

How Would an Appreciation of the RMB and Other East Asian Currencies Affect China's Exports?

Willem Thorbecke*
George Mason University and RIETI

Gordon Smith**
George Mason University

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* Corresponding Author, RIETI, 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8901, Japan; Tel.: 81-3-3501-8286; Fax: 81-3-3501-8416; E-mail: wthorbec@gmu.edu .

** Department of Economics, MSN 3G4, George Mason University, Fairfax, VA 22030, U.S.; Tel.: (703) 993-1151; Fax: (703) 993-1133; E-mail: gsmith2@gmu.edu .

How Would an Appreciation of the RMB and Other East Asian Currencies Affect China's Exports?

Abstract: China's global current account surplus equaled 9 percent of Chinese GDP in 2006 and 12 percent of GDP in the first half of 2007. Many argue that an RMB appreciation would help rebalance China's trade. Using a panel data set including China's exports to 33 countries we find that a 10 percent RMB appreciation would reduce ordinary exports by 12 percent and processed exports by less than 4 percent. A 10 percent appreciation of all other East Asian currencies would reduce processed exports by 6 percent. A 10 percent appreciation throughout the region would reduce processed exports by 10 percent. Since ordinary exports tend to be simple, labor-intensive goods while processed exports are sophisticated, capital-intensive goods, a generalized appreciation in East Asia would generate more expenditure-switching towards U.S. and European goods and contribute more to resolving global imbalances than an appreciation of the RMB or other Asian currencies alone.

1. Introduction

China's global current account surplus equaled 9 percent of Chinese GDP in 2006 and 12 percent of GDP in the first half of 2007. The Chinese government, in its 2006-2010 five-year plan, acknowledged the need to rebalance its economy. Many have argued that an appreciation of the renminbi would help to achieve this goal. How would an appreciation of the RMB affect China's trade?

As the IMF (2005) discusses, few studies report the responsiveness of China's exports and imports to exchange rate changes. Mann and Plück (2005), using a dynamic panel specification and disaggregated trade flows, report that price elasticities for U.S. imports from China are wrong-signed and that price elasticities for U.S. exports to China are not statistically significant. Thorbecke (2006), employing Johansen MLE and dynamic OLS techniques, finds that the long run real exchange rate coefficients for

exports and imports between China and the U.S. equal approximately unity. Cheung, Chinn, and Fujii (2007), using dynamic OLS methods, find that an appreciation of the RMB increases U.S. exports to China but does not affect China's exports to the U.S. Marquez and Schindler (2007), using an autoregressive distributed lag model and China's shares in world trade, report that a 10 percent appreciation of the RMB would reduce China's share of world exports by half a percentage point and China's share of world imports by a tenth of a percentage point.

Marquez and Schindler (2007) find that disaggregating Chinese trade into ordinary trade and processing trade produces better estimates. Ordinary exports are produced primarily using domestic inputs. Processed exports are produced through intricate production and distribution networks centered in East Asian countries. Japan, South Korea, Taiwan, and multi-national corporations (MNCs) in ASEAN export sophisticated technology-intensive intermediate goods and capital goods to China for assembly by lower-skilled workers. The finished products are then exported throughout the world. These processed exports accounted for 53 percent of China's total exports in 2006.

Because of these trading networks, Chinese value-added in processed exports is smaller than the value of intermediate goods imported from other (primarily Asian) countries. Thus one would not expect a unilateral RMB revaluation against the countries purchasing final exports to affect import prices in the importing countries' currencies as much as a generalized appreciation of Asian currencies against the countries purchasing final exports.

Rahman and Thorbecke (2007) compare the effects on China's exports of 1) a unilateral RMB appreciation and 2) a joint appreciation among supply chain countries against countries purchasing processed exports. Results obtained using generalized method of moments techniques indicate that a joint appreciation would significantly reduce China's exports while a unilateral appreciation would not.

Rahman and Thorbecke's paper, however assumes that one can consider a change in the bilateral RMB exchange rate holding the trade-weighted exchange rate in the rest of East Asia constant. While this is possible to do mathematically, it may not be possible economically given the fact that these variables move closely together.¹

This paper takes a different tack. It constructs a single integrated exchange rate variable to measure changes in the relative foreign currency costs not just of China's value-added but of China's entire output of processed exports. It also assumes that ordinary (non-processed) exports are affected by the RMB exchange rate, since they are produced primarily using domestic inputs.

