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Investigating the Effect of Exchange Rate Changes on the People's Republic of China's Processed Exports

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Abstract

Many argue that the yuan needs to appreciate to rebalance the People's Republic of China's trade. However, empirical evidence on the effects of a CNY appreciation on the People's Republic of China's exports has been mixed for the largest category of exports, processed exports. Since much of the value-added of these goods comes from parts and components produced in Japan, the Republic of Korea, and other East Asian supply chain countries, it is important to control for exchange rate changes in these countries. Employing dynamic ordinary least squares, or DOLS, techniques and quarterly data, this paper finds that exchange rate appreciations across supply chain countries would cause a much larger drop in processed exports than a unilateral appreciation of the yuan.

Contents

1. INTRODUCTION

The People's Republic of China's (PRC) global current account surplus averaged US$400 billion in 2007 and 2008 and is forecasted to equal US$370 billion in 2009. Relative to gross domestic product (GDP), the PRC's current account surplus equaled 11% in 2007, 10% in 2008, and 9% in 2009. Economists and policymakers both inside and outside of PRC have argued that the PRC economy needs to be rebalanced and to rely less on exports. Many claim that an appreciation of the yuan would help to achieve these goals. Empirical evidence on the effect of a yuan (CNY) appreciation on the PRC's exports, however, has been mixed.

These mixed results are more apparent for processed exports than for ordinary exports. Processed exports, as defined by the China Customs Agency, are final goods that are produced using parts and components imported from the rest of the world. Ordinary exports, by contrast, are produced primarily using local PRC inputs. Marquez and Schindler (2007), employing an autoregressive distributed lag model and monthly data over the January 1997–July 2006 period, found that a 10% appreciation of the CNY would reduce China's processed exports relative to total world exports by 24 to 32 basis points. Thorbecke and Smith (2010), using a panel data set including annual exports to 33 countries over the 1994–2005 period, reported that a 10% appreciation of the CNY and other East Asian currencies would reduce processed exports by 10%. On the other hand Cheung, Chinn, and Fujii (2010), using dynamic ordinary least squares (DOLS) techniques and quarterly data over the 1993Q3 – 2006Q2 period, found that an appreciation of the CNY is associated with an increase in the PRC's processed exports (i.e., the coefficient has the wrong sign). While the results for processed exports were mixed, all of these authors reported that a CNY appreciation would lower ordinary exports.

One reason for these conflicting results is that, while the yuan exchange rate is the correct variable to use in explaining China's ordinary exports, it is not the correct variable to use in explaining processed exports. For ordinary exports, most of the value-added is produced domestically (see Gaulier, Lemoine, and Unal-Kesenci 2005). An appreciation of the CNY against the importing country would thus have a large effect on the foreign currency cost of China's ordinary exports. For processed exports, on the other hand, the majority of the value-added comes from imported parts and components rather than from production activities within China. An appreciation of the CNY against the importing country would thus have a smaller effect on the foreign currency cost of China's processed exports.

For example, the largest category of processed exports is computers and office equipment.[1] Koopman, Wang, and Wei (2008) found that China's value-added in the computer industry is small. Using mathematical programming techniques and detailed data from trade statistics and input-output tables they reported that Chinese value-added in electronic computers is less than 5%. Koopman, Wang, and Wei (2008) noted that in cases where the share of domestic content in exports is small, the effect of exchange rate changes in assembly countries on trade volumes will also be small.

Yoshitomi (2007) and the International Monetary Fund (IMF) (2007) similarly argued that a unilateral appreciation of the yuan would not affect processed exports much, since the majority of the value-added came from parts and components produced in other countries. A generalized appreciation in Asia, on the other hand, would essentially change the relative foreign currency cost of the PRC's entire output of processed exports. This should have a much larger effect on the PRC's processed exports.

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[1] According to the Centre D'Etudes Prospectives et D'Information Internationales-Comptes Harmonisés sur les Echanges et l'Economie Mondiale (CEPII-CHELEM) database (https://chelem.bvdep.com/), 12% of the PRC's total exports in 2007 were in the category computers and office equipment (International Standard Industrial Classification number 300).

