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East Asian Value Chains, Exchange Rates, and Regional Exchange Rate Arrangements*

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Abstract

Tariffs and trade wars threaten East Asian economies. Exchange rate appreciations would be less disruptive than protectionism. This paper reports dynamic ordinary least squares findings indicating that appreciations in Asian supply chain countries reduce exports and increase imports. However, despite large current account surpluses, there has been little exchange rate appreciation outside of China. Modified Frankel-Wei (1994) regressions indicate that Asian countries focus on the U.S. dollar in their implicit currency baskets. These high weights on the dollar imply that regional exchange rates are in a Nash Equilibrium. No Asian country wants its exchange rate to appreciate against the dollar for fear of losing price competitiveness relative to its neighbors. A better equilibrium would occur if they assigned more weight to regional currencies and less to the dollar. This would facilitate a concerted appreciation of Asian currencies against the dollar.

JEL classification: F14, F23, F42

Keywords: East Asian value chains; Trade elasticities; Frankel-Wei regressions

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1. Introduction

China's trade surpluses with the U.S. are pronounced (Figure 1). Because parts and components for China's exports flow from East Asian countries, China's surpluses are actually Asian surpluses. East Asia's exports to the rest of the world outweighed its imports by 45 percent per year since 2015, and its annual surpluses exceed one trillion dollars (Figure 2). These surpluses have generated protectionist pressures, tariffs, and trade wars.

Such impediments to trade are problematic because exporting has contributed to miraculous growth in Japan, South Korea, Taiwan, ASEAN, and China (Yoshitomi, 2003). Since these economies now produce sophisticated goods, exporting offers the opportunity to sustain growth.[‡]

Tariffs disrupt trade much more than equivalent changes in exchange rates. Benassy-Queré, Bussière, and Wibaux (2018) investigated bilateral trade flows between 110 countries at the Harmonized System (HS) six-digit level. They found that a 10 percent tariff reduces exports by 1.3 percent and that a 10 percent exchange rate appreciation reduces exports by 0.5 percent. Tariffs thus reduce exports three times more than appreciations do. This effect is called the international elasticity puzzle, and has also been reported by Fontagné, Martin, and Orefice (2018), Fitzgerald and Haller (2014), and Ruhl (2008).

The disruption caused by tariffs is multiplied by the uncertainty that accompanies trade wars and protectionism. Bloom (2009) showed that heightened uncertainty deters investment. Capital formation is crucial for East Asia's flagship industry, electronics, and for many other

[‡] According to the Economic Complexity Index of Hausmann *et al.* (2013), Japan was the most complex economy out of 128 countries in 2016, Korea the third most complex, Singapore the fifth most complex, and China the eighteenth most complex. These data are available at: http://atlas.cid.harvard.edu/ .

industries. By reducing investment, uncertainty jeopardizes the ability of Asian firms to remain close to the technological frontier.

Adjustments through exchange rate appreciations would disrupt Asian economies less than adjustments through managed trade. However, China's exports contain value-added from upstream Asian countries. Thus, exchange rates in upstream Asian countries may matter along with the renminbi for China's exports. Ahmed (2009), employing an autoregressive distributed lag model (ARDL) over the 1996Q1 – 2009Q2 period, found that a 10 percent appreciation of the renminbi relative to non-Asian countries would reduce China's processed exports by 17 percent and a 10 percent appreciation relative to Asian supply chain countries would increase China's processed exports by 15 percent. Thorbecke (2011a), using a dynamic ordinary least squares (DOLS) model over the 1993Q4 – 2008Q1 period, found that a 10 percent appreciation of the renminbi and of upstream supply chain countries would reduce China's processed exports by more than 15 percent. These findings indicate that appreciations in upstream Asian countries reduce China's exports

Appreciations across the supply chain may not only reduce imbalances but may also benefit countries in the region by increasing the purchasing power of consumers and allowing them to import more. Cheung, Chinn, and Qian (2015), using an ARDL model over the 2001Q1 – 2012Q4 period, reported that 90 percent of China's imports from the U.S. are from the "ordinary trade" customs regime and that a 10 percent renminbi appreciation would increase ordinary imports by 17 percent. Thorbecke (2011b), using panel DOLS estimation and data from 1979 to 2007, reported that exchange rate appreciations would increase consumption imports into several East Asian countries. These results imply that stronger exchange rates may allow Asia to function as an engine of growth.

Concerted appreciations could thus allow the region to rebalance trade and resist protectionist pressures. Results presented below indicate that, despite large current account surpluses, exchange rates other than the renminbi have appreciated little. This could be because of the high weights on the U.S. dollar in Asian currencies' implicit currency baskets. Kawai and Pontines (2016), using rolling regressions of regional exchange rates on major international currencies over the January 2000 – September 2013 period, reported that the weights on the U.S. dollar in Asian currencies' currency baskets remained high. This hinders joint appreciations of Asian currencies against the dollar.

This paper uses recent data to examine how appreciations in East Asia would affect exports and imports and to investigate the implicit currency baskets that countries are using. The results using data extending to 2017 and 2018 indicate that exchange rate throughout the region continue to matter for China's exports and for the region's imports. In addition, data extending to 2019 indicate that Asian countries assign high weights to the U.S. dollar in their currency baskets. Reducing their reliance on the dollar as an anchor currency would help to rebalance trade in the region.

Section 2 uses DOLS to investigate how the RMB and upstream exchange rates affect China's processed exports and Section 3 employs panel DOLS to investigate how they affect China's electronics exports. Section 4 utilizes panel DOLS to examine how exchange rates affect imports into East Asian countries. Section 5 employs modified Frankel-Wei (1994) regressions to estimate the weights that East Asian countries' assign to the dollar and other currencies in their implicit currency baskets. Section 6 draws policy lessons and concludes.

