other hand, are both statistically significant at the 1 percent level. For France, the elasticity equals 0.94 and for Germany it equals 1.22. Germany and Japan thus have the highest income elasticities of the countries in our sample.

Tables 6 and 7 present sensitivity tests. Table 6 truncates the sample in 2008 to exclude the Great Trade Collapse of 2009.⁵ The results are very similar to the results in Table 5. Table 7 presents results using the PPI-deflated exchange rate for the four exporting countries for which the data are available. The exchange rate elasticities for the United Kingdom, Japan, and Germany are very similar to the results reported in Tables 5-7. The exchange rate elasticity for the United States is larger (-0.98) and remains statistically significant at the 1 percent level.⁶

The evidence reported here thus indicates that exchange rates matter for capital goods exports from the U.S. and the U.K and are insignificantly different from zero for France and Germany. In addition, the results in Tables 5 and 6 indicate that income elasticities are

⁵ Results using the BLS capital goods export price deflator instead of the BLS capital goods import price deflator, available on request, are very similar to the results in Table 5.

⁶ The U.S. data in Table 8 only extend to 2008, but the results are similar if data including 2009 are used.

statistically significant for all of the countries and largest for Japan and Germany. For these two countries, the income elasticities exceed 1.2.

4. Further Evidence for Japan

Table 4 indicates that the null hypothesis of no cointegration cannot be rejected for China and Japan. One possible remedy for this problem is to increase the sample size in order to increase the power of the tests. For China, this is not possible since China only became a major exporter of capital goods recently. For Japan, however, this is possible since Japan has been a major exporter for many years. To specify a model for Japan not only is a larger sample size employed but also Japanese exports are considered in more detail.

Figure 2a shows Japanese capital goods and intermediate goods exports to East Asian supply chain countries and Figure 2b shows these exports to the rest of the world. The East Asian supply chain countries are China, Indonesia, Malaysia, Singapore, South Korea, Taiwan, and Thailand. Figure 2 makes clear that Japanese capital goods exports to East Asia are closely related to Japanese intermediate goods exports to East Asia, while Japanese capital goods exports to the rest of the world are more decoupled from Japanese intermediate goods exports to the rest of the world. Japanese capital goods exports to East Asia are thus closely linked to East Asian supply chains.

As Ozawa (2007) discusses, there tends to be a complimentary relationship between Japanese FDI and Japanese exports to Asia. As wages in Japan increase and as new products became more capital and knowledge intensive, Japanese firms transfer the location of production to lower wage Asian countries. Japan then exports sophisticated parts and components and capital goods to the assembly country, implying that there is a complementary relationship

between exports and FDI. These inputs from Japan are then used in the supply chain countries to produce goods for re-export. Many have noted that Japanese exports of intermediate and capital goods to Asia thus depend on exports from these countries to the rest of the world (see IMF, 2005, and Kamada and Tamagawa, 2005).

Kwan (2004) also notes that many downstream Asian countries rely on Japan for capital goods, and if they cannot import these from Japan they often cannot obtain these goods. Since many of these sophisticated exports to Asia have few substitutes, price elasticities for Japanese exports to Asia may be lower.

It may thus be appropriate to include exports from Asian countries as an explanatory variable for Japanese capital goods exports to Asia. It may also make sense to estimate price elasticities for Asian supply chain countries and for other countries separately.

The model employed in Section 3 is thus modified in several ways. First, data from 1980 to 2010 are employed. Second, Japanese exports to Asian supply chain countries are sometimes modeled as a function of exports from supply chain countries to the world while Japanese exports to non-Asian countries continue to be modeled as a function of GDP in the importing country.⁷ Third, in some specifications coefficients on Asian and non-Asian exchange rates and GDP are estimated separately. Cointegration test results for all of the specifications employed, available on request, indicate that the null hypothesis of no cointegration can be rejected.