This paper investigates how exchange rate changes throughout the supply chain would affect the PRC's processed exports. To do this it employs a DOLS model and quarterly data on the PRC's processed exports, as Cheung, Chinn, and Fujii (2010) did, but supplements the specification with exchange rates changes in supply chain countries. The results indicate that a joint appreciation of the yuan and of the currencies of the other (primarily East Asia) supply chain countries would produce a large drop in processed exports. An appreciation of either the yuan or the currencies of other supply chain countries individually, however, would produce smaller drops in processed exports. This finding perhaps reflects the fact that multinational corporations can shift production between the PRC and other supply chain countries in response to changes in relative exchange rates in Asia.

One way for Asian countries involved in processing trade to appreciate together would be for the PRC to adopt a regime characterized by a multiple-currency, basket-based reference rate with a reasonably wide band. In this case, the huge surpluses generated within East Asian production networks would cause currencies in the region to appreciate together. Market forces could then allocate these appreciations across supply chain countries as a function of the size of their surpluses in processing trade.

The next section presents the data and methodology. Section 3 contains the results. Section 4 concludes.

2. DATA AND METHODOLOGY

2.1 China's Imports for Processing and Processed Exports

East Asia is characterized by intricate production and distribution relationships, constituting part of a global triangular trading network. Japan, the Republic of Korea (hereafter Korea), Taipei,China and multinational companies located in ASEAN countries produce sophisticated technology-intensive intermediate goods and ship them to the PRC and ASEAN countries for assembly by lower-skilled workers. The finished products are then exported throughout the world.

Foreign direct investment (FDI) flows and multinational companies (MNC) play an important role in these triangular trading patterns. As Gaulier, Lemoine, and Unal-Kesenci (2005) discuss, FDI flows and MNC activities reduce costs in host countries, transfer technological and managerial know how, increase local procurement, multiply trade in intermediate goods, and strengthen distribution networks. In the case of the PRC, the importance of FDI is seen by the fact that 84% of the PRC's processed exports in 2006 were produced by foreign-invested enterprises (Feenstra and Wei 2009).

Figures 1 and 2 show China's role in the triangular trading structure. The data are taken from the PRC's Customs Statistics, which distinguishes between imports and exports linked to processing trade and ordinary imports and exports.[2] Imports for processing are goods that are brought into the PRC for processing and subsequent reexport. Processed exports, as classified by PRC 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 enter the PRC'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.

Figure 1 shows that the lion's share of imports for processing come from other East Asian countries. By contrast, only one-twentieth of each came from the United States (US) and from the European Union (EU).

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[2] The website for the PRC's Customs Statistics is www.ChinaCustomsStat.com.