2. The Effect of Exchange Rates on China's Processed Exports

2.1 Data and Methodology

China has two primary customs regimes, processing trade and ordinary trade. Imports for processing are parts and components that enter China duty free and that can only be used to produce goods for re-export. Processed exports are the final goods produced using imports for processing. Ordinary exports rely more on domestic inputs and ordinary imports can flow into the domestic market.

China's surplus in processing trade exceeded $300 billion in every year from 2010 and 2018. Its surplus on ordinary trade, on the other hand, rises and falls with the value of imported primary products and averaged $85 billion per year over this period. This section thus focuses on processing trade.

Standard export functions imply that China's exports should depend on the real effective exchange rate and real income in the importing countries:

$$ex_t = \beta_0 + \beta_1 rmbreer_t + \beta_2 y_t^* \quad , \tag{1}$$

where ex_t represents the log of real exports, $rmbreer_t$ represents the log of the renminbi real effective exchange rate, and y_t* represents the log of foreign real income.

Quarterly data on processed exports are measured in U.S. dollars and are available from the CEIC database over the 1993Q1 – 2018Q4 period. Following Cheung *et al.* (2012) and others, exports are deflated using the Hong Kong to US re-export unit value indices obtained from the Customs and Statistics Department of the Government of Hong Kong.

Thorbecke (2011a) reported that the lion's share of processed exports flow to higher income countries. Quarterly data on the volume of real GDP in OECD countries are thus used to represent y_t* in equation (1). These data are seasonally adjusted and obtained from the OECD.[§] Quarterly data on the Chinese CPI-deflated real effective exchange rate are available from the IMF and are sourced from the CEIC database.

Since much of the value-added of China's processed exports comes from the countries providing parts and components (imports for processing), equation (1) should be modified to include exchange rates in supply chain countries. Year after year, the leading suppliers of imports for processing to China are Taiwan, Japan, South Korea, the United States, Malaysia, Thailand, Singapore, Germany, and the Philippines. Weights ($w_{i,t}$) can be assigned to these economies based on the value of imports for processing each country provides to China relative to the value of parts and components coming from all nine countries together.[**] These weights can be recalculated each year and converted to quarterly frequencies using linear interpolation. They can then be employed to calculate a geometrically weighted average of exchange rates in supply chain countries ($ssreer_t$) by using the formula:

$$ssreer_t = ssreer_{t-1} \prod_{i=1}^{9} (reer_{i,t} / reer_{i,t-1})^{w_{i,t}} \ , \tag{2}$$

where $reer_{i,t}$ is the real effective exchange rate in supply chain country i at time t. Increases in $reer_{i,t}$ and in $ssreer_t$ represent real exchange rate appreciations. $ssreer_t$ is set to 100 in the first quarter of 1993. Data on CPI-deflated real effective exchange rates are obtained from the CEIC database.

[§]The website for these data is http://stats.oecd.org

[**] Over the 1993-2018 sample period, the average value of imports for processing coming from each economy individually relative to the value coming from all nine economies together was: 0.268 for Taiwan, 0.258 for Japan, 0.231 for South Korea, 0.080 for the U.S., 0.046 for Malaysia, 0.039 for Thailand, 0.034 for Singapore, 0.024 for Germany, and 0.022 for the Philippines.

Augmented Dickey–Fuller tests indicate that the series are integrated of order one (I(1)). The trace statistic and the maximum eigenvalue statistic permit rejection at the 1 percent level of the null hypothesis of no cointegrating relations against the alternative of one cointegrating relation.

Since the evidence points to a cointegrating relationship between the variables, the parameters are estimated using DOLS. DOLS 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:

$$ex_t = \beta_0 + \beta_1 y_t * + \beta_2 rmbreer_t + \beta_3 ssreer_t + \sum_{j=-p}^{p} \alpha_{y*,j} \Delta y_{t-j} * +$$

$$+ \sum_{j=-p}^{p} \alpha_{rmbreer,j} \Delta rmbreer_{t-j} + \sum_{j=-p}^{p} \alpha_{ssreer,j} \Delta ssreer_{t-j} + \varepsilon_t \ , \qquad (3)$$

where the variables are defined above. Seasonal dummy variables are also included.

2.2 Results

Table 1 presents the results. Column (1) presents the results including exchange rates in supply chain countries and column (2) presents results excluding *ssrer*. All of the coefficients in both specifications are correctly signed and statistically significant at the 1 percent level. The first row indicates that a 1 percent appreciation of the renminbi would reduce processed exports by between 1.3 and 1.7 percent. The second row indicates that a 1 percent appreciation in supply chain countries would reduce exports by 2.7 percent. The third row indicates that a 1 percent fall in rest of the world GDP would reduce exports by between 5.8 and 7.1 percent.

Imports for processing fell after 2016 relative to processed exports. This implies that more of the value added of processed exports since then has come from China. Xing (2014) and others have also found that China's value-added in processing trade has increased. This could imply that exchange rates in supply chain countries mattered in earlier years but do not matter now. To investigate this the models with and without exchange rates in supply chain countries are used to perform out of sample forecasts over the 2018Q1 to 2018Q4 period using actual values of the independent variables. The bottom row of Table 1 reports that the root mean squared error measure of the model's forecast error equals 0.386 when *ssrer* is included and 0.608 when only *rmbreer* and y_t* are included. This implies that exchange rates in supply chain countries still matter for China's processed exports.