The results indicate that if the RMB appreciated by 10 percent against importing countries then ordinary exports would decline in the long run by 11 or 12 percent. The effect on processed exports would depend on what happened to exchange rates in the rest of Asia. If the RMB appreciated by 10 percent against importing countries and exchange rates in the rest of East Asia remained the same then processed exports would fall by 4 percent. If the RMB remained unchanged but the rest of East Asia appreciated by 10 percent against countries purchasing final goods then processed exports would fall by 6

¹ We are indebted to Prof. Menzie Chinn for this point.

percent. If both the RMB and other East Asian currencies appreciated by 10 percent then processed exports would decline by 10 percent.²

Thus an RMB appreciation alone would primarily affect ordinary exports. These tend to be simple, labor-intensive goods such as toys and textiles. If the goal of an RMB appreciation is to resolve imbalances between China and the rest of the world (especially the U.S. and Europe), a reduction in ordinary exports would not be helpful. A reduction in ordinary exports from China to the rest of the world would be replaced by an increase in labor-intensive exports from other countries on lower rungs of the ladder of comparative advantage.

An appreciation in the rest of East Asia alone would also be insufficient to cause a large decline in processed exports. A generalized appreciation in both China and the rest of the region would be necessary to produce a large drop in the export of capital-intensive, technologically-sophisticated processed exports. Thus a generalized appreciation would be needed to switch expenditures towards U.S. and European goods and rebalance world trade.³

The next section surveys China's position in the global supply chain. Section 3 presents our empirical framework. Section 4 contains the results. Section 5 concludes.

² This is true assuming all imports for processing come from other East Asian countries.

³ The expenditure-switching effect of exchange rate changes depends on the degree of exchange rate pass-through to tradable prices. The IMF (2005) estimates that a 10 percent RMB appreciation would raise the foreign currency prices of China's exports by 5 percent. Vigfusson, Sheets, and Gagnon (2007) report that 10 percent currency appreciations would raise the foreign currency prices of the Asian NIEs' exports by 7 percent and of Japan's exports by 5 percent. Thus the degree of exchange rate pass-through should be sufficient to permit exchange rate appreciations in Asia to reduce exports.

2. China's Position in the Global Supply Chain

East Asia is characterized by intricate production and distribution relationships, constituting part of a global triangular trading network. Japan, South Korea, Taiwan and MNCs located in ASEAN produce sophisticated technology-intensive intermediate goods and capital goods and ship them to China for assembly by lower-skilled workers. The finished products are then exported throughout the world. These production and distribution networks have promoted economic efficiency and helped to make East Asia as a whole (not just China) a major manufacturing center.

While networks are common in other parts of the world (e.g., parts and components exported from the U.S. for assembly in Mexico), fragmentation in East Asia is particularly elaborate and well-developed. It involves complicated combinations of intra-firm trade, arms-length transactions, and outsourcing (see Kimura and Ando, 2005).

These networks have allowed firms to exploit comparative advantage by slicing up long production processes and allocating the production blocks created in this way throughout Asia. These trade-FDI linkages have led to production-distribution networks in East Asia that can be characterized as vertical intra-industry trade (VIIT).

VIIT differs both from the exchange of final goods emphasized by traditional trade theory for vertical inter-industry trade between the North and the South (e.g., between capital goods and apparel) and for horizontal intra-industry trade between the North and the North (e.g., between two differentiated types of automobiles). As Fukao *et al.* (2002) and Yi (2003) discuss, the production processes of an industry

(e.g., the electronics industry) can be split into fragmented production blocks that are located in different countries and the new VIIT is essentially based on differences in factor endowments in the fragmented production blocks between developing, emerging, and developed economies in the region.

Table 1 shows China's role in this triangular trading structure. The data are taken from China's Customs Statistics, which distinguishes between imports and exports linked to processing trade and ordinary imports and exports.⁴ Imports for processing are goods that are brought into China for processing and subsequent re-export. Processed exports, as classified by the Chinese customs authorities, are goods that are produced in this way. Imports for processing are imported duty free and neither these imported inputs nor the finished goods produced using these imports normally enter China's domestic market. By contrast, ordinary imports are goods that are intended for the domestic market and ordinary exports are goods that are produced primarily using local inputs.

Table 1 shows that in 2006 41 percent of China's imports were for processing. Of this percent, about seven-tenths came from other East Asian countries. By contrast, only one-twentieth each came from the U.S. and from the EU.

Table 1 also shows that in 2006 53 percent of China's exports were processed exports. Of this 53 percent one-quarter went to the U.S., another one-quarter went to East Asia (excluding Hong Kong), one-quarter went to Hong Kong (largely as entrepôt trade), and one-sixth went to Europe.

