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The impact of yuan revaluation on the Asian region

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Contents

Abstract

This paper studies how an appreciation of the yuan affects the exports of other Asian countries. It finds mixed effects. Countries that export consumer goods to China or compete in third markets benefit from yuan appreciation, while countries that supply capital goods to China lose. These findings suggest that a revaluation of the yuan may not lead to a generalised revaluation of Asian currencies.

Key words: Global imbalance, exchange rate, China and Asia.

JEL classification: F3, F4.

Summary

This paper aims to analyse how an appreciation of the yuan affects the exports of other Asian countries, by controlling for the rapid change in the structure of China's exports.

China has increasingly been acting as a 'world factory' since the early 1990s. Because of this, if China's exports fall following a yuan appreciation, then its demand for upstream intermediate and capital goods may decline as well, even if these imported goods become less expensive. Therefore, it is possible that yuan appreciation will have a much smaller positive impact (or perhaps even a negative one) on the trade surplus of high-income Asian capital-goods exporters than on low-income Asian consumer-goods exporters – a hypothesis that this paper will examine.

There is extensive empirical research on how exchange rate movements affect the trade balance in general and those of Asia and China in particular. But the literature so far has shared a limitation: the estimation tends to be based on a relatively long historical period (25 years or more). But there has been a significant change in the structure of international trade, and of Asian trade in particular, over this period. This paper aims to fill this gap by using a panel estimation that uses a large data sample that controls for the change in the commodity structure of trade.

Bilateral export and import equations are estimated between China and nine Asian countries: India, Indonesia, Japan, Korea, Malaysia, Pakistan, the Philippines, Singapore, and Thailand since the early 1990s. Competition between China and these countries in third markets is also estimated.

Three related empirical models are examined: China's own exports, China's imports, and the competition between Asian countries and China in third markets. The results are consistent with the supply-chain story, whereby China imports capital goods from advanced Asian countries to facilitate the production of consumer goods exported to third markets. When the yuan appreciates, China's exports fall, which then reduces China's demand for upstream capital goods. Consequently, exporters of mainly capital goods to China, such as Japan and Korea, are found to be adversely affected by a yuan appreciation. There is also little evidence that Asian countries benefit from yuan's appreciation in their exports to third markets.

1 Introduction

China's emergence as an industrial and export superpower is one of the most important forces reshaping the contemporary world economy. A now standard way of conveying this point is to observe that the increase in employment in China's manufacturing sector is equivalent to adding another middle-sized industrial country to the world economy each year. Thus, China's growing importance as an assembly platform for exports of manufactures, a destination for foreign investment, and a consumer of imported technology, raw materials and industrial goods is not a one-time shock; rather, it is an ongoing process continually reshaping the balance of global supply and demand.

As China's impact on world markets rises, there has been a growing literature on whether its exchange rate arrangements explain its competitiveness and trade surplus, and the extent to which yuan revaluation could contribute to reducing global imbalances. However, these studies seem to generate conflicting results. For example, Dunaway and Li (2005) examine recent research on the 'equilibrium' real value of China's currency. They find that estimates of undervaluation range from zero to nearly 50%. They attribute the wide variation in these estimates to the influence of a number of factors – the different methodologies used, explanatory variables included, subjective judgements of the various researchers in deriving their results, and the instability in underlying economic relationships given that China is rapidly developing.

This paper aims to analyse how an appreciation of the yuan affects the exports of other Asian countries, by controlling for the rapid change in the structure of China's exports. According to conventional wisdom, a yuan appreciation should reduce China's own exports but increase those of other Asian countries. This is because exports from other Asian countries would become relatively cheaper both in China and in competition with Chinese goods in third markets.

However, there are a number of reasons to suggest that the impact of yuan appreciation could be more complicated than this stylised description. In some cases, economies in Asia (and elsewhere) compete head on with China in third markets, owing to similarities in the stage of economic development, factor abundance, technological capability, and production costs. Thus, a yuan appreciation may reduce the competitive pressure felt by these Asian economies. In other countries, different stages of economic development, technological capability and comparative advantage may mean that Chinese and own exports are complements rather than substitutes. To the extent that China's exports are still concentrated in consumer goods, China does not compete

directly in third markets with advanced Asian economies such as Japan and South Korea that export mainly machinery and equipment. For instance, Eichengreen, Rhee and Tong (2004) find that China does not crowd out capital goods exports from other Asian countries to third markets, while competing with them in consumer goods exports. Therefore, it is possible that yuan appreciation will have a much smaller positive impact (or perhaps even a negative one) on the trade surplus of high-income Asian countries than on low-income Asian ones – a hypothesis that this paper will examine.