How have the renminbi and exchange rates in supply chain countries evolved? Figure 3 shows that the renminbi has appreciated 10 percent between the first quarter of 2012 and the last quarter of 2018. It also shows that *ssrer* has the same value at the end of 2018 as it did in the first quarter of 2012. Over this period 55 percent of *ssrer*'s value has been driven by Taiwanese and Korean exchange rates and 80 percent by Taiwanese, Korean, Japanese and Singaporean exchange rates. Taiwan's current account surplus from 2010 to 2018 averaged 12 percent of GDP; Korea's averaged 5.7 percent; Japan's averaged 2.5 percent; and Singapore's averaged 17 percent. In spite of these enormous surpluses, their currencies have barely appreciated.

3. The Effect of Exchange Rates on China's Electronic Exports

China's global surplus in electronics goods has averaged $330 billion per year since 2011.[††] This equals more than half of China's overall surplus. China's electronics exports are produced using electronic parts and components (ep&c) from upstream countries. This section investigates whether upstream exchange rates and the renminbi matter for China's electronics exports. Thorbecke (2017) presented evidence using data up to 2014 that China's exports of

[††] These data come from the CEPII-CHELEM database.

final goods such as computers and cellphones depend on exchange rates in East Asian supply chain countries. Since China has become an exporter of ep&c and other electronic goods, this section examines all of China's electronics exports and uses data up to 2017.

3.1 Data and Methodology

Exports are again modeled as a function of the Chinese real exchange rate, exchange rates in upstream countries, and GDP in importing countries. China's exports to major importing countries are examined. These are: Australia, Canada, the Czech Republic, France, Germany, Japan, Malaysia, Mexico, the Netherlands, the Philippines, Poland, Singapore, South Korea, Taiwan, Thailand, the United Kingdom, and the United States.

Data on electronics exports come from the CEPII-CHELEM database. Electronics goods include consumer electronics, telecommunications equipment, computer equipment, electronic components, precision instruments, clock making, and optics. China's exports are again deflated using the Hong Kong to U.S. re-export unit value indices

Data on GDP in importing countries and bilateral real exchange rates between China and each importing country are obtained from the CEPII-CHELEM database. An increase in the real exchange rate represents an appreciation of the renminbi.

To investigate how exchange rates in upstream countries affect the price competitiveness of China's electronics exports, a weighted average of exchange rates in countries providing ep&c is constructed. Since 2000, more than 90 percent of China's imports of electronic parts and components (ep&c) has come from Taiwan, South Korea, Malaysia, Japan, Singapore, the

Philippines, the U.S., Thailand, and Germany.[‡‡] Exchange rates in these countries are used to construct a weighted exchange rate in supply chain economies.[§§]

Data on the bilateral real exchange rates between China and the importing countries and real GDP in the importing countries come from the CEPII-CHELEM database. The real exchange rate variable measures the units of consumer goods in the exporting country needed to buy a unit of consumer goods in the importing country. An increase in the exchange rate represents an appreciation of the renminbi. The real GDP variable is measured in U.S. dollars.

Weighted exchange rates between the leading suppliers of ep&c to China and the countries purchasing electronics goods from China are calculated using the formula:

$$wrer_{j,t} = \sum_{i} w_{i,t} * rer_{i,j,t} \text{ ,} \tag{4}$$

where $wrer_{j,t}$ is the weighted exchange rate between the nine countries providing ep&c to China and country *j* importing electronic goods from China, $w_{i,t}$ is the value of ep&c exported from upstream country *i* to China divided by the value of ep&c exported from all nine upstream countries to China, and $rer_{i,j,t}$ is the bilateral real exchange rate between upstream country *i* and country *j* importing electronic goods from China. An increase in $wrer_{j,t}$ represents an appreciation in upstream exchange rates relative to the country importing China's electronic goods.

A battery of panel unit root tests indicates that the variables are integrated of order one (I(1)). Kao residual cointegration tests permit rejection of the null hypothesis of no cointegration

[‡‡] Electronic parts and components come from the International Standard Industrial Classification (ISIC) classification number 3210.

[§§] Over the 2001-2017 sample period, the average value of imports for processing coming from each economy individually relative to the value coming from all nine economies together was: 0.230 for Taiwan, 0.183 for South Korea, 0.177 for Malaysia, 0.173 for Japan, 0.082 for the Philippines, 0.057 for the U.S., 0.051 for Singapore, 0.035 for Thailand, and 0.012 for Germany.

at the 0.0000 level. Panel DOLS, a technique for estimating cointegrating relations, is thus employed.

The estimated model takes the form:

$$EX_{j,t} = \beta_0 + \beta_1 wrer_{j,t} + \beta_2 rmb_{j,t} + \beta_3 y_{j,t}^{*} + \sum_{k=-p}^{p} \alpha_{1,k} \Delta wrer_{j,t-k} + \sum_{k=-p}^{p} \alpha_{2,k} \Delta rmb_{j,t-k}$$
$$+ \sum_{k=-p}^{p} \alpha_{3,k} \Delta y_{j,t-k}^{*} + u_{i,j,t}, \qquad (5)$$
$$t = 1, \cdots, T; \qquad j = 1, \cdots, N.$$

Here $EX_{j,t}$ represents electronics exports from China to country *j*, $wrer_{j,t}$ represents weighted exchange rates between economies supplying ep&c to China and country *j* importing electronics goods from China, $rmb_{j,t}$ represents the bilateral real exchange rate between China and importing country *j*, and $y_{j,t}^*$ represents real GDP in country *j*. Cross-section specific lags and leads of the first differenced right-hand side variables are included to asymptotically remove endogeneity and serial correlation. The number of lags and leads is determined by the Schwarz Information Criterion. A sandwich estimator is used to allow for heterogeneity in the long-run residual variances. Individual specific fixed effects are included. Because of the persistent increase in China's electronics exports, individual specific time trends are also included. The data extend from 2001, when China joined the WTO, until 2017.