The results are presented in Table 8. In column (1) the income elasticity and the exchange rate elasticity are both significant at the one percent level. The results indicate that a 10 percent appreciation of the yen would reduce exports by 3.7 percent and that a 10 percent increase in income in the rest of the world would increase exports by 11.1 percent. In column (2),

⁷ Data from supply chain countries to the world are obtained from the CEPII-CHELEM database. They are measured in US dollars and are deflated using the US consumer price index.

the exchange rate elasticities are estimated separately for Asian and non-Asian countries. The income elasticity remains almost unchanged. The exchange rate elasticities imply that a 10 percent yen appreciation would reduce Japanese exports to Asian countries by 3.3 percent and Japanese exports to non-Asian countries by 5.1 percent. These results imply that Japanese capital goods exports to non-Asian countries are more responsive to exchange rate changes than Japanese capital goods exports to Asian countries.

Columns (3) and (4) include GDP for Asian importers and non-Asian importers separately and also include exports from Asian supply chain countries to the world as an explanatory variable. For Asian importers, the coefficient on real GDP is no longer statistically significant but the coefficient on exports to the rest of the world is statistically significant at the 1 percent level and equal to about 0.8. The coefficient on real GDP in non-Asian countries is now statistically significant at the 1 percent level and equal to about 0.5. Finally, the findings continue to indicate that Japanese capital goods exports to non-Asian countries are more responsive to exchange rate changes than Japanese capital goods exports to Asian countries. For Asian countries, the results indicate that a 10 percent yen appreciation would reduce Japanese exports by 3.1 percent while for non-Asian countries the results indicate that a 10 percent appreciation would reduce exports by 7.2 percent.

Columns (5) and (6) report results dropping GDP in Asian importing countries and using only GDP in non-Asian countries and exports from Asian countries as measures of economic activity in the importing countries. All of the variables are now statistically significant at the one percent level. The coefficient on GDP in non-Asian countries equals about 0.7. The coefficient on exports from Asian countries equals about 0.75. The results also indicate that Japanese capital goods exports to non-Asian countries are more responsive to exchange rate changes than

Japanese capital goods exports to Asian countries. For non-Asian countries, the exchange rate elasticity equals -0.75 and for Asian countries it equals -0.38.

The important implications of these results are that Japanese capital goods exports are sensitive to exports from Asia to the world, to GDP in non-Asian countries, and to the yen exchange rate relative to non-Asian countries. The combination of the collapse in Asia's exports in 2009, the worldwide recession, and the appreciation of the yen was thus a perfect storm for Japanese capital goods exports. This explains why they fell so much in Figure 1 between 2008 and 2009.

5. Conclusion

Capital goods exports play important roles in the global economy. The majority of these exports come from China, France, Germany, Japan, the United Kingdom, and the United States. This paper has used the imperfect substitutes model to try to understand the determinants of capital goods exports from these countries.

The results indicate that income elasticities are high and price elasticities are low for Germany. Capital goods produced in Germany tend to be high quality, differentiated products. Many of these sophisticated exports have few substitutes. It thus makes sense that their price elasticities should be low.⁸

The high income elasticities for German exports imply that German firms are dependent on economic conditions in the rest of the world. Since Table 1 indicates that one-third of Germany exports go to the Euroland, German firms are exposed to a slowdown in Europe.

⁸ Vigfusson, Sheets, and Gagnon (2007) that German exporters have pricing power because they export sophisticated capital goods.

Japanese capital goods exports are sensitive to the yen exchange rate relative to non-Asian countries, GDP in non-Asian countries, and exports by Asian countries. A slowdown outside of Asia and an appreciation of the yen could thus cause a large drop in Japanese capital goods exports. These exports would also fall if China succeeds in its goal of switching from an investment-led growth model to a consumption-led model.⁹

Although income elasticities in Tables 5 and 6 are highest for Germany and Japan, they are statistically significant for all six countries. Thus firms in all of the major exporting countries are exposed to slowdowns in the rest of the world. Table 1 indicates that France and the U.K. are especially exposed to a slowdown in Europe, while the U.S. and China are exposed to a slowdown in North America.

The results also indicate that exchange rate changes in both the U.K. and the U.S. affect capital goods exports. For the U.K., the coefficients imply that a one-standard deviation drop in the real exchange rate would cause exports to increase by 10 percent. For the U.S., the coefficients imply that a one-standard deviation depreciation would cause exports to increase by 16 percent. These findings support the claim of Chinn (2012) that using U.S. monetary policy to lower exchange rates would have a stimulative effect on U.S. exports, at least for capital and equipment goods exports which are the largest category of U.S. exports.