Since intermediate inputs are imported primarily from East Asia but not from Europe and the U.S. and since processed exports are exported throughout the world,

⁴ The website for China's Customs Statistics is www.ChinaCustomsStat.com.

China tends to run trade deficits with Asia but trade surpluses with Europe and the U.S. As Table 1 shows, China's deficit with East Asia (excluding Hong Kong) in 2006 equaled \$100 billion and its surpluses with Europe and the U.S. equaled \$76 and \$153 billion, respectively.

China's surplus with Europe and the U.S. was actually larger than the official statistics indicate because of the distortionary effects of entrepôt trade through Hong Kong. Kwan (2006) argues that, because of entrepôt trade, import data are much more accurate than export data. When Chinese firms transship goods through Hong Kong, the Chinese government often does not know the final destination of the goods. They thus record these goods as being exported to Hong Kong. On the other hand, when the goods arrive at their ultimate destination the importing country records the goods as coming from China. Kwan thus advocates using import data from both trading partners to calculate bilateral trade balances.⁵ Using this approach, China's surplus with Europe in 2006 increased from \$76 billion to \$93 billion. China's surplus with the U.S. increased from \$153 billion to \$243 billion. \$243 billion far exceeds China's overall 2006 surplus of \$177.5 billion. Thus, for China is to rebalance its economy, it must reduce its surplus with Europe and especially with the U.S.

3. The Empirical Framework

Bilateral and Weighted Exchange Rates

⁵ A more sophisticated approach would take into account adjustments for c.i.f. – f.o.b factors and for the value added by Hong Kong middlemen. See Fung and Lau (2003).

Most of the value-added for Chinese processed exports comes from other (primarily East Asian) countries. Therefore a unilateral appreciation of the RMB against the countries purchasing final exports would not affect the costs of Chinese processed exports measured in the importing country's currency as much as a generalized appreciation in East Asia. A generalized appreciation in Asia against the countries purchasing final exports, as Yoshitomi (2007) discusses, would essentially change the relative foreign currency cost not just of China's value-added but of China's entire output of processed exports. This should have a much larger effect on China's processed exports than a unilateral appreciation of the RMB.

China's share of the total costs (its value-added in processing trade) equals the difference between the value of China's processed exports (VPE_t) and the value of imports for processing from all supply chain countries ($\sum_i VIP_{i,t}$):

$$VA_{Chin,t} = (VPE_t - \sum_i VIP_{i,t}) / VPE_t = 1 - \sum_i VIP_{i,t} / VPE_t, \quad (1)$$

where $VA_{Chin,t}$ equals China's value-added in processing trade. Each year we use data on the total value of processed exports and the total value of imports for processing, obtained from China Customs Statistics, to calculate China's value-added.

To calculate the share of total costs for other supply chain countries we collect annual data from China Customs Statistics on imports for processing from 33 countries over the 1992-2005 period.⁶ For each year we include every country that supplies at least one percent of the total value of imports for processing from the 33 countries. For these

⁶ The countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Indonesia, Iceland, Ireland, Italy, Japan, Luxembourg, Malaysia, Mexico, the Netherlands, New Zealand, the Philippines, Portugal, Russian Federation, Singapore, South Korea, Spain, Sweden, Taiwan, Thailand, the United Kingdom, and the United States.

countries we determine weights ($w_{i,t}$) by dividing their contribution to China's imports for processing by the amount of imports for processing coming from all the countries supplying at least one percent of the total. We then use these weights to find the weighted exchange rate ($wrer_{j,t}$) for a country j that purchases China's processed exports by calculating the inner product of the weights and the bilateral real exchange rates between the countries supplying imports for processing and country j :

$$wrer_{j,t} = \sum_i w_{i,t} * rer_{i,j,t} , \quad (2)$$

where $rer_{i,j,t}$ is the bilateral real exchange rate between supply chain country i and country j purchasing the final processed exports.

We combine $wrer_{j,t}$ with the bilateral exchange rate between China and country j ($rer_{Chin,j,t}$) weighted by China's value-added in processing trade. This allows us to calculate a single integrated exchange rate ($irer_{j,t}$) measuring how exchange rate changes affect the entire cost of China's exports of processed goods to country j :

$$irer_{j,t} = VA_{Chin,t} * rer_{Chin,j,t} + (1 - VA_{Chin,t}) * wrer_{j,t} . \quad (3)$$

To calculate $irer$ in this way it is necessary to measure exchange rates using a common numeraire. We can do this by employing the real exchange rate variables constructed by the Centre D'Etudes Prospectives et D'Information Internationales (CEPII). These variables compare observed exchange rates to PPP ones, and exceed 100 when the currency is overvalued. They are thus comparable both cross sectionally and over time. These variables are obtained from the CEPII-CHELEM database.