In addition, China's modern, export-oriented manufacturing sector relies on imported raw materials, energy, components, and capital equipment. Thus, its demand for materials, components and equipment from its neighbours would be expected to grow along with its exports. Indeed, China and some other Asian countries are part of the same production chain. A stylised description is that Korea and Japan produce high-tech capital goods, Malaysia and Thailand provide components, Indonesia supplies energy while China, as the 'world factory', is at the end of the chain. Based on China's *Customs Statistics*, Thorbecke (2006) finds that in 2004, 40% of China's total imports were of processing goods for re-export. Of these imports, 70% came from other East Asian countries. Also, more than half (55%) of China's exports in 2004 were processed goods. Of these, 20% were exported to Europe, 20% to Hong Kong (largely as entrepôt trade), 25% to the United States, and 25% to East Asia. Moreover, the majority of China's processed exports come from FDI companies. China's foreign-owned companies' share of exports has risen from only 13% in 1995 to more than one third by 2004.

All these facts confirm China's role as a world factory. Because of this, if China's exports fall, then its demand for upstream intermediate and capital goods may decline as well, even if these imported goods become less expensive to China. But the most that can be said at this level of generality is that the impact of China's growth in exports on other Asian economies is ambiguous.

2 Literature review

There is extensive empirical research on how exchange rate movements affect the trade balance in general and those of Asia and China in particular.

Wei *et al* (2000) examine how yuan devaluation affects the stability of the Hong Kong dollar. They use a computable general equilibrium model to estimate the impact of the yuan on Hong Kong's trade balance. They find that the net impact on Hong Kong's foreign reserves and the Hong Kong dollar of a devaluation of the yuan is, in fact, negligible. [(1)] Eckaus (2004) examines how China's exports to the United States move with the exchange rate over the 1985-2002 period. In his paper, China's exports to the United States are regressed on US GDP, the exchange rate between the euro and the dollar, and the bilateral real exchange rate between China and the United States. He does not find that the rapid growth of Chinese exports to the United States in recent years has been due mainly to a real depreciation of the yuan, but rather more because of higher US GDP growth. Park (2005) analyses the impact of a 'one-step' nominal appreciation of the yuan against the dollar using the Oxford Economic Forecasting model. He finds that a revaluation reduces the (local currency) export prices to China from other Asian economies and thus – everything else equal – improves their trade surpluses. But the reduction in the growth of China's real income also reduces China's demand for imports. The net effects then depends on the price and income sensitivity of China's demand for imports. Generally, countries with similar endowments to those of China's (ie those producing labour-intensive goods that compete in third markets), would be expected to experience an expansion in net exports. Conversely, countries that have complementary endowments and strong bilateral trading links with China should experience a contraction in net exports. However, somewhat surprisingly, Park (2005) finds that trade impacts are significantly positive in Korea, Singapore, and Taiwan, but negative in India and Malaysia.

The studies described above share a limitation: the estimation is based on a relatively long historical period (often 25 years or more). But there has been a significant change in the structure of international trade, and of Asian trade in particular, over this period. Indeed, Dunaway and Li (2005) argue that 'the various estimation approaches are particularly difficult to implement in developing and transition economies, like China, where substantial structural changes make underlying economic relationships unstable'. Therefore, one could cast doubt on the robustness of results estimated over such long periods of marked structural changes.

There have been some attempts to address this structural break problem. For example, Cerra and Dayal-Gulati (1999) study how the reforms of China's exchange and trade systems affect the

[(1)] They study both trade and market psychological linkages. The latter is based on a survey of financial market participants. In spite of the small calibrated trade balance effect, all respondents believe that a yuan devaluation would lead to a panic selling of Hong Kong assets, and thus put downward pressure on the Hong Kong dollar.

price elasticities of its aggregate exports and imports. They find that trade flows have become increasingly price-sensitive, owing to gradual trade liberalisation and the growing share of foreign-funded enterprises in trade. However, the size of their data sample is small with only 60 observations (quarterly data from 1983 to 1997), which may reduce the reliability of the results. Moreover, they have not considered how the commodity structure of exports affects the adjustment of the trade balance to exchange rate movements. This paper aims to fill these two gaps by using a panel estimation that uses a large data sample and controlling for the change in the commodity structure of trade.

3 Methods

As in the previous literature, time-series analysis could be applied to analyse bilateral trade. However, the data sample may not be long enough to make robust inferences. Even if there are quarterly data available for 20 years, this would still provide only 80 observations at most, as well as being subject to structural instability as discussed above. A small sample size would make it difficult to detect and test structural breaks. As an alternative, panel data analysis is used in this paper, which pools countries together and increases the sample size significantly. For instance, with 180 countries and 80 quarterly observations, the sample size rises to 10,000.

One concern with country panel data analysis is that countries are assumed to be homogeneous when in fact they could respond differently to exchange rate movements. To control for this potential heterogeneity, in this study movements in the exchange rate are interacted with the commodity structure of a country's exports. Moreover, the estimations control for importing and exporting country fixed effects, as well as time fixed effects. Finally, the estimated standard errors control for potential heterogeneity among the shocked terms.