Of course, seeking to lower exchange rates to stimulate exports has a beggar-thy-neighbor element to it. It may stir resentment in the global economy. More modestly, policymakers could seek to limit wild exchange rate fluctuations that occur during crisis times. The results in this paper indicate that the massive appreciations of the dollar and the yen between 2008 and 2009 contributed to the collapse of U.S. and Japanese capital goods exports. Monetary authorities should consider how to limit this type of exchange rate overshooting.

⁹ This is discussed in IMF (2012).

References

- Bahmani-Oskooee, M., and Ardalani, Z., 2006, Exchange Rate Sensitivity of U.S. Trade Flows: Evidence from Industry Data, *Southern Economic Journal* 72, 542-59.
- Barbieri, L. 2005. Panel Unit Root Tests: A Review, Working Paper, Università Cattolica del Sacro Cuore. Available at: <http://www.unicattolica.it/>
- Bénassy-Quéré, A., Fontagné, L., Lahrière-Révil, A., 2001, Exchange Rate Strategies in the Competition for Attracting Foreign Direct Investment, *Journal of the Japanese and International Economies* 15, 178-98.
- Bhagwati, J., 1998, Notes on Krugman's Article on Myth of Asian Miracle, Working Paper, Columbia University. Available at www.columbia.edu.
- Böll, S., 2012, Leading German Economist Higher Inflation 'Would not be a Disaster' <www.spiegel.de> (15.5.2012).
- Chinn, M., 2012, Some Implications of the Trade Release <www.econbrowser.com> (12.4.2012).
- Chinn, M., 2005, Doomed to Deficits? Aggregate U.S. Trade Flows Re-visited, *Review of World Economics* 141, 460-85.
- Goldstein, M., and Khan, M., 1985, Income and Price Effects in Foreign Trade, in R. Jones and P. Kenen, eds., *Handbook of International Economics*, (Elsevier, Amsterdam).
- Hamilton, S., 2012, King Seen Balance Shift on Inflation with One Eye on Pound <www.bloomberg.com> (15.5.2012).
- Hooper, P., Johnson, K., and Marquez, J., 2000, Trade Elasticities for the G-7 Countries, *Princeton Studies in International Economics* No. 87, (Princeton University Press, Princeton, NJ).
- IMF, 2012, Regional Economic Outlook: Asia and Pacific, (International Monetary Fund, Washington).
- IMF, 2005, Asia-Pacific Economic Outlook, (International Monetary Fund, Washington).
- Kamada, K., and Takagawa, I., 2005, Policy Coordination in East Asia and across the Pacific, Bank of Japan Working Paper Series No. 05-E-4, (Bank of Japan, Tokyo).

- Kao, C.D., 1999, Spurious Regression and Residual-based Tests for Cointegration in Panel Data, *Journal of Econometrics* 90, 1-44.
- Kwan, C., 2004, Japan's Exports to China Increasing not Despite but Because of the Yen's Appreciation, China in Transition Working Paper, Research Institute of Economy, Trade, and Industry.
- Ozawa, T., 2007, Professor Kiyoshi Kojima's Contributions to FDI Theory: Trade, Structural Transformation, Growth, and Integration in East Asia, *The International Economy* 11, 17-33.
- Subramanian, A., 2012, Why Greece's Exit Could Become the Eurozone's Envy, *The Financial Times*, May 14.
- Thorbecke, W., 2008, Global Imbalances, Triangular Trading Patterns, and the Yen/Dollar Exchange Rate, *Journal of the Japanese and International Economies* 22, 503-517.
- Vigfusson, R., Sheets, N., and Gagnon, J., 2007, Exchange Rate Pass-Through to Export Prices: Assessing Some Cross-Country Evidence, International Finance Discussion Papers Number 902, (Federal Reserve Board, Washington).
- Yoshitomi, M., 2003, *Post-Crisis Development Paradigms in Asia*, (ADB-I Publishing, Tokyo).