We recalculate China's value-added, the weighted exchange rate, and the integrated exchange rate each year.

Unlike China's processed exports, China's ordinary exports are produced primarily using local inputs. We thus employ the bilateral RMB exchange rate ($rer_{Chin,j,t}$) to explain China's ordinary exports to country j .

Identifying Trade Elasticities

It is difficult to estimate price elasticities for China's trade because the RMB has not fluctuated very much. Both the real effective exchange rate and the bilateral RMB rate against the dollar have been relatively stable in recent years.

To circumvent this problem we look at China's exports to 33 countries over the 1994-2005 period. While the U.S. dollar/RMB exchange rate has not changed very much, there has been substantial variation both cross-sectionally and over time in the real RMB exchange rate relative to the 33 countries. This approach should thus help to identify in an econometric sense how exchange rate changes affect China's multilateral exports.

Following the imperfect substitutes model of Goldstein and Khan (1985), we represent exports as:

$$\ln x_t = \alpha_1 \ln er_t + \alpha_2 \ln rgdp_t^* \quad (4)$$

where x_t represents real exports, er_t represents the real exchange rate, and $rgdp_t^*$ represents foreign real income.⁷

⁷ Equation (4) is derived by assuming that the quantity of China's exports *demanded* by other countries depends on income in the other countries and the price of China's exports relative to the price of domestically produced goods in those countries and that the quantity of exports *supplied* by China depends on the export price relative to China's price level. By equating demand and supply one can derive (4) (see, e.g., Chinn, 2005).

It is standard in the literature to take the real exchange rate and real income as given when estimating trade equations (see, for example, Rose and Yellen, 1989). This approach may be subject to simultaneous-equation and omitted-variable bias. If the elasticity of supply is infinite, however, it is possible to identify the parameters in equation (4).

In the case of China there are reasons to believe that the perfect supply elasticity assumption may be reasonable. First, China has about 200 million redundant laborers.⁸ This large pool of workers seeking employment in the export sector may enable Chinese exporters to increase supply at constant prices. Second, as the IMF (2005) argues, the supply of imports for processing will vary one for one with the demand for processed exports. Marquez and Schindler (2007) present formal evidence supporting this assertion. They report that the coefficient on imports for processing is nearly always one in regressions where the dependent variable is China's processed exports. Thus both labor and sophisticated intermediate goods tend to flow elastically into China's export industries to accommodate increases in demand in the rest of the world.

Following Marquez and Schindler (2007) and Cheung, Chinn, and Fujii (2007) we do investigate the relationship between imports for processing and processed exports. We do this by including Chinese imports for processing relative to GDP in one of our specifications.

*Choice of Deflators*⁹

⁸ China has between 150 and 200 million redundant rural laborers, 7-8 million new workers joining the labor force each year, and 14 million urban workers who are unemployed or underemployed. We are indebted to the Chinese Academy of Social Sciences for these data.

⁹ We are indebted to an anonymous referee for the analysis in this section.

There is no price index for China's exports over our sample period. If we had data on export prices, export volume could be represented as:

$$x_t = \frac{XV_t}{Px_t}, \quad (5)$$

where XV is the nominal value of exports and Px is the price of China's exports. If

instead of Px we use a proxy \hat{Px} then export volume can be represented as:

$$\hat{x}_t = \frac{XV_t}{\hat{Px}_t}. \quad (6)$$

Assuming:

$$Px_t = \frac{\hat{Px}_t}{\theta_t}, \quad (7)$$

where θ_t is the approximation error, then one gets:

$$x_t = \frac{XV_t}{Px_t} = \frac{XV_t}{\frac{\hat{Px}_t}{\theta_t}} = \theta_t \frac{XV_t}{\hat{Px}_t} = \theta_t \hat{x}_t. \quad (8)$$

Taking logs yields:

$$\ln x_t = \ln \theta_t + \ln \hat{x}_t . \quad (9)$$

Equation (4) implies:

$$\ln \hat{x}_t = -\ln \theta_t + \alpha_1 \ln er_t + \alpha_2 \ln rgdp_t . \quad (10)$$

Since θ_t is not directly observable we need to make an assumption about it. We assume that θ_t depends on China's capital stock:

$$\theta_t = AK_t^{\alpha_3} . \quad (11)$$

This implies that:

$$\ln \hat{x}_t = -\ln A + \alpha_1 \ln er_t + \alpha_2 \ln rgdp_t - \alpha_3 \ln K_t . \quad (12)$$

We thus estimate equations of the form (12).¹⁰

Data and Econometric Methodology

Our dependent variable is either processed or ordinary exports from China to 33 countries. These data are obtained from China's Customs Statistics and are measured in U.S. dollars.