3.2 Results

The results from estimating equation (5) are:

$$\underset{}{EX_{j,t}} = \underset{(0.44)}{-1.40^{***}wrer_{j,t}} - \underset{(0.39)}{1.19^{***}rmb_{j,t}} + \underset{(0.85)}{1.67^{**}\, y_{j,t}^{*}} + \ldots$$

Adjusted R-squared = 0.956, Standard error of regression = 0.212, Sample period = 2001-2017. 17 cross sections included. Standard errors in parentheses.
***(**) denotes significance at the 1% (5%) levels.

All of the coefficients are correctly signed and statistically significant. They indicate that a 1 percent appreciation in countries providing ep&c to China would reduce China's electronics exports by 1.4 percent and that a 1 percent appreciation of the renminbi would reduce exports by 1.19 percent. A 1 percent increase in GDP in the importing countries would increase China's exports by 1.67 percent. These results and the results in the previous section both indicate that appreciations in supply chain countries causes larger decreases in China's exports than appreciations of the renminbi.

The estimation includes $rmb_{j,t}$ and $wrer_{j,t}$ relative to 17 countries importing China's electronics goods. The variable $rmb_{j,t}$ can be aggregated into a single time series using the formula:

$$rmb_t = rmb_{t-1} \prod_{j=1}^{17} (rmb_{j,t} / rmb_{j,t-1})^{w_{j,t}} \quad , \tag{6}$$

where rmb_t is the weighted real renminbi exchange rate relative to all 17 importers at time *t*, $rmb_{j,t}$ is the bilateral real renminbi exchange rate relative to country *j* at time *t* and $w_{j,t}$ is the share of China's electronics exports going to country *j* at time *t* relative to China's electronics exports going to all 17 countries. A weighted exchange rate in supply chain countries relative to all 17 importers ($wrer_t$) can be calculated in the same way.

The aggregated exchange rate variables (rmb_t and $wrer_t$) are presented in Figure 4. The figure shows that the renminbi has appreciated significantly but that exchange rates in supply chain countries have not. This supports the findings in Figure 3 with very different exchange rate measures indicating that, despite large current account surpluses, exchange rates in supply chain countries have not appreciated.

4. The Effect of Exchange Rates on East Asian Imports

Since protectionist pressures in the U.S. have intensified, East Asia should look to its own markets. In theory, appreciations will increase the purchasing power of domestic agents and increase imports. How do exchange rates affect Asian imports?

4.1 Data and Methodology

Examining the impact of exchange rates on East Asian imports has proven difficult. The coefficients on exchange rates in import equations often take on the wrong sign. As Kamada and Takagawa (2005) discussed, this occurs because many imports into Asian countries are parts and components or capital goods that are employed to produce goods for re-export. Exchange rate appreciations that lower exports will also reduce the demand for imported inputs that are used to produce exports. This causes exchange rate coefficients in import equations to take on the wrong sign.

To circumvent these problems Thorbecke (2011b) examined consumption imports. Consumption imports are intended for the domestic market rather than for producing goods for re-export. Using data up to 2007, he reported that appreciations increase imports for many East Asian countries. This paper investigates this question by extending the sample by 11 years up to 2017.

Standard import functions are estimated:

$$im_t = \beta_0 + \beta_1 rer_t + \beta_2 rgdp_t \quad , \tag{7}$$

where im_t represents real imports, rer_t represents the real exchange rate, $rgdp_t$ represents domestic real income, and all variables are measured in natural logs.

Imports into the Asian economies studied above are investigated. These are China, Japan, Korea, Malaysia, the Philippines, Thailand, and Taiwan. Singapore's import data may be distorted by entrepôt trade and Singapore is not included.

Data on final consumption goods imports (im_t), the real exchange rate, and real GDP in importing countries are obtained from the CEPII-CHELEM database.[***] Consumption imports are deflated using import unit value indices. Unit value data are obtained from the World Bank except for Taiwan, where the data are obtained from CEIC.

For each of the importing countries, imports from major exporters of consumer good to the country are included. Major exporters for each country are listed in Table 2. Their number varies from 14 to 16.

Data on real GDP in the importing country ($rgdp_t$) are also obtained from the CEPII-CHELEM database. Real GDP is measured in constant U.S. dollars (base year 2011).

Data from 1980 to 2017 are used in the estimation except for Taiwan and China. Taiwan's estimation begins in 1985 because this is when unit value data become available. For China, consumption imports from some major trading partners were less than USD 300,000 in 1980. It is difficult explaining changes in imports using macroeconomic variables when the base is so low. The sample for China begins in 2004, after China's export miracle led to rising consumption imports.

[***] Consumption imports include beverages, carpets, cars, cereal products, clothing, clock making, consumer electronics, domestic electrical appliances, knitwear, manufactured tobaccos, miscellaneous manufactured articles, motorcycles, optics, pharmaceuticals, preserved fruits, preserved meat & fish, and toiletries.

The East Asian Crisis was associated with a marked drop in consumption goods imports in 1998 and 1999. To control for this, a dummy variable is included for crisis-hit economies (Indonesia, Malaysia, the Philippines, South Korea, and Thailand) that equals one in 1998 and 1999 and zero otherwise.

After Xi Jinping became the Secretary General of the Communist Party in November 2012, he vowed to crack down on corruption. One form of corruption that aroused anger among Chinese netizens was when government officials flaunted expensive imported goods such as Rolex watches. Qian and Wen (2015) found that the anti-corruption campaign reduced luxury imports. To control for this, a dummy variable is included for Chinese imports that equals one beginning in 2013 and zero before 2013.

Panel unit root tests and Kao residual cointegration tests in many cases point to cointegrating relations among the variables. A panel DOLS model like the one employed in the previous section is used to estimate equation (7).