Export and import data used in this study are trade values rather than volumes. Usually, only trade value data are reported in common trade data sets, such as the IMF's *Direction of Trade Statistics*, rather than trade volume data, so data on trade prices are used to derive volumes. However, time series of Chinese trade price data are not available, so proxies, such as trade prices from Hong Kong, have been used in practice. But according to Marquez and Schindler (2006), the currently applied proxies for China's trade prices are poor. They suggest using trade value rather than trade volume to get an untainted picture. This approach is also adopted in this paper.

The downside though is that the impact of changes in the price on trade volumes *per se* cannot be estimated.

Below, three related empirical models are estimated: China's own exports, China's imports, and the competition between Asian countries and China in third markets.

3.1 China's own exports

The empirical model for China's quarterly exports to country *j* at time *t* is:

$$\Delta \ln(EX_{China,j,t}) = a_0 + a_1 \Delta \ln(EX_{China,j,t-1}) + a_2 \Delta \ln(R_{China,j,t-1}) + \alpha_3 \Delta \ln(GDP_{j,t}) + \alpha_4 \Delta \ln(GDP_{China,t}) + u_i + e_{China,j,t} \quad \textbf{(1)}$$

where,

$\Delta \ln(EX_{China,t})$: Change of the log of China's exports at time *t.*

$\Delta \ln(R_{China,t-j})$: The change of the log of the real exchange rate of the yuan versus the US dollar. A positive change means an appreciation of the yuan.

$\Delta \ln(GDP_{j,t})$: The change of importing country *j*'s GDP, measured in constant US dollar.

u_i : Country fixed effect for exporter *i*.

As the yuan appreciates, the dollar value of China's exports may either rise or remain unchanged, depending on whether local currency pricing (LCP) or producer currency pricing (PCP) is more prevalent:

- If China's exporters are price-takers in world markets, then the dollar price and thus the foreign volume demand for China's exports will remain unchanged, following a yuan revaluation. However, the amount of yuan per unit of exports received by China's exporters will decline. This could then reduce the supply of China's export volumes, and thus values.
- If, on the other hand, China's exporters are price-setters in yuan terms (ie PCP), then the dollar price of China's exports will increase, following a yuan appreciation. Consequently, the volume demand for China's products would fall. Here the impact on trade values in dollar terms though is unclear *ex ante*, depending on whether the price elasticity of demand is above or below one.[(2)]

All this suggests that, *a priori*, the sign of a_2 is ambiguous.

[(2)] Campa and Goldberg (2005) provide cross-country and time-series evidence for the imports of 25 OECD countries. Across OECD countries, at least, and especially within manufacturing industries, they find evidence of partial pass-through in the short run, rejecting both PCP and LCP. Over the long run, however, PCP is more prevalent for many types of imported goods.

Equation **(1)** considers exports from China to more than 140 separate countries, rather than China's aggregate exports. This is because during the sample period, China's real effective exchange rate has been relatively stable, which makes it difficult to identify the effects of exchange rates on China's aggregated exports. By using the bilateral trade instead, there is more variation in the exchange rate, which mitigates the identification problem.

The trade equations estimated are for the change rather than the level of exports and imports. The reason is that some key variables, such as bilateral trade and bilateral exchange rates, are non-stationary series. Several panel unit root tests have been run, including Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003), Fisher-type tests using ADF and PP tests (Maddala and Wu (1999) and Choi (2001)), and Hardi (2000). The first two tests have the null hypothesis that there is a common unit root process in the variable. Im, Pesaran and Shin (2003) and Fisher-type tests are similar but allow for individual unit roots. That is, for the same time-series variable, each country could have its own unit root process. Hardi (2000), on the contrary, has the null that there is no unit root. All these tests have their own strengths and weaknesses, and sometimes give conflicting results. Therefore, all five tests were run, to examine whether there is a unit root in the panel data. Allowance was made for individual fixed effects and individual time trends. The tests suggest the presence of unit roots for bilateral exchange rate and bilateral trade for most countries. Consequently, the estimations below are made in first differences in order to reduce potential estimation bias.[3]

3.2 Exports to China

The equation for exports to China from other countries is:

$$\begin{aligned}\Delta \ln(EX_{i,t}) = {} & b_0 + b_1 \Delta \ln(ChinaGDP_t) + b_2 \Delta \ln(EX_{i,t-1}) \\ & + (b_3 + b_4 V_{i,t-1}) \Delta \ln(CHR_{i,t-1}) + b_5 \Delta \ln(GDP_{i,t}) + u_i + e_{i,t}\end{aligned} \qquad \textbf{(2)}$$

where:
$\Delta \ln(EX_{i,t})$: Change of the log of exports from country *i* to China at time *t*.

[3] It would be preferable to estimate with a panel cointegration. One possibility would be to apply panel vector autoregressions with homogeneous slopes as in Binder, Hsiao and Pesaran (2005). An alternative would be to use an error correction format applying a pooled mean group estimator as in Pesaran, Shin and Smith (1999). However, they assume that all regressors are not cointegrated. But if there is more than one cointegration relationship, then the asymptotic results are no longer valid. However, tests of panel cointegration are also problematic. A weak point of the panel cointegration tests as proposed, for example, by Pedroni (2004), is that if the null hypothesis of no integration is rejected, it does not address the issue of how many cointegrating vectors exist. This makes it difficult to estimate two or more sets of cointegrating parameters for a given set of variables. Therefore, panel cointegration estimation and testing is left to future work.