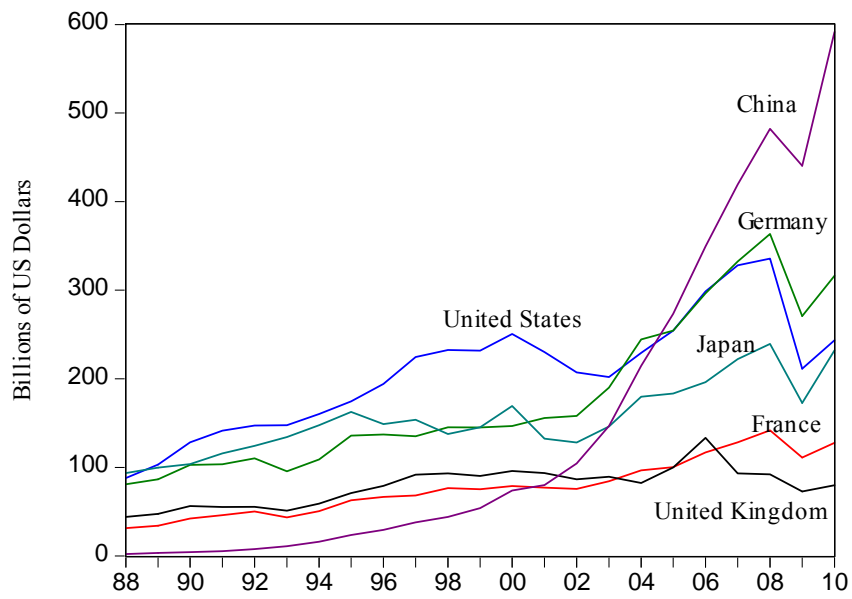


Figure 1. The Value of Capital and Equipment Goods Exports from Major Exporting Countries to the World.

Source: CEPII-CHELEM Database

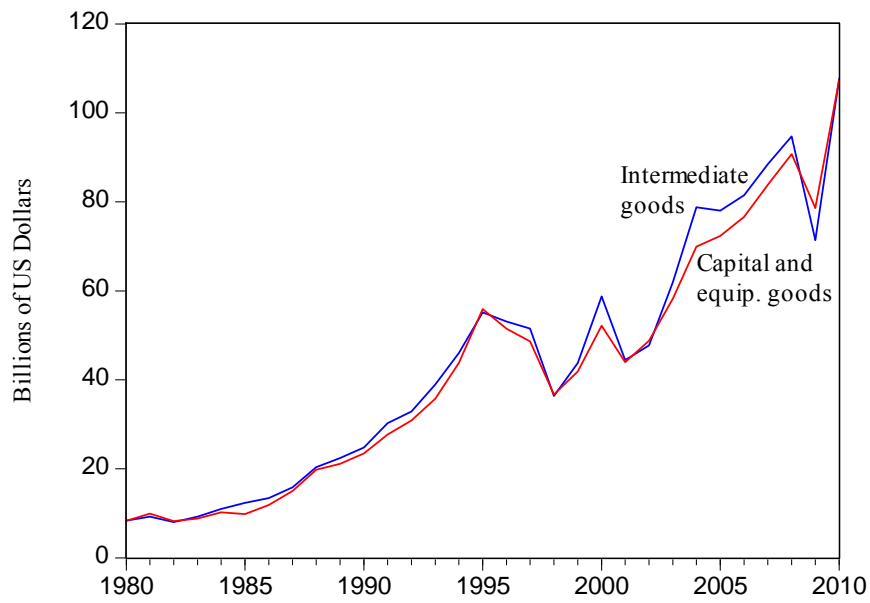


Figure 2a. The Value of Japanese Capital and Equipment Goods Exports and Intermediate Goods Exports to East Asia

Note: East Asia includes China, Indonesia, Malaysia, Singapore, South Korea, Taiwan, and Thailand.