We deflate the export data in three ways. First, following Chinn (2006), we deflate Chinese exports using the U.S. Bureau of Labor Statistics (BLS) price deflator for imports from non-industrial countries. Chinn finds that this series closely matches the

¹⁰ A second rationale for including the capital stock in equation (12) is provided by Cheung, Chinn, and Fujii (2007). They argue that the Chinese capital stock in manufacturing helps to control for supply side factors.

BLS price deflator for imports from China, which became available in 2003. Second, we use the Hong Kong export price deflator. Since many of Hong Kong's exports are re-exports from China, this measure may be a useful proxy for Chinese export prices. Third, following Eichengreen *et al.* (2004), we use the U.S. consumer price index to deflate China's exports. This measure would be appropriate if the bundle of goods and services exported from China corresponds to the bundle purchased by U.S. consumers. The results reported below are similar regardless of which deflator we use.

Our independent variables include the integrated real exchange rate ($irer_i$) when the left hand side variable is processed exports and the bilateral RMB real exchange rate ($rer_{Chin,i}$) when the left hand side variable is ordinary exports. We also use real income in the importing country ($rgdp_i$), the Chinese capital stock in manufacturing (K), Chinese imports for processing relative to Chinese GDP ($imgdp$), and a WTO dummy variable that takes on a value of 1 after China joined the WTO.¹¹ As discussed above, $irer_i$ is constructed using real exchange rate data obtained from the CEPII-CHELEM database. Data on $rer_{Chin,i}$ and $rgdp_i$ are also obtained from CEPII-CHELEM. An increase in either $irer_i$ or $rer_{Chin,i}$ represents an appreciation of the exchange rate. The Chinese capital stock data have been constructed by Bai, Hsieh, and Qian (2006). Data on China's imports for processing are obtained from China's Customs Statistics.

We estimate the model using dynamic ordinary least squares (DOLS). DOLS involves regressing the left hand side variable on a constant, the right hand side variables,

¹¹ Garcia-Herrero and Koivu (2007) posit that China's WTO accession began affecting China's trade after it became certain that China would join the WTO in the beginning of 2000. We thus set the WTO dummy variable equal to one beginning in 2000.

and lags and leads of the right hand side variables. The individual export equations have the form:

$$x_{i,t} = \beta_0 + \beta_1 er_{i,t} + \beta_2 rgdp_{i,t} + \beta_3 K_t + \beta_4 Time + \beta_5 WTO + \sum_{j=-p}^p \Delta er_{i,t-j} + \sum_{j=-p}^p \Delta rgdp_{i,t-j} + \sum_{j=-p}^p \Delta K_{t-j} + \mu_i + u_{it}, \quad (13)$$

$$t = 1, \dots, T; \quad i = 1, \dots, N.$$

Here $x_{i,t}$ represents real exports (either processed or ordinary) from China to country i , $er_{i,t}$ represents either the integrated real exchange rate ($irer_{i,t}$) or the bilateral real exchange rate between China and country i ($rer_{Chin,i,t}$), $rgdp_{i,t}$ equals real income in the importing country, K_t denotes the Chinese capital stock in manufacturing, $Time$ is a time trend, WTO is the WTO dummy variable, μ_i is a country i fixed effect, and p represents the number of leads and lags. $x_{i,t}$, $er_{i,t}$, $rgdp_{i,t}$, and K_t are measured in natural logs. $x_{i,t}$, $er_{i,t}$, and $rgdp_{i,t}$ vary both over time and across countries and K_t only varies over time. In one specification for processed exports we also include Chinese imports for processing relative to Chinese GDP ($imgdp_t$).

By estimating a log-linear model we are assuming that the elasticities are constant. An alternative would be to estimate a linear model and assume that the marginal propensity to import is constant. Marquez (1999) has argued persuasively that as economies become more open to trade the marginal utility of imports and thus the associated income elasticity falls. As a general proposition he is clearly correct. In our case, however, most of the countries we use are East Asian or OECD countries that were open to imports throughout our sample period. Imports from China, though, were a

miniscule share of expenditures at the beginning of the sample period and an enormous share at the end. Because of this we think that imposing a constant marginal propensity to import from China would do violence to the data. On the other hand, given the strong demand for imports from China that continued unabated until 2005, there did not appear to be a significant decrease in the marginal utility of these goods over our sample period. Thus we assume that the income elasticity of demand rather than the marginal propensity to import remains constant.