$\Delta ChinaGDP_t$: Change of China's GDP at time *t*. This variable controls for China's aggregate demand for goods.

$\Delta CHR_{i,t-j}$: Lagged change of the real exchange rate between exporter *i* and China. A positive $\Delta CHR_{i,t-j}$ means an appreciation of the yuan against the exporter's currency.

$V_{i,t-1}$: the commodity structure of country *i*'s exports to China at time *t*-1, defined as the country *i*'s exports of intermediate or capital goods to China divided by its total exports to China.

$\Delta \ln(GDP_{i,t})$: GDP growth rate of exporter.

u_i : Country fixed effect for exporter *i*.

Our prior is that as China's economy grows, its demand for foreign goods would increase as well ($b_1 > 0$). Moreover, as the yuan appreciates, its demand for foreign goods would increase too ($b_3 > 0$), owing to the stronger purchasing power of yuan.[4] However, as China serves as an important final assembly point in the international production chain, part of China's imports of capital and intermediate goods are actually inputs for China's processing exports. If an appreciation of the yuan reduces China's exports (equation **(1)**), it could also reduce China's demand for upstream inputs (ie $b_4 < 0$). The overall exchange rate effect, $b_3 + b_4 V_{i,t-1}$, is then ambiguous.

3.3 Non-China Asian exports to third markets

The equation for exports from non-China Asian countries to third markets is:

$$\Delta \ln(EX_{i,k,t}) = c_0 + c_1 \Delta \ln(EX_{i,k,t-1}) + (c_2 + c_3 S_{i,k,t-1}) \Delta \ln(R_{i,k,t-1}) + (c_4 + c_5 S_{i,k,t-1}) \Delta \ln(CHR_{i,t-1}) + u_{ik} + e_{i,k,t} \quad \textbf{(3)}$$

where:

$\Delta \ln(EX_{i,k,t})$: Change of the log of exports of country *i* to country *k* at time *t*.

$\Delta \ln(R_{i,k,t-j})$: Lagged change of the real exchange rate between importer *k* and exporter *i*. A positive $\Delta \ln(R_{i,k,t-j})$ implies an appreciation of the importer's currency.

$\Delta \ln(CHR_{i,t-j})$: Lagged change of the real exchange rate between exporter *i* and China. Positive $\Delta \ln(CHR_{i,t-j})$ means an appreciation of the yuan against the exporter's currency.

$S_{i,k,t-1}$: the commodity structure of country *i*'s exports to country *k* at time *t*-1, defined as exports of intermediate or capital goods divided by total exports.

u_{ik} : Country-pair fixed effect for *i* and *k*.

Our prior is that as the importer's currency appreciates, non-China Asian exports will increase ($c_2 > 0$). But the size of the impact may depend on the commodity structure. If intermediate and capital goods are more responsive to exchange rate movements than consumer goods, then

[4] This holds for both PCP and LCP pricing. Under PCP pricing, the dollar price of China's imports will not change following yuan appreciation, but the yuan price of China's imports will have fallen. Consequently, the volume and thus dollar value of China's imports will increase. Under LCP pricing, the yuan price of China's imports will not change, following yuan appreciation. Then the volume of imports will not change, but the dollar price will increase, and thus too the dollar value of imports.

$c_3 > 0$; otherwise, $c_3 < 0$. But the aggregate effect of the appreciation of the importer's currency on its imports, $c_2 + c_3 S_{i,k,t-1}$, would likely be positive, *ceteris paribus*.

The impact of a yuan appreciation on the exports of other Asian countries to third markets is unclear *ex ante*. On the one hand, as China's products become more expensive, there might be an increase in demand from third markets for similar products from other Asian countries, ie the substitution effect. On the other hand, an increase in the price of China's exports may reduce importers' real income and therefore their demands for goods from the rest of the world, ie the income effect. If the substitution effect dominates the income effect, then $c_4 > 0$; otherwise, $c_4 < 0$. The substitution effect may also depend on the exporter's commodity structure. As shown in Table 1 more than half (55%) of China's exports are of consumer goods. So exporters from other Asian countries engaged mainly in consumer goods are more likely to benefit in third markets from a yuan appreciation. The combined effect, $(c_4 + c_5 S_{i,k,t-1})$, therefore could be positive or negative, depending on the signs of the coefficients and the magnitude of $S_{i,k,t-1}$.

4 Data

Bilateral export and import equations are estimated for ten Asian countries: Mainland China, Korea, Japan, Singapore, India, Indonesia, Malaysia, Pakistan, Philippines and Thailand.[5] The bilateral quarterly data on trade flows are from the IMF's *Direction of Trade Statistics*. They provide quarterly bilateral merchandise trade for 180 IMF countries through 2005. Imports are recorded in millions of current US dollars.