4.2 Results

Table 3 presents the results. For the Northeast Asian economies (China, Japan, South Korea, and Taiwan), all of the coefficients are correctly signed and statistically significant. For these economies, a 1 percent appreciation of the currency would increase consumption imports by between 0.6 and 0.8 percent. Consumption imports are thus sensitive to the exchange rate. They are also sensitive to GDP. A 1 percent increase in GDP would cause imports to increase by between 1.3 and 4.8 percent.

The results for the ASEAN countries are not compelling. There is no evidence that currency appreciations would increase imports and two of the three coefficients on GDP are incorrectly signed. These weak results may be due to distortions caused by the fact that consumption imports from some of the exporters are small for parts of the sample period.

The important implication of the results presented in Table 3 is that growth and stronger exchange rates in Northeast Asian economies significantly increase imports. This suggests the intra-regional trade may be able to supplant trade with the U.S. and function as an engine of growth.

5. Investigating East Asian Countries' Implicit Currency Baskets

5.1 Data and Methodology

Sections 2 and 3 reported that exchange rates in supply chain countries have appreciated much less than the renminbi. This section investigates the weights that Asian countries assign to key currencies in their implicit currency baskets. To do this, it employs Kawai and Pontines (2016) modification of Frankel and Wei's (1994) method.

Frankel and Wei (1994) investigated the influence of international reference currencies on a country's exchange rate. To do this, they regressed the log difference of the country's exchange rate relative to the Swiss franc on the log differences of the international anchor currencies relative to the Swiss franc. Traditionally, the key anchor currencies were the U.S. dollar, the euro, the Japanese yen, and the British pound. In November 2015 the International Monetary Fund decided to add the Chinese renminbi to these currencies in calculating the Special Drawing Right (SDR) basket.

Kawai and Pontines (2016) noted that including the change in the log of the renminbi as a right hand side variable along with the other SDR currencies is problematic because the renminbi can move closely with the dollar. They recommended a two-step approach, where the log change in the renminbi's value relative to the New Zealand dollar is regressed on the log change in the other SDR currencies' values relative to the New Zealand dollar. The estimated residual from this regression, ω, is then employed in the following regression:

$$\Delta\log(x/NZD) - \omega = \gamma_0 + \gamma_1 (\Delta\log(USD/NZD) - \omega) + \gamma_2 (\Delta\log(EURO/NZD) - \omega) + \gamma_3 (\Delta\log(JPY/NZD) - \omega) + \gamma_4 (\Delta\log(GBP/NZD) - \omega) + \nu , \qquad (8)$$

where x/NZD is the log of a currency relative to the New Zealand dollar, USD is the U.S. dollar, EURO is the euro, JPY is the Japanese yen, and GBP is the Great Britain pound. The implied coefficient on the renminbi from equation (8) is $1 - \gamma_1 - \gamma_2 - \gamma_3 - \gamma_4$.

McCauley and Shu (2018) investigated the co-movement between Asian currencies and the renminbi over three periods: 18 August 2015 - 13 February 2016, 14 February 2016 – 25 May 2017, and 26 May 2017 – 1 August 2017. They reported large co-movements between the renminbi and Asian currencies during the second period but found that the co-movements had declined during the third period. They concluded that the dollar had become more important relative to the renminbi in the implicit currency baskets of Asian countries during the last period. This paper uses data from 1 August 2017 to 15 March 2019 to investigate the weights assigned to the renminbi, the dollar, and other SDR currencies.

5.2 Results

Table 4 presents the results. In every case except Thailand the coefficient on the U.S. dollar is at least twice as large as the coefficient on the renminbi. Even for Thailand, the coefficient on the dollar is larger than the coefficient on the renminbi. The only case where all of the SDR currencies have statistically significant coefficients is for Singapore. This makes sense since Singapore follows a "basket, band and crawl" system of managing the Singapore dollar relative to a basket of currencies.

The important implication of the results in Table 4 is that the U.S. dollar remains dominant in the implicit currency baskets of East Asian countries. The renminbi and euro maintain some weight, and except for Singapore the yen and pound do not.[†††]

6. Conclusion

Tariffs, trade wars, and the accompanying uncertainty threaten East Asian industries. Exporting has stimulated economies in the region and closing foreign markets will stall this growth engine. The prominence of cross border value chains will multiply the damage (see IMF, 2019). The uncertainty accompanying trade wars will also deter the investment needed to stay close to the technological frontier.

Exchange rates can help to rebalance trade with less disruption than tariffs. The tricky part is that exchange rates in upstream countries matter for China's exports and trade balance. If U.S. and Chinese officials focus only on the Chinese renminbi and other Chinese and American variables, they may never resolve the China/U.S. imbalances that are generating protectionist pressures.

There would be several advantages if East Asian currencies could appreciate together against the U.S. dollar. This would help to maintain intra-regional exchange rate stability, reducing the cost of linking cross border production blocks and facilitating the slicing up of the value chain (see Hayakawa and Kimura, 2009). Appreciating together would also help

[†††] For South Korea and Taiwan (the NIEs), the coefficient on the Japanese yen is negative. An appreciation of the won or NT dollar is thus associated with a weaker yen. Since Japan is a key supplier of ep&c and capital goods to these economies, a weaker yen will reduce the cost of imported inputs and mitigate the impact of appreciations on the price competitiveness of NIE exports.

rebalance China's exports away from the U.S. This could reduce protectionist pressures Joint appreciations would prevent one Asian exporter from gaining a competitive advantage against its neighbors. This could prevent unpleasant outcomes such as beggar-thy-neighbor policies in Asia. A concerted appreciation would also redirect exports to Asian consumers, allowing them to enjoy the fruits of their labors.