Figure 1: The PRC's Imports for Processing by Country and Region
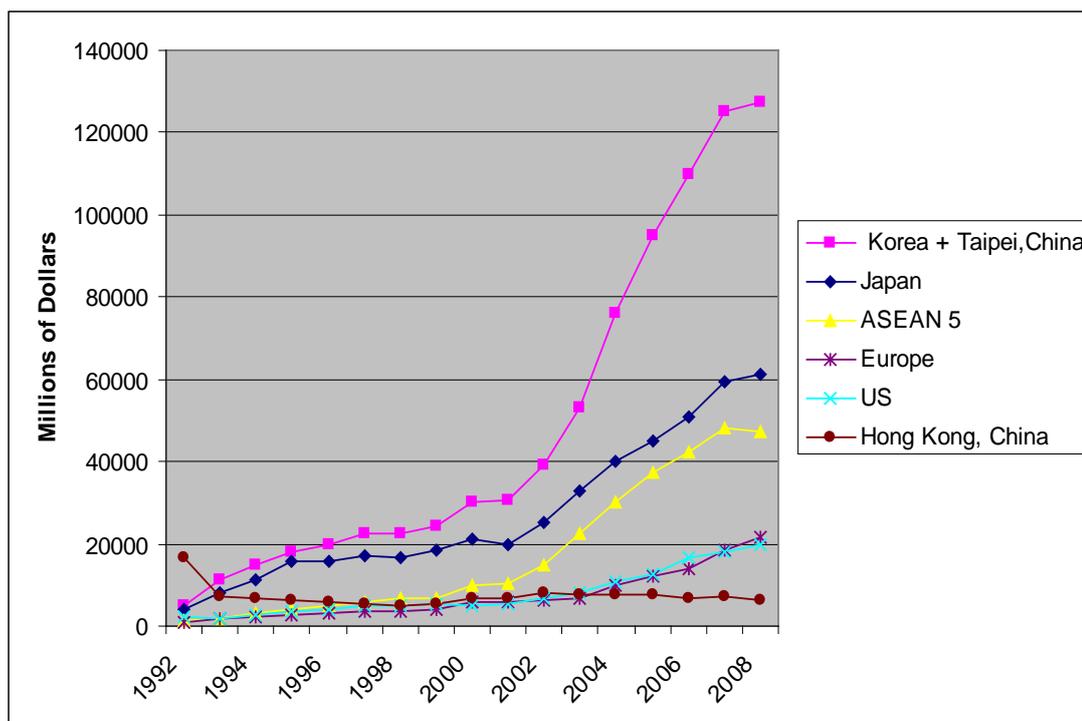
Source: China Customs Statistics (2009).

Figure 2 shows that processed exports flow primarily to the US; Europe; Japan; and Hong Kong, China. Many of the exports to Hong Kong, China actually represent entrepôt trade. As Kwan (2006) notes, when PRC firms transship goods through Hong Kong, China the PRC government often does not know the final destination of the goods. They thus record these goods as being exported to Hong Kong, China. On the other hand, when the goods arrive at their ultimate destination the importing country records the goods as coming from the PRC. Kwan thus advocates using import data from both trading partners to calculate bilateral trade balances.[3] Using this approach, Thorbecke and Smith (2010) found that the PRC's exports to Europe increased 12% and the PRC's exports to the US increased 50%. Thus exports to Hong Kong, China are largely bound for the US and Europe, and the PRC's processed exports flow primarily to high income countries.

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[3] A more sophisticated approach would take into account adjustments for c.i.f.(cost insurance and freight) – f.o.b (free on board) factors and for the value added by Hong Kong, China middlemen. See Fung and Lau (2003).

Figure 2: The PRC's Processed Exports by Country and Region
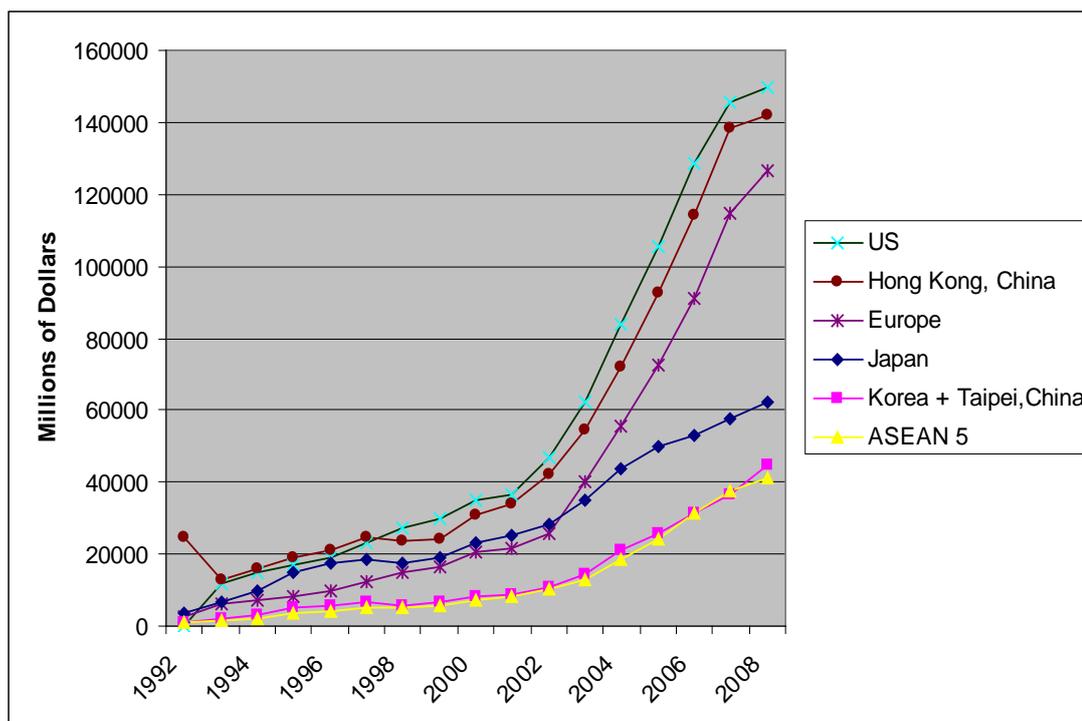
Source: China Customs Statistics (2009).