However, IMF's *Direction of Trade Statistics* does not disaggregate trade by commodity type. Therefore the United Nations' disaggregated commodity trade data base (UN Comtrade) is also used.[6] The cost is that UN Comtrade data are annual frequency, while IMF data are quarterly frequency. The UN Comtrade data are classified on the basis of the Standard International Trade Classification (SITC version 2). In this paper, commodity exports are separated into capital goods, consumer goods, and intermediates in the following way. Capital goods include machinery and transport equipment (a subset of SITC 7). Consumption goods consist of food (SITC 0), beverages and tobacco (SITC 1), miscellaneous manufactured articles (SITC 8), television and radio receivers (7.6.1, 7.6.2, and 7.6.3), passenger motor vehicles and cycles (7.8.1 and 7.8.5), and medicinal and pharmaceutical products (5.4). All the remaining goods (SITC 2, 3,

[5] Note that Hong Kong is not included in the sample as either part of China or as a foreign country. Hong Kong's special role for China's exports is discussed below.
[6] http://unstats.un.org/unsd/comtrade/.

4, 5, 6 and 9) are classified as intermediates. Table 1 presents the export shares by commodity type and destination for fourteen Asian countries in 2003. It shows that exports to China and elsewhere from Japan, the NIEs and ASEAN are concentrated in capital goods. In contrast, the poorest Asian economies mainly export consumer goods (Charts A and B further show the share of intermediates and capital goods in exports for Asian countries from the year 1990 to 2003).

The quarterly real exchange rate index is collected from Thomson Financial Datastream and Bloomberg, covering 103 countries. A rise in the index means an appreciation of the currency against the US dollar. Unfortunately, indices for some Asian countries, such as Vietnam and Cambodia, are not available. So these countries were dropped from the sample. GDP growth rate data are from the World Development Indicators.

5 Results

The results of China's export equation are shown first since this is what establishes the extent to which China loses from a yuan appreciation (Table 2). Then the results of how an appreciation of the yuan affects other Asian countries' exports to China are presented. In principle, this will depend on the type of goods that other Asian countries export to China (Tables 3 and 4). Finally, the impacts of yuan appreciation on other Asian countries' exports to third markets are shown. Again, the results depend on the commodity structure of exports (Tables 5 and 6).

The estimates in Table 2 suggest that a 10% yuan appreciation reduces China's value of exports by around 3.7%. The results with importing countries' fixed effects are similar to those without. Indeed, an F-test cannot reject that all importing-country fixed effects are zero. More lags of the impact of exchange rate movements were also added. All the coefficients are negative, confirming that a stronger yuan has a negative impact on China's export values. Moreover, the quarterly growth rate of world trade was added as an additional explanatory variable to control for the unobserved global factors. In the estimation, the growth of world trade is not significantly different from zero at the 10% level. As an alternative control for world demand, the growth rate of world GDP is used. It is also statistically insignificant, with a p-value of 0.5. Finally, time fixed effects are added for each year and quarter. Then the growth in China's GDP, world GDP and world trade are excluded from the estimation, as they are linear function of time dummies. Reassuringly, the results still hold, with a yuan appreciation resulting in a fall in China's value of exports.

Table 3 reports the equation for export values from the rest of Asia to China. As expected, the estimates show that as China's GDP grows, so do exports to China from the rest of Asia. For every 10% increase in GDP growth in China, export growth to China from the rest of Asia rises by 5%. However, as the yuan appreciates, China's imports from Asian countries in general do not seem to increase significantly. This is especially the case for exporters of capital goods (mainly machinery and components): the estimated coefficient for the interaction of capital goods and exchange rate movement is -2.0, different from zero at the 15% significance level.[7]

Note that the equation in Table 3 only considers Asian exporting countries. There may not be enough variation in the commodity structure of exports over country and time. To increase the variation, and to better illustrate the importance of the commodity structure, the sample is expanded to also include the exports of non-Asian countries to China, which increases the sample size six times to around 2,600 observations. The cost is that the coefficients are assumed to be homogeneous when they might in reality vary over such a large sample. To reduce this cost, the expanded sample is estimated by controlling for country fixed effects. The new results are reported in Table 4.

Table 4 presents results similar to those in Table 3 but with greater statistical significance. As the yuan appreciates, exports to China increase (at a 7% significant level). This is consistent with the hypothesis that an appreciation increases China's purchasing power. But the positive effect declines as the share of capital and intermediate goods rises. This effect is particularly pronounced for capital goods, where the estimated coefficient differs from zero at the 3% significance level. An interpretation of this result is that yuan appreciation makes China's own products more expensive, reducing its exports and thus also its demand for imported machinery and components.

In order to see how the results on commodity structure make a big difference across country type, consider two Asian countries – Japan and Pakistan – which have very different patterns of exports to China. In 2003, 57% and 25% of Japan's total exports to China were of capital and intermediate goods respectively. The corresponding figures for exports from Pakistan were only 0.1% and 17.3%. Based on the point estimates in Table 4, a 5% appreciation of the yuan against the yen would reduce Japan's exports to China in the next quarter by 2.5%. However, a 5%

[7] The standard error is based on the Huber/White/sandwich estimator, which controls for potential heterogeneity in the error terms.

appreciation of the yuan against the Pakistani rupee would increase Pakistan's exports to China by 14%.