How could Asian currencies appreciate together? One step would be for countries to decrease the weight of the U.S. dollar in their implicit currency baskets. Ogawa and Ito (2002) noted that if an important trading partner of Asian country A puts heavy weight on the U.S. dollar, it may cause country A to do so also. This can produce a Nash equilibrium. On the other hand, if A's trading partner put more weight on regional currencies, then it may be optimal for A to put more weight on regional currencies. This would also be a Nash equilibrium. Putting more weight on regional currencies however would facilitate a concerted appreciation against the dollar.

No Asian country wants to let its exchange rate appreciate against the U.S. dollar for fear of losing price competitiveness relative to its Asian neighbors. However, perennial surpluses put pressure on their currencies to appreciate. Policymakers should consider acceding to these market forces and allowing their currencies to appreciate together. In addition, if Japan put less emphasis on its 2 percent inflation target the yen could appreciate. If South Korea and Taiwan reduced outflows from insurance and government pension funds, the won and New Taiwan dollar could appreciate. If China extended fewer high interest rate loans to poorer countries, the renminbi could appreciate. None of these countries should act unilaterally though. Rather, given the intricate value chains linking Japan, Korea, Taiwan, China, and ASEAN, policymakers should view exchange rates as a regional issue and confer deeply about exchange rate policy.

Asian countries should also propose a deal with the U.S. whereby their currencies appreciate against the dollar in response to assurances of free trade. This would resemble the 1985 Plaza Accord, when France, Germany, Japan, and the UK appreciated their currencies against the dollar in exchange for the U.S. maintaining free trade and reducing its budget deficit. Figure 1 shows that the U.S. current account balance increased after the Plaza Accord and that the U.S. ran its last current account surplus a few years later.

Economies in the region should establish ironclad free trade agreements among themselves. When South Korea and Japan faced off over wartime labor, the Japanese Finance Minister threatened tariffs on Korean products (*Japan Times*, 2019). When South Korea deployed the US-built Thaad missile shield, Beijing banned Chinese tour groups from visiting South Korea (Harris *et al*., 2017). Asian countries should eschew protectionism and employ other policy instruments to address these difficult issues.

If the region can establish a free trade zone, it should then seek to broaden the scale to include Europe and the rest of the world. This would generate pressure from U.S. businesses for the U.S. to join.

The East Asian miracle occurred as Asian countries succeeded at exporting in industries such as electronics with tight profit margins. Investments in human and physical capital and the discipline of competing in world markets contributed to learning by doing and productivity growth. Exchange rate appreciations could act as a stick and open markets abroad as a carrot to goad Asian economies to continue assimilating technologies and innovating.

Table 1

DOLS estimates of China's Processed exports.

	(1)	*(2)*
	Processed Exports	Processed Exports
Independent Variables		
RMB REER	*-1.33**** *(0.20)*	*-1.67**** *(0.22)*
SSREER	*-2.67**** *(0.95)*	
GDP in OECD Countries	*5.82**** *(0.53)*	*7.05**** *(0.25)*
Adjusted R-squared	*0.968*	*0.958*
Standard Error of Regression	*0.158*	*0.181*
Sample Period	*1993:III-2017:IV*	*1993:III-2017:IV*
No. of observations	*98*	*98*
RMSE	*0.386*	*0.608*

Notes: DOLS (1,1) estimates. Heteroskedasticity-consistent standard errors are in parentheses.
RMB REER is the Chinese real effective exchange rate. SSREER is a weighted average of real effective exchange rates in supply chain countries. GDP in OECD Countries is real, seasonally adjusted GDP in OECD countries. RMSE represents the root mean squared error measure of the model's forecast error for the 2018:I-2018:IV period using actual out-of-sample observations.
*** denotes significance at the 1% level.

Table 2
Major Exporters of Consumption Goods to East Asian Economies.

	Importing Economies						
	China	Japan	Korea	Malaysia	Philippines	Thailand	Taiwan
Exporting Economies							
Australia				X	X	X	
Belgium	X	X	X				X
China		X	X	X	X	X	X
France	X	X	X	X		X	X
Germany	X	X	X	X	X	X	X
India				X		X	
Indonesia		X		X	X	X	
Ireland		X					
Italy	X	X	X	X		X	X
Japan	X		X	X	X	X	X
Korea	x	X		X	X	X	X
Malaysia	X	X	X		X	X	X
Netherlands	X		X		X	X	X
Philippines				X			
Singapore	X	X	X	X	X	X	
Switzerland	X	X	X	X	X	X	X
Taiwan	X	X	X	X	X	X	
Thailand	X		X	X	X		X
United Kingdom	X	X	X	X	X	X	X
United States	X	X	X	X	X	X	X
Vietnam	X	X					X

Table 3
Panel DOLS estimates of Asian Countries' Consumption Imports.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	China	Japan	Korea	Malaysia	Philippines	Thailand	Taiwan
Independent Variables							
Real Exchange Rate	0.69*** (0.19)	0.56*** (0.09)	0.79*** (0.13)	0.07 (0.09)	-0.25* (0.13)	-0.00 (0.07)	0.59*** (0.15)
GDP	1.28*** (0.09)	4.70*** (0.22)	1.85*** (0.12)	-0.75 (0.20)	-4.45*** (0.22)	0.48*** (0.10)	3.39*** (0.31)
Adjusted R-squared	0.976	0.976	0.948	0.948	0.964	0.928	0.841
Standard Error of Regression	0.203	0.261	0.309	0.236	0.347	0.265	0.581
Sample Period	2004-2017	1981-2017	1981-2017	1981-2017	1981-2017	1981-2017	1985-2017
No. of Cross Sections	15	15	14	16	15	16	14
No. of observations	210	550	507	584	548	584	462

Notes: The table presents trade elasticities for consumption imports into East Asian countries. The exporting countries are listed in Table 2. The number of leads and lags in the DOLS estimation are determined by the Schwarz Information Criterion.
*** (*) denotes significance at the 1% (10%) level.