2.2   The Imperfect Substitutes Framework

The imperfect substitutes model of Goldstein and Khan (1985) implies that the quantity of exports *demanded* by other countries depends on income in the other countries and the price of exports relative to the price of domestically produced goods in those countries. The quantity of exports *supplied* depends on the export price relative to the domestic price level in the exporting country. By equating demand and supply one can derive an export function:

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

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

Researchers often take the real exchange rate and real income as given when estimating trade equations (see, for example, Rose and Yellen 1989). However, 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 (1).

In the case of the PRC's processed exports there are reasons to believe that the perfect supply elasticity assumption is reasonable. First, the PRC has hundreds of millions of redundant laborers. This large pool of workers seeking employment in the export sector holds wages down and may enable PRC exporters to increase supply at constant prices. Second, as the IMF (2005) argued, the supply of imports for processing will vary one for one with the demand for processed exports. Thus both labor and sophisticated intermediate goods tend to flow elastically into the PRC's export industries to accommodate increases in demand in the rest of the world.

2.3 Calculating an Integrated Exchange Rate for the PRC's Processed Exports

Most of the value-added for PRC processed exports comes from other East Asian countries. Therefore a unilateral appreciation of the CNY would not affect the costs of PRC processed exports measured in the importing country's currency as much as a generalized appreciation throughout East Asia. A generalized appreciation in Asia would change the relative foreign currency cost not just of the PRC's value-added but of the PRC's entire output of processed exports (Yoshitomi 2007).

Following Tong and Zheng (2008), the PRC's value-added in processing trade can be measured as the difference between the value of the PRC's processed exports (VPE$_t$) and the value of imports for processing from all supply chain countries ($\sum_i$VIP$_{i,t}$):

$$VA_{Chin,t} = (VPE_t - \sum_i VIP_{i,t})/VPE_t = 1 - \sum_i VIP_{i,t}/VPE_t, \qquad (2)$$

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

In calculating the share of total costs for other supply chain countries the focus is on ASEAN, Japan, Korea, and Taipei,China. As Figure 1 indicates, the lion's share of imports for processing come from these countries. The two other leading supply chain countries are Germany and the US.[4] The nine major suppliers are thus Germany, Japan, Korea, Malaysia, the Philippines, Singapore, Taipei,China, Thailand, and the US. For these suppliers weights ($w_{i,t}$) are calculated by dividing their contribution to the PRC's imports for processing by the amount of imports for processing coming from the nine major suppliers together. These weights are then used together with the data on the PRC's value-added to calculate an integrated exchange rate index ($irer_t$) for the entire value (both domestically produced and imported) of the PRC's processed exports by using the following formula:

$$irer_t = irer_{t-1}(chinareer_t/chinareer_{t-1})^{VA_{Chin,t}} \prod_{i=1}^{9}(reer_{i,t}/reer_{i,t-1})^{(1-VA_{Chin,t})w_{i,t}} \qquad (3)$$

where $chinareer_t$ is the PRC's real effective exchange rate at time t and $reer_{i,t}$ is the real effective exchange rate for supply chain country i at time t. An increase in $chinareer_t$, $reer_{i,t}$, and $irer_t$ represent real exchange rate appreciations. $irer_t$ is set equal to 100 in 1992q4.