Table 5 reports the competition in third markets. It shows as expected that when the importer's currency appreciates exports from non-China increase. However, the impact of yuan appreciation on the exports of consumer goods from the rest of Asia to third markets are not, on average, significantly affected. This suggests that the income and substitution effects of yuan's revaluation are offsetting. The impact of a yuan appreciation in third markets also does not depend significantly on the structure of exports, although there is some weak evidence that any gain from yuan's appreciation decreases as the share of capital goods increases.

Based on the 2003 commodity trade patterns in Table 1 and the estimates in Table 5, exports to third markets from low-income Asian countries, such as Bangladesh, Pakistan, Sri Lanka and Vietnam, may not benefit from an appreciation of yuan, while high-income Asian countries may suffer somewhat (albeit weakly) in third markets from yuan's appreciation. To check that the results in Table 5 are not driven by a single Asian exporter, countries are dropped from the sample one at a time. It turns out that the results in Table 5 are not driven by any single Asian country.

In sum, Tables 2 to 5 are consistent with the supply-chain story, where China imports capital goods from advanced countries to facilitate the production of consumer goods exported to third markets. When the yuan appreciates, exports of China's consumer goods decrease, which then reduces China's demand for upstream capital goods. Consequently, exporters of mainly capital goods to China, such as Japan and Korea, would be expected to be hurt from a slowdown in China's own exports, following a yuan appreciation. In addition, there is little evidence that Asian countries benefit from yuan's appreciation in their exports to third markets.

6 Robustness checks

Given China's ongoing transition both from a rural to an industrial economy and from a command to a free market economy, one issue is the robustness of the results to structural changes. In particular, given the rapid changes in the composition and direction of Chinese exports, the third-country effects could have changed over the sample period. Therefore, the sample period is split in half (before and after 1998), and the same analysis is replicated to see whether there are any other structural differences besides the change in commodity type which

are accounted for. There is no evidence of other structural changes: the estimated coefficients are not significantly different between periods (Table 6).

The estimations above also exclude exports from China to third markets that pass through Hong Kong. To control for this, China and Hong Kong's exports to third markets are added together. Certainly, this would exaggerate China's exports – the share of Chinese exports shipped through Hong Kong has declined over time from 24% in 1993 to only 17% in 2004 – so this aggregation is used only as a robustness check.[8] Reassuringly, the results are little changed. As shown in Table 7, when the yuan appreciates, China's exports decrease (albeit the significant level is lower than before as reported in Table 2).

7 Conclusions and policy implications

The results of this paper suggest that a yuan appreciation has mixed effects on the exports from the rest of Asia. Countries that export mainly consumer goods to China and third markets are unlikely to benefit significantly from yuan appreciation, while countries that supply capital and intermediate goods to China may in fact lose.

The impact of China's exports on those of other Asian countries has implications for whether a yuan revaluation should be expected to lead to a generalised revaluation of Asian currencies thereby helping to redress current global imbalances. One frequently heard argument is that if the yuan revalues, other Asian economies will be more willing to revalue their currencies too. This would result in a generalised realignment of Asian currencies against the US dollar, which may help to narrow the US current account deficit. However, the growth of China's own exports is positively correlated with those of its high-income Asian neighbours – those also with large current account surpluses (and accumulated foreign exchange reserves). Therefore, a revaluation of the yuan which reduces the growth of China's exports may also reduce the exports of its neighbours, such as Korea and Japan, depressing rather than boosting their own GDP growth rates and creating pressure for currency depreciation rather than appreciation. Thus, a generalised revaluation of Asian currencies seen by some observers as an important part of the solution to the current problem of global imbalances may not in fact follow from a slowing of Chinese growth due to a yuan revaluation.[9]

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[8] The share of Chinese imports from third markets shipped through Hong Kong has also declined from 10% in 1993 to 2% in 2004.

[9] Or if it does the mechanism would be indirect through, for example, other Asian countries instead boosting growth by stimulating domestic demand and thus imports.