Following Cheung, Chinn, and Fujii (2007) and Marquez and Schindler (2007), we begin our estimation in 1994. Our data set extends to 2005. To preserve degrees of freedom we use one lead and lag in the DOLS estimation. Our panel includes annual exports to 33 countries.¹²

4. Results

Table 2 presents the results for ordinary exports and Table 3 for processed exports. In both tables results are presented using all three deflators. The findings are similar including and excluding the capital stock and the time trend. We thus report results only from our preferred specification including the capital stock and excluding the time trend. The other results are available upon request.

In Table 2 for ordinary exports the coefficient on income, while always positive, is small. The elasticity estimates range from 0.53 to 0.55. These values are less than the income elasticities we report below for processed exports. This is probably because,

¹² The countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Indonesia, Iceland, Ireland, Italy, Japan, Luxembourg, Malaysia, Mexico, the Netherlands, New Zealand, the Philippines, Portugal, Russian Federation, Singapore, South Korea, Spain, Sweden, Taiwan, Thailand, the United Kingdom, and the United States.

compared with processed exports, ordinary exports contain more simple labor-intensive goods (e.g., textiles and toys) that have lower income elasticities.

The exchange rate elasticity, on the other hand, is large. The coefficient on the bilateral exchange rate is of the expected negative sign, indicating that an appreciation of $rer_{Chin,i,t}$ reduces ordinary exports. The coefficient is statistically significant in all three specifications, and ranges in value from -1.15 to -1.18. This elasticity may be large because profit margins for ordinary exports are thin, and thus cost increases arising from exchange rate changes cause a large drop in output.

Thin profit margins may also explain the coefficient on the WTO dummy variable. It is positive and statistically significant in all three specifications, with values ranging from 0.19 to 0.23. These results imply that, controlling for other factors, ordinary exports rose about 20 percent higher following China's accession to the WTO. Favorable access to overseas markets evidently led to a large increase in ordinary exports.

Finally, the Chinese capital stock variable is positive and statistically significant. The coefficients range from 1.59 to 2.02. These values are not far from those reported by Cheung, Chinn, and Fujii (2007). They reported values of this coefficient between 1.83 and 2.51.

Table 3 presents the findings for processed exports. The income elasticity is positive and statistically significant in all three specifications. Coefficient values range from 2.30 to 2.32. The relatively high income elasticity probably reflects the fact that processed exports contain many sophisticated, high-tech goods such as digital cameras and laptop computers that consumers are more likely to purchase as their incomes increase.

The coefficient on the integrated exchange rate is of the expected negative sign, indicating that an appreciation of *irer* reduces processed exports. The coefficient is statistically significant in every specification, with values ranging from -1.03 to -1.06.

The coefficient on the WTO dummy variable is positive in two specifications and negative in one. In all three cases the coefficient is small and not statistically significant. These results imply that China's WTO accession did not lead to an increase in processed exports.

Finally, the Chinese capital stock variable is always positive and statistically significant. The coefficient values range from 0.99 to 1.41. Cheung, Chinn, and Fujii (2007) reported slightly higher values of these coefficients, ranging from 1.52 to 1.99.

Table 4 presents results with imports for processing relative to Chinese GDP used in place of the WTO dummy variable. The coefficient on this variable is positive in all three specifications but never statistically significant. The coefficients on the other variables remain statistically significant. One interpretation of these findings is that export demand is driven by exchange rate and income changes, and imports for processing vary passively with export demand. Thus imports for processing do not have an independent effect on processed exports. A second interpretation is that *imgdp* does not have explanatory power because it represents aggregate imports for processing while the left hand side variable represents processed exports to specific countries. Maybe *irer* and *rgdp* have more explanatory power than *imgdp* because they take on different values both across countries and across time while *imgdp* only takes on different values across time.

In any case, the results are consistent with the hypothesis that changes in *irer*

and *rgdp* that affect the demand for processed exports will in turn affect the flow of imports for processing into China. For instance, a generalized appreciation in East Asia that reduced China's processed exports would reduce China's imports of intermediate goods from the region.¹³

Interestingly, the coefficient on the exchange rate is not very different if the integrated exchange rate is replaced with the bilateral exchange rate between China and the countries purchasing processed exports. The coefficient values for the bilateral exchange rate range from -0.93 to -0.96 and the other coefficients are almost unchanged.