Source: CEPII-CHELEM Database

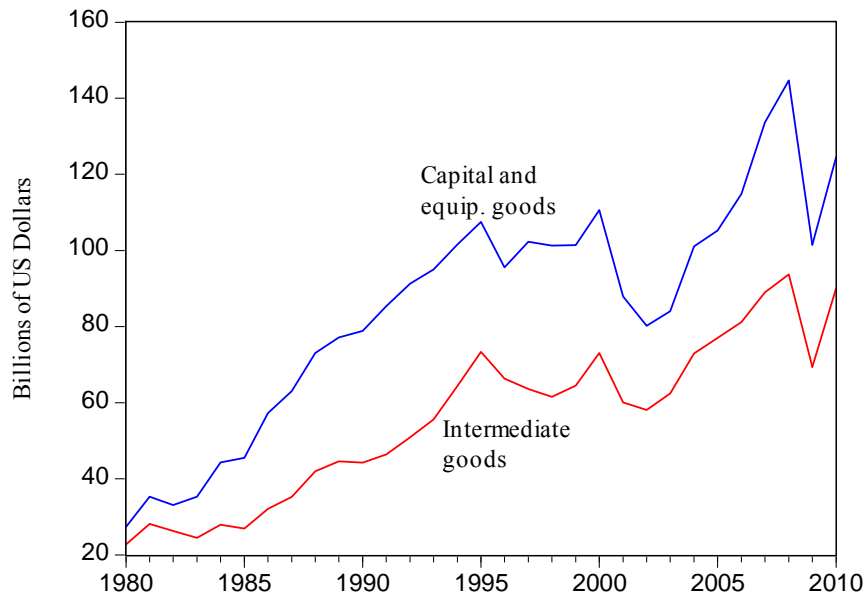


Figure 2b. The Value of Japanese Capital and Equipment Goods Exports and Intermediate Goods Exports to non-East Asian Countries

Note: Non-East Asian countries include all countries except those listed in Table 2a.
 Source: CEPII-CHELEM Database

Table 1. Share of Capital Goods Exports Flowing from Major Exporting Countries to Individual Regions, 2010

Exporting Country or Region	Importing Region			
	East Asia	Euroland	NAFTA	Rest of World
China	18.0%	17.2%	28.9%	35.9%
East Asia Ex-Japan	25.2%	15.4%	25.4%	34.0%
France	10.5%	38.8%	11.1%	39.5%
Germany	14.0%	32.5%	9.5%	44.0%
Japan	45.8%	10.0%	17.0%	27.1%
United Kingdom	9.3%	37.8%	17.2%	35.6%
United States	24.1%	15.8%	26.8%	33.3%

Source: CEPII-CHELEM database.

Notes: East Asia includes China, Japan, Malaysia, the Philippines, Singapore, South Korea, Taiwan, and Thailand. The Euroland includes all countries that use the euro as its currency. NAFTA includes, Canada, Mexico, and the United States.

Table 2. Major Capital Goods Exporting and Importing Countries

Importing Countries	Exporting Countries					
	China	France	Germany	Japan	United States	United Kingdom
Australia				○	○	○
Austria			○			
Belgium-Luxembourg		○	○		○	○
Brazil					○	
Canada	○	○	○	○	○	○
China		○	○	○	○	
Denmark			○			
France	○		○	○	○	○
Germany	○	○		○	○	○
Hong Kong	○			○		○
Indonesia				○		
Ireland						○
Italy	○	○	○		○	○
Japan	○	○	○		○	○
Malaysia	○			○		
Mexico					○	
Morocco		○				
Netherlands	○	○	○	○	○	○
Norway			○			○
Portugal		○				
Singapore	○			○	○	
South Korea	○	○		○	○	
Spain	○	○	○		○	○
Sweden		○	○			○
Switzerland		○	○			
Taiwan	○			○	○	
Thailand	○			○		
Turkey			○			
United Kingdom	○	○	○	○	○	
United States	○	○	○	○		○

Source: CEPII-CHELEM database.