Table 1: Export shares by commodity type and destination (%), by Asian country, 2003

	Exports of non-consumer goods to China/ total exports to China			Exports of non-consumer goods to third markets/total exports to third markets			Total exports of non-consumer goods/total exports			Exports to China/total exports
	Capital	**Intermediate**	**Total**	**Capital**	**Intermediate**	**Total**	**Capital**	**Intermediate**	**Total**	
Bangladesh	0.3	77.3	77.6	0.4	5.1	5.5	0.4	5.5	5.9	0.6
Cambodia	0.0	82.2	82.2	0.4	2.5	2.8	0.4	3.5	3.9	1.3
India	3.7	88.4	92.2	8.0	46.8	54.8	7.6	50.7	58.2	9.4
Indonesia	17.3	76.8	94.1	11.4	53.0	64.4	12.0	55.6	67.6	10.9
Japan	57.6	24.7	82.4	46.6	15.7	62.2	48.8	17.5	66.2	19.9
Malaysia	62.9	33.9	96.8	59.5	21.2	80.7	60.0	22.9	82.9	13.6
Pakistan	0.1	17.3	17.4	0.7	9.0	9.7	0.6	9.6	10.3	7.9
Philippines	89.2	6.6	95.8	69.7	9.2	78.9	72.7	8.8	81.5	15.3
Korea	43.5	37.0	80.5	49.0	21.0	70.0	47.5	25.4	72.9	27.3
Singapore	52.9	39.5	92.4	59.2	29.9	89.1	58.3	31.3	89.5	14.4
Sri Lanka	24.3	57.4	81.7	4.8	18.0	22.8	4.9	18.2	23.2	0.5
Taiwan	48.4	32.2	80.6	59.0	23.0	82.0	55.3	23.0	78.3	32.4
Thailand	47.3	43.9	91.2	37.3	21.5	58.7	38.6	24.5	63.1	13.3
Vietnam	3.6	81.2	84.7	7.9	25.3	33.2	7.5	29.8	37.3	8.1

Table 2: China's export growth (equation (1))

	Coef.	Std. Err.
% change in quarterly exports (one lag)	**-0.29**	**0.03**
Appreciation of yuan (one lag)	**-0.36**	**0.15**
China's quarterly GDP growth rate	0.36	0.23
Importer's quarterly GDP growth rate	0.74	0.41
Constant	-0.01	0.04
R-squared	0.08	
Observations	3,455	

Note: Coefficients significantly different from zero at the 5% level are in bold.

Table 3: Export growth to China from other Asian countries (equation (2))

	Coef.	Std. Err.
% change in quarterly exports (lagged)	**-0.35**	**0.04**
Quarterly growth in China's GDP	**0.52**	**0.05**
Appreciation of yuan	0.34	0.93
Appreciation of yuan* (share of capital goods)	-2.03	1.41
Appreciation of yuan* (share of intermediates)	-0.23	1.05
Quarterly growth in exporter's GDP	0.24	0.20
Constant	0.05	0.01
Observations	423	
R-squared	0.45	

Note: Coefficients significantly different from zero at the 5% level are in bold. Country fixed effects for exporters are controlled for.

Table 4: Export growth to China from the rest of the world (equation (2))

	Coef.	Std. Err.
% change in quarterly exports (lagged)	**-0.36**	**0.04**
Quarterly growth in China's GDP	**0.63**	**0.07**
Appreciation of yuan	3.38	1.84
Appreciation of yuan*share of capital goods	**-5.32**	**2.41**
Appreciation of yuan*share of intermediates	-3.42	1.95
Quarterly growth in exporter's GDP	-0.20	0.40
Constant	0.05	0.02
Observations	2,592	
R-squared	0.18	

Note: Coefficients significantly different from zero at the 5% level are in bold. Country fixed effects for exporters are controlled for.

Table 5: Export growth of (non-China) Asia to third markets (equation (3))

	Coef.	Std. Err.
% change in exports (lagged)	-0.31	0.01
Appreciation of importer	**0.49**	**0.13**
Appreciation of importer*share of capital goods	-0.02	0.26
Appreciation of importer*share of intermediates	**-0.60**	**0.25**
Appreciation of yuan	-0.08	0.17
Appreciation of yuan*share of capital goods	-0.47	0.32
Appreciation of yuan*share of intermediates	0.05	0.30
Constant	0.03	0.00
Observations	30,441	
R-squared	0.10	

Note: Time fixed effects are included. Coefficients significant at 5% are in bold.

Table 6: Export growth of (non-China) Asia to third markets (equation (3))

	1990 Q1 to 1997 Q4	1998 Q1 to 2004 Q4
% change in exports (lagged)	**-0.31**	**-0.31**
	(0.01)	**(0.01)**
Appreciation of importer	**0.61**	**0.44**
	(0.19)	**(0.19)**
Appreciation of importer*share of capital goods	-0.03	-0.02
	(0.41)	(0.34)
Appreciation of importer*share of intermediates	**-0.90**	-0.51
	(0.37)	(0.35)
Appreciation of yuan	0.28	-0.22
	(0.27)	(0.23)
Appreciation of yuan*share of capital goods	-0.68	-0.43
	(0.51)	(0.42)
Appreciation of yuan*share of intermediates	-0.68	0.30
	(0.52)	(0.40)
Constant	0.04	0.03
	(0.00)	(0.00)
Observations	13,850	16,591
R-squared	0.1	0.1

Note: Time fixed effects are included. Standard errors are in parentheses. Coefficients significant at 5% are in bold.