We nevertheless believe that the specification with the integrated exchange rate is preferable to the specification with the bilateral exchange rate. As the IMF (2007) and Yoshitomi (2007) discuss, exchange rates in all supply chain countries and not just the bilateral exchange rate should affect China's processed exports. In addition, a specification with *irer* allows us to say what would happen in a situation like the present where exchange rates in other Asian countries such as South Korea and Thailand appreciate much more than the RMB does.

For the integrated exchange rate the exchange rate elasticity is approximately equal to unity. In addition, China's value-added in processed exports equaled 37 percent in 2006. Thus a 1 percent appreciation of the RMB alone against the countries purchasing final exports would reduce processed exports by 0.4 percent ($=0.37*1.0$). A 1 percent appreciation in the rest of East Asia alone against the countries purchasing final exports would reduce processed exports by 0.6 percent.¹⁴ A 1 percent appreciation in

¹³ We are indebted to an anonymous referee for this point.

¹⁴ This is true assuming that all imports for processing come from other East Asian countries.

both China and East Asia, on the other hand, would reduce processed exports by 1 percent.

An important implication of these results is that a generalized appreciation in both China and East Asia would be necessary to produce a large drop in capital-intensive processed exports. Such a drop would help to switch expenditures towards U.S. and European goods and rebalance world trade.

A second implication of the results presented here is that an appreciation of the RMB alone would cause a large drop in China's ordinary exports. A 1 percent appreciation of the RMB would cause ordinary exports to decline by 1.1 or 1.2 percent. Ordinary exports tend to be simple, labor-intensive goods such as toys and textiles. If the goal of an RMB appreciation is to resolve imbalances between China and the rest of the world (especially the U.S. and Europe), a reduction in ordinary exports would not be helpful. A reduction in ordinary exports from China to the rest of the world would be replaced by an increase in labor-intensive exports from other countries on lower rungs of the ladder of comparative advantage.

A final implication of the results reported here is that a slowdown in the rest of the world would significantly reduce processing trade. The income elasticity for processed exports equals about 2.3. A downturn outside of Asia could thus cause a large drop in China's processed exports. This in turn would decrease the flow of intermediate goods from the rest of Asia into China, reducing employment and output throughout the region.

5. Conclusion

China's export growth and penetration have been remarkable. While China was basically a closed economy 30 years ago, it is now the leading exporter to Japan, the second leading exporter to Europe, and the third leading exporter to the U.S.

This surge in exports has been accompanied by growing trade imbalances between China and the rest of the world. China's global current account surplus equaled 9 percent of Chinese GDP in 2006 and 12 percent of GDP in the first half of 2007. These surpluses are primarily with the U.S. and Europe.

This paper has investigated how an appreciation of the RMB and other Asian currencies would affect China's exports. The results indicate that the RMB exchange rate matters more for China's ordinary exports than for China's processed exports. A 10 percent unilateral appreciation of the RMB against the countries purchasing final exports would reduce ordinary exports by 11 or 12 percent and processed exports by 4 percent. A 10 percent appreciation in other (primarily East Asian) supply chain countries against the countries purchasing final exports without an accompanying increase in the RMB would reduce processed exports by 6 percent. A 10 percent joint appreciation in both China and other supply chain countries would reduce processed exports by 10 percent

Ordinary exports tend to be simple, labor-intensive goods while processed exports tend to be sophisticated, high-tech goods. A reduction in ordinary exports from China would be replaced by an increase in labor-intensive exports from other countries on lower rungs of the ladder of comparative advantage. A reduction in processed exports, on the other hand, would switch expenditures towards U.S. and European goods. Thus currency appreciations throughout East Asia are required to reduce China's massive surpluses with the U.S. and Europe and rebalance world trade.