Table 3. Results of Unit Root Tests

Level, intercept included	(1)	(2)	(3)	(4)
China-Capital Exports	155.5**	126.7**	-6.90**	-12.1**
China-Real Exchange Rate	34.0	48.2**	-1.90**	1.19
China-Importer's Real GDP	106.3**	39.4	-1.15**	-5.72**
France-Capital Exports	21.8	20.2	1.52	-1.29
France-Real Exchange Rate	50.0**	38.7	-1.43	-1.39
France-Importer's Real GDP	75.8**	26.8	1.42	-2.57**
Germany-Capital Exports	6.29	6.53	3.97	0.28
Germany-Real Exchange Rate	17.4	21.5	1.92	2.50
Germany-Importer's Real GDP	22.8	24.1	1.07	-3.24**
Japan Capital Exports	39.6	40.0	-1.36	-3.37**
Japan-Real Exchange Rate	25.7	35.8	-1.37	-0.77
Japan-Importer's Real GDP	97.6**	32.0	0.07	-3.92**
United Kingdom-Capital Exports	25.8	24.7	-0.53	-2.56**
United Kingdom -Real Exchange Rate	16.2	22.3	0.43	0.43
United Kingdom -Importer's Real GDP	46.4**	28.1	0.28	-3.83**
United States – Capital Exports	36.2	24.1	0.20	-3.22**

United States –Real Exchange Rate	20.4	33.0	-0.76	-0.11
United States -Importer’s Real GDP	57.3**	29.0	2.42	-2.33
First difference, intercept included	(1)	(2)	(3)	(4)
China-Capital Exports	142.1**	192.1**	-12.1**	-15.3**
China-Real Exchange Rate	172.4**	149.5**	-9.95**	-11.0**
China-Importer’s Real GDP	114.9**	116.5**	-8.00**	-9.53**
France-Capital Exports	260.8**	216.7**	-14.5**	-15.6**
France-Real Exchange Rate	173.2**	121.2**	-7.77**	-4.67**
France-Importer’s Real GDP	133.2**	101.7**	-6.91**	-6.57**
Germany-Capital Exports	193.9**	168.4**	-11.0**	-13.8**
Germany-Real Exchange Rate	148.9**	131.7**	-8.55**	-7.63**
Germany-Importer’s Real GDP	90.6**	89.9**	-6.27**	-6.51**
Japan-Capital Exports	299.8**	204.2**	-13.8**	-14.6**
Japan-Real Exchange Rate	123.6**	147.8**	-9.94**	-10.4**
Japan-Importer’s Real GDP	109.3**	110.4**	-7.63**	-9.11**
United Kingdom-Capital Exports	165.9**	165.9**	-11.6**	-11.4**
United Kingdom -Real Exchange Rate	121.5**	124.0**	-8.85**	-11.1**

United States –Capital Exports	177.9**	147.3**	-9.79**	-10.9**
United States -Real Exchange Rate	122.9**	126.3**	-8.43**	-10.4**
United States -Importer's Real GDP	102.6**	109.9**	-7.23**	-7.63**

(1) PP test-Fisher Chi-square statistic (null hypothesis: unit root)
(2) ADF test-Fisher Chi-square statistic (null hypothesis: unit root)
(3) Im, Pesaran, and Shin W-statistic (null hypothesis: unit root)
(4) Levin, Lin, and Chu t-statistic (null hypothesis: unit root)
Notes: Lag selection is based on the Schwarz Information Criterion.
For the United States the sample extends from 1988-2008.
For the other countries the sample extends from 1988-2010.
** denotes significance at the 5 percent level.

Table 4. Kao Residual Cointegration Tests for Export Equations

Countries	
China	-0.23
France	-1.80**
Germany	-3.01**
Japan	0.15
United Kingdom	-2.82**
United States	-4.71**

(1) *Notes:* t-statistic from Kao Residual Cointegration test of the null hypothesis of no cointegration. Lag selection is based on the Schwarz Information Criterion. The sample period extends from 1988-2010.

** denotes significance at the 5% level.

Table 5. Panel DOLS Estimates of Trade Elasticities for Capital Goods Exports

	Country					
	(1) China	(2) United Kingdom	(3) United States	(4) Japan	(5) France	(6) Germany
Real Exchange Rate (CEPII)	-0.78* (0.47)	-0.54*** (0.09)	-0.48*** (0.08)	-0.27*** (0.10)	-0.19 (0.13)	-0.02 (0.10)
Real GDP	0.83** (0.39)	0.81*** (0.11)	0.72*** (0.09)	1.22*** (0.11)	0.94*** (0.09)	1.22*** (0.11)
Cross-section Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Period Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	0.93	0.96	0.96	0.95	0.97	0.99
Sample Period	1990-2009	1990-2009	1990-2009	1990-2009	1990-2009	1990-2009
No. of Importing Countries	15	14	16	15	15	16
No. of Observations	299	280	320	300	300	320

Notes: Heteroskedasticity-consistent standard errors are in parentheses. Exports are deflated using the U.S. Bureau of Labor Statistics capital goods import price index.