Table 7: China's exports growth
(including exports from Hong Kong)

	Coef.	Std. Err.
% change in quarterly exports (one lag)	**-0.30**	**0.04**
Appreciation of yuan (one lag)	-0.19	0.15
China's quarterly GDP growth rate	**0.50**	**0.22**
Importer's quarterly GDP growth rate	0.65	0.37
Constant	-0.02	0.03
R-squared	0.09	
Observations	3,451	

Note: Coefficients significantly different from zero at the 5% level are in bold.

Chart A: Share of intermediates and capital goods in total exports (% 1990-2003)

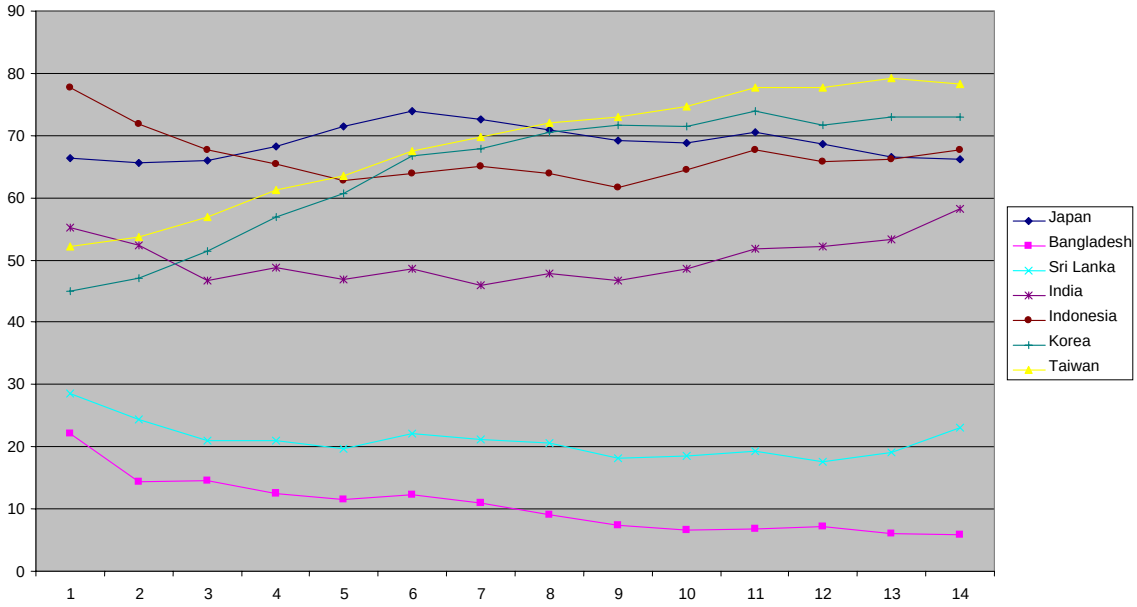
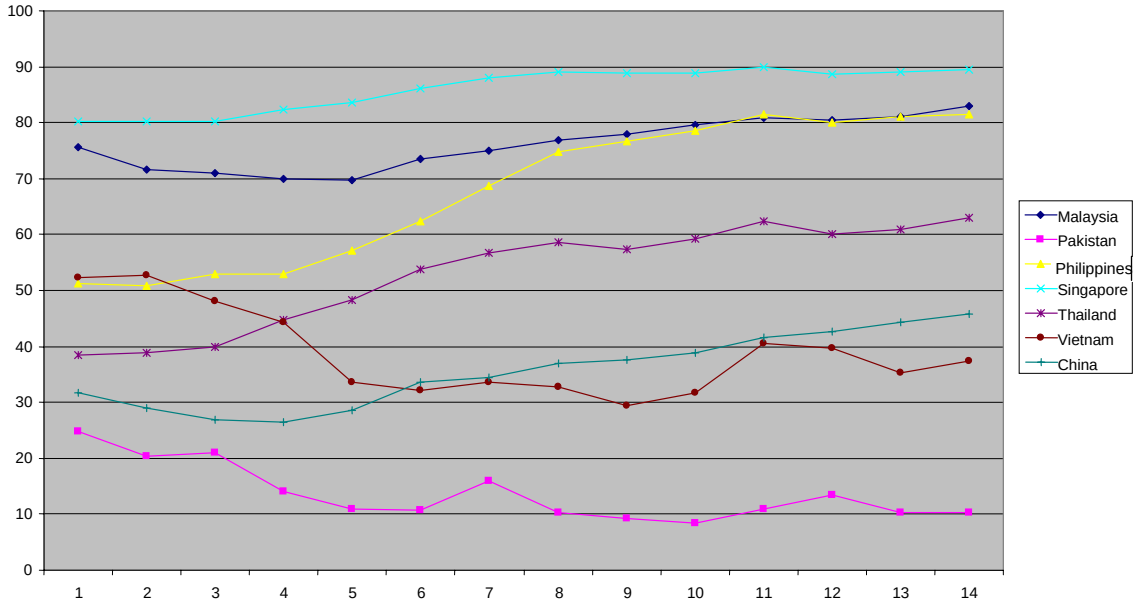


Chart B: Share of intermediates and capital goods in total exports (% 1990-2003)



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