Data on the real effective exchange rate were taken from the IMF's *International Financial Statistics* except for Korea and Taipei,China. In these two cases the data were obtained from the Bank for International Settlements.[5]

Data on imports for processing and processed exports disaggregated by country were used to calculate the PRC's value-added ($VA_{Chin,t}$) and the weights on supply chain countries($w_{i,t}$). These data were obtained from the China Customs Statistics on an annual basis. As Figure 1 shows, these data series are relatively smooth. Linear interpolation was used to obtain quarterly data for the PRC's value-added and the weights on supply chain countries.

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4 The US supplies about 5% of the PRC's imports for processing and Germany a little less.

5 The websites for these data are: www.imf.org and www.bis.org.

2.4   Other Variables

Data on the PRC's aggregate processed exports were obtained from the China Customs Statistics via the CEIC database. These data are available monthly in US dollars and were summed to obtain quarterly values.

Price indices for the PRC's exports are not available over the sample period. Exports were deflated in three ways. First, following Cheung, Chinn, and Fujii (2010), the US producer price index was used. Second, following Thorbecke and Smith (2010), the Hong Kong, China export price deflator was used. Since many of Hong Kong, China's exports are re-exports from the PRC, this measure may be a useful proxy for PRC export prices. Third, following Eichengreen, Rhee, and Tong (2004), the US consumer price index was used to deflate the PRC's exports. This measure would be appropriate if the PRC's processed exports correspond to the bundle of goods purchased by US consumers. The results reported below are similar regardless of which deflator was employed.

Since the lion's share of processed exports go to higher income countries, quarterly data on income in Europe, North America, Japan, Korea, and Australia were used to represent real income in the importing countries.[6] These data are measured in real US dollars and are seasonally adjusted. They were obtained from the Organisation for Economic Cooperation and Development (OECD).[7]

The other independent variables are the stock of FDI, the PRC capital stock in manufacturing, and a WTO dummy variable that takes on a value of one after the PRC joined the World Trade Organization (WTO). As discussed above, 84% of processed exports are produced by foreign-invested enterprises. It is thus important to control for the stock of FDI. In addition, Cheung, Chinn, and Fujii (2010) found that the PRC capital stock helped to explain the PRC's exports. Finally, Garcia-Herrero and Koivu (2007) and others argued that the PRC's WTO accession had a positive effect on the PRC's trade.

Data on the stock of FDI were obtained from the United Nations Conference on Trade and Development (UNCTAD) website.[8] Data on the PRC capital stock have been constructed by Bai, Hsieh, and Qian (2006).[9] The FDI and capital stock data were converted to quarterly frequencies using linear interpolation methods.

The WTO dummy variable was set equal to one starting in 2000, since Garcia-Herrero and Koivu (2007) posited that the PRC's WTO accession began affecting the PRC's trade after it became certain that the PRC would join the WTO in the beginning of 2000.

Imports for processing are not included in the specification because, following the IMF (2005), these are assumed to respond passively to demand for processed exports in the rest of the world. Since the goal is to estimate demand elasticities, including imports for processing might lead to overfitting.

2.5   Econometric Methodology

The model was estimated using DOLS, which involves regressing the left-hand-side variable on a constant, the right hand side variables, and lags and leads of the right hand side variables. The equation has the form:

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6 Europe includes France, Germany, Italy, the Netherlands, Spain, and the United Kingdom.

7 The website for these data is http://stats.oecd.org

8 The website is www.unctad.org. The data are measured in US dollars. Following Eichengreen and Tong (2007), they were deflated using the US consumer price index.