*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table 6. Panel DOLS Estimates of Trade Elasticities for Capital Goods Exports

	Country					
	(1) China	(2) United Kingdom	(3) United States	(4) Japan	(5) France	(6) Germany
Real Exchange Rate (CEPII)	-0.84 (0.51)	-0.57*** (0.10)	-0.49*** (0.09)	-0.25** (0.10)	-0.19 (0.14)	-0.00 (0.10)
Real GDP	0.94** (0.43)	0.75*** (0.11)	0.76*** (0.09)	1.28*** (0.11)	0.96*** (0.09)	1.22*** (0.12)
Cross- section Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Period Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	0.93	0.96	0.97	0.95	0.97	0.98
Sample Period	1990- 2008	1990- 2008	1990- 2008	1990- 2008	1990- 2008	1990- 2008
No. of Importing Countries	14	14	16	15	15	16
No. of Observations	284	266	304	285	285	304

Notes: Heteroskedasticity-consistent standard errors are in parentheses. Exports are deflated using the U.S. Bureau of Labor Statistics capital goods import price index.
 *** (**) denotes significance at the 1% (5%) level.

Table 7. Panel DOLS Estimates of Trade Elasticities for Capital Goods Exports

	Country			
	(1) United Kingdom	(2) United States	(3) Japan	(4) Germany
Real Exchange Rate (PPI- deflated)	-0.57*** (0.11)	-0.98*** (0.13)	-0.26 (0.16)	0.00 (0.01)
Real GDP	1.02*** (0.12)	0.56*** (0.10)	0.33** (0.13)	1.02*** (0.07)
Cross- section Fixed Effects	Yes	Yes	Yes	Yes
Period Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R ²	0.96	0.97	0.96	0.99
Sample Period	1990- 2009	1990- 2008	1990- 2009	1993- 2009
No. of Importing Countries	14	15	14	16
No. of Observations	266	262	255	272

Notes: Heteroskedasticity-consistent standard errors are in parentheses. Exports are deflated using the U.S. Bureau of Labor Statistics capital goods import price index.

*** (**) denotes significance at the 1% (5%) level.

Table 8. Panel DOLS Estimates of Trade Elasticities for Japanese Capital Goods Exports

	(1)	(2)	(3)	(4)	(5)	(6)
Real Exchange Rate	-0.37*** (0.08)		-0.45*** (0.09)		-0.49*** (0.08)	
Real Exchange Rate (Asian Importers)		-0.33*** (0.09)		-0.31*** (0.11)		-0.38*** (0.10)
Real Exchange Rate (Non-Asian Importers)		-0.51*** (0.09)		-0.72*** (0.10)		-0.75*** (0.09)
Real GDP	1.11*** (0.04)	1.09*** (0.05)				
Real GDP (Asian Importers)			-0.07 (0.10)	-0.17 (0.10)		
Real GDP (Non-Asian Importers)			0.49*** (0.15)	0.45*** (0.14)	0.67*** (0.13)	0.71*** (0.12)
Exports (Asian Importers)			0.77*** (0.06)	0.82*** (0.07)	0.74*** (0.04)	0.74*** (0.05)
Cross-section Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Period Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	0.96	0.96	0.97	0.97	0.97	0.97
Sample Period	1982-2009	1982-2009	1982-2009	1982-2009	1982-2009	1982-2009
No. of Importing Countries	15	15	15	15	15	15
No. of Observations	420	420	420	420	420	420

Notes: Heteroskedasticity-consistent standard errors are in parentheses. Japanese exports are deflated using the U.S. Bureau of Labor Statistics capital goods import price index. Asian importers include China, Indonesia, Malaysia, Singapore, South Korea, Taiwan, and Thailand. Non-Asian importers include the other 8 countries listed in Table 2. Exports from Asian exporters represent exports from each of the 7 Asian importers to the world, measured in dollars and deflated using the US consumer price index.

*** (**) denotes significance at the 1% (5%) level.