Table 4
Currency Weights in Modified Frankel-Wei Regressions over the August 2017 - March 2019 period.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Independent Variables	Malaysia	Philippines	Singapore	South Korea	Taiwan	Thailand
U.S. Dollar	0.81*** (0.04)	1.04*** (0.04)	0.43*** (0.02)	0.61*** (0.08)	0.76*** (0.03)	0.51*** (0.06)
Renminbi	0.08*** (0.02)	-0.03 (0.02)	0.19*** (0.01)	0.33*** (0.04)	0.18*** (0.02)	0.45*** (0.05)
Euro	0.10*** (0.03)	0.04 (0.04)	0.26*** (0.02)	0.25*** (0.07)	0.14*** (0.03)	-0.00 (0.06)
Japanese yen	0.01 (0.03)	-0.02 (0.03)	0.08*** (0.02)	-0.19*** (0.06)	-0.05* (0.03)	0.03 (0.05)
British Pound	0.01 (0.02)	-0.04 (0.03)	0.04** (0.02)	0.00 (0.05)	-0.03 (0.03)	0.01 (0.04)
Adjusted R-squared	0.870	0.854	0.917	0.505	0.850	0.449
No. of observations	381	381	381	381	381	381

Notes: The table presents the weights assigned to Special Drawing Rights (SDR) currencies (the renminbi, the U.S. dollar, the euro, the Japanese yen, and the British pound) in Asian currencies' implicit currency baskets. To correct for multicollinearity between the renminbi and the dollar, a two-step approach is used. First the log change of the renminbi/ New Zealand dollar is regressed on the log change of the other SDR currencies relative to the NZ dollar. The residuals are used in a second stage regression to obtain the coefficients in the table. The sample period extends from 1 August 2017 to 15 March 2019. Heteroscedasticity and autocorrelation consistent standard errors in parentheses.
*** (*) denotes significance at the 1% (10%) level.

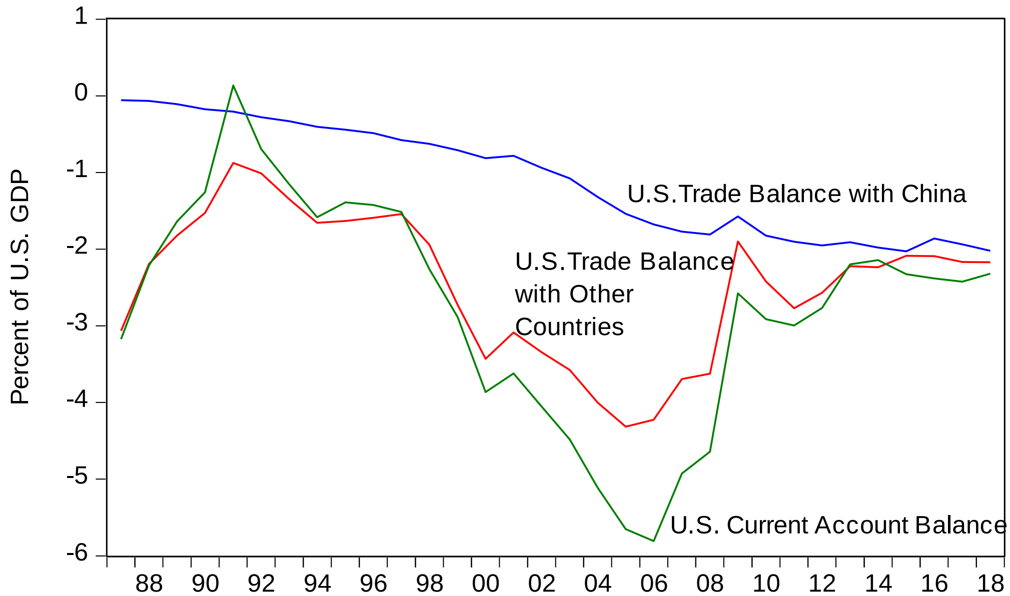

Fig. 1. U.S. Imbalances with China and the Rest of the World
Source: IMF World Economic Outlook and U.S. Census Bureau.

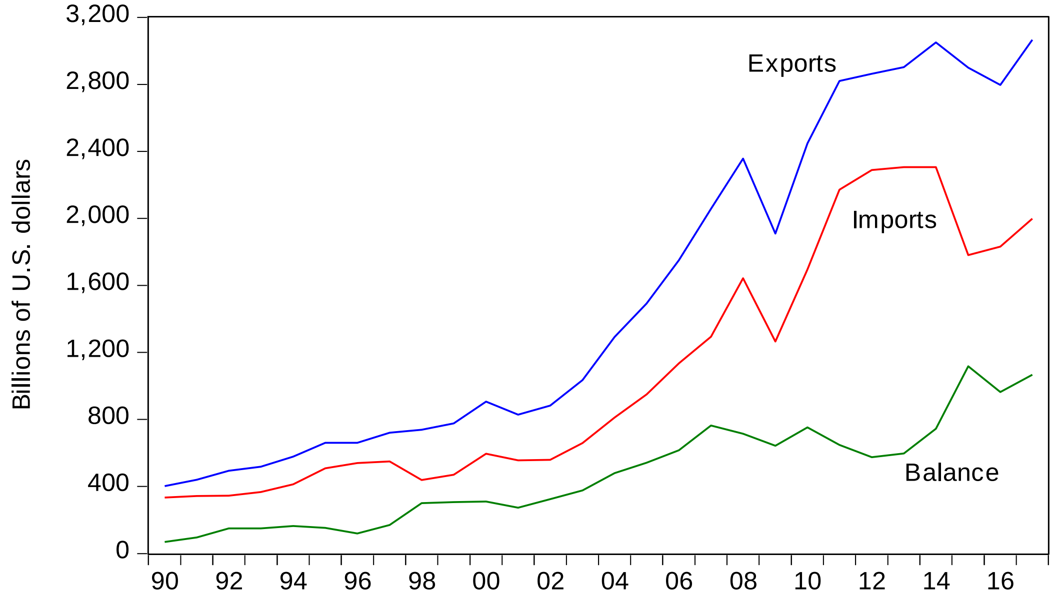

Fig. 2. East Asia's Exports, Imports, and Trade Balance with the Rest of the World
Note: East Asia includes China, Japan, Indonesia, Malaysia, Singapore, South Korea, Taiwan, and Thailand.
Source: CEPII-CHELEM Database.