9 Based on communication with the World Bank staff, it is assumed that the PRC capital stock grew by 10.44% in 2006, 10.01% in 2007, and 9.63% in 2008.

$$x_t = \beta_0 + \beta_1 irer_t + \beta_2 rgdp_t + \beta_3 FDI_t + \beta_4 K_t + \beta_5 WTO + \beta_6 Time + \sum_{j=-p}^{p} \alpha_{irer,j} \Delta irer_{t-j}$$

$$+ \sum_{j=-p}^{p} \alpha_{rgdp,j} \Delta rgdp_{i,t-j} + \sum_{j=-p}^{p} \alpha_{FDI,j} \Delta FDI_{t-j} + \sum_{j=-p}^{p} \alpha_{K,j} \Delta K_{t-j} + u_t, \qquad (4)$$

Here x_t represents the PRC's real processed exports to the world, $irer_t$ represents the integrated real exchange rate index, $rgdp_t$ equals real income in the rest of the world, FDI_t represents the stock of foreign direct investment, K_t denotes the PRC capital stock in manufacturing, *WTO* is the WTO dummy variable, and *Time* is a time trend. Seasonal dummy variables are also included. x_t, $irer_t$, $rgdp_t$, FDI_t, and K_t are measured in natural logs.

Data on processed exports are available from the CEIC database beginning in 1993Q1 and data on the stock of FDI are available until 2008Q4. Equation (4) is estimated using a DOLS(2,2) model. Since this involves using two leads and lags of the first differences of the right hand side variables, the actual sample period for the estimation is 1993Q4–2008Q1.

3. RESULTS

Table 1 reports the results from estimating equation (4). The first two columns report the results for exports deflated using the Hong Kong, China unit value index, the next two columns for exports deflated using the US producer price index (PPI), and the last two for

exports deflated using the US consumer price index (CPI). Columns (1), (3), and (5) report the results excluding a time trend, and columns (2), (4), and (6) present results including a time trend.

Table 1: DOLS Estimates of China's Processed Exports over the 1993–2008 Period

Independent Variables	Exports deflated by:					
	Hong Kong, China unit value index (1)	Hong Kong, China unit value index (2)	PPI-finished goods (3)	PPI-finished goods (4)	U.S. CPI (5)	U.S. CPI (6)
Rest of the World GDP	7.73**	7.60**	7.72***	8.56**	9.07***	9.90***
	(3.35)	(3.72)	(2.62)	(3.23)	(2.89)	(3.55)
Integrated RER	-2.96***	-2.80**	-2.75***	-3.38***	-2.61***	-3.22***
	(0.49)	(1.03)	(0.49)	(0.87)	(0.53)	(0.95)
FDI Stock	0.01	0.09	0.41	0.11	0.52*	0.23
	(0.29)	(0.52)	(0.26)	(0.44)	(0.28)	(0.46)
WTO Dummy	0.03	0.02	0.01	0.02	0.00	0.00
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Capital Stock	-0.03	-0.28	-0.55	0.40	-0.93	0.00
	(0.89)	(1.57)	(0.75)	(1.34)	(0.82)	(1.39)
Time		-0.01		-0.03		-0.02
		(0.04)		(0.04)		(0.04)
Adjusted R-squared	1.00	1.00	0.99	0.99	0.99	0.99
No. of observations	58	58	58	58	58	58

Notes: DOLS (2, 2) estimates. Heteroskedasticity-consistent standard errors are in parentheses.

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

Source: Author's calculations.

The coefficients on rest of the world income and the integrated real exchange rate are of the expected sign and statistically significant in every specification. The coefficient on the stock of FDI, while always positive, is only statistically significant in one case at the 10% level. The coefficients on the other variables are never statistically significant.

The coefficients on rest of the world income vary from 7.60 to 9.90. They remain large and statistically significant whether or not a time trend is included. These values imply that a 1% drop in rest of the world income will reduce China's processed exports by between 7.6 and 10%.

These values seem large. They could be influenced by specific events in the sample period, such as the large increase and subsequent fall in rest of the world income and in detrended and deseasonalized exports associated with the dot-com bubble and its subsequent burst in 2000.

On the other hand, these coefficients are very consistent with experiences that occurred during the global financial crisis immediately after the sample period. Between the third quarter of 2008 and the first quarter of 2009, real processed exports fell by 50%. Rest of the world income fell by 4% over this period, while the other variables exhibited little change. If the fall in exports during the crisis is due to the fall in income, then the results reported in Table 1 would understate the impact. Chinn (2009), using an error-correction model to explain the fall in US imports during the crisis, reported an income elasticity of 6.93. Similarly Ahmed (2009), using a first difference specification to explain the PRC's processed exports, found an income elasticity of 6.29.

The coefficients on the integrated exchange rate vary from -2.61 to -3.38. They remain large and statistically significant whether or not a time trend is included. These values imply that a 1% appreciation of exchange rates across supply chain countries including the PRC would reduce the PRCs processed exports by between 2.6 and 3.4%.

One explanation for why these values are large is that an appreciation across all supply chain countries would have a larger effect than an appreciation that is a subset of the supply chain countries. For instance, an appreciation of the Japanese yen could cause Japanese MNCs to shift production from Japan to the PRC and an appreciation of the yuan could cause MNCs to shift production back to Japan. If all currencies appreciate together, however, this source of savings disappears.

Support for this explanation comes from Table 2. The table reports the coefficients on the yuan exchange rate and on the exchange rates in other supply chain countries separately. The coefficients indicate that a 1% appreciation of the yuan would reduce processed exports by about 1% and a 1% appreciation of exchange rates in other supply chain countries would reduce exports by about 2%. A joint appreciation would thus reduce exports by the amount indicated in Table 1.

Table 2: DOLS Estimates of the PRC's Processed Exports over the 1993–2008 Period

Independent variables	Exports deflated by:					
	Hong Kong, China unit value index (1)	Hong Kong, China unit value index (2)	PPI-finished goods (3)	PPI-finished goods (4)	US CPI (5)	US CPI (6)
Rest of the World GDP	3.74	3.74	4.07	4.09	4.44	4.43
	(4.02)	(4.14)	(4.04)	(4.14)	(4.08)	(4.20)
Supplier's RER	-2.08***	-2.04*	-2.20***	-2.32**	-2.02***	-1.98*
	(0.71)	(1.02)	(0.70)	(0.98)	(0.72)	(1.01)
CNY RER	-1.18*	-1.17	-0.74	-0.78	-0.78	-0.77
	(0.61)	(0.71)	(0.58)	(0.65)	(0.63)	(0.73)
FDI Stock	-0.34	-0.31	-0.28	-0.38	-0.32	-0.29
	(0.58)	(0.82)	(0.60)	(0.85)	(0.58)	(0.83)
WTO Dummy	0.01	-0.00	0.01	0.02	-0.01	-0.01
	(0.05)	(0.04)	(0.04)	0.04	(0.05)	(0.05)
Capital Stock	1.01	0.92	0.68	0.97	0.63	0.56
	(1.07)	(2.03)	(1.09)	(2.03)	(1.08)	(2.11)
Time		0.00		-0.01		0.00
		(0.05)		(0.04)		(0.05)
Adjusted R-squared	1.00	1.00	0.99	0.99	0.99	0.99
No. of observations	58	58	58	58	58	58

Notes: DOLS (2, 2) estimates. Heteroskedasticity-consistent standard errors are in parentheses.

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

Source: Author's calculations.

Table 3 reports results including only the real effective exchange rate of the yuan and not the exchange rates in countries supplying parts and components. The coefficient on the yuan is negative, indicating that an appreciation of the CNY would reduce processed exports. However, the coefficient is only significant when the time trend is excluded. In addition, the coefficient on rest of the world income now takes on the wrong sign in half of the cases. These weaker results probably reflect the fact that the model is misspecified when only the CNY exchange rate is included and exchange rates in the countries supplying most of the value-added are excluded.[10]

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[10] The results are robust to excluding the PRC capital stock and the WTO variable. They are not robust, however, to excluding the stock of FDI. This perhaps reflects the fact that the model is misspecified when the FDI stock is excluded, since 84% of processed exports were produced by foreign-invested enterprises.

Table 3: DOLS Estimates of the PRC's Processed Exports over the 1993–2008 Period

Independent variables	Exports deflated by:					
	Hong Kong, China unit value index (1)	Hong Kong, China unit value index (2)	PPI-finished goods (3)	PPI-finished goods (4)	US CPI (5)	US CPI (6)
Rest of the World GDP	1.68	2.14	-1.63	-2.94	0.48	-0.79
	(3.99)	(3.84)	(4.97)	(4.44)	(4.93)	(4.34)
CNY RER	-1.90***	-1.08	-1.31**	-0.51	-1.38**	-0.60
	(0.47)	(0.64)	(0.51)	(0.64)	(0.51)	(0.65)
FDI Stock	0.48	1.09*	0.17	0.48	0.34	0.64
	(0.54)	(0.54)	(0.82)	(0.80)	(0.80)	(0.78)
WTO Dummy	-0.04	-0.02	-0.02	-0.02	-0.05	-0.04
	(0.05)	(0.05)	(0.05)	0.05	(0.05)	(0.05)
Capital Stock	1.32	-1.98	1.93	-0.64	1.34	-1.16
	(1.10)	(1.67)	(1.67)	(1.99)	(1.64)	(0.05)
Time		0.08**		0.71**		0.07**
		(0.03)		(0.03)		(0.05)
Adjusted R-squared	0.99	1.00	0.99	0.99	0.99	0.99
No. of observations	58	58	58	58	58	58

Notes: DOLS (2, 2) estimates. Heteroskedasticity-consistent standard errors are in parentheses.

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

Source: Author's calculations.

An important implication of the results presented here is that a generalized appreciation in both the PRC and East Asia would produce a large drop in processed exports. These results make sense since much of the value-added of the PRC's processed exports comes from East Asian supply chain countries. A generalized appreciation would also produce a larger drop than an appreciation in other supply chain countries or in the PRC alone.

A second 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 is large. A downturn outside of Asia would thus cause a large drop in the PRC's processed exports. This in turn would decrease the flow of intermediate goods from the rest of Asia into the PRC, reducing employment and output throughout the region. To a large extent this is what happened during the 2008–2009 global financial crisis.

4. CONCLUSION

The PRC's global current account surplus averaged 10% of GDP between 2007 and 2009. Economists and policymakers throughout the world have argued that the PRC needs to rebalance its economy and to rely less on exports. Many claim that an appreciation of the yuan would help to achieve these goals.

However empirical evidence on the effect of a CNY appreciation has been mixed for the largest category of exports, processed exports. These exports are assembled using parts and components produced in other countries. Since much of the value-added of these exports comes from other East Asian countries, Yoshitomi (2007) and others have argued that exchange rate changes throughout Asia should matter for processed exports.

This paper tests this hypothesis and finds evidence supporting it. The results indicate that an appreciation across East Asia would lead to a large drop in processed exports. An

appreciation in the PRC or in other supply chain countries alone, however, would have a smaller effect on exports.

One obstacle to a generalized appreciation throughout East Asia is the PRC's *de facto* peg to the US dollar. Since Asian economies do not only cooperate within production networks but also compete in third markets, the PRC's peg puts pressure on other countries in the region to prevent their exchange rates from appreciating.

A solution to this impasse would be for the PRC to adopt a regime characterized by a multiple-currency, basket-based reference rate with a reasonably wide band. In this case, the huge surpluses generated within East Asian production networks would cause currencies in the region to appreciate together.

A joint appreciation would benefit East Asia in several ways. It would maintain greater intra-regional exchange rate stability, thus facilitating the flow of parts and components within regional production networks (Hayakawa and Kimura 2009). It would allow consumers in the PRC to import more from the rest of the world (Thorbecke 2009). Finally, it would help prevent unpleasant outcomes such as beggar-thy-neighbor policies and excessive reserve accumulation while also giving Asian firms an incentive to produce for domestic markets. If domestic markets rather than exports could drive job creation in Asia, not only would producers be less exposed to a slowdown in the rest of the world but also consumers in the region could enjoy more of the fruits of their labor.

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