Table 1

China's Processing Trade – 1993 and 2006

	Imports (%)							
	World	S. Korea & Taiwan	Japan	ASEAN 5	Hong Kong	United States	Europe	Rest of World
1993								
Total Imports	100	18	22	6	10	10	15	19
Normal Imports	37	2	8	3	1	5	8	9
Imports for Processing	35	11	8	2	7	2	2	3
Others	28	5	7	1	2	3	6	5
2006								
Total Imports	100	19	12	9	1	6	8	45
Normal Imports	42	5	5	3	0	4	6	19
Imports for Processing	41	14	7	5	1	2	2	10
Others	17	0	0	0	0	0	0	17
	Exports (%)							
	World	S. Korea & Taiwan	Japan	ASEAN 5	Hong Kong	United States	Europe	Rest of World
1993								
Total Exports	100	5	17	5	24	18	13	18
Normal Exports	47	2	10	4	10	6	7	9
Processed Exports	48	2	7	1	14	13	7	4
Others	5	0	0	0	0	0	0	5
2006								
Total Exports	100	7	9	6	15	20	14	29
Normal Exports	43	3	4	3	3	7	7	16
Processed Exports	53	3	6	3	12	13	8	8
Others	4	0	0	0	0	0	0	4

Table 1 (continued).

China's Processing Trade – 1993 and 2006

	Balance of Trade (billions of US Dollars)							
	World	S. Korea & Taiwan	Japan	ASEAN 5	Hong Kong	United States	Europe	Rest of World
1993								
Balance of trade	-12.2	-14.0	-7.5	-1.3	11.60	6.3	-3.5	-3.8
Normal trade	5.2	0.3	0.7	-0.1	7.7	0	-2	-1.5
Processing trade	7.9	-9.5	-1.3	-0.6	5.7	9.7	4.2	-0.3
Others	-25.2	-4.9	-6.9	-0.6	-1.7	-3.4	-5.8	-1.9
2006								
Balance of trade	177.5	-88.6	-3.2	-7.7	136.2	152.7	75.9	-87.8
Normal trade	83.1	-10.3	-4.8	3.1	21.59	40.8	15.0	17.7
Processing trade	188.9	-78.3	1.8	-10.7	107.2	112.0	61.1	-4.2
Others	-94.6	-7.8	-0.2	0	0	-0.1	-0.2	-86.3

Notes: Source: Gaulier, Lemoine, and Nal-Kesenci (2005), China's Customs Statistics, and calculations by the authors. Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Luxembourg, Netherlands, Italy, Portugal, Spain, and Sweden.

Table 2
 Panel DOLS Estimates of China's Ordinary Exports to 33
 Countries over the 1994-2005 Period

Independent variables	Exports deflated by:		
	Hong Kong Export Price Deflator	BLS Manu- facturing Price Deflator	U.S. CPI
Real GDP	0.55 (0.43)	0.55 (0.43)	0.53 (0.43)
Bilateral RER	-1.16** (0.52)	-1.15** (0.52)	-1.18** (0.52)
WTO Dummy	0.23*** (0.09)	0.22** (0.09)	0.19** (0.09)
Capital Stock	2.02*** (0.27)	2.01*** (0.27)	1.59*** (0.27)
Adjusted R-Squared	0.99	0.99	0.99
No. of Observations	363	363	363

Notes: DOLS(1,1) estimates. Heteroskedasticity-consistent standard errors are in parentheses.

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

Table 3
 Panel DOLS Estimates of China's Processed Exports to 33
 Countries over the 1994-2005 Period

Independent variables	Exports deflated by:		
	Hong Kong Export Price Deflator	BLS Manufacturing Price Deflator	U.S. CPI
Real GDP	2.32*** (0.70)	2.32*** (0.70)	2.30*** (0.71)
Integrated RER	-1.06*** (0.30)	-1.06*** (0.30)	-1.03*** (0.30)
WTO Dummy	0.031 (0.070)	0.021 (0.071)	-0.009 (0.069)
Capital Stock	1.41*** (0.25)	1.40*** (0.24)	0.99*** (0.25)
Adjusted R-Squared	0.98	0.98	0.98
No. of Observations	363	363	363

Notes: DOLS(1,1) estimates. Heteroskedasticity-consistent standard errors are in parentheses.

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

Table 4
 Panel DOLS Estimates of China's Processed Exports to 33
 Countries over the 1994-2005 Period

Independent variables	Exports deflated by:		
	Hong Kong Export Price Deflator	BLS Manufacturing Price Deflator	U.S. CPI
Real GDP	2.34*** (0.71)	2.34*** (0.71)	2.34*** (0.71)
Integrated RER	-0.97*** (0.32)	-0.97*** (0.32)	-0.97*** (0.32)
Imports for Processing/GDP	3.63 (8.41)	5.58 (8.42)	5.65 (8.48)
Capital Stock	1.36*** (0.36)	1.30*** (0.36)	0.96*** (0.36)
Adjusted R-Squared	0.98	0.98	0.98
No. of Observations	363	363	363

Notes: DOLS(1,1) estimates. Heteroskedasticity-consistent standard errors are in parentheses.

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

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