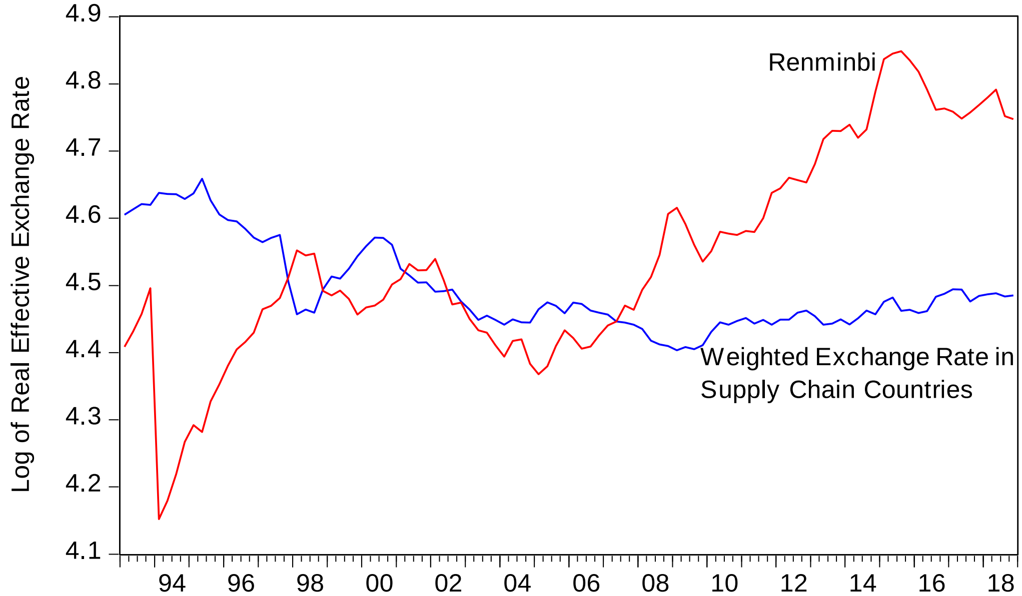

Fig. 3. The Renminbi Real Effective Exchange Rate and a Weighted Exchange Rate of Countries Supplying Parts and Components to China

Note: The Weighted Exchange Rate is the geometrically weighted average of real effective exchange rates in the nine leading suppliers of imports for processing to China.

Source: CEIC Database and calculations by the author.

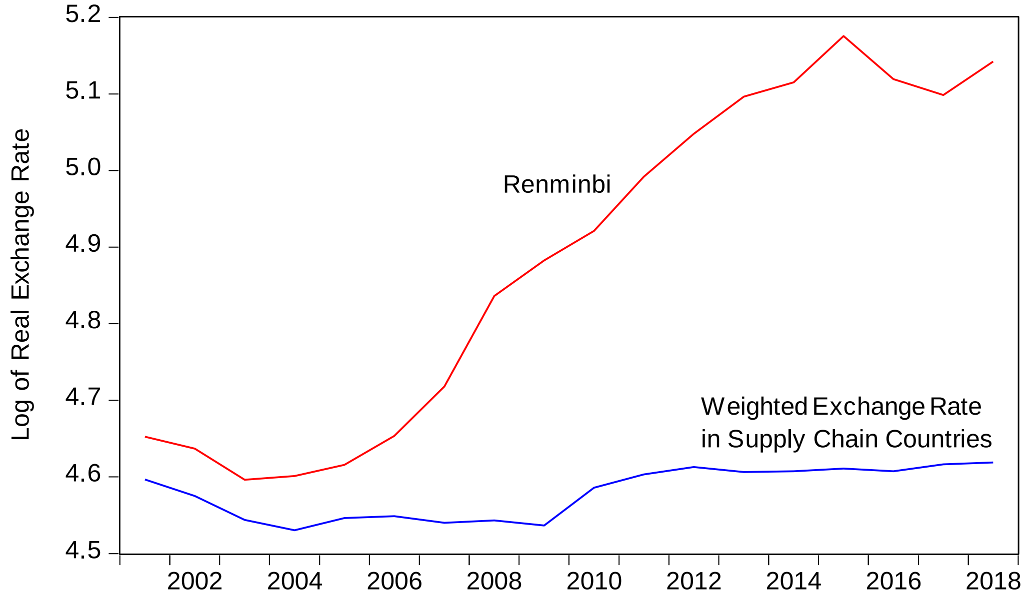

Fig. 4. The Renminbi Real Exchange Rate and Weighted Exchange Rates in Supply Chain Countries Relative to the 17 Leading Importers of China's Electronics Goods

Note: The exchange rates are geometrically weighted averages of the renminbi and exchange rates in supply chain countries relative to the seventeen leading importers of China's electronics goods. The weights are determined by the share of China's electronics exports going to each individual country relative to China's electronics exports going to all 17 countries together.

Source: CEPII-CHELEM database and calculations by the